An Analysis Of The Performance Of Certification Schemes In The Hotel Sector In Terms Of CO_2 Emissions Reduction

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To my beautiful children Saoírse and Åke who are my world

and my loving parents
Ada and Finían

and my brothers
Gregory, Finín and Gavin.

Abstract

In assessing the impact of global tourism on climate change, emissions from transport receive the most attention although emissions associated with accommodation account for more than 20% of the total. A plethora of hotel certification schemes have been established worldwide that assess various environmental performance indicators, among them energy use. However, none explicitly quantify CO_2 emissions, and in many, energy is poorly accounted for, or other non-energy related factors are weighted so that the overall impact of energy use (and hence CO_2 emission) is weak. This main thrust of the research is to ascertain the effect of certification on CO_2 emissions. The research questions whether the certification schemes are robust and rigorous and whether the results are credible.

First, four widely used certification schemes are compared Nordic Swan (Scandinavia), Green Globe (Worldwide), EU Flower (European) and Green Hospitality Award (Ireland). The key issues are identified such as performance and process related criteria, use of benchmarks, and the weighting of different categories. A comparison is made with LEED-EB, a well-established environmental certification scheme, not dedicated to the hotel sector. Secondly, the way in which emissions from electricity, including so-called green electricity and carbon offsetting, are accounted for is examined since it is found that in obtaining certification, this often plays an important part.

Actual annual energy use data is desperately needed as feedback to designers, managers and owners in order to give confidence that certification schemes have true validity. Results are presented from large multi-hotel data samples and for detailed results from the quality, illustrative in-depth studies which provided invaluable insight into the technical realities of a multitude of causes and effects which can often be masked in large data samples. An analysis was carried out for four In-depth studies located in Sweden (Nordic Swan), Maldives (Green Globe), Malta (EU Flower) and Ireland (Green Hospitality Award).

Global CO_2 emissions were compared and calculated from the delivered electricity and fuels consumption data from seventy selected certified hotels worldwide. No corrections were made in the calculations for climate, quality of services, existence of services etc. The performance indicator used is $kgCO_2$ per guest night.

The analyses shows no clear pattern. CO_2 emissions show a wide variance in performance for 8 hotels certified under *different* schemes, as well as for 28 hotels certified under the *same* scheme. In some cases emissions reduced after certification in others no change. Certified hotels do not necessarily have lower emissions than uncertified hotels and a comparison of before – and after – certification shows no significant improvement prior to certification. Most dramatically emissions from certified hotels widely vary by a factor of 7. Although it is arguable a number of corrections should be made to account for different climates, the research highlights that hotels with high CO_2 emissions are being awarded certification and it questions what message ‘certification’ gives to guests and other stakeholders. At worst it appears ‘business as usual’ can achieve certification with no obvious improvement in performance.

The overall conclusion is that existing certification schemes do not properly account for CO_2 emissions and do not produce more energy efficient (or less CO_2 intensive) buildings. Hotel accommodation was found to be more CO_2 intensive than domestic emissions. The findings also uncovered inconsistencies in current methods of certification and indicate a vital need for improved methods. The results also challenge prevailing aesthetic stereotypes of sustainable hotels.

The author concludes a simple CO_2 accounting method is needed as the first step of a diagnostic process leading to a solution *i.e. reduced emissions*, to the problem *i.e. high energy consumption and/or emissions*, thus reducing the environmental impact (in terms of emissions reduction) of the hotel. This method of accounting can be adopted universally by using a Regional, European (O.475 kgCO_2/kWh) or Universal (0.55 kgCO_2/kWh) conversion factor. In relation to the proper calculation of energy and CO_2 emission, sub-metering is a key factor, and with current technological developments, realistic and affordable. Furthermore, apart from certification itself, an essential quality with any monitoring system is that the user can obtain results easily and understandably, in order to get feedback from their actions. This could be facilitated by incorporating sub-metering as part of the building environmental management system software. This ensures that the certification activity is not simply a benchmark, but is also part of a diagnostic and educational process, which will continue to drive emissions down. Only then should it be ethically justified to use as a marketing tool providing diagnostic support in existing buildings, and design and operational guidance for new designs.

Declaration

This dissertation is the result of my own work and includes nothing which is the outcome of work done in collaboration except where specifically indicated in the text. This thesis does not exceed the permitted length of 80,000 words specified by the Department of Architecture.

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The Beginning

The seeds for this research began in 1999 whilst working on various sustainable projects in Nassau, Bahamas. In 2001, the Bahamas Ministry of Tourism sponsored an Ecolodge Design Competition in collaboration with the Inter-American Development Bank. Architects from 12 of the top Bahamian firms submitted designs for an ecologically sensitive resort. The objective of the competition was to educate local architects in eco-sensitive design concepts. As the tourism industry expands, the Ministry seeks to ensure the long-term health of the natural resources that helped attract more than four million visitors to the Bahamas in 2000. The author's team entry was placed runner up and provided the impetus for this research.

This experience gained in practice became the focus of my thesis proposal which was originally entitled '*Sustainable Development of Eco-Tourism in The Bahamas Archipelago'* which later developed into '*The Application Of Ecological And Sustainable Codes Of Practice & Regulation To Tourist Development, With Special Reference To Tropical Island Communities*.' In the formulation of the trial codes of practice and regulations, the research would critically examine those of other countries with particular focus on their impact and ability to be enforced. However, a month into the first year of my research it became clear these had become superceded by Ecolabels and certification schemes which resulted in a shift in the focus of the research. The title of my first year report was *'A Performance Analysis of Certification systems on Sustainable Tourist development: environmental, economic, social and cultural impacts.'* Subsequent to feedback on the report I was advised to focus on just one impact in one sector which resulted in the present title of my thesis *'A Performance Analysis of Energy Benchmarking and Certification in the Actual Reduction of Global* CO_2 *Emissions in the Hotel Sector.'*

This progressive refinement of the thesis title mirrored the shift in focus of the thesis in response to the new research findings encountered during my PhD journey. The revelation to me now nearing the end of this incredible journey is that despite the many paths I have ventured down in pursuit of answers to the many questions this research has uncovered, I find the research has in fact come full circle in line with the original seeds of my research which I hope can now be planted and the benefits reaped in the coming years.

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List of Publications

Peer Reviewed Conference papers

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Abbreviations and Acronyms

Acronym

AGO	Australian Greenhouse Office
APAT	Italian National Agency for the Protection of the Environment and for Technical Services
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BERR	Department of Business, Enterprise and Regulatory Reform
BIPV	Building Integrated Photovoltaics
BMS	Building Management System
BREEAM	Building Research Establishment Environmental Assessment Method
BRESCU	Building Research Establishment Conservation Unit
BWEA	The British Wind Energy Association
CASBEE	Comprehensive Assessment System for Building Environmental Efficiency
CCC	Committee on Climate Change
CCS	Carbon Capture and Storage
CDD	Cooling Degree Day
CDM	Clean Development Mechanism
CEC	California Energy Commission
CER	Certified Emissions Reduction
CERT	Carbon Emissions Reduction Target
CFL	Compact Fluorescent Lamp
CGPP	Cleaner Greener Production Programme
CHP	Combined Heat and Power
CSP	Concentrated Solar Power
CST	Certificate of Sustainable Tourism
DCLG	Department of Communities and Local Government
DECC	Dept Energy and Climate Change
DECs	Display Energy Certificates
DEFRA	Department for Environment, Food and Rural Affairs
DH	District Heating
ECOTRANS	European Network for Sustainable Tourism Development
EIA	Energy Information Administration
EMAS	Eco Management and Audit System
EMC	Enemalta Corporation
EMS	Environmental Management System
ENGO	Environmental Non-governmental organization
EPBD	European Directive on the Energy Performance of Buildings
EPCs	Energy Performance Certificates
ERUs	Emission Reduction Units
ESB	The Electricity Supply Board
ESRU	Energy Systems Research Unit
ETS	European Emissions Trading Scheme
EUAs	European Union Allowances
EUGENE	European Green Electricity Network
FTTSA	Fair Trade Tourism in South Africa
GB Tool	Green Building Tool
GD	Green Deal
GECOP	Green Electricity Code of Practice
GG21	Green Globe 21
GHA	Green Hospitality Award
GHGs	Green House Gases
GIS	Green Investment Schemes
GSTC	Global Partnership for Sustainable Tourism Criteria
GTBS	Green Tourism Business Scheme
HAWT	Horizontal axis Wind Turbine
HCFC	Hydrochlorofluorocarbons
HDD	Heating Degree Day

HER	Hilton Environmental Reporting
HVAC	Heating, Ventilation & Air-Conditioning
IAQ	Indoor Air Quality
IBLF	The International Business Leaders Forum
IEA	International Energy Agency
IERN	International Energy Regulation Network
IGCC	Integrated Gasification Combined Cycle
IHEI	International Hotels Environment Initiative
IPCC	Intergovernmental Panel on Climate Change
ISEAL	The International Social and Environmental Accreditation and Labelling Alliance.
ISO	International Organization for Standardization
ITP	International Tourism Partnership
IVL	Svenska Miljöinstitut *(Swedish Environmental Research Institute)*
JI	Joint Implementation
LED	Light-Emitting Diodes
LEED	Leadership in Energy and Environment Design
LEED-EB	Leadership in Energy and Environment Design - Existing Buildings
LEED-NC	Leadership in Energy and Environment Design - New Construction
M.O.T.	Ministry of Transport
MSA	Malta Standards Authority
MVHR	Mechanical Ventilation with Heat Recovery system
NGO	Non-governmental Organisation
NSO	National Statistics Office
O&M	Operations & Maintenance
OECD	Organisation for Economic Co-operation and Development
OPD	Ocean Power Delivery
OPSI	Office of Public Sector Information
OR	Operational Rating
PG&E	Pacific Gas & Electricity
PV	Photovoltaic
RECS	Renewable Energy Certificates
REGOs	Renewable Energy Guarantees of Origin
RES	Renewable Energy Sources
RO	Renewable Obligation
ROC	Renewable Obligation Certificates
SBEM	Simplified Building Energy Model
SEI	Sustainable Energy Ireland
STCRC	Sustainable Tourism Cooperative Research Centre
STSC	Sustainable Tourism Stewardship Council
SUS	Scandic Utility System
SUTOUR	Supporting Tourism Enterprises for Eco-labelling and Environmental Management
SV	Smart Voyager
SWE	Sweden
TIES	The International Eco-tourism Society
TTYD	Turkish Tourism Investors Association
UBT	The Usable Building Trust
UNEMG	United Nations Environment Management Group
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNWTO	United Nations World Tourism Organisation
U.S. SOX	The Sarbanes-Oxley Act of 2002
USGBC	U.S. Green Building Council
VAWT	Vertical axis Wind Turbine
VISIT	Voluntary Initiative for Sustainability in Tourism
WEF	World Economic Forum
WEO	World Energy Outlook
WMO	World Meteorological Organisation
WRI	World Resources Institute

WTO	World Tourism Organization
WTTC	World Travel and Tourism Council
WWF	World Wildlife Fund

Glossary

Accreditation refers to the procedure by which an authoritative body formally recognizes that a certifier is competent to carry out specific tasks. In other words, an accreditation program "*certifies the certifiers."* For the purpose of this research, an "*accreditation body*" is understood as a stewardship council.

Activity Measure The activity measure needs to be both relatively easy to obtain and be relevant to the type of activity of the enterprise.

Accommodation: per *Guest Night*

Communities or Destinations: per *Person Year*

Assessment is all activities related to the certification of business or entity to determine whether it meets all the requirements of the specified standard necessary for granting certification.

Baseline Level establishes the existing level of performance within an operation. The baseline level is the value for an indicator that has been assessed as the minimum responsible level of performance for that indicator.

Baseline Performance is set with reference to the type of enterprise, as well as regional, national and international environmental data, all of which take into account social, geographical and climatic impacts.

Best Practice Level

Is used to designate highest quality, excellence, or superior practices by a tourism operator. The term is widely used in many award and certification programmes, as well as academic studies, to designate the best in a particular class or a leader in the field. "Best," however, is a contextual term. There is no set standard of measurement, and the term is often loosely or ill-defined.

Benchmarking is a process of comparing performances and processes within an industry to assess relative position against either a set industry standard or against those that are *'best in the class.'* Benchmarks are fixed and used as a control against which the indicators are measured. Benchmarks provide a performance positioning across a range of area's and provides the user with quantitative figures which can be cross-checked against a set database. Benchmarks are assessed in standard SI units.

Carbon Tax is essentially an effluent (*pollution*) tax on the consumption of carbon-based non-renewable fuels, such as petrol, diesel-fuel, jet fuels and natural gas. The object is to reduce the release of carbon into the atmosphere. The purpose of the tax is both financial and environmental.

Certification Currently, in the United States, Europe and Latin America, certification within the tourism industry refers to a procedure by which a third party audits and gives written assurance that a product, process, service or management system meets specific standards. Third party is considered the most objective and more credible.

Community is people living in one place, district, state or country.

Conventional (or mass) tourism certification covers companies within the mass market or conventional tourism industry. These programs, are based on setting up environmental management systems (often ISO 14001 or other derivatives) and focus internally on the physical plant, product, or service. They are insufficient to ensure sustainable development.

Cultural Tourism is travel for the purpose of learning about cultures or aspects of cultures.

Culture is the sum total of ways of living by a group of human beings that is transmitted from one generation to another.

Degradation is any decline in the quality of natural or cultural resources or the viability of ecosystems that is caused directly or indirectly by humans.

Day guests:

Added to the *guest night* figure, is an assessment of the number of non-resident *day guests* (i.e., the number of people turning up to use on site facilities (*such as horse riding, sports activities and/or fitness centre*), but do not stay overnight) added up over the benchmarking period (*typically the 365 days of the year*).

Destination refers broadly to an area where tourism is a relatively important activity and where the economy may be significantly influenced by tourism revenues.

Earthcheck™ is a proprietary system used to measure and benchmark performance and environmental and social impact.

Ecolabel is a label or logo supported by a national or international accredited body that identifies a product as meeting "acceptable" level of environmental impact. The acceptable level of environmental impact may be determined by consideration of a single environmental hurdle or after undertaking an assessment of its overall impacts. Ecolabelling sometimes refers to the natural environment only: sometimes it takes into account social and cultural environments as well. An ecoquality label marks the state of the environmental quality, such as water quality for beaches or quality of wildlife in national parks.

Ecotourism The International Eco-tourism Society defines eco-tourism as *"responsible travel to natural areas that conserves the environment and sustains the well-being of local people."* Sometimes it is defined as a sub-category of sustainable tourism or a segment of the larger nature tourism market. A more comprehensive definition is travel to fragile, pristine and usually protected areas that strives to be low impact and (*usually*) small scale. It helps educate the traveler; provides funds for conservation; directly benefits the economic development and political empowerment of local communities; and fosters respect for different cultures and human rights.

Energy Consumption Benchmark Energy will be consumed by both individual developments and communities from the use of a variety of fuels *(e.g., grid electricity, natural gas, gasoline, diesel, wood and nuclear)* and as a consequence, total usage is assessed with a standard energy unit basis (Giga (10^9) Joules (GJ)). In addition to the type of energy, supply units are often varied.

Environmental Reporting is a voluntary method of communicating environmental performance to the stakeholders of an organisation.

Enterprise is any company, business, organization and/or activity.

Environmental Impact Assessment (EIA) is a process of predicting and evaluating the impacts of specific developments or actions on the environment. Associated with the development planning process and found in most countries, the purpose of an EIA is to prevent degradation by giving decision makers better information about the likely consequences that the action could have on the environment. The EIA process involves reviewing the existing state of the environment and the characteristics of the proosed development; predicting the state of the future environment with or without the devlopment; considering methods for reducing or eliminating any negative impacts; producing the environmental impact statement for public consultation that discusses these points; and making a decision about whether the development should proceed at the proposed site, along with a list of relevant mitigation measures.

Environmental management system (EMS) is part of the overall management system that includes the organizational structure, responsibilites, practices, procedures.

Greenhouse Gas A greenhouse gas is an atmospheric gas that has the ability to prevent energy radiated from the earth's surface from passing into space. The result is known as the greenhouse effect and is known to contribute to global warming.

Green Tax A form of pollution control where a tax equal to the marginal external cost of pollution is charged on output.

Greenwash is a term used to describe businesses, services, or products that promote themselves as environmentally friendly when they are not.

Guest Night: The definition for an activity measure for indicators *(such as energy or potable water consumption)* used to benchmark enterprises that accommodate both “overnight stays” and “day visitors” (*e.g. multi-activity resorts, convention centres etc.)* is *Guest Nights*.

Indicators is the quantity against which other quantities are normalized. Indicators are used to contribute to the overall certification. *An example of a key indicator is kg/CO2 or litres of water per guest night.* Common indicators used in certification schemes include energy, water, waste, social commitment and use of chemicals. For each indicator there are baseline and best practice levels.

Industry sector is a specific type of activity, service and/or facility (e.g., plastics manufacture, accommodation, airline, bus company, convention centre, golf course, railroad, restaurant, vehicle rental, vineyard etc).

ISO 14000, is the international series for environmental management systems that include five elements: 1) an environmental policy; 2) an assessment of environmental aspects and legal and voluntary obligations; 3) a management system; 4) a series of periodic internal audits and reports to top management; and 5) a public declaration that ISO 14001 is being implemented.

ISO 14001, the cornerstone of the ISO 14000 series, is a prescriptive document against which the company will be benchmarked and receive certification.

Life-cycle assessment is a variant of an EMS that evaluates the environmental burden associated with a product, process or activity from ‘cradle to grave.’ It does so by identifying and qualifying energy and materials used and waste released to the environment and by evaluating opportunities for reducing the impacts of these processes.

Monitoring is an ongoing review, evaluation, and assessment to detect changes in the condition of the natural or cultural integrity of a place with reference to a baseline condition.

Nature Tourism is travel to unspoiled places to experience and enjoy nature.

Performance-based programmes use a set of externally determined environmental and usually sociocultural and economic criteria or benchmarks to measure companies, services, products, individuals and attractions seeking certification.

Process-based programmes use environmental managements systems to measure companies seeking certification.

Pro-poor tourism addresses the key principles and needs of sustainable tourism as a development option at the economic, social, cultural, and environmental levels of developing countries. Increased economic benefits, positive non-economic impacts, and policy/process reform are the three strategies identified by the pro-poor tourism model that are considered central to unlocking opportunities for the poor in tourism destinations.

Rating is the process of actions that lead to the carrying out of certification. The figures used are compared to established benchmarks.

Small and medium enterprises (SME) are generally companies that employ more than ten but less than 250 individuals. Companies employing less than ten people are generally referred to as microenterprises.

Stakeholders Individuals who have an interest in a particular tourism project or certification programme including community members; environmental, social, and community NGOs; natural resource, planning, and government officials; hotel owners, tour operators, guides, transportation providers, and representatives from other related services in the private sector.

Standard is a technical specification or other document available to the public, drawn up with the cooperation and consensus or general approval of all interests affected by it. A standard is based on the consolidated results of science, technology, and experience , aimed at the promotion of optimum community benefits, and approved by a body recognized on the national, regional or international level.

Stewardship Councils are multistakeholder partnerships designed to provide a forum in which various actors with different interests in the targeted sectors can engage in collaborative soltuion-oriented dialogue to their mutual advantage and can create market-based incentives to stimulate the production and consumption of certified sustainable products. Stewardship councils accredit certifiers based on their performance and help ensure that certification is being conducted through objective and transparent mechanisms. An *'accreditation body'* is understood in this research will be considered as a stewardship council.

Sustainability Indicators *are* the heart of the certification programs yet there is as yet no universally accepted definition. Further, these social and environmental indicators often affect visitor satisifaction in less direct and more long term ways than do quality, health and safety conditions. Social Indicators reveal change over time and provide a benchmark against which to measure change. They are the quantitative variables that are measured to reflect the condition of social factors.

Sustainable Tourism embraces all segments of the industry with guidelines and criteria that seek to reduce environmental impacts, particularly the use of non-renewable resources, using measurable benchmarks, and to improve tourism's contribution to sustainable development and environmental conservation.The notion that tourism could be *"sustainable"* is the result of ongoing discussions and debates around the whole notion of Sustainable Development. The best of intentions have gone into developing strategies that promote the development of natural resources in a manner that does not destroy them for future generations.

Triple Bottom Line The Triple Bottom Line (TBL) concept widens the scope of traditional management and reporting to include the social, environmental, and economic performance of an organisation. Landcare Research offers advice in the development of a TBL approach to management and reporting.

Weighting The relative value given to different compatible indicators. For example, the value of a kg of water in Dubai is significantly higher than the corresponding amount in a country where water is abundantly available. Therefore, in this case a water value co-efficient would be developed which might relate to energy costs and availability of water.

1

Introduction

The problem addressed in this research is concerned with certification, the hotel sector and global CO_2 emissions. The main thrust of the research is to establish the effect of certification on emissions reduction. The research questions whether the certification schemes are robust and rigorous and whether the results are credible.

This chapter is divided into three sections. The first section presents the context, relevance, aims and the scope of the research. The main research questions and methods in relation to chapters of the thesis are presented followed by a description of the research method and the organization of the thesis.

1.0 Context and Relevance

In assessing the impact of global tourism on climate change, emissions from transport receive most attention, although those associated with accommodation account for more than 20% of the total emissions from global tourism. (UNWTO, 2007) Furthermore, whilst transport emissions could be reduced by reducing journey distance, accommodation emissions could only be reduced by improved performance of the buildings, or by reducing tourism activity altogether.

Certification is the process of assessing compliance with pre-established criteria and has been heralded as a tremendous step towards the *'greening'* of hotels. (Honey, 2002) However, tourism certification has been hurt by a lack of credibility and market confusion because there is not yet an internationally accepted framework against which to measure certification programmes. (Honey, 2002) A plethora of certification schemes for hotels have been established worldwide, assessing various environmental performance indicators, amongst them energy use. (Synergy, WWF, 2000)

The scientific community is unequivocal in its acceptance of the connection between climate change and green house gas emissions (IPCC, 2007a and b) yet the findings of this research show that none of the schemes explicitly quantify CO_2 emissions, and in many, energy is poorly accounted for, or other non-energy related factors are weighted so that the overall impact of energy use (and hence CO_2 emission) is weak.

Rapid reductions in CO_2 emissions are essential to the planet's survival as we know it. This is particularly relevant since energy use in buildings in the UK, account for nearly fifty percent of these emissions and since *'building energy performance is not yet seriously on the radar of most organizations'* it therefore both vital and urgent to improve energy performance. (Bordass, 2005) The most significant improvements available are not in the construction of the building, but during the period when the building is in use, when more than 80% of the total energy is consumed (Bordass, 2005). It has been increasingly been found that there are major discrepancies between predicted and actual energy use, and efforts have been focused on post-occupancy evaluation and data to provide a true picture of energy performance in buildings. (Bordass et al., 2004a) Norford et al., (1994, in Bordass et al., 2004a) note that annual CO_2 emissions of two - and sometimes even three - times design expectations are far from unusual thus indicating a massive credibility gap. The method used in this research is based on *energy in use* rather than *reported or predicted* energy use.

The climate change problem is principally an energy problem. Levels of emissions are highly correlated with levels of energy use. (WRI, 2005) In particular, as a result of the use of electricity and fossil fuels in buildings with the associated CO_2 emissions at the power station or boiler room. Globally, space heating is the dominant energy end-use in both residential and commercial buildings. Developed countries account for the vast majority of buildings-related CO_2 emissions, but the bulk of growth in these emissions over the past two decades was seen in developing countries. (IPCC, 2007a) Although no collective data is available on the global energy consumption in the hotel sector, Gössling (Gössling, 2002 in Bohdanowicz, Martinac, 2007) estimated that 97.5 TWh (351.1 PJ) of energy was used in hotel facilities worldwide in 2001. In the UK, the hotel and catering sector accounting for 2.2% of total energy consumption. (BERR, 2002) There exists a large volume of literature on energy conservation of hotels for example, Deng and Burnett, 2000, Bohdanowicz, 2006, Warnken et al., 2005, Becken and Simmons, 2001, however, none had a particular focus on hotel CO_2 emissions.

The way a building is managed, used and controlled are critical to its performance. (Baker and Steemers, 2000) These issues are examined in the hospitality sector, specifically in hotels, where energy is used more intensively than in other sectors due to their diverse range of services and amenities offered and their 24 hour operation. In hotels the provision of luxury is directly associated with conspicuous consumption of resources. In the overwhelming majority of our buildings, particularly in hotels, the use of electricity and gas is poorly controlled. The reasons are many and varied and include: obsolete and inefficient plant and equipment, inadequate management practices and a general lack of awareness at all levels from top management to individual users. (Macmillan, 2009)

The results of the research indicate hotel accommodation is more CO_2 intensive than domestic emissions and that certification schemes do not produce more energy efficient (or less CO_2 intensive) buildings. The findings also indicate inconsistencies in current certification schemes and a vital need for improved methods.

1.1 Research Questions

The problem is broken down into one primary question and four secondary questions which define the main thrust of the work and are addressed in Chapters 2 through 6. Figure 1.1 shows the chapters in relation to the research questions and methods.

Primary RQ1 What is the effect of certification on CO2 emissions? Did the hotel reduce its energy consumption (and emissions) prior to certification? (Chapter 4, 5 and 6)

RQ2 Do the schemes correctly account for CO_2 emissions? (Chapter 4)

RQ3 Are certification schemes rigorous and are the results credible? (Chapter 4, 5 and 6)

RQ4 How are emissions from electricity, including so-called ‘green’ electricity, accounted for, since it was found that in obtaining certification, this often plays an important part? (Chapter 2, 4, 5 and 6)

RQ5 What are the causal (physical, operational and managerial) differences for variances in hotel CO_2 emissions? (Chapter 5 and 6)

The relationship between environmental certification for buildings (Display Energy Certificates-DECs, Chapter 2) and tourism certification (Chapter 3 and 4) will be examined in Chapter 7 of this research. The issue of whether or not the application of correction factors to energy benchmarks simply compensates hotels for increased energy use and actually allows them to emit more is questioned in Chapter 3.

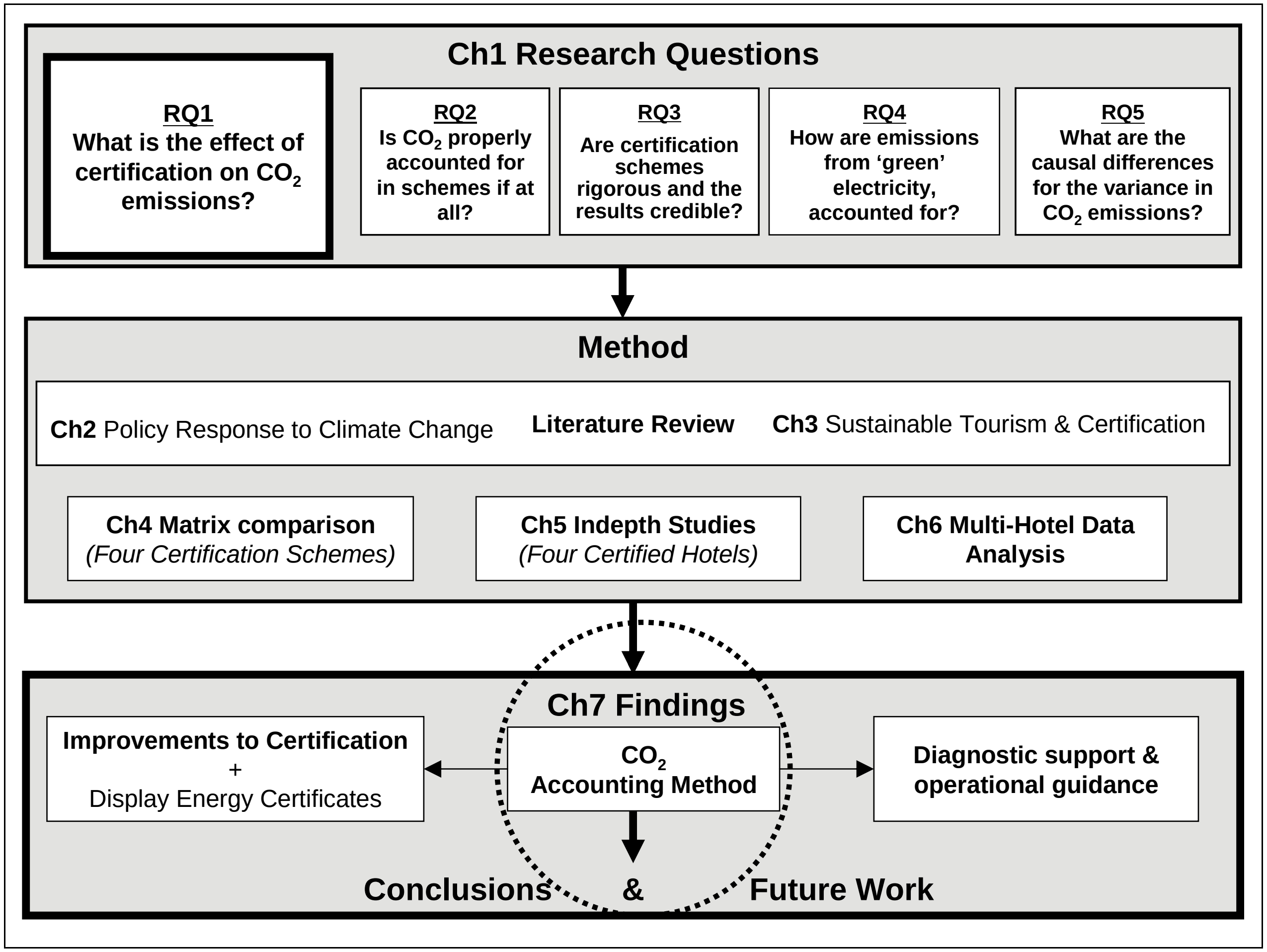

Figure 1.1 Research questions and methods in relation to chapters of the thesis.

1.2 Aim and Scope of the Research

The main purpose of this research is to study the effectiveness of certification in reducing global CO_2 emissions in the hotel sector. The focus of the research is in the effectiveness of energy benchmarking to motivate the hospitality sector to improve its practices and reduce its environmental impact in relation to CO_2 emissions.

The associated economic, social and cultural impacts and transport issues particularly in relation to aviation emissions are acknowledged but outside the scope of this research. Although important, the contribution of lifestyle and behavioural changes are outside the scope of this research.

The stakeholders targeted by the tourism certification schemes contained in the literature review are aimed at hotel owners, environmental managers, architects, engineers, guests, the public etc. However, the stakeholders targeted by this thesis include scientists, policy makers and the people responsible for formulating the certification schemes.

The research addresses the research questions by analysing the actual energy consumption data of selected hotels to ascertain energy usage and CO_2 emissions data and how this corresponds to environmental certification. This has been accomplished by a thorough literature review of the current state of certification as well as an investigation of the key criteria and methods employed in the selected certification schemes used in this study. Results from the individual indepth studies and multi-hotel analysis of the raw operational data collected from the selected hotels have shown no direct reduction in CO_2 emissions attributable to certification alone.

In the concluding chapter, the achievement of this piece of research is evaluated and how far the aims set out here have been realized. In summarizing these achievements, there is also a discussion about further research including recommendations for improvement, followed by a closing statement.

1.3 Research Method

The method is based on the analysis of a database of *actual* energy in use, rather than *reported* or predicted energy use.

Firstly, an extensive literature review was conducted covering a broad range of subjects to ascertain the importance of CO_2 emissions for certification. This included policy response to climate change and global CO_2 emissions; global and local energy supply, sustainable tourism and tourism certification, energy benchmarking used in certification schemes, the issues associated with 'green' electricity certificates (with a focus on the Swedish market) and carbon offsetting, building design techniques and policies for energy conservation and finally, the potential impact of Display Energy Certificates (DEC's) on certification was investigated.

The next stage involved case study research of four widely used certification schemes. The selected schemes included Nordic Swan (Regional - Scandinavia), Green Globe (International - Worldwide), EU Flower (Pan European - EU) and Green Hospitality (formerly Fàilte) Award (National - Ireland). The key issues such as performance and process related criteria, use of benchmarks, and the weighting of different categories and of CO_2 related criteria were identified in each scheme. A comparison was also made with LEED-EB *For Existing Buildings*, a well-established environmental certification scheme, not dedicated to the hotel sector. (Chapter 4)

Global CO_2 emissions were compared and calculated from the delivered electricity and fuels consumption data collected from a variety of sources i.e. meter readings, invoices and consumption databases, for seventy selected certified hotels worldwide. No corrections were made in the calculations for climate, quality of services and existence of services. From the data collected from 70 hotels worldwide, the *actual* energy consumption was analyzed using three different methods to ascertain energy usage and CO_2 emissions data and to investigate how this corresponds to certification. An energy benchmark (kWh/m^2) is measurable and widely understood and a CO_2 benchmark ($kgCO_2/m^2$ or $kgCO_2$/guest night) involves a calculation related to fuel mix using the appropriate published conversion factor. The energy consumption metric (kWh/m^2) does not give any information on the environmental impact of the energy consumed by the hotel in terms of CO_2 emissions. Since the focus of this research is targeted at the scientists and people responsible for formulating the certification schemes who are familiar with the unit $kgCO_2$ and since the certification schemes are targeted at hoteliers and hotel environmental managers, it makes sense to use the 'currency' they are most familiar with which is the unit of consumption e.g. kWh, m^3 gas, litres oil etc. from which the certifier can calculate the CO_2 emissions. The hotelier is already familiar with the unit of guest night. Therefore in order to address the specific research questions raised by this thesis, the key performance indicator used is $kgCO_2$/guest night. (Chapter 5 and Chapter 7)

Results are presented from large multi-hotel data samples and for detailed results from the quality, illustrative in-depth studies which provided invaluable insight into the technical realities of a multitude of causes and effects which can often be masked in large data samples. Three levels of analyses were carried out. Chapter 5 presents the results of four illustrative in-depth studies, each hotel being certified under each of the selected schemes. The hotels were located in Sweden, Maldives, Malta and Ireland respectively. Available documentation was studied with respect to building design, technologies applied and resulting energy performance. Key low energy technological and/or building design techniques were show cased for each hotel.

The CO_2 emissions with regard to the energy usage are analysed on the basis of their energy supply. The result will be different if the surrounding energy system is regarded as national i.e. Swedish (mostly hydroelectric) or a European electricity mix (which is more diversified with mainly nuclear, coal, hydro and natural gas fired power production), or district heating as a substitute for electrical heating. The case for the application of the more realistic application of a European Conversion Factor (0.475 $kgCO_2/kWh$) to delivered electricity is presented and argued for in Chapter 5. The author also discusses the case for indeed a Universal Conversion Factor to be used to enable global comparison of hotels. Certain rules will apply, for example if district heating is supplied by Combined Heat and Power (CHP) in which case it is argued that the CO_2 emissions have already been ascribed to the electricity thus the CO_2 emissions for the heating should be considered zero. The reasons for this assumption are detailed in Chapter 5.

Chapter 6 presented two analyses using the same CO_2 accounting method described in Chapter 5. One which compared the *calculated* emissions per guest night for 8 hotels certified in *different* schemes and another which compared the *reported* emissions for 28 hotels *certified* within the same scheme. The purpose of these analyses is to demonstrate the wide range of emissions permitted *between* schemes and those permitted within the *same* scheme.

1.4 Thesis Organisation

The thesis is organized into three parts; the first part (Chapters 2 and 3) present the findings of the literature review based on secondary research sources. The review examines policy response to climate change and sustainable tourism & tourism certification. The second part presents the research method and the results of the empirical data. The third part presents the key findings, conclusions, discussion and recommendations for improvement.

Literature Review

Chapter 2 presents an inventory of global and local energy technologies and policy instruments used for CO_2 emissions reduction. The purpose of this inventory is to make clear why CO_2 emissions is necessary to be included in tourism certification in order to make it a more reliable and robust measure of environmental impact.

The chapter presents a review of the following; 1) The Climate Change Problem 2) Global Policy Response To Climate Change 3) Policy Instruments for CO_2 Emissions Reduction including a) Regulatory instruments *(including Energy Performance Building Directive)* b) Economic and market based instruments (*including emissions trading mechanisms, offsetting and 'green' electricity certificates*) c) Fiscal instruments (*including energy taxes and fiscal instruments*) d) Voluntary tools *(including VISIT Ecolabel, SUTOUR and TourBench.[1])*

Chapter 3 presents an overview of sustainable tourism and tourism certification and its role in reducing global emissions in the hotel sector. The chapter is divided into four sections including; past, present and future trends in tourism; Sustainable Tourism and Ecotourism; Tourism Certification and Accreditation followed by a summary of the findings. The final section looks at Benchmarks and its role in the setting of performance levels. A review is included of three published sources of benchmarks used to assess energy performance in hotels. The effectiveness of benchmarks and certification in reducing CO_2 emissions from energy use in buildings is examined and discussed in this chapter.

Method

The second part of the thesis is based on primary research sources and raw data collected by the author for use in her analysis. In Chapter 5, the author will explain her CO_2 accounting method in the calculation of CO_2 emissions from the hotels used in this analysis and the research method. This part of the thesis seeks to examine the effect of certification on CO_2 emissions using three methods of analysis;

1) Comparison of five selected certification schemes *(Chapter 4)*

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[1] Other methods of tourism certification will be reviewed in Chapter 3.

2) Four Indepth Studies of four hotels certified under each of selected certification schemes (*Chapter 5*)
3) Multi-hotel Data Analysis to compare the emissions *between* schemes and within the *same* scheme (*Chapter 6*)

Actual annual energy use data is desperately needed as feedback to designers, managers and owners in order to give confidence that the selected certification schemes have true validity. There is a need for both results from large samples to give statistically significant evidence but also for detailed results from quality indepth studies which usually provide far more insight into technical realities than the statistical data which can mask a multitude of causes and effects.

Chapter 4 presents four hotel specific (Nordic Swan, Green Globe, Green Hospitality Award and EU Flower) and one non-hotel specific (LEED-EB) certification schemes and critically compares the methods of energy accounting, how other non-energy related factors are weighted and if CO_2 emissions have been quantified, so that the overall impact of energy use (and hence CO_2 emission) can be judged.

Chapter 5 This chapter presents a description of the CO_2 accounting method and the results of an analysis of four indepth studies, each hotel being certified under each of the schemes mentioned above. The hotels were located in Sweden (Nordic Swan), Maldives (Green Globe), Malta (EU Flower) and Ireland (Green Hospitality Award). Available documentation will be studied with respect to building design and technologies applied. The resulting energy performance and CO_2 emissions will be calculated by the author using the CO_2 accounting method described. Key low energy technological and/or building design techniques will be show cased for each hotel. An analysis will be conducted on how the hotel scored points in each scheme with particular focus on energy related points.

Chapter 6 This chapter presents two analyses, one which compares the *calculated* emissions per guest night for hotels certified in *different* schemes and another which compares the *reported* emissions for hotels *certified* within the same scheme. The purpose of these analyses is to demonstrate the wide range of emissions permitted *between* schemes and those permitted within the *same* scheme.

The purpose of the study is to examine if CO_2 is properly accounted for in certification and to examine its effect on certification. Attention will also be given to the role of ‘green’ electricity in the awarding of certification.

Key Findings, Conclusions and Recommendations

The third part of the thesis summarizes the key findings and significance of the research as well as proposing recommendations for improvement of certification and discussing the extent to which the objectives of the research have been achieved**.**

Chapter 7 The key findings from the research in the area of certification in the hotel sector in relation to global CO_2 emissions reduction are summarized in this chapter. The extent to which the objectives have been achieved will be set out and followed by a preliminary discussion of the findings and key recommendations such as the need for the introduction of mandatory CO_2 certificates, used either on their own or integrated with statutory regulations such as the Display Energy Certificate. The importance of changes in our lifestyle and behaviour in emissions reduction is discussed although it is outside the scope of this research.

Recommendations for improvement of certification based on the findings of this research are presented in the second part of Chapter 7. The key recommendations call for mandatory sub-metering and the appointment of an independent assessor to ensure accurate data collection in hotels. The research proposes three levels of assessment be carried out using the authors CO_2 accounting method. The author also proposes and discusses the merit of developing individual CO_2 benchmarks for different energy intensive parts of the hotel which would provide diagnostic value and points to where technical improvements could be made. This method would be the first step of the diagnostic process leading to a solution to the problem thus reducing the environmental impact of the hotel in terms of emissions reduction and associated impacts.

2

Policy Response To Climate Change

Chapter 2 presents an inventory of global and local energy technologies and policy instruments used for CO_2 emissions reduction. The purpose of this inventory is to make clear why CO_2 emissions is necessary to be included in tourism certification in order to make it a more reliable and robust measure of environmental impact.

The chapter is structured as follows 1) The Climate Change Problem 2) Global Policy Response To Climate Change 3) Policy Instruments for CO_2 Emissions Reduction including a) Regulatory instruments *(including Energy Performance Building Directive)* b) Economic and market based instruments (*including emissions trading mechanisms, offsetting and 'green' electricity certificates*) c) Fiscal instruments (*including energy taxes*) d) Voluntary tools *(including VISIT Ecolabel, SUTOUR and TourBench.*[1]*)*

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[1] Other methods of tourism certification will be reviewed in Chapter 3.

2.0 Overview

Under current energy policies, greenhouse gas emissions are projected to grow rapidly, with a major contribution coming from fossil fuel combustion in power plants and industry. The IEA, in its 2008 *Energy Technology Perspectives* (ETP) study, projects that energy-related CO_2 emissions would grow by 130% until 2050 in the absence of new policies. This increase would largely be a result of increased fossil fuel usage. (OCED/IEA, 2008) The 2007 Intergovernmental Panel on Climate Change (IPCC) *4th Assessment Report* indicates that such a rise in emissions could lead to a temperature increase in the range of 4 - 7^oC, with major impacts on the environment and human activity. There is a large consensus that a halving of energy-related CO_2 emissions is needed by 2050 to limit the expected temperature increase to less than 3 degrees. (IPCC, 2007a)

According to IEA, meeting this formidable challenge will take an energy technology revolution and a change in government policies with closer international collaboration is necessary in order to meet the 2050 emissions reduction target. From a technological perspective, this will involve enhanced energy efficiency, increased renewable energies and nuclear power, and the decarbonisation of power generation from fossil fuels. (OECD/IEA, 2008)

2.1 The Problem of Climate Change

2.1.1 Past, Present and Future: Global Emissions Trends

According to the Intergovernmental Panel on Climate Change (IPCC), emissions of the greenhouse gases (GHGs) covered by the Kyoto Protocol increased by about 70% (from 28.7 to. 49.0 $GtCO_2$-eq) from 1970–2004 (by 24% from 1990–2004), with carbon dioxide (CO_2) being the largest source, having grown by about 80% as seen in Figure 2.1 below. (IPCC, 2007a) Global emissions of CO_2 from fossil fuels have risen steeply since the start of the industrial revolution, with the highest rate increases coming after 1945.

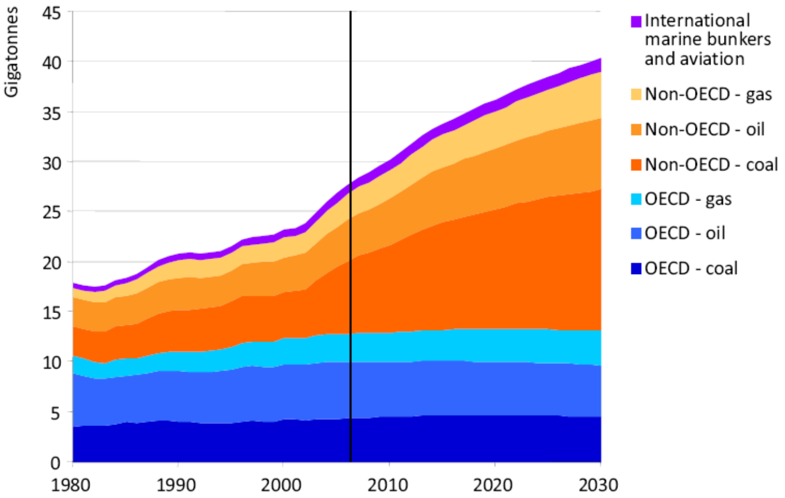

Figure 2.1 Energy-related C0$_2$ emissions World Energy Outlook 2008 - Reference Scenario (*OECD/IEA, 2008).*

Ninety seven per cent of the projected increase in emissions between now & 2030 comes from non OECD countries – three quarters from China, India & the Middle East alone. Currently, almost 90% of world resources are owned by 20% of the world population, and 20% by about only 1%. (OECD/IEA, 2008) Figure 2.2 below shows the top 12 CO_2 emitting countries, in both absolute and per capita terms. (WRI, 2005) In 2004, the UK's per capita emissions were twice the world average and the USA was four times the world average. The United States and Canada have the highest per capita emissions with European countries, Japan, Russia, S. Korea and South Africa not far behind. China may be one of the biggest emitters but its per capita emissions are below world average and inversely Canada may be a below world average emitters yet is one of the highest per capita emissions. (WRI, 2005)

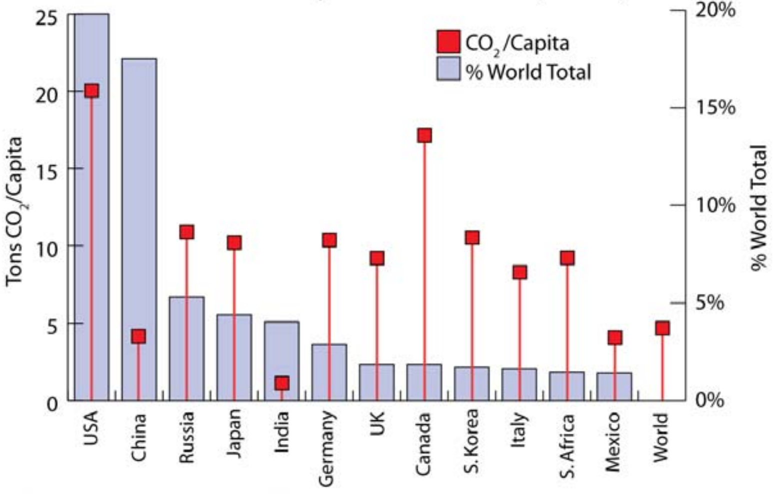

Figure 2.2 Top 12 CO_2-emitting countries & their per-capita emissions 2004 *(Climate Analysis Indicators Tool: http:cait.wri.org as cited in WRI, 2005).*

Many of the cross-country differences can be explained by economic structure and energy efficiency. More significantly, levels of economic development shape energy use for example, many developing countries lack access to electric power and modern transportation. Still other cross-country differences are explained by “natural factors” such as climatic conditions, land area, population densities, and natural resource endowments. These factors influence energy use through differential heating and cooling needs, transportation requirements, and energy technology choices. (WRI, 2005)

Most tourism takes place within or between developed countries. Citizens from wealthier nations, comprising less than 25 per cent of the global population, account for 85 per cent of the world tourist arrivals. Europe as a whole captures 59 percent of international arrivals, with France the number one destination worldwide. The United States ranks second in numbers of arrivals (but first in earnings from international tourism in part because tourists spend more in The United States than in other regions of the world. (Honey, 2002)

Around the world, there are some 260 voluntary initiatives, including tourism codes of conduct, labels, awards, benchmarking, and “best practices.” Of these, 104 are ecolabelling and certification programmes. (WTO, 2002 in Honey, 2002) By 2001, there were about 60 certificates in Europe alone, the majority of these – more than – thirty – certify accommodations including hotels. Europe has far more “green” certification schemes than any other region in the world. (Honey, 2002)

2.1.2 Climate Change, Energy Consumption and Hotels

The climate change problem is principally an energy problem. Levels of emissions are highly correlated with levels of energy use, in large part because 61 percent of total greenhouse gases (GHGs) (and almost 75 percent of all CO_2) stem from energy-related activities, with the large majority coming from fossil fuel combustion. These emissions result from electricity and heat generation, transport, industry, other fuel combustion, and fugitive emissions (for example, from oil and gas extraction). Absolute emissions in this sector, estimated here for 2000, are 10,269 $MtCO_2$. (WRI, 2005)

Across fuels, oil constitutes the most commonly used energy fuel, at 35 percent of global primary energy use, followed by coal (24 percent), natural gas (21 percent), and other non-fossil sources that do not emit greenhouse gases (GHGs) directly.2 (WRI, 2005) Differences between energy use and GHG shares are explained by differences in efficiencies and the carbon content of the fuels. Coal, the highest carbon fuel, plays a dominant role in global electric power generation, and its future growth is expected to be significant. It has a carbon content that is 34 percent higher than oil and 75 percent higher than gas. (WRI, 2005)

Electricity and heat account for 70 percent of coal consumption. Residential and commercial activities (such as heating) collectively account for about 15 percent of oil consumption. Electricity and heat production account for about 38 percent of natural gas consumption, while the residential and commercial sector account for 35 percent. (WRI, 2005) Avoiding dangerous climate change will require reduced coal use or sequestration of coal-related emissions. Similarly, major emitting countries will need to reduce their dependence on oil. Natural gas, because of its lower carbon content and increasing cross-border trade, has the potential to offer climate benefits if it can reduce coal and oil consumption. (WRI, 2005)

According to the DTI report, Energy Consumption in the UK (BERR, 2002) in final energy terms by sector, the transport sector was the largest single consumer of energy in 2001, accounting for 34 per cent of the total as seen in Figure 2.3 on the next page. The domestic sector was responsible for a further 30 per cent and industry for another 22 per cent. The remaining 14 per cent was consumed by the service sector (13 per cent) and the agriculture sector (1 per cent). Since 1990, the contribution that each of these sectors has made to overall energy consumption has not changed greatly, although there have been more major changes since 1970, reflecting the shift from energy-intensive industry to the service sector and growth in the transport sector. (BERR, 2002)

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[2] Some hydropower installations, it should be noted, can result in significant emissions of greenhouse gases, particularly dams in tropical countries (WRI, 2005).

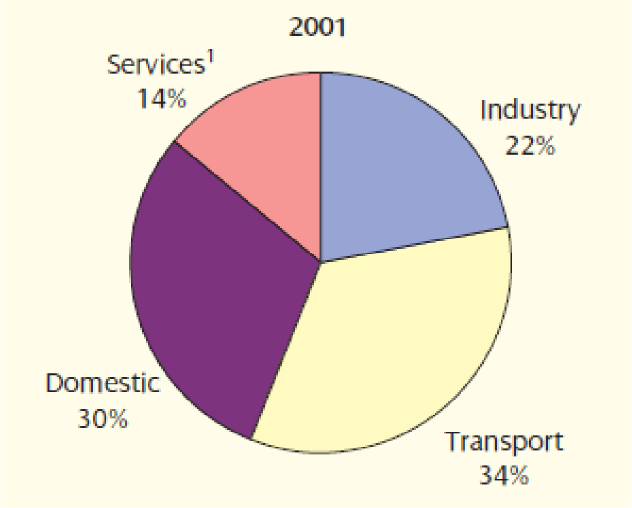

Figure 2.3 Percentage sector shares in total energy consumption, 2001. *(DTI in BERR, 2002)* [1] *Includes agriculture.*

According to the DTI report, the service sector energy consumption (excluding agriculture) accounted for 13 per cent of all final energy consumed for energy purposes in 2001. The service sector can be split into two main components: public administration which covers government activities, education and health and private commercial which covers retail, hotels, financial, real estate and computer activities. In 2001 energy consumed in the public administration sub-sector accounted for 39 per cent of all service sector energy consumption, while the private commercial sector accounted for the remaining 61 per cent. (BERR, 2002) A detailed breakdown of service sector energy consumption in 2000 is shown in Figure 2.4. This shows that the largest energy consuming sub-sectors are retail, hotels and catering and education with the hotel and catering sector accounting for 2.2% of total energy consumption in the UK.

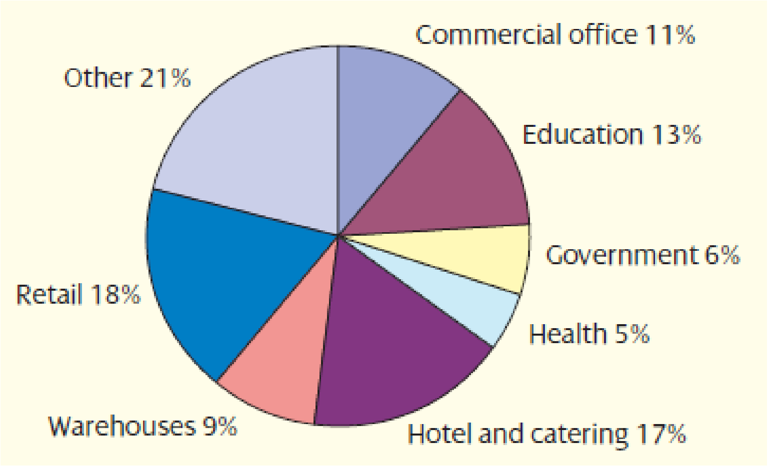

Figure 2.4 Service sector energy consumption by sub-sector, 2000 *(BERR, 2002)*

The chart shown in Figure 2.5 below shows the range in the German government benchmarks for public buildings as used in the German Energy Performance Certificate for public display (DEC). The benchmarks are shown in kWh/m^2 on an annual basis and are based on delivered kWh. These benchmarks were developed on the basis of a large database of energy use and are calculated on a statistical basis. (Cohen et. al., 2008) The chart shows that energy benchmark for hotels with 3, 4 and 5 stars (and those without stars including pensions and bed and breakfasts) are higher than those of retail (non-food <2000m^2) and office buildings.

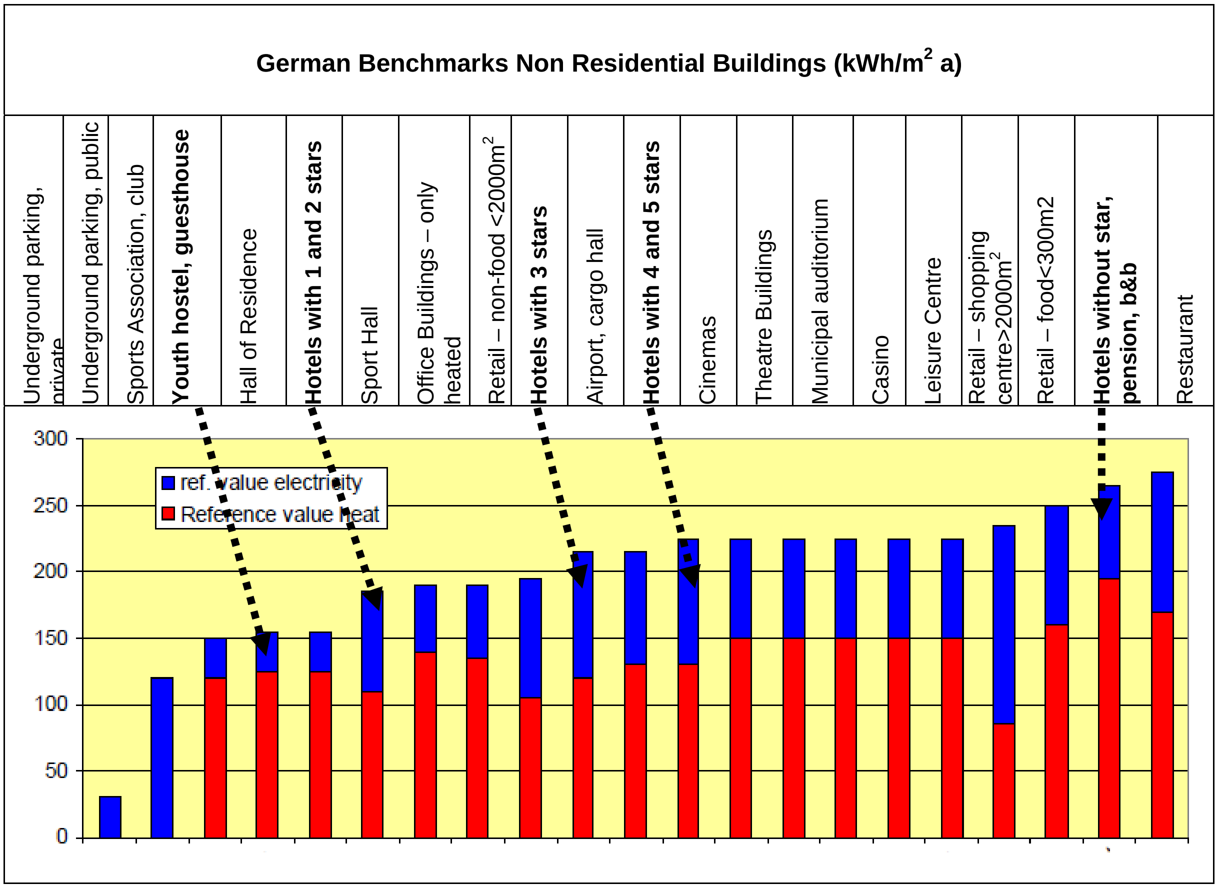

Figure 2.5 German benchmarks, non-residential buildings, kWh/m^2/yr (based on delivered kWh) *(Cohen et. al., 2008)*

In terms of CO_2 emissions, the UK has produced sector benchmarks (kgCO_2/M^2/yr). The standard value for annual electricity and fossil fuel use for each benchmark category are shown in Figure 2.6. below and are converted to common units of kgCO_2/M^2/yr.

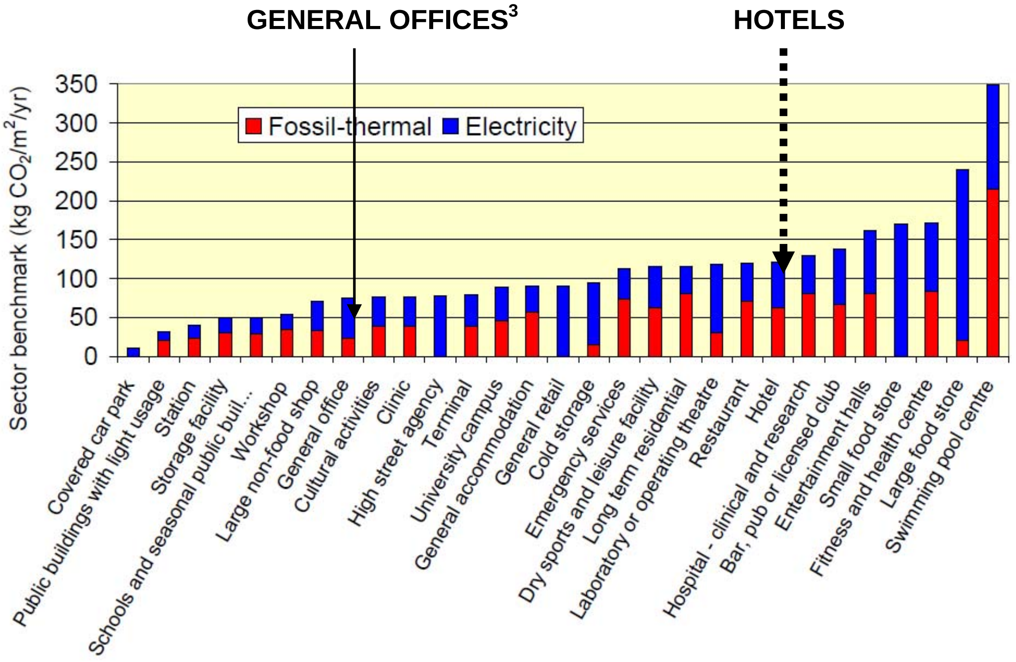

Figure 2.6 UK Standard values for each benchmark category, converted to $kgCO_2/m^2/year$ *(Cohen et al., 2008)*

Energy Use for Service Sector

More than half of all energy consumed in the service sector was for space heating in 2000. Hot water energy consumption accounted for a further 9 per cent, lighting for 14 per cent and catering for an additional 10 per cent of the total. (BERR, 2002)

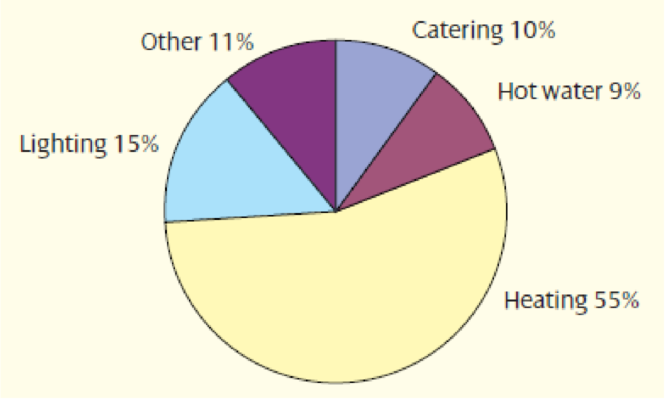

Figure 2.7 Services sector energy consumption by end use, 2000 *(BRE in BERR, 2002[4])*

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[3] Includes crown court, a conference centre and a public sector or commercial office have been placed in the general office benchmark category. (Cohen, 2008)

[4] The consumption tables which are National Statistics were updated in July 2008.

A comparable pie chart is produced by The Carbon Trust (2007a) as shown in Figure 2.8 but does not show a percentage breakdown.

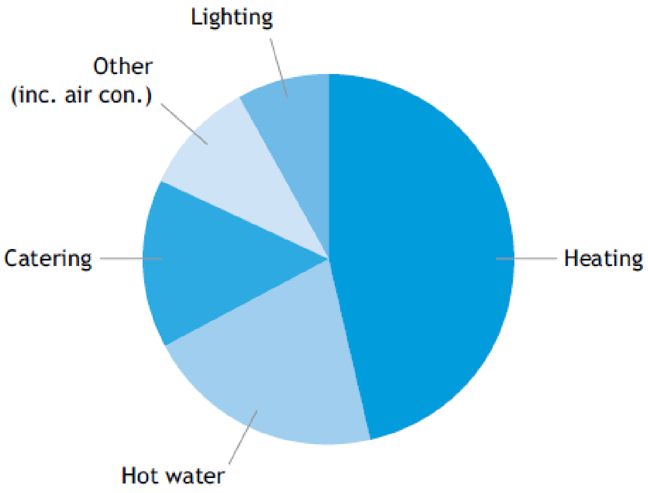
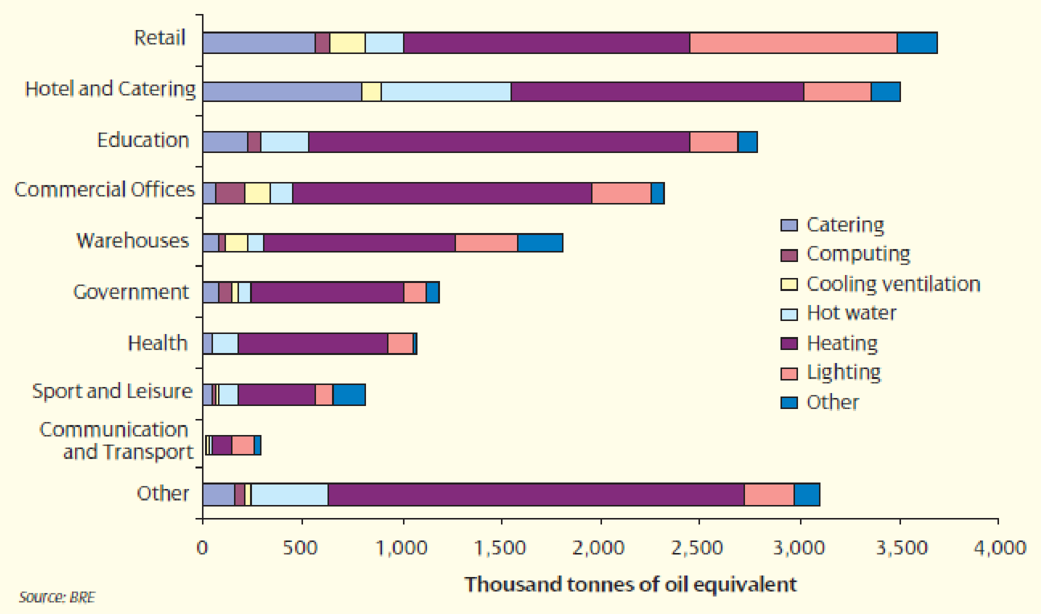


Figure 2.8 Breakdown of energy use in the average hotel *(Carbon Trust, 2007a)*

The breakdowns for energy consumption by end use for different sector are shown in Figure 2.9. Most of the energy consumed for space heating is for commercial offices, schools and colleges, hotels, caterers and shops. (BERR, 2002)



Source: BRE

Figure 2.9 Energy consumption for service sector buildings by end use, 2000 – thousand tonnes of oil equivalent. *(BRE in BERR, 2002*[5]*)*

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[5] The consumption tables which are National Statistics were updated in July 2008.

As seen in Figure 2.9, space heating made up the largest share of all energy consumed by each of the service sub-sectors. Energy used for heating water was most important in the hotels and catering sub sector, accounting for 19 per cent of all of the energy consumed by hotels and catering. (BERR, 2002) As shown in this chart, the hotel and catering sector is the most energy intensive sector after retail which underlines its importance in emissions and consumption reduction.

2.2 Global Policy Response to Climate Change

Addressing our climate change problems necessitates a global policy response, guided by a common international understanding of the long terms goals for climate policy and strong frameworks for co-operation. (ITP, 2008) The IPCC has concluded that emissions must be reduced by 50% to 85% by 2050 if global warming is to be confined to between 2°C and 2.4°C. G8 leaders agreed at the Heiligendamm Summit in 2007 to seriously consider a global 50% CO_2 reduction target. (OECD/IEA, 2008)

In the UK, the Climate Change Act[6] became law on 26 November 2008 and makes it the duty of the Secretary of State to ensure that the net UK carbon account for the year 2050 is at least 80% lower than the 1990 baseline[7]. (OPSI, 2008) To achieve this reduction, emissions need to be reduced from their current level of 695 $MtCO_2e$ (2006) to 159 $MtCO_2e$ as shown below in Figure 2.10.

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[6] The Climate Change Act sets a target for the year 2050 for the 80% reduction of targeted greenhouse gas emissions; to provide for a system of carbon budgeting; to establish a Committee on Climate Change; to confer powers to establish trading schemes for the purpose of limiting greenhouse gas emissions or encouraging activities that reduce such emissions or remove greenhouse gas from the atmosphere; to make provision about adaptation to climate change; to confer powers to make schemes for providing financial incentives to produce less domestic waste and to recycle more of what is produced; to make provision about the collection of household waste; to confer powers to make provision about charging for single use carrier bags; to amend the provisions of the Energy Act 2004 about renewable transport fuel obligations; to make provision about carbon emissions reduction targets; to make other provision about climate change; and for connected purposes.

[7] "The 1990 baseline" means the aggregate amount of—
(a) net UK emissions of carbon dioxide for that year, and
(b) net UK emissions of each of the other targeted greenhouse gases for the year that is the base year for that gas.

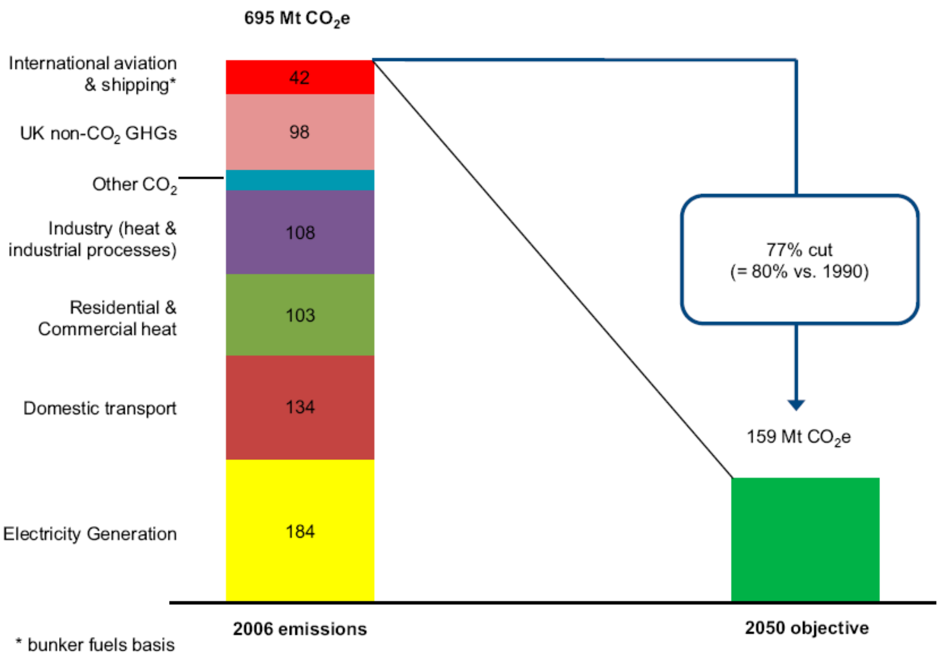

Figure 2.10 The scale of the UK challenge *(UK National Atmospheric Emissions Inventory, 2008 in CCC, 2008).*

According to CCC, the 2050 target and the required 80% emissions reduction can be reduced by using low-carbon energy sources and by improving energy efficiency at a cost to the UK economy of 1-2% of GDP. For example, one method might be by decarbonising electricity generation by using a combination of renewables, nuclear and carbon capture and storage (CCS). Another method might be by reducing emissions from buildings and industry in both the residential and commercial sectors, by decarbonising the way that we produce heat and through implementing policies to improve energy efficiency i.e. switching to low-carbon fuels, including a higher share of renewable energy. (CCC, 2008)

An urgent global energy technology revolution and a change in government policies with closer international collaboration is necessary in order to meet the 2050 emissions reduction target (OECD/IEA, 2008) The OECD/IEA publication, *Energy Technology Perspectives* (ETP) was chosen out of the many other strategies that currently exist, since it examines the available options for switching to a cleaner and more efficient energy future and the policies required to achieve these targets. The OECD/IEA analysis demonstrates that technology is crucial to a more sustainable energy future with increased energy efficiency, CO$_2$ capture and storage, renewables, and nuclear power all playing important parts. The study contains technology road maps for all key energy sectors, including electricity generation and buildings which are both relevant to hotels as a building type and in relation to their energy intensive nature.

2.2.1 Energy Technology

The ETP report proposes two scenarios (*ACT and BLUE)*; the ACT scenario targets emissions stabilisation to 2005 levels and the BLUE scenario targets a 50% reduction in CO_2 emissions as shown in Figure 2.11. (OECD/IEA, 2008)

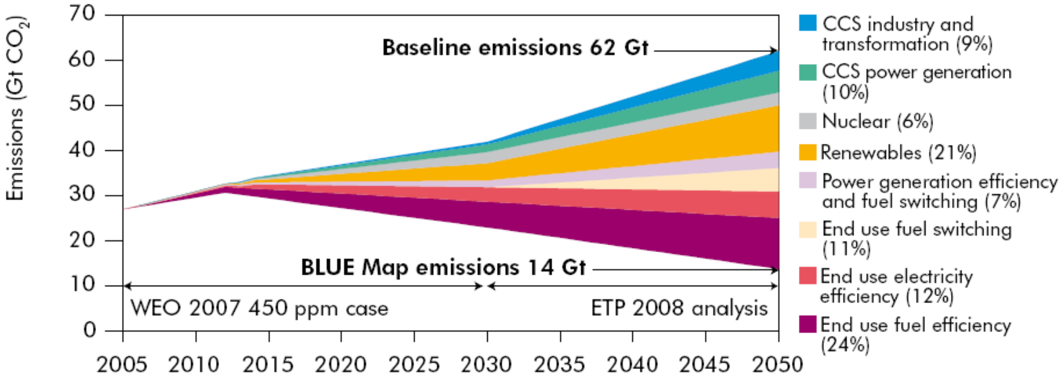

Figure 2.11 Sources of CO_2 savings in the BLUE Map scenario compared to the baseline scenario *(OECD/IEA, 2008).*

The *Energy Technology Perspective* ETP reports that the ACT scenarios can become reality using technologies for buildings and appliances widely available today and economically viable on a life-cycle cost basis. However, it points out that the BLUE scenarios call for new and emerging technologies; in some cases are only economic at relatively high CO_2 reduction costs[8], at least when initially deployed.

Over 18,000 TWh (18000 billion kWh) per annum of electricity is produced globally, emitting around 11 $GtCO_2$. (CCC, 2008) There are a range of low-carbon sources to facilitate decarbonisation of electricity generation in the near term, such as wind, hydro, biomass and nuclear. Over the medium term, a wider range of renewable technologies and Carbon Capture and Storage (CCS) could play a major role. In order for the UK to be on a path to reducing emissions by 80% by 2050, it is vital that emissions from the power sector are reduced by more than 90% from today's levels. This is partly because it is easier and cheaper to reduce emissions in this sector, but also because electricity could play a major role in achieving required emissions reductions in both transport and heat. (CCC, 2008) Some technologies to achieve

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[8] USD 45 trillion additional investment cost for BLUE scenario (1.1% of GDP).

power sector decarbonisation from the global and local supply side are described in more detail in Appendix 2A.

The Energy Technology Perspective (ETP) report provides a roadmap of key technologies which provide 87% of CO_2 savings to halve the energy related CO_2 emission by 2050 as outlined below in Table 2.1 (OECD/IEA, 2008) Emissions reductions in energy supply and demand, at both global and local level would significantly reduce the environmental impact of the hotel sector.

<table>
<tr><th colspan="2">Key Technology Options
<i>87% of emissions reduction in BLUE scenario</i></th></tr>
<tr><th>Supply Side
<i>Global</i></th><th>Demand Side
<i>Local</i></th></tr>
<tr><td>CCS power generation</td><td>Energy efficiency in buildings</td></tr>
<tr><td>Coal - IGCC[9]</td><td>Energy efficient motor systems</td></tr>
<tr><td>Coal - USCSC</td><td>Efficient ICEs</td></tr>
<tr><td>Nuclear III + IV</td><td>Heat Pumps</td></tr>
<tr><td>Wind (<i>Large, scale</i>)</td><td>Industrial CCS</td></tr>
<tr><td>Biomass – IGCC & co-combustion</td><td>Solar Heating</td></tr>
<tr><td>2nd generation bio fuels</td><td>CHP</td></tr>
<tr><td>Marine Renewables</td><td></td></tr>
<tr><th>Supply Side
<i>Global</i></th><td></td></tr>
<tr><td>Wind (<i>Medium & micro scale</i>)</td><td></td></tr>
<tr><td>Solar - PV</td><td></td></tr>
<tr><td>Solar – CSP (Concentrated Solar power)</td><td></td></tr>
</table>

Table 2.1 Key technology options *(Adapted by Author from OECD/IEA, 2008).*

2.2.2 Policy Response – local level

Widespread conversion of buildings to very low energy consumption and even “zero” energy buildings are part of the Blue scenario. (OECD/IEA, 2008) According to the ETP report, the policy implications for efficiency standards for buildings and

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[9] Integrated Gasification Combined Cycle (IGCC).

appliances are huge. This is particularly relevant since the use of electricity and gas is poorly controlled in the overwhelming majority of buildings, particularly in the hotel sector. The reasons are many and varied and include: obsolete and inefficient plant and equipment, inadequate management practices and a general lack of awareness at all levels from top management to individual users. A combination of building-shell measures, heat pumps, solar heating and highly efficient appliances and lighting reduces energy needs in buildings as well as shifting fuel use to renewables and low-carbon electricity.

The OECD/IEA sets out 25 energy efficiency policy recommendations as shown below in Table 2.2 below. (OECD/IEA, 2008) With the exception of transport and industries sections, the policy recommendations for the remaining five priority areas are relevant to the hotel sector. Implementation of these recommendations would have a considerable impact on increasing energy efficiency in the energy intensive hotel sector.

IEA 25 Energy Efficiency Policy Recommendations across 7 Priority Areas	
1. Across Sectors*	**4. Lighting***
1.1 Measures for increasing investment in energy efficiency	4.1. Best practice lighting and the phase out of incandescent bulbs
1.2. National energy efficiency strategies and goals	4.2. Ensuring least cost lighting in non-residential buildings and the phase out of inefficient fuel-based lighting
1.3. Compliance, monitoring, enforcement and evaluation of energy efficient measures	**5. Transport**
1.4. Energy efficiency indicators	5.1 Fuel efficient tyres
1.5. Monitoring and reporting progress with the IEA energy efficiency recommendations	5.2. Mandatory fuel efficiency standards for light-duty vehicles
2. Buildings*	5.3 Fuel economy of heavy duty vehicles
2.1. Building Codes for new buildings	5.4. Eco-driving
2.2. Passive Energy Houses and Zero Energy Buildings	**6. Industry**
2.3. Policy Packages to promote energy efficiency in existing buildings	6.1. Collection of high quality energy efficiency data for industry
2.4. Building certification schemes	6.2. Energy performance of electric motors
2.5. Energy Efficiency improvements in glazed areas	6.3. Assistance in developing energy management capacity

3. Appliances *	6.4. Policy packages to promote energy efficiency in small and medium sized enterprises
3.1. Mandatory energy performance requirements or labels	**7 Utilities***
3.2. Low-power modes, including standby power for electronic or networked equipment	7.1. Utility end-use energy efficiency schemes.
3.3. Television or “set-up” boxes	
3.4. Energy performance test standards and measurement protocols	

Table 2.2 IEA 25 Energy Efficiency Policy Recommendations across 7 priority areas. Note. * indicates particular relevance to the hotel sector *(OECD/IEA, 2008).*

Global implementation of these recommendations could save around 8.2 $GtCO_2$/yr by 2030 which is equivalent to 20% of the WEO’s global reference scenario which assumes no new government policies. (OECD/IEA, 2008)

2.2.3 Interactions of Mitigation Options with Vulnerability and Adaptation

It is important to note that many energy systems are themselves vulnerable to climate change. For example, fossil fuel based offshore and coastal oil and gas extraction systems are vulnerable to extreme weather events. Cooling of conventional and nuclear power plants may become problematic if river waters are warmer. Renewable energy resources can also be affected adversely by climate change (such as solar systems impacted by changes in cloud cover; hydropower generation influenced by changes in river discharge, glaciers and snow melt; wind power influenced by changing wind velocity; and energy crop yields reduced by drought and higher temperatures).

Adaptation measures to climate change, like air conditioning and water pumps use energy and may contribute to even higher CO_2 emissions, and thus necessitate even more mitigation (IPCC, 2007a) If the world experiences warming, energy use for heating in temperate climates will decline (e.g., Europe, parts of Asia and North America), and for cooling will increase in most world Regions Several studies indicate that, in countries with moderate climates, the increase in electricity for additional cooling will outweigh the decrease for heating, and in Southern Europe a significant increase in summer peak demand is expected. (IPCC, 2007b) Depending on the generation mix in particular countries, the net effect of warming on CO_2 emissions may be an increase even where overall demand for final energy declines. This causes a positive feedback loop: more mechanical cooling emits more greenhouse gases (GHGs), thereby exacerbating warming. (IPCC, 2007a) This is particular issue for hotels which are already energy intensive and where guest comfort is critical to a positive guest experience.

2.3 Policy Instruments for CO_2 Emissions Reduction

It is widely argued that a large reduction in CO_2 emissions from the building sector could be achieved solely by diffusing available energy efficiency technologies. There is a great gap between the most energy efficient technologies available and those that are actually being used. The main issue of policy design in this area may be to explore the great energy saving potential of the building sector by narrowing the energy efficiency gap. OECD countries have introduced several types of policy to reduce the environmental impact of the new and existing building sector. (OECD, 2003) The policy instruments are classified into the following categories as defined in the UNEP report. (UNFCCC 1999, UNEP, 2007)

- *Regulatory and control mechanisms*: "laws and implementation regulations that require certain devices, practices or system designs to improve energy efficiency" (IEA 2005b in UNEP, 2007). Following the MURE[10] methodology, these tools were further subdivided into *regulatory- normative* for standards and *regulatory-informative* when the end-user is just informed, but not obliged to follow the energy efficiency advice (UNEP, 2007)
- *Economic/ market-based instruments* are usually based on market mechanisms and contain elements of voluntary action or participation, although often initiated/promoted by regulatory incentives.
- *Fiscal instruments and incentives* usually correct energy prices either by a Pigouvian tax[11] aimed at reducing energy consumption or by financial support if first-cost related barriers are to be addressed.
- *Support, information and voluntary action.* These instruments aim at persuading consumers to change their behaviour by providing information and examples of successful implementation (UNEP, 2007).

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[10] The MURE database is an electronic database which includes descriptions and mostly short assessments of over 300 policy measures divided by sectors implemented in the different EU member states (MURE 2007 in UNEP, 2007).

[11] A Pigouvian tax is a tax levied in order to correct negative externalities of a market activity such as environmental pollution due to industrial activities. (UNEP, 2007).

The selected policy instruments relevant to tourism certification were divided into the different categories as shown in Table 2.3 below.

Control and regulatory instruments	**Economic and market-based instruments**	**Fiscal instruments and incentives**	**Support, information and voluntary action**
Mandatory labeling and certification programmes[12]	• Kyoto flexibility mechanisms • Energy Efficiency Certificates	Energy Taxation	Voluntary certification and labeling
Energy Performance Building Directive (EPBD)	• Emissions Trading • Carbon Offsetting • ‘Green’ Electricity Certificates	Energy Tax Feed-In Tariff	• VISIT Ecolabel • Tourism Certification (Chapter 2)

Table 2.3 Classification of policy instruments chosen for assessment in the study. *(Adapted from Crossley et al. (1999), Crossley et al. (2000), EFA (2002), Vine et al. (2003), and Wuppertal Institute (2002), Verbruggen et al, 2003, Grubb (1991), and IEA (1997) in UNEP, 2007).*

One example was chosen from each policy type in terms of how it relates to tourism certification. The purpose of the review is to examine how each type could enhance each other’s effectiveness if they were appropriately combined.

The primary instruments of action include the legislation of mandatory legal regulations, environmental taxes (on the use of energy) as well as voluntary tools and schemes. European environmental policy contributes towards sustainable development with EU-Directives such as EPBD and voluntary tools. (Ecotrans, 2006) Voluntary tools include European initiatives such as VISIT Eco labels and tourism certification schemes which will be reviewed in the following chapter 3. The following four sections review key regulatory, economic and market based, fiscal and voluntary instruments that relate to tourism certification.

2.3.1 Regulatory Instruments

The European Directive on the Energy Performance of Buildings (EPBD)

The EPBD is reviewed to examine its potential impact on tourism certification. It is important to note that while EPBD may be regulatory at EU level however only some articles are mandatory. Energy certificates are categorized mostly as a voluntary instrument but some classify them as market based which can lead to some confusion. Improvement actions of energy certificates are voluntary.

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[12] regulatory-informative (UNEP, 2007).

The European Directive 2002/91/EC (OJEC, 2003) on the Energy Performance of Buildings (EPBD) requires that by January 2006 (with full implementation of all Articles by Jan 2009) all member states of the EU include the following in their legislation on building:

1) Minimum Energy Performance Standards

- a methodology for the calculation of the energy performance of buildings
- minimum energy performance standards for new buildings, and for large, existing buildings subject to major renovation
- energy certification of buildings

2) Energy Performance Certificates

- provided to prospective purchaser/tenant
- Prominent display of the energy certificate in all public buildings and "institutions providing public services" i.e. hotels.

3) Regular inspection of boilers, air-conditioning systems and assessment of heating systems with boilers that are more than 15 years old.

One of the four key elements described in the Directive is the introduction of energy certificates for the existing building stock. The existing buildings stock in European countries accounts for over 40% of final energy consumption in the European Union (EU) member states. Consequently, an increase of building energy performance can constitute an important instrument in the efforts to alleviate the EU energy import dependency and comply with the Kyoto Protocol to reduce carbon dioxide emissions. The Directive leaves it opens for each Member State to decide whether to combine the energy certificate with economic policy instruments, or to use it only for communication purposes. (Poel et al., 2007)

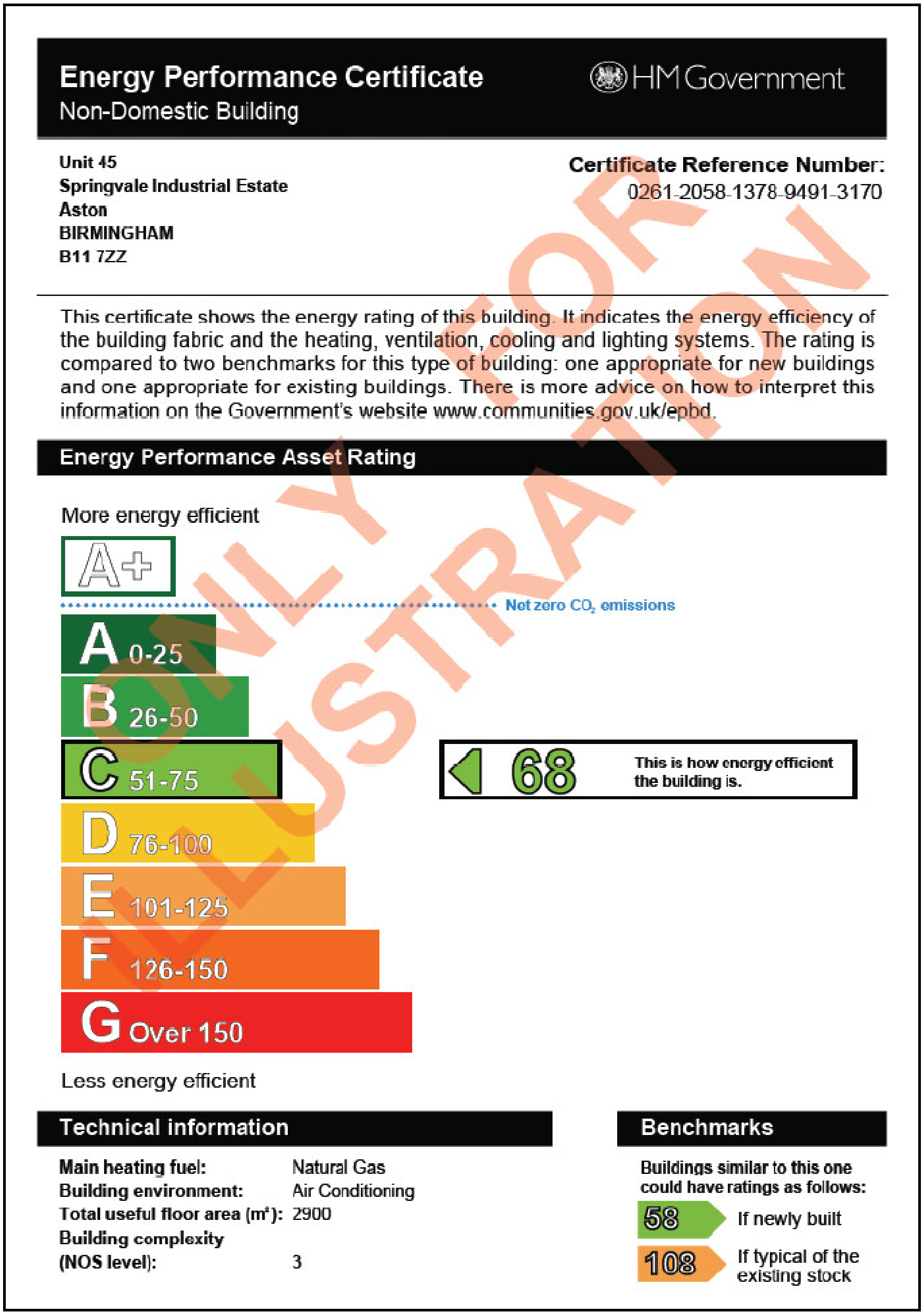
The European Directive on the energy performance of buildings (EPBD) requires that an energy performance certificate is made available when buildings are constructed, sold or rented out. The certificate has to be accompanied by recommendations for the cost effective improvement of the energy performance. The calculation of the energy performance should be carried out according to a methodology based on a general framework set out by the EPBD. (Poel et al., 2007)

2.3.1.1 Energy Performance Certificates (EPCs)

Energy Performance Certificates form part of the UK Government's response to the EU Energy Performance in Buildings Directive. (SI, 2007) The certificates must be produced by accredited assessors and entered into a national register. The Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations, which came into force April 2007 and amended July 2007 ''*require that an energy performance certificate ("EPC"), and a report providing recommendations as to how the energy efficiency of the building can be improved is made available to a prospective buyer on the sale or rent of a building.*" The certificate shows the energy rating of a building.

Energy Performance Certificates award the building an 'asset rating' as shown in Figure 2.12 on the next page. They are produced using standard methods and assumptions about energy usage which allows comparison with two benchmarks for the type of building: one appropriate for new buildings and one appropriate for existing buildings. This allows prospective buyers, tenants, owners, occupiers and purchasers to see information on the energy efficiency and carbon emissions from their building so they can consider energy efficiency and fuel costs as part of their investment. (DCLG, 2008a)

A sample EPC:



Energy Performance Certificate
Non-Domestic Building

HM Government

Unit 45
Springvale Industrial Estate
Aston
BIRMINGHAM
B11 7ZZ

Certificate Reference Number:
0261-2058-1378-9491-3170

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Asset Rating

More energy efficient

A+

Net zero CO_2 emissions

A 0-25

B 26-50

C 51-75

D 76-100

E 101-125

F 126-150

G Over 150

Less energy efficient

68 This is how energy efficient the building is.

Technical information

Main heating fuel: Natural Gas
Building environment: Air Conditioning
Total useful floor area (m²): 2900
Building complexity (NOS level): 3

Benchmarks

Buildings similar to this one could have ratings as follows:

58 If newly built

108 If typical of the existing stock

Figure 2.12 Example of an Energy Performance Certificate *(DCLG, 2008b).*

Buildings are rated in bands from A to G where A is very efficient and G is very inefficient, similar to the efficiency rating systems used for domestic appliances and home information packs. The bands will vary according to building use. The calculation is theoretical and is intended to provide potential occupants with information about the energy efficiency of the building fabric, the heating, cooling and ventilation systems and the lighting. The approved calculation methods to prove compliance and derive energy performance ratings for Existing Non-Dwellings are: Assessment using Simplified Building Energy Model (SBEM) and Operational rating for public display. (DCLG, 2008a)

The certificate is not intended to be an indication of what the actual energy consumption will be as this is influenced to a large degree by occupant behaviour. EPCs are valid for a period of up to 10 years and is accompanied by a recommendation report that lists cost effective and other measures (such as low and zero carbon generating systems) to improve the energy rating. Any improvement actions are done on a voluntary basis. A rating is also given showing what could be achieved if all the recommendations were implemented. (DCLG, 2008a) The certificate is important because nearly 50 per cent of the UK's energy consumption and carbon emissions arise from the way our buildings are lit, heated and used. Even comparatively minor changes in energy performance and the way we use each building will have a significant effect in reducing energy consumption. EPCs are produced by accredited energy assessors. (DCLG, 2008a) The requirements for commercial buildings are to be implemented in 2008 as follows: Buildings over 10,000m^2 (6th April 2008), Buildings over 2,500m^2 (1st July 2008) and all other commercial buildings i.e. hotels (1st October 2008).

2.3.1.2 Display Energy Certificates (DECs)

Display Energy Certificates (DECs) show an *operational rating*, which conveys the actual energy used by a building, as opposed to an Energy Performance Certificate (EPCs) which shows an *asset rating*, conveying the intrinsic performance of the building. (DCLG, 2008c) A Display Energy Certificate shows the energy performance of a building based on actual energy consumption as recorded annually over periods up to the last three years (the Operational Rating - OR). The Display Energy Certificate DEC also shows an Asset Rating for this building if this is available (by way of an EPC). A DEC is valid for one year and must be updated annually. Display Energy Certificates are only required for buildings with a total useful floor area over 1,000m^2 that are occupied by a public authority and institution providing a public service to a large number of persons and therefore visited by those persons. The accompanying Advisory Report is valid for seven years. The requirement for Display Energy Certificates comes into effect from 1 October 2008. (DCLG, 2008c)

The Operational Rating (OR) is a numerical indicator of the actual annual carbon dioxide emissions from the building. The various types of energy consumption from occupying a building must be brought together on a common basis so that the performance of one building can be compared with that of another. The UK has decided that the common unit should be CO_2 emissions, since this is a key driver for energy policy. (DCLG, 2008c)

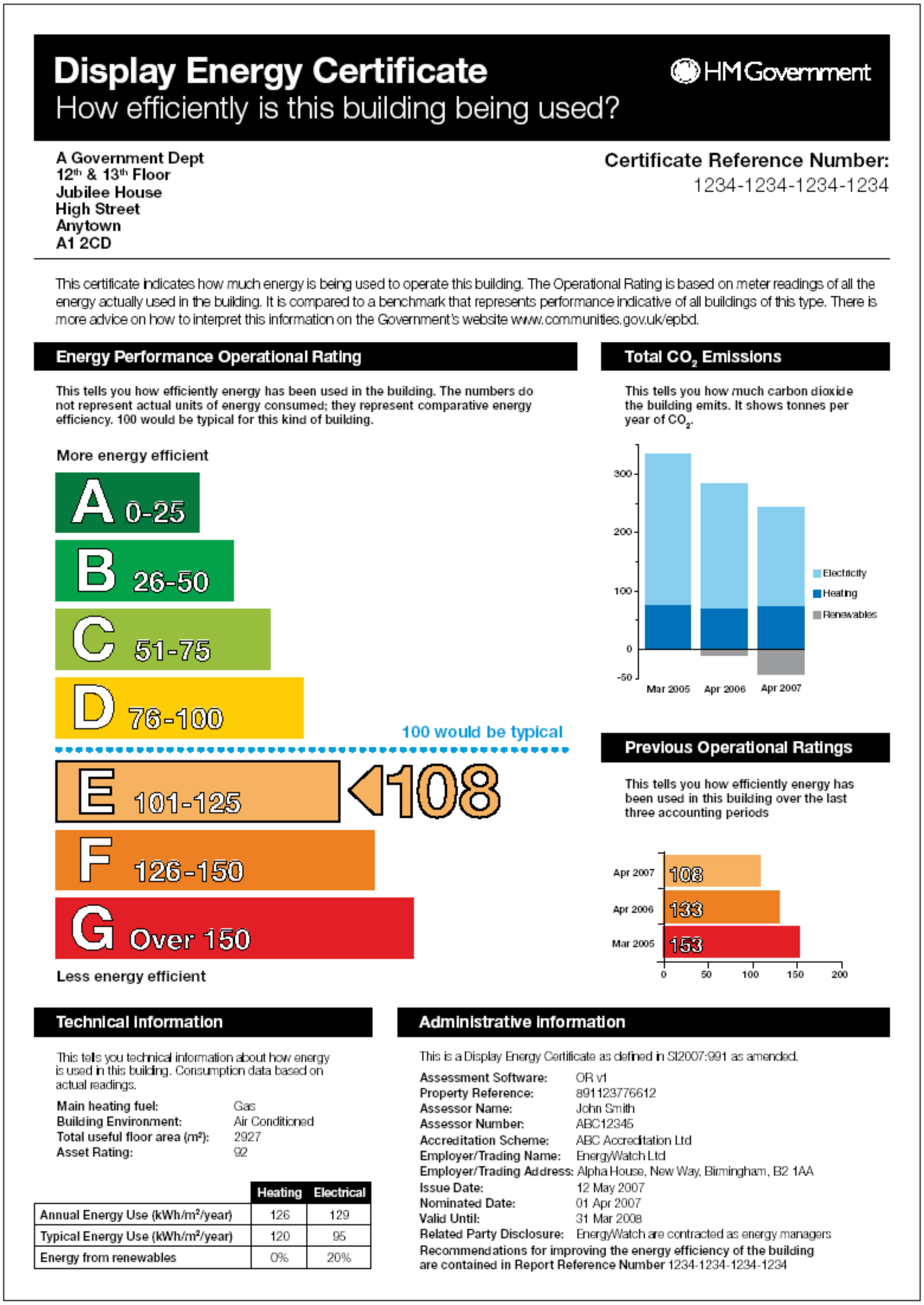
This rating is shown on a scale from A to G, where A is the lowest CO_2 emissions (best) and G is the highest CO_2 emissions (worst) as seen in Figure 2.13. Also shown are the Operational Ratings for the previous two years; this provides information on whether the energy performance of the building is improving or not. (DCLG, 2008c)

The OR is based on the amount of energy consumed during the occupation of the building over a period of 12 months from meter readings and is compared to a hypothetical building with performance equal to one typical of its type (the benchmark). Typical performance for that type of building would have an OR of 100. A building that resulted in zero CO2 emissions would have an OR of zero, and a building that resulted in twice the typical CO2 emissions would have an OR of 200. If the building is a net energy generator, it would still be given an Operational Rating of zero. The OR must be calculated according to the approved methods. (DCLG, 2008c)

A DEC must be accompanied by an advisory report and the owner of the building must have a valid one available. The advisory report highlights recommendations to improve the energy performance of the building (i.e. its fabric and associated services such as heating, ventilation and lighting). An advisory report is valid for seven years. The DEC should be displayed in a prominent place that is clearly visible to members of the public. A sample certificate is shown. (DCLG, 2008c)

The implication of mandatory energy labeling is that they will act as significant new drivers for building clients, owners and operators associated with; brand equity/CSR issues, Environmental reporting (and disclosure requirements) associated with property portfolios and will have an impact on asset value (both positive and negative). Energy labeling introduces a new requirement into the property transaction process and will make architectural ‘green wash’ more difficult. It is anticipated that there will be greater integration of passive energy systems such as: free cooling/heating, passive/natural ventilation, optimized use of daylight and exploiting the thermal mass (DCLG, 2008c)

However, there are some weaknesses as the Government has yet to publish a number of items of information necessary to issue an EPC: The values of the bands commercial buildings - the asset rating (A to G) cannot be calculated, details of the national register and the format of the certificates. (DCLG, 2008c)



Display Energy Certificate

How efficiently is this building being used?

HM Government

A Government Dept
12th & 13th Floor
Jubilee House
High Street
Anytown
A1 2CD

Certificate Reference Number:
1234-1234-1234-1234

This certificate indicates how much energy is being used to operate this building. The Operational Rating is based on meter readings of all the energy actually used in the building. It is compared to a benchmark that represents performance indicative of all buildings of this type. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Operational Rating

This tells you how efficiently energy has been used in the building. The numbers do not represent actual units of energy consumed; they represent comparative energy efficiency. 100 would be typical for this kind of building.

Total CO_2 Emissions

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO_2.

Previous Operational Ratings

This tells you how efficiently energy has been used in this building over the last three accounting periods

Technical information

This tells you technical information about how energy is used in this building. Consumption data based on actual readings.

Main heating fuel:	Gas
Building Environment:	Air Conditioned
Total useful floor area (m²):	2927
Asset Rating:	92

	Heating	Electrical
Annual Energy Use (kWh/m²/year)	126	129
Typical Energy Use (kWh/m²/year)	120	95
Energy from renewables	0%	20%

Administrative information

This is a Display Energy Certificate as defined in SI2007:991 as amended.

Assessment Software:	OR v1
Property Reference:	891123776612
Assessor Name:	John Smith
Assessor Number:	ABC12345
Accreditation Scheme:	ABC Accreditation Ltd
Employer/Trading Name:	EnergyWatch Ltd
Employer/Trading Address:	Alpha House, New Way, Birmingham, B2 1AA
Issue Date:	12 May 2007
Nominated Date:	01 Apr 2007
Valid Until:	31 Mar 2008
Related Party Disclosure:	EnergyWatch are contracted as energy managers

Recommendations for improving the energy efficiency of the building are contained in Report Reference Number 1234-1234-1234-1234

Figure 2.13 Example of Display Energy Certificate *(DCLG, 2008d).*

2.3.2 Economic and Market Based Instruments

This section includes a review of emissions trading mechanisms such as Joint Implementation Plan (JI) and Clean Development Mechanism (CDM) which is particularly relevant to the reduction of global emissions from the hotel sector. Carbon offsetting and ‘green’ electricity certificates are also reviewed since it was found in obtaining certification this plays an important part.

2.3.2.1 Kyoto Flexibility Mechanisms

Under the Kyoto Treaty, countries must meet their targets primarily through national measures. Annex 1 state that States can meet their GHG emissions targets through various flexible mechanisms which allow them to purchase reductions from financial exchanges;

1) Emissions trading – is also known as the carbon market. The industrialized countries with obligations under the Kyoto Protocol may trade the quotas they have been allocated. That is to say that if it is less expensive to reduce CO_2 emissions in Finland than in Denmark, and then Denmark may let Finland reduce its emissions for it. In this way, Finland can store up CO_2 quotas, which Denmark may buy. Accordingly, the emissions of CO_2 are reduced in the cheapest way possible.

2) Joint implementation (JI) - The mechanism makes it possible for industrialised countries to supplement their CO_2 reductions at home with investments in projects in other industrialised countries, such as in Eastern Europe that reduce greenhouse gas emissions or increase the rate of absorption of CO_2. The CO_2 “gain” is converted into credits [Emission Reduction Units (ERUs)] that can be deducted from the industrialised country’s national climate account.

3) *Clean development mechanism (CDM)* - works in the same way as JI projects, the difference is that it concerns developing countries. [Certified Emissions Reductions (CERs)].

For both JI and CDM projects, independent bodies must confirm that the projects do in fact lead to genuine emission reductions prior to them being included in the CO_2 account. One CER or ERU are equivalent to one metric tonne of CO_2 and are tradable on carbon markets. There are several emissions trading schemes in existence with varying degrees of linkage, including the European Emissions Trading Scheme (ETS) and the Chicago Climate Exchange. (ITP, 2008)

European Union Emissions Trading Scheme (EU ETS)

The European Union Emissions Trading Scheme (EU ETS) is by far the largest emissions trading scheme in the world. It covers around 12,000 installations, in six major industrial sectors, across 25 countries. It encompasses over 40% of Europe's and the UK's CO_2 emissions. Companies included in this scheme have the choice to reduce their own emissions, buy allowances in the market (called EU allowances, EUAs) or purchase credits through CDM or JI projects (although there are limits on the volume of CDM and JI credits that can be purchased). The scheme has been running since 1st January 2005. Its second phase will start on 1st January 2008 and end on 31st December 2012, in line with the first Kyoto commitment period. A third phase is expected to run after this, but its form and duration have yet to be defined. (Carbon Trust, 2006)

Emissions trading mechanisms can take two basic forms: cap-and-trade or project-based (sometimes also called baseline-and-credit). (Carbon Trust, 2006)

a) Cap-and-trade system

Cap-and-trade systems are based on the allocation of a ceiling or cap on emissions over a period of time. The authority allocates allowances either free or by auctioning them. Each allowance represents a defined emissions amount (e.g. tonne of CO_2 equivalent). In order to create a market, authorities allocate a limited number of allowances, below the current expected emissions level, which creates scarcity in the market, generating a positive value for the permits. Examples of this system include the US SOX allowances trading scheme, the Kyoto emissions trading scheme and the EU ETS. (Carbon Trust, 2006)

b) Project-based or baseline-and-credit system

This system is based on projects which reduce emissions beyond a *business-as-usual* scenario — in other words; they generate emissions reductions that are additional to what would have happened in the absence of the project. The *business-as-usual* scenario provides the baseline for these projects. Baselines are established from historical emissions data or through other methodologies (e.g. ratio of emissions to output). Projects that reduce emissions beyond the baseline are entitled to emissions reduction credits, which can be sold to parties that can use them for compliance or voluntary purposes. Typically, emissions reduction credits are not issued until the reductions have actually occurred. Examples of this system are CDM and JI projects as explained above. (Carbon Trust, 2006)

2.3.2.2 Carbon Offsetting

Carbon offsetting is the act of mitigating CO_2 emissions. It involves quantifying the emissions due to an activity and then purchasing ‘credits’ from emission reduction projects which are claimed to prevent or remove an equivalent amount of carbon dioxide elsewhere. The concept of paying for emissions reductions to be made somewhere else is similar to that of emissions trading as previously described. Whilst emissions’ trading is regulated by a strict formal and legal framework, carbon offsets generally refer to voluntary acts by individuals or companies that are arranged by commercial or not-for-profit carbon-offset providers. The quantity and varying quality of available schemes has proved controversial but some formal standards for voluntary carbon offsets are starting to emerge. (ITP, 2008) However, with so many schemes and very little in the way of verification it is difficult to establish which schemes are truly authentic.

Carbon offsetting has become popular in recent years, particularly with consumers in western countries who are concerned about reducing the negative effects of their energy intensive lifestyles and economies on the environment and who wish to reduce their carbon footprint. Various sectors within the travel and tourism industry have been enthusiastic in embracing the concept and an increasing number of hotels around the world now claim they are ‘carbon neutral’ by offsetting their emissions. (ITP, 2008)

The early method of offsetting carbon was simply to plant trees but more sophisticated offsets now include support for renewable energy and energy conservation projects in developing countries and even offsets in methane capture projects. (ITP, 2008) The voluntary offset market today is small and fragmented, but growth is expected for the foreseeable future. (The Carbon Trust, 2006) Growth in the voluntary market will be dependent on the level of interest from the general public and key stakeholders interested in climate change, and on the perception of whether offsetting is the right way to address climate change in the long term. According to the Carbon Trust, some non-governmental organizations (NGOs) and the media have started to question the role of offsetting as they see it as a license to continue the status quo and delay true changes in behaviour that would drive society towards a low-carbon economy. In addition, the voluntary market could be changed considerably by the introduction of a common standard that could improve credibility, or by the evolution of a new international climate change agreement post 2012. This is why some market participants are cautious about the expected growth rate. They predict that continued growth can be sustained for the next 4-5 years but that after 2012 there is uncertainty as to how the market is going to evolve. (The Carbon Trust, 2006)

The use of Baselines in Carbon Offsetting

The credits that an offsets project generates are calculated by subtracting the emissions of the world that has the project in it from the emissions of an otherwise-identical world that doesn't have the project; representing the 'baseline' as illustrated in Figure 2.14. (The Carbon Trust, 2006)

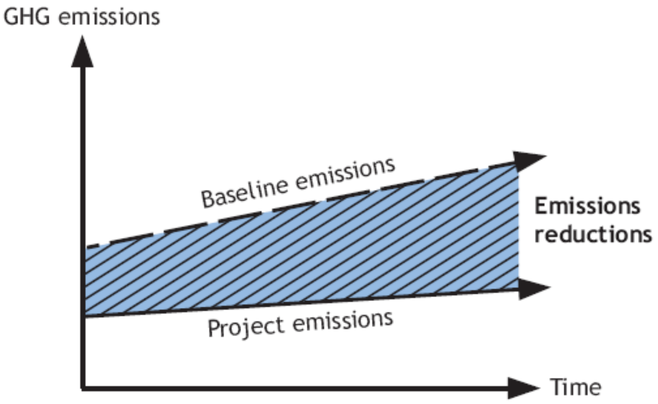


Figure 2.14 Net reductions generated from offset projects (Carbon Trust, 2006).

The quantity of offsets credits that are generated and available to sell is equivalent to the emissions reductions beyond this baseline. (Carbon Trade Watch, 2007) In order for the system to work, this baseline has to be accurately determined. According to The Carbon Trade Watch, the assessment by experts and verifiers of the hypothetical scenario without the project is, at best, informed guesswork. They argue there are innumerable factors that could alter the baseline of the without-project scenario, such as socio-economic trends, future land use, demographic changes and international policy making. (Carbon Trade Watch, 2007)

Additionality

Much of the baseline speculation relates to the principle of '*additionality*' – that is, the idea that the project would not have happened without the funding from the offset companies. *'Additionality'* is the defining concept of offset projects. The Carbon Trade Watch points out that while scientists, using appropriate instruments and calibrations, are able to agree on how to directly measure real emissions, there is no consensus possible on how to accurately choose one genuine baseline out of the multitude of possibilities and calculate the hypothetical emissions reductions from it.

They go on to comment that the lack of verification about baselines also means that there are enormous incentives and opportunities for companies to employ creative accountancy to choose a baseline that would result in larger numbers of sellable credits to be generated on paper. (Carbon Trade Watch, 2007)

Additionality is defined by the UNFCCC (2005) as meeting the following criteria:

- *Legal and Regulatory Test.* If the project is implemented to fulfil official policies, regulations or industry standards, it cannot be considered additional. If the project goes beyond compliance, it might be additional but more tests are required to determine that. For example, an energy efficiency project implemented because of its cost savings would not be additional.
- *Financial Test.* This test assumes that a project is additional if it would have a lower than acceptable rate of return without revenue from carbon offsets.
- *Barriers Test.* This looks at implementation barriers such as local resistance, lack of know-how, and institutional barriers.
- *Common Practice Test.* If the project employs technologies that are very commonly used, it might not be additional because it is likely that the carbon offset benefits do not play a decisive role in making the project viable.

Besides *additionality*, The Carbon Trust lists a number of other important characteristics that affect an offset project's integrity and credibility; (Carbon Trust, 2006)

- *Verification* of emissions reductions provide guarantees that the emissions reductions claimed by a project have actually been achieved by an accredited independent third party according to an established standard or protocol.
- *Permanence* refers to the ability of a project to maintain the reductions achieved over time and is important as some projects might mitigate emissions which may be released into the atmosphere later.
- *Leakages* is defined as increases or decreases in emissions that take place beyond the project boundary and which are measurable and attributable to the project activity. Leakages need to be quantified and taken into account in the project, adjusting the emissions reductions achieved by the level of leakage identified.
- *Double Counting* could happen at a project level, when a credit is sold two or more times to different buyers; and/or at a national level, where voluntary reductions are counted against national mandatory targets. To avoid the

former, offset sellers should always have a registry in place where credits are accounted for and retired.

2.3.2.3 ‘Green’ Electricity Certificates

Green electricity: One term, many meanings

In response to growing climate and environmental concerns, certification and self-certification of “green” electricity (with different and often conflicting definitions) have proliferated in the marketplace. Green Electricity is defined *as 'a generic term for electricity generated from clean, environmentally preferable energy sources such as wind, water, solar, energy-from-waste and energy-from-crops (biomass), collectively known as renewable energy'* (Lipp, 2000).

Green electricity as a product has been available to some customers in the UK since 1997, but only since complete liberalization of the electricity market in May 1999 has every consumer had the option of signing up for the special green electricity tariffs offered by most electricity suppliers. Able to choose their supplier and a specific electricity product, consumers were, it was claimed, then able to make a conscious choice about the environmental impact of their electricity consumption. With this choice came the need for information and assurances that what was claimed was also being delivered, especially as green electricity is being marketed as a premium-price product. (GECOP, 2006)

What qualifies as ‘renewable’ energy?

There is confusion on this issue, as the UK Government has different definitions of what qualifies as renewable energy for each of its own policy instruments. Most notably, the Renewables Obligation and the Climate Change Levy which seek to promote the building of additional capacity exclude old large hydroelectric plants as these have already been paid for. Nonetheless, suppliers who purchase 100% hydro still market their product as coming from 100% renewable sources, even though it is excluded from these Government schemes. Renewable Energy Guarantees of Origin (REGOs) are not seeking to promote new capacity, but rather are used as a tracking mechanism for renewable energy. They are therefore much more inclusive in their definition of what qualifies as 'renewable energy'. However, within the environmental field, disagreement remains on the inclusion of some of these sources such as energy-from-waste, which can be sold as a green electricity product in the UK. Many feel energy generated from waste does not strictly come from a renewable source and should therefore not be sold as green electricity (Lipp, 2000)

Common Criteria Used to Certify Green Electricity

Of the various green electricity certification schemes in operation around the world, each has its own definition of what qualifies as green electricity, both in terms of the type of renewable energy eligible, as well as other information. Most schemes are, at a minimum, assessed on the basis of the renewables they source their green electricity from – the decision about what to include is usually made on the basis of environmental impact. Some schemes go further and consider other features before being certified as follows: (GECOP, 2006)

1. Type of offering. There are two broad classifications of green electricity (or green tariff) products currently on the market denoted 'green source' and 'green fund' which amount to the same thing – only that in the second case it is the *capacity* for generation, rather than *actual* generation.

- *Green source* consumers buy electricity from suppliers and are assured that for every kWh of electricity they consume the corresponding amount of renewable generated electricity will enter the network over the span of one year (Lipp, 2000).
- *Green fund* customers on the other hand, donate money into a fund that supports new renewable capacity or other related initiatives. Typically the fund will pay for new capacity to be installed either by independent developers or by the supplier themselves (Lipp, 2000).

2. Additionality requirement. One of the key concepts within the green electricity sector is that of *additionality* - the idea that products should provide benefits beyond that already required by existing legislation. Many of the green tariffs that are marketed as being "green" actually provide no additional benefits above those already required by existing legislation (e.g. guaranteed prices for renewables or obligations placed on energy suppliers) promoting renewable energy. This is particularly important in the UK where the Renewables Obligation required a defined level of green electricity generation.

3. Energy balancing. Since green electrons don't necessarily flow directly to the consumer making the purchase, it is necessary to balance the supply mix with the purchases made. The supply is balanced in terms of energy over a given time period - not a continuous second-by second balancing of power. There are often time requirements on when those balances have to be made (*e.g.* yearly).

4. ***Straightforward information.*** Some schemes include requirements about the type of information supplied to consumers. Of principal concern is whether customers are likely to be misled or confused by information provided to them.

5. ***Price.***

According to the GECOP (2006) green electricity products are often sold at a premium price under the argument that it costs more to produce this electricity. In the case of old large hydro generation and RE projects supported through public funds this claim is highly questionable. It is therefore necessary to establish criteria about which projects can justifiably charge more for the green electricity produced.

6. ***Supply services***. Some schemes examine other services included with the GE product and assign certification on that basis, among other criteria. (GECOP, 2006)

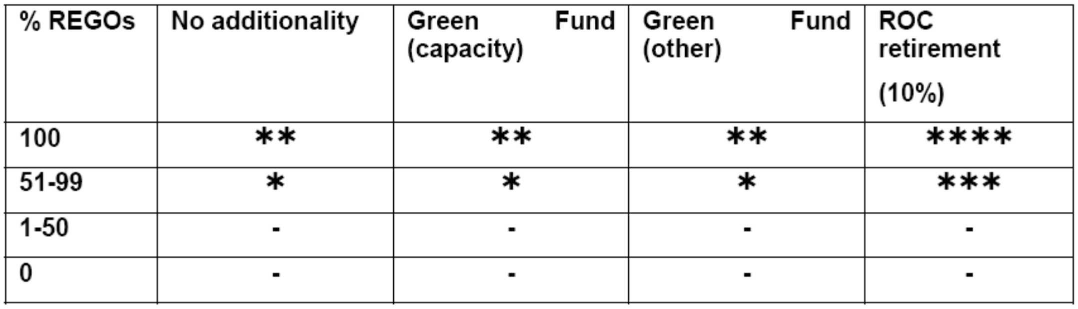
The Green Electricity Code of Practice (GECOP, 2006)

The Environmental Change Institute at the University of Oxford produced a scoping study for implementation of The Green Electricity Code of Practice (GECOP). The study acknowledges that a Code of Practice for green electricity would be a good step towards restoring confidence in the market and ensuring that consumers are given clear and transparent information on which to base their product choice. There has been no official accreditation scheme for green electricity since the demise of the Future Energy scheme in 2002, although Friends of the Earth did try to fill this niche with their League Tables. At present there is no official accreditation scheme in the UK. Ideally an accreditation scheme would be Government run, but in Ofgem were unwilling to take on this role. Therefore, a voluntary Code of Practice based on industry consensus is seen as the only way develop such a scheme. The GECOP report outlines how such a system might work, by drawing on the experience of other similar schemes worldwide. (GECOP, 2006)

The study advises that any Code of Practice should integrate with existing policies, including the Renewables Obligation, the Climate Change Levy, and Renewable Energy Guarantees of Origin (REGOs). These all issue certificates alongside the generated electricity, but each scheme has different definitions of what counts as renewable. It is possible for one kWh of electricity to be allocated three different certificates each corresponding to a different definition of ‘greenness’. It is therefore important to only use one of these systems for the purposes of green electricity accreditation to avoid double counting. GECOP recommends that Renewable Energy Guarantees of Origin (REGOs) are used for this purpose – they have the most inclusive definition of renewable generation, the certificates are held by the supplier making auditing simple, and they are used for other consumer information such as electricity disclosure. (GECOP, 2006)

The study explains that whilst Renewable Energy Guarantees of Origin (REGOs) determine the source of the electricity, many green electricity products are sold based on other environmental features, such as green funds, or Renewable Obligation certificates (ROC) retirement. A green fund will set aside money into a fund, which is then used to install new generating capacity, fund R&D or other environmental projects. Some companies also retire Renewable Obligation certificates (ROC), which have the effect of using consumer demand for green electricity to adjust government renewable electricity targets upwards (GECOP, 2006)

The first step is to clarify and agree the criteria that make a product eligible for certification. A banded approach is recommended because of the various types of products available in the market as shown in Table 2.4 below. At a minimum, products must be at least 51% from renewable sources but no additionality. Products that are 100% from renewables and retire 10% of ROCs are rated the highest. Intermediate products are given a 2 or 3 star rating. Green funds should not be eligible as additional at this time since they do not contribute to new generation in the presence of the Renewable Obligation certificates (ROC), except under specific, hard to quantify circumstances. (GECOP, 2006)



% REGOs	No additionality	Green Fund (capacity)	Green Fund (other)	ROC retirement (10%)
100	**	**	**	****
51-99	*	*	*	***
1-50	-	-	-	-
0	-	-	-	-

Table 2.4 Four-star rating of green electricity products *(GECOP, 2006).*

The Code of Practice also needs to clarify the auditing process and the means to address noncompliance. Formation of an Advisory Board is recommended to oversee the implementation and annual operation of the Code of Practice. This would include the annual audit. The cost of setting up an accreditation programme on this basis is estimated to be £60,000 to cover start-up costs and £60,000 a year to cover its annual operation. The auditing process, which is crucial to the success of this programme and to gain consumer confidence, represents a large part of the operation costs. This cost may be reduced if auditing was carried out by a central body like the electricity regulator (Ofgem). (GECOP, 2006) The next step involves consultation with stakeholders on the contents of this report leading to agreement by at least four suppliers to move forward with the COP. Strict guidance and compliance regarding marketing of Green Electricity and the use of the certification logo is essential. (GECOP, 2006)

The study concludes that a Code of Practice is required in the UK to ensure clarity, consistency and protection for the consumer within the green electricity sector. It is hoped that this work will provide a framework for the development of such a scheme. (GECOP, 2006)

Final Green Supply Guidelines (Ofgem, 2009)

In February 2009, Ofgem published its Final Green Supply Guidelines, the key aim of which was to provide clarity to customers on whether green tariffs are truly green. This in turn requires that where tariffs are marketed as 'green' by suppliers, they must apply the principles outlined in Annex 1 of the report which includes: (Ofgem, 2009)

- *Transparency:* need to be clear and consistent with public understanding and expectations as to what constitutes green supply. Customers should have easy access to specific information regarding the tariff as well as more general information regarding the way that the electricity market, supplier obligations and green tariffs interact.
- *Evidence of Supply:* suppliers will need to have and retain evidence, for the duration of the relevant compliance period, to verify all claims regarding both the source of electricity supply and additionality (as described in the next bullet) so that this can be made available to the public or an external verifier.
- *Additionality:* customers choosing a green tariff need to be able to be satisfied that their support is contributing to additional environmental benefits or additionality. As such, they must be assured that the environmental benefit secured through their decision to sign up to the tariff would not have occurred in the absence of this decision. Benefits derived from existing support schemes, e.g. through the Renewables Obligation (RO) or under the Carbon Emissions Reduction Target (CERT), are not included.
- *Accreditation:* suppliers who have signed up to the guidelines will be required to agree and develop an accreditation scheme within given time periods. This process may result in detailed accreditation scheme rules which could be appended to these guidelines. The scheme will require the employment of an

> independent accreditation body (details to be agreed). The aim of having the tariffs accredited will be to provide assurance to consumers that suppliers are actively engaging in the activities in which they claim they are undertaking within their marketing materials.

A key feature of the guidelines is the introduction of *'volume tests'* to ensure that suppliers do not double-count the 'greenness' of a unit of renewable electricity. According to the report, even once the *'volume test'* is met, a supplier cannot make claims that a green tariff is either carbon-free or "100% renewable electricity". However, a supplier can claim that it has matched the amount of electricity sold under its green tariffs with purchases of renewable electricity, if this is the case. Furthermore, a green tariff must meet both the 'additionality' and 'volume tests' to receive accreditation under the green supply guidelines. Fuel mix allocations will not be taken, by themselves, to imply that a green tariff is additional and therefore further measures are necessary to be accredited under the green supply guidelines. (Ofgem, 2009)

Ofgem goes on to state that energy companies will have to prove they are creating environmental benefits beyond those already mandated by law to receive accreditation for their 'green tariffs'. New guidelines set down by energy regulator Ofgem will require companies to prove additionality and that they have improved the environment beyond what would have happened anyway. (Ofgem, 2009)

However, there is concern that this will still result in 'green wash' and not all companies have signed up for these guidelines including Ecotricity who state on their website that "*this is a green wash and we simply won't be a party to it*" and that "*Green electricity tariffs should be about green electricity, first and foremost In these guidelines Ofgem are accrediting everything you can imagine except the thing that really counts – green electricity. Of course we believe in planting trees, protecting wildlife and cutting carbon, all of these things have an important role to play – but not in green tariffs!*" (Ecotricity, 2009a)

Green Electricity Certification Elsewhere

There are a number of green electricity certification schemes in operation around the world. These can be both government led or initiated by a third party, often led by an Environmental Non-governmental Organization (ENGO) or other non-profit organization. Most European labels are issued by a third-party and in some instances more than one labeling scheme has emerged. These programmes verify claims made by green electricity suppliers in order to provide consumers a quality assurance. Canada and Australia each have government backed schemes while Germany and the United States of America have multiple programmes developed by non-governmental groups. (Bird et al, 2002)

Towards European Harmonization: the EUGENE Standard

The European Green Electricity Network (EUGENE) is an initiative of a consortium of groups and organizations in Europe which aim to develop a harmonized EU green electricity certification scheme called the Eugene Standard. (Figure 2.15) It is a membership-based network and a not-for-profit organization (EUGENE, 2006).

Figure 2.15 The EUGENE logo *(Eugene, 2006).*

Eugene applies the following *additionality* criteria on suppliers to be eligible for two levels of certification (gold and silver standard): (Eugene, 2006)

- *Consumption based products (green supply):* 10% (silver standard)/30% (gold standard) of supply must be from new renewable sources where these sources are over and above governmental renewable legislation such as incentives and obligations.
- *Contribution based products (green fund):* at least 0.5 ct/kWh (silver standard)/1.5 ct/kWh (gold standard) is invested in new renewable plant.
- *Green hydropower:* at least 0.15 ct/kWh (silver standard)/0.5 ct/kWh (gold standard) is invested in measures to reduce the facility's environmental impact (Green Hydro Eco-investments). These plants must have a significantly reduced ecological impact.

However, in January 2009, after 5 years of operation, Eugene's General Assembly agreed that the members and board would continue to work together to promote green energy in Europe, but that the EUGENE standard would cease to exist under Belgian law. During the 5 years when EUGENE was operating, it became clear that green power labels are difficult to harmonise, as they are tailored to the needs of different national electricity markets and national consumer expectations. Creating new labels in some countries has proved difficult, as several European markets are not adapted for a functioning voluntary green power market. The first aim of EUGENE, to create a harmonised quality standard for labels, became difficult to implement further than its current state. (Eugene, 2009)

Even though EUGENE is now dismantled, it is reviewed here because of the criteria chosen for green electricity eligibility. The Eugene Standard built upon the guidance given by a number of international and national regulations and set out a code of best practice for green energy suppliers. (Eugene, 2006) It provides a benchmark that suppliers can use to assess and promote their green energy portfolios, to reduce reputational risks and maximize consumer confidence and uptake. The Eugene Board reviewed the Eugene Standard on a regular basis taking consideration of new experiences, feedback and policy developments. Any necessary modifications were recommended to the Assembly of Eugene Members and a decision made to modify the standard. The Eugene Standard operated in parallel with certification programmes in the member states. Green marketers may have chosen to accredit their product by the national body as well as EUGENE. Only two green marketers currently have a EUGENE label. The organization does, however, provide a list of other green electricity marketers on its website and endorses some suppliers based on their adherence to the Eugene criteria. (Eugene, 2006).

Costs of 'Green' Electricity

It would be expected that if the price charged by green providers were significantly higher than fossil-electricity, then increasing the demand for green electricity might generate extra funds for investment in more 'green' electricity. A realistic increase would be a 50% to 150%, whereas extra costs for green electricity are typically 10% and sometimes significantly lower as seen in the findings below. This unrealistic cost of purchasing 'green' electricity raises questions about its credibility.

It was not possible to establish the cost of buying 'green' electricity on a commercial basis nor to compare the costs between suppliers since this information is only disclosed 'on request' by a commercial customer. However, the information on costs for domestic customers was available in the public domain. In the UK, the 'green' electricity supplier, Whichgreen, an Ecotricity initiative, have produced a measure for spending on new 'green' electricity called 'pounds per customer' – which shows how much each electricity company actually spends on new 'green' electricity for each of it's customers. (Appendix 2B) Even though this information is not specific to the hotel sector it serves to put the costs of 'green' electricity in context and is therefore referred to in the appendices. A League Table for 14 UK Green Electricity Suppliers (Ranking by CO_2 Emissions) for the period April 2007 - March 2008 is presented in Appendix 2C together with a 'test hotel' scenario to demonstrate the range in CO_2 emissions per guest night for delivered electricity for the 14 different energy suppliers in the UK.

2.3.3 Fiscal Instruments

To make the certification schemes more effective will also result in making them more costly. The use of fiscal instruments can help reduce these costs for hotels and therefore maintain the attractiveness of and increase the effectiveness of hotel certification. Fiscal instruments can be used to do two things; reduce energy consumption through tax exemptions, subsidies, grants, loans and rebates and increase the use of renewable energy through the introduction of Feed-in Tariffs.

2.3.3.1 Taxes to Reduce Energy Consumption

The UNEP defines fiscal instruments and incentives as policy tools which influence energy prices either by imposing a Pigouvian tax aimed at reducing energy consumption or by financial support if first-cost related barriers are addressed. This is particularly relevant to the energy intensive hotel sector. Environmental economists often consider fiscal instruments and especially taxes to be the best instruments, as they can give a uniform signal to the whole economy and equalize compliance costs. (UNEP, 2007)

According to the assessment of case studies presented in the UNEP report, the effectiveness of fiscal instruments varies considerably and cost-effectiveness and depends strongly on the design of the instrument. (UNEP, 2007) The findings of the UNEP report in relation to fiscal instruments found that;

> *'The effectiveness of taxes depends, for instance, on the level of taxes or on the use of the tax revenue by the government. Tax exemptions are usually more effective and seem to be one of the most neglected, yet very useful instruments. Subsidies, grants, loans and rebates can be effective if designed well, and are especially needed in developing countries where lack of financing constitutes a major barrier. In these countries, tax exemptions are not enough. Fiscal instruments can help overcome the barriers under the categories financial costs vs. benefit and market failures.*

> *In addition, fiscal incentives need to be high enough to attract attention.'* (UNEP, 2007)

2.3.3.2 Feed-in Tariff (FIT) to Increase Renewable Energy Supply

The effort to increase renewable energy consumption is shared across the EU with the EU Renewable Energy Directive (EC, 2009b) setting a binding target of achieving 20% of the EU's energy consumption from renewable sources by 2020. The UK's share of the EU target commits to sourcing 15% of the UK's energy from renewable sources by 2020. The RES proposes that: (DECC, 2009)

- Over 30% of UK electricity may come from renewables compared to 5.5% in 2008. This could be made up from 29% large scale electricity generation and 2% small-scale electricity generation;
- 12% of UK heat may come from renewable sources; and
- 10% of road fuel may come from sustainable bio fuels.

Feed-in Tariffs (FITs) aim to support the market development of renewable energy technologies, specifically for electricity generation and is a key instrument to encourage the take up of renewables, in particular, small-scale low-carbon electricity technologies: (DECC, 2009)

- Wind;
- Solar photovoltaic's (PV);
- Hydro;
- Anaerobic digestion;
- Biomass and biomass combined heat and power (CHP); and
- Non-renewable micro-CHP.

FITs put a legal obligation on utilities and energy companies to purchase electricity from renewable energy producers at a favourable price per unit, and this price is usually guaranteed over a certain time period. The most effective schemes are guaranteed for a period of around 20 years. (e-parl, 2003)

The Feed-In Tariff (FIT) has proven to be one of the most effective policy instruments in overcoming the cost barriers to introducing renewable energy and making it economically viable. The simple guarantees that FITs provide – including priority access to the grid, a set price per Kilowatt Hour (kWh) that will cover the costs associated with electricity production, and a guaranteed term for which they will receive that rate has turned several European countries into world leaders in the renewables sector. This is the case for Denmark on wind energy and for Germany on solar energy. (e-parl, 2003)

The solar sector in Germany has grown considerably as a result of the Feed-in Laws. Germany is the largest solar heating producer in the world with a 47% share of the global market. There are now over 40 companies in Germany that produce solar system components, and the industry employs more than 20,000 people, and has a turnover of €1.7 billion per year. The renewables industry as a whole in Germany had a turnover of €21.6 billion in 2006, up from €16.4 billion in 2005, and employed about 214,000 people – more than the nuclear and the hard and brown coal industries combined. It is expected that by 2020 the renewable energy industry will employ 500,000 people. (e-parl, 2003)

The Energy Act 2008 (OPSI, 2008b) established enabling powers for the introduction of FITs to supplement the RO and offer incentives for small-scale low-carbon electricity generation, up to a maximum limit of 5 megawatts (MW) capacity (50 kilowatts (kW) in the case of fossil-fuelled combined heat and power). It also provides powers to implement a new Renewable Heat Incentive (RHI) aimed at renewable heat installations of all sizes, which we will implement by April 2011. (DECC, 2009) The two subsidies are designed to dovetail, so for example, an hotelier with solar panels on the roof and a ground-source heat pump would be paid for all the energy produced, regardless of its form. With the advent of smart meters, heat will be measurable in the same way as electricity is now. It is expected that this will help to increase the UK’s proportion of heat being generated from renewable sources which is currently only 0.6 per cent compared to the European average of 10 per cent. (Arnott, 2010)

The key element to the success of the scheme is the correct setting of the tariff level. Under the UK feed-in scheme, any electricity which is fed back to the grid will receive at least 5p per kilowatt hour although; major energy suppliers may bid to buy the surplus to meet their own green requirements. Arnott (2010) in discussing tariff levels states that:

> *“Government's calculations suggest that the lower level tariff will encourage small-scale generation to the tune of just 2 per cent of Britain's electricity by 2020 through fewer than 1 million new installations. By raising the return to*

> *10 per cent, the size of the scheme will triple to nearer 3 million sites, claims the REA. "*

The tariff rates in the 2004 Amendment in Germany ranged from €0.0539 (4.7 pence per kWh[13]) per kWh for electricity generated form wind, to €0.5953 (51 pence per kWh[14]) for solar electricity from small façade systems. The rates at which the guaranteed tariff would reduce each year (annual digression rates) were also set fairly high in the amendment, ranging from 1% - 6.5% annually depending on the technology. The rates are set to reduce annually in this way because it encourages technical innovation and cost cutting in the renewable sector. (e-parl, 2003) In fact, it is expected that by April 2010, Germany may reduce its Feed-in Tariff for electricity produced by solar panels by 17% due to the success of the solar market Germany. (Solar Feed-in Tariff, 2010).

The initial generation tariff levels proposed in the UK are shown in Table 2.5.[15] The Renewable Electricity Financial Incentives Consultation, launched on 15 July 2009, sets out how DECC intend the FITs scheme to work, including the proposed tariff levels. (DECC, 2009)

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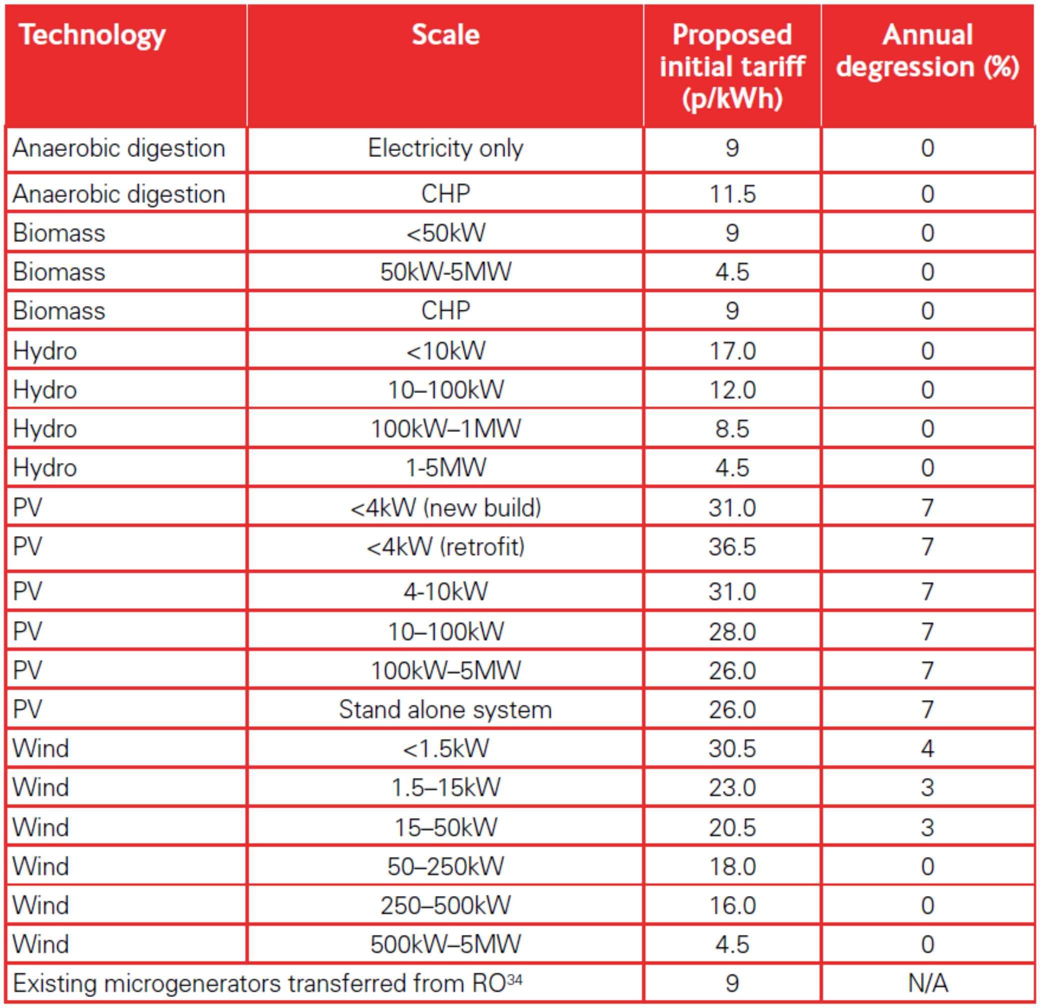
[13] Based on published currency conversion rates on 4th February, 2010.

[14] Based on published currency conversion rates on 4th February, 2010.

[15] These initial proposals have been developed with input from stakeholders - energy industry trade associations, energy suppliers, Ofgem and NGOs. (DECC, Date 2009)



Technology	Scale	Proposed initial tariff (p/kWh)	Annual degression (%)
Anaerobic digestion	Electricity only	9	0
Anaerobic digestion	CHP	11.5	0
Biomass	<50kW	9	0
Biomass	50kW-5MW	4.5	0
Biomass	CHP	9	0
Hydro	<10kW	17.0	0
Hydro	10–100kW	12.0	0
Hydro	100kW–1MW	8.5	0
Hydro	1-5MW	4.5	0
PV	<4kW (new build)	31.0	7
PV	<4kW (retrofit)	36.5	7
PV	4-10kW	31.0	7
PV	10–100kW	28.0	7
PV	100kW–5MW	26.0	7
PV	Stand alone system	26.0	7
Wind	<1.5kW	30.5	4
Wind	1.5–15kW	23.0	3
Wind	15–50kW	20.5	3
Wind	50–250kW	18.0	0
Wind	250–500kW	16.0	0
Wind	500kW–5MW	4.5	0
Existing microgenerators transferred from RO[34]		9	N/A

Table 2.5. Table of generation tariffs for first year of FITs: 2010-11 (DECC, 2009)

There are currently around only 15,000 micro-generation installations in the UK, compared to countries with long-standing feed-in schemes, such as Germany and Spain. As a result, more than 90 per cent of the UK renewable industry's business is overseas. (Arnott, 2010) The UK energy sector is incredibly consolidated, however feed-in tariffs have the potential to making an important contribution by open up the energy market to a wide range of suppliers and investors if introduced correctly.

Feed-in Tariffs have the potential to play a pivotal role in encouraging hotels in increase their renewable energy supply which would have a considerable impact on emissions reduction considering it is one of the most energy intensive service sectors as will be discussed in Chapter 3. For example, if a hotel decides to cover its façade in photovoltaic’s, then the benefits are two fold; the hotel can increase its renewable energy supply and benefit from the Feed-In Tariff and the marketing benefits of being able to visually convey its ‘green’ image to the public and guests. Secondly, in order for the hotel to meet the more stringent energy and CO_2 criteria, the hotel will also need to reduce its energy demand which might require, for example, installing a more efficient boiler which will prove costly for which there may be grants or loans available.

These fiscal instruments i.e. tax exemption, grants. Loans, subsidies and Feed-In Tariff, have the potential to play a pivotal role in making voluntary instruments such as certification more effective in terms of emissions reduction whilst at the same time offsetting the costs of achieving this level of more robust certification. The next step in making certification more effective would be to make certification mandatory as currently seen with the introduction of Display Energy Certificates as previously discussed in this chapter.

2.3.4 Voluntary Instruments

Since the 1990s, researchers have identified a remarkable proliferation of awards, prizes, tools, eco labels and certification initiatives given for environmentally sustainable performance. Despite the growth in numbers of programmes for environmental quality, most are not well known, by either consumers or tourism businesses. For those, who are aware of them, competition and overlap among local, national and international eco labels that cover the same product group and have similar criteria can cause confusion (Ecotrans, 2004).

Since 1993, the European Network for Sustainable Tourism Development (ECOTRANS) with its 20 partners in 12 European countries has been doing systematic research and monitoring of efforts to set sustainable standards within Europe's tourism industry. Its database, ECO-TIP contains more than 60 eco labels and awards and over 300 examples of "good practice" by tourism businesses. The diversity of tourism in Europe presents, however, enormous challenges for certification initiatives. (Ecotrans, 2004) Analysis of the criteria of the leading certificates in Europe shows that many recommend or request businesses to regularly monitor energy, water and waste consumption per overnight stay. This requirement is part of the VISIT standard for tourism eco labels in Europe, developed within the LIFE project, ECO-LAB (2001-2004). (Tourbench, Date Unknown)

Ecotrans (2004) states that an eco label needs a homogeneous product group with clear and common components or services so that environmental impacts can be compared and rated. (Ecotrans, 2004) Every eco label initiative has to face this diverse range of products and issues when defining the product group and developing the criteria for a certification scheme. It is argued here and, indeed, the rule of thumb for many certification researchers and practitioners in Europe that the set of criteria for “better environmental performance” has to both go beyond what is required by law (national or regional) and still be achievable by between 10 and 30 % of the target group of tourism providers. This is more straightforward for certification schemes for which the target group is very specific but a greater challenge when the target group is the accommodation industry in general, ranging from urban hotels to seaside resorts to bungalows, guest houses, and alpine huts. This can lead to less rigorous, more generalized performance criteria and to the use of criteria based on process or environmental management systems. Some of these certification schemes do see their role in the wider context of sustainable development and may include some socio-economic criteria, usually linked to work force and the local community. (Ecotrans, 2004) Ecotrans goes on to state that environmental criteria are the core of every European eco label although the results of this research indicate that this has been given low priority and is often not even a mandatory category in many schemes or tools.

2.3.4.1 VISIT Eco Label

In 2001/2002, a partnership with 10 regional, national and international eco-labeling schemes was established within the VISIT project. VISIT stands for “Voluntary Initiative for Sustainability in Tourism.” Together with Ecotrans, as independent co-coordinator, these labels based their work on the internationally recognized ISO 14024 standard for “Type I Eco-labels”. Membership to VISIT is available at two levels as a full member or as an associate member. Full membership is open to tourism eco-labels. There are 21 criteria as seen in Appendix 2D and five core criteria as seen below.

Core Criteria

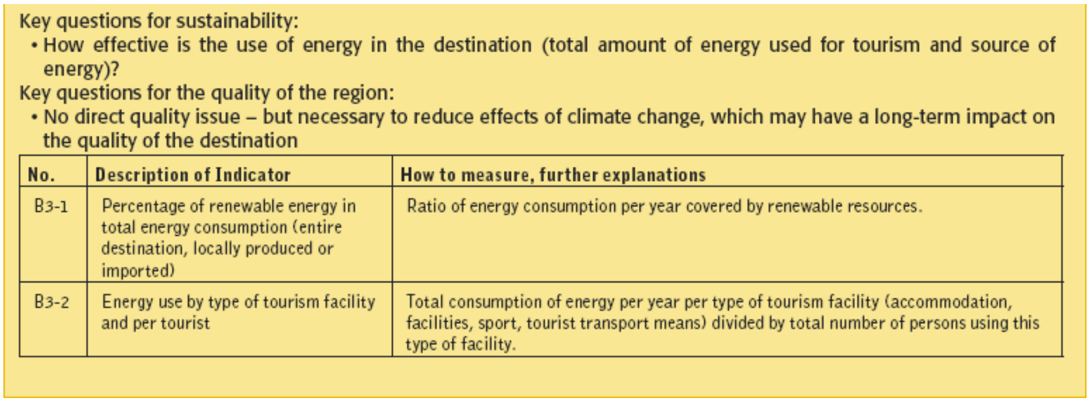
A Political implementation of sustainability concepts

B Environmental Indicators

  B1. Tourism transport (access to destination and return travel, local mobility)

  B2. Carrying capacity - land use, bio-diversity, tourism activities

  B3. Use of energy



Key questions for sustainability:

- How effective is the use of energy in the destination (total amount of energy used for tourism and source of energy)?

Key questions for the quality of the region:

- No direct quality issue – but necessary to reduce effects of climate change, which may have a long-term impact on the quality of the destination

No.	Description of Indicator	How to measure, further explanations
B3-1	Percentage of renewable energy in total energy consumption (entire destination, locally produced or imported)	Ratio of energy consumption per year covered by renewable resources.
B3-2	Energy use by type of tourism facility and per tourist	Total consumption of energy per year per type of tourism facility (accommodation, facilities, sport, tourist transport means) divided by total number of persons using this type of facility.

B4. Use of water

B5. Solid waste management

C Social and cultural performance indicators

D Economic performance indicators

Criteria Overlap between Schemes

The VISIT eco-labels (for accommodation) have intensively collaborated with each other and it was found that there is considerable criteria overlap. Nine out of eleven VISIT eco-labels already require same or similar criteria for 23 different environmental issues[16]. This "criteria overlap" allows the VISIT eco-labels and the EU Flower to agree on joint targets for the next revision of their criteria with the aim to have a set of 20 mandatory criteria implemented at more than 1000 certified hotels and camping sites in Europe. (VISIT, 2006)

Verification procedure

The VISIT standard requires an "on-site visit" as part of the verification audit, at least once every 3 years. The degree of detail differs from scheme to scheme.[17] All the schemes wish to limit the cost and fee for the applicants. The effectiveness and control of hundreds of environmental criteria should allow the eco-labels to agree on a short list of criteria which may minimise audit cost without reducing the credibility of the results. On a national level the competent bodies responsible for the EU Flower can collaborate with the VISIT eco-labels which for the applicant this would mean, limited cost and time and "two for one" benefits. (VISIT, 2006)

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[16] These also form part of the EU Flower.

[17] EU Flower does not yet make it obligatory but recommends on-site audits to the national competent bodies responsible for the verification.

Special strengths of the VISIT eco-labels

Each eco-label has its own additional standards which are considered important to the national or local situation. These may relate to additional legislation, specific environmental risks, and local climatic factors or relate to the existing achievements of the tourism product in their operation areas. This tends to ensure that the eco-label is restricted to the better performing tourism practitioners in their area. (VISIT, 2006) Such individual strengths can be seen as justification for the existence of national eco-labels beside international certification programmes. They are more appropriate to local situations; they can consider national standards and strategies when updating their criteria and can more readily develop their scheme for new product groups along the tourism supply chain. They should be more destination specific than international schemes, and thus be in a position to exchange new experiences and maintain their focus on leading the way in sustainable development in tourism practice. (VISIT, 2006)

It is likely that further developments will lead to the creation of a global forum and accreditation body for sustainable tourism certificates (between 2005 and 2010), which can investigate, recognise and promote tourism certification schemes world wide. The new Sustainable Tourism Stewardship Council (STSC) initiative would agree upon an international standard for sustainability certificates for tourism services, based on existing experiences and approaches. The VISIT Association in Europe, as regional partner network, would contribute to the development of an international standard and complements it with European specifications for the accreditation of certificates. The participating eco-labels collaborate with each other to harmonise part of their criteria and procedures, and establish a common communication strategy (logo) to consumers. Thus raising the effectiveness of marketing and promotion and minimising costs. These eco-labels would collaborate with eco-labels for non-tourism products and other complementary initiatives for sustainable tourism development. (VISIT, 2006)

2.3.4.2 Sutour, Tourbench

The first European instruments for monitoring, benchmarking and environmental management in tourism businesses have been made available by Sutour and TourBench. Sutour is used to manage environmental measures and to prepare for *processed based* certification such as EMAS. (Cross reference Chapter 3, section 3.4.1) TourBench is used to monitor environmental consumption and cost, to calculate return on Investment and offers benchmarks of other businesses for comparison purposes.

Sutour

The acronym *Sutour* derives from “Supporting Tourism Enterprises for Eco-Labelling and Environmental Management.” *Sutour* uses the newly developed software tool for environmental analysis in hotels and restaurants called E-KUH. With the help of a checklist, the tool can also determine the current environmental performance of a business, as well as how to embark on environmental management systems in accordance with EMAS, EU Flower and/or ISO 14001. (Ecotrans, IER, 2006)

1. *Formulating an environmental policy*

In the course of the implementation of a process based certification such as EMAS, the hotel has to set up an environmental policy at first. This includes both the formulation of environmentally-oriented themes and operational principles as well as the commitment to comply with the respective environmental laws and regulations.

2. *Implementation of an environmental audit*

In a first check up, the hotels situation in terms of ecological weak points and saving potentials is identified. All environmental aspects, including all activities, products and services of the enterprise important to the business are taken into account. This includes activities that are not related directly with the hotels operation, such as the environmental behaviour of suppliers, the effects of investments, etc.

3. *Setting up of an environmental programme*

Based on the preceding analysis of the establishment‘s current situation, the environmental audit helps to identify actual improvement measures. These measures are fixed and documented in the environmental programme. In addition to the aims and organisational and technical measures, the environmental programme also specifies deadlines for their actual implementation. (Ecotrans, IER, 2006)

TourBench

TourBench is a freely available, practical and easy-to-use web-based, multilingual monitoring and benchmarking tool that enables an hotel to determine the environmental impact over a period of years, based on the input of the hotels consumption of (and costs for) energy, water, chemicals and waste production. Furthermore, it enables the hotel to compare this impact with other, similar accommodation in the same country or similar accommodation all over Europe. The input of data and the comparison with other hotel accommodation is treated in confidence by the project partners. TourBench helps managers and owners of hotels to monitor online their energy and water consumption, as well as the production of waste and the use of chemical substances, to make the appropriate investment decisions and to compare themselves anonymously with other similar enterprises at an international level. (TourBench, 2008)

Data

In order to calculate benchmarks, a variety of factors are taken into account such as the existence of a restaurant or swimming pool, the level of service, the geographical location, the number of overnight stays, the building area, the number of beds/pitches, electricity and other energy consumption. By filling in this basic data, the individual hotel is able to monitor the development of environmental consumption and its reduction, as well as the corresponding costs year by year as seen in Figure 2.16 (TourBench, 2008).

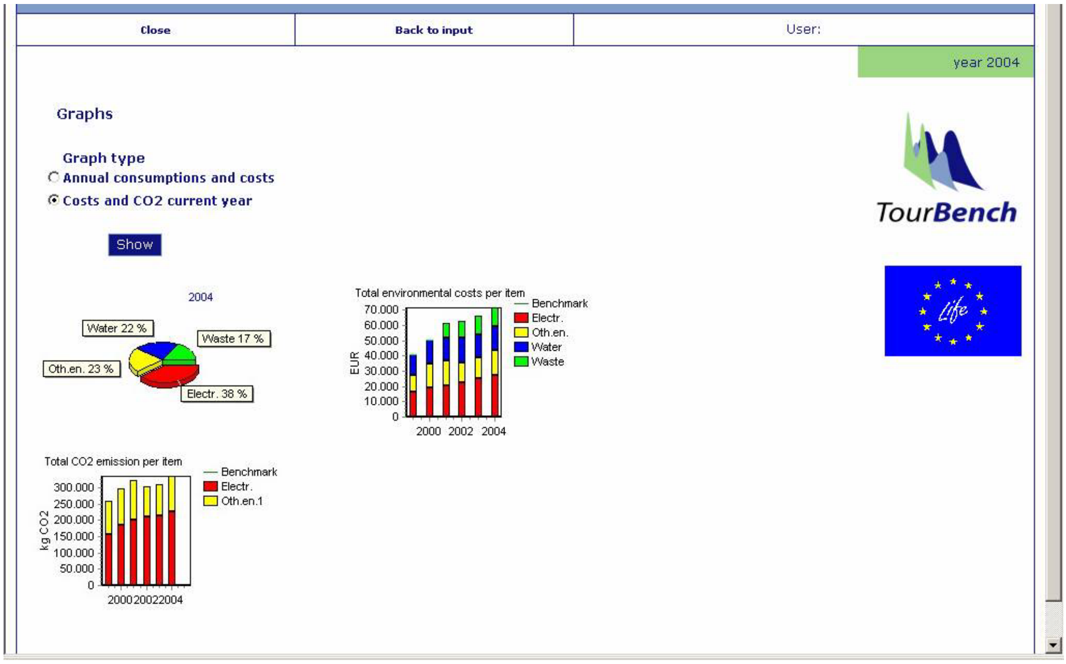


Figure 2.16 Screenshot example of results *(TourBench, 2008).*

The average consumption and benchmarks will be calculated for comparable businesses that are certified by a specific eco-label. These figures can be compared to average consumption and benchmarks of comparable businesses certified by other eco-labels. In addition, average consumption and benchmarks can be compared with businesses that are not (yet) certified. Individual figures from specific businesses will not be made known. The system works with the most common units and the most important currencies in Europe. In addition to the calculation of individual consumption figures and costs, TourBench also calculates the CO_2

production of the hotel- and thus its own impact on the climate change. (TourBench, 2008)

2.3.5 Effectiveness of and Experience with Policies for Reducing CO_2 Emissions from Energy Use in Buildings.

The UNEP (2007) report found that the effectiveness and use of the Kyoto Flexibility Mechanisms, i.e. Joint Implementation (JI) and Clean Development Mechanisms (CDM) in the buildings sector are much lower than expected (Novikova et al. 2006 in UNEP, 2007). These reasons also explain the very low share of projects on energy efficiency in buildings among all CDM projects today (UNFCCC 2007 in UNEP, 2007). It also found that although the CDM-market is developing dynamically, the prospects for projects in the buildings sector are rather negative due to the currently very complicated pre-registration and approval-procedure and the lack of a methodology adapted to the buildings sector, due to the uncertainty about the post-2012 regime, and to the high transaction costs (Novikova *et al*. 2006 in UNEP, 2007).

According to the UNEP report, possible suggestions for improvement for Kyoto Flexibility Mechanisms includes the rapid development of a simplified methodology and procedures specifically for buildings, the establishment of a facility providing project funding, information and awareness campaigns as well as a link to programmatic CDM or green investment schemes (GIS). (Novikova *et al*. 2006 in UNEP, 2007) Monitoring systems enabling the annual evaluation of buildings' energy performance improvement would also be helpful (UNEP 2007).

An IPCC review of 60 policy evaluations from about 30 countries, conclude that the highest CO_2 emission reductions were achieved through building codes, appliance standards and tax-exemption policies.(IPCC, 2007a) The review found that appliance standards, energy-efficiency obligations and quotas, demand-side management programmes and mandatory labeling were the most cost-effective policy tools as opposed to subsidies and energy or carbon taxes which they found to be the least cost effective instrument. (IPCC, 2007a)

According to the IPCC, the limited overall impact of policies so far is due to several factors: (IPCC, 2007a)

1) Slow implementation processes

2) The lack of regular updating of building codes (requirements of many policies are often close to common practices, despite the fact that CO_2 neutral construction

without major financial sacrifices is already possible) and appliance standards and labeling

3) Inadequate funding

4) Insufficient enforcement. In developing countries and economies in transition, implementation of energy-efficiency policies is compromised by a lack of concrete implementation combined with poor or non-existent enforcement mechanisms.

Another challenge is to promote GHG-abatement measures for the building shell of existing buildings due to the long time periods between regular building retrofits and the slow turnover of buildings in developed countries (IPCC, 2007a)

2.4 Findings

The climate change problem is principally an energy problem with levels of emissions being highly correlated with levels of energy use, the large majority coming from fossil fuel combustion resulting from electricity and heat generation.

Considering that European countries have one of the highest per capita emissions, captures 59 percent of international arrivals and has far more “green” certification schemes than any other region in the world, there is considerable potential for it to become an effective ‘tool’ for emissions reduction. If implemented correctly, European certification could set international precedent and provide a means of reducing the global emissions and environmental impact of the hotel sector.

The results of the review propose that economic instruments and voluntary information tools, such as eco labels and certification, could enhance each other’s effectiveness if they were appropriately combined with each other. For example, voluntary initiatives (such as ecolabels and tourism certification) could become much more effective if combined with regulatory instruments (such as display energy certificates for CO_2 emissions performance). The question is whether this would make tourism certification more robust and therefore a more reliable measure of environmental impact? These questions will be examined in the following chapter which reviews Sustainable Tourism and Tourism certification.

3

Sustainable Tourism and Tourism Certification

'Tourism has a major impact on local communities in tourist destinations. It can be a significant source of income and employment for local people. It can also pose a threat to an area's social fabric and its natural and cultural heritage, upon which it ultimately depends, but if it is well planned and managed it can be a force for their conservation. If tourism is to contribute to sustainable development, then it must be economically viable, ecologically sensitive and culturally appropriate.'

(UNEP WTO, 2005)

Chapter 3 presents an overview of sustainable tourism and tourism certification and its role in reducing global emissions in the hotel sector. The chapter is divided into four sections including; past, present and future trends in tourism; Sustainable Tourism and Ecotourism; Tourism Certification and Accreditation followed by a summary of the findings. The final section looks at Benchmarks and its role in the setting of performance levels. A review is included of three published sources of benchmarks used to assess energy performance in hotels. The effectiveness of benchmarks and certification in reducing CO_2 emissions from energy use in buildings is examined and discussed in this chapter.

3.1 Overview

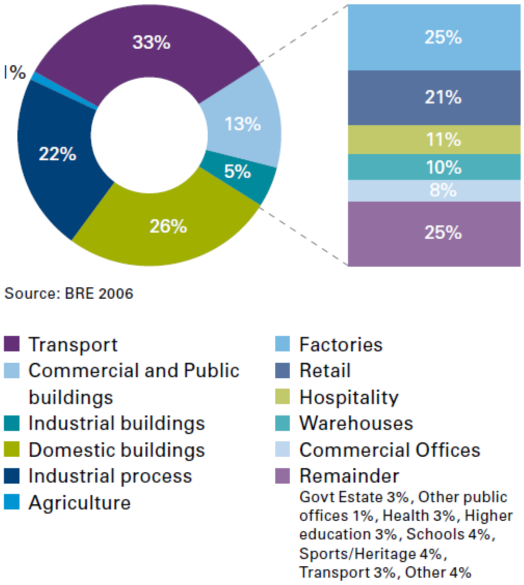
Most ‘green’ certification programmes started in the wake of the 1992 Rio Earth Summit. The first international gathering of ecotourism and sustainable tourism certification programmes took place in 2000 and produced the Mohonk Declaration, a framework document of fundamental principles necessary for all legitimate sustainable and ecotourism certification programmes. The Rainforest Alliance then spearheaded a 2-year feasibility study and global consultation, which resulted in a plan to create a global accreditation body, the Sustainable Tourism Stewardship Council. In October 2005, another meeting of key certification programmes, resulted in the formation of an advisory council. More importantly, the United Nations’ International Year of Ecotourism in 2002 signaled that ecotourism had taken on global importance and gave it further impetus in efforts to set standards to measure environmental and socio-cultural impacts. (Black and Crabtree, 2007)

Parallel to these milestones, is the growing consumer demand for environmentally and socially responsible travel as well as a growth in efforts to ‘green’ some of the more mainstream sectors of the tourism industry. Today, there are some 80 certification programmes functioning or in development, dozens of ‘green’ awards programmes, hundreds of codes of conduct, and a range of other mechanisms for measuring and rewarding sustainable tourism and ecotourism. (Black and Crabtree, 2007) The question addressed in this chapter is whether any of these initiatives are resulting in actual reduced CO_2 emissions?

The stakeholders targeted by the tourism certification schemes contained in the literature review include hotel owners, environmental managers, architects, engineers, guests, the public etc. There is a growing demand for specialist environmental, green building, LEED consultants and other specialist parties who are subcontracted by architects and/or clients to assist with satisfying certification requirements. However, the stakeholders targeted by this thesis include scientists, policy makers and the people responsible for formulating the certification schemes.

3.1.2 Tourism Growth & CO_2 Emissions

In the UK, carbon emissions from energy use in non-domestic buildings account for around 18% of total emissions, with the hospitality sector accounting for 2% of these total emissions as seen in Figure 3.1. (Carbon Trust, 2008a) Annual energy costs for the hospitality sector are in excess of £1 billion, resulting in carbon emissions of more than 3.5 million tonnes per year. (Carbon Trust, 2007a)



Source: BRE 2006

Figure 3.1 UK Carbon Emissions (2003) for the whole economy and broken down by non-domestic building type. *(BRE, 2006 in Carbon Trust, 2008a)*

Emissions from the hospitality sector account for 11%, almost 3 times as much as that from schools which account for 4% of UK emissions. This emphasizes the importance of this growth sector as a key focus area in terms of emissions reduction.

Global tourism is the world's second largest economy and largest employer. It accounts for around 10 per cent of the world's economic activity and is one of the main generators for employment. Tourism is currently growing globally at a rate of 9% per year, and has grown 25% in the past ten years. International arrivals world-wide are expected to reach nearly 1.6 billion by the year 2020 from 25 million in 1950. (Figure 3.2) It is growing fastest in developing countries. (UNWTO, 2006)

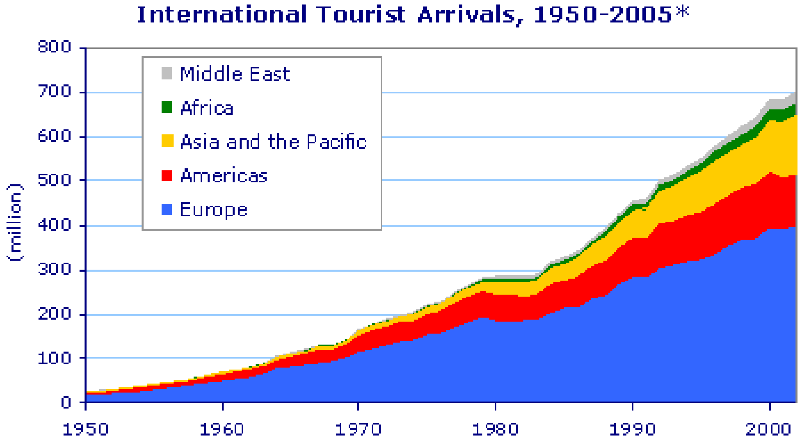


Figure 3.2 International tourist arrivals, 1950-2005 *(UNWTO, 2006).*

Tourism growing at such a rate will result in increasing impacts on the host destination. These impacts can be positive, with money being generated in local economies, benefits for local communities etc. However, tourism impacts can also be negative, with environmental degradation. These two faces of tourism – the Jekyll and Hyde, the positive and negative – mean there are avid supporters both for and against tourism. (Black and Crabtree, 2007)

This rate of growth affects both transport and accommodation equally. If carbon intensive transport reduces then this proportion could become much higher as the focus will tend to shift onto accommodation. The scientific community is unequivocal in its acceptance of the connection between climate change and green house gas emissions yet there are no international benchmarks for CO_2 emissions in hotels. Although transport is commonly identified as a major emitter, accommodation receives much less attention, in spite of the fact that it typically accounts for one quarter of the total emissions from global tourism as seen in Table 3.1. (UNWTO, 2007)

	CO_2 (Mt)
Air transport	517
Other transport	468
Accommodation	274
Activities	45
TOTAL	**1,304**
Total world	**26,400**
Share (%)	4.94

Table 3.1 Global Tourism CO_2 emissions in 2005 including same day visitors *(UNWTO, 2007)*.

As can be seen in Figure 3.3, emissions from the accommodation sector are estimated to increase by +170% by 2035.

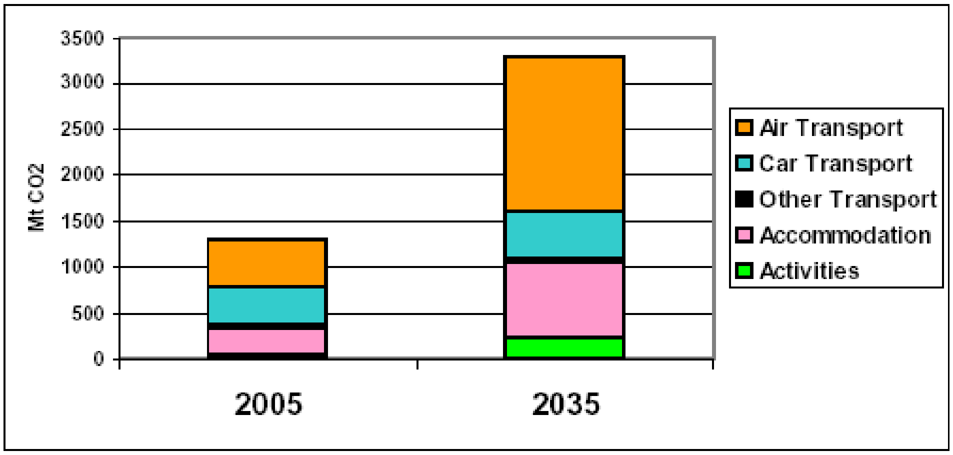


Figure 3.3 Emissions from Global Tourism, 2005 & 2035 *(United Nations Environment Programme (UNEP); Oxford University Centre for the Environment (OUCE); United Nations World Tourism Organization (UNWTO); World Meteorological Organization (WMO) in UNWTO, 2007).*

Fossil fuels are needed for travel to destinations, for cooking, heating, cooling, cleaning, transport, the import of foods and products, and services such as the additional demand of tour guides and other staff. There is little information in the scientific literature on energy consumption in these sectors, but there is some evidence that the demand for fossil fuels can easily exceed 100 kg per tourist during a two week vacation in a resort hotel (Gössling, unpublished data 2000).

Visitors expect high environmental quality – both at their holiday destination and in their accommodation establishment. Due to the high standards of hygiene and the various services in an accommodation establishment, the daily consumption of water, energy, cleaning agents and detergents, as well as the daily amount of waste produced are well above those encountered in normal domestic usage. Better management, detailed information for visitors and staff members, as well as high-grade technologies can help considerably to reduce the environmental impact. (ECOTRANS, IER, 2006)

3.2 Climate Change and Tourism Certification

In response to the problem of climate change a series of International meetings, Agreements have taken place and are described in the following sections.

3.2.1 Mohonk Agreement (2000)

The Mohonk Agreement document (Appendix 3A) contains a set of general principles and elements that should be part of any sound ecotourism and sustainable tourism certification programme. This framework was unanimously adopted at the conclusion of an international workshop convened by the Institute for Policy Studies with the support of the Ford Foundation. It was held at Mohonk Mountain House in New Paltz, New York State in November 2000. The Workshop was attended by 45 tourism certification specialists from 20 countries around the world. (Honey & Rome, 2002) The Mohonk meeting accomplished three things:

- It reviewed a draft report of ecotourism and sustainable tourism certification programs prepared by Martha Honey and Abigail Rome;
- It facilitated the sharing of experiences, successes and challenges among certification practitioners; and,
- It began to lay the foundations for creating ecotourism and sustainable tourism certification principles and standards as well as for an international accreditation system under the terms of what has become known as the Mohonk Agreement.

Workshop participants recognized that tourism certification programmes need to be tailored to fit particular geographical regions and sectors of the tourism industry but agreed that the overall framework for certification scheme and the criteria for sustainable tourism and ecotourism are the universal components that must frame any ecotourism and sustainable certification programme. (Honey & Rome, 2002)

3.2.2 Global Sustainable Stewardship Council (STSC) (2002)

In 1999, Rainforest Alliance explored the subject of tourism certification and they concluded that while the use of certification mechanisms to ‘green’ the tourism industry at large is valid and important, the lack of a global accreditation body has become one of the main obstacles in turning certification into an effective tool for change. With initial support they coordinated a project[1] whose objective was to investigate the possibility for establishing an international accreditation body for sustainable tourism certification and provide a fully developed implementation plan. The main responsibilities of a potential accreditation body would be to establish international criteria for accreditation, monitor compliance with such criteria, promote consumer awareness, and increase credibility of certification schemes (See Appendix 3B). (Rainforest Alliance, 2002)

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[1] “Feasibility Study, Organizational Blueprint and Implementation Plan for a Global Sustainable Tourism Stewardship Council: An Accreditation Body for Sustainable Tourism Certifiers” (STSC Project) (Rainforest Alliance, 2002).

The Sustainable Tourism Stewardship Council (STSC) responds to the market demand to have international, comparable standards to identify and purchase sustainable holidays and to minimize false claims. Bringing certification schemes with high standards under one umbrella will give them competitive advantage in marketing, planning and managing their schemes; this in turn will benefit the companies they certify. (Rainforest Alliance, 2002)

The STSC has since served as a principle reference for the development of most sustainable tourism and ecotourism certification programmes around the world, as well as a fundamental reference for: The United Nations World Tourism Organization (UNWTO) indicators for certification in "A Guidebook for Indicators of Sustainable Development for Tourism Destinations", the "VISIT Standard for European certification standards" and the "Baseline Criteria for Sustainable Tourism Certification in the Americas" of the Sustainable Tourism Certification Network of the Americas. (Anon., 2000 in Rainforest Alliance, 2002) It is expected, along with more recent developments, such as those just cited, to form part of the baseline criteria for a future accreditation program, currently under development, tentatively entitled the "Sustainable Tourism Stewardship Council" or STSC. (Rainforest Alliance, 2002). In fact in October 2008, The Global Partnership for Sustainable Tourism Criteria (GSTC Partnership) was launched (See Section 3.2.5).

3.2.3 Djerba Declaration on Climate Change and Tourism (2003)

The World Tourism Organization, upon the invitation of the Government of Tunisia, made an important initial step to address the complex relations between climate change and tourism by convening the First International Conference on Climate Change and Tourism, in April 2003, in Djerba, Tunisia. Participants included more than 150 participants from 42 countries and six international organizations.

The conference focused on climate change related impacts on water resources, at coastal and island destinations, as well as mountain areas. A specific session was also dedicated to policy and mitigation issues. The main outcome of the conference was the *"Djerba Declaration on Climate Change and Tourism*" (See Appendix 3C) which provides a basic reference and framework for further action by the major stakeholder groups. The Declaration recognizes the two-way relationship between climate change and tourism: that tourism is both impacted by climate change and contributes to the causes of this phenomenon. (WTO, 2003)

3.2.4 DAVOS Declaration on Climate Change and Tourism (2007)

To support this action the UN World Tourism Organization (UNWTO), jointly with the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO), with the support of the World Economic Forum (WEF) and the Swiss Government, convened the Second International Conference on Climate Change and Tourism, in Davos, Switzerland in October 2007. This event, built upon the results of the First International Conference organized on this topic in Djerba, Tunisia in2003. The conference *"urges action by the entire tourism sector to face climate change as one of the greatest challenges to sustainable development, and to the Millennium Development Goals in the 21st Century."* (UNWTO, 2007)

The Davos Declaration (Appendix 3D) concluded that "*the tourism sector must rapidly respond to climate change, within the evolving UN framework if it is to grow in a sustainable manner*". This will require action for the tourism sector to: (UNWTO, 2007)

- mitigate its Greenhouse Gas GHG emissions, derived especially from transport and accommodation activities
- adapt tourism businesses and destinations to changing climate conditions;
- apply existing and new technology to improve energy efficiency; and
- Secure financial resources to help poor regions and countries.

The Davos Conference called on UNWTO, in collaboration with UNEP and WMO, to strengthen this process, and to convene a Third Conference on Climate Change and Tourism, at an appropriate time in the future, to review progress, to maintain response levels and to identify further needs and actions. The WMO urges *"governments and the industry to strengthen climate-tourism partnerships and effectively use climate information and prediction services provided by the National Meteorological and Hydrological Services, and to incorporate climate factors in tourism policies, development and management plans, so as to ensure a sustainable future for the sector"* (Ttyd, 2007).

The Davos Declaration and results of the Conference provide the basis for the UNWTO Minister's Summit on Tourism and Climate Change, at the World Travel Market, London in November 2007, was submitted for adoption at the UNWTO General Assembly in Cartagena de las Indias, Colombia in November 2007, and was presented at the United Nations Climate Change Conference in Bali, Indonesia, in December 2007.

3.2.5 The Global Partnership for Sustainable Tourism Criteria - GSTC (2008)

The Global Partnership for Sustainable Tourism Criteria (GSTC) was launched in October, 2008 and is a coalition of organizations working together to foster increased understanding of sustainable tourism practices and the adoption of universal sustainable tourism principles. The Partnership was initiated by Rainforest Alliance, the United Nations Environment Programme (UNEP), United Nations Foundation and the United Nations World Tourism Organization (UNWTO). They launched the Sustainable Tourism Criteria at the World Conservation Congress in October 2008.[2] (GSTC, 2008)

The Global Sustainable Tourism Criteria (Appendix 3E) are organized around four main themes: effective sustainability planning; maximizing social and economic benefits for the local community; enhancing cultural heritage; and reducing negative impacts to the environment. Although the criteria are initially intended for use by the accommodation and tour operation sectors, they have applicability to the entire tourism industry. The criteria are part of the response of the tourism community to the global challenges of the United Nations' Millennium Development Goals. Poverty alleviation and environmental sustainability – including climate change – are the main cross-cutting issues that are addressed through the criteria. (GSTC, 2008)

The Sustainable Tourism Criteria have been developed in accordance with The International Social and Environmental Accreditation and Labelling Alliance (ISEAL) Code of Best Practice, and as such will undergo consultation and receive input every two years until feedback is no longer provided or unique. Some of the expected uses of the criteria include the following: (GSTC, 2008)

- Serve as basic guidelines for businesses of all sizes to become more sustainable, and help businesses choose sustainable tourism programs that fulfill these global criteria;
- Serve as guidance for travel agencies in choosing suppliers and sustainable tourism programs;
- Help consumers identify sound sustainable tourism programs and businesses;
- Serve as a common denominator for information media to recognize sustainable tourism providers;

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[2] Beginning in 2007, a coalition of 27 organizations – the Partnership for Global Sustainable Tourism Criteria – came together to develop the criteria. Since then, they have reached out to close to 100,000 tourism stakeholders, analyzed more than 4,500 criteria from more than 60 existing certification and other voluntary sets of criteria, and received comments from over 1500 individuals. (GSTC, 2008)

- Help certification and other voluntary programs ensure that their standards meet a broadly-accepted baseline;
- Offer governmental, non-governmental, and private sector programs a starting point for developing sustainable tourism requirements; and
- Serve as basic guidelines for education and training bodies, such as hotel schools and universities.

The criteria indicate what should be done, not how to do it or whether the goal has been achieved. This role is fulfilled by performance indicators, associated educational materials, and access to tools for implementation, all of which are an indispensable complement to the Global Sustainable Tourism Criteria. The Partnership conceives the Global Sustainable Tourism Criteria as the beginning of a process to make sustainability the standard practice in all forms of tourism. (GSTC, 2008)

3.2.6 Sustainable Buildings Alliance (2008)

Globalisation and the rise of the trans-national businesses have combined with an increasing sense of responsibility to the environment to generate demand for ‘international’ systems of measuring the environmental performance of buildings and the urban landscape. (SB Alliance, 2008) However, the environmental assessment systems currently in use in the market were never designed to be used across multiple countries and often have features with a significant ‘local’ flavour. This explains why comparisons between the systems are not straightforward. It is envisaged that all scheme operators will begin to collaborate to work towards the development of common minimum standards. (SB Alliance, 2008) The Alliance advises that setting common minimum standards and common indicators for all schemes would ensure consistency; it could also help the move towards dual certification. Dual or multi certification would allow multinational companies to demonstrate and compare the environmental performance of their buildings in the countries in which they are based with the buildings they occupy overseas. The SB Alliance model allows these comparisons by providing a common platform for all buildings and construction stakeholders for addressing sustainability issues of global significance, especially climate change. The objectives of the alliance are listed in Appendix 3F. (SB Alliance, 2008)

3.3 Sustainable Tourism and Ecotourism

3.3.1 Sustainable Tourism

Sustainable tourism is defined as '*tourism that seeks to minimize ecological and socio cultural impacts while providing economic benefits to local communities and host countries. '* (Mohonk Agreement, 2000) It applies to mass tourism as well as some forms of Ecotourism and *"Meets the needs of the present without compromising the ability of the future generations to meet their own needs."* (Brundtland,1987) Sustainable tourism is *"envisaged as leading to management of all resources in such a way that economic, social and aesthetic needs can be fulfilled while maintaining cultural integrity, essential ecological processes, biological diversity and life support systems".*

Jamieson et al. (2000) in their '*Manual for Sustainable Tourism Destination Management',* report that there is increasing evidence showing that an integrated approach to tourism planning and management is now required to achieve sustainable tourism. In 2005, the corporate guide *'Making tourism more sustainable,'* was published (UNEP WTO, 2005) and is considered to be the 'Bible' for all decision makers involved in Sustainable Tourism. The guide lists twelve integrated aims of sustainable tourism (See Appendix 3G)

The book states that *'Sustainable tourism embraces all segments of the industry with guidelines and criteria that seek to reduce environmental impacts, particularly the use of non-renewable resources, using benchmarks to improve tourism's contribution to sustainable development and environmental conservation.'* (UNEP WTO, 2005) Yet as seen in Appendix 3G, only one category (resource efficiency) out of twelve refer to CO_2 related criteria. Considering this is the 'bible' for decision makers involved in sustainable tourism it is very surprising to see that such key criteria to minimizing environmental impact is given such low priority. Even more worrying is the fact that this is the foundation on which many certification schemes are based.

The book goes on to highlight the fact that '*The notion that tourism could be "sustainable" is the result of ongoing discussions and debates around the whole notion of sustainable development. The best of intentions have gone into developing strategies that promote the development of natural resources in a manner that does not destroy them for future generations.'* (UNEP WTO, 2005)

There is still considerable confusion associated with the definition of 'sustainable tourism.' This has also been observed by Honey (2002); Bohdanowicz (2006), Synergy WWF (2000), UNEP WTO (2005), Font (2002), Font and Harris (2004). However, despite the consensus of opinion, the criteria being proposed for sustainable tourism does not acknowledge nor include CO_2 related impacts. How can tourism be sustainable without attention being focused on the aspects of tourism that cause the greatest environmental impact? There is a lot being written about this new buzz word but as evident in the literature review, there is a fundamental lack of understanding of the key impacts that relate to CO_2 emissions and tourism. These should be recognized as a priority before tourism can truly become sustainable.

3.3.2 Ecotourism

The results of my review found there to be more confusion when trying to pin down a definition for Ecotourism. The Mohonk Agreement (Mohonk, 2000) defines Ecotourism as '*tourism with a natural area focus, which benefits the environment and communities visited, and fosters environmental and cultural understanding, appreciation, and awareness*.' The International Eco-tourism Society (TIES) defines Eco-tourism as *'responsible travel to natural areas that conserves the environment and sustains the well-being of local people.'* According to TIES, sometimes it is defined as a sub-category of sustainable tourism or a segment of the larger nature tourism market. (TIES, 2009)

Honey (2002) and Buckley (2003) both agree the precise definition of ecotourism is vague and there is lack of standard terminology, adding to the confusion. They are both of the opinion that Ecotourism does not necessarily denote sustainability and can be used by anyone at anytime for anything from a small-scale locally-run rainforest lodge where the money goes to support a local community, to a large, luxury, foreign-owned resort which has little community involvement and uses masses of natural resources. (Honey, 2002, Buckley, 2003)

In brief, Ecotourism purports to benefit the environment and the people in the host country by providing local environmental, cultural and economical benefits. However, there is no specific reference to impacts that relate to CO_2. If the organizations defining these terms cannot be specific then it is no surprise they is considerable confusion with the terminology and its lack of reference to specific environmental impacts. If the very terms 'Sustainable Tourism' and 'Ecotourism' are so ill-defined and vague then what hope of success do the certification schemes have that are based on these terms?

3.4 Tourism Certification

Certification is the process of assessing compliance with pre-established criteria and has been heralded as an important step towards the *'greening'* of hotels. Certification schemes are created by privately operated companies and NGO's and are based on voluntary initiatives by the hotels themselves. The schemes provide the participating hotel with a certificate claiming that it satisfies a number of environmental criteria. (Honey, 2002) Honey defines Certification in its broadest sense to mean *'any programme that offers a "logo" or "marketing brand" that leads the consumer to believe that their choice of accommodation implements good environmental practices'* (Honey, 2002) For example, Honey gives the example of Green Globe which allows its logo to be used as soon as a company commits to undertaking the certification programme. A subtly different logo is awarded when certification is achieved but it is unlikely that consumers will recognise the difference. (Honey, 2002) The criticism here is that certification (and logo) is awarded to a hotel whether or not they reduce their environmental impact in terms of emissions.

Tourism certification has been hurt by a lack of credibility and market confusion because there is not yet an internationally accepted framework against which to measure certification programmes. Currently over 100 ecolabels and certification schemes are available for tourism, ecotourism and the hospitality industry worldwide. Europe alone has over 60 labelling schemes. (Honey 2002) Examples of certification programmes in Europe are shown in Figure 3.6. Europe has far more 'green' certification schemes than any other region in the world and accounts for 78% of world tourist arrivals as seen in Figure 3.4. It can also be seen that certification of accommodation accounts for 68% within the tourism sector as seen in Figure 3.5. (WTO, 2002) If certification were made more robust and reliable then it clearly, has the potential to make a significant impact on emissions reduction.

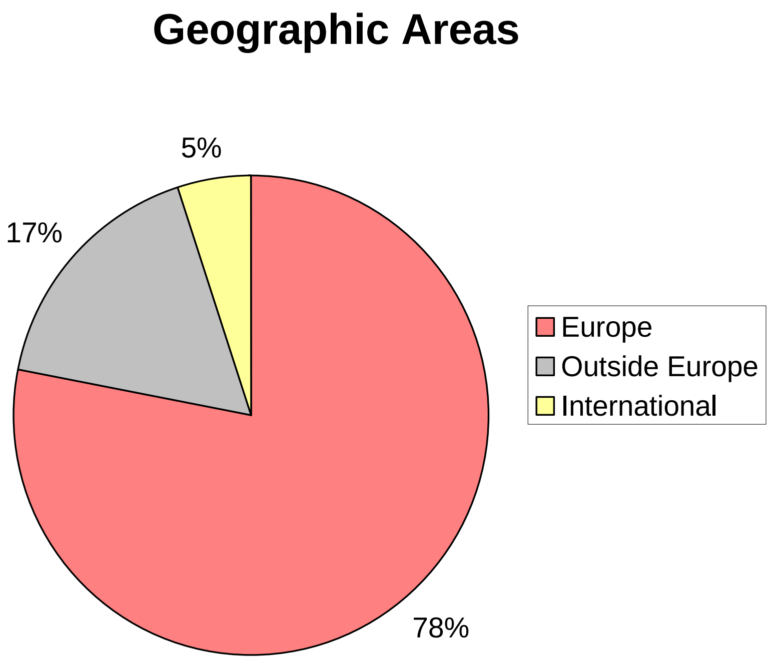


Figure 3.4 Geographic areas *(WTO, 2002).*

Figure 3.5 Tourism sectors certified *(WTO, 2002).*

Examples of Certification Programs in Europe

200	Das Österreichische Umweltzeichen für Tourismusbetriebe
25	Ecolabel Luxemburg
>100	Den Groenne Noegle
250	Legambiente Turismo
13	Ö+ Steinbock
70	Cataluna Ecolabel
450	Green Tourism Business Scheme
220	Milieubarometer
60	Nordic Swan
70	La Clef Verte
53	Green Certificate Latvia
>1.500	
2093 & 729	Blue Flag International

www.yourvisit.info

Figure 3.6 Examples of certification programmes in Europe *(Grip, 2006)*

3.4.1 Process, Performance and Hybrid Scheme

Most certification schemes can be distinguished by their method i.e. *Process and Performance*. *Process* relates to management activities which probably lead to reduced environmental impact – e.g. holding staff training seminars to encourage staff into energy saving practices. *Performance* refers to actual measurable results – e.g. energy consumption. Most schemes are, strictly, hybrids, having both kinds of criteria, which either have to be satisfied individually, or are combined in a weighted points system. (Honey, 2002)

The term benchmark is often used loosely, but in this research refers strictly to a standard performance figure against which the subject's performance is judged. The establishment of these benchmarks is often unclear and their value, often unpublished.

Within the two distinct methods of certification (*process vs. performance*), all certification schemes share at least five components as follows (McLaren, 2002):

- *Voluntary Enrolment:* At present, all certification schemes in the travel and tourism industry are strictly voluntary. Most do so only if they believe that certification can bring them market distinction and increased profits.
- *Logo:* All schemes award a selective logo, seal or brand designed to be recognizable to consumers. Most permit the logo to be used only after

certification is achieved. Many certification schemes give logos for different levels of achievement.

- *Complying With or Improving Upon Regulations: Process-based* certification schemes require, at a minimum, that companies comply with local, national, regional and international regulations, while most *performance-based* programmes have criteria that require companies go beyond the regulations to include socio-cultural and conservation criteria.
- *Assessment and Auditing:* All certification schemes award logos based on some kind of assessment or audit. This can be first-party (by the company itself, typically by completing a written questionnaire), by the certification body, or by independent or third-party auditors which is considered the most rigorous and credible because it avoids any conflict of interest. The audit covers all categories used in the certification scheme typically involving energy, water, waste consumption and management at a minimum.
- *Membership and Fees:* Many schemes charge an enrolment fee to those seeking certification. This money is used for administration and to support advertising and promotion of the logo and of the companies that are certified. They, or the independent auditing body, also charge fees for the onsite assessment. Usually there is a sliding scale with larger and more profitable businesses paying more. (Honey, 2002)

The results of this review found there is a lack of transparency as to whether the certification has been awarded on the basis of design intent or for operational performance. Pre-construction, design-based schemes – e.g. BREEM and LEED-NC can in fact be used for both. These could also be, in principle, process or performance, but in this case performance data are provided by standard simulation. There is no correlation between the two and there should be no confusion between certification that goes to design i.e. LEED-NC, BREEAM and one that goes to real building i.e. LEED-EB, Green Globe, Nordic Swan, EU Flower.

3.4.2 Evolution of Tourism Certification

Honey (2002) says it is argued that programmes that modify the practices of individuals have more potential to influence change than specific regulations targeting the activities of large businesses. In response, a wide range of voluntary initiatives have emerged from the sector. Codes of conduct in the 1980s and early 1990s have been taken forward by self-help guides and manuals, and latterly by certification and benchmarking programmes. Tourism itself is thousands of years old and certification for hotels and restaurants based on quality and cost is a century old.

Most of the green certification schemes started in the mid-to late- 1990s but the roots of certification lie in the manufacturing industry and have gestated over the past thirty years: (Honey, 2002, Tribe, Font, Griffiths, Vickery, & Yale, 2000 in Font, 2002)

1970s: Rise of global environmental movement - beginnings of ecotourism
1980s: Rise of sustainable development
1987: Brundtland Report – Sharing Our Future
1992: Rio Earth Summit - Agenda 21
2002: United Nations International Year of Ecotourism

Font (2002) presents an overview of the key dates and events in the environmental certification of tourism and hospitality operations (see Appendix 3H). Font (2002) describes how codes of practice, industry manuals and awards precede ecolabels in their efforts to improve industry and tourist actions and awareness towards the environment. Ecolabels were introduced as a more formalized method to focus on environmental efficiency. They require verification by an independent third party, they are linked to technical advice, the label can be regained through a cyclical review, and criteria evolve in stages. (Font, 2002)

In December 1998, the United Nations Environmental Programme published the first report on tourism ecolabels (UNEP, 1998 in Font, 2002), which welcomed them and encouraged governments and NGO's to develop them further. At the same time, the growing number of ecolabels was seen with caution by the WTO to investigate their effectiveness. (Font, 2002)

3.4.3 Certification Process

The progress made in the development and establishment of certification needs to be understood in the context of how it works. Font (2002) provides a model for internationally agreed principles of compliance assessment as shown in Figure. 3.7.

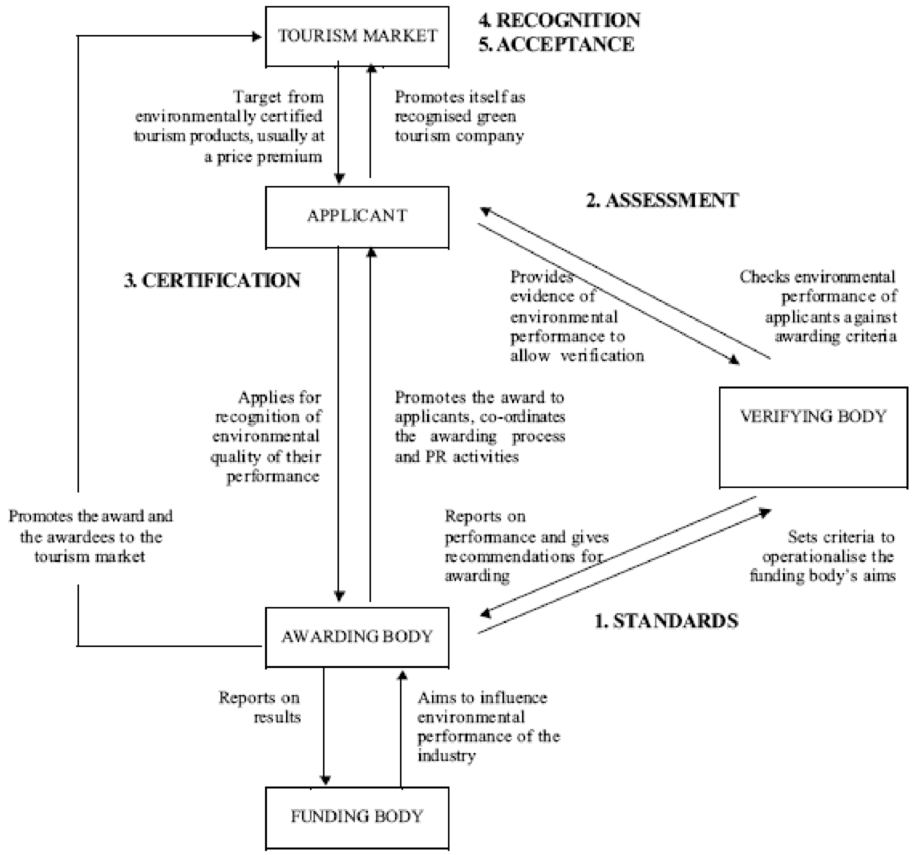


Figure 3.7 The players in tourism ecolabels (*Font, 2001b).*

3.4.4 Certification Method: Process vs. Performance

As previously mentioned most certification schemes can be categorized and analyzed by their method and by sector of the tourism industry they cover (conventional tourism, sustainable tourism or ecotourism). A hybrid of process-based environmental management systems and performance benchmarks are more effective. (Honey, 2002) Understanding the process vs. performance distinction is vital to any analysis of the integrity. While process based schemes set up a system for monitoring and improving performance, performance based methods states that the goals or targets that must be achieved to receive certification and use of a logo. These same performance criteria are then used to measure all hotels seeking certification under that particular scheme. (Honey, 2002)

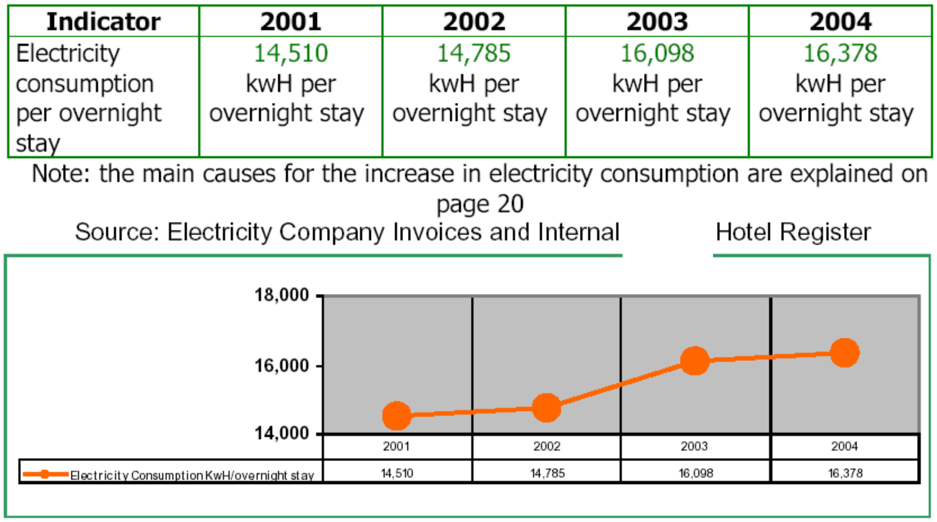
Process Based Schemes

Processed based certification schemes are all variations of environmental management systems (EMS) of which there are various types i.e. ISO 14001, Eco-management and Audit System (EMAS), EU Flower, life cycle assessment, The Natural Step – as well as regional and national variations of the standards. (Honey,

2002) Process based schemes measures progress descriptively and usually a hotel uses an EMS to measure its own performance over time. For example, a typical EU Flower Environmental report is detailed and descriptive sometimes involving the production of a 152 page report is shown in Appendix 5.4A. An extract of a typical EMAS report showing the energy related criteria is shown in Appendix 3C. The report typically contains contact details, a description of the hotel and facilities offered. Followed by a detailed description of the energy consumption for a number of years. The report details monthly occupancy, food covers, laundry (kg) electricity, fuels, waste, water consumption on an annual basis and in some cases total CO_2 emissions. A conclusion is provided at the end of each section describing the actions taken. At the end of the report there is a section describing recommendations for improvement. The key features of a process based scheme such as EMAS are;

- Award of a logo based on creation of systems for on-going monitoring of environmental targets. No reference to a baseline performance standard.
- Certification valid for maximum three years
- Versatile and applicable across industries and with different industry sectors.
- Fit well with organization of large companies, can operate globally and across tourism sectors
- Allows a company to set their own targets for improvement and draw up its own environmental policy against which its management system is designed.

An example of how an EMAS certified hotel monitors its own performance over time (in terms of electricity consumption) is shown below in Figure 3.3.



Indicator	2001	2002	2003	2004
Electricity consumption per overnight stay	14,510 kwH per overnight stay	14,785 kwH per overnight stay	16,098 kwH per overnight stay	16,378 kwH per overnight stay

Note: the main causes for the increase in electricity consumption are explained on page 20

Source: Electricity Company Invoices and Internal Hotel Register

Figure 3.8 *Extract from EMAS Declaraçion Ambiental Report* Electricity consumption (kWh) per overnight stay for EMAS certified hotel*. (Appendix 3I)*

The hotel records energy consumption every month and makes year to year comparisons in order to assess the improvement obtained and to detect any unusual consumption. However, this setting of environmental performance targets does not mean the hotel is sustainable. In this case the report provides an explanation for this increase which resulted from two factors. Firstly, the introduction of new facilities requiring a gradual and constant increase in energy consumption, such as for example the air conditioning, the mini bars in each room, the new sauna, the buffet in the restaurant and new kitchen equipment. Secondly, the renovations carried out in the hotel also consumed a great deal of electricity.

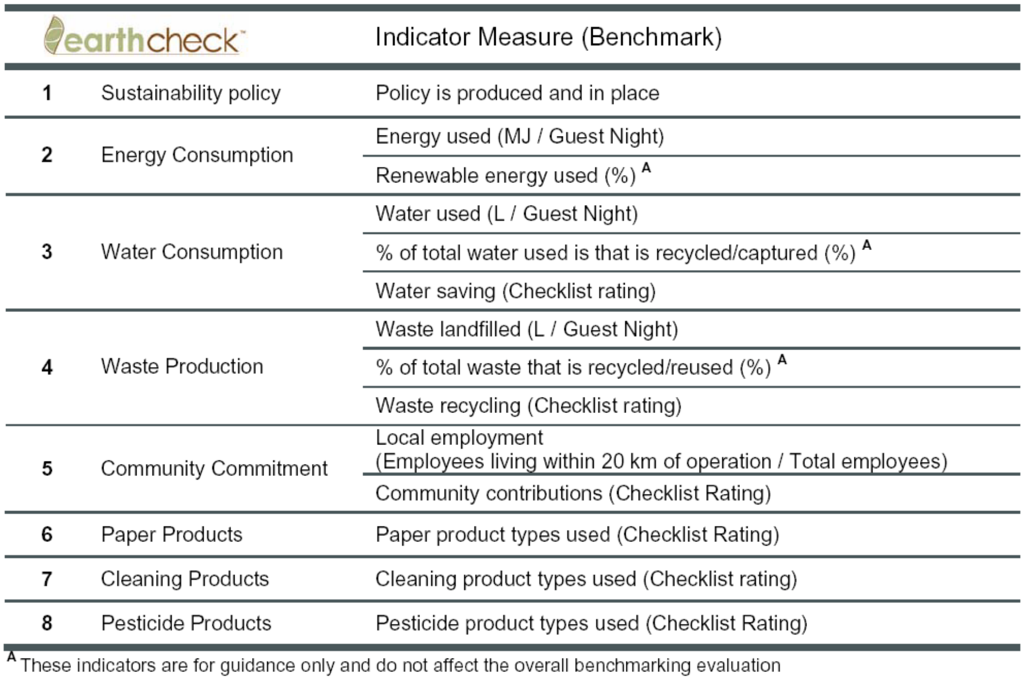
Some other disadvantages are identified by Honey below (2002);

- Implementing, monitoring and continually improving its management system does not mean that a company or hotel is sustainable.
- The focus of schemes ignore issues important to tourists, host communities, conservation
- Their path to implementation and certification not transparent resulting in additional expenses to hire consultants and trainers.
- Certified companies cannot be compared to one another because there are no common standards, less useful to consumers.
- High Cost and less applicable to small businesses

Performance Based Schemes

Performance based certification scheme use a set of externally determined environmental (sociocultural / economic) criteria or benchmarks to quantatively measure the performance of a hotel seeking certification. Examples include EC3 Green Globe, Nordic Swan. An example of a performance based scheme is presented for Green Globe. If a hotel fails to meet the minimum requirements for up to two submitted earthcheck™ indicators (Baseline or better performance), but achieves Baseline or better performance in all the other earthcheck™ Indicators, then the operation is allowed to use the Green Globe Benchmarked logo. It is, however, given a maximum of 12 months to improve performance in at least one of the indicators to Baseline or better performance. If on the next submission this is not achieved without substantiated evidence that the situation was beyond the control of that operation (e.g., occurrence of a natural disaster), then the right to use the Green Globe Benchmarked logo will be withdrawn.

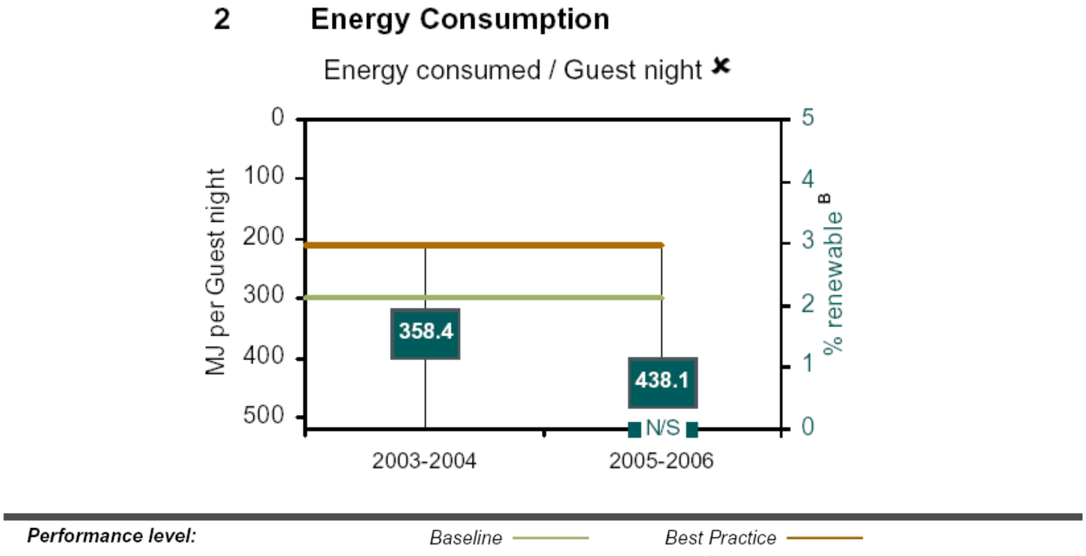
An example of a performance based scheme is Green Globe. The assessment is based on a checklist as shown in Figure 3.9 which is carefully selected to track performance in key areas of environmental and social performance impact. The outcome which is presented in the Green Globe report is used by Earthcheck to evaluate whether the operation has reached the standards necessary to use the Green Globe Benchmarked logo is shown in Figure 3.10.



earthcheck		Indicator Measure (Benchmark)
1	Sustainability policy	Policy is produced and in place
2	Energy Consumption	Energy used (MJ / Guest Night)
		Renewable energy used (%) [A]
3	Water Consumption	Water used (L / Guest Night)
		% of total water used is that is recycled/captured (%) [A]
		Water saving (Checklist rating)
4	Waste Production	Waste landfilled (L / Guest Night)
		% of total waste that is recycled/reused (%) [A]
		Waste recycling (Checklist rating)
5	Community Commitment	Local employment (Employees living within 20 km of operation / Total employees)
		Community contributions (Checklist Rating)
6	Paper Products	Paper product types used (Checklist Rating)
7	Cleaning Products	Cleaning product types used (Checklist rating)
8	Pesticide Products	Pesticide product types used (Checklist Rating)

[A] These indicators are for guidance only and do not affect the overall benchmarking evaluation

Figure 3.9 Example of an **earth**check™ benchmarking indicators and checklists developed for Green Globe *(Green Globe, 2006).*



[A] Each benchmark has been assessed on a per annum (12 months) basis
[B] Indicator is for guidance only and does not affect the overall benchmarking evaluation
[C] Represented in litres (L), where 1000 L = 1 cubic metre (m^3) or 1 kilolitre (kL)
N/S = Not submitted

Figure 3.10 Green Globe energy consumption benchmark *(Green Globe, 2006).*

Some *advantages* of a performance based scheme as identified by Honey (2002);

- Award logo on achievement of a set of specific environmental and, usually, social and economic equity criteria, benchmarks, or standards against which all applicants are measured.
- Hotels or resorts with higher environmental impact unlikely to apply for membership because of the difficulty to meet the stringent criteria.
- Meet consumer demand because they can measure performance inside and outside the business.
- Easier to implement than process based schemes because they do not require setting up complex and costly management systems.
- Allow comparison amongst businesses or products. Include checklists easily intelligible to both businesses and consumers
- Less expensive and more applicable to small and medium businesses

Some *disadvantages* as identified by Honey (2002);

- Many standards and criteria qualitative, subjective, and imprecise and therefore difficult to measure.
- Many sustainability targets are undefined
- No agreed methodology for measuring benefits and negative impacts to host communities.

The main criticism of performance based schemes such as Green Globe is that since energy consumption is not mandatory for certification and the CO_2 benchmark does not affect the overall benchmarking evaluation, then a hotel such (as shown previously in Figure 3.9) can fail to meet the energy consumption benchmark yet still become certified as ‘green’ or ‘sustainable’ despite the fact it emits 68.5 kg CO_2/gn!

3.4.5 Similarities between Process and Performance Based Schemes

Most Certification schemes consist of at least a five category rating system each measuring a different category of environmental performance: solid waste management; energy management; water conservation and preservation; employee education and community involvement. Mc Laren identifies elements common to both *Process and Performance* Based Schemes. (Honey, 2002)

- Can involve first, second or third party audits
- Award of a logo, recognisable to consumers, differentiating the sustainability or environmental credentials of the product or service from those of other providers,

- Compliance with local regulations as a minimum requirement of membership,
- Published commitment to the environment and/or sustainable development as a minimum requirement of membership,
- Environmental management system (EMS) or set criteria which must be met or exceeded by members, which may indicate continuous improvement in process and/or performance,
- Scoring, reporting, auditing or verification system as a guarantee that standards are met,
- Facility to provide technical help and support to ensure progress
- Fee structure to underpin the operation of the system.

Process based schemes are insufficient, by themselves, to generate sustainable tourism practices. They award certification to companies when they set up an EMS rather than when certain standards are met (Synergy, 2000 in Honey, 2002) and therefore cannot guarantee that companies are performing in environmentally and socially responsible ways. It is essential for the credibility and effectiveness of tourism certification schemes, that both consumers and the travel and tourism industry understand and recognise this process – performance distinction. Without the comparability that setting performance levels allow, tourism certification schemes remain open to the accusation of 'green wash.' There is growing agreement that for schemes to be credible they must include performance standards. (Honey, 2002) Crucially, consumers and businesses alike must ask what is being certified before assuming a logo implies sustainability.

3.4.6 Accreditation

Accreditation bodies develop internationally recognized brands that facilitate consumer choice, and protect consumers, industry and certifiers against false claims. Internally, they help certifiers in developing their schemes by becoming a forum to share industry expertise, setting benchmarks and encouraging a harmonization of policies, procedures, and standards. As a joint front, accreditation bodies represent certification schemes at an international level and lobby on their behalf. Accreditation bodies help certified companies gain access to *'green'* funds, and attract political and financial support. Stewardship councils accredit certifiers based on their performance and help ensure that certification is being conducted in an objective and transparent manner. Being accredited works as a "license" to perform certification based upon agreed principles and standards. Examples of these accreditation bodies include, Global Sustainable Tourism Criteria (GSTC) and Sustainable Building Alliance.

3.5 Benchmarks

A benchmark is a standard value or target, against which the performance of the subject building is compared. Benchmarking is taken to be the method by which an accommodation business or set of businesses compares their performance against themselves over time or against their competitors at a certain space in time. Most benchmarking "tools" aim to compare performance between hotels (and this is the most difficult thing to do) and so they contain some form of calculation from which to normalise the data (for example to take account of a swimming pool or air conditioning system when providing an assessment of results in comparison to hotels that may not have these facilities).

The use of benchmarks in the setting of performance levels allows for comparability. Setting new benchmarks in the practice of hotel energy management has also led to improved guest and staff comfort. (IBLF, 2005) Benchmarking is an integral tool within environmental management process that assesses environmental performance and helps to identify and prioritise areas to manage. This follows the old adage that says you cannot manage what you cannot measure. Benchmarking helps assess the potential cost savings that could accrue from actions to improve performance. Hotels that maximize efficiency and reduce waste are more cost-effective than their competitors. Generally, a hotel can reduce its energy by 20 to 40 per cent without adversely affecting performance. Hotels use large amounts of energy to keep people cool in hot climates and warm in cold climates. (IBLF, 2005)

A key question of this review is whether the application of correction factors to energy benchmarks is simply compensating hotels for their increased energy use and allowing them to emit more? Three published guides for energy management in hotels are reviewed and the validity and reliability of current methods of benchmarking is examined. The guides include; Environmental Management for Hotels (ITP, 2008), Environmental initiatives by European tourism businesses; Instruments, indicators and practical examples (Ecotrans, IER, 2006), Guide 36 Energy Efficiency in Hotels – A Guide for Owners and Managers (Brescu, 1993).

3.5.1 International - Environmental Management in Hotels (ITP, 2008)

Environmental Management for Hotels (ITP, 2008), is a guide for quality environmental management and sustainable operations. The guide enables hotels to calculate their energy and fresh water consumption and identify areas where savings can be made. The guide states that this information helps the hotel to assess the current status of its environmental performance (energy and water consumption, waste production, waste water quality, purchasing programmes, hazardous chemical consumption) and compares its current year-on-year performance, in confidence, to that of similar hotels in similar climate zones. The guide recommends that a hotel sets up an environmental management programme which needs to include targets and objectives against which business managers can measure performance. The guide recommends these should be based on last year's performance and the hotel should aim to achieve a percentage improvement. It suggests distinguishing between short-term targets (usually covers 12 month period and expressed as percentage reductions or increases) and long term objectives (qualitative statements of intent with deadlines up to five years away). (ITP, 2008)

Data Source

No information available on the data source or the method used to create the benchmarks. The only reference made in the guide is that '*The energy performance benchmarks used in this guide are sourced from the International Tourism Partnership's environmental benchmarking tool 'Benchmarkhotel.'* However, this is not available in the public domain but the author was able to source the 2005 version of benchmarks as shown in Appendix 3J.

Benchmarks

The benchmarks are divided into three hotel categories and three climatic zones (Table 3.3) for each of the categories of hotels. The guide only presents information on the luxury hotel category as shown in Table 3.2. The energy performance categories are shown in Table 3.4.

Luxury
• Fully serviced 4 to 5 star • 150 to 1000 rooms[3] • Year round opening, operating 70% occupancy • 1.2. guests per room and 1 employee per room • Cover: 2.5 per guest • Air-conditioning/heating (see climatic zones) • Laundry producing 6kg/laundry per occupied room (OCRM) per day. • A health suite and pool of up to 150m^2 surface area & gardens up to 1000 m^2

Table 3.2 Luxury hotel category *(ITP, 2008).*

Temperate	Mediterranean	Tropical
Assumes full heating, ventilation & air-conditioning (HVAC) using centrally controlled electrical chillers.	As per temperate.	Year round air-conditioning and no heating.

Table 3.3 Climatic zones *(ITP, 2008).*

Excellent	Satisfactory	High
The best that typical hotels could expect to achieve.	The gap between the best that most hotels could expect to achieve and average performance.	The gap between the satisfactory level of performance and high consumption. Consumption greater than this is excessive and illustrates poor resource management practices.

Table 3.4 Benchmark performance levels *(ITP, 2008).*

The benchmark values vary for hotels depending on their climatic zone and are calculated on a per square metre rather than per guest night basis as shown below in Table 3.5. For example, the *excellent* electricity benchmark for a typical luxury hotel in a temperate climate zone is <135 kWh/m^2, whereas the *excellent* electricity benchmark for a typical luxury hotel in a tropical climate zone is <190 kWh/m^2. The benchmarks also vary for a number of factors such as: whether they operate absorber chillers; if they have pools and spa facilities; in house or out-source laundry, or the number of covers served. It is important to monitor performance against like hotels. In terms of comparing energy performance against industry benchmarks, the guide only provides the following benchmark values for electricity and other energy

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[3] Average 55-100m2 per room (incl. public space and back-of-house) with approx. 60% of the total area dedicated to guest bedrooms.

consumption for luxury, fully-serviced hotels. (ITP, 2008) Benchmarks are not published in this guide for other standards of hotels which is a criticism of this guide.

Hotel profile	**Climatic zone and energy type**		**Energy consumption** (kWh/m^2 of serviced space)		
			Excellent	**Satisfactory**	**High**
Luxury Serviced Hotel	**Temperate**	Electricity	<135	<145	<170
		Other energy	<150	<200	<240
		Total	**<285**	**<345**	**<410**
	Mediterranean	Electricity	<140	<150	<175
		Other energy	<120	<140	<170
		Total	**<260**	**<290**	**<345**
	Tropical	Electricity	<190	<220	<250
		Other energy	<80	<100	<120
		Total	**<270**	**<320**	**<270**

Table 3.5 Benchmark values for electricity and other energy consumption in luxury fully-serviced hotels *(ITP, 2008).*

The Use of Correction factors for benchmarks

The ITP (2008) applies correction factors to benchmarks to take account of weather conditions and occupancy levels, as well as the presence of facilities such as laundry, indoor pool and health club, air-conditioning, number of covers served, if the hotel operates at different occupancy levels, each of which will have a significant impact on energy use. Depending on the facilities at the hotel, the benchmarks in Table 3.5 may need to be modified so that they are applicable to the specific property, wherever it deviates from the typical profile using the table in Appendix 3K. ITP (2008)

Weather –Normalising Benchmarks using Degree Days

The guide recommends that weather changes are to be taken into consideration in order to analyse and compare seasonal energy performance year-on-year, since heating and cooling requirements are proportional to the change in average temperatures during the relevant seasons. In addition, humidity has a major influence on the energy requirements for cooling, as the air-conditioner’s cooling coils must remove moisture, which is an added load. The process of ‘normalising’ or compensating for temperature is done by factoring in the change in the total number of degree days.[4] This is different for normalising for different climatic locations.

3.5.2 European - European Indicators for Accommodation Establishments

This guide gives an overview of all the issues relating to tourism and sustainability from a European perspective. The guide provides the hotelier with clear and reasonable aims, practical instruments and assistance in relation to achieving sustainability in their businesses. The data is sourced from the TourBench database and other European surveys [5] carried out from 2001 to 2006 which were used to calculate benchmarks for energy, water and waste. This review will focus on the energy benchmarks only. (Ecotrans, IER, 2006)

The energy performance benchmark is calculated on a per square metre and per guest night basis for increasing grade of hotel as shown in Table 3.6 and Table 3.7 below. All individual data refers to delivered energy (the value of energy at the point it enters the business) *i.e. electricity is not converted into primary energy.* (Ecotrans, IER, 2006)

	Average		**Benchmark**	
	kWh/overnight stay	kWh/m^2	kWh/overnight stay	kWh/m^2
Campsite	16.5	-	3.4	-
Bed & Breakfast	57.7	216.7	15.8	49.8
Hotels	77.2	305.8	30.6	165.5

Table 3.6 Average energy benchmarks per overnight stay and per square metre, for different types of accommodation *(ECOTRANS, IER, 2006).*

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[4] A degree day is a unit of measurement used to estimate the fuel and power requirements for heating and cooling a building. It is equal to a difference of one degree between the outdoor daily average temperature and the reference temperature. Degree days are an indicator of how far the average temperature departs from a human comfort level, called the base. Each degree of outside average temperature below the base is one heating degree day (HDD) and each degree above the base is one cooling degree day (CDD). (ITP, 2008)

[5] A total of several hundred establishments in 15 countries (Germany, Austria, Spain, Italy, France, Greece, The Netherlands, United Kingdom, Denmark, Malta, Sweden, Luxembourg, Latvia, Czech Republic, Portugal) made their data available. The detailed data sets of 466 businesses were included in the calculation, comprising 55 camping sites, 119 hotels from the ‘Hotel Garni’ chain (proving overnight accommodation and breakfast only) and 292 hotel businesses (with and without restaurants). 349 of these businesses have been analyzed in more detailed. The arithmetic mean was defined as the average, and the 25 % quantile as the benchmark. (Ecotrans, IER, 2006)

		Average		Benchmark	
	Average kWh	kWh/overnight stay	kWh/m^2	kWh/overnight stay	kWh/m^2
2 star	490,926	96.4	299.6	58.6	209.9
3 star	860,644	83.5	324.4	34.2	199.5
4 star	2,963,495	77.8	357.6	33.7	185.6
5 star	4,265,639	74.8	315.3	33.4	169.4

Table 3.7 Average energy benchmarks per overnight stay and per square metre, for different hotel categories *(Ecotrans, IER, 2006).*

On average, a hotel requires 3-4 times more energy per guest and per overnight stay than a camping site (16.5 kWh) as seen in Table 3.6. The specific energy demand per overnight stay is on average 96.4 kWh in 2-star-, 83.5 kWh in 3-star-, 77.8 kWh in 4-star- and 74.8 kWh in 5-star rated hotels, meaning that the specific energy demands decreases with rising service offer. Although that may be contradictory at first glance, the guide offers various reasons for this fact. Typically, in a 4 and 5-star rated hotels the basic energy demand is better distributed due to the high workload and these hotels usually employ company technicians to monitor and optimize the consumption because of the high over-all energy consumption (in the survey the average for 5-star hotels was over 4 million kWh). The *best* (benchmark) of all 3, 4 and 5-star rated hotels, with about 34 kWh per overnight stay, need over 60 % less than the average. The distribution of energy consumption is on average 32.5 % for electricity and 77.5 % for heating and gas use in the kitchen. With the installation of induction or electric cookers and electric combi steamers values of up to 45% for electricity and 55% for heating and kitchen could be achieved. The proportion allocated to electricity within the total energy consumption in enterprises with electric heating is generally even higher. (Ecotrans, IER, 2006)

Use of Correction Factors

a) Overnight / accommodation and restaurant

The guide advises that in order to account for the gastronomy area of full-service hotels in comparison to hotels with only small restaurants, the total number of guests, comprising overnight guests and gastronomy guests should be taken into account and weighted. The results in these businesses show average values of roughly 40 kWh per guest, whereas the ‘best’ benchmark is 22 kWh per guest as shown in Table 3.8 (Ecotrans, IER, 2006).

	Average		**Benchmark**	
Average kWh	kWh/overnight stay	kWh/guest	kWh/overnight stay	kWh/guest
1,777,716	56.9	39.8	31.7	22.0

Table 3.8 Weighted benchmarks for guest nights and restaurant *(ECOTRANS, IER, 2006).*

b) Kitchen services

A warm meal requires on average about 10 kWh of energy –in general 4 kWh of electricity and 6 kWh of gas. Measurements have shown that for a 3- or 4-course meal in a premium category restaurant the consumption is 3 times as high with roughly 30 kWh (8 kWh electricity, 22 kWh of gas). (Ecotrans, IER, 2006)

3.5.3 UK - Energy Efficiency in Hotels – A Guide for Owners and Managers - Guide 36

Guide 36 is intended for hotel owners and operators who are responsible for managing premises. It contains data which will allow the owner/operator to how their premises compare with the industry norms in terms of energy consumption and costs. In addition, it contains advice on controlling energy better, using energy more efficiently and reducing avoidable waste while adding to customer comfort. (BRESCU, 1993)

Data Source

The information in Guide 36 is based on data from over 300 UK hotels of various kinds – ranging from small hotels with fewer than 20 bedrooms to fully air-conditioned international standard hotels with 500 or more rooms. Information about energy use is presented in two basic units – consumption in kWh per square metre per year and cost in £ per bedroom per year based on 1993 prices. Electricity is shown separately from fossil fuels (natural gas, oil, LPG, and solid fuel). (BRESCU, 1993)

The Guide 36 is based on the results of energy surveys and the monitoring of energy use by hotel operators in the UK. It sets out performance benchmarks for the three types; luxury, business or holiday and smaller hotel as shown in Table 3.9 below.

Luxury Hotel	**Business or Holiday Hotel**	**Smaller Hotel**
• City Centre location • Edwardian grandeur or modern • Generous reception & circulation space	• 3 to 4 star purpose built • Business or Holiday trade	• 2 star older possibly converted building
• Restaurant, conference & leisure facilities	• Restaurant, conference & leisure facilities	• Varying facilities
• Av. Floor area *(70 - 90m^2 per bedroom)*	• Av. Floor area *(40 - 60m^2 per bedroom)*	• Varying Floor area *(60 to 70m^2 per bedroom)*
• Number guest bedrooms *(100 to 500+)*	• Number guest bedrooms *(50 to 100+)*	• Number guest bedrooms *(20 to 100+)*

Table 3.9 Description of the three hotel types *(BRESCU, 1993).*

Benchmarks

Three bands of performance have been established – good, fair and poor. These bands have been derived so that the 25% of hotels in the sample with the lowest energy consumption (kWh/m^2) comprise the *good* band, while the 25% with the highest energy comprise the *poor* band. The remaining 50% comprise the *fair* band.[6] The guide presents typical energy consumptions for each hotel type as shown in Table 3.10.

Hotel Type	**Good**		**Fair**		**Poor**	
	Gas	Electricity	Gas	Electricity	Gas	Electricity
Luxury	<300	<90	300 - 460	90 - 150	>460	>150
Business *or* holiday	<260	<80	260 - 400	80 - 140	>400	>140
Smaller	<240	<80	240 - 360	80 - 120	>360	>120

Table 3.10 Annual energy consumption in kWh/m^2 for three hotel types *(BRESCU, 1993).*

The charts are based on measured consumptions in 'typical' hotels with 'normal' facilities for their type. The guide defines two conditions which affect consumption and emphasizes the importance of considering how the pattern of energy consumption relates to each of these items. It recommends if the hotel has any of these items, it should introduce sub metering of fuel to ascertain how much energy they consume and how much they are costing.[7] (BRESCU, 1993)

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[6] It should be noted that: (a) for clarity and ease of use, the values given in the tables are rounded to the nearest ten units; for practical purposes, consumption values of (for example) 76 and 84 kWh/m2 are the same, and (b) for different hotel types, the average room size varies, as does the relationship between number of rooms and total floor area; this explains why there is not a constant relationship between kWh/m2 and £/bedroom values throughout the tables. (BRESCU, 1993)

[7] For detailed calculations on how to allow for abnormal weather conditions consult EE0 Fuel Efficiency Booklet No.7: Degree Days. (BRESCU, 1993)

1) '*Abnormal factors'*

- Exceptionally exposed, or sheltered location
- Unusually severe, or mild, weather conditions
- Very high or low occupancy.

2) *'Exceptional facilities'* or operation such as On-site laundry, large swimming pool and /or Intensive programme of banquets.

Method of Comparison with Benchmarks

The fuel bills and/or meter readings for the most recent 12 monthly period are obtained for which they are available[8] and the annual consumption is calculated, keeping electricity separate from fossil fuels. The heated floor area of the hotel is then measured in square metres and areas such as unheated storage and car parking is excluded. The number of available bedrooms is also noted.[9] The consumption is divided by the floor area and the category (out of three) in which the hotel lies should be established and then the consumption is compared to the bands given in the charts. The guide estimated in 1993, a typical hotel releases annually about 10,000 kgCO_2 per bedroom. (BRESCU, 1993)

3.6 Findings

Literature Review

Several fundamental weaknesses were identified in the literature review of sustainable tourism and certification;

1) Lack of key CO_2 related criteria in certification
2) Existing Weighting of categories that have the highest environmental impact
3) 'Green-Wash' and Overuse of Eco-terminology
4) Confusing proliferation of certification schemes with varying criteria and benchmarks.
5) Lack of transparency in methods of certification
6) Lack of Market Penetration

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[8] Using the unit kWh/m^2 has the advantage of taking into account wide variations in reception and conference areas, and other facilities – which in turn affect the average floor area per bedroom. Conversely, certain uses of energy, such as hot water and catering, are likely to be related to the number of bedrooms rather than the floor area. Using cost rather than kWh also ensures that maximum demand, power factor and standing charges are included in the calculation. Using both units can help to identify anomalies. (BRESCU, 1993)

[9] As a check, the floor area is divided by the number of bedrooms and the results compared with the values given for the three hotel types. If the hotel averages out to very large or very small rooms, kWh/m^2 should be used. (BRESCU, 1993)

1) Lack of CO_2 related criteria in certification

Considering the basis of sustainable tourism and ecotourism purports to benefit the environment and to minimize environmental impact, it is surprising to see that emissions reductions is not a priority in certification as evident in the lack of reference of any CO_2 related criteria referred to in the literature nor is it mentioned in certification (apart from Green Globe). Moreover, despite the fact much has been written and debated, for example by, Buckley (2003), Honey (2002), Font (2002), Font and Harris (2004), Synergy WWF (2000), UNEP WTO (2005), this fact has not been addressed by the authors nor by the certification schemes. The focus has been on sustainability in general using vague terms with no reference to specific issues that result in high environmental impact. This is a fundamental weakness in the sustainable tourism movement and certification in general.

2) Weighting of categories that carry the highest environmental impact

As mentioned at the beginning of this chapter it is very surprising to see that in the guide 'Making Tourism More Sustainable,' the only reference to criteria that has a direct environmental impact is 'resource efficiency' only one of the twelve 'aims' in the guide. Even in this single reference there is no specific reference or guidance on how to achieve this 'aim'. This list of 'aims' lays the foundation for other certification schemes to be based on which is a worry considering the low priority given to CO_2 related data.

Despite all that has been written on the subject, for example, by Buckley (2003), Honey (2002), Font (2002), Font and Harris (2004), Synergy WWF (2000), UNEP WTO (2005) and the various debates, no explicit reference has been made to the weighting of criteria in certification in relation to those criteria with the highest environmental impact.

3) 'Green-Wash' and Overuse of Eco-terminology

There is unanimous consensus in the concerns over *'green-washing'* by operators who were only interested in gaining a marketing advantage and the fact that this reduces the credibility of operators with genuine motives. [Buckley (2003), Honey (2002), Font (2002), Font and Harris (2004), Synergy WWF (2000), UNEP WTO (2005), Bohdanowicz (2006)] There is general agreement that the abundance of eco-labels and concern over the degree of rigour in the various certification processes is causing market confusion. [Buckley (2003), Honey (2002), Font (2002), Font and Harris (2004), Synergy WWF (2000), UNEP WTO (2005), Bohdanowicz (2006)]

Lubbert (2001 in Font and Buckley, 2001) goes so far as to say that the extent of the confusion leads many customers to ignore them. Font (2002) states that attempts to promoting sustainable tourism and ecotourism as quality products suffer from a lack of methods to ensure these are not just a '*green wash'*. [Buckley (2003), Honey (2002), Font (2002), Font and Harris (2004), Synergy WWF (2000), UNEP WTO (2005) and Bohdanowicz (2006)] Most certification schemes have a focus on social-cultural agenda rather than on issues that have the highest and direct environmental impact. To add to the confusion in terminology, Honey (2002) reports that currently Australia, New Zealand, Fiji and Canada use the term accreditation instead of certification to refer to systems for rating services, such as accommodation. (Honey, 2002) The question is how credible are these certification schemes or are they simply a marketing ploy?

4) Confusing proliferation of certification schemes with varying criteria and benchmarks.

Honey (2002) states that certification and ecolabelling are among the hottest topics within the travel and tourism industry. Around the world, there are some 260 voluntary initiatives, including tourism codes of conduct, labels, awards, benchmarking and "best practices." Of these, 104 are ecolabelling and certification programmes offering logos, seals of approval, or awards designed to signify socially and/or environmentally superior tourism practices. (Honey, 2002) However, there is general consensus that this proliferation of certification schemes with varying criteria and requirements is undermining the credibility of the schemes and leading to market confusion. [Honey (2002), Font (2002), Font and Harris (2004), Synergy WWF (2000), UNEP WTO (2005) and Bohdanowicz (2006)]

5) Lack of transparency in methods of certification

There is general consensus that lack of transparency is an issue with all schemes that the source of information, especially relating to the "pass" levels is difficult to find. [10] Most of the data about baseline indicators for tourism destination and accommodation assessment is not yet available for public domain. [Scott, Bohdanowicz, (2006), Font (2002), Font and Harris (2004), Synergy WWF (2000), UNEP WTO (2005)] In practice, all five programs[11] reviewed by Font and Harris (2004) have different means of assessment, with the larger ones relying on more

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[10] As identified by Professor Ashley Scott, Director, Research & Development, Earth Check Pty. Ltd.

[11] Green Globe 21 (GG21), Certificate of Sustainable Tourism (CST), Green Deal (GD), Smart Voyager (SV), Fair Trade Tourism in South Africa (FTTSA).

standardized and objective measurements to manage the volume and quality assurance procedures. Font and Harris (2004) found that they all, except Green Globe, reflected on the fact that monitoring compliance with social criteria is not easy, that quantitative measures do not reflect the actual impacts, and that alternative methods need to be identified. Green Globe manages the challenge of assessment by employing local professionals who are aware of social issues and by including such criteria in their assessor training. This problem was also identified by Twining-Ward is that with most certification schemes is that they are not '*place*' specific. Twining-Ward (2003) has developed Sustainable Tourism Indicators and applied them to accommodation facilities. (Twining-Ward, 2003) The Green Globe system includes actual energy consumption using the Earthcheck™ system for benchmarking based on local conditions and used on an annual basis. Nordic Swan and Green Hospitality Award also use energy consumption benchmarks but Nordic Swan uses benchmarks which differ according to geographical location. Only Nordic Swan and Green Hospitality publish their benchmarks in the public domain.

6) Lack of Market Penetration

According to the Synergy WWF (2000) report, the success of schemes in terms of take-up depends upon consumer demand for sustainable tourism. This provides the tourism industry with a powerful market-driven incentive to demonstrate improved performance through certification. One reason for the lack of take-up across the tourism sector has been the apparent lack of concern for issues of sustainability in choice of holidays by consumers, despite recent research that indicates a growing willingness to pay for a more sustainable product. The report found that the strongest determining factors are price, health and safety. (Synergy WWF, 2000) Bohdanowicz (2006) found that the results obtained from the questionnaire study of four European chain hotels show that respondents generally perceived the environment as an important factor for the development and success of tourism and the hotel industry. She found that hoteliers do have a certain (though varying) level of environmental knowledge and they are generally aware of measures that can be taken towards greater environmental responsibility. Bohdanowicz (2006) concludes if there exists outspoken customer demand for 'green' hotels then hoteliers will respond with greater environmental responsibility. Bohdanowicz (2006) examines the issue of hotelier's environmental attitudes in Papers I-IV in Bohdanowicz (2006).

7) Certification Self-Regulation

There is general agreement between authors that there is no regulation to limit which tourism, hospitality and ecotourism businesses declare themselves as being sustainable, green, environmentally friendly, eco-friendly and so on. [Buckley (2003), Honey (2002), Font (2002), Font and Harris (2004), Synergy WWF (2000)] In most cases, certification schemes are created by privately operated companies and NGOs. The schemes are based on voluntary initiatives by the hotels themselves and cost a lot of money so hotels who can afford registration are the ones who can afford to be certified.

There is concern that the complexity and cost of certification systems precluded smaller facilities such as B&B's. [Buckley (2003), Honey (2002), Font (2002), Font and Harris (2004), Synergy WWF (2000), UNEP WTO (2005)] One author, Font (2002), stresses that with the many definitions for sustainability and ecotourism, and disagreements around about what is in and what is outside tourism, it is a difficult industry to regulate. Even in the case of governments taking an active attitude towards regulating claims, this is limited to governmental boundaries, which make it inefficient due to the international nature of the tourism industry. There is concern that certification results in just more bureaucracy. (Font, 2002) The WWF report suggest a possible solution might be the creation of an umbrella body overseeing all schemes which would monitor and accredit the standards employed and so improve credibility. (WWF, 2000)

Findings of Review of the Three Published Guides

1) Current ITP Benchmarks allows hotels to use more energy with increasing amenities

2) Correction Factors compensate hotels for their increased energy use

3) Accountability through design and operation rather than through the use of correction factors.

4) Erroneous Energy Benchmarks as a result of adding together delivered electricity and heating fuels together.

5) ITP Benchmarks are only published for luxury category. It is stated in the guide that benchmarks for other categories are available online (Website: benchmarkhotel) but this is not available in public domain.

6) ITP Benchmarks not revised or updated since the 1993 edition despite increase in energy efficiency etc.

7) ITP Benchmarks for the luxury hotel category range from hotels with 100 to 1000 bedrooms. The range should be narrowed to 500 as in Guide 36.

8) ITP and GUIDE 36 benchmarks measured in per square metre only.

9) To date, the benchmarks published in Guide 36 have not been updated and revised yet they are still used to set performance benchmarks for the UK and Ireland hotel sector.

10) No mention in any of the guides of the potential contribution of lifestyle & behavioural changes

Use of Normalization Factors

Hotels use large amounts of energy to keep people cool in hot climates and warm in cold climates. A key question is whether the application of normalization factors to energy benchmarks is simply compensating hotels for their increased energy use and allowing them to emit more? The advantages and disadvantages of normalization are addressed under the following headings:

1. Fuel mix
2. Hotel Facilities
3. Guest Nights
4. Climatic Normalization

1. Fuel mix

The following is a summary of the use of CO_2 emissions factors for fuel mix; however, this is discussed in more detail in the Introduction section of Chapter 5. The amount of CO_2 emissions per kWh electricity depends on the surrounding energy system. Either the national average supply mix can be used to calculate the CO_2 emissions from electricity production or a marginal production method where the CO_2 emissions from the marginal[12] production plant are used. (Sjödin, Grönqvist, 2004) For example, in the deregulated Nordic electricity market, countries have varying kinds of power generation. In Norway, hydropower generation dominates, while the Swedish electricity production largely consists of equal shares of hydro and nuclear power production with the latter accounting for more than fifty percent. There is a larger share of fossil fuel power generation in Finland, especially, in Denmark. Cross-border trade between the countries is considerable. Increased use of electricity

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[12] Different schemes are used in the literature to account for emissions when changing electricity supply or demand. One method calculates national or regional average emissions for all existing plants used during recent months or years. Another method assumes a certain regional marginal power plant to be turned on and off depending on the dynamics in the system. A marginal plant is normally the one assumed to have the highest variable costs of all running plants. This variable cost could be interpreted as the short-term marginal cost. An alternative marginal accounting scheme may use data for an assumed future power technology, similar to a long-term marginal cost approach. (Sjödin, Grönqvist, 2004)

anywhere in the region may thus entail augmented emissions of greenhouse gases. (Sjödin, Grönqvist, 2004) Sweden is connected to the other Nordic countries through the Nordic market, NordPool, which also has connections to the European continent. The European mix is more diversified with mainly nuclear, coal, hydro and natural gas fired power production. (Karlsson, Moshfegh, 2007) To account for this cross border trade of electricity (see Figure 5.0.2) the author argues it is more realistic to apply the average European conversion factor to delivered electricity when calculating CO_2 emissions.

Is it fair that a hotel in Sweden be effectively ‘penalized’ even though 95% of its electricity is generated from hydroelectric power? The author argues that as a result of Sweden’s connection to NordPool and the European continent and the resulting cross border trade of electricity, together with the fact that Sweden is a net exporter of electricity, it is more realistic to apply the average European emission factor for delivered electricity for hotels in Sweden.

2. Hotel facilities

Hotels may include activities that consume energy and which are not considered typical of that building type. Including these activities could reduce the validity of the benchmark, and so it is arguable to subtract these separable energy uses in certain circumstances using normalization factors or in other cases it may be more reasonable to benchmark these facilities separately.

Hotel facilities typically include restaurant and laundry and may include other energy intensive facilities such as a spa, swimming pool, conference centre etc. It has been debated whether or not the energy consumption for these facilities should be subtracted from the total energy consumption for the hotel or separate benchmarks to account for these facilities should be applied. It is argued here, that energy consumption resulting from the use of these, would take place elsewhere, off-site, if they were not present at the hotel. In these cases, energy consumption of these facilities should by separately monitored, and could themselves be subject to certification, but not applied to the standard hotel benchmark. And, certification should make it quite clear, that for a hotel with extra facilities, the main certification is for “standard hotel service” only. Whilst those that simply mean more luxury and possibly waste – such as room size, should not be normalized.

3. Guest nights

If a hotel has live-in staff that uses the hotel as their residence, and has no other home, then they could be counted as a guest night. If on the other hand they are commuting from another residence, and simply spend the odd night on night shift, then it could not be counted as a guest night. A separate consumption and emissions benchmark could be used for hotels with truly live-in staff, i.e. where they do not have alternative accommodation, and could be normalized in order to facilitate comparison between hotels in the same scheme. This is discussed in more detail in the in-depth studies in Chapter 5. To account for the live-in staff, the author recommends the introduction of a ‘staff night’ which should be weighted to relate to the standard of hotel the staff member enjoys. The weighting applied should be reasonably universal, for example, a weighted staff night for a 2 star hotel might be in 0.25 whereas that for a 5 star might be 0.5. This should be developed in further work.

4. Climatic Normalization

Climatic normalization deals with climate and weather. The author argues that weather should be taken into account, where for example, there is an increase in energy consumption for heating due to exceptionally cold weather. Without the use of normalization factor for weather, the hotel’s energy consumption may be higher than the benchmark for that particular year.

However, climatic normalization is different since this is usually accounted for in the design of the building to meet the requirements of the building regulations and good practice. In terms of making hotels accountable for their emissions and reducing their impact, the hotels should be designed to take account of their climate, thus reducing the environmental load to begin with. For example, is it reasonable that a hotel in sub-Artic Sweden be required to meet the same energy performance benchmarks as a hotel in southern France? The hotel in Sweden will probably have been built to comply with building regulations particularly designed to account for the climate resulting in higher energy efficiency to begin with. The hotel may even have access to more readily available renewable energy sources although this not taken into account for current methods of certification. The hotel sector is an intensive user of energy and one in which luxury and service is associated with conspicuous consumption. It is arguable that the application of normalization factors for climate simply provides the hotel with a license for profligate energy use.

The use of correction factors allows some hotels to use more energy (and emit more) just because, for example, it has a grossly extravagant swimming pool. Similarly, should a hotel in hot or cold climate be allowed to use more energy (and emit more) just because of its location. The use of correction factors in all cases simply compensates the hotels for their increased energy usage and provides a license to have a greater environmental impact. In terms of making hotels accountable for their emissions and reducing their impact, the hotels should be designed to take account of their location and weather conditions, thus reducing the environmental load to begin with. Secondly, by making all hotels accountable for their energy use and emissions (regardless of the factors that impact energy use) hotels could compensate for any factors that affect their energy use through good design and operation instead.

In the EU guide (Ecotrans, IER, 2006), correction factors have been introduced for the first time as well as weighted guest number (which differentiates between overnight guests and restaurant guests) and the influence of a swimming pool on the water (but not energy) consumption are considered. The guide recommends that energy indicators in Europe in particular should always contain a local climatic correction factor as energy consumption varies significantly between heating and non-heating period.

It is a shortcoming of this revised edition of the ITP guide (2008) that no other energy performance benchmarks are provided for hotels other than for the luxury category. The guide states that the benchmarks used in the guide are based on those in the environmental benchmarking tool but this is not available in the public domain so it was not possible to analyse the benchmarks for other categories of hotels. The author also contacted the International Tourism Partnership directly to request access to the remaining benchmarks but no response has been received despite numerous attempts. The benchmarks in Appendix 3J were published in a document entitled '*Why Environmental Benchmarking will help your hotel*' (IBLF, WWF, 2005) and can be used as reference for other categories of hotel. It should be pointed out that this is the only guide who includes international benchmarks and despite just being revised from the 1993 edition, the energy benchmarks have not been updated.
The ITP (2008) recommends that *'when combined with energy efficient practises, the purchase of 'green' electricity from generating companies that use renewable energy sources can help to significantly lower the carbon footprint of the hotel.*' (ITP, 2008) However, many of these 'green products' do not contribute to *additionality* (i.e. the development of new low or zero-carbon generation) but instead involve double

selling of electricity already paid off by consumers. The lack of minimum common standards cause significant confusion in the public and undermines the future uptake of green electricity. (CLEAN-E, 2006)

The results of the review also found that the only option for hotels located in a ‘cold ‘environment is to select ‘temperate’ environment as the nearest climatic zone as seen in the ITP 2008 benchmarks. Clearly this would not be accurate for a hotel in northern Norway to have to compare its energy consumption with the energy consumption benchmark in a ‘temperate’ zone? Energy consumption varies with climate and this should be reflected in the choice of benchmarks used. The review found that the range for the ‘luxury’ category was very broad ranging from 100-1000 rooms rather than the narrower range of 100 to 500+ recommended in the BRESCU (1993) guide.

The argument of this thesis is that hotels should be made accountable for their emissions regardless of their size, facilities offered or climatic location. A large, luxury fully serviced hotel would then not be able to use correction factors to justify its high emissions. Similarly, a hotel in a tropical or cold climate with high emissions resulting from high energy consumption (as a result of high heating or cooling load) would be made answerable for its high emissions. Rather than ‘creating excuses’ for its emissions due to its size, facilities offered or climatic location, Hotel design needs to adapt and account for the local climatic conditions or for the level of facilities offered or its size.

The focus of all the benchmarks in all the published guides available for hotels is on energy consumption benchmarks per square metre. There are two recommendations to be made in this respect. Firstly, high energy consumption does not necessarily result in high CO_2 emissions as this will depend on the fuel mix of the electricity as previously explained in the last chapter. In fact, the findings of the last chapter indicate that as a result of switching to renewable sources of energy or decarbonization of electricity we may even start to see an increase rather than a decrease in electricity. This clearly reinforces the need for creating CO_2 benchmarks as a performance indicator as argued in this thesis.

The second issue relates to the normalization of the performance indicator. The argument is for the new CO_2 benchmark to be calculated on a per guest night basis rather than per square metre. Clearly room size varies from hotel to hotel however; a focus on emissions per guest night would be more representative of the actual emissions produced per night and make guests more accountable for their emissions during their stay.

If CO_2 performance benchmarking of hotels was to become a mandatory part of certification and if hotels were not able to justify their emissions through the use of correction factors, then we might start to see the beginnings of genuine ‘green and sustainable’ hotels which would use renewable sources of energy supply, respond to their climatic context using bioclimatic or passive design principles to reduce their energy demand and efficiency not to mention the significant contribution to be made through lifestyle and behavioural changes of both the staff and guests.

4

A Comparison Of Five Certification Schemes

This chapter presents four hotel-specific and one non-hotel-specific certification schemes. It critically compares the methods of energy accounting, and how other non-energy related factors are weighted , so that the overall impact of energy use (and hence CO_2 emission) can be judged.

A table of comparison of the schemes is shown in Table 4.1. This is followed by a short description of the criteria and method for each scheme. This comparative approach will expose the strengths and weaknesses of each of the schemes and help to identify where improvements can be made. A summary of the findings of the comparative study is presented at the end of the chapter.

4.1 A Comparison of Five Certification Schemes

A plethora of certification schemes of buildings have been established worldwide assessing various environmental performance indicators, amongst them energy use. These include BREEAM (Building Research Establishment Environmental Assessment Method, launched in UK, 1991), LEED (Leadership in Energy and Environment Design, launched US 1998), GB Tool (Green Building Tool, iiSBE, first launched Canada, 2002) and CASBEE (Comprehensive Assessment System for Building Environmental Efficiency (launched Japan, 2002).

However, none of these schemes are dedicated to the hotel sector. BREEAM Bespoke, LEED-EB (Existing Buildings) and LEED-NC (New Construction) however can be applied to hotels. No hotels have been certified with BREEAM Bespoke to date so this scheme will not be included in our comparison. However, there are eight LEED-certified hotels in the U.S, one in Sri Lanka. In addition, nearly 200 buildings, many of them in the hospitality sector, are considered “registered” for LEED status. The disparity between the small number already certified and the relatively large number of hotels who are now trying to get certified shows an increasing trend in the sector.

The key difference between LEED-EB and LEED-NC is that the former assesses actual energy performance whilst the latter is based on energy performance predictions using EnergyPro software or similar. Since this research is based on actual performance, LEED-NC, will not be considered in the comparison. However, reference will be made to the award of points in the Energy & Atmosphere section of two LEED-NC certified hotels.

Four widely used ‘hotel specific’ certification schemes; together with the multi building type LEED-EB will be examined. All are for existing buildings and respond to operational performance only. The selected schemes are - EC3 Green Globe, Nordic Swan, EU Flower and The Green Hospitality Award, and LEED-EB. A summary of their essential characteristics is shown in Table 4.1 on the next page.

Table 4.1. Summary Table Of Selected Certification Schemes *(Source: Author)*

	Green Hospitality Award	**EC3 Green Globe**	**Nordic Swan**	**EU Flower**	**LEED-EB (*Operations & Maintenance*)**
Region	Ireland Only	Worldwide	Scandinavia *Finland, Sweden, Norway, Iceland, Denmark*	Europe*15* *+ Norway, Iceland, Liechtenstein*	International, *mostly US*
Hotels Specific	√	√	√	√	X
Operational Data Only	√	√	√	√	√
Mandatory Energy Management System	√	√	√	√	√
Back Up Documentation Required	√	√	√	√	√
Independent On-Site Audit	X	√	X	√	√
Award Levels	Bronze Silver Gold Platinum	Bronze Silver Gold	One Level	One Level	Certified Silver Gold Platinum
Does Increased Award Level Indicate Increased Environmental Performance?	√	X[1]	One Level	One Level	√
Categories	1) Environ. Management System 2) Water Management 3) Waste Management 4) Energy Management	1) Sustainability Policy 2) Energy Consumption 3) Water Consumption/Saving 4) Waste sent landfill/Recycling 5) Community 6) Paper Products 7) Cleaning Products 8) Pesticide Products	1)Energy Consumption 2)Water Consumption 3)Waste Consumption 4) Waste Management	1) Energy 2) Water 3) Chemicals 4) Management 5) Waste 6) Other	1) Sustainable Sites 2) Water Efficiency 3) Energy & Atmosphere 4) Materials & Resources 5) Indoor Air Quality 6) Innovations in Operations
Energy Mandatory Category	√	X	√ (since 2007)	√	√
Rigorous Energy Accounting[2]	***	****	***	*	****
Are key CO$_2$ emissions reduction criteria included in Mandatory section?[3]	X	N/A	X	√	√
Are key CO$_2$ emissions reduction criteria weighted the same as criteria that have no direct impact?[4]	√	N/A	√	√	√
Number of Categories required for certification	4	2	2	6	6
Obligatory Requirements & Optional Points Score in each category?	√	N/A	√	√	√
Use of Benchmarks?	√	√	√	X	√ External Rating System
Benchmarks Published in Public Domain	√	X	√	N/A	X
Is certification Awarded on the basis of passing Benchmarks Only?	X	√	X	X	X
CO$_2$ Benchmark	X	X	X	N/A	X
Reporting CO$_2$ emissions	X	√ Optional	√ Optional	X	√ Mandatory
Mandatory Energy Benchmark	X	X	√	N/A	√
Key Energy Performance Indicator	kWh / m^2	MJ / guest night	KWh/M^2 or kWh/guest night	No calculation	EPA Rating 1-100 (kBtU/ft^2)
Energy Benchmark	3 Best / Good Average High/Poor	2 Baseline Best Practice	One benchmark	N/A	√ External Rating System
Energy Benchmark vary with Geographical Location	N/A	√	√	N/A	√
One day guest equivalent (staying at hotel for at least 4 hours)	Calculates per square metre	0.3 guest nights	0.5 guest night	No calculation	Calculates per square foot
1 Conference Guest equivalent (Guests staying 1 day & part day)	Calculates per square metre	x	1.5 guest nights	No calculation	Calculates per square foot
1 Restaurant guest equivalent (Hotel Occupancy >60% Restaurant Turnover >45% total)	Calculates per square metre	x	0.25 guest night	No calculation	Calculates per square foot
Accounting of resident staff in guest night calculation	Calculates per square metre	√	x	No calculation	Calculates per square foot
Additional optional points scored for % renewable resources	√ Platinum	X	√	√	√
Additional optional points scored for insulation of existing building	√	X	X	√	X
Additional optional points scored for use of energy efficient light bulbs	√	X	√	√	X
Boiler Efficiency >90%	√ Gold & Platinum	X	X	√	X
Energy Consumption Sub-Metering	√ Gold & Platinum	x	√[5]	√	√
Extra Optional Points (ENERGY RELATED) for Hotels with Laundry, Leisure Centre, Conference	√ Gold & Platinum	x	√[6]	√	x
Are extra points explicitly awarded for passive or bioclimatic architectural design principles?	x	x	x	√	x
Additional Features	x	2007: Separate Spa Performance Benchmarks (MJ per treatment hour)	Consumption for banqueting, catering and spa facilities may be deducted from total.	x	x

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1 A gold award signifies the hotels has been certified continuously for over five years.

2 **Rigorous Energy Accounting:**

**** = Use of Primary Energy AND/OR Electricity & non-electricity calculated separately AND/OR CO2 accounted for (kgCO2 per guest night or per square metre)
*** = Electricity & non-electricity calculated separately
** = Energy consumption calculated quantitatively
* = Process based schemes, energy not calculated quantitatively
0 = Energy not considered.

3 Key (CO2 emissions reduction) Energy Criteria, for example, Energy analysis, Proportion of electricity or heat from renewable resources, Boiler efficiency (new) >90%, Use of energy efficient light bulbs, Combined Heat & Power, Heat Recovery, Sub-metering, Automatic switching off of lights and air-control, photovoltaic and wind generation, insulation of existing buildings.

4 i.e. presence of waste paper basket in the bathroom or no smoking in rooms.

5 ‘ Non-Swan labeled’ Kitchen energy consumption is measured and recorded separately (1 optional point)

6 Water and/or energy consumption metered separately for the pool facilities (0.5-1 optional point)

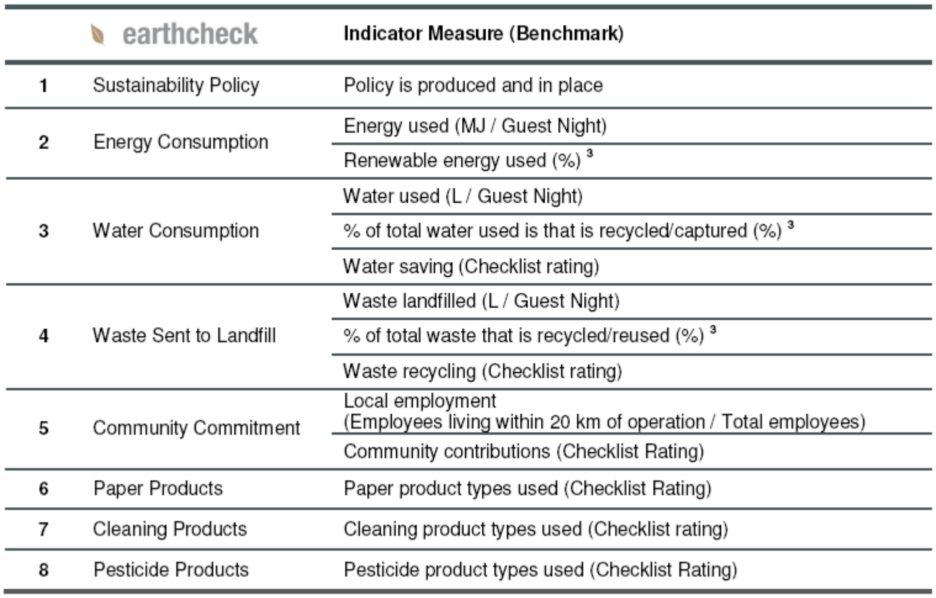
4.1.1 Green Globe

Description of scheme

The World Travel and Tourism Council (WTTC) established Green Globe in 1992 as a response to the United Nations Rio de Janeiro Earth Summit the Agenda 21 principles of Sustainable Development were endorsed by Heads of State. To date, EC3 Green Globe is the only hotel specific certification scheme that can be applied worldwide.[7] There are four GREEN GLOBE Standards i.e. Company Standard, International Ecotourism Standard, Community / Destination Standard, Design & Construct Standard. Green Globe also certifies airports, airlines, cruise boats, railways, and, more recently, destinations themselves. (Green Globe, 2009)

Criteria

The certification process consists of two types of assessments. Firstly quantitative data (energy, water and waste) is collected from the hotel and used by an independent third party, Earthcheck (2009), to determine how the hotel is performing. This annual assessment of the resort was undertaken against Earthcheck criteria and checklists developed for Green Globe and listed below in Figure 4.1.



	earthcheck	Indicator Measure (Benchmark)
1	Sustainability Policy	Policy is produced and in place
2	Energy Consumption	Energy used (MJ / Guest Night)
		Renewable energy used (%) [3]
3	Water Consumption	Water used (L / Guest Night)
		% of total water used is that is recycled/captured (%) [3]
		Water saving (Checklist rating)
4	Waste Sent to Landfill	Waste landfilled (L / Guest Night)
		% of total waste that is recycled/reused (%) [3]
		Waste recycling (Checklist rating)
5	Community Commitment	Local employment (Employees living within 20 km of operation / Total employees)
		Community contributions (Checklist Rating)
6	Paper Products	Paper product types used (Checklist Rating)
7	Cleaning Products	Cleaning product types used (Checklist rating)
8	Pesticide Products	Pesticide product types used (Checklist Rating)

[3] *These criteria are for guidance only and do not affect the overall benchmarking evaluation.*

Figure 4.1 Green Globe list of benchmarks & checklist ratings *(Green Globe, 2007a).*

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[7] It was announced in June 2008 that EC3 Global is a wholly owned subsidiary of Australia's Sustainable Tourism Cooperative Research Centre (STCRC), the world's largest tourism research organization. EC3 Global manages the Green Globe benchmarking and certification program in destinations around the world. This initial agreement expands EC3 Global exclusive rights to deliver Green Globe benchmarking and certification from Asia Pacific to all territories worldwide. This initial agreement means that Green Globe clients will have one standard approach for comparing sustainability performance data, including energy consumption, water use, waste production and social commitment. (Green Globe, 2009)

Performance is measured against benchmarks which are derived from hotels offering similar standards, although these benchmarks are not published. In the calculation of the benchmarks, hotels are separated into five separate sub-sectors: business hotels; vacation hotels; motels; bed and breakfasts; and hostels. Resorts are considered a completely separate sector. The differentiation is in recognition of the varied facilities offered and which vary with location. An example of the energy consumption benchmark is shown in Figure 4.2 below.

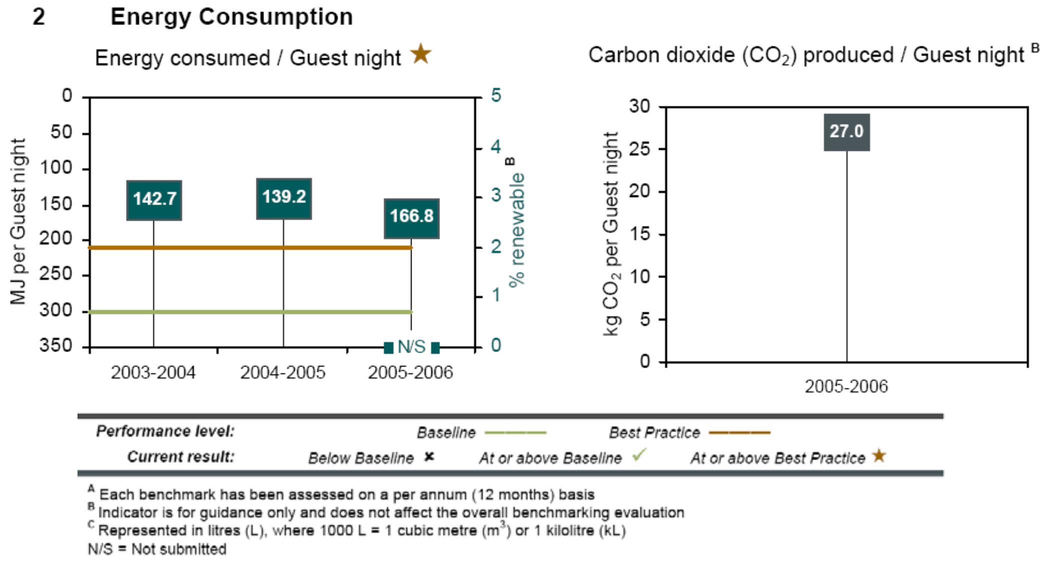


Figure 4.2 Examples of Green Globe performance criteria indicating baseline and best practice levels used as benchmarks to compare the hotels energy consumptions against. Note inverted scale *(Green Globe, 2007a)*

The non-quantitative assessment covered in the scheme includes sustainability policy, community commitment, paper products, cleaning products and pesticide products. A score from 0 to 10 is awarded, allowing the user to gauge how the practices and procedures they have in place will aid long-term sustainability. (Green Globe, 2008)

Procedure

To be allowed to use the Green Globe Benchmarked logo the hotel must meet the minimum requirements for up to two submitted categories (Baseline or better performance). Baseline and Best Practice performance levels are set with reference to the type of activity and appropriate national and international data which take into account social, geographical and climatic impacts. Energy is not mandatory. All performance criteria are continuously reviewed, along with the performance levels which hotels have to achieve in order to use the Green Globe Benchmarked logo. (Green Globe, 2008) If a hotel fails to meet the minimum requirements for up to two submitted categories but achieves Baseline or better performance in all the other categories, then the hotel is allowed to use the Green Globe Benchmarked logo. It is, however, given a maximum of 12 months to improve performance in at least one of the categories to Baseline or better performance. If on the next submission this is not achieved without substantiated evidence that the situation was beyond the control of that operation (e.g., occurrence of a natural disaster), then the right to use the Green Globe Benchmarked logo will be withdrawn. (Green Globe, 2008)

In 2008, Green Globe introduced differed stages of certification as seen Figure 4.3. The Green Globe procedure involves three stages of certification from Benchmarked Bronze, Certified Silver and Certified Gold after five plus years of continuous certification.

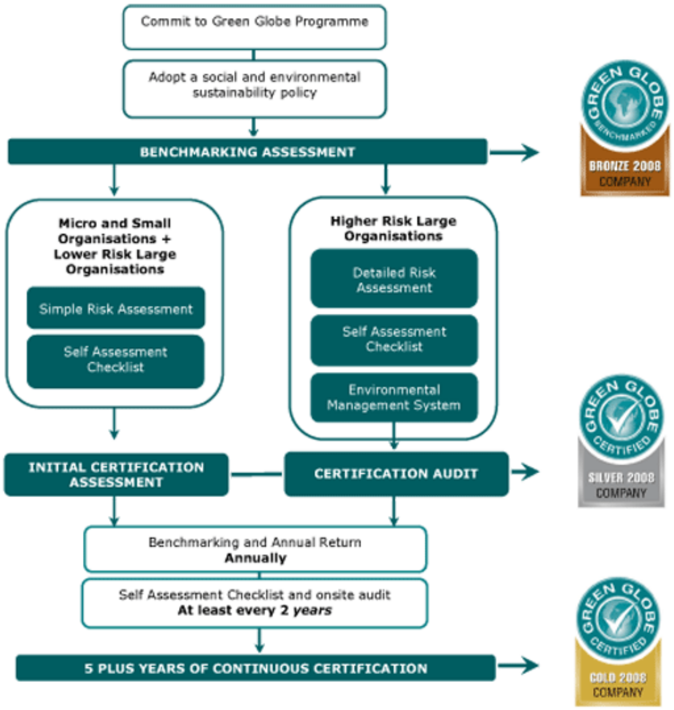


Figure 4.3 Green Globe journey from benchmarking to certified 5 plus years *(Green Globe, 2008).*

The award logo is misleading to the guest who would assume that the different logos awarded for the different stages of certification were representative of different levels of certification. For example, a gold award suggests better environmental performance than a bronze award however; instead a gold award signifies the hotel has been certified continuously for over five years.

4.1.2 Nordic Swan

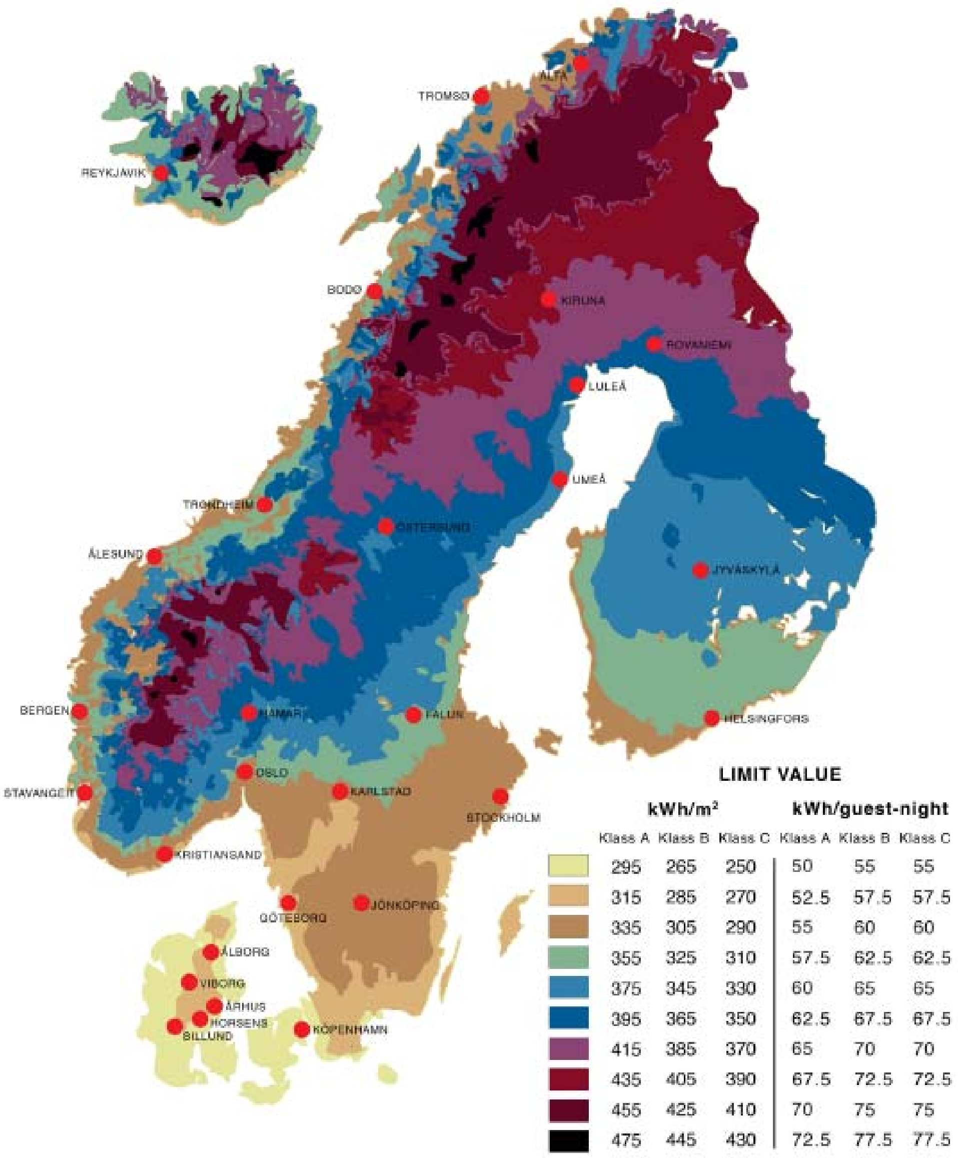
Description

The Nordic Ecolabel is the official ecolabel for the Nordic countries. In 1989, voluntary measures were introduced by the Nordic Council of Ministers and in 1999 the first criteria document for hotel facilities was produced. The Nordic Ecolabel covers 67 different product groups ranging from washing-up liquid, furniture to hotels. The label is usually valid for three years, after which the criteria are revised and the company must reapply for a licence. (Nordic Ecolabelling, 2009)

Criteria

The scheme is made up of four benchmarks; energy, water, chemical products and waste management. The requirements for Swan certification include submission of a general description of hotel, benchmarks (referred to as limit values in scheme) for four categories: energy (*mandatory*), water, chemical products and waste management. In addition to the above benchmarks, the hotel must comply with a number of mandatory and optional point requirements across all categories ranging from on-site sorting of waste, CFC free operation, fittings and inventory. (Nordic Ecolabelling, 2007) A detailed breakdown of the points score system is presented in Appendix 4A together with the weighting of energy related points in the overall award of points in Nordic Swan certification.

The benchmarks vary depending on the type of operations being conducted and vary according to geographical location. (Nordic Ecolabelling, 2007) Hotels are divided into three different classes which applies to the calculation of the limit values as shown in Figure 4.4 below.



LIMIT VALUE

	kWh/m²			kWh/guest-night		
	Klass A	Klass B	Klass C	Klass A	Klass B	Klass C
■	295	265	250	50	55	55
■	315	285	270	52.5	57.5	57.5
■	335	305	290	55	60	60
■	355	325	310	57.5	62.5	62.5
■	375	345	330	60	65	65
■	395	365	350	62.5	67.5	67.5
■	415	385	370	65	70	70
■	435	405	390	67.5	72.5	72.5
■	455	425	410	70	75	75
■	475	445	430	72.5	77.5	77.5

Source: NORDKLIM 2001, Nordic climate maps, DNMI report 06/01

Figure 4.4 Nordic Swan energy performance benchmarks (Limit values) *(Nordic Ecolabelling, 2007)*

A breakdown of the weighting (represented as a percentage of total points) of each individual category in the *Environmental Requirements* in Section 2 is shown in the Figure 4.5 below. (See also Appendix 4A).

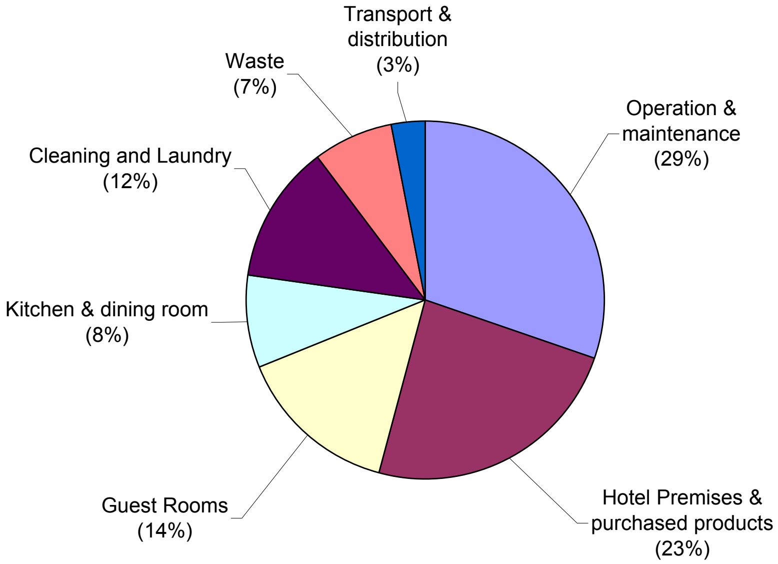


Figure 4.5 Example of point score breakdown in the 'environmental requirements' section 2 of Nordic Swan*. (Source: Author, based on information taken from Nordic Ecolabelling, 2007)*

In addition to the 'environmental requirement' Section 2, there are extra point requirements for hotels with restaurants and/or conference facilities and/or pools. Also extra points from the benchmarks (referred to as limit values), energy consumption and bonus points (Note: Swan labelled restaurant can be awarded points but these are not included in the total maximum score as shown in Table 4.2).

Extra points are awarded if the hotel meets the extra requirements for hotels with pool/hot springs as follows; Water and energy consumption *are* metered separately for the pool facilities (1p), Water or energy consumption *is* metered separately for the pool facilities (0.5p), Energy consumption for hot springs is regulated and optimized: 1p (applies only for Iceland) Extra points can be achieved if the hotel's total energy consumption is 5-35% lower than the respective energy benchmark.

To demonstrate how a hotel may score points, the results from In depth Study 1 Hotel, which is examined in more detail in Chapter 5, is presented in Column one of Table 4.2. Column two represents the maximum possible score available by the scheme which allows the reader to compare how the case study hotel scored in each category. Column three presents the points score breakdown of energy related points which can be compared with the maximum points available in column two. Column four of the table presents the number of energy related obligatory requirements in each section. Together the table shows the distribution of points achieved by this hotel and the weighting of energy related points and obligatory requirements in each section.

Criteria	**Case Study 1 Score**	**Max. Possible Score *(points)***	**Energy Related Score *(points)***	**Energy Related Obligatory Requirement**
Operations and maintenance	18	25	19	2 out of 3
Hotel Premises and purchased products	15.5	20	1	1 out of 4
Guest Rooms	8	13	6.5	0
Kitchen and dining room	2.5	7.5	0	0
Cleaning and Laundry	7	11	2	0
Waste	6	6	0	0
Transport	3	3	0	0
Total (Part A)	**60**	**85.5**	**28.5**	**0**
Extra requirements for hotels with restaurant	6	7.5	4	0
Extra requirements for hotels with conference	4	6	0	0
Extra requirements for hotels with pools	0	4	1	0
Total (Part B)	**10**	**17.5**	**5**	**0**
Extra points from the limit values	*4*	*4*	*2*	*0*
Extra points energy consumption	*4*	*4*	*4*	*0*
Bonus points, Swan labelled restaurant	*0*	*1*	*0*	*0*
Total[8](Part C)	***8***	***9***	***6***	***0***
TOTAL POINTS SCORE (Parts A, B, C)	**78**	**98.5**	**39.5**	**3 out of 7**

Table 4.2 Breakdown of points scored by the Case Study hotel and the maximum points score available by Nordic Swan for different categories. *(Source: Author, based on information taken from Nordic Ecolabelling, 2007)*

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[8] These points shall not be included in the total maximum score. (Nordic Ecolabelling, 2007)

Procedure

To acquire a Nordic Swan label, at least one benchmark, over and above energy consumption must be fulfilled. If a hotel complies with several benchmarks or surpasses the benchmark for energy consumption, extra points are awarded. In addition to the mandatory requirements, the hotel must accomplish a minimum of 65% (At least 50% for Icelandic hotels) of all point requirements and 60% of all point requirements in the Operations and Maintenance section. All environmental management requirements must be met. Finally, the hotel must be audited and actions approved by Nordic Swan. (Nordic Ecolabelling, 2007)

The criterion for the energy category involves passing a mandatory energy benchmark which varies with location as well as both mandatory and optional point requirements. The energy benchmark is either related to a hotel's total area or to the number of guest nights a year and the other three are related to guest nights only. The benchmark for energy consumption is mandatory as of 2007 and takes into account the hotels geographical location as shown in Figure 4.5. The Swan label categorizes the establishments as Class A, B or C depending on the share of the restaurant turnover, the total turnover for restaurant and hotel, the hotel occupancy rate, as well as the availability of pool facilities. (Nordic Ecolabelling, 2007)

4.1.3 EU FLOWER

Description

EU Flower was created in 1992. It is a voluntary scheme and is valid across EU, Norway, Iceland and Liechtenstein. It is certified by an independent third party. Like Nordic Swan, the scheme differs from Green Hospitality Award, LEED and EC3 Green Globe in that it is not specific to tourism accommodation only, certifying everything from tissue paper, to laptops to washing up liquid, each with its own set of criteria. However, EU Flower differs from all the other schemes as it is a process *only* based scheme.

Criteria

The scheme is made up of six categories; energy, other, waste, water, management and chemicals. The criteria are divided into two levels of requirement, mandatory criteria and optional criteria as shown in Table 4.3 below. The Energy category accounts for 10 out of 37 Mandatory points and 17 out of 47 optional points (*at least 16.5 points must be achieved in this section*) as seen in Appendix 4B. (EC, 2003)

EU Flower **84 Criteria**		
Categories	**37 Mandatory Requirements**	**47 Optional Points** *(16.5 required out of possible 77)*
Energy	10	17
Water	10	7
Chemicals	2	5
Management	8	5
Waste	5	5
Other	2	8

Table 4.3 Breakdown of mandatory and optional points system for each category for EU Flower certification. *(Source: Author based on information taken from EC, 2003)*

All the mandatory criteria must be fulfilled, if applicable and the specific assessment and verification requirements are indicated within each category. Documentation of non-applicability is to be provided as well as that for compliance. All optional criteria have been awarded score points. The number of criteria complied with must correspond to a total of 16.5 points. The total score required shall be increased by 1 point for each of the following three additional facilities offered that are under the management or ownership of the tourist accommodation service: food services, fitness activities, green areas. Food services include breakfast. Fitness activities include saunas, swimming pools and all other such facilities which are within the accommodation grounds. Green areas include parks and gardens which are open to guests. The mandatory and optional requirements in the Energy category are listed in Appendix 4B. (EC, 2003) The main criticism of this scheme is that it does not make sense to score more points if you offer more facilities and consequently, the more points you score the higher your overall score.

Procedure

To receive the EU Flower, the hotel must meet the mandatory and optional criteria set out above. The specific assessment and verification requirements are indicated within each criterion. (Appendix 5.4D) Where appropriate, competent bodies may require supporting documentation and may carry out independent verifications. The implementation of recognized environmental management schemes, such as EMAS or ISO 14001, when assessing applications and monitoring compliance with the criteria. (*Note:* it is not required to implement such management schemes.)

STOP PRESS

A new Commission Decision was made on the 9th July 2009. (EC, 2009) The old criteria (EC, 2003) is valid until the 31st October 2009.

4.1.4 Green Hospitality Award[9] (Ireland)

Description

The Green Hospitality Award is Ireland's first Environmental Award Scheme for the Hospitality Sector. The Green Hospitality Award is largely based on the EU Flower scheme however, the schemes differ from each other in that energy, waste and water benchmarks are included, but are used for reference purposes only. The benchmarks relate to a hotel's total area and are measured in units per square metre. The Green Hospitality Award is granted based on performance in Environmental Management Systems, Waste Management, Water management and Energy management. Green Hospitality participants undergo audits, which ensure that the hospitality business is meeting its requirements and is acting responsibly with respect to the environment.

The Green Hospitality Award has four levels: Bronze (Introductory), Silver (Good Practice in operation), Gold (Generally Best Practice in operation) and Platinum (World Class Performance). The categories are designed to allow companies move at their own pace but also to start the process. Platinum Award winners will be positioned to move towards achieving the EU Flower Accreditation level. (GHA, 2008a)

Criteria

The four main categories of the scheme are Energy Management System (EMS), Energy Performance, Water and Waste. As part of the mandatory requirements, the hotel must submit data for the current and previous year. A key part of the scheme is the audit which reviews the information, documentation and reported data. The scheme awards four levels of certification as indicated in Table 4.4 below. (GHA, 2008a)

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[9] Formerly Green Faílte Award.

Green Hospitality Award				
Bronze/Silver/Gold/Platinum Awards	**Mandatory Achieved** *Yes to all*	**Additional Mandatory Requirements**		
	Bronze	**Silver**	**Gold**	**Platinum**
Environmental Management System	Yes	5	5	6
Waste Management	Yes	4	6	8
Water Management	Yes	4	8	10
Energy Management	Yes	8	10	13
Optional Score Required	**N/A**	**20**	**30**	**40**

Table 4.4 Breakdown of mandatory and optional points system for each category for Green Hospitality Award. *(Source: Author, based on information taken from GHA, 2008a)*

Procedure

The mandatory categories for the Bronze Award require compliance across all categories and are rigorous. Requirements range from submitting completed audits, benchmark workbooks and back up verification, evidence of EMS, monitoring energy consumption and identifying major energy using equipment. Every award level above Bronze has increasing mandatory requirements and a requirement to have implemented a number of further actions which are detailed in the optional section. The mandatory and higher level requirements of the energy management section of the Silver/Gold/Platinum Award is listed in Appendix 4C.

In addition to the mandatory and optional score criteria, the hotel consumption data is collected and compared against International benchmarks. This is used for guidance only and achieving the benchmark level is not a requirement for certification. The energy benchmarks for the Green Hospitality Award are derived primarily from the data for 40 hotels using verified data only. These benchmarks are shown in Figure 4.7 and are used to establish where properties stand in relation to International/National benchmarks and for guidance only. According to Mr. Bergin, *"the 'world' Best/Good; Average; High/Poor benchmarks were derived from Green Globe, IHEI, Benchmarkhotel.com, Canadian Hotels, US Hotels, Accor, Nordic Swan and an average as opposed to a range was calculated since it was deemed that Irish Hotels were not ready yet for a "range" as many would choose to view the lowest/worst level as their target*." (Bergin, 2008a)

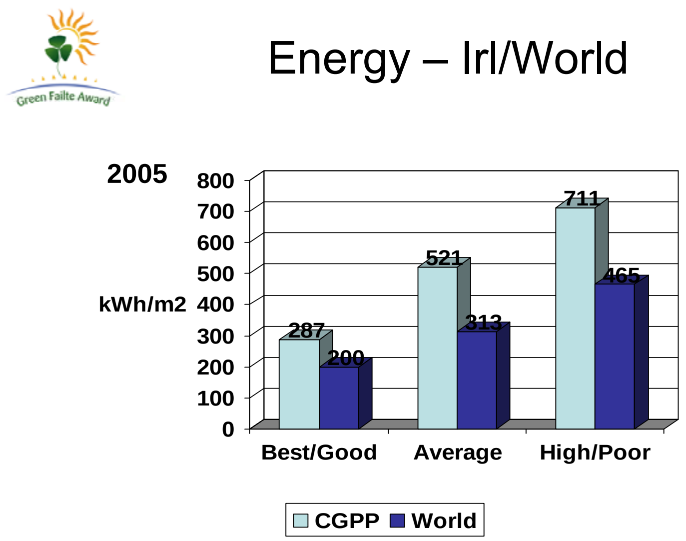

Figure 4.6 Energy consumption (kWh/m^2) for Cleaner Greener Production Programme (CGPP) hotels compared to International values *(Hogan and Bergin, 2006).*

4.1.5 LEED for Existing Buildings: O&M *(Operations & Maintenance)*

Description

LEED[10] for Existing Buildings: O&M (Operations and Management) is a certification scheme for the ongoing operations and maintenance of existing buildings. It differs from all the other schemes discussed here as it is not hotel specific however, it has been included in this comparison since eight hotels in the US have become certified to date with almost 200 awaiting certification. LEED is a third-party certification programme which assesses building performance against a wide range of environmental and sustainability issues covering a number of categories. It is one of a suite of published LEED rating schemes which includes LEED-NC, for New Buildings and Major Renovations; LEED-EB, for Existing Buildings (operations & maintenance; LEED-CI, for Commercial Interiors; and LEED-CS for Commercial Core and Shell projects, LEED for Homes, Retail, Schools, Healthcare and Neighbourhood Development which is in the pilot stage. (USGBC, 2009a)

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[10] LEED 2009 has been launched and couples an expanded third-party certification program and significant enhancements to LEED Online. It will incorporate New Construction, Core and Shell, Commercial Interiors, Existing Buildings: Operations & Maintenance and Schools.(USGBC, 2009a)

Criteria

To achieve LEED-EB certification, the building must meet all prerequisites[11] in the rating system and earn a minimum of 34 points in the optional point section of each category. LEED for Existing Buildings: O&M (September, 2008) award levels are determined according to the following point thresholds as shown in Figure 4.7 (USGBC, 2009b):

Certified - 34-42 points

Silver - 43-50 points

Gold - 51-67 points

Platinum - 68-92 points

Figure 4.7 LEED award logos and point thresholds for different certification levels *(USGBC, 2009b).*

LEED-EB is divided into five categories: site, water, energy, materials and indoor environmental quality. For each category, one or more 'credits'[12] are available when specific levels of performance or process are achieved as shown in Table 4.5. After a review of all documentation, the total number of points obtained determines the final LEED score, which results in a rating ranging from Certified, Silver, and Gold to Platinum. (USGBC, 2009c)

LEEB for Existing Buildings *(Operations & Maintenance)*		
Categories	**Mandatory Requirements**	**Optional Points**
Sustainable Sites	0	9
Water Efficiency	1	4-10
Energy & Atmosphere	3	13-30
Materials & Resources	2	9-14
Indoor Environmental Quality	3	16-20
Innovation in Operation (IO)	0	4-7
Total	**85 Possible Base Points *(plus 7 for IO)***	

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[11] For ease of comparison, 'pre-requisites' shall be referred to as 'mandatory requirements.'

[12] For ease of comparison, 'credits' shall be referred to as 'points.'

Table 4.5 Breakdown of pre-requisites and optional points system for each category for LEED-EB certification. *(Source: Author, based on information taken from USGBC, 2009c)*

In the Energy & Atmosphere section, there are 3 mandatory requirements (referred to as ‘pre-requisites’ in list below) for fundamental building systems commissioning, chlorofluorocarbon (CFC) reduction in HVAC&R equipment and minimum energy performance; 13-30 optional points can be achieved in this section. It is mandatory that 2 of these points are earned in the points in Credit 1 in the Optional point section. A breakdown of the requirements is shown below in Table 4.6 (USGBC, 2009c).

Energy & Atmosphere		**(13 - 30 pts)** ***Optional Points***
Prerequisite 1 C	Fundamental Building Systems Commissioning	Required
Prerequisite 2 D	Minimum Energy Performance *Earn at least 2 points EA Credit 1.0*	Required
Prerequisite 3 D	Refrigeration Management: Ozone Protection	Required
Credit 1.0	*Optimize energy performance*	*2-15 points (2points mandatory)*
Credit 2.1-2.3	*Existing Building Commissioning*	*2-6 points*
Credit 3.1-3.3	*Performance Measurement*	*1-3 points*
Credit 4.1-4.4	*Renewable Energy: Off/On-site*	*1-4 points*
Credit 5.0	*Refrigeration Management*	*1 point*
Credit 6.0	*Emissions Reduction Reporting*	*1 point*

Table 4.6 Breakdown of pre-requisites and optional points system in the Energy & Atmosphere category for LEED-EB certification *(Source: Author based on information taken from USGBC, 2009c).*

Procedure

LEED-EB uses an external rating system EnergyStar (2008), in which primary energy performance can be rated on a scale of 1–100 relative to similar buildings nationwide as shown in Figure 4.8. The rating system is based on primary energy and accounts for the impact of weather variations as well as key physical and operating characteristics of each building. Buildings rating 75 or greater may qualify for the ENERGY STAR label. Ratings of 69 or more qualify for LEED-EB points. A full 12 months of continuous measured energy data is required (EnergyStar, 2008).

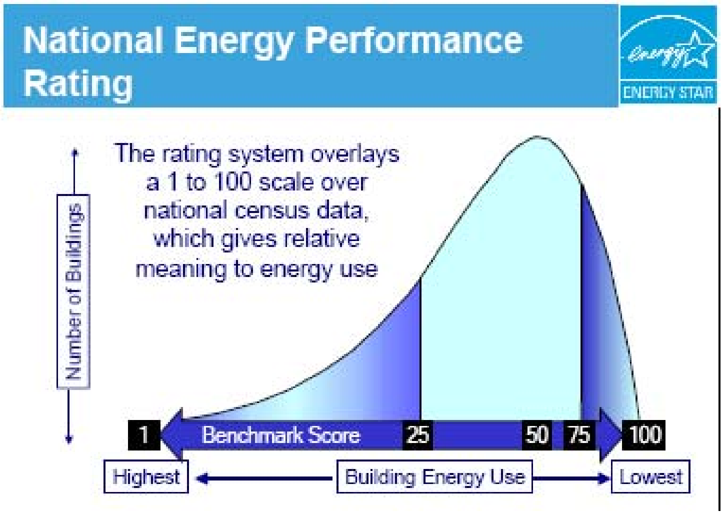

Figure 4.8 EnergyStar-National Energy Performance Rating Systems *(EnergyStar, 2008).*

In the LEED-EB (O&M) system, to satisfy the mandatory requirement for Prerequisite 2 Minimum Energy Performance, the building must have its energy performance rated using one of three options (USGBC, 2009c):

- *Option A* For buildings eligible to receive an EPA rating using the EnergyStar Portfolio Manager tool, achieve an energy performance rating of at least 69 (LEED-EB 2 points).
- *Option B* for buildings not eligible to receive an EPA rating using the above, demonstrate energy efficiency in at least the 19th percentile (LEED-EB 2 points) for typical buildings of similar type by benchmarking against the national median source energy data provided in the portfolio manager tool or USGBC supplementary calculator as an alternative to EPA ratings.
- *Option C* is used for buildings not eligible for either of the above in which case the alternative method in LEED-EB (O&M) Reference Guide should be used.

In addition to options A, B, C above, the following requirements must be met: 1) Energy efficiency performance better than the minima listed above. Additional points are awarded on an incremental scale of energy performance,[13] 2) Building must have an energy meter(s) that measure all energy use throughout the performance period of each building to be certified. Each building's performance must be based on actual metered energy consumption for both the LEED building and all comparable buildings used in the benchmark (USGBC, 2009c).

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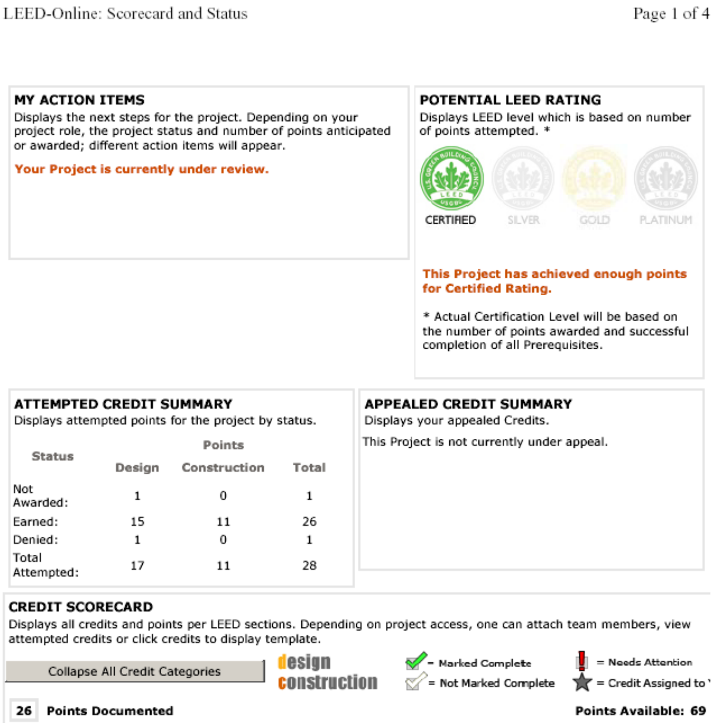
[13] Option A: EPA EnergyStar rating 89 = LEED-EB 12 points;
Option B and C: Percentile level above national median 39 = LEED-EB 12 points;

4.1.5.1 An Example of the Distribution of Points Awarded to LEED Certified Hotel

Access was granted to actual score cards for two hotels which became certified with LEED-NC in 2007. They are included as examples to demonstrate the distribution of points for a LEED certified hotel. The LEED-NC system has the same pre-requisites as LEED-EB in the Energy & Atmosphere section but differs in that only 17 optional points are required instead of 13-30 required in LEED-EB. The key difference between the two systems is that LEED-EB uses actual energy consumption whereas LEED-NC is based on simulated data. The other difference between the two is that for LEED-NC there are 69 possible points as opposed to a possible 92 points for LEED-EB as previously described. (USGBC, 2009b)

Example 1

The first example is from a LEED-NC certified hotel located in San Francisco, California. (USGBC, 2009b) At 10 stories, the 5,202 m^2 (56,000 ft^2) building includes 86 guestrooms and a 56-seat restaurant and bar. The hotel outsource to a "green" laundry. The hotel opened in 2006, and in 2007, it became the third hotel in the U.S. and the fourth hotel in the world to earn LEED certification. According to the hotel fact sheet, the hotel has high levels of insulation and more than 80% of all regularly occupied spaces are day lit. Lights are CFL, halogen or LED throughout the hotel and a Key Card Management System has been installed which reduces energy usage by about 20 percent. Contact was made with the environmental manager of the hotel, Mr. Stefan Muhle and access was granted to their LEED scorecard which enabled me to examine the distribution of points awarded in a LEED-NC certified hotel as shown in Figure 4.9. (See also Appendix 4D)



LEED-Online: Scorecard and Status

Page 1 of 4

MY ACTION ITEMS

Displays the next steps for the project. Depending on your project role, the project status and number of points anticipated or awarded; different action items will appear.

Your Project is currently under review.

POTENTIAL LEED RATING

Displays LEED level which is based on number of points attempted. *

This Project has achieved enough points for Certified Rating.

* Actual Certification Level will be based on the number of points awarded and successful completion of all Prerequisites.

ATTEMPTED CREDIT SUMMARY

Displays attempted points for the project by status.

Status	Points		
	Design	Construction	Total
Not Awarded:	1	0	1
Earned:	15	11	26
Denied:	1	0	1
Total Attempted:	17	11	28

APPEALED CREDIT SUMMARY

Displays your appealed Credits.

This Project is not currently under appeal.

CREDIT SCORECARD

Displays all credits and points per LEED sections. Depending on project access, one can attach team members, view attempted credits or click credits to display template.

26 **Points Documented**

Points Available: 69

Figure 4.9 Extract from LEED Scorecard for example 1 hotel *(USGBC, 2007a).*

The review found that the hotel was able to become LEED-NC Certified by earning only 1 optional point (out of a possible 17 points) in the Energy & Atmosphere category which meant in fact it only had to earn 1 optional point for energy out of a possible 69 maximum points to be come LEED certified as seen in Table 4.6 below. The single optional point was earned for ozone depletion by stating that '*the HVAC & R systems were free from HCFC's and Halon'*. (See Appendix 4D).

LEED for New Construction *(Certification awarded 31st May, 2007)*	
Certified 26 *	
Sustainable Sites	5/14
Water Efficiency	2/5
Energy & Atmosphere	1/17
Materials & Resources	7/13
Indoor Environmental Quality	7/15
Innovation & Design	4/5

Table 4.7 Extract from Project Profile for example LEED-NC hotel * Out of a possible 69 points. *(Source: Author, based on information taken from USGBC, 2009e and USGBC, 2007a).*

Access was also gained to the hotels PG&E (Pacific Gas and Electric Company) invoices which allowed me to calculate their emissions at 18.3 $kgCO_2$/gn, using Average US conversion factor[14] for electricity and published conversion factor for natural gas[15]. (See Appendix 4E and 4F)

The environmental manager, Mr. Muhle, provided the author with the hotels PG&E invoices for another hotel (certified with LEED-EB) in their group also located in downtown San Francisco. Access to the score card was not available for the hotel, however, based on the invoices and using the same calculation method (Appendix 4G and 4H) the emissions were calculated to be 24 $kgCO_2$/gn. The two hotels are part of the same hotel group located in San Francisco, CA, and are therefore subject to compliance with California's Title 24 Energy Standard.[16] At the time of writing, the LEED-NC hotel was applying for LEED-EB certification. (ASHRAE, 2004 and CEC, 2005)

The analysis of the LEED score card found that no points are awarded for passive solar design despite the fact that more than 80% of the regularly occupied spaces in the hotel are day lit (Appendix 4D, EQ Credit 8.1) which would have a direct impact on reducing energy consumption and emissions. This example exposes several weaknesses in the LEED schemes and it emphasis on awarding points to installing or improving mechanical and electrical systems rather than rewarding or promoting passive solar or bioclimatic design. This was also concluded by Shaviv (2008).

Example 2

This example is a hotel, conference centre and spa located in California, USA which achieved a LEED Gold rating under the LEED for New Construction v2.1 rating system. It is the first hotel in the U.S. to achieve the LEED Gold rating. (USGBC, 2009b) The two story hotel is 8,361m^2 (90,000 ft^2) comprising three buildings and was completed 2006. The hotel has a lodge with 133 guest rooms, a reception building, and a conference centre, which contains meeting rooms, a kitchen, and a banquet room. The hotel also has a pool and offers spa services. (USGBC, 2009e)

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14 0.619 $kgCO_2$/kWh (UNEMG, 2009)
15 0.19 $kgCO_2$/kWh (Carbon Trust, 2008)
16 As previously approved by the LEED interpretation committee and as referenced in USGBC 10/25/2005 CIR Ruling, Title 24 compliance can be used in lieu of the ASHRAE 90.1 standard. Therefore, by complying with Title 24, both hotels had satisfied Prerequisite 2 of the Energy & Atmosphere section.

The hotel achieved 43 points out of a maximum 69 points and its anticipated rating is Gold. (See Appendix 4I) In the Energy & Atmosphere section it achieved 10 out of a maximum 17 points in addition to the pre-requisites (Fundamental Building Systems Commissioning, Minimum Energy Performance, and CFC Reduction in HVAC&R Equipment) which must be met. Non-compliant pre-requisites must be resolved before certification can be awarded. The 10 points were achieved in the following sections; (USGBC, 2007b)

6 points Optimizing Energy Performance

The hotel performs 29% better than Title-24 2001 (CEC, 2005) requirements using LEED ECB Method. Energy efficiency measures incorporated into the building design include improved wall and roof insulation, high performance fenestration, lower installed lighting power density, occupant sensor controls, day lighting controls, improved HVAC efficiency and improved water heating efficiency.

2 point Renewable Energy

36 kW solar array providing 10.5% of project's energy cost met by on-site generation

1 point Additional Commissioning

1 point Green Power

Project purchased Renewable Energy certificates (RECS), equal to 50% of project's energy consumption that meets the Green-E definition for renewable energy for a minimum of two years.

In addition to the points achieved in the 'Energy & Atmosphere' section, the hotel achieved the following points in actions that have a direct impact on emissions and energy consumption. (USGBC, 2007b)

1 point Sustainable Sites

The hotel design consists of 98.5% of roof covered with EnergyStar rated roof product with an emissivity of at least 0.9%

1 point IAQ Thermal Comfort (comply with ASHRAE 55-1992)

The project narrative describing the HVAC systems and the local climate conditions also includes a psychometric data confirming that the installed HVAC systems have been designed to maintain indoor comfort within the ranges listed by ASHRAE Standard 55-1992.

2 points IAQ Controllability of Systems

The project narrative confirms that, for perimeter spaces, all lighting, temperature controls, airflow controls and operable windows comply with the credit requirements and that temperature, airflow and lighting controls have been provided for a minimum of 50% of occupants in regularly occupied non-perimeter areas. The credit requires, *on average, 1 operable window must be provided for every 200ft2 of occupied perimeter space.*

1 point IAQ Thermal Comfort, Permanent Monitoring System

The project narrative describes the HVAC system and the local climate conditions and together with the psychometric data confirms that the maximum humidity levels will not be exceeded based on local climate. Based on this information the project complies with the alternative compliance path for this credit.

1 point Daylight & Views, Views for 90% of Spaces

The project has direct line of sight views from a minimum of 90% of all space occupied for critical visual tasks. (Zero points scored for Daylight Views for 75% of Spaces)

1 point Innovation in Design

One part of the hotels Education Program includes an educational display that uses kiosks to highlight the building's sustainable design features as shown in Figure 4.10.

Figure 4.10 Photograph showing the dials indicating the hotels CO_2 emissions, electricity and water consumption *(Source: Confidential).*

Disappointingly, the hotel would not co-operate further when asked for actual consumption data so I was unable to compare the *actual* with *predicted* consumption. It was not possible to confirm if the dials shown in the reception were indeed indicative of the actual energy consumption for the whole building and not just representative of the 10% on site generation as is suspected. (Figure 4.10)

The tubular skylights throughout the hotel bring daylight into hallways and other spaces in the interior core, reduce the lighting demand in those spaces but there is no provision for this passive design feature to be credited under the LEED-NC certification which is a shortcoming of the scheme.

4.2 Findings

The overall conclusion is that existing schemes do not properly account for CO_2 emissions and do not in general lead to a reduction in emissions in this case due to weighting method currently used in all schemes.

Due to the complexity of the schemes and their heterogeneity, particularly in the level and varying criteria to be satisfied, it was not possible to make a detailed comparison; rather the main characteristics are highlighted and compared. In order to calculate a single score from the broad range of environmental topics that each of the methods cover, each scheme attributes to them a different weighting. This weighting varies between schemes.

In most cases methods of calculation, data about baseline indicators and algorithms for use in performance assessments are not disclosed to the hotel operator nor are they available in the public domain. There is also concern that the complexity and cost of certification systems preclude smaller businesses.

1) Commonalities between the schemes

There are some commonalities between the schemes. A mandatory energy management system and back up documentation is common to all the schemes. An independent on-site audit[17] is required by three out of five of the schemes. They all are hotel specific and are based on operational (energy in use) data only apart from LEED-EB which is not hotel specific and is based on primary energy only.

All the schemes include a range of categories (4 minimum to 8 maximum) for certification but all include criteria for energy and water consumption and waste consumption/management. Energy is a mandatory category for all the schemes but Green Globe which is a key failing particularly of a scheme purporting to be a measure of sustainability. Energy is only mandatory as of 2007 in Nordic Swan which is surprising considering the Swan label has been around for a over a decade.

The rigorousness of energy performance criteria[18] is good (***) or excellent (****) in all schemes apart from EU Flower (*) which uses a process only based criteria hence

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[17] Nordic Swan and Green Hospitality Award do require an on-site audit but it is not independently verified.

[18] As defined in Table 4.1.

energy is not measured quantitatively. No matter how prescriptive the energy requirements, mandatory or otherwise, it is a fact that if performance is to be improved, it must be measured.

2) Scope

LEED and Green Globe certify buildings only unlike Green Hospitality Award and Nordic Swan, EU Flower which also certify materials, products and services. LEED is the only scheme which is not specific to hotels or resorts.

Green Globe is the only scheme that can be applied worldwide with benchmarks varying with geographical location as is the case with Nordic Swan using benchmarks for each specific Scandinavian county. EU Flower is a process based scheme which does not use benchmarks and can be applied to all countries across Europe. Green Hospitality Award is based on EU Flower but is specific to Ireland only.

In the schemes that do have a mandatory, additional mandatory and optional points system i.e. Nordic Swan, EU Flower, Green Hospitality Award, LEED-EB the following difference in awarding of points is observed:

3) Energy

Energy is a mandatory category for all schemes apart from Green Globe which clearly is at odds with a logo that suggests to the guest that the hotel has a low environmental impact. All the schemes use different energy units i.e. kBtu/ft2 etc, and different normalisations - /m^2 or /GN (guest nights). The former are different but convertible, the latter require extra information. This makes cross comparison of energy benchmarks very difficult unless the extra information is available. For example, energy performance in LEED-EB is measured in (kBtu/ft$^{2,)}$, Nordic Swan (kWh/m^2 or kWh/guest night), Green Hospitality Award (kWh/m^2) whereas Green Globe is measured in (MJ/guest night).

Apart from energy, performance benchmarks for water and waste consumption are used in Green Globe, Nordic Swan and Green Hospitality Award and are typically measured as litres per guest night for water consumption and kilogram's per guest night[19] for waste production.

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[19] Green Globe measures waste production as litres per guest night.

4) Weighting of categories in awarding credits for certification

Energy consumption is one of the most significant areas of environmental impact yet this is not reflected in the weighting of energy against other categories in any of the selected schemes. Most schemes involve four or more assessment categories yet success in only one or two categories (energy is not always mandatory) enables a hotel to become certified despite having poor environmental performance. In 2007, Nordic Swan made energy performance a compulsory category. EC3 Green Globe includes an indicator for CO_2 emissions and Renewable energy (expressed as a percentage) used but does not affect the overall benchmarking evaluation. In LEED, it was found that five of the ten *least* popular (and most difficult to achieve) credits were made up entirely from the Energy & Atmosphere category, which deals directly with CO_2 emissions. (Kramer, 2006) Where LEED has been used for hotels there is some uncertainty as to what building type is being used to establish the benchmarks against which the subject hotel is being judged.

5) Accountability of CO_2 emissions in schemes and tools

Only one certification scheme calculates CO_2 emissions but this is included in a non-mandatory category for certification. As a result, a hotel could in fact have low energy consumption and due to its high proportion of electricity use, have high CO_2 emissions yet still become certified. Nordic Swan alludes to emissions in the optional requirement for an energy analysis (3 optional points) and states that '*in order for the hotel to be considered CO_2 neutral, the hotel's total CO_2 emissions and the hotel's CO_2 cut-back's must be zero*.' However, LEED-EB does convert energy consumption data to primary energy thus providing an accurate method for CO_2 emissions calculation. It also uses an independent and rigorous external energy performance rating system.

A common problem with all the schemes is that key CO_2 emissions reduction criteria are weighted the same as criteria that have no direct impact. For example, in EU Flower, one can be awarded 4 optional points for the use of eco-labelled detergents whereas in the energy category only 1.5 optional points for using Combined Heat and Power, 1.5. optional points for heating from renewable energy sources, insulation of existing building (2 optional points) and finally 2 optional points for hotels built to bioclimatic architectural principles, although document this is poorly defined. All of the above have a considerable impact in reducing energy consumption and the resulting CO_2 emissions yet this is not reflected in the weighting of points.

Nordic Swan awards the presence of a waste paper basket in the bathroom (1 point) or non-smoking rooms (1 point) and at the same time proportion of electricity and heat which comes from renewable energy sources or waste industrial heat/heat pumps (1-3 pts depending on %). Clearly, the weighting of points does not reflect the environmental impact in terms of emissions reduction.

The same weighting problem is seen in Green Hospitality Award where a participant can be awarded 2 optional points for the use of eco-labelled detergents, 1 optional point for avoiding bottled water, 1 optional point for donating recyclable office items for charity, whereas in the energy category 2 optional points for using Combined Heat and Power, 1.5. Optional points for heating from renewable energy sources, and 2 optional points insulation of existing building. Again, from this point of view one can see that is quite possible for the energy criteria to be rigorous but then to weighted low against other non-energy related categories.

Only two out of the five schemes i.e. LEED-EB and EU Flower include key CO_2 emissions reduction criteria in the mandatory category. Examples of key criteria include proportion of electricity and/or heat from renewables resources, new boiler efficiency of >90%, photovoltaic and wind generation, insulation of existing buildings, etc.

If the true aim of a scheme was to reduce environmental impact then these specific energy related criteria should be more heavily weighted to reflect their environmental impact and emissions reduction. Furthermore, criteria which play a crucial role in reducing the environmental impact should be included in the mandatory section and not awarded optional points only. From this point of view one can see that is quite possible for an assessment to be rigorous but then to weighted low against other categories.

Green Globe also calculates electricity and non-electricity separately (MJ per guest night) which is good. It uses a third party to develop the country specific energy benchmarks (baseline and best practice) for different hotel sub-sectors which is also excellent. It also accounts for the number of day guest equivalent (people who stay at the hotel for at least four hours) and includes resident staff in its guest night calculations which is also excellent. In 2007, it introduced separate Spa Performance Benchmarks (MJ per treatment hour), again this is a good improvement to the scheme however the problem is that it is not mandatory to benchmark spa facilities separately which means some hotels energy consumption figures are inclusive of spa consumption figures and not in others which has an impact on whether or not a hotel is able to achieve the benchmark or not.

*6) **Renewable Energy** (On-site and Off-site)*

In LEED-EB out of a maximum of 85 possible base points (plus 7 for Innovative Operations) *either* 1-4 points are awarded for on-site renewable energy *OR* off-site RECS. However, it is not clear how points are awarded if both off-site and on-site are used. (USGBC, 2009b)

Out of a maximum total point score of 85.5 points in Part A of in Nordic Swan, 1-3 optional points are awarded for proportion of heat which comes from renewable energy sources or waste heat/heat pumps. 1-3 optional points are awarded for proportion of electricity which comes from renewable energy sources. Ecolabelled electricity is included as 100% renewable energy and awarded 3 points. (Nordic Ecolabeling, 2007)

In EU Flower it is a mandatory requirement that 22% of electricity and 22% of electricity used for heating comes from renewable energy sources. In the optional criteria section, 2 optional points (out of 47 optional points[20]**)** are earned for photovoltaic and wind `generation of electricity that supplies 20% of the energy consumption per year and for heating from renewable energy sources (1.5 optional points are awarded). There are additional related points, not referred to in the other schemes, which include 1 point for district heating, Combined Heat & Power (1.5 optional points), Heat Pump(1.5 optional points), Heat Recovery (2 optional points). (EC, 2003)

In the Green Hospitality Award, there are additional mandatory requirements (such as 22% from renewable energy sources) for the Silver/Gold/Platinum Award and additional optional requirements for Silver/Gold/Platinum Award as shown in Appendix 4B. (GHA, 2008a)

In Green Globe, the calculation of CO_2 emissions and/or the percentage (%) of energy produced from renewables does not effect overall benchmarking evaluation. (Green Globe, 2007a)

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[20] 16.5 points required out of possible 77 points.

7) Passive Solar or Bioclimatic Architectural Design

There are no points awarded in any of the schemes apart from EU Flower which awards 2 points if the building is built according to bioclimatic architectural principles although there are difficulties in defining these.

Strengths and Weaknesses of the Individual Schemes

Due to the diversity of the schemes, each has its own merits and drawbacks. For example, process based schemes such as EU Flower these have been criticised as being onerous and time consuming due to the requirement to complete a 152 page verification document (Appendix 5.4a) however this necessitates a hotel becoming familiar with its own operations and maintenance thus enabling it to assess its own performance over time. On the other hand a scheme such as Green Globe which has been heralded as a major step forward relies solely on the use of benchmarks to assess energy performance and does not oblige a hotel to meet such specific and detailed mandatory and optional requirements. Or indeed, as in the case of LEED, the objective of the scheme may result in it becoming no more than a ‘point hunting’ exercise based on mechanical and electrical systems rather than promoting passive or bioclimatic design. (Shaviv, 2008)

The specific strengths and weaknesses found in the review are listed below;

Green Globe. The *strengths* of the Green Globe scheme is that it is the only one which can be applied worldwide using national benchmarks (baseline and best practice) as an indicator to assess energy performance. The scheme has also recently introduced separate spa performance benchmarks which are good. The scheme is also to be commended for reporting energy consumption separately i.e. electricity and fuels, reporting energy performance on a per guest night basis, measuring and monitoring CO_2 emissions per guest night and the percentage of renewable energy used which is all good.

However, the main *weakness* of Green Globe is that energy is not even a mandatory category in this particular scheme which would seem fundamental to an environmental certification scheme. The reliance on benchmarks alone to assess energy performance is not very rigorous when compared to the level of mandatory and optional point’s requirements required by other schemes particularly in some schemes where benchmarks are required in addition to rigorous points system. Another weakness of the scheme is the fact that the percentage of renewables used and the CO_2 emissions per guest do not affect the overall benchmarking evaluation which means that a hotel may in fact pass the energy consumption benchmark but emit high levels of emissions yet still become certified. This effectively allows a hotel with a high environmental impact to be awarded the 'Green' Globe logo. In other cases, a hotel may even fail the energy consumption benchmark and still become certified as 'green'. This raises questions about the true meaning of the logo and what it implies to the unsuspecting guest.

Nordic Swan. The key *strengths* of Nordic Swan is the choice of energy benchmark normalization e.g. kWh per m^2 or per guest night dependent on the geographical location and the class division (which takes into account the occupancy, restaurant turnover and presence of a swimming pool). The scheme also accounts for day, conference and restaurant guests which all have an impact on the accurate calculation of the energy benchmark. Secondly, on top of the energy benchmarks a hotel has to fulfil rigorous mandatory energy requirements and optional points.

A *weakness* of the scheme is that there are no energy related points awarded in hotels with conference facilities, cleaning and laundry, kitchen and dining all of which have a considerable impact on a hotels energy consumption[22] Extra points are awarded if the hotels total energy consumption is a 5-35% lower than the respective energy benchmark. However, the total score that can be achieved is not affected by any extra points from the benchmarks. This does not seem to be weighted fairly when one considers one can earn a point for simply having a waste paper bin in the bathroom!

EU Flower. EU Flower differs from the Nordic Swan, Green Globe and Green Hospitality as it is a process based scheme based on mandatory and optional points. The mandatory category include some good performance targets, for example, at least 22% must come from renewable resources – while the optional category contain criteria that can range from eliminating disposable drink cans and single breakfast portions to using natural and local construction materials, and orientating the buildings to take account of the sun. While these are all admirable steps they are

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[22] Reference is made in *Section 3.5 extra requirements for hotels with restaurant* where 1 point awarded for measuring and recording the kitchen's energy consumption separately. (Nordic Ecolabelling, 2007)

clearly unequal in terms of cost and effect, yet all four seem to be awarded the same number of points for compliance.

LEED-EB*.* The analysis of the LEED-EB scheme concludes it is complex and has rigorous energy criteria however, as is the case with all the other schemes there is a problem with the weighting such that the same number of points is being awarded for energy as non-energy related criteria. For example, 1-3 points can be earned for the purchase of sustainable cleaning products and materials and 1 point for light pollution reduction whereas 1 point can be scored for achieving daylight and views for 90% of Spaces or 2 points for renewable energy which have a direct impact on emissions reduction.

There is no incentive in LEED for passive solar design or bioclimatic architecture. The results of the analysis by Shaviv (2008) found that the emphasis is on achieving energy efficiency by improving the mechanical electrical and hot water systems only rather than awarding points for bio-climatic and/or passive solar aspects in the design. Based on this observation, a passive or bio-climatic design may not be able to achieve Green Building Accreditation which raises questions about the objective of the scheme itself. The examples show how it is possible to become LEED certified by only scoring one additional energy related point out of 69 maximum available points which may mean a hotel can become certified without improving its energy performance of the building at all.

Green Hospitality Award. The mandatory requirements of the higher level award range from somewhat trivial in the waste category i.e. presence of waste bins in toilets to quite prescriptive energy requirements which have a direct impact on emissions reduction i.e. 90% boiler efficiency, 60% of all light bulbs shall be energy efficient Class A. It is only a requirement of the Platinum Award to have 80% of all light bulbs situated where they are likely to be turned on for more than 5 hours a day shall be energy efficient Class A which surely should be a mandatory requirement to achieve Bronze as with the 90% boiler efficiency. The optional requirements for the higher level are quite prescriptive and rigorous including sub-metering of energy intensive areas like laundry and leisure centre, electronic EMS linked to weather compensator to automatically regulate heating/cooling in zoned areas, automatic turnoff of lights and air-conditioner in 80% of rooms. The rigorousness of energy in both the mandatory and higher award categories is HIGH (***). However, a weakness of the Green Hospitality Award scheme is that key criteria which have a greater ability to reduce environmental impact and emissions are not included in the Mandatory energy category to achieve the Bronze Award.

Energy and CO_2 emissions need to be made mandatory categories in all schemes that purport to be a measure of environmental impact. In order to assess improved performance, energy and emissions need to be measured. The weighting of the award of points between energy and non-energy related criteria needs to rigorous and increased points awarded for key CO_2 emissions reduction criteria which should be mandatory. The percentage of renewable energy used needs to be accounted for perhaps by introducing a points system similar to that used in Nordic Swan, EU Flower and more recently in Green Hospitality Award but in such a way that perhaps increasing use might correlate with increasing award of points. A physical description of the hotel needs to be included in the submission documentation. This needs to be linked with the evaluation of the building in certification in order to give incentive to both hotel designers and clients to incorporate passive design features into their designs which would reduce the impact on the environments. Lifestyle and behavioural changes needs to be included in the award of certification again to give incentives to managers and guests like.

5

In depth Study of Four Certified Hotels

This chapter begins with a description of the research method including the different ways to account for changes in emissions as a result of changed use or supply of electricity as seen in the deregulated electricity market and increased cross border trade. An example is given for The Nordic electric power system. This is followed by an explanation of the authors CO_2 accounting method. The next section provides an overview of the data collection and case study selection are presented before the detailed hotel studies (Section 5.1-5.4). The research method used in this chapter is also applied to the data for analysis in Chapter 6.

An analysis was carried out for four illustrative in depth studies, each hotel being certified under one of the schemes reviewed in Chapter 4. The hotels were located in Sweden (Nordic Swan), Maldives (Green Globe), Malta (EU Flower) and Ireland (Green Hospitality Award). Available documentation was studied with respect to building design, technologies applied and resulting energy performance and CO_2 emissions was calculated by the author. Key low energy technological and/or building design techniques were show cased for each hotel. An analysis was conducted on how the hotel scored points in each scheme with particular focus on energy related points.

These quality indepth studies uncover some very important insights into technical realities of certified hotels which otherwise would have been masked. The indepth studies examined the certification schemes in more detail to see if the actual emissions from the selected certified hotels perform better than business-as-usual. For example, the actual energy consumption data sent directly by the hotels are examined to see whether there are errors in reporting, inconsistency in CO_2 accounting method in terms of use of guest nights and to see whether hotels emitting very high levels of emissions are awarded certification. The indepth studies also examine whether the problems uncovered are a direct result of the design of the criteria used in the respective certification scheme in question or relate to the reported data from the hotel.

5.0.1 Dependency of CO_2 Emissions Calculations to Chosen Fuel Mix

Certification schemes should be judged against their ability to reduce CO_2 emissions and mitigate global warming which is why a credible accounting scheme is needed. When national energy systems are becoming more integrated, it is important to view CO_2 emissions from an international perspective. Several European countries are in the process of deregulating their electricity sectors and national power systems in Europe are becoming increasingly interconnected. Since electricity markets will be more open, it will become less relevant to refer to separate national electrical systems in the future. For example, Sweden is now connected with Norway, Finland, Denmark, Germany, and Poland. The exchange in electricity between Sweden and the surrounding countries is extensive. There are also plans to build new cables between the European continent and the Nordic countries as seen in Figure 5.0.1 It is as a result of this cross border exchange that it is more realistic to apply a European Conversion factor for Electricity to delivered electricity for European hotels.

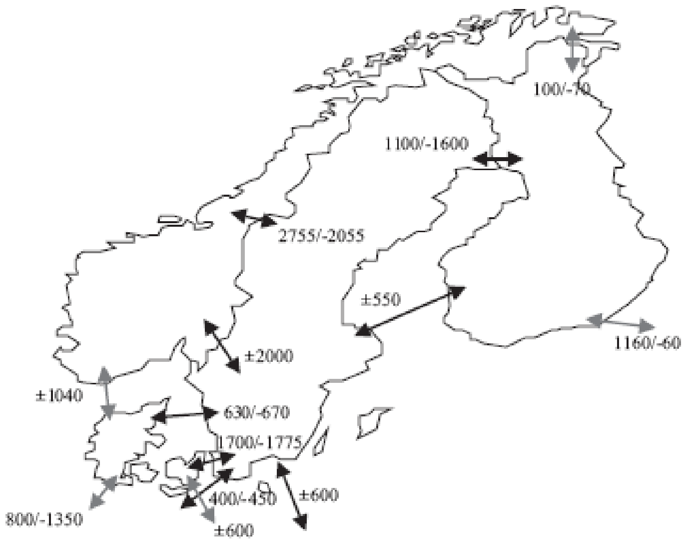

Figure 5.0.1 Nordic Exchange capacities in megawatt, MW. (Note: positive figures indicate Swedish export capacity. The capacity can be different for export and import due to differences in network properties and the location of production facilities) *(Swedenergy, 2003 in Karlsson and Moshfegh, 2007).*

The amount of CO_2 emissions per kWh electricity depends on the surrounding energy system. Either the national average supply mix can be used to calculate the CO_2 emissions from electricity production or a marginal production method where the CO_2 emissions from the marginal production plant are used. (Sjödin and Grönqvist, 2004) Sweden is connected to the other Nordic countries through the Nordic market, NordPool, which also has connections to the European continent. Hence, another accounting method that can be used is the average European emissions. The energy production mix in those three areas is very different. In Sweden nuclear and hydro power is the major part, the latter stands for more than fifty percent of the production mix. The European mix is more diversified with mainly nuclear, coal, hydro and natural gas fired power production (Figure 5.0.2). (Karlsson, Moshfegh, 2007)

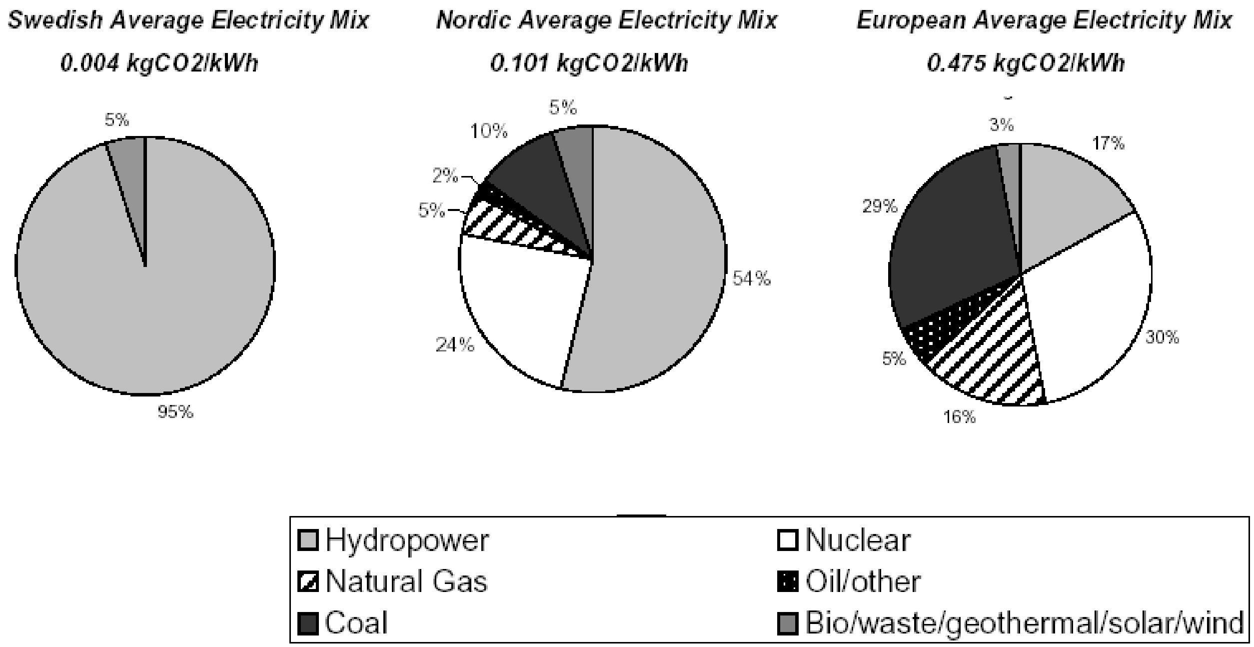

Figure 5.0.2 Fuels used in 'Green', Nordic, European and UK electricity power production. *(Adapted and developed from Karlsson, Moshfegh, 2007, UK figure from BERR 2008a)*

5.0.2 CO_2 Accounting Method

The CO_2 accounting method involves applying the correct conversion factor to the data collected from the delivered electricity and fuels consumption data from the hotels.

Delivered Electricity

In the case of delivered electricity, the European electricity conversion factor (0.475 kg CO_2/kWh) gives a more realistic account of emissions as a result of the cross-border trade of electricity within the European Union. In the case of The United States (0.61 kg CO_2/kWh) and Australia (0.95 kgCO_2/kWh), the national average figures should be applied to the delivered electricity. It is debatable whether in fact it would be more accurate to apply a Universal figure (0.5kg CO_2/kWh) to delivered electricity. (Table 5.0.A)

Average National or Regional	**Delivered Electricity Conversion Factor *(kgCO_2/kWh)***
Australia	0.95[1]
U.S.	0.619[2]
U.K.	0.475[3]
European	0.475[4]
Nordic	0.101[5]
Sweden	0.004[6]
Universal	0.5[7]

Table 5.0.A Delivered electricity conversion factors - Universal, Regional and National. *(AGO 2004,* UNEMG 2009*, BERR 2008b, Sjödin and Grönqvist 2004, IVL 2006, Vattenfall 2006, DECC, 2009)*

The consumption data for delivered fuels, electricity and heat was extracted from invoices, meter readings, monitoring data in excel files, intranet access of hotel

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[1] AGO, 2004
[2] UNEMG, 2009
[3] BERR, 2008b
[4] Sjödin, Grönqvist, 2004
[5] IVL, 2006
[6] Vattenfall, 2006
[7] Calculated by author by calculating the average of the countries included in the International Electricity Emissions Factor (2009 Guideline to DEFRA /DECC's GHG Conversion Factors For Company Reporting)

databases and benchmarking assessment reports. The delivered fuels consumption data differed in units and was converted to CO_2 emissions using the conversion factors from The Carbon Trust and IPCC. The national average electricity fuel mix breakdown and conversion factor was collected from BERR for UK, government and academic sources for each respective country.

Fuels

For heating fuels, the published conversion factor ($kgCO_2$/unit) would then be applied to the figure for heating fuels. (Table 5.0.B below)

Fuel	**Heating Fuels Conversion Factor** *($kgCO_2$/kWh)*
Natural Gas	0.19
LPG	0. 21
Oil	0. 28
Diesel	0. 26
Coal	0. 31
Charcoal	0. 35

Table 5.0.B Diagram of selected published heating fuel conversion factors
(Carbon Trust, 2008).

However, there are some particular rules for CO_2 accounting for fuels which include:
1) *Combined Heat & Power (CHP):* The CO_2 is already accounted for in the electricity; therefore the heat is considered CO_2 free. (See explanation below)
2) *District Heating (DH):* If the district heating not produced by CHP only, then published conversion factors will be applied for the specific combination of heating technology used.

In order to know which conversion factor to apply for, for example in the case of Study 1 hotel Sweden, the district heating information was collected from the supplier about how the heating was generated. If for example, it was found that the heat was delivered from Combined Heat and Power (CHP) stations, then the carbon emissions are counted as zero. This is because the total emissions are already attached to the electricity production. It has been pointed out[8] that in order to deliver useful heat,

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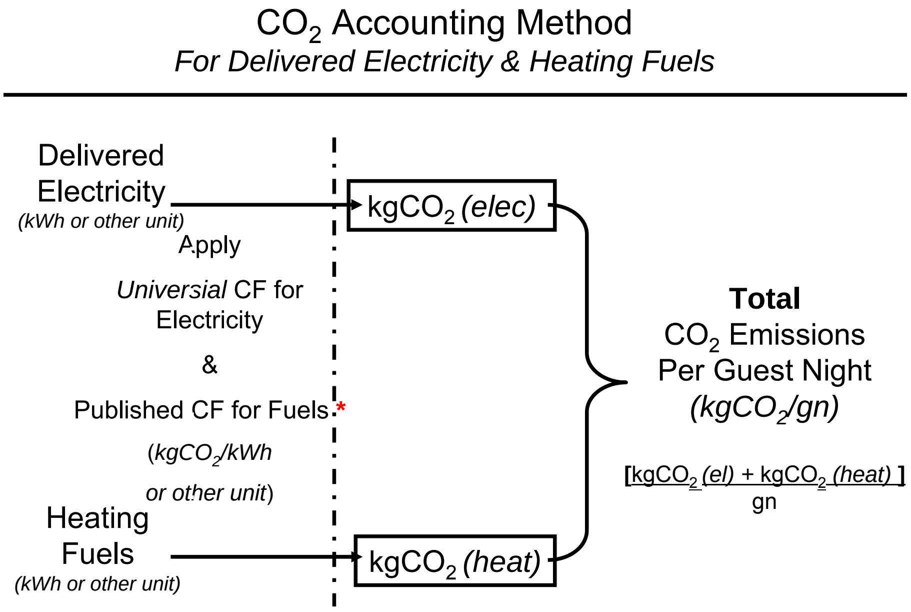
[8] Private Communication with Professor David JC MacKay. (See also MacKay, 2008)

CHP stations generate electricity at slightly reduced thermodynamic efficiency, and thus there should be a small carbon emissions penalty attached to the delivered heat. However, because we are not using local carbon emission factors for electricity, but ones representing the whole grid, this simplification has been adopted.

The author proposes a simple, accurate method of CO_2 emissions calculation (Figure 5.0.3 below) to be used to enable a hotel to assess (and improve) its performance. The key performance indicator would be CO_2 emissions per guest night ($kgCO_2/gn$). The regional, national or universal conversion factor can be applied to the delivered electricity and published conversion factor for fuels as appropriate. This method could be used on its own and developed and adopted universally, in which case certification could be used as a secondary goal. Alternatively, it could be integrated into a certification scheme to make it a more rigorous and reliable measure of environmental impact. The method could be integrated into the design process so that 'cause and effect' scenarios could be tested. This is discussed in more detail in Chapter 7.

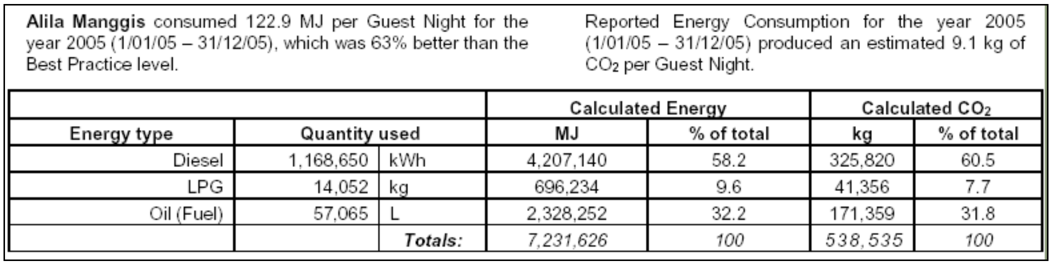


* *Conversion Factors (CF) to be continuously reviewed.*

Figure 5.0.3 Diagram of CO_2 accounting method.

Example Calculation using CO_2 accounting method

An example of a calculation is shown for a resort hotel in Ubud, Indonesia. This is an interesting example since the conversion factor for delivered electricity is applied to the diesel in this case since it is used for the on site generator for electricity to supply the resort. The energy supply for the hotel also includes LPG and oil. The monitoring period is 1 January 2005 – 31 December 2005 and the total annual number of guest nights was 58, 865.



Alila Manggis consumed 122.9 MJ per Guest Night for the year 2005 (1/01/05 – 31/12/05), which was 63% better than the Best Practice level.

Reported Energy Consumption for the year 2005 (1/01/05 – 31/12/05) produced an estimated 9.1 kg of CO_2 per Guest Night.

			Calculated Energy		Calculated CO_2	
Energy type	**Quantity used**		**MJ**	**% of total**	**kg**	**% of total**
Diesel	1,168,650	kWh	4,207,140	58.2	325,820	60.5
LPG	14,052	kg	696,234	9.6	41,356	7.7
Oil (Fuel)	57,065	L	2,328,252	32.2	171,359	31.8
		Totals:	*7,231,626*	*100*	*538,535*	*100*

Table 5.0C Extract from Green Globe Benchmarking Assessment Report. *(Green Globe, 2007)*

Diesel: 1,168,650 kWh x 0.55 $kgCO_2/kWh$[9] = 642,757.50 kg CO_2
LPG: 14,052 kg x 2.82 kg CO_2/kg[10] = 39,626.64 kg CO_2
Oil: 57,065 L x 2.75 kg CO_2/L[11] = 156,928.75 kg CO_2
TOTAL CO_2 Emissions = 839,312.89 kg CO_2

Total CO_2 emissions per guest night = 839,312.89 / 58,865 gn
= 14.25 $kgCO_2$ per guest night

It is interesting to note that the difference between the author's calculations (14.25 $kgCO_2/gn$) and that published in the Green Globe report (9.1 $kgCO_2/gn$). Since the calculation method is not transparent, the author estimates that a conversion factor for diesel (0.26 $kgCO_2/kWh$[12]) has been applied even though it is known that the diesel is used for electricity generation. The figure for diesel is also quoted in kWh rather than litres which support this assumption.

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[9] Universal Conversion Factor for delivered electricity.
[10] Carbon Trust, 2008.
[11] Ibid., 2008
[12] Ibid., 2008.

5.0.3 Data Collection

The research method is described in the following diagram. (Figure 5.0.4)

Research Method

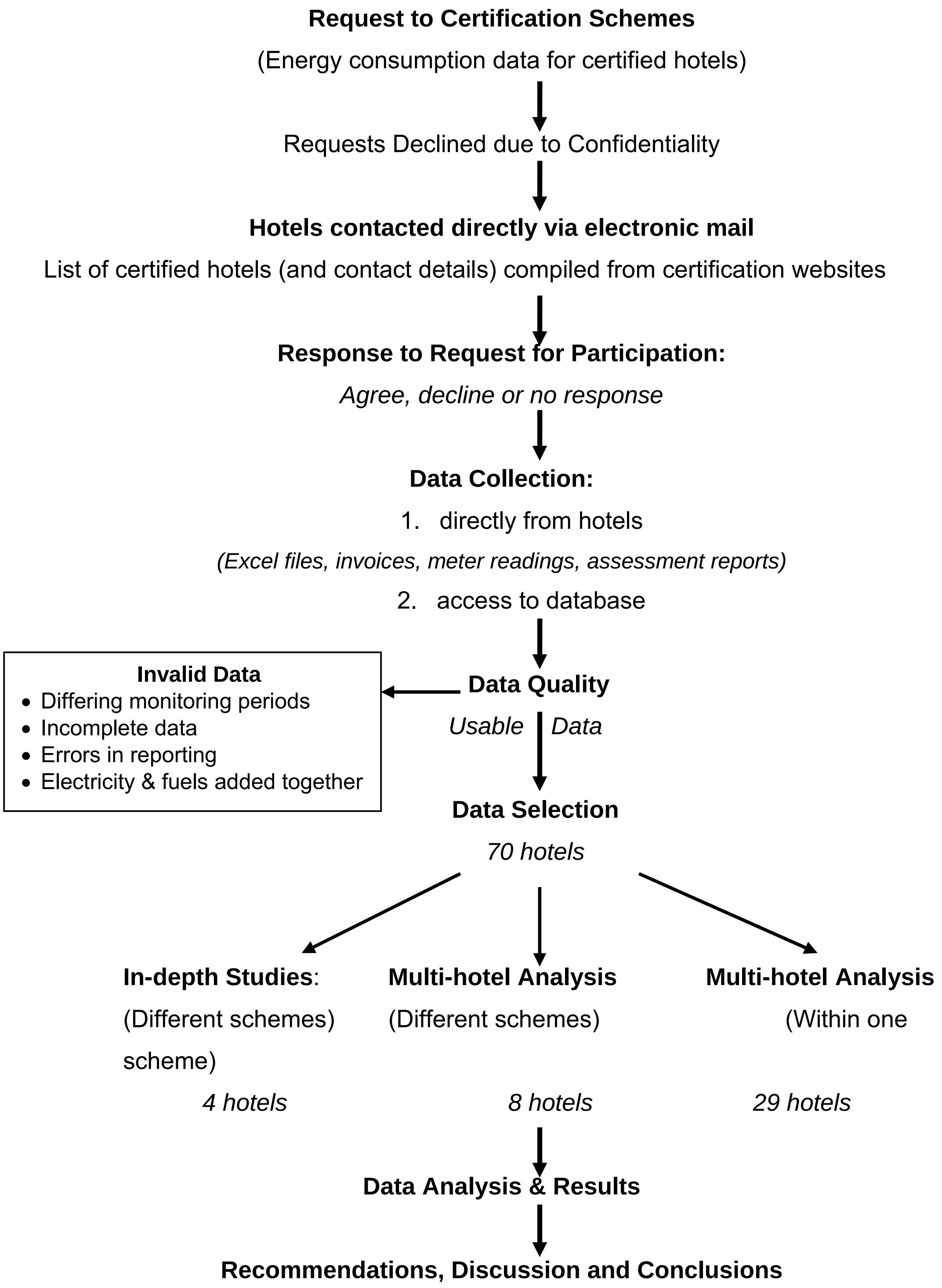

Figure 5.0.4 Diagram of research method for data collection and analysis.

As explained in Chapter 1, the four indepth studies are drawn from the reliable data of seventy selected certified hotels worldwide and information was collected on the physical and operational parameters of the building including: date of certification, total number of guest nights, size, structure, age, orientation and design of the building, number of bedrooms, floors, total area, number of facilities and level of services offered, geographical and climatic location, the type of energy system installed and how they are operated and maintained.

The consumption data for delivered fuels, electricity and heat was collected using the following methods;

- Direct Access to Intranet Database
  (Data submitted to database from hotel)
- Selected Data extracted from intranet database provided by secondary person *(data submitted to database from hotel)*
- Data Benchmarking Assessment Report from certifiers (secondary)
  (Data submitted to certifiers from hotel)
- Data direct from hotel (primary)
  - *Excel format*
  - *Invoices, meter readings*
  - *E-mail (answers to specific questions)*

Reporting Energy Performance

CEN defines Energy Performance as the annual consumption by the building of all fuels, district heating and cooling, electricity etc. (the generic ISO term is “energywares”), under the appropriate conventions including carbon, carbon dioxide, delivered energy in the form of electricity or fuels– each separately measured and where necessary combined into a single number using an appropriate weighting system. According to Bordass (2005), the UK is likely to use CO_2 (e.g. in $kgCO_2/kWh$ for energyware), but other countries may well adopt other factors (e.g. primary energy) to take account of their national or regional energy economies and the appropriate policy drivers. (Bordass, 2005)

The energy performance may be converted into an Energy Performance Indicator (EPI for each energyware or for the weighted total), by dividing it by a measure of extent of the building. This will normally be floor area (to agreed definitions e.g. conditioned space). Other denominators (e.g. guest nights, and number of hotel bedrooms) might be included. (Bordass, 2005) It should also be pointed out that the energy consumption performance indicator (kWh/m^2) is only useful if electricity and fossil fuels (natural gas, oil, LPG, and solid fuel) are calculated separately which enables the total CO_2 emissions to be calculated using the proposed CO_2 Accounting Method (see section 5.0.2).

Existing energy performance indicators and benchmarks tend to be area based and are typically presented for consumption in kWh per square metre per year which can then be compared to published energy consumption benchmarks as used in BRESCU (1993), ECOTRANS IER (2006), ITP (2008), Nordic Ecolabelling (2007). These benchmarks are usually derived from the measured performance of hotels, sometimes statistically as in EnergyStar used in LEED-EB or in others, for example, Guide 36 (BRESCU, 1993), three bands of performance have been established - *good, fair* and *poor.* These bands have been derived so that the 25% of hotels in the sample with the lowest energy consumption (kWh/m2) comprise the *good* band, while the 25% with the highest energy comprise the *poor* band. The remaining 50% comprise the *fair* band. (BRESCU, 1993) In others as in the case of Nordic Ecolabelling (2007), in order to account for hotels with a high occupancy rate, a hotel can choose between an energy performance benchmark based on area (kWh/m^2) or there is also the alternative of relating it to the number of guest nights (kWh/gn).

While area is considered to be the most practical denominator for many reasons, modern commercial buildings tend to use their floor space more intensively: for such buildings, a high energy use in relation to a historic benchmark may not necessarily mean inefficient. (Bordass, 2005) The energy consumption metric (kWh/m^2) does not give any information on the environmental impact of the energy consumed by the hotel in terms of CO_2 emissions.

The delivered fuels consumption data collected from the sources differed in units as described in the previous section. The most appropriate unit for the hotelier to collect data is in kWh which can then be converted to kgCO_2 for the purpose of assessment. By comparing the benchmark to the unit most relevant for emissions which is kgCO_2 which could be on a per square metre or a per guest night basis. This research is concerned with the significance of hotel emissions on a global scale and a more enlightened approach would be to measure kgCO_2 relating to the occupancy metric which is per guest night. Putting the universal CO_2 unit (kgCO_2) with most commonly used hotel unit which is per guest night. The most appropriate unit for the purposes of this research (which is addressed at scientists who are familiar with the use of this CO_2 unit) is $kgCO_2$/gn which ensures that the efficiency of providing the service i.e. accommodation is credited, rather than simply providing space, which may be over provided due to poor planning and design, or serviced unnecessarily due to poor controls and management.

The delivered fuels consumption data differed in units and was converted to CO_2 emissions ($kgCO_2$/kWh) using the published conversion as shown in Table 5.0B. The national average electricity fuel mix breakdown and conversion factor was collected from BERR for the UK and government and academic sources for each respective country as shown in Table 5.0A.

In order to know which conversion factor to apply, the delivered electricity and heating information was collected from the respective supplier to determine how the heating and electricity was generated. For example, in Study 1 hotel, Sweden the information on the Hilton Environmental Reporting (HER) database indicated the heating was supplied by District Heating. Further contact was made with the hotel and then directly with the supplier who then confirmed that this was a Combined Heat and Power plant for which the emissions would be calculated as zero as per the CO_2 accounting method previously described. In this particular example, the particular hotel purchased 'green' electricity certificates from their electricity provider and the hotel felt justified to apply the conversion factor for hydroelectric (0.04 $kgCO_2$/kWh) whereas the argument of this thesis is that it is more realistic to apply the European conversion factor (0.475 $kgCO_2$/kWh) due to Sweden's connection to Nordpool as previously explained. This hotel example will be discussed in more detail in section 5.1.

Data Limitations

The most serious error in the data collection process was the fact that the delivered electricity and heating had been added together giving an erroneous performance figure and in other cases, the data was sent as a single energy performance indicator (kWh/m^2) with no breakdown of the electricity and heat resulting in the data being usable. Where access to the database had been provided or where separated electricity and heating figures had been provided prior to being added together then this data was unusable for calculation purposes.

Other reasons for invalid data included the data being incomplete. For example, the data was provided for only 8 months of the year or data was missing for certain months of the year, or the data was unreliable as repeating identical values were given for different months of the year. Where consumption data was provided in directly from the hotel as well as the benchmarking assessment reports, then errors in reporting were found or the data was inaccurate and therefore invalid. In another case where data was received from hotels certified under EU Flower, it could not be included in the analysis since in one case the hotel only operated for four months of the year and in other case the energy consumption data was unavailable.

Data Quality

As previously discussed in Chapter 3 and 4, the problem of lack of transparency, accuracy and validity in the publication of the benchmarks was evident whilst collecting consumption data to analyse. Due to confidentiality issues, none of the selected certification schemes would disclose any information or release consumption data for any of the hotels certified under the respective schemes. The author then decided to compile a list of the certified hotels from the website for the respective certification scheme. She then contacted each of the hotels individually via electronic mail to request data confirming confidentiality. This direct approach proved most successful in terms of response.

The author also established a relationship with Dr. Paulina Bohdanowicz [13] Sustainability Manager of Hilton Europe and Mr. Jan-Peter Berkvist, the Environmental Director of Scandic, who very kindly granted access to the Hilton and Scandic Resource Consumption Europe and Africa database for 75 hotels worldwide. In addition, Dr. Bohdanowicz arranged for the data for twelve Scandic hotels to be extracted from the Scandic Utility System (SUS) database. A relationship was also developed with Ms. Pia Heidenmark-Cook, the environmental manager of Reizador SAS hotel group who very kindly sent the energy performance indicators for 121 hotels worldwide although this could not be included in the analysis due to data limitations.

Contact was established Mr. Maurice Bergin, the developer of The Green Hospitality (formerly Fáilte) Award, Ireland's first environmental award scheme for the hospitality

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[13] Dr. Bohdanowicz was responsible for developing the Hilton Environmental Reporting (HER) system.

sector. Mr. Bergin kindly provided me with Draft Final report entitled the 'Development of a CP programme for the Irish Hotel Industry, "Greening Irish Hotels"' submitted to the Environmental Protection Agency in Ireland. (Hogan and Bergin, 2006) This report described the scheme criteria in detail as well as the published energy performance benchmarks together with a brief outline of three case studies. The author contacted each of the certified hotels via electronic e-mail in March 2007. Only 2 out of 47 hotels responded. These two hotels provided energy consumption data for their hotels however, one of the hotels data was unusable as several months' consumption data was missing. The missing data was not received despite direct requests to the hotel. The second hotel had a complete dataset and therefore was included as Study 3 hotel, Ireland.

A question arose as to how to test the performance (in terms of energy consumption and CO_2 emissions) of hotels certified under *process based* schemes that did not use quantitative data or energy benchmarks to assess performance. The author contacted the hotels directly describing her research objectives and assuring confidentiality of any data received. The hotels then sent her their energy consumption data typically in excel format. This method enabled the researcher to assess and compare the performance of a hotel certified under *a process based* scheme with a *performance based* scheme such as Green Globe, Nordic Swan or Green Hospitality Award.

5.0.4 Case Study Selection

From the available data for 70 hotels worldwide, four indepth study hotels were selected one for each of the four certification schemes. The intention of the indepth studies is illustrative rather than comparative, to showcase the diversity in certified 'green' hotels on an International level but also on a local level depending on the scope of the certification scheme. The characteristics of each are shown in Table 5.0D and Table 5.0E. below.

Indepth Study	**Certification**	**Calculated CO_2 Emissions** ($kgCO_2/gn$)	**Country**	**Hotel Type**	**Hotel Rating**
1	Green Globe	22.0	Maldives	Vacation, Resort Chain	6 star

2	Nordic Swan	6.8	Sweden	Business, Chain	4 star
3	EU Flower	53.0	Malta	Vacation/Business, Chain	5 star
4	Green Failte Award	16.3	Ireland	Vacation, Local	4 star

Table 5.0D Summary of four selected certified hotels.

Indepth Study	***Area (m^2)***	***Number of Bedrooms***	***Restaurant***	***Swimming Pool***	***In House Laundry***	***Conference Facilities***
1	16,000	283	√	X	X	√
2	18,650	65 villas *(124 guests)*	√	√	√	X
3	41,100	294	√	√	√	√
4	5,728	85	√	X	√	X

Table 5.0E Summary of facilities offered by the four selected certified hotels.

The studies were selected depending on the data availability and/or key features that make the hotel a good example of a ‘green’ hotel and/or it may have been chosen to examine how a ‘gold standard green’ hotel performs in practice. Each hotel will be explained in more detail in Sections 5.1 to 5.4.

5.1

Indepth Study 1

Chain Hotel, Stockholm, Sweden

This case study building was chosen as an example of a Nordic Swan certified ‘green’ hotel and one that challenges our preconceptions of such a hotel. Is it possible for a large, business chain hotel to have a significantly lower environmental impact than our traditional image of a ‘sustainable’ or ‘eco-hotel’? Is this performance attributable to a more sustainable energy supply and good energy conservation rather than due to the fact the hotel is ‘eco-certified’? The contribution of ‘Green’ electricity and the concept of the ‘Eco-room’ are challenged in this study, and the benefits presented of the sea water cooling system and district heating (CHP plant).

5.1.1 Physical Description

Study 1 hotel is a business, chain hotel located on the water front in Stockholm, Sweden where the climate is continental. As a result of the Gulf Stream, Stockholm has relatively mild temperatures, summers are warm & pleasant[1], winters are cold[2] and spring and autumn are generally cool to mild.

A summary sheet of Study 1 hotel is shown overleaf. (Table 5.1A) No information was available from the hotel concerning the construction of the hotel other than the basement is made out of concrete and the rest of the building is made of steel frame and concrete floors. (Palmu, 2007a) The hotel was purpose built in 1989 and has a two storey basement, one floor of which is below sea level. The building comprises three blocks; one 18 storey, 62m high accommodation block (Encircled red in Figure 5.1.1,2,3 and 4) and two five storey blocks around a central atrium as shown in Figure 5.1.5. The building occupied by the hotel, is owned by an independent company which rents out the two (five storey) blocks of the building to private companies (Encircled yellow in Figure 5.1.1, 2 and 4). The consumption data for these two five storey blocks is not included in the data provided by the hotel. The ground floor of these two blocks is leased by Study Hotel 1 forming part of the hotel.

The hotel floor plan layout of the accommodation block is 'double corridor' slab configuration where the rooms are laid out on both sides of a corridor. The block consists of 283 guest bedrooms, half of which face east across the harbour with the other half facing west. The majority of the rooms are double rooms, with an average room size of 19 m^2. The hotel rooms are very well day lit.

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[1] Average daytime high temperatures of 20 - 22°C (68 - 72°F) ,lows of around 13°C (55°F), temperatures frequently exceed 25°C (77°F).

[2] Average temperatures range from -5 to 1°C (23 - 33°F) and rarely drop below −10°C (14 °F).

Study Hotel 1
Stockholm, Sweden

Description of Hotel

Study hotel 1 is a modern waterfront hotel located outside Stockholm city centre. The building comprises of one 18 floor accommodation block 62m high and two five storey office blocks around a central atrium.

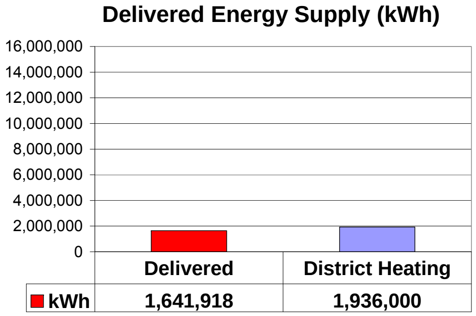
Facilities

- Atrium
- 17 meeting rooms
  (10>10 people, 7<10 people)
- 1 restaurant (600 covers: buffet & a la carte)
- Atrium bar (light meals), Sky Bar
- Sauna department

Key Features

- 'Green' Electricity Certificate
- District Heating (CHP Plant)
- Sea-water Cooling System
- 'Eco' Room: 97% recyclable and/or biodegradable

Key Performance Indicator	
$kgCO_2$ per guest night	**6.8**
$kgCO_2$	**738,863**



Key Facts	
Logo	
Certification	Nordic Swan
Date of Certification	October 2003
Surface/ Bed	57
Hotel Type	Business
Location	Waterfront
Year Built	1989
Hotel Area (m^2)	16,000
Number floors	18
Bedrooms	283
Restaurant	1 (*See Facilities*)
Conference	Yes (*See Facilities*)
Swimming Pool	No
Jacuzzi	No
Laundry	Out Sourced

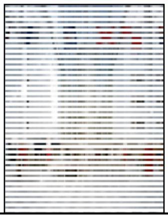


Table 5.1A Summary Sheet of Study 1 hotel *(Source: Author).*

Figure 5.1.1 Photograph of business, chain hotel, Stockholm, Sweden
(Source:Confidential)

Figure 5.1.2 Massing of the building
(Source:Confidential)

Figure 5.1.3 Harbour front elevation
(Source:Confidential)

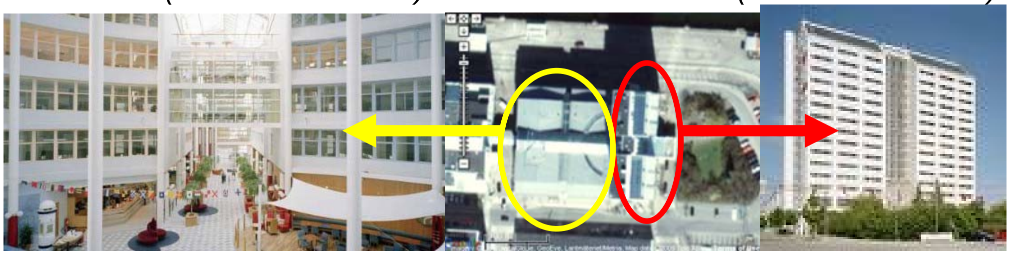


Figure 5.1.4. Photographs A, B, C showing the massing of the building.
(Source: Confidential)

Figure 5.1.1 East facing accommodation block facing the harbour. (Source: Confidential)

Figure 5.1.2 Accommodation block in red and five storey block in yellow (Source: Confidential)

Figure 5.1.3 East façade of accommodation block (Source: Confidential)

Figure 5.1.4 Central atrium looking west along the 'street' showing offices rented to private companies on the upper floors. (Source: Confidential)); Aerial photograph showing the massing of the building. The yellow zone shows the five storey office blocks running along the 'street' atrium, the red zone shows the 18 floor accommodation block.(Source: Confidential)

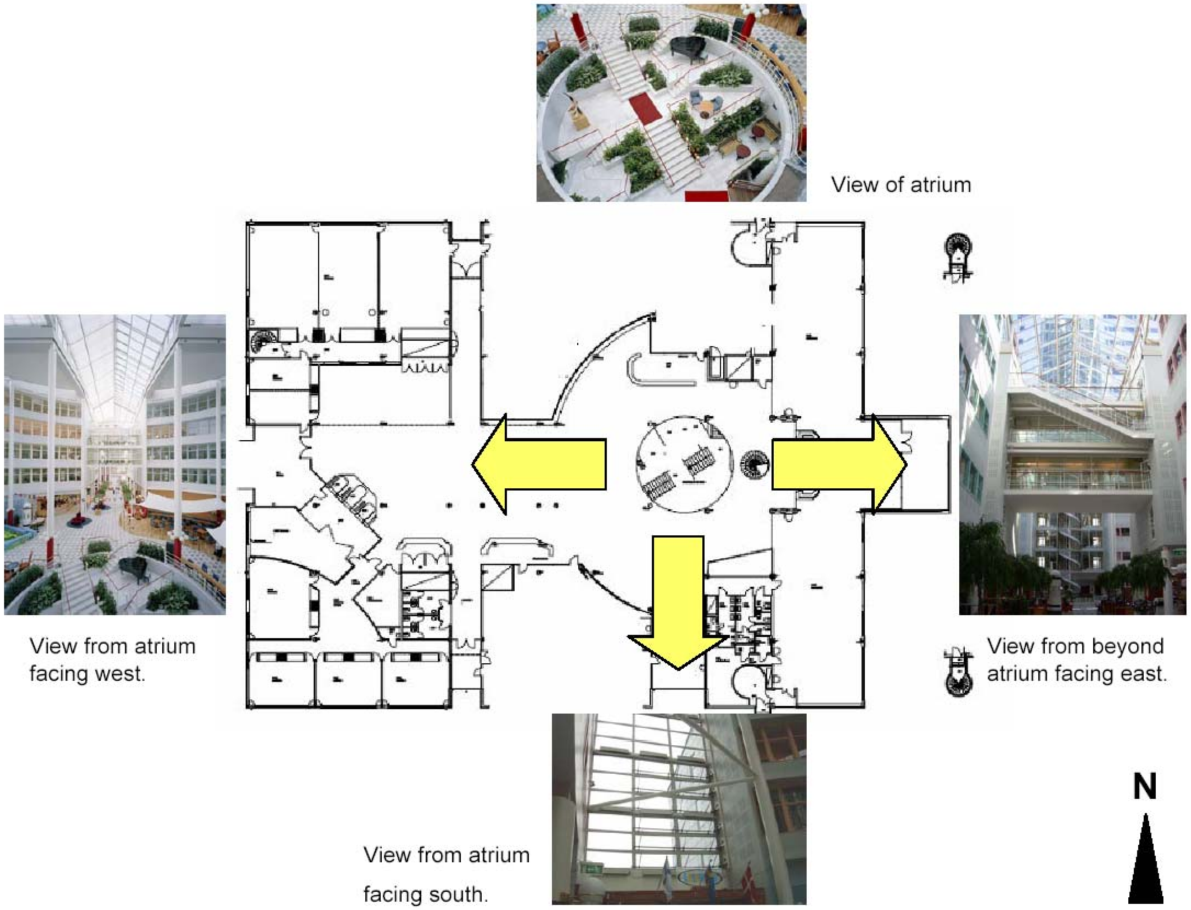


Figure 5.1.5 Ground Floor Plan showing the central atrium, restaurant, meeting and conference rooms and fitness suite. *(Source: Confidential)*

The bed to surface ratio of the hotel is 57. The activities of the hotel are partly conference and partly hotel business. The hotel operates year around. There are seventeen meeting rooms (ten occupying more then ten people and seven for less than ten people) centered around the central atrium located on the ground floor. The hotel has one restaurant (600 covers offering buffet and a la carte). There is also an atrium bar offering light snacks and a sky bar and meeting rooms located on the 18th floor of the accommodation block. The restaurant as well as the café/bar is open to the public, not only to conference/hotel guests. The ground floor plan of the hotel is shown in Figure 5.1.5

5.1.2 Energy Supply

The annual local energy supply to the building in 2006, consists of delivered electricity and district heating (CHP) as shown in Table 5.1B below.

2006	**Quantity**	**CO_2 Emissions ($kgCO_2$)**
Delivered Electricity	1,641,918 kWh	738,863 $kgCO_2$[3]
Delivered Electricity Per Guest Night[4]	15 kWh/gn	
District Heating (CHP)	1,936,000 kWh	zero[5]
Delivered Electricity Per Guest Night	18 kWh/gn	
Total CO_2 Emissions		**738,863 $kgCO_2$**
Total CO_2 Emissions Per Guest Night		**6.8 $kgCO_2$/gn**

Table 5.1B Summary of Energy Supply for Study 1 hotel. *(Source: Author)*

Delivered Electricity

The electricity net in Värtahamnen, where the building is located, is owned by Fortum and is responsible for heat/cold production and for the district heating/cooling systems in the greater Stockholm area. (Friotherm, 2005a) Telge Kraft purchase all the electricity for this building in which the hotel is located.

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[3] Average EU Conversion factor: 0.45 $kgCO_2$/kWh (ÅF, 2006 in Sjödin, Grönqvist, 2004)

[4] Sleepers only – 108,757 guest nights (SUS database, 2007)

[5] The district heating is supplied by Combined Heat and Power (CHP) and we have already ascribed the CO_2 emissions to the electricity. Thus the CO_2 emissions for the heating are considered to be zero. The CO_2 emissions for electricity from CHP are in fact higher than for normal power stations. (See section 5.0.2)

During 2006-7, the building owners bought a 'green' electricity certificate called "Bra Miljöval" (see Appendix 5.1A) which claims that all electricity consumed comes from 100% hydropower. Scandic pays 0,28öre[6]/kwh extra for green electricity from the electricity supplier, Vattenfall who are now merged with Fortum.[7] Fortum is a publicly listed energy supplier focussing on the Nordic and Baltic counties. Before buying 'green' electricity certificates, the electricity was bought on NordPool[8]. According to Fortum, the total fuel mix for all deliveries to their customers (except those who have bought "Bra Miljöval" – 'green' electricity certificates) is 70% renewable (hydro[9], wind and bio) 18 % fossil (coal, oil and peat) and 12% nuclear as seen below in Figure 5.1.6 below (Fortum, 2008)

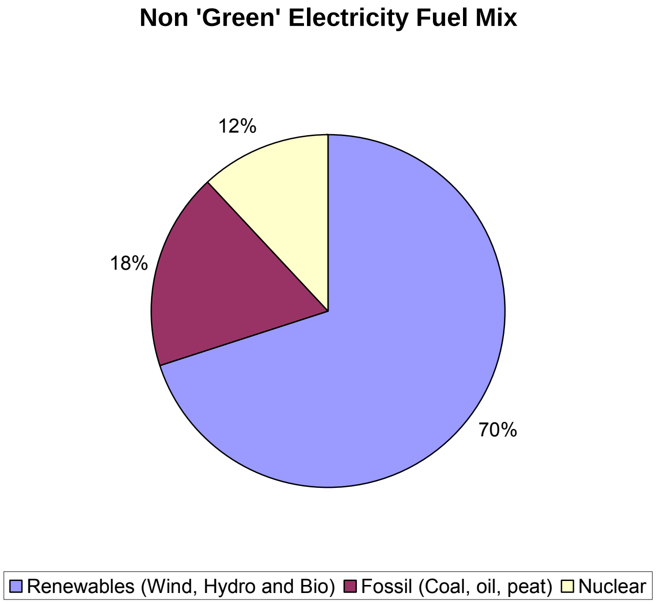

Figure 5.1.6 Non 'Green' electricity fuel mix *(Fortum, 2008).*

District Heating

In Stockholm there is no supply of natural gas, therefore district heating competes mainly with local oil heating as well as electric heating Almost 75 percent of the customers on Stockholm's total heat market have chosen district heating. (Fortum, 2006) The building is supplied with heating from a district heating plant (CHP) located

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[6] Öre 1 Krona =100 Öre = 1 Swedish crown is 100 Öre (Money) (Palmu, 2007b)
[7] Palmu, 2007c.
[8] NordPool is Europe's largest marketplace for physical and financial power contracts, and amongst the largest exchanges within trading of European Union emissions allowances (EUAs) and global certified emissions reductions (CERs) (Nordpool, 2009).
[9] Hydropower accounts for over one third of Fortum's annual power generation. (Fortum, 2009).

in Stockholm-Värtan. The energy sources for the heat supply for District Heating from the Stockholm Värtan Heat and Power Plant in Figure 5.1.7 below:

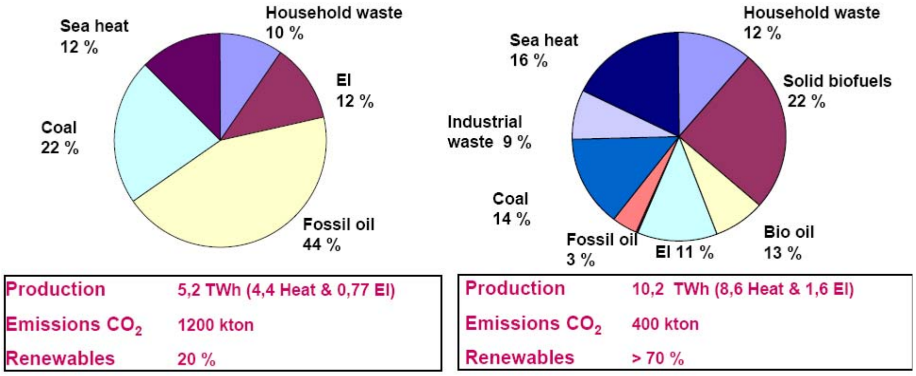

Figure 5.1.7 Fuel Mix 1986 and 2006: Fortum district heating plants in Stockholm. *(Fortum, 2008)*

Sea Water Cooling System

The installed system utilises local sea water for heating and cooling[10] resulting in a 30% lower requirement for district heating. Cooling is produced by cold sea water being drawn in through the inlet to the heat pump and then passing six plate heat exchangers that cool the water pumped out into the district cooling network. The heat exchanger plates are made of titanium in order to withstand the corrosive, brackish sea water. The temperature of the cooling water leaving the plant is 6°C or lower and the return temperature from the distribution grid is 16°C at high load and a few degrees lower at low load. (Friotherm, 2005b)

Standard Matrix For Fuels Use

See Table 5.1C on the following page.

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[10] It is estimated that the seawater cooling system saves about 30% of the cooling load for comfort cooling. (Palmu, 2007d)

Study 1	**On Site Electricity**	**Space Heating**	**A/C Comfort Cooling**	**Hot Water**	**Catering**	**Lighting**	**Laundry**	**Lifts**	**Swimming Pool**	**Sauna**	**Other**[11]
Grid Electricity			√[12]		√[13]	√		√		√	√
District Heating/CHP		√		√							
Natural Gas											
LPG											
Oil											
Diesel											
Biomass											
Other *Gas*					√						
Sea Water Cooling		√	√								

Table 5.1C Standard Matrix for Energy Use for Study 1 *(Source: Author).*

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[11] Electricity is used for cooling installations such as refrigerators, dish washers etc.
Individual air-conditioning units are used in areas where there is more heat gain such as computer rooms.
[12] To run fans, ducts etc.
[13] Electricity is used for some cooking and for ovens to keep food warm.

District Heating (CHP)

District Heating (Combined Heat and Power) in the hotel is used to produce the space heating and domestic hot water. Domestic hot water is pumped around the buildings from a series of hot water storage tanks in the plant room to heat wet radiators in each room. To the guest the heating system looks conventional as seen in Figure 5.1.8 and 5.1.9 below

Figure 5.1.8. Example of heat emitter in a typical guest bedroom (Source: Houlihan, 2007)

Figure 5.1.9 Hot water storage tanks located in the heating plant room. (photo: Houlihan, 2007)

Delivered Electricity

It is not possible to provide an accurate account of the energy end use since the hotel is not sub-metered. However, it is estimated by the hotel's environmental manager that the electricity is used mainly for the mechanical ventilation with heat recovery system (MVHR). Electricity is also used for lighting in the hotel as well as to supply the sauna facilities as seen in Figure 5.1.10. Although gas is used for cooking in the kitchen, electricity is used for some cooking and for ovens to keep food warm as well as other cooling installations such as refrigerators, and dish washers etc. Individual air-conditioning units are used in some areas such as computer rooms. The lifts are a special low energy lift which utilises an electromagnetic braking system and gravitational force.

Figure 5.1.10 Typical Electricity End Uses i.e.: electrical sauna, refrigerators *(photo: Houlihan, 2007)*

5.1.3 Energy Use

Energy conservation measures include more efficient use of heating and reduced use of cooling which are adjusted to occupancy. The hotel is well designed to maximize the benefits natural lighting. The central atrium is glazed and the meeting room and the break out area have large windows for daylight, which is beneficial for the occupants and saves electricity. Approximately 80% of all lamps at Scandic Ariadne (app. 15000 bulbs) are low energy lamps. Outdoor lighting is controlled according to the illumination (dusk relais). Lights in guest rooms are switched on/off with guest's key card, meaning that the lights will only be switched on if the guest is in the room. (Nordic Ecolabelling, 2007)

Ventilation is provided in the re-circulation system. The daytime cooling requirement is further controlled by the automatic sun shades installed on windows. When hot – the roof in the atrium automatically opens to provide natural ventilation and fans are turned off. It is suggested that the lower energy consumption is also due to changes in behaviour among team members and the presence of a proactive environmental manager. In addition, Scandic has a programme for improving the utilization of natural resources is called"Save and Change". (Nordic Ecolabelling, 2007)

Ventilation and Comfort Cooling

In addition to natural ventilation (operable windows in guest bedrooms and some areas not intended for guests etc.), there is a mechanical ventilation with heat recovery system (MVHR) as shown in figure 5.1.11 A and B. The recovered heat is recirculated in the system. The ventilation has two Air Handling Units located in both the 18th floor plant room and in the basement. The cooling load is reduced by 30% through the sea water cooling system located in the basement: The air handling units supply the conference/meeting rooms, atrium, restaurant and sky bar/meeting room.

A **B**

Figure 5.1.11 A and B Examples of typical ventilation supply/extract in main conference room *(Houlihan, 2007).*

The ventilation and heating strategy includes some ‘comfort cooling.’ Comfort cooling tempers the fresh air supply by +/- 4^0C and uses a third of the energy required for air-conditioning. The system is controlled by a computerized building environmental management system located in the plant room that is operated by external consultants.

The heating and lighting is controlled from a panel located in the service area of the hotel. The panel and individual switches is shown in figure 5.1.12. The switches control the heating and lighting in different zones of the hotel for example the entrance foyer, hotel corridors etc. This allows the front of staff and the manager to over ride the automatic system if required and turn off the heating for example in a corridor during periods of low occupancy. (Palmu, 2009)

Figure 5.1.12 A and B Zoned heating control panels *(photo: Houlihan, 2007).*

Guest Rooms: ‘ECO-ROOM’ - 97% Recyclable or Biodegradable

The concept of the eco-room (a 97% recyclable hotel room) was introduced by Scandic in 1995. The initiative implies that the rooms are designed and built for their eventual disassembly. These rooms utilize environmentally-benign components to the greatest possible extent possible under current technology. Materials used to construct these rooms are 97% recyclable and include wooden furniture and floors, pure cotton or wool textiles (Figure 5.1.13 A and B) and limited amount of fittings made of chrome, metal or plastic.

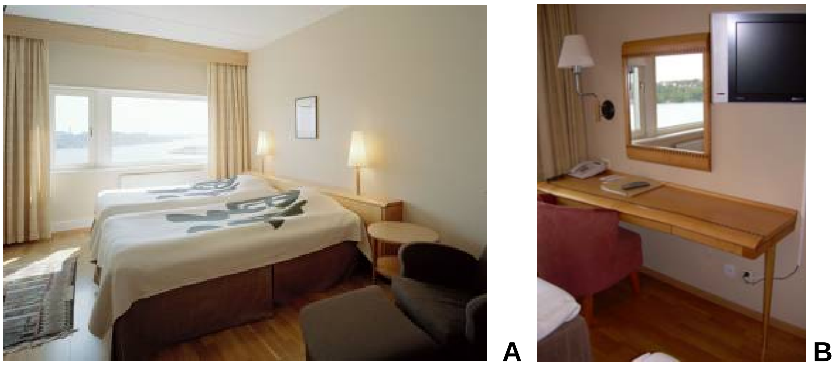

Figure 5.1.13 A and B Example of an 'Eco-room' designed for low impact and recycling *(A: Source Confidential, B: Houlihan, 2007).*

Guest Interaction

There is a key card system (A) in each guest room and the temperature inside the rooms is between 19-21⁰C. Each room is provided with comfort control which allows the occupant to increase or decrease the temperature by 4⁰C using manual controls located inside the room. (B) There are also operable windows to provide natural ventilation. (E)

A Guest key card system
B Ventilation and heating control
C Manual input to confirm windows closed, lighting switched off, ventilation/heating set to a minimum.
D Water radiators for heating
E Openable windows
F Ventilation supply and return duct
G Compact fluorescent lighting

Figure 5.1.14 A-G Interior photographs of 'Eco-room.' *(photos: Houlihan, 2007)*

Energy conservation measures involved the co-operation of the chamber maids as seen above. After cleaning a room, the chambermaid uses the TV remote control to confirm the room is clean and to report any breakages. She would also ensure the windows have been closed, the lighting has been switched off (switches off automatically when the card is removed), and ventilation/heating controls have been set to the normal position. (Palmu, 2009e)

5.1.4 Nordic Swan Analysis of Actual Energy Consumption Data

Data Collection

In order to perform this analysis, Nordic Ecolabelling of Hotels and Youth Hostels Version 3.2, 14 June 2007 - 30 June 2012 was referred to. A copy of the hotel Checklist-2008 for Nordic Swan certification (See Appendix 5.1C) was obtained from the environmental manager at the hotel. This contained a description of the hotel, limit value figures and a breakdown of the hotels points awarded and obligatory requirements are also included. This data enabled me to establish the weighting in relation to the actual reduction of energy consumption (and emissions).

Analysis

As described in Chapter 4, the requirements of Nordic Swan certification is in three parts; 1) Description of hotel 2) Limit Values (benchmarks) 3) Points awarded for Environmental Requirements *(Obligatory requirements, points from Part A, B, C)*. According to the Nordic Swan certification documentation (See Appendix 5.1C), this hotel is a Class A hotel [14]and its total delivered energy consumption was calculated as 335 kWh/m^2 or 55kWh per guest night which is 43% lower than the limit value required by the scheme. Appendix 5.1D shows a breakdown of the mandatory requirements and point scores awarded to the Study 1 hotel for each different category together the total points score.

In the *Section 3 - environmental requirements,* Figure 5.1.15 below shows the maximum possible score & obligatory requirements and how many of these points were energy related and of these how many were achieved by the hotel. (See Appendix 5.1E)

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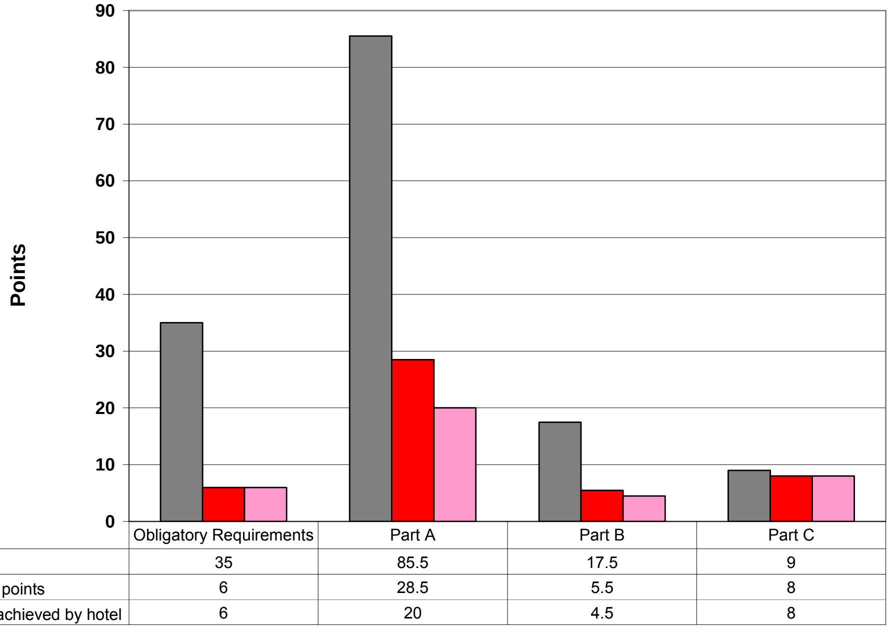
[14] Nordic Ecolabelling, 2007, p.8.



	Obligatory Requirements	Part A	Part B	Part C
■ Total points	35	85.5	17.5	9
■ Energy related points	6	28.5	5.5	8
■ Energy points achieved by hotel	6	20	4.5	8

Obligatory Requirements[15] *in Part A, B and C*
Part A: Total Available Points
Part B: Extra requirements for hotels with restaurants and/or conference facilities and/or pool.
Part C: Extra points from the limit values and bonus points, Swan-labelled restaurants.

Figure 5.1.15 Weighting of energy related points in the overall award of points in Section 3 - environmental requirements (*Source: Author, Information taken from Nordic Ecolabelling, 2007).*

In Part A, Only 28.5 out of the 85.5 points (maximum available) are energy related and out of these points the hotel achieved 20.

In Part B, the hotel scored 10 (6 points in the *extra requirements for hotels with restaurants* and 4 points in the '*with conference facilities'* section) out of maximum 17.5 points. Out of these maximum available points, 5.5 are energy related of which the hotel achieved 4.5 points.

In Part C, the hotel scored a further 8 out of maximum 9 available points from the limit values and energy consumption section. Eight of the available points are energy related and the hotel achieved all of these points.

This gives a total of 18 extra points in addition to the original 60 points giving a total for the hotel of 78 points which means the hotel scored 75% of the maximum total point score (65% min. required for certification) and 70% of the maximum score for Operation and maintenance (60% min. required for certification).

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[15] For clarity, of the 35 total obligatory requirements, 6 were energy related and all 6 were achieved by the hotel. The requirements are not points.

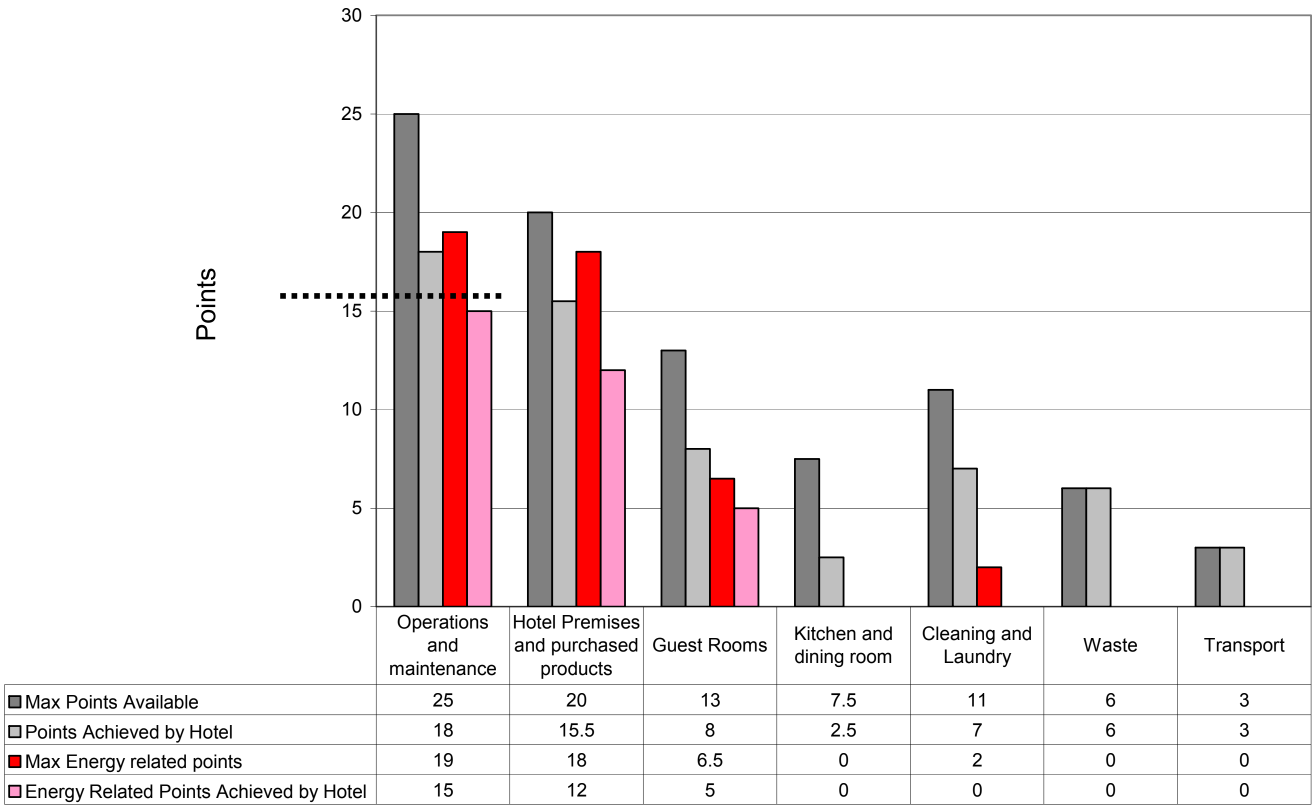
In the *Section 1-description of the hotel*, no reference is made to bioclimatic architecture or any passive design features that relate to the reduction of energy consumption (emissions). In *Section 2-limit values*, energy consumption is one of four benchmarks (water consumption, chemical products and waste management) and is mandatory as of 2007 when the criteria was revised. In *Section 3 - environmental requirements - Part A,* Figure 5.1.16 on the next page, shows the breakdown of points and energy related points scored by the hotel. (Appendix 5.1E)

Results

From the analysis, it is clear that the weighting of energy related points and obligatory requirements in all categories apart from Operations & Maintenance is very low and non-existent in energy intensive areas such as the kitchen and laundry.

Only 50% of the points awarded in the guest rooms are energy related and where they are awarded it does not necessarily correlate to the impact on energy reduction (and emissions). For example, in P26 lighting, only 1 point is awarded for having over 90% of the lighting in the guest bedrooms being presence controlled which clearly has a high impact on emissions reduction in a hotel of this size with 283 bedrooms. A reverse example is seen in P21 where 3.5 points are awarded for the purchasing of ecolabelled consumables or as seen in P62, 2 points for flip charts and pens.

Breakdown of Points and Energy Related Points Score *(Section 3 - Part A)*



	Operations and maintenance	Hotel Premises and purchased products	Guest Rooms	Kitchen and dining room	Cleaning and Laundry	Waste	Transport
■ Max Points Available	25	20	13	7.5	11	6	3
□ Points Achieved by Hotel	18	15.5	8	2.5	7	6	3
🟥 Max Energy related points	19	18	6.5	0	2	0	0
□ Energy Related Points Achieved by Hotel	15	12	5	0	0	0	0

...... *At least 60% of the maximum point score in Operation and maintenance to be achieved.*

Figure 5.1.16 Breakdown of 1) maximum points available and 2) maximum *energy related* points available compared to those achieved by hotel. *(Source: Author, Information taken from Nordic Ecolabelling, 2007).*

5.1.5 Authors Analysis of Actual Energy Consumption Data

Data Collection

In this phase of the research the focus was on the analysis of energy consumption (and emissions per guest night) for the hotel. Access to the Scandic Utility System (SUS)[16] was granted in 2007. Information from 10 Scandic hotels was extracted from this database. All these hotels were Nordic Swan labelled in the beginning of 2003. The hotel was recommended by Dr. Bohdanowicz as a case study and access was granted for a site visit and interview with the environmental manager in September 2007. Subsequent to the site visit, the environmental manager sent me the resource consumption worksheets which were cross compared with the Scandic Utility System (SUS) data for accuracy.

Through Hilton Environmental Reporting (HER) and Scandic Utility System (SUS), hotels are required to send monthly reports documenting the consumption of electricity, district heating/cooling, fuel and the energy mix used to generate these; heating as well as cooling degree days; water and waste (unsorted, sorted and hazardous); types and amounts of refrigerants used; together with a number of other key parameters e.g. number of guest-nights, turnover, etc. Each hotel has its own profile which includes basic facility information (Bohdanowicz et el., 2005) According to Bohdanowicz, the data contained in the Scandic Utility System (SUS) database is considered consistent and accurate and therefore reliable. (Bohdanowicz, 2006) Appendix 5.1F shows typical screenshots from HER database and demonstrates an example of the data collection from the Scandic Utility System (SUS) database similar to that used for this case study hotel.

Data Limitation

The most serious limitation of this data is the adding of different types of energy together *i.e. delivered electricity and fuels* to give an erroneous energy consumption figure. The data contained in the database differed from the information from the hotel database or from information supplied from providers. For example, in the case of district heating, the information provided from the database stated that the fuel mix was; coal 40%, oil 40%, other 20% and the information from the fuel mix provided by Fortum.

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[16] Courtesy of Dr. Paulina Bohdanowicz and Mr. Jan-Peter Berkvist, Hilton Scandic, 2007.

According to Bohdanowicz, the Scandic Utility System (SUS) database has suffered from a number of limitations. Some of those have been overcome with time, others remain as detailed in Papers V, VI, VII and X in Bohdanowicz (2006) as well as in Bohdanowicz et al. (2005).

Energy Consumption

From the data extracted from Scandic Utility System (SUS) (Appendix 5.1G) and the excel data (Appendix 5.1H) sent directly from the hotel, the following graphs were produced showing monthly delivered electricity (kWh) (Figure 5.1.17) and district heating (kWh) (Figure 5.1.18) for the years 1998-2006 and the monthly total number of guest nights (Figure 5.1.19). As previously mentioned, the energy supply to the building is made up of delivered electricity and district heating. There is consistent electricity consumption profile throughout the year and a reduced heating consumption profile between April and September typical of the hotel's location in a temperate, maritime climate.

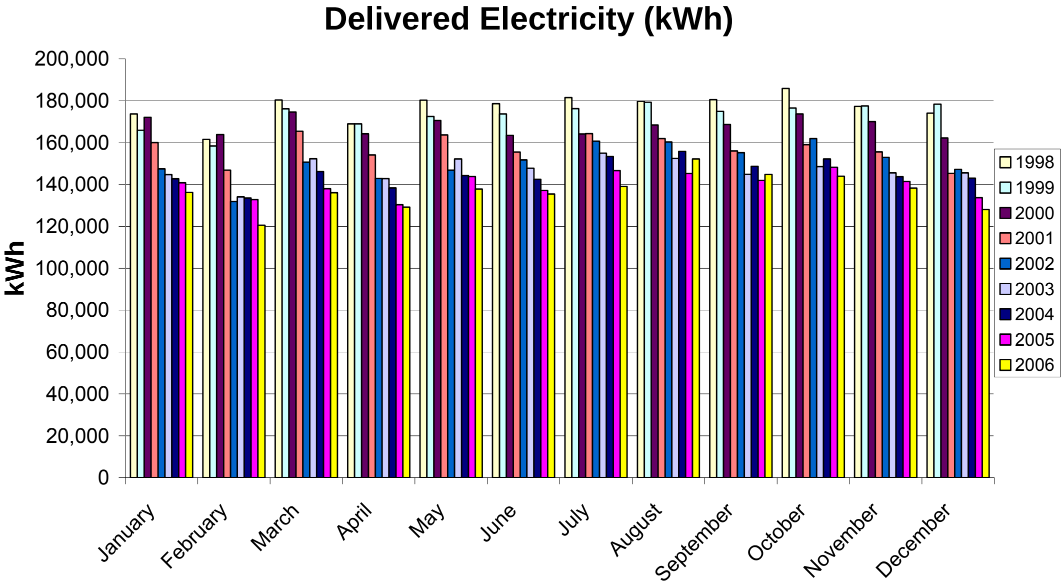


Figure 5.1.17 Monthly Delivered Electricity (kWh): 1998 – 2006

(Data extracted by Author from Scandic Utility System – SUS software courtesy of Bohdanowicz and Bergkvist, Hilton Scandic, 2007)

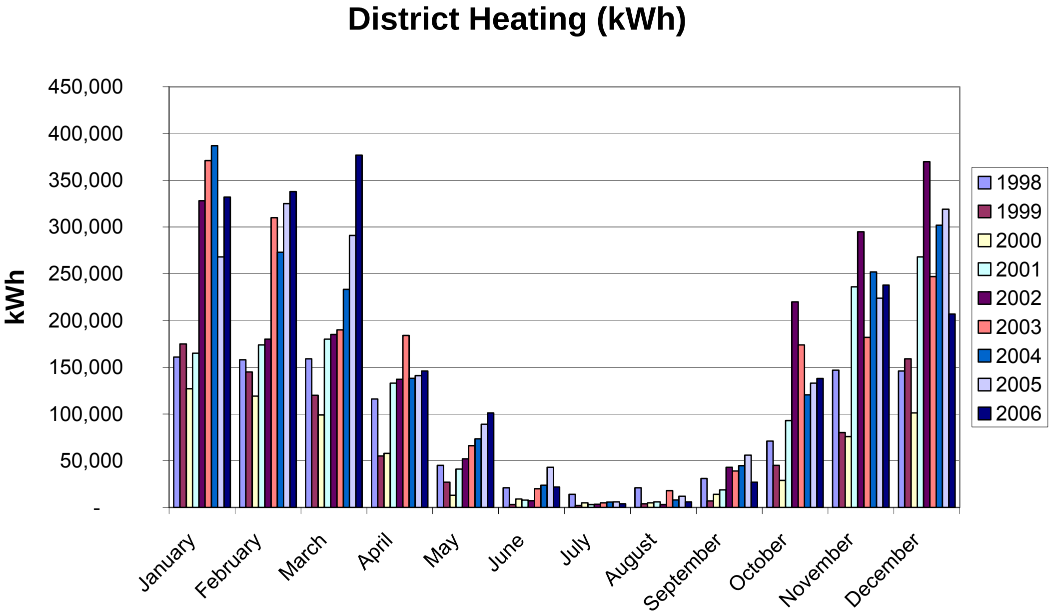


Figure 5.1.18. Monthly District Heating (kWh): 1998 – 2006

(Data extracted by Author from SUS courtesy of Bohdanowicz, Hilton Scandic, 2007)

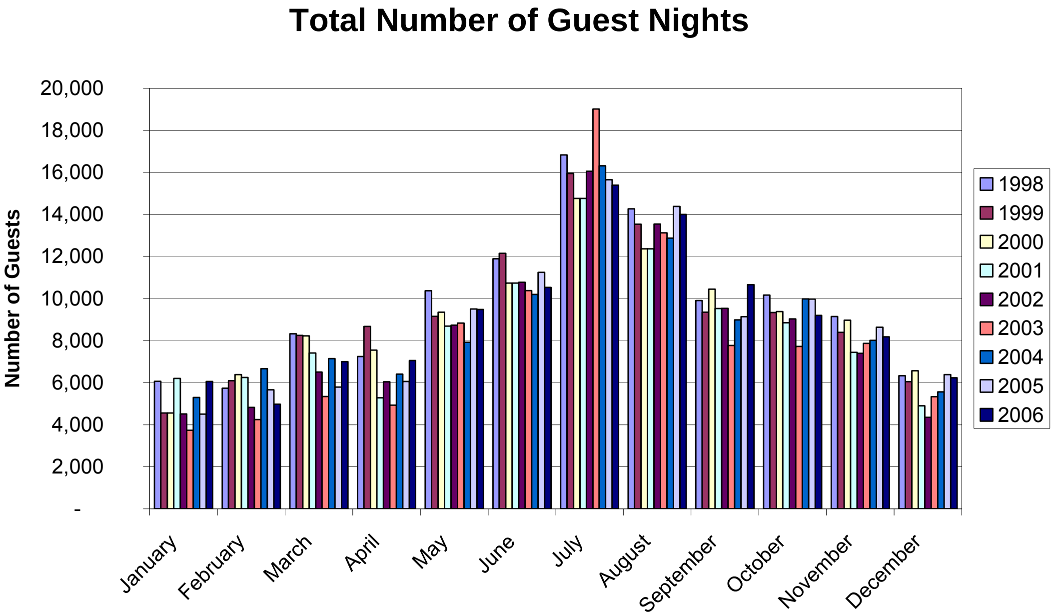


Figure 5.1.19 Monthly Total Number of Guest Nights: 1998-2006

(Data extracted by Author from Scandic Utility System – SUS software courtesy of Bohdanowicz and Bergkvist, Hilton Scandic, 2007)

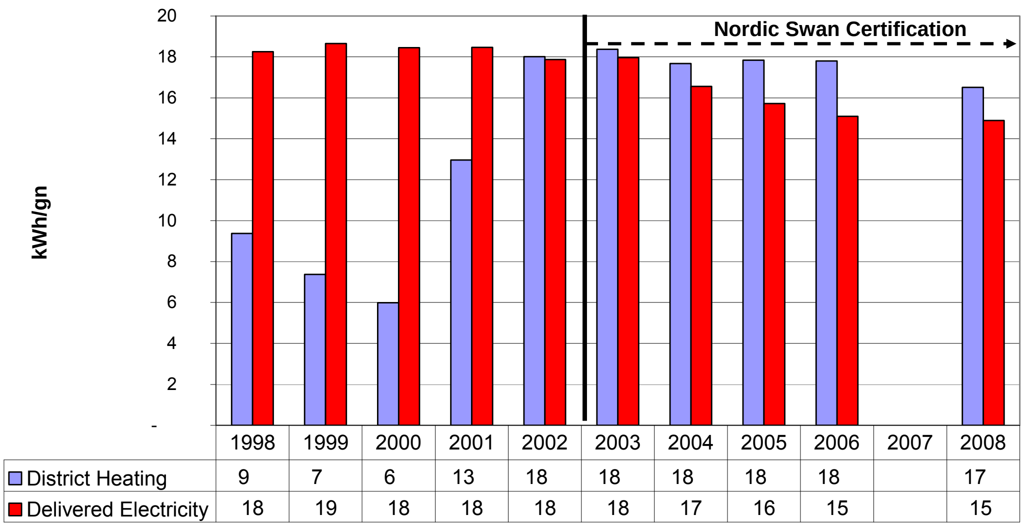
These graphs clearly indicate that the number of guest nights and outdoor weather condition does have a direct impact on the hotel district heating consumption however, in terms of electricity consumption, the hotel runs at a baseline level irrespective of the number of guest nights and outdoor weather condition.

It should be noted that only the number of 'sleepers' are accounted for in the calculation of energy consumption (kWh) or emissions (kgCO_2) per guest night. From the information provided in the hotel checklist submitted by the hotel to Nordic Swan for 2008; Number of 1) guest nights (sleepers): *101,189;* 2) day guests[17]:*30,706* 3) restaurant guests[18]: *47,469*. A more accurate calculation would account for the conference delegates (day guests) and restaurant guests as well as the *sleepers* in the total figure for guest nights.

Time series analysis of CO_2 emissions per guest night for chosen fuel mix before and after certification

In order to test the 'effect' of certification, the data was analyzed to see if the hotel reduced its consumption and emissions prior to going for certification. Usually, an owner seeks to reduce emissions and other environmental effects before seeking certification to obtain the highest level possible. The time series analysis reflects emissions before and after certification.

Delivered Electricity and District Heating (kWh per guest night)



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
🟦 District Heating	9	7	6	13	18	18	18	18	18		17
🟥 Delivered Electricity	18	19	18	18	18	18	17	16	15		15

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[17] Establishments with more than 35% day guests (of the total number of guests) are allowed to count one day guest as 0.5 guest nights. This can even be applied if conference establishments that have guests that stay for one day (24 hour period) plus a part of a day. Guests may be treated as a day-guest for this additional period. (Nordic Ecolabelling, 2007)

[18] Establishments which have a restaurant turnover excluding breakfast of greater than 45% of the completed turnover for the restaurant and accommodation and which also has a lodging occupancy greater than 60%, may count every restaurant guest as 0.25 guest nights, subject to the approval by Nordic Ecolabelling (Nordic Ecolabelling, 2007).

Figure 5.1.20 Annual Delivered Electricity for the period 1998-2008.
(Data extracted by Author from Scandic Utility System & excel data sent from hotel)

Figure 5.1.20 above shows a reduction in electricity consumption from 18 to 15 kWh/gn and district heating consumption from 18 to 17 kWh/gn from the period 2002 to 2008. The electricity consumption has consistently been reduced from 1998 to 2008 however the district heating reduced from 1998 to 2000 and then increased dramatically to 2002. An explanation for this increase was offered by Mr. Palmu, *"the real estate owner changed the meters, and so after that it's correct again."* (Palmu, 2009).

CO_2 Emissions

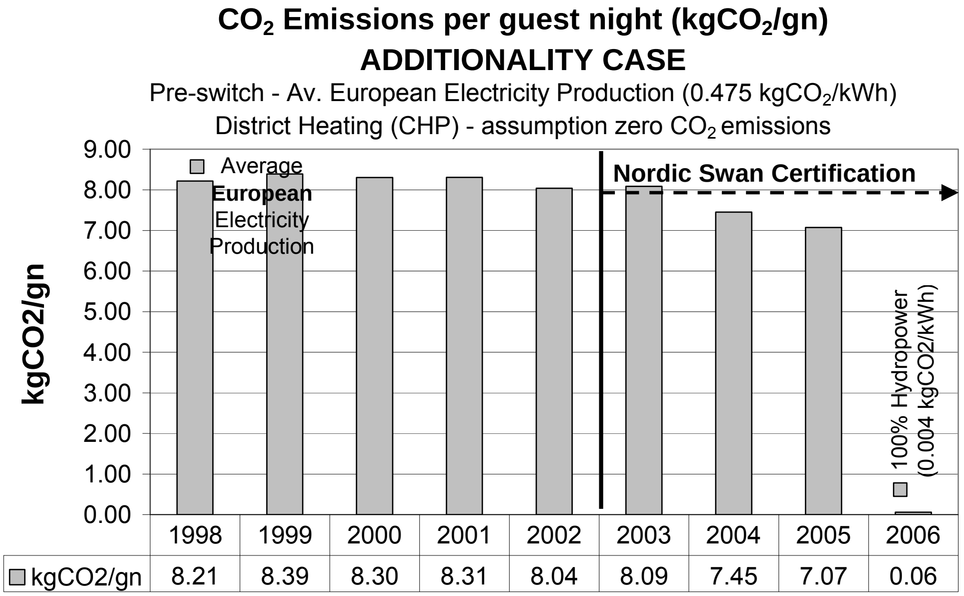

Figure 5.1.21 Time series analysis of claimed CO_2 emissions for chosen fuel mix for Study 1 hotel, Sweden (kg CO_2 per guest night). Note reduction after switch to *'green'* electricity.

Figure 5.1.21 above shows the resulting CO_2 emissions using the average European electricity mix (0.475 kg CO_2 /kwh) before the hotel switched to 'Bra Miljövil – green' certified electricity in 2006. (See Appendix 5.1A) By selecting the average European electricity mix, the author is presenting the worst-case scenario, which is reasonably justified due to Sweden's connection to the European continent via Nordpool. Heating is supplied by district heating (CHP) and is considered here to have zero emissions since the emissions have already been accounted for in the production of the electricity. The graph clearly shows the significant impact on emissions of the choice of fuel mix chosen. The CO_2 emissions have been calculated in kg CO_2 per guest night.

By contrast, if the 'non-additionality' case is applied, where the 'green' electricity argument is not accepted, then the average European electricity mix (0.475 kg CO_2 /kwh) is applied to the delivered electricity for 2006 to give a more realistic emissions figure of 6.8 kgCO_2/kWh results. This shows a more significant reduction in emissions attributable to switching to 'green' electricity rather than to certification alone. It is acknowledged there is a 10-15% reduction in emissions after the hotel became certified which may be explained by the skilled expertise of the newly appointed environmental manager around the time of certification.

5.1.6 Results

It should be noted that "getting certified" does not result in a reduction in emissions – the graph reflects emissions before and after. The results show a reduction in emissions, albeit a small one of about 10-15% from the pre-certification average.

Usually, an owner seeks to reduce emissions and other environmental effects before seeking certification to obtain the highest level possible. The hotel uses its certification to document or imply that it is has good levels of emissions. However, certification in this instance cannot imply good levels of emissions since it does not measure levels of emissions nor is it a mandatory category for certification. The results of the analysis show that depending on the fuel mix chosen (and the choice of CO_2 conversion factor applied), the resulting CO_2 emissions per guest night can vary by a factor of 7.

The key findings of the case study are summarized below; (See also Appendix 6.1I.)

1) 'Ecolabelled or Green' Electricity

The hotel purports to be zero carbon largely as a result of purchasing 'green' electricity certificates however, as discussed in Chapter 2, unless 'additionality' is proven this argument is not accepted. It is argued that the average European conversion factor is more realistic due to Sweden's connection to Nordpool.

2) Accounting of Conference delegates (day guests)

One of the requirements of Nordic Swan certification, is the fulfilment of the benchmark for energy consumption which is either related to the establishment's total area or to the number of guest-nights a year.

The energy consumption benchmark has been calculated per square meter and per guest night. However, the delivered electricity (kWh) and district heating (kWh) have been added together to give an erroneous energy consumption figure whether it be on a square meter or per guest night basis.

Secondly, the energy consumption benchmark calculated for this hotel is based on the number of guest nights (sleepers) only, despite the existence of 17 meeting rooms (conference facilities) and over 30% day guests.

3) ***There is no award of points or mandatory accounting of bioclimatic architecture or passive design features.***

As a result of the incorporation of passive design features, the energy limit value may be easily achieved and result in the award of additional points e.g. *'P59 Energy consumption lower than limit value (max. 4p).'* However, there is no direct awarding of points for passive design measures other than referred to in *'P6 Control of ventilation and interior lighting (max. 3p)*' where three additional points are awarded if the ventilation system is natural draft only. (Appendix 5.1C)

In the current criteria there is no provision for awarding points for the use of the atrium space. Most atria increase energy consumption, which would not be a positive attribute in emissions terms but it would be very interesting to determine if there was a large heat loss through the glazing in the winter (resulting in an increased heating consumption) and conversely if there was an increased cooling load due to overheating in the space in summer.

In this case since Nordic Swan certification is awarded to existing hotels and is based on operational data, the certification itself does not have the opportunity to enhance bio-climatic and energy conscious architecture but it does have the ability to play a more pivotal role in reducing actual CO_2 emissions if the weighting and award of points reflected CO_2 impact. Points need to be awarded for the incorporation of passive design features, such as natural ventilation, increase use of day lighting, solar control. Points also need to be awarded for changes in behaviour of the guests and the staff which would offer an incentive to both parties.

4) No sub-metering

Due to the lack of sub-metering (apart from kitchen), it was not possible to calculate if the 'Eco-room' had any real impact on the hotel's energy consumption and/or emissions. It would be interesting to examine in further work if guests feel more motivated to be pro-active in conserving energy if they chose to stay in an 'Eco-room'? The author has some reservations about the authenticity of the 'Eco-room' when I noted that the chrome table legs and metal legs of bed removed and replaced with wooden legs. It is questionable whether this was part of the maintenance schedule or to make the room look more 'eco'.

5) Weighting of measures that have a high impact on reducing energy consumption and related emissions in Nordic Swan certification;

The low weighting of measures that have a high impact on reducing energy consumption (and associated emissions) does not offer any incentive to the hotel to invest in high CO_2 impact and key low energy consumption and conservation measures.

Only three points (out of a possible 85 points) are awarded for electricity produced from over 90% renewable sources. These three points are awarded for ecolabelled or 'green' electricity which is included as 100% renewable energy. As discussed in chapter 2, this cannot be verified unless it is generated on site or the supplier can prove that this is additional to the quota required by government as well as other criteria listed in The Eugene Standard.

6) Accounting of Conference delegates (day guests)

Therefore in this case, a more accurate CO_2 emissions calculation would take account of these conference guests. It would also be extremely useful to have these conference facilities and business centre sub-metered to monitor and target the energy consumption. A record of the number of conference delegates using the facilities (0.5.day guest) and delegates who spent a day and a night (1.5 day guest) should also be accounted for. A more accurate calculation of the hotels CO2 emissions could then start to be monitored and targeted. If the day visitors were taken into account, this would mean the emissions per guest night equivalent, would in fact reduce significantly but the emission per m^2 would increase significantly, if the conference only areas were disallowed from the calculation. If it was found that the conference facilities was an energy intensive area then measures could start to be taken to reduce emissions in this area and the resulting impact on consumption and emissions could be monitored. Many of the recommendation Appendix 5.1J could be implemented in this area and the resulting performance monitored and improved.

7) Weighting of measures that have a high impact on reducing energy consumption and related emissions in Nordic Swan certification;

The weighting of measures that have a high impact on reducing energy consumption (and associated emissions) needs to be integrated into the criteria in order to offer incentives to the hotel to invest in high CO_2 impact and key low energy consumption and conservation measures. This weighting of high CO2 impact criteria would start to make certification a more reliable indicator of environmental impact.

The analysis of the data found a seven-fold difference in emissions depending on the delivered electricity conversion factor used. This is significant as it means that the hotel can claim to be carbon neutral or have zero emissions based on whether or not one accepts the ‘green’ electricity argument. The hotel uses its certification to document or imply that is has good levels of emissions yet the graph shows that certification has had only a modest effect on reducing CO_2 emissions.

The effectiveness of certification should be shown by hotels reducing their emissions prior to submitting for certification however based on the analysis of the data, there was no significant reduction in CO_2 emissions per guest night before certification but it could be argued that it was already quite good, and was therefore already a case for certification. It is noted there was a 18% reduction in emissions from 2002-2006, however, the most significant impact was the purchasing of ecolabelled or ‘green’ electricity certificate which resulted in the claimed emissions of the hotels being almost zero.

5.1.7 Recommendations to Hotel for Improvement

In terms of actual reductions, the hotel has low emissions for a hotel of its size and for the facilities offered. This is partly as a result of its heating requirement being supplied by district heating. The hotel's cooling demands, which would normally be met by electricity, are reduced by 30% through the use of a sea-water cooling system. The hotel is also well designed and benefits from a large, central day lit atrium. All the guest bedrooms and conference facilities are also day lit with operable windows for natural ventilation. The hotel employs mechanical ventilation with heat recovery system (MVHR) supplying over 90% of its requirements. The hotel uses low energy lighting for 90% of its sources and in over 90% of the bedrooms the lighting and ventilation is presence controlled. The hotel benefits from a committed and proactive environmental manager, Mr. Richard Palmu and a dedicated team which undoubtedly underscores the achievements of the hotel.

In this case the hotel would achieve low CO_2 emissions with or without certification. The certification in this case is more an affirmation of their environmental actions. However, the hotel can still make some improvements as described below but detailed recommendations for improvement are listed in Appendix 5.1J.

The recommendations relate to technical, operational and managerial changes whereas others relate more to the improvement of the weighting and awarding of points in the certification scheme. For example, one recommendation could be that hotels should not be allowed to claim carbon neutrality (or similar) through the purchase of 'green' electricity certificates unless 'additionality' is proven (for grid electricity) or if the electricity is generated on-site. Examples of technical, operational and managerial recommendations include; (See also Appendix 5.1J)

1) *Reduce energy consumption and associated emissions*

   Match source to load (MVHR) i.e. controls match building occupancy and shut off equipment when not required. For example, demand control means that the ventilation system /lighting are adapted to the number of individuals in the room. Another example might be not to allow simultaneous heating and cooling.

   Decrease heating and cooling load using daylight sensors, installing energy efficient lights in remaining 20% of hotel, provide shade control on windows, check for leakage around windows.

Introduce night setback controls. For example, savings could be made by allowing temperatures in common areas such as corridors and stairwells to fall to 16C between midnight and 5am when most guests will be in their rooms.

2) *Zoning for heating and cooling*

A solution is to create ‘zones’ in the building where separate time and temperature controls are installed.

Identify, monitor and target performance in energy intensive areas

Daily or weekly sub-metering readings in guest rooms, sauna and conference areas would identify exceptional or unusual patterns of energy consumption and inefficiencies can be traced at source. This is vital to good management.

3) Check and regularly maintenance of pump, fans and motor efficiency.

Consult a maintenance technician to assess performance of whole system reviewed annually and replacements parts ordered as necessary.

4) Adjust thermostatic controls and time switches

Install occupancy-linked Controls: switches, timers, motion detectors

5) Appropriate hot water temperatures and installation of water conserving devices

6) Maintain building fabric i.e. walls, floors, ceilings through regular staff walk through.

7) Kitchen

Much of the wasted energy is dispersed into the kitchen as heat. Improvements, such as sub-metering, regular maintenance could be made to the equipment (‘A’ rated and switches off automatically) and to the refrigeration and consider passive solar panels for pre-heating water.

8) Guest Bedrooms

Install sub-meters and analyze hourly consumption to identify where the peaks are during the day and whether there are any leaks.

During periods of low occupancy, group the rooms in which guests are put relative to the mechanical and electrical systems and shut off unoccupied areas. During the heating season, occupy the rooms in the sunny side of the building first and during the cooling season on the opposite side.

9) Laundry

Outsource to ecolabelled laundry.

10) Conference facilities.

Consider timer or demand control for the ventilation system

Close curtain, blinds to reduce solar gain.

11) *Energy Management and people solutions*

Assign a member of staff to switch off all non-essential lighting and equipment. Install timers or sensors to help with this.

Have chamber maids vacate rooms as early as possible in order to switch off lights, ventilation and turn down thermostats.

During hot or cold weather, keep curtains, blinds, shades closed to reduce heating and cooling gains and losses.

12) *Sauna*

Consider demand control in addition to timer control system.

To conclude these results and findings raise questions about the value and meaning of certification. In this case the hotel would achieve low CO_2 emissions with or without certification. The certification in this case is more an affirmation of their environmental actions. In this case since Nordic Swan certification is awarded to existing hotels and is based on operational data the certification it does not have the opportunity to enhance bio-climatic and energy conscious architecture but it does have the ability to play a more pivotal role in reducing actual CO_2 emissions if the weighting and award of points reflected CO_2 impact.

5.2

In depth Study 2

Resort Hotel, Maldives

This hotel is known for "*high-end, eco-friendly, all-natural opulence*". The vision of the resort is to achieve 60% emission reductions by 2008 and to be zero-carbon by 2010. To meet this goal, the owners of the resort engaged consultants XCO2 to produce a Zero Emission Plans.[1] However, these proposals have yet to be implemented. (See Appendix 5.2.E, F and G)

The aim of this in depth study is to analyze the impact on CO_2 emissions of the hotel in relation to Green Globe certification. The study comprises six sections; physical description, energy supply, energy end use, energy conservation measures, Green Globe analysis of *actual* consumption data and Author's analysis of *actual* consumption data. Recommendations for improvement are outlined at the end of the chapter.

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[1] The unpublished Zero Emissions Plan for the resort (plus four draft reports) prepared by the energy consultants XCO2, (based on data from the client and site visits) was provided by the resident engineer with permission by XCO2. The references for these unpublished reports are contained in the References.

5.2.1 Physical Description

The six star resort is on the tropical island of Kunfunadhoo (1,400 metres long and 400 metres wide) in Baa Atoll in the Republic of the Maldives. (Figure 5.2.1).

A summary sheet of Study 2 hotel is shown overleaf. (Table 5.2A) The resort is built in the vernacular building style and responds well to its context and location in terms of architectural aesthetics. On site observation by consultants XCO_2, state that this was made to look more traditional than it was, with breeze block walls covered with soft uneven render. Other partitions were thin timber. No further technical information was available concerning the construction of the building.

Study Hotel 2
Kunfunadhoo Island Maldives

Description of Hotel

Study hotel 2 is a luxury 6 star island resort built in vernacular style. The resort comprises 65 guest villas, some with private pools and gym. Other facilities include: Conference Room, Gym and Spa.

Facilities

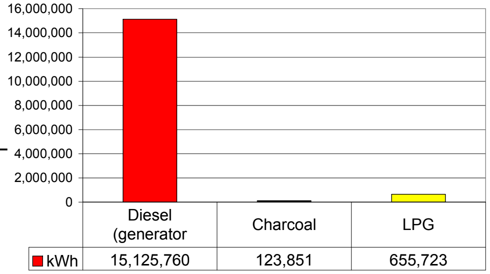
- 65 Guest Villas (all A/C)
- 38 Private Pools
- 1 restaurant and bar
- Spa and gym
- Library, conference room
- Dive Centre

Key Features

- Proposed Zero Emission Plan
- Deep sea water cooling system for air-conditioning.

Key Performance Indicator	
$kgCO_2$ per *guest* ***+staff*** night	96 ***(+staff 22)***
$kgCO_2$	3,962,488

Delivered Energy Supply (kWh)



Key Facts	
Logo	
Certification	Green Globe
Date of Certification	
Surface/ Bed	287
Hotel Type	Vacation, resort
Location	Waterfront
Year Built	
Hotel Area (m^2)	18,650
Number floors	Single storey
Bedrooms	65 (villas)
Restaurant	Yes
Conference	Yes (1 room)
Swimming Pool	38 (private)
Jacuzzi or Spa	Yes
Laundry	Yes
A/C	Yes

Table 5.2A Summary Sheet of Study 2 hotel *(Source: Author)*

Figure 5.2.1 Site Location Plan *(XCO2, 2007)*

The area of the resort is 18,650 m^2 including all facilities kitchen, spa, dive school, guest villas, staff accommodations etc. The bed-to-surface-area ratio is one of the lowest in the Maldives: 65 thatched villas of varying size and luxury accommodate a maximum of just 124 guests. There are seven different accommodation types (all air-conditioned), several having their own pools. All types come with overhead fan, air-conditioning and mini-bar. (Table 5.2B)

The more secluded villa type even includes a private air-conditioned gym! Other air-conditioned guest related areas include: Library, Conference Room, Gym, Gallery, New dive centre, Host offices, Jewellery, Spa and Wedding Chapel.

		
Type 1 (15) Total area 182 sqm (internal 48 sqm)	**Type 2 (15) (7 with Pool)** Total area 235 sqm (internal 64 sqm)	**Type 3 (15) (with Pool)** Total area 395 sqm (internal 80 sqm)
		
Type 4 Suite (9) (with Pool) Total area 594 sqm (internal 96 sqm)	**Type 5 Suite (6) (4 with Pool)** Total area 649 sqm (internal 230 sqm)	**Type 6 Retreat (2) (with pool)** Total area 873 sqm (internal 190 sqm)
		
Type 7 Jungle Reserve (1) *With Pool* Total area 1,720 sqm (internal 700 sqm)		

Table 5.2B Different guest accommodation types. *(Hotel Website, 2009)*

5.2.2 Local Energy Supply

The annual local energy supply to the building in 2007, consists of electricity generated on-site using diesel generators as well as LPG for cooking in kitchens, charcoal for BBQ's and canned heat (250g cans containing fuel for keeping food items hot) as shown in Table 5.2.C below.

2007		
Electricity [2]	4,519,199 kWh	
Electricity Per Guest Night	15 kWh/gn	Electricity generated by diesel generator, emissions already accounted for.
Fuels		
Diesel	15,125,760 kWh [3]	3,781,440 kgCO$_2$[4]
Petrol [5] *(used for boat engines)*	*1,572,940 kWh* [6]	*377,505* kgCO$_2$[7]
Canned heat consumption[8]	*5,310 kg*	
Charcoal[9]	123,851 kWh [10]	43,347 kgCO$_2$[11]
LPG[12]	655,723 kWh [13]	137,701 kgCO$_2$[14]
Total CO$_2$ Emissions		**3,962,488 kgCO$_2$**[15]
Total CO$_2$ Emissions Per Guest Night		**22 kgCO$_2$/guest + staff night**[16] ***(96 kgCO$_2$/guest night)***[17]

Table 5.2C Summary of Energy Supply for Study 2. *(Source: Author)*

---

[2] The electricity is generated by diesel generators.

[3] 1,454,400 L x 10.4 kWh/L = 15,125,760 kWh

[4] Conversion factor: 0.25 kgCO2/kWh (Carbon Trust, 2008)

[5] The petrol used at Soneva Fushi was mainly used to fuel the boat engines but also machinery and engineering tools so is excluded from our calculations since we are concerned with the emissions from the hotel only. (Appendix 5.2.B)

[6] Not considered in calculations since the petrol is only used on boats. (Appendix 5.2.B) Transport to and from hotel/resort considered outside the scope of this study if a comparison of emissions between hotels is to be conducted.
163,848 L x 9.6 kWh/L = 1,572,940 kWh (Carbon Trust, 2008)

[7] Conversion factor: 0.24 kgCO2/kWh (Carbon Trust, 2008)

[8] Used to keep food warm

[9] Used for BBQ

[10] 18,654 kg (445,831MJ Green Globe, 2007). 445,831MJ x 0.2778 = 123,851 kWh (Carbon Trust, 2008)

[11] Conversion factor: 0.35 kgCO2/kWh (Carbon Trust, 2008)

[12] Used in kitchen for cooking.

[13] 47,640 kg(2,360,416 MJ Green Globe, 2007) 2,360,416 MJ x 0.2778 – 655,723 kWh (Carbon Trust, 2008)

[14] Conversion factor: 0.21 kgCO2/kWh (Carbon Trust, 2008)

[15] This figure does not include petrol and canned heat consumption.

[16] This figure is calculated per guest night (sleepers) and resident staff = 178,323.

[17] This figure is calculated per guest night (sleepers) only = 41,259.

5.2.3 Energy Use

The pie chart below show the breakdown of the delivered energy consumption (based on information provided by the hotel (*assuming 76% occupancy rate and 24 hrs/day of air-conditioning use*). (XCO2, 2006)

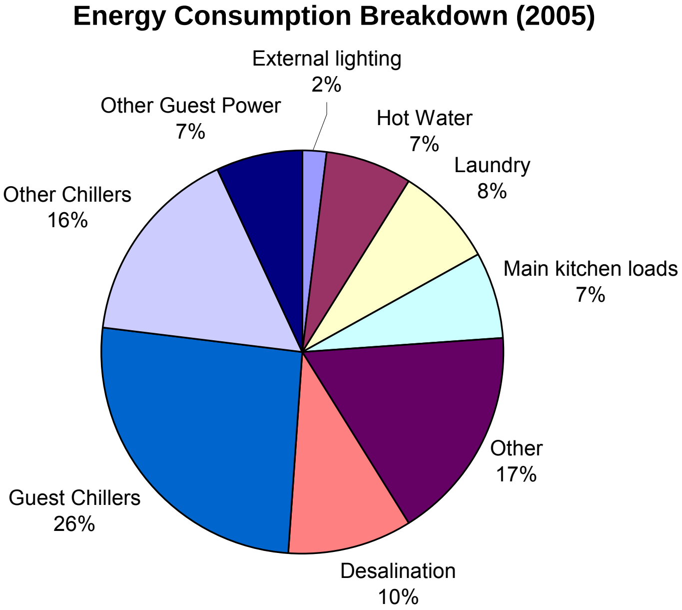


Figure 5.2.2 Energy Consumption Breakdown - 2005 *(XC02, 2006)*

Guest and other chillers and guest power accounts for 49% of total energy consumption as shown in Figure 5.2.2. Hot water and laundry accounts for 15%, even though guest accommodation only accounts for 35% of total energy consumption. (XC02, 2006)

- Hot water needs for the guest rooms are about 16,620 kWh *(Assuming 50 litres water/day per unit, 50% hot water, 75% occupancy rate)*
- Staff hot water use: 12,465 kWh *(assuming 30% guest use, 2.5 staff per guest)*
- Laundry drying requires about 88,500 kWh *(assuming 8hrs/day use).*
- Total air-conditioning demand in guest areas is 1,917,310 kWh *(Assuming 75% occupancy and 8hrs/day of usage).*

All of this energy is supplied by electricity generated by diesel generators which waste 5,800,000 kWh of heat. This heat could be recovered for hot water and laundry drying.

Standard Matrix For Fuels Use

See Table 5.2D on the following page.

Study 2	**On Site Electricity**	**Space Heating**	**A/C Comfort Cooling**	**Hot Water**	**Catering**	**Lighting**	**Laundry**	**Lifts**	**Swimming Pool**	**Sauna**	**Other**
Grid Electricity											
District Heating											
Natural Gas											
LPG					√[18]						
Oil											
Diesel *For generators*	√		√[19]	√[20]	√	√	√		√[21]		
Biomass											
Other *Charcoal (BBQ)* *Canned Heat*					√						

Table 5.2D Standard Matrix for Energy Use for Study 2. *(Source: Author)*

---

[18] Used for cooking in kitchen.
[19] Electricity is converted to coolth via chillers. (XCO2, 2007)
[20] Electricity is converted into hot water in hot water cylinders. (XCO2, 2007)
[21] To run pumps.

Cooling Demand and Hot Water Production

Generators

On Maldivian islands, diesel-powered generators are considered “the heart of the island”, as all islands are autonomous and have so far heavily depended on their own generators for electricity production although the efficiency of the generators is generally low. In 2005, 84% of all diesel used at the resort was used for electricity generation; the other 11% was used for the boats and vehicles on the island. (XCO2, 2006)

Electricity is used to provide hot water in hot water cylinders, and electricity is converted to coolth via chillers. XCO2 state that both of these processes are inefficient and would be better provided centrally, although this would require two additional sets of insulated pipes, buried in shallow trenches. (XCO2, 2006) They point out that the advantage of centralization is not the reduction of distribution losses, which are probably better with electricity than hot or cold water, but the advantages come with the efficiency of conversion. If hot water was provided centrally it could be derived from the waste heat of the generators, using a resource which is otherwise completely wasted. Small chillers are generally less efficienct than large units and again centralisation allows the use of other technologies, for example, absorption cooling from the generator waste heat for instance which would not be possible with small scale units.

Back of House

Some of the fridges in the kitchens suffer from condensation on their exterior surfaces. This means that heat is being gained by the space, and energy is being wasted. XCO2 suggest it would be better to insulate the fridges and provide double glazed windows which would improve their performance. (XCO2, 2006) Fridges are located inside cooled areas, with their waste heat being exhausted to those spaces. This is inefficient and increases the cooling load. XCO2 propose that the waste heat should be channeled to the building exterior. (XCO2, 2006) They observed that there were not any particular measures to either insulate cooled areas or control condensation as seen in Figure 5.2.3 and 5.2.4. (Cochrane, 2009).

Figure 5.2.3 Condensation on cold store door *(XC02, 2006).*

Figure 5.2.4 Patchwork insulation *(XC02, 2006).*

Other

Extracts from observations[22] made by XCO2 upon arrival at the resort include *'Having the lights on created a welcoming arrival. Hopefully these had only been switched on when the bags were delivered a few minutes before I arrived? It took a few minutes to find all the light switches to turn off the lights, some thing that few regular guests may do.*' In response to this problem, XCO2 advised a Key-tag entrance system to be installed, which switches off all lights when guests leave. The system would also switch off the AC, with a pre-cool system being used and a Siemens master control. They observed that the '*Cooling was running on a sensible setting. The villa was pleasantly cool compared to outside'* and was four degrees cooler than outside. The '*Conditioned volume is reasonably large, since there is no door to dressing room but bathroom door and louvers were shut, which limited the cooling losses'* but they did observe that the *'Pump for pool and bathroom running 24 hours!'* which represents substantial energy consumption considering there are 38 swimming pools! (XCO2, 2006)

It was observed that some villas are receiving direct sun through the glass and that a deeper overhang or exterior horizontal shutters must be applied. (XCO2, 2006)

Another observed problem were villas with partial-height wall between bedroom and closet and in villas with loft space behind air-conditioner as seen in Figure 5.2.5 and 5.2.6 below. The remedy suggested by XCO2 is that the air-conditioned area should be reduced by extending to the ceiling the wall where the air-conditioner is located, therefore covering the loft space.

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[22] Detailed in the XCO2 'Environmental Performance of Sampled Villa 57' report. (XCO2, 2006)

Figure 5.2.5
Villa with partial height wall
Between bedroom and closet.
(XCO2, 2006)

Figure 5.2.6 Villa with loft space behind air-conditioner. (XCO2, 2006)

5.2.4 Energy Conservation Measures

As expected of a six star resort, visitors come from different climates all over the world, therefore it is expected that some artificial cooling is required the key efficiency task is to minimise the energy demand. The energy consultants XCO2 have made proposals in their *Zero Emissions Plan* to make the existing buildings more energy efficient and provide for additional roof ventilation, cross ventilation, and passive and active cooling. High-R insulation materials, and double glazed windows with low radiation glass that allows less ultra violet rays to pass through, would be incorporated. Key features of these proposals are summarized in Appendix 5.2.E, F and G. However, it should be pointed out that to date none of these proposals have been implemented.

5.2.5 Green Globe Analysis Of Actual Energy Consumption Data

Data Collection

A copy of Green Globe benchmarking assessment report, accommodation benchmarking (Green Globe, 2008), was provided by the engineering department at the resort. The report structure is described in detail in chapter 4 and contains consumption data, square area of resort, and total number of guest nights as well as Green Globe performance benchmarks used to assess this hotels performance. This data enabled the author to establish the weighting in relation to the actual reduction of energy consumption (and emissions). Where there were queries concerning the data, direct e-mail communication was directed to Ms. Hofmeister and the resort engineering department, as seen in Appendix 5.2B.

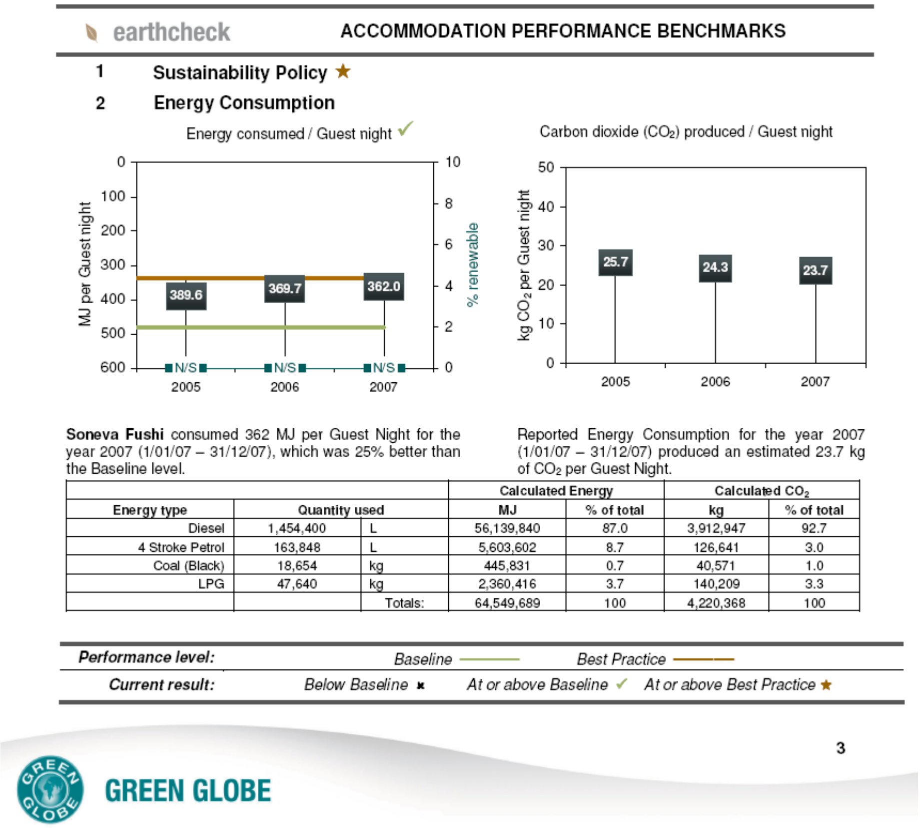
Data Limitation

The Green Globe Benchmarking Assessment Reports are not available in the public domain.

Analysis

The requirements of Green Globe certification are detailed in chapter 4. According to the Green Globe report for this hotel, in addition to having a Sustainability Policy in place, all ten assessed criteria were at or above the Baseline level. From the data provided, four criteria, *Water Consumption, Waste Sent to Landfill, Community Commitment,* and *Community Contributions,* were at or above the Best Practice level. (Green Globe, 2008)

Appendix 5.2A presents a breakdown of the benchmarks and checklist achieved by the hotel for Green Globe certification. It can be seen that energy consumption is one of eight criteria for Green Globe certification. As seen in Figure 5.2.7 below, the baseline performance benchmark for energy consumption is reported as 480 MJ per guest night (133 kWh per guest night) and the best practice benchmark is 336 MJ per guest night (93 kWh per guest night). The assessment report also provided information on the energy types used in their emissions calculations. None of the other seven categories include any energy related benchmarks or checklists that actually result in reduced energy consumption or emissions.



earthcheck **ACCOMMODATION PERFORMANCE BENCHMARKS**

1 **Sustainability Policy** ★

2 **Energy Consumption**

Soneva Fushi consumed 362 MJ per Guest Night for the year 2007 (1/01/07 – 31/12/07), which was 25% better than the Baseline level.

Reported Energy Consumption for the year 2007 (1/01/07 – 31/12/07) produced an estimated 23.7 kg of CO_2 per Guest Night.

			Calculated Energy		Calculated CO_2	
Energy type	**Quantity used**		**MJ**	**% of total**	**kg**	**% of total**
Diesel	1,454,400	L	56,139,840	87.0	3,912,947	92.7
4 Stroke Petrol	163,848	L	5,603,602	8.7	126,641	3.0
Coal (Black)	18,654	kg	445,831	0.7	40,571	1.0
LPG	47,640	kg	2,360,416	3.7	140,209	3.3
		Totals:	64,549,689	100	4,220,368	100

Performance level: *Baseline* —— *Best Practice* ——

Current result: *Below Baseline* ✖ *At or above Baseline* ✓ *At or above Best Practice* ★

3

GREEN GLOBE

Figure 5.2.7 Extract of energy consumption data from the benchmarking assessment report *(Green Globe, 2008)*

Please note that reference to coal (black) in the benchmarking assessment report is representative of charcoal consumption for use in the BBQ although it is acknowledged that 18 tonnes is a large amount although it is feasible.

Results

The results of the Green Globe analysis show that the hotel consumed 100 kWh/gn (362 MJ/gn) for the year 2007 (1/01/07 – 31/12/07), which was 25% better than the Baseline level. The Reported Energy Consumption for the year 2007 (1/01/07 – 31/12/07) produced an estimated 23.7 kg of CO_2 per Guest Night.

There is no reference made to the actions taken by the hotel to reach the baseline benchmark for energy consumption. In addition, there were no specific comments or remedial advice was included in the recommendations part of the Benchmarking Assessment report as seen in Appendix 5.2C.

5.2.6 Authors Analysis of Actual Energy Consumption Data.

Data Collection

The monthly consumption data for the 2005-7 period was sent by the engineering department at the resort by Ms. Hofmeister. (Appendix 5.2D) The data is for all facilities and buildings on the resort including the kitchens, the spa, the dive school, guest villas, and staff accommodations. The total guest accommodation was calculated to make up around 35 % of the total energy consumption. The total area under roof is 18,650 square metres. The consumption data is in excel format as seen in Appendix 5.2D and contains data on the electricity and fuels consumption as well as the total annual number of guest and resident staff nights. The file was developed to include the authors own CO_2 calculations are included in this same appendix. The data sent from the resort corresponded with the data presented in the XCO2 feasibility study and Zero Emissions Plan and is considered reliable.

Data Limitation

None.

Analysis

From the data extracted from the excel file sent from the resort and the information contained in the Green Globe Benchmarking Assessment report, the following graphs were produced showing the monthly total number of guest nights (Figure 5.2.8), delivered electricity (kWh) (Figure 5.2.9) and delivered electricity per guest night (kWh/gn) (Figure 5.2.10) for the years 2005-2007. As previously mentioned, the energy supply to the building is made up of supplied electricity generated on site using diesel generator and to a lesser extent LPG (cooking), charcoal (BBQ) and canned heat. Eighty five per cent of electricity is used for space cooling, hot water and lighting typical of a hotel in a warm, humid climate.

Electricity consumption

Figure 5.2.8 shows the resort's guest numbers during the period 2005 - 2007. In 2005, the occupancy was highest in March and April (having recovered from a low after the tsunami) and between October and December, while in 2006, most guests were attracted between January and April as well as between October and December.

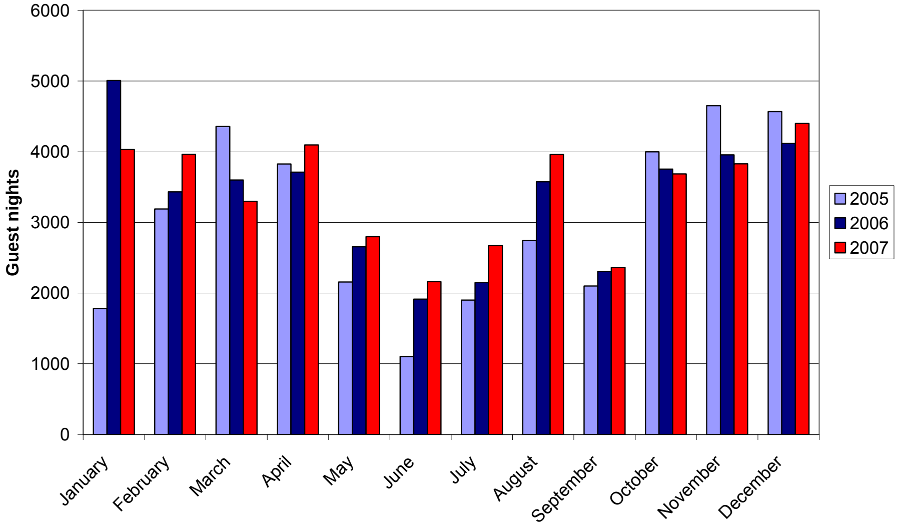


Figure 5.2.8 Monthly guest nights for the period 2005 – 2007 for Study 2 hotel. ***(Data extracted by Author from Excel data sent by hotel energy department, 2007)***

In 2005, the electricity consumption corresponded well to the change in guest numbers. (Fig. 5.2.9.) On average 129 kWh per guest night were used each month. (Fig. 5.2.10) The electricity consumption per guest night seemed particularly high in the low-occupancy periods. However, this was due to the resort's continued operations to keep it functioning (e.g. restaurants, excursions, maintenance work, staff accommodations and activities), the large number of resident employee's due to the island's remote location and the low guest numbers that the energy figures were divided by. The ratio of resident staff to guest is 3:1.

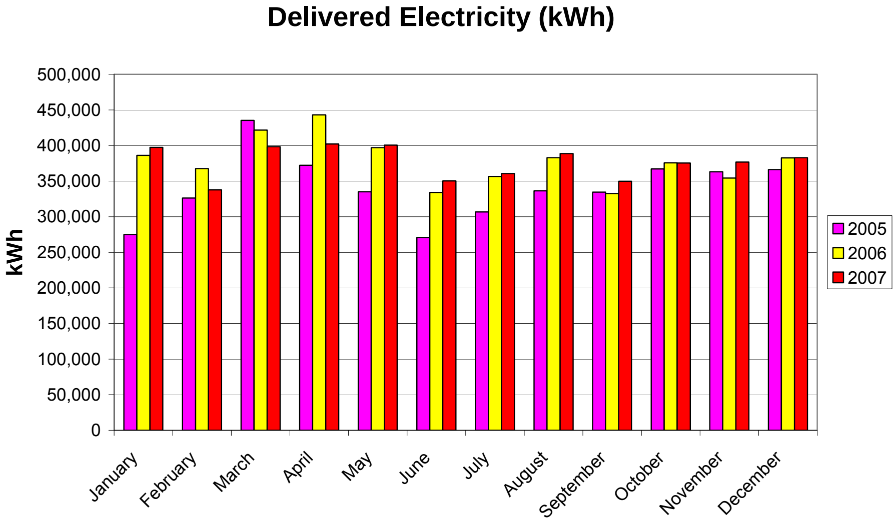


Figure 5.2.9. Monthly electricity consumption (kWh) for the period 2005 – 2007 for Study 2 *(Data extracted by Author from Excel data sent by hotel energy department, 2007).*

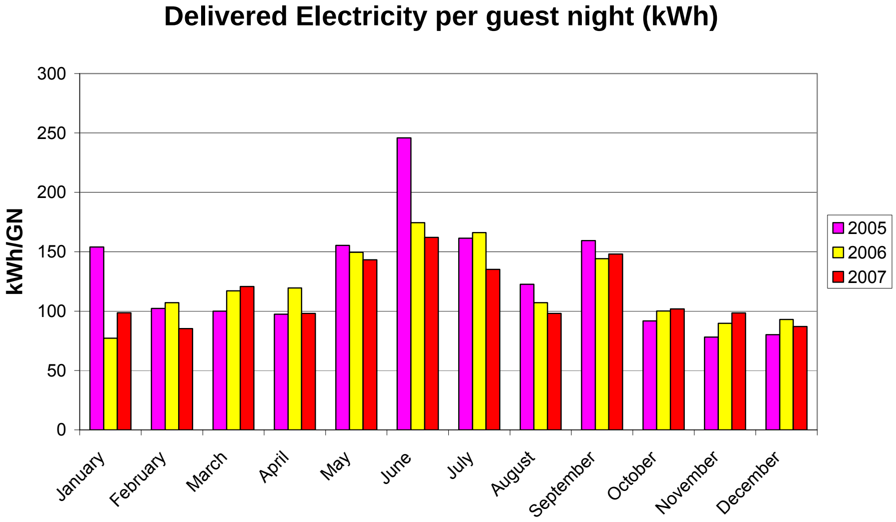


Figure 5.2.10. Monthly electricity consumption per guest night (kWh/gn) for the period 2005 – 2007 for Study 2 hotel *(Data extracted by Author from Excel data sent by hotel energy department, 2007).*

However, a different picture emerges when the electricity consumption is divided by the total number of guests plus resident staff nights as seen in Figure 5.2.11 below.

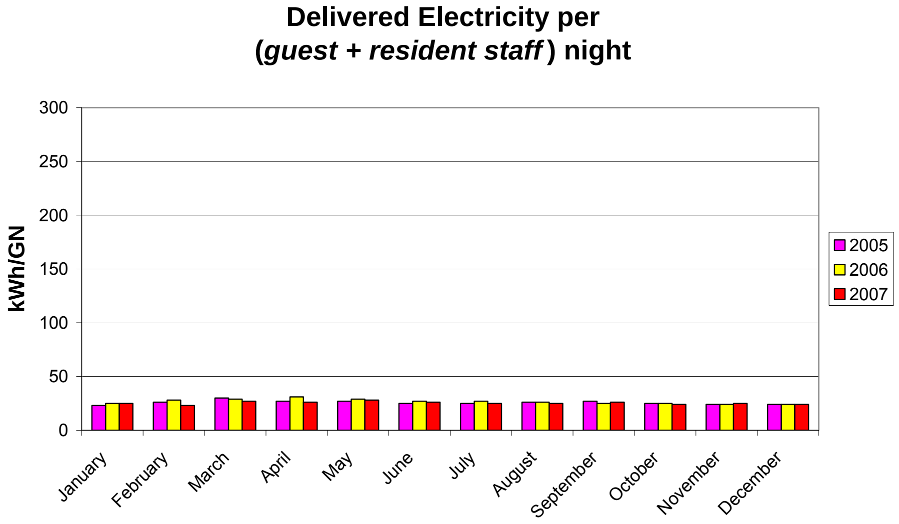


Figure 5.2.11. Monthly electricity consumption per 'guest+resident staff' night (kWh/gn) for the period 2005 – 2007 for Study 2 hotel *(Data extracted by Author from Excel data sent by hotel energy department, 2007).*

The total electricity consumption in 2006 was 10.9 % higher than in 2005, which conforms to the 10.4 % increase in guest numbers. Despite greater awareness for the need of energy-efficient equipment and energy-saving initiatives, the resort has not been able to reduce its electricity consumption to date. This is partly due to many of the *Zero Emissions Plan* proposals not being in place in 2007 when the data was collected.

Diesel consumption

In 2005, 84% of all diesel used at the resort was used for electricity generation, while 89% was used in 2006. The remaining 11% was used to run the boats and vehicles on the island. There was hardly any difference in the overall diesel consumption between 2005 and 2006, with only a 1.1 % increase in 2006 despite a 10.4 % increase in guest numbers (Fig. 5.2.12).

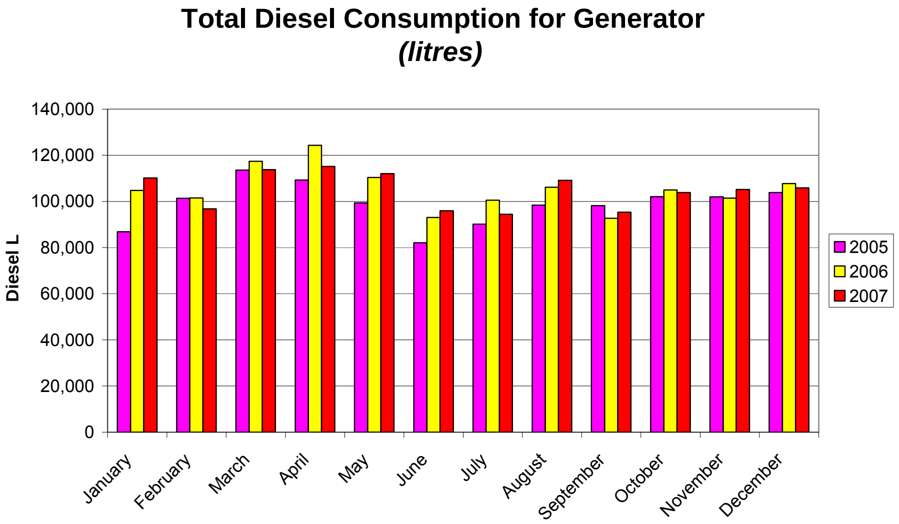


Figure 5.2.12 Monthly diesel consumption (L) for the period 2005 – 2007 for Study2. *(Data extracted by Author from Excel data sent by hotel energy department, 2007)*

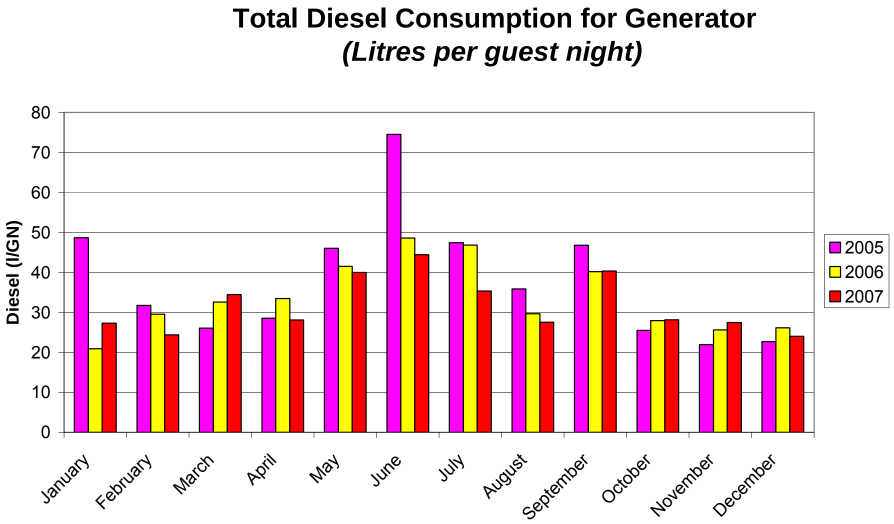


Figure 5.2.13 Monthly diesel consumption per guest night (L/gn) for the period 2005 – 2007 for Study 2 *(Data extracted by Author from Excel data sent by hotel energy department, 2007).*

C0$_2$ Emissions

The report has made plans to move towards 'zero carbon' operations and to replace the current practices with energy-saving initiatives and renewable energy sources. However, the results of these actions have not yet shown in the emissions graph because they have not been implemented to date. (Fig.5.2.14-16). In fact, 2% more carbon was emitted by the resort in 2006 compared to the previous year. A larger volume of greenhouse gases could have been expected due to the higher occupancy rate in 2006. However, the long-term goal of minimizing the use of fossil fuels by replacing them with solar, wind or tidal energy or cold deep-sea water should be focused on and committed to according to XCO2. (XCO2, 2007)

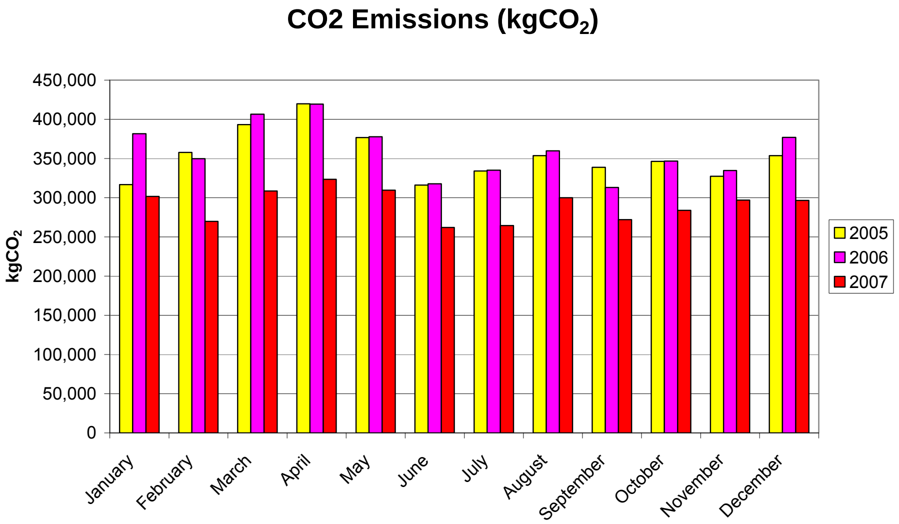
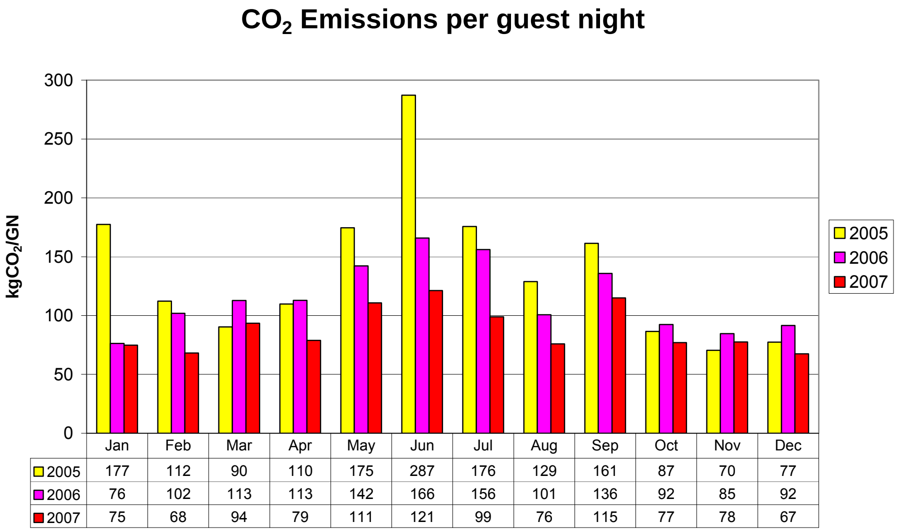
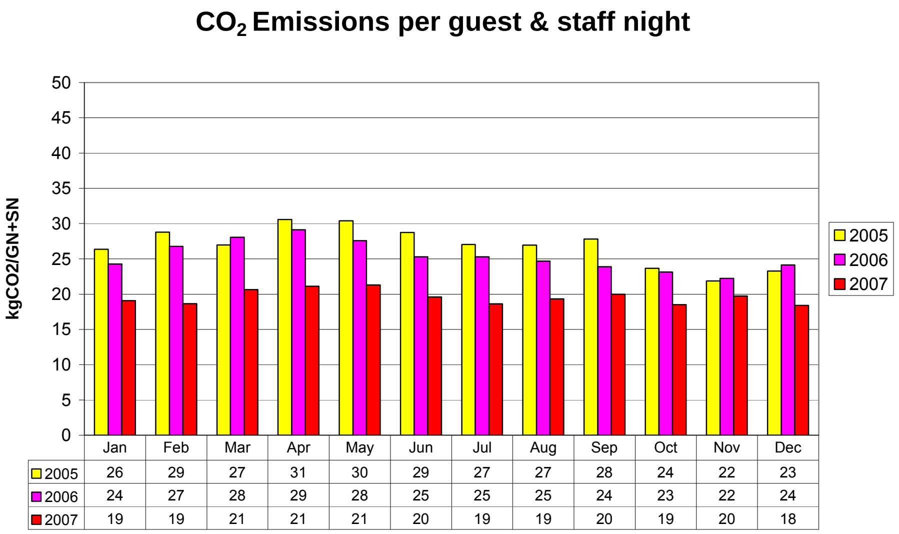


Figure 5.2.14 Monthly CO$_2$ Emissions for the period 2005 – 2007 for Study2. *(Data extracted by Author from Excel data sent by hotel energy department, 2007)*



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005	177	112	90	110	175	287	176	129	161	87	70	77
2006	76	102	113	113	142	166	156	101	136	92	85	92
2007	75	68	94	79	111	121	99	76	115	77	78	67

Figure 5.2.15 Monthly CO$_2$ Emissions per guest night (kgCO$_2$/gn) for the period 2005 – 2007 for Study 2 *(Data extracted by Author from Excel data sent by hotel energy department, 2007).*



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005	26	29	27	31	30	29	27	27	28	24	22	23
2006	24	27	28	29	28	25	25	25	24	23	22	24
2007	19	19	21	21	21	20	19	19	20	19	20	18

Figure 5.2.16 Monthly CO_2 Emissions per 'guest + resident staff' night ($kgCO_2/gn$) for the period 2005 – 2007 for Study 2 *(Data extracted by Author from Excel data sent by hotel energy department, 2007).*

5.2.7 Results

By far the biggest impact on CO2 emissions reduction for this resort is yet to become evident once the zero emissions plan proposals prepared by consultants XCO2 have been put in place.

As a result of its isolated location, the Study 2 hotel has to generate electricity on site using diesel generators which have low efficiency so that great amounts of energy in the form of heat are wasted. (XCO2, 2006) It was found that the resort has a high electricity consumption base load due to the resort's continued operations to keep it functioning and partly due to the large number of resident employees. In 2007, there were on average 378 employees and 137,064 resident staff nights to 41,259 guest nights which means there are on average 3.2 staff for every guest (137,064/41,259).

It was also found that electricity consumption had risen significantly (to about 4,360,000 kWh/year), which is mostly attributed to the resorts improvement of its installations and level of services to its guests.

The results of the analysis show the effects on performance due to the choice of accounting method depending on choice of '*guest nights'* only (92 kgCO2/gn) or *'guest + host nights'* (25kgCO2/gn). Although it is acknowledged that this is an *apparent* effect on performance rather than a *'real*[23]*'* effects on emissions Clearly, in the case of a remote island location where staff live on-site this is a completely justified calculation to include the resident staff, however this should be weighted into the calculations if the same level of certification is to be awarded to different types of hotels or reflected in the level of the award.

Discussion

In terms of actual emissions per guest night i.e. kgCO_2/gn, the Maldives hotel emits three times as much CO_2 as the urban chain hotel in Stockholm, Sweden. This result challenges our preconception of what a 'green' hotel should look like (Figure 5.2.17 and 5.2.18 below)

Figure 5.2.17 Study Hotel 1 (**7kgCO_2/gn**)

Figure 5.2.18 Study Hotel 2 (**25kgCO_2/gn)**

The difference in kgCO_2 per guest night is 7kgCO2/GN *('guest nights'* only) for the Swedish hotel and 25kgCO_2/GN (*'guest + resident staff'* night). So, why is the range in emissions so great between two certified hotels? If one were to look at the two building one would naturally consider the resort with vernacular huts to have the least impact on the environment.[24] However, the results show it is indeed the large, urban chain hotel that has the significantly lower CO2 emissions this is largely as a result of its energy supply. The hotel uses district heating from a CHP plant so its emissions from heat are considered zero. The hotel's cooling demands, which would normally be met by electricity, are reduced by 30% through the use of a sea-water cooling system. The energy consumption (kWh) of the Maldives hotel is two and a half times that of the Swedish hotel. This is explained by the high level of facilities offered by the hotel i.e. air-conditioning in all 65 villa huts, 38 private swimming pools (all with pumps running 24 hours a day). Moreover, the electricity is generated on site using inefficient diesel generators with large amounts of

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[23] Such as implementation of XCO2 proposals which includes capturing waste heat from diesel generator or increasing the use of renewable energy sources.

[24] Notwithstanding the argument that guests contribute towards global emissions in order to travel to their holiday destination which is acknowledged, but considered outside the scope of this research.

waste heat. There are also considerable cooling losses through the fabric of the lightweight villa huts i.e. thatched roof, open louvers etc.

Conclusion

The Maldives hotel uses its certification to document or imply that it is has good levels of emissions. However, certification in this instance cannot imply good levels of emissions nor is it a reliable measure of a hotel's emissions since it does not acknowledge or reward emissions reductions brought about by an increasing use of renewables.

The bottom line is that an exclusive six star resort such as Study 2 should not be justified in emitting 3 (to 11 times if '*resident staff'* is not included in accounting method) the CO2 emissions of another certified hotel. To the guest, the Nordic Swan and the Green Globe logo represent that they are going to stay in a 'green' hotel. The fact that the resort offers six star facilities and is in a remote island location does not justify such a range in emissions when both are awarded similar logos of '*greenness*.' The results also points towards an urgent need for lifestyle and behavioural changes which will make hotels to adapt to these changes and eventually lead to changes in the industry and perhaps even different approaches in the way we design 'green' hotels.

5.2.8 Recommendations for Improvement

Appendix 5.2.E and F present a summary list of recommendations for improvement adapted and developed from the XCO2 Zero Emissions Plan (2006), XCO2 Feasibility Study (2007), Hospitality Saving energy without compromising service, CTV013, Carbon Trust, Environmental Management for Hotels (ITP, 2008). These proposals towards achieving its zero-carbon goal are summarized below. (XCO2, 2006)

1. One strategy for reducing the energy consumption at the resort involves cooling, lighting and water efficiency measures. By replacing the existing with more efficient lighting systems and water fixtures, by educating the guests about proper use of air-conditioning as well as by extending the air-drying facilities for the laundry, for example, up to 30 % of the current energy is expected to be saved. One key energy efficiency task is to minimize the need for A/C and three different environmental modes are proposed in Appendix 5.2.F.
2. Another 30 % of the energy consumption is targeted in a more gradual approach, which, it is anticipated, is completed in 2008. One of the main components of this approach is the installation of a heat recovery system in the generators and incinerator. By establishing a heat recovery connection, this heat could be

recovered for hot water and laundry drying and would provide for all of the resort's heating needs. The employment of absorption chillers and district cooling are other opportunities for increasing the reuse of waste heat.

3. With regard to the resorts energy supply and the targeted reduction in emissions, the use of biodiesel (essentially vegetable oil) is thought to be an interesting alternative to current diesel imports for back-up and residual electricity needs. It would have significantly less environmental impact, as it is virtually carbon neutral, and a large portion of the existing carbon emissions could be avoided.

Besides these options, both XCO2 and the resort put most emphasis on the gradual replacement of finite fuels such as diesel with renewable energy sources such as solar, wind and hydropower in their quest for an integrated and sustainable energy management. (See Appendix 5.2.F)

5.3

Case Study 3

Clew Bay, Mayo, Ireland

This case study building was chosen as an example of a Green Hospitality Award certified hotel. The hotel has received a Gold Standard level of Green Hospitality Award certification in 2008. The hotel is also interesting as it has been renovated from an old Millhouse dating from 1783. Does this certified hotel have significantly lower emissions and environmental impact than business as usual? What features makes this hotel 'green' other than its certification logo? What did the hotel have to do in order to become a gold level 'green' hotel?

Study Hotel 3
Clew Bay, Co. Mayo, Ireland

Description of Hotel

Study hotel 3 is a vacation 4 star hotel is an original grain warehouse building dating back to1783.

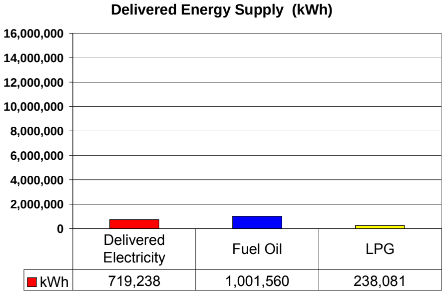
Facilities

- Swimming Pool
- Leisure Centre / Spa
- Banqueting room
 (doubles as conference room)
-

Key Features

- Gold Standard of certification
- Comprehensive report including recommendations for improvements prepared by Sustainable Energy Ireland (SEI)

Key Performance Indicator	
kgCO$_2$ per *guest* night *(Guest night+total food covers+ leisure/spa user)*	**16** **(5)**
kgCO$_2$	**695,363**



Key Facts	
Logo	
Certification	Green Hospitality Award
Date of Certification	2008
Surface/ Bed	67
Hotel Type	Vacation 4 star
Location	Waterfront
Year Built	1783 *(refurb 1999)*
Hotel Area (m^2)	5,728
Number floors	4 (plus roof)
Bedrooms	85
Restaurant	Yes
Conference	Yes (1 room)
Swimming Pool	Yes
Jacuzzi or Spa	Yes
Laundry	Yes
A/C	No

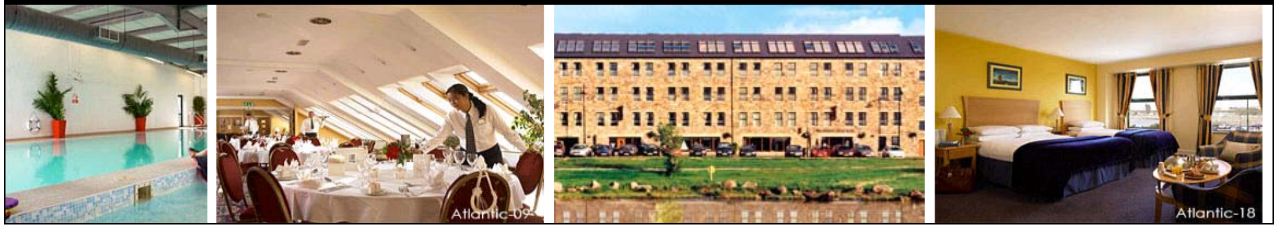


Table 5.3A Summary sheet of Study hotel 3 *(Note.* Indicates Figure submitted for certification).*

5.3.1 Physical Description

The hotel is located in Westport town in Co. Mayo in the west coast of Ireland. Overall, Ireland has a mild but changeable oceanic climate with few extremes.

A summary sheet of Study 3 hotel is shown overleaf. (Table 5.3A) The four star vacation hotel is located on the quayside of the town. The four (plus floor space in roof) storey hotel is an original grain warehouse building which dates back to1783 and was renovated and converted to its present use as a hotel in 1999. According to Mr. John Mc Grath, the environmental manager, *"very little of the original building was kept during the refurbishment"* and *"the main building fabric for the floors was hollow core concrete."* (Mc Grath, 2009).

According to the mandatory energy requirements for certification, '*all windows in rooms shall have an appropriately high degree of thermal insulation, according to local climate. (Except where planning restrictions apply*)' (GHA, 2008a) No further reference to the construction of the building was available from either the documentation containing the requirements for certification or from the hotel manager.

The heated area of the hotel is 5,728 m^2 including the swimming pool, guest rooms, bars/restaurant and conference/banqueting rooms on the 4th floor. The 85 bedroom hotel consists of six distinct areas including: (SEI, 2007)

- Leisure Centre/Spa of 673 m^2
- Banqueting rooms of 226 m^2 (also functions as conference room)
- Bedrooms including Corridors of 3713 m^2
- Bars/Restaurants of 376 m^2
- Back of House/Kitchen of 588 m^2
- Front of House Public Area of 152 m^2

5.3.2 Energy Supply

The local energy supply to the building is made up of delivered electricity and fuel oil and LPG as shown in Table 5.3B below. The figure in brackets is the CO_2 emissions figure when the average Ireland conversion factor (0.538 $kgCO_2/kWh$) for delivered electricity is applied.

2006	**Quantity**	**CO_2 Emissions ($kgCO_2$)**
Delivered Electricity	719,238 kWh	298,531[1] *(338,125[2])*
Delivered Electricity Per Guest Night[3]	17 kWh/gn	
Fuel Oil	1,001,560 kWh	367,514[4]
LPG[5]	238,081 kWh	29,318[6]
Total CO_2 Emissions		**695,363 $kgCO_2$** *(734,957 $kgCO_2$)* [7]
Total CO_2 Emissions Per Guest Night		**16.3 $kgCO_2/gn$[8]** **5.0 $kgCO_2/gn$[9]**

Table 5.3B Summary of energy supply for Study 3.

Delivered Electricity

The electricity for the hotel is delivered from the grid. Power generation in Ireland is carried out by Electricity Supply Board (ESB) as well as by a number of independently owned power stations. These stations generate electricity from fuels such as oil, coal and gas, as well as indigenous fuels including hydro, wind, peat and biomass. (CER, 2009) The overall fuel mix for Ireland is shown overleaf in Figure 5.3.1.

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[1] Conversion factor: 0.475 kgCO2/kWh (Carbon Trust, 2008)
[2] Conversion factor: 0.538 kgCO2/kWh (CER, 2008)
[3] Sleepers only - 42,621 guest nights (Master Workbook, 2008)
[4] Conversion factor: 3.179 kgCO2/L (Carbon Trust, 2008)
[5] Used in kitchen cooking
[6] Conversion factor: 1.495 kgCO2/L (Carbon Trust, 2008)
[7] Using electricity Conversion factor: 0.538 kgCO2/kWh (CER, 2008)
[8] Sleepers only - 42,621 guest nights (Master Workbook, 2008)
[9] Total guest night = (sleepers + total food covers + leisure/spa users) = 149,288 guest nights (Master Workbook, 2008)

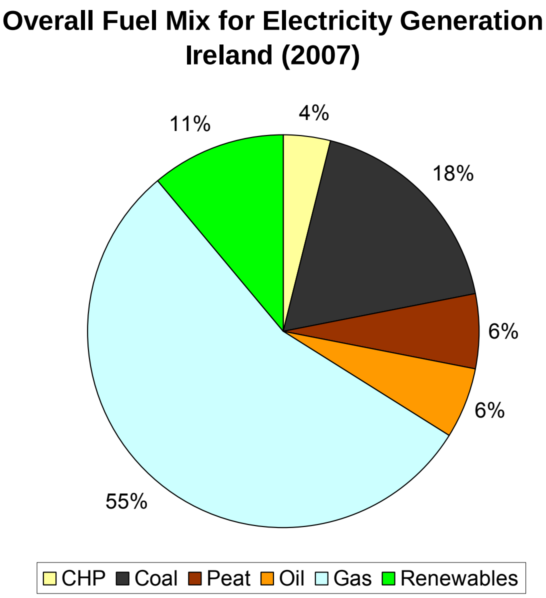

Figure 5.3.1 Ireland's overall fuel mix – 2007 *(CER, 2008)*

Heating

Fuel oil is used for space heating and domestic hot water for the hotel.

5.3.3 Energy End Use

In 2006, the energy supply to the building was made up of grid electricity (37%) for catering, lighting, laundry and lifts, fuel oil - (51%) for space heating and hot water for the hotel and the leisure centre and LPG (12%) providing all laundry drying requirements as seen in Figure 5.3.2 below. (SEI, 2007)

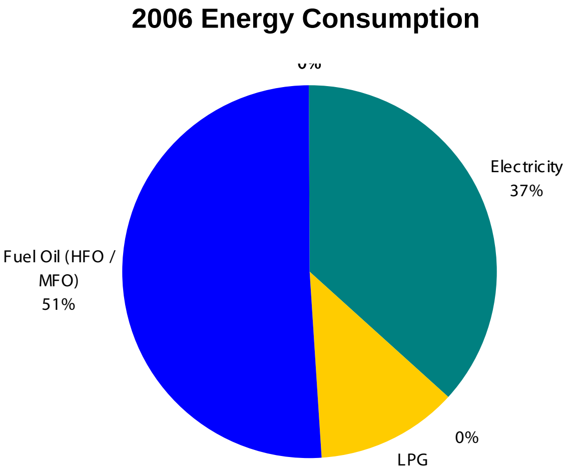

Figure 5.3.2 Breakdown of energy consumption 2006 for Study 3 hotel. *(SEI, 2007)*

Standard Matrix for Fuels Use

See Table 5.3.C on page.

Delivered Electricity

Unfortunately, it is not possible to provide an accurate account of the energy end use since the hotel is not sub-metered. Although from information provided in the SEI report, 2007 it is known that the electricity is used for lighting, catering, and laundry and to run the lifts. Although gas is used for cooking in the kitchen, electricity is used for some cooking and for ovens to keep food warm as well as other cooling installations such as refrigerators, dish washers etc. It is not known if the lifts are of the low energy type nor was any information obtainable on the laundry facilities and type of tumble dryers used.

Heating

Fuel oil is used in the hotel is used to produce the space heating and domestic hot water. Domestic hot water is pumped around the buildings from a series of oil fired boilers and circulated to heat wet radiators around the building and the guest rooms. According to the Sustainable Energy Ireland (SEI) report, the boilers consume 51% of the total quantity of energy consumed and emit 34% of the total CO_2 emissions for the site. SEI suggested the hotel install correct sized gas boilers when natural gas arrives in Westport in April 2008. When the report was written in 2007 they suggested consideration be given to separate boilers for hotel heating, hot water and the swimming pool. It is assumed LPG is used for catering i.e. cooking.

Ventilation

No specific information obtainable. It is expected that in many areas openable windows will be used for natural ventilation. (See section.5.3.5,)

Guest Rooms

No specific information obtainable.

Guest Interaction

No specific information obtainable

Study 3	**On Site Electricity**	**Space Heating**	**A/C Comfort Cooling**	**Hot Water**	**Catering**	**Lighting**	**Laundry**	**Lifts**	**Swimming Pool**	**Sauna**
Grid Electricity					√ [10] [11]	√	√	√		
District Heating										
Natural Gas										
LPG							√			
Fuel Oil		√		√			√		√	
Diesel										
Biomass										
Other										

Table 5.3C Standard matrix for energy use for Study 3 hotel.

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[10] Electricity is used for some cooking and for ovens to keep food warm.
[11] Electricity is used for cooling installations such as refrigerators, dish washers etc.

5.3.4 Green Hospitality Award Certification Analysis of Actual Energy Consumption Data

Data Collection

In order to perform this analysis, the Green Hospitality Award Master Audit Criteria was referred to. (GHA, 2009b) A copy of the hotel's actual GHA Audit Criteria Checklist (GHA, 2008a) for The Green Hospitality Award certification was obtained from the General Manager, Mr. Mc Grath at the hotel. This data enabled the author to interpret how many of the requirements were energy related with respect to the hotel being awarded a Gold Standard level of certification. In addition to these GHA checklist criteria, the actual benchmark data from the Master Workbook 2008 was sent by the general manager. (Appendix 5.3A-E) This contained data on the electricity and fuels consumption as well as the total annual number of guest (sleeper) nights, guest and staff food covers and the number of leisure spa users. This workbook also includes consumption data on waste and water.

Data Limitation

No information was available in the public domain on points scored by the hotel in each category for certification. A direct request was made to the hotel for this information but unfortunately this information was not available for this analysis.

The SEI (2007) report state that further improvements in performance will provide a 10% reduction in energy consumption and bring the kWh/m^2/yr down to 306 kWh/m^2/yr yet this figure was found to be erroneous since the figure for delivered electricity and heating fuels were added together.

Analysis

As described in Chapter 4, section 4.1.4 the scheme is made up of four main categories; Energy Management System (EMS), Energy Performance, Water and Waste. As part of the mandatory requirements, the hotel must submit data for the current and previous year. A key part of the scheme is the audit which reviews the information, documentation and reported data. The scheme awards four levels of certification: Bronze (Introductory), Silver (Good Practice in operation), Gold (Generally Best Practice in operation) and Platinum (World Class Performance).

The mandatory and higher level requirements of the energy management section of the Silver/Gold/Platinum Award is listed in Chapter 4, Appendix 4Ca and 4Cb. In addition to the mandatory and optional score criteria, the hotel consumption data is collected and compared against International benchmarks. This is used for guidance only and is achieving the benchmark level is not a requirement of certification. A breakdown of mandatory and optional points system for each category is shown in Chapter 4, Table 4.3.

Although the hotel could not provide the author with the checklist of points awarded for certification, the author was able to make the following assumptions concerning energy end use since the hotel was awarded with Gold level of certification and would have had to have satisfied the following mandatory requirements for the Energy Management section for Bronze Award. This requires the hotel to; 1) fulfil record and monitor energy consumption, 2) have an action plan with objectives/targets/dates outlined, 3) identify the major energy using equipment and 4) conduct a light audit. In addition, to achieve Gold certification, the hotel would have had to satisfy the following mandatory requirements; (Cross Reference Chapter 4, Appendix 4C)

1. Boiler Efficiency (New) The efficiency of any new boiler (heat generator) purchased within the duration of the Green Hospitality award shall be at least 90%
2. Air Conditioning Purchase Any air conditioning system purchased within the duration of the Green Hospitality award shall have at least a Class B energy efficiency
3. Window Insulation All windows in rooms shall have an appropriately high degree of thermal insulation, according to local climate, and shall provide an appropriate degree of acoustic insulation. (excepting where planning restrictions apply)
4. Control - A/C & Heating If the heating or the air conditioning does not switch off automatically when windows are open, there shall be easily available information reminding the guest to close the window(s) if the heating or the air conditioning is on.
5. Switching off lights If there is no automatic off switch(or electronic key card) for lights in the room, there will be easily available information to the guests asking them to turn off the light when leaving the room
6. Energy Efficient Light Bulbs Within one year from the date of application, at least 60% of all light bulbs in the accommodation shall have an energy efficiency of Class A.

7. Maintenance & Servicing of Equipment All main equipment used to provide the tourist business service shall be serviced and maintained in compliance with the law and when otherwise necessary and the work shall be carried out by qualified personnel only.
8. Maintenance & Servicing of Boilers Maintenance and servicing of boilers shall be carried out at least yearly and Management must know the % efficiency of each main hot water or heating boiler in use.
9. Sub Metering Major Energy using departments shall be sub metered - specifically Laundries and Leisure Centres - and the data monitored monthly and entered into the data workbooks

5.3.5 Author's Analysis of Actual Energy Consumption Data

Data Collection

The monthly consumption data for 2008 was sent by the general manager, Mr. John Mc Grath of Study 3 hotel. (Appendix 5.3 A – E). The data includes electricity and fuels consumption as well as the total annual number of guest (sleeper) nights, guest and staff food covers and the number of leisure spa users. This author developed and adapted the database to include her own CO_2 calculations (Appendix 5.3F).

Direct e-mail communication was also conducted with Mr. Mc Grath to address specific points or queries regarding the consumption data or the hotel in general. This direct communication proved invaluable since inaccuracies observed in the data sent by the hotel were corrected after further clarification with Mr. Mc Grath.

Recommendations for improvement and specific site observations were sourced from the unpublished SEI report 'Follow-up Site Visit Report for Carlton Atlantic Hotel Westport on Boiler over sizing.' (SEI, 2007) Information on the energy benchmarks used in Green Hospitality Scheme was sourced from the unpublished CBPD document entitled 'Development of a CP programme for the Irish Hotel Industry, Greening Irish Hotels.' (Hogan and Bergin, 2006)

Data Limitation

The main limitation of this study is that a site visit was not conducted by the author, instead site observations are based on secondary information contained in the unpublished SEI (2007) and Hogan and Bergin (2006) report. Careful analysis of the excel data sent by the hotel was required as inaccuracies were uncovered in the input of the consumption data. However, this was rectified after further clarification with the manager. For example, the November 2008 electricity consumption figure of 144,279 kWh (indicated red in Appendix 5.3C) and was followed by no data input for December 2008 which led to some speculation as to the accuracy of this data particularly as a typical monthly consumption was in the region of 50,000 kWh. This was pointed out to Mr. Mc Grath, who agreed this figure for November was inaccurate and instead should be similar to January and that the figure for December 2008 should read 44,000 kWh. These changes were adjusted into my calculations. (Appendix 5.3F) However, this did raise questions as to the credibility of the scheme which awards Gold Standard level of certification to a hotel with incomplete and inaccurate energy consumption data.

Analysis

From the consumption data in the excel file sent from the hotel together with the information contained in the SEI (2007) report, the following graphs were produced showing the monthly total number of guest nights and *guest nights +food covers+leisure spa users* (Figure 5.3.3), monthly delivered electricity 2008 (kWh) (Figure 5.3.4), monthly delivered electricity per guest night 2008 (kWh/gn) (Figure 5.3.5) and fuels consumption (kWh) (Figure 5.3.6) for 2008. The monthly CO_2 emissions in 2008 (Figure 5.3.7) and emissions per guest nights and *guest nights +food covers+leisure spa users* are shown in Figure 5.3.8.

Electricity consumption

Figure 5.3.3 shows the monthly total number of guest nights and *guest nights +food covers+leisure spa users*. The occupancy was highest between March and November. Occupancy is at a lowest in December. There is peak *guest night* occupancy in March.

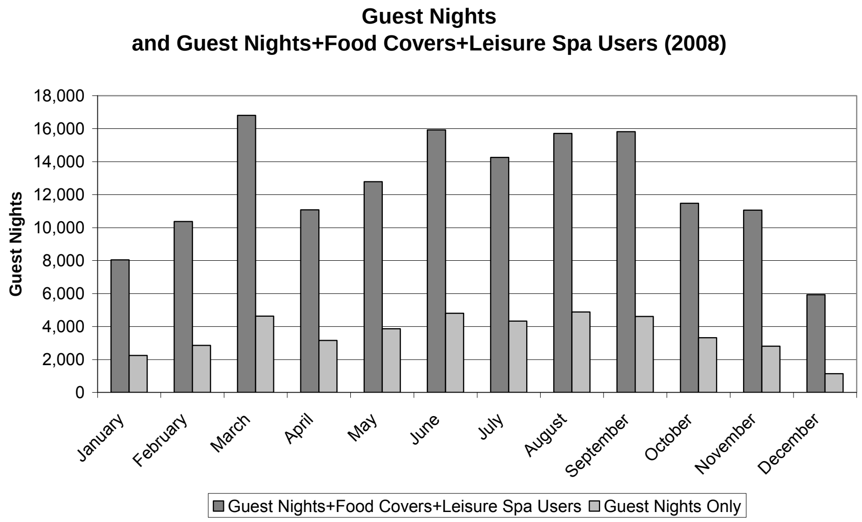


Figure 5.3.3 Monthly ‘guest nights only’ and ‘guest nights+food covers+leisure spa users’ for 2008 for Study 3 hotel. *(Data extracted from Master Workbook, 2008b).*

Figure 5.3.4 below shows the monthly delivered electricity for 2008. The hotel appears to have a relatively consistent electricity base load throughout the year and fluctuates slightly with the number of guest nights and outdoor climate.

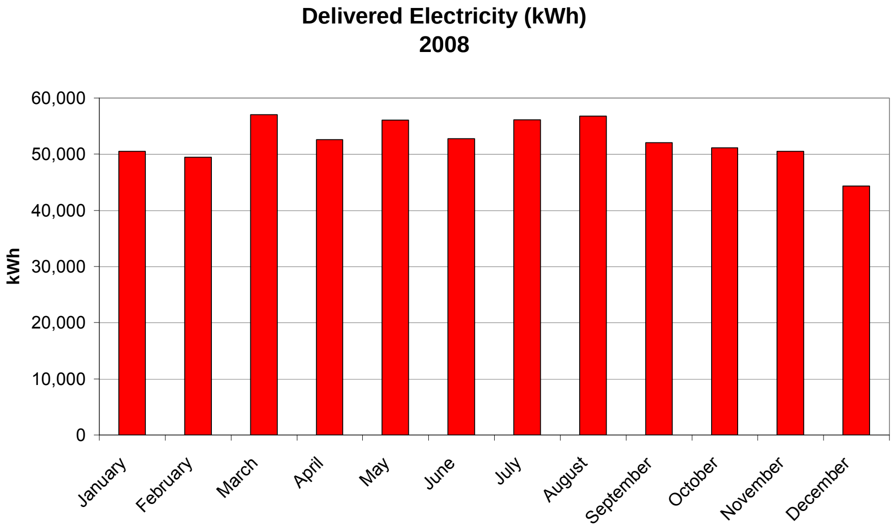


Figure 5.3.4 Monthly electricity consumption for 2008 for Study 3 hotel *(Data extracted from Master Workbook, 2008b).*

The electricity consumption profile is somewhat different when compared on a per guest night basis as seen in Figure 5.3.5 below. The high electricity consumption per guest night may be explained by the fact there are almost 50% less guests (5,923 guest nights) staying in the hotel in December compared with 11,063 guest nights in November yet the electricity consumption remains almost constant between these two months. This suggests that the hotel has a high electricity base load irrespective of the occupancy of the hotel.

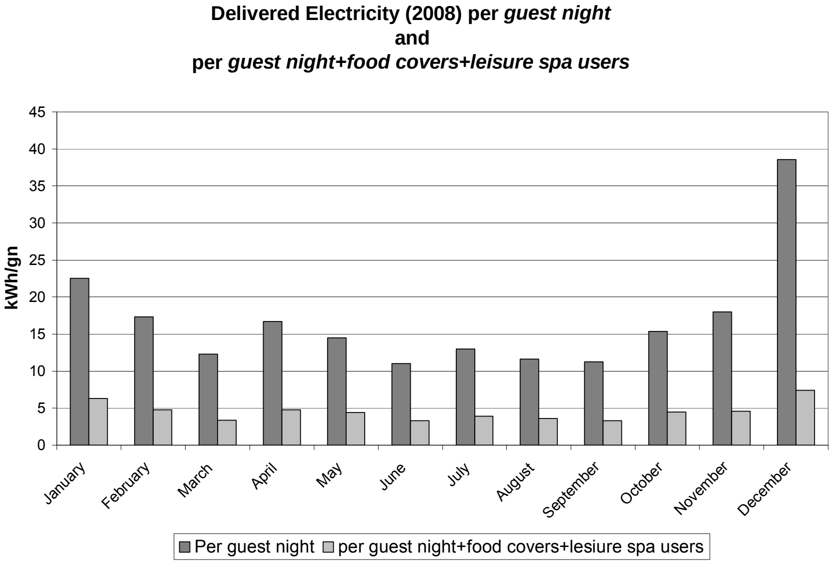


Figure 5.3.5 Monthly electricity consumption for *guest nights* and *guest nights+food covers+leisure spa u*sers for 2008 for Study 3 hotel.

The fuel oil consumption profile is more extreme as seen in Figure 5.3.6 below and does not seem to correspond with fluctuating guest nights nor changes in outdoor temperature. The LPG consumption is consistently lower throughout the year, with lowest consumption during the months of least occupancy namely December and January.

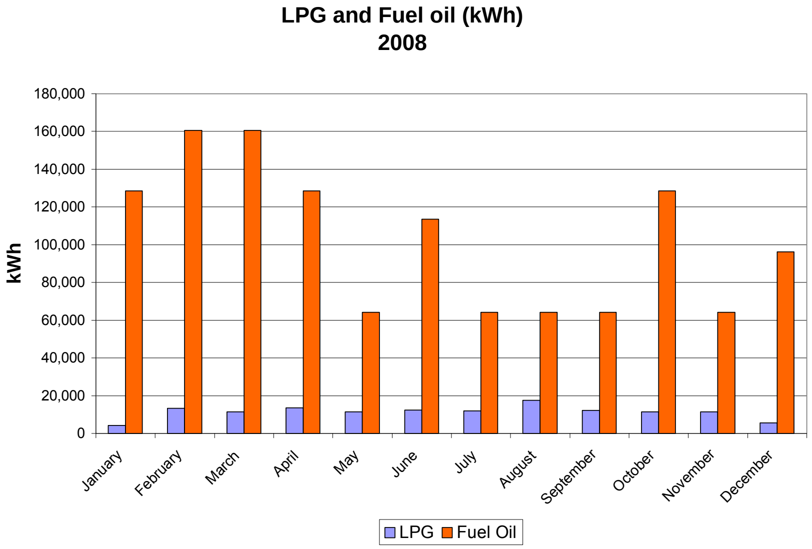


Figure 5.3.6 Monthly fuel oil and LPG consumption in 2008 for Study 3 hotel. *(Data extracted from Master Workbook, 2008b)*

C0$_2$ Emissions

In terms of CO_2 emissions, the hotel emitted 695,363 $kgCO_2$ in 2008, using the average UK conversion factor for delivered electricity of 0.475 $kgCO_2$/kWh. This figure rises slightly to 734,957 $kgCO_2$ in 2008 if the Ireland conversion factor of 0.538 $kgCO_2$/kWh is applied to the delivered electricity figure.

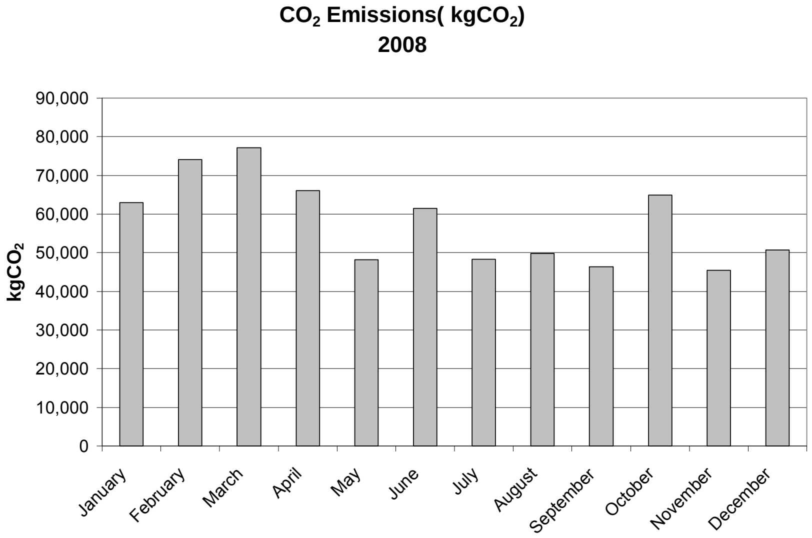


Figure 5.3.7 Monthly CO_2 Emissions in 2008 for Study 3 Hotel *(Authors calculations based on data extracted from Master Workbook, 2008b).*

The resulting CO_2 emissions per guest night is four fold that of total guests which includes guest nights, total (staff and guest) food covers and leisure spa users. A peak in December is observed for CO_2 emissions per guest night as shown in figure 5.3.8 below.

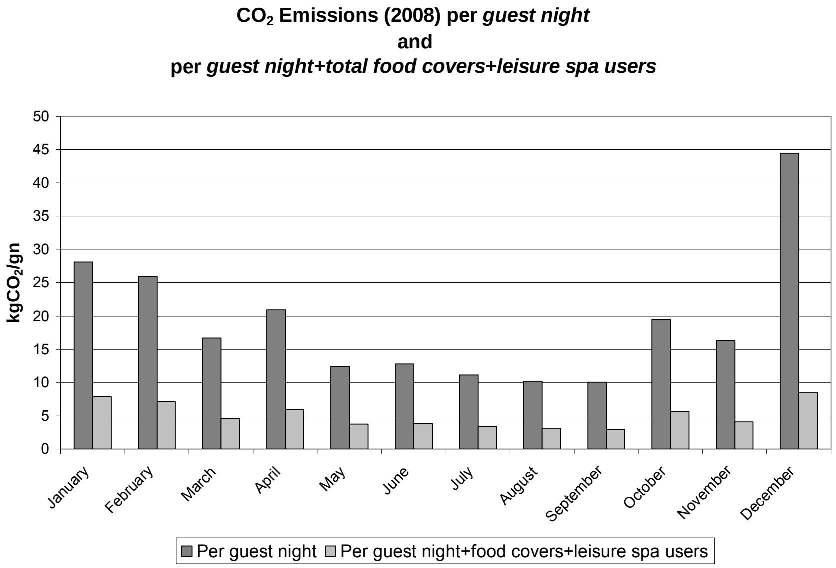


Figure 5.3.8 Monthly CO_2 Emissions consumption for ‘guest nights’ and ‘guest nights+food covers+leisure spa users’ for 2008 for Study 3 hotel. *(Authors calculations based on data extracted from Master Workbook, 2008b)*

The annual average in 2008 is calculated as 16.3kgCO_2 per ‘guest night ‘and 4.7 kgCO_2 per ‘guest night + food covers + leisure spa users’ respectively.

5.3.6 Results

The Ireland hotel case study was chosen to analyze the performance in terms of energy consumption and emissions of a ‘Gold level’ certified of hotel. The hotel uses its Gold Standard level of certification to document or imply that it is has good levels of emissions However, it was found that certification in this instance cannot imply good levels of emissions since levels of emissions are not measured for the award of certification.

According to the data sent to the author, the hotel’s total electricity consumption in 2008 was calculated to be 678,765 kWh or 118 kWh/m^2. If the hotels electricity consumption (kWh/m^2) is compared to the Energy Consumption Guide 36 and is categorized as a business or holiday hotel, then its electricity consumption would be in the 'fair' category of performance (80-140 kWh/m^2).

Careful analysis of the excel data sent by the hotel was required as inaccuracies were uncovered in the input of the consumption data which raised questions as to the credibility of a scheme which awards Gold Standard level of certification to a hotel with incomplete and inaccurate energy consumption data.

Analysis of this data also revealed that the hotel has a high electricity base load irrespective of the occupancy of the hotel due to the hotels continued operations to keep it functioning.

It was found that the hotel has a very high fuel oil consumption accounting for over 51% of the overall energy consumption. This high consumption is due to the over sizing of the boilers as diagnosed by the SEI report. A number of opportunities were identified by the report for further energy savings in the following areas; end user heat demand, distribution system and generation system along with renewable options which would be suitable but they point out that the sizing of any potential CHP plant is directly linked to the base heat load as many energy efficiency opportunities need to be identified prior to sizing or possible installation of solar panels. The award of Gold level certification to a hotel with high base load brings the credibility of the scheme into question.

Discussion

The results showed that the CO_2 emissions per guest night is four fold that of total guests which includes guest nights, total (staff and guest) food covers and leisure spa users. If hotels are to be accountable for their emissions then they should be compared on the same 'per guest night' basis with the same 'rules' being applied across schemes. If hotels are not using the same accounting method then this should be reflected in the award of certification.

This hotel emits 16.3 $kgCO_2$/gn which almost three times *less* emissions than the EU Flower certified hotel in Malta (53 $kgCO_2$/gn) and less then the Green Glob certified hotel in The Maldives (22 $kgCO_2$/gn). When compared with the other case study hotels, this hotel performs considerably better. However, it is worth pointing out that this hotel emits about the same as the *business-as-usual* hotel at 17.5 $kgCO_2$/gn and about two and half times the emissions 'at home' (6.7 $kgCO_2$/gn).

5.3.7 Recommendations for Improvement

The SEI list of potential opportunities (Appendix 5.3G) focus specifically around the heating system such as;(SEI, 2007)

a) Boiler Controls

b) Insulation within the boiler house

c) Insulation of distribution system

d) Renewable energy alternatives such as Solar Panels and CHP (Combined Heat and Power for both hot water and heating requirements

e) Natural gas instead of oil (available in Westport in March 2008). This provides the opportunity to correctly size the boilers and ensure that they have the correct controls.

In their list of recommendations, SEI advise the hotel that '*Prior to sizing any Combined Heat and Power (CHP) plant for the Hotel it is important to understand that the sizing of the CHP plant is directly linked to the base heat load. Therefore it is important to carry out as many of the energy efficiency opportunities as possible prior* *to sizing of CHP plant or Solar panels. Boiler Management is also a requirement as this hotel is grossly oversupplied with boilers.*' (SEI, 2007)

The report goes on to say that '*The hotel has been managing their energy for a number of years and have turned off considerable air handling plant permanently. Management are very aware of the importance of controls, though most of these are manual as there is no Building Management System.*' (SEI, 2007)

In relation to the boilers the following initiatives were implemented by SEI following the report;

1. One jet removed from both 1,100kW boilers reducing the capacity by 50%
2. The capacity of the existing jet on the 1,100kW boilers was reduced by 11% by restricting the oil flow through the jet.
3. On/off times of the heating system restricted.
4. Heating turned off in unoccupied rooms.

A number of opportunities were identified by SEI for further energy savings in the following areas; end user heat demand, distribution system and generation system along with renewable options which would be suitable to the site; these are summarised by SEI and shown in (Appendix 5.3G) (SEI, 2007)

5.4

Indepth Study 4

Chain Hotel, St. Julian's, Malta

This case study building was chosen as it is the first hotel in Malta to be awarded the EU Eco Label - EU Flower. (Ecotrans, IER, 2006). The hotel also was a finalist in the 'hotel/guesthouse' category of The Royal Accommodation Award 2006. It begs the question; is it possible for a large, five star luxury chain hotel to have a significantly lower environmental impact than our traditional image of a 'sustainable' or 'eco-hotel'?

This study will question whether any improvements in performance are attributable to (1) a lower carbon energy supply, (2) effective energy conservation measures or (3) the hotel was EU Eco Labeled, or (4) as a result of the intranet based Hilton Environmental Reporting (HER) system? These questions are particularly interesting in the light of the hotel's high electricity consumption (as a result of the climate and high level of facilities offered) and the fossil based fuel mix for its electricity generation, which is a particular challenge due to its island location.

5.4.1 Physical Description

The Republic of Malta is a small and densely populated island nation consisting of an archipelago of seven islands in the middle of the Mediterranean Sea. Malta lies directly south of Sicily, east of Tunisia and north of Libya. The climate is Mediterranean, with mild, rainy winters and hot, dry summers. Study 4 hotel is part of the unique waterfront of Portomaso and is situated on Malta's north-eastern coast.

A summary sheet of Study 4 hotel is shown overleaf. (Table 5.4A) No information was available from the hotel concerning the construction of the hotel. The EU Flower verification forms confirm that the hotel has insulation performances higher than the minimum national requirements and the windows in the guest rooms are insulated with double glazing. (MSA, 2004)

The 11 storey hotel was built in 2000 and has a floor area of 41,100m^2. The business and conference centre (capacity of 1,400 delegates) was opened in 2003 has a floor area of 3,500m^2. The centre includes 10 meeting halls spread over 3,500 square meters and four floors. The consumption data does not include the consumption in the convention centre or the new seven storey extension (110 guest bedrooms) completed in 2008.

Study Hotel 4
St. Julian's, Malta

Description of Hotel

Study hotel 4 is a modern waterfront hotel located in north-eastern coast Malta. The building comprises of 11 floor accommodation block (2000). There is also a conference centre (2003) and recently completed 7 storey accommodation block (110 beds) but these not included in calculations.

Facilities

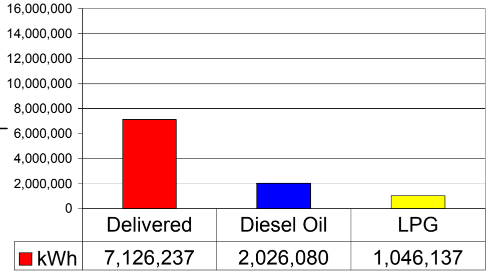
- Fitness, leisure and beauty centre (gymnasium, indoor heated pool, jacuzzi, plunge pool, sauna and steam bath, four outdoor and one indoor pool)
- 19 meeting rooms
- 3 restaurants,
- In-house and out sourced laundry.

Key Features

- changeover from two diesel burners (warm water boilers) to LPG.
- First hotel in Malta to be Eco-labelled – EU Flower.

Key Performance Indicator	
$kgCO_2$ per guest night	53
$kgCO_2$	7,107,055

Delivered Energy Supply (kWh)



	Delivered	Diesel Oil	LPG
🟥 kWh	7,126,237	2,026,080	1,046,137

Key Facts	
Logo	
Certification	EU
Certification	
Surface/ Bed	140
Hotel Type	Vacation, Business
Location	Waterfront
Year Built	2000
Hotel Area (m^2)	41,100
Number floors	11
Bedrooms	294
Restaurant	3 (*See Facilities*)
Conference	Yes (*See Facilities*)
Swimming Pool	Yes (4 outdoor)
Jacuzzi	Yes
Air-conditioning	Yes
Laundry	In & Out Sourced

Table 5.4 A Summary Sheet of Study 4 hotel.

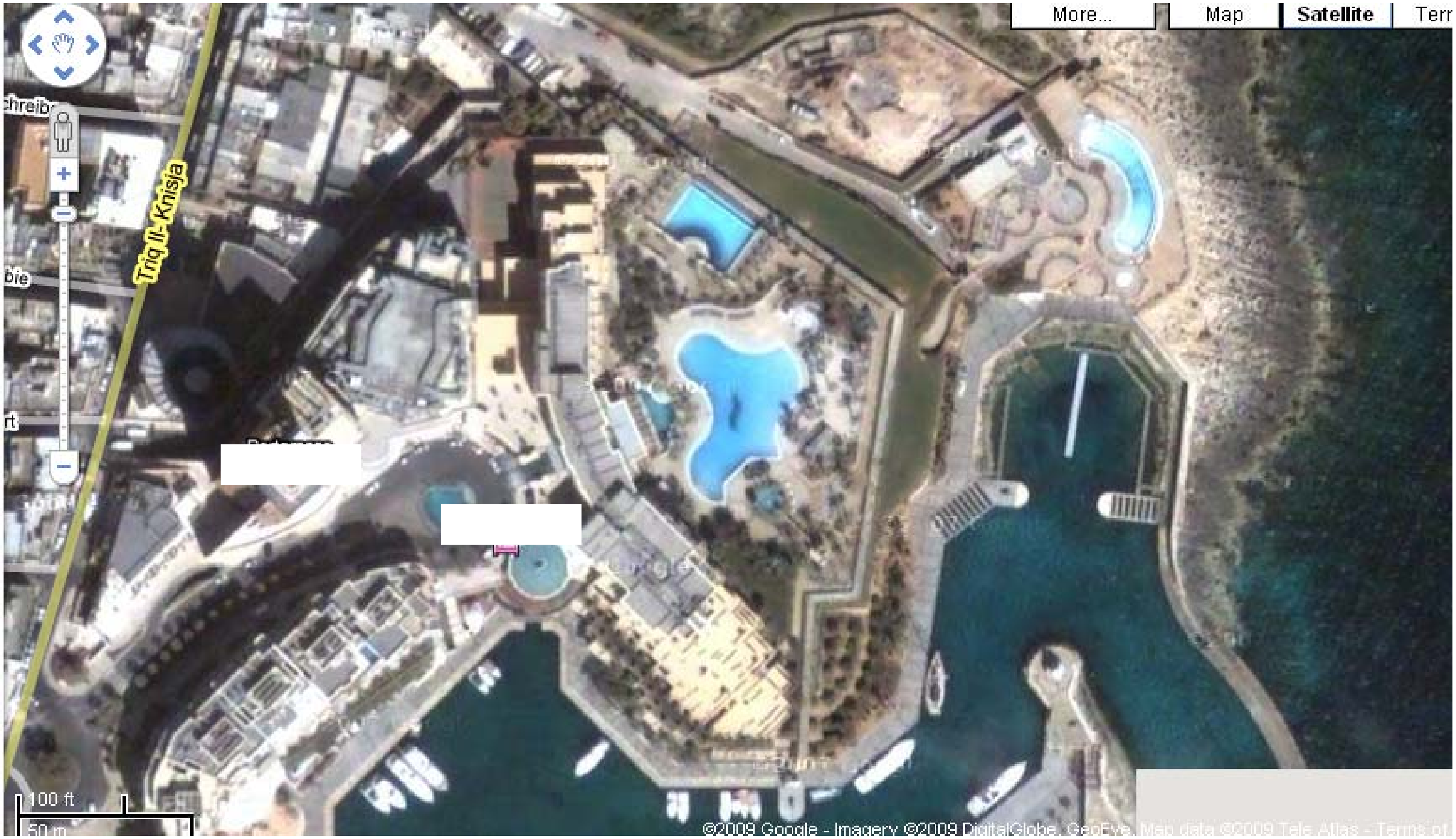


Figure 5.4.1 Aerial view of Study 4 hotel, Malta *(Google, 2009).*

The bed-to-surface-area ratio is 140. The conditioned area of the hotel is 41,100m^2, including 294 guest bedrooms, fitness, leisure and beauty centre (gymnasium, indoor heated pool, Jacuzzi, plunge pool, sauna and steam bath, four outdoor and one indoor pool) 3 restaurants, 3 kitchens, in-house and out sourced laundry. The area also includes 19 meeting rooms.

Each guest bedroom comes with air-conditioning and central heating. Other energy users include minibar, TV, hairdryer etc). Guest rooms vary in size from the Deluxe Room (37m²) as shown in Figure 5.4.2, through the Corner Suite with separate living room and Executive Lounge benefits (68m²) to the Deluxe Suite with living room and dining area and Executive Lounge access (115m²) There is a Presidential Suite but no dimensions are given. (Source: Confidential)

1. Deluxe Room **2.** Corner Suite **3.** Deluxe Suite

4&5 Presidential Suite

Figure 5.4.2 Typical Room types of varying size and facilities *(Source: Confidential)*

5.4.2 Local Energy Supply

The annual local energy supply to the building in 2005, consists of the local energy delivered electricity, diesel oil and LPG as shown in Table 5.4B below.

2005	**Quantity**	**CO_2 Emissions ($kgCO_2$)**
Delivered Electricity	7,126,237 kWh	6,342,350[1]
Delivered Electricity Per Guest Night[2]	53 kWh/gn	
Diesel Oil	2,026,080 kWh	545,015[3]
LPG	1,046,137 kWh	219,689[4]
Total CO_2 Emissions		**7,107,055 $kgCO_2$** [5]
Total CO_2 Emissions Per Guest Night[6]		**53 $kgCO_2$/gn**[7]

Table 5.4B Summary of Energy Supply for Study 4 hotel. *(Source: Author)*

(Note: *In the CO_2 calculations, the Malta conversion factor was applied to the figure for delivered electricity since it is not connected to continental Europe).*

Malta has no indigenous energy sources and depends totally on oil imports resulting in high energy costs. Electricity generation in Malta is totally based on oil since 1995, which was the last year that hard coal was. Total generation has been steadily increasing over the years. (EC, 2007) Energy statistical data for the Maltese Islands show that there is a continuous annual increase of 17% for fossil fuel energy consumption during the past eight years. (NSO, 2008) As specified in the hotels EU Flower verification forms, (See Appendix 5.4A) the hotel does not have access to electricity from Renewable Energy Sources (RES).

Electricity is currently generated solely by Enemalta Corporation (EMC), a nationally owned corporation; even though the generation sector is open to competition. EMC operates two Power Stations with a total combined nominal installed capacity of 571MW, are interconnected together by means of the existing grid. The fuel mix for the electricity generation in 2006/07 consisted of 92% heavy fuel oil and 8% gas oil. (IERN, 2009)

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[1] Conversion factor: 0.89 kgCO2/kWh (UNEMG, 2008)
[2] Sleepers only – 134,637 guest nights (Hilton HER database, 2007)
[3] Conversion factor: 0.269 kgCO2/kWh (Carbon Trust, 2008)
[4] Conversion factor: 0.19 kgCO2/kWh (Carbon Trust, 2008)
[5] Conversion factor: 0.89 kgCO2/kWh (UNEMG, 2008)
[6] Sleepers only - 134,637 guest nights (Hilton HER database, 2007)
[7] Conversion factor: 0.89 kgCO2/kWh (UNEMG, 2008)

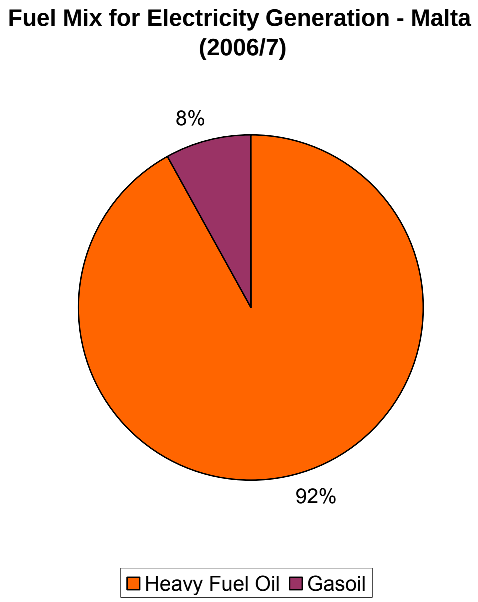

Figure 5.4.3 Fuel Mix for Electricity Generation – Malta, 2006/7 *(IERN, 2009)*

5.4.3 Energy Use

Space Heating and Hot Water

There are no natural gas systems in Malta. (IERN, 2009) The Ecotrans, IER report states that space heating and hot water is provided by diesel oil. According to the ECOTRANS, IER (2006) report, the changeover from two diesel burners (hot water boilers) to liquefied petroleum gas in 2004 has led to a 60% reduction in heating costs, while the burner‘s efficiency increased at the same time reducing emissions significantly. (ECOTRANS, IER, 2006)

There is also some confusion in the verification document (See Appendix 5.4C) which states that the hotel does not have to fulfil the requirements of criterion no.7 (sheet n.26) of the EU Flower verification document since ‘*switching off heating or air-conditioning*’ is ‘*not applicable*’ in Malta yet on sheet n.27, the hotel declares it complies with this criterion. Whereas in the Optional Criteria section (criterion n.49) the hotel achieved 1 point for complying with *‘the automatic switching off of air-conditioning.’* (See Appendix 5.4D)

Cooling

There is a conflict between the information provided in the hotel fact sheet, ECOTRANS, IER report and the information contained in the Hilton HER database which states that the hotel has air-conditioning in public areas, meeting rooms and guest bedrooms. However, it is claimed in the EU Flower verification forms that it is not provided and therefore it does not need to comply with criterion no.5 for certification. (See Appendix 5.4C)

5.4.4 Energy Conservation Measures

A list of the energy conservation measures are listed in this section and have been extracted from the hotels verification forms sent to EU Flower for certification. Documentation to prove compliance is necessary for verification.

Standard Matrix For Fuels Use

See Table 5.4C on the following page.

Heating

The changeover from two diesel burners (warm water boilers) to liquefied petroleum gas has led to a 60 % reduction in heating costs, while the burner‘s efficiency increased at the same time reducing emissions significantly. The gas condensing gas boiler is serviced once a year and its efficiency is checked to ensure it the requirement of 90% boiler efficiency.

As seen in Appendix 5.4A, the hotel uses LPG for space heating and domestic hot water since 2004. (Ecotrans, IER, 2006) However, these conflicts with the consumption data table required to satisfy criterion n.35 of the verification document, which lists natural gas and Bio-diesel consumption as the energy sources for heating rooms and sanitary water. (See Appendix 5.4F)

The hotel scored points in the optional criteria as follows; heat recovery system 1.5pts, thermoregulation 1.5 pts (Building Management System – BMS which for example switches off outside lights), and heat pump which runs the indoor swimming pool (1.5pts).

Electricity end use

It is not possible to provide an accurate account of the energy end use since the hotel is not sub-metered although according to Criterion n.83 (energy and water meters 1 pt) in the verification forms, there is an energy metre for laundry services and energy relative to specific machines such as refrigerators, washing machines etc.

However, it is deduced from the EU Flower Verification forms, energy consumption data and information on the hotel, that the electricity is used for the air-conditioning, lighting, to run the pool heat pump, and fans. Although not specified in verification forms, it is assumed gas is used for cooking in the kitchen, although electricity would be used for some cooking and for ovens to keep food warm as well. It is assumed that electricity is used for the lifts and to power the proportion of laundry that is done in house.

From the information submitted for criterion 9 of the EU verification forms that 60% of the light bulbs are non-energy efficiency light bulbs (2947 out of a total number 4941 of light bulbs in the accommodation) Class B light bulbs are used in back of house and kitchens. (Appendix 5.4D)

Ventilation and Comfort Cooling

The Heating, Ventilation and air-conditioning (HVAC) is serviced and maintained three times a year as well as kitchen equipment such as refrigerator, washing machines and dishwasher. (MSA, 2004)

In addition to natural ventilation (operable windows in guest bedrooms, meeting rooms and some public areas) there is air-conditioning provided in the guest bedrooms, meeting rooms and public areas. The hotel has an automatic system that turns off the air-conditioning when windows are open. There is a copy of the Hilton Services Directory which includes a copy of the information text given to guests on switching off heating and /or air conditioning when windows are open and lights when leaving the room.

There is a key card system in each guest room. The temperature inside the rooms is pre-set between 19-21^{0}C. Each room is provided with a manual temperature control which allows the occupant to increase or decrease the temperature by 4^{0}C.

According to criterion n.50 (bioclimatic architecture 2 pts) of the MSA verification forms the hotel made the best use of cooling by appropriate orientation of hotel to summer shade, appropriate shading of windows with natural or artificial shading devices and appropriate devices to bring air from cool to warm sites (for example through mechanical ventilation systems which input cool air from basement in common rooms). (See Appendix 5.4D)

Other Energy Related Measures

- Copy of environmental policy given to guests and evidence of acceptance by the guest of changing sheets and towels only on his/her request.
- Installation and maintenance of sauna timer control.
- The refrigerator is positioned far from source of heat such as oven and the cooling tubes are cleaned regularly.

Study 1	**On Site Electricity**	**Space Heating**	**A/C Comfort Cooling**	**Hot Water**	**Catering**	**Lighting**	**Laundry**	**Lifts**	**Swimming Pool**	**Sauna**	**Other[8]**
Grid Electricity			√[9]		√[10]	√	√	√	√	√	√
District Heating											
Natural Gas											
LPG		√[11]		√[12]			√				
Diesel Oil		√[13]		√[14]							
Diesel											
Biomass											
Other											

Table 5.4C Standard matrix for energy use for Study 4 ***Note***: LPG and Diesel not simultaneous. *(Source: Author)*

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[8] Electricity is used for cooling installations such as refrigerators, dish washers etc.
[9] To run fans, ducts etc.
[10] Electricity is used for some cooking and for ovens to keep food warm.
[11] Switchover to LPG in 2004.
[12] Switchover to LPG in 2004.
[13] Switchover Diesel Oil to LPG in 2004.
[14] Switchover Diesel Oil to LPG in 2004.

5.4.5 EU Flower Certification Analysis Of Actual Energy Consumption Data

Data Collection

In order to perform this analysis, the verification forms for The European Eco-Label for Tourist Accommodation Service EU Eco-Label. (MSA, 2004) were sent directly to the author by Mr. Mario Morano, environmental manager for Study 4 hotel. Reference was made to the EU Flower criteria document, Commission Decision of 14 April 2003 (2003/287/EC) (EC, 2003). In addition, direct e-mail communication was made with Mr. Morano of the hotel and Dr. Paulina Bohdanowicz of Hilton Hotel Group who granted access to the Hilton Worldwide Database of over 300 hotels. The date for this case study hotel was extracted and inputted into the author's database. (Appendix 5.4E)

Data Limitation

No information available in the public domain on points scored by hotel in each category for EU Flower certification. Access was granted to the EU Flower verification forms courtesy of Mr.Mario Morano following direct e-mail communication.

Analysis

As described in Chapter 4, section 4.2.3 the scheme is made up of six categories; energy, other, waste, water, management and chemicals. The criteria are divided into two levels of requirement, mandatory criteria and optional criteria as shown in Chapter 4, Table 4.3. The Energy category accounts for 10 out of 37 Mandatory points and 17 out of 47 optional points (*at least 16.5 points must be achieved in this section*). (See Chapter 4, Appendix 4B).

Based on the consumption data extracted from Hilton HER database, its energy consumption for the year 2006 was calculated as 161kWh/m^2[15] or 48 kWh per guest night. Based on the verification forms submitted to EU Flower for certification, (MSA, 2004) the criteria achieved in the mandatory category for Energy is shown in Table 5.4D below.

Energy Mandatory Category	**Declaration of *non* applicability**	**Compliance Met with Criterion**
Criterion n.1 Electricity from renewable sources	✓	
Criterion n.2 Coal/Heavy Oil	✓	
Criterion n.3	✓	

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[15] 6,618,253 kWh / 41,100m^2

Electricity for heating	*(no access to RES)*	
Criterion n.4 Boiler Efficiency		✓
Criterion n.5 Air-conditioning	✓	
Criterion n.6 Window Insulation		✓
Criterion n.7 Switching off heating or air-conditioning	✓	
Criterion n.8 Switching off lights		✓
Criterion n.9 Switching off lights	✓	
Criterion n.10 Sauna timer control		✓

Table 5.4D Criterion achieved by hotel in the Energy Mandatory category *(Developed by Author from Hotel 4 EU Flower Verification Forms, MSA 2004).*

As seen in Table 5.4D, the hotel complied with four out of ten criterions in the mandatory category for energy. The hotel fulfilled the required Declaration of non-applicability for the remaining six mandatory criterions. In the optional criteria section, the hotel achieved thirteen out of 17 optional points in the energy category as seen in Table 5.4E.

Criterion Number	*Energy optional criteria (point score)*	*Criterion achieved*
n.38	Photovoltaic and wind generation of electricity (2 points)	
n.39	Heating from renewable energy sources (1,5 points)	
n.40	Boiler energy efficiency (1 point)	✓
n.41	Boiler NOx emissions (1,5 points)	✓
n.42	District heating (1 point)	
n.43	Combined heat and power (1,5 points)	
n.44	Heat pump (1,5 points)	✓
n.45	Heat recovery (2 points)	✓
n.46	Thermoregulation (1,5 points)	✓
n.47	Insulation of existing buildings (2	✓

	points)	
n.48	Air conditioning (1,5 points)	
n.49	Automatic switching-off of air conditioning (1 point)	✓
n.50	Bioclimatic architecture (2 points)	✓
n.51	Energy efficient refrigerators (1 point), dishwashers (1 point), washing machines (1 point) and office equipment (1 point)	
n.52	Refrigerator positioning (1 point)	✓
n.53	Automatic switching off lights in guest rooms (1 point)	
n.54	Automatic switching off outside lights (1 point)	✓
	TOTAL Optional points	**14.5 points [16]**

Table 5.4E Breakdown of optional points scored by hotel in Energy Optional Criteria *(Developed by Author from Hotel 4 EU Flower Verification Forms, MSA 2004).*

5.4.6 Authors Analysis of Actual Energy Consumption Data

Data Collection

In this phase of the research the focus was on the analysis of energy consumption (and emissions per guest night) for Study 4 hotel. Access was granted to the Hilton Environmental Reporting System (HER)[17] in 2007. Information from over 300 Hilton hotels worldwide was included in this database. Of these hotels only one had achieved EU Flower certification in 2006 and access to the HER system prompted the choice of this hotel for further in depth study.

To comply with Hilton (HER), Study 4 hotel is required to send monthly reports documenting the consumption of electricity, district heating/cooling, fuel and the energy mix used to generate these; water and waste (unsorted, sorted and hazardous); types and amounts of refrigerants used; together with a number of other key parameters (number of guest-nights, turnover, etc.). It is also required to provide local heating and cooling degree days. The hotel has its own profile which includes basic facility information (Bohdanowicz et el., 2005) According to Bohdanowicz, the data contained in the HER database is considered consistent and accurate and therefore reliable. (Bohdanowicz, 2006) Appendix

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[16] Not possible to give maximum score for comparison since not all criteria are applicable.
[17] Courtesy of Dr. Paulina Bohdanowicz and Mr. Jan-Peter Berkvist, Hilton Scandic, 2007.

5.4E shows the extracted energy consumption data from the HER database for this hotel which was inputted into the authors own database.

Data Limitation

The most serious limitation of this data is the adding of different types of energy together *i.e. delivered electricity and fuels* to give an erroneous energy consumption figure.

The consumption data for 2000 was not included as only 8 month's monitoring period was available in the database. This is explained by the fact the hotel was only completed in 2000.

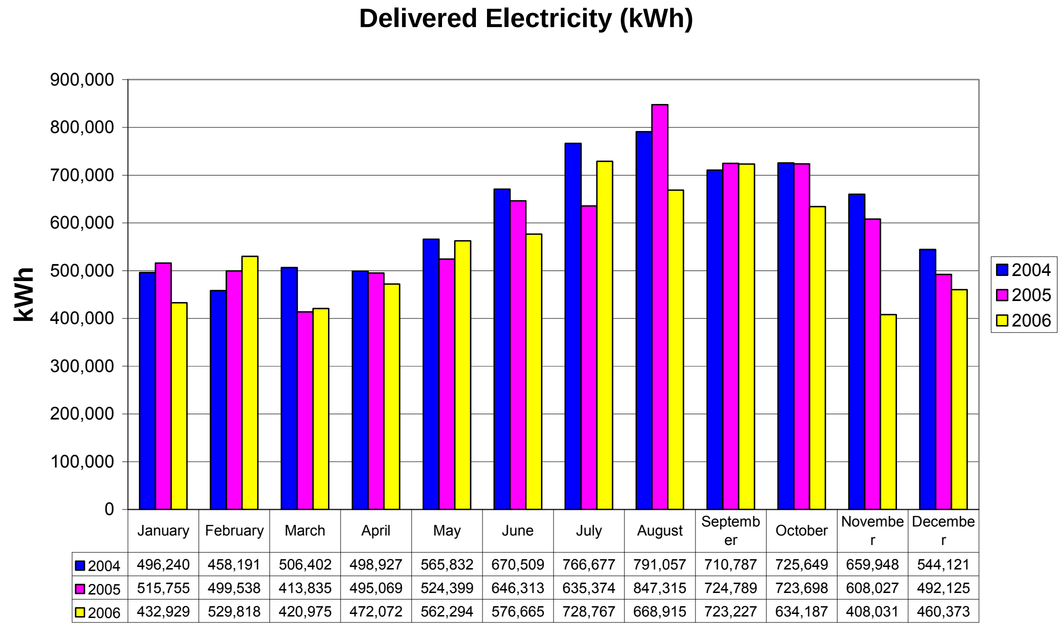
The total number of guest nights for the period 2001–3 has the same numbers entered for each month which meant the data was unreliable and was not included in the analysis. The same problem was identified during the same period for the electricity and gas/diesel oil consumption and therefore was unreliable and could not included in the analysis.

There was some uncertainty with the diesel oil consumption in 2006 as there was one entry in January 2006 (5,360kWh) and March (71,288 kWh) and no other figures for the remaining 10 months which may be explained by the switch over from gas/diesel oil to LPG but according to the reports this occurred in 2004. This led to some confusion and uncertainty with the data for that year.

This problem has also been identified by Bohdanowicz who found that the Hilton (HER) database has suffered from a number of limitations and she says that some of those have been overcome with time, others remain as detailed in Papers V,VI,VII and X in Bohdanowicz (2006) as well as in Bohdanowicz et al. (2005).

Energy Consumption

As previously mentioned, the energy supply to the building is made up of delivered electricity and diesel oil with a switch to LPG in 2004. From the data extracted from HER (Appendix 5.4E) the following graphs were produced showing monthly delivered electricity (kWh) (Figure 5.4.4) and the monthly total number of guest nights (Figure 5.4.5) and the monthly total electricity per guest night (kWh/gn) (Figure 5.4.6) for the years 2004-6. The electricity consumption profile fluctuates throughout the year with the number of guest nights and outdoor climatic conditions as seen in Figure 5.4.6. There is an increase in electricity consumption profile between April and November.



	January	February	March	April	May	June	July	August	Septemb er	October	Novembe r	Decembe r
■ 2004	496,240	458,191	506,402	498,927	565,832	670,509	766,677	791,057	710,787	725,649	659,948	544,121
■ 2005	515,755	499,538	413,835	495,069	524,399	646,313	635,374	847,315	724,789	723,698	608,027	492,125
□ 2006	432,929	529,818	420,975	472,072	562,294	576,665	728,767	668,915	723,227	634,187	408,031	460,373

Figure 5.4.4 Monthly Delivered Electricity (kWh): 2004-6 *(Data extracted by Author from Hilton Environmental Reporting System (HER) software courtesy of Bohdanowicz, Hilton, 2007).*

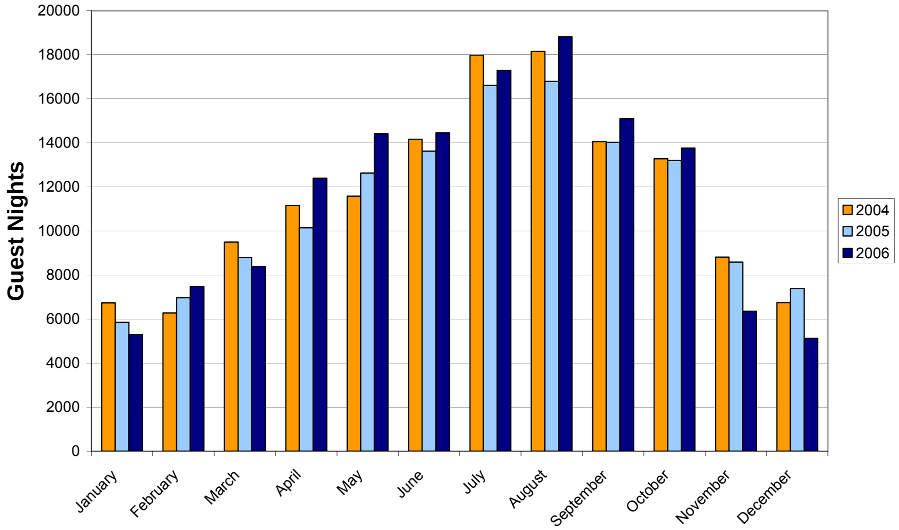
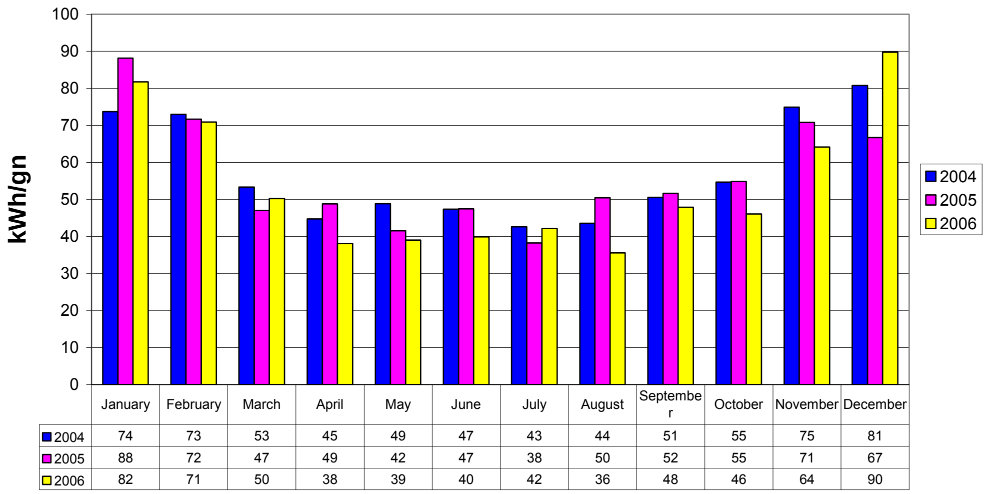


Figure 5.4.5 Monthly Total Number of Guest Nights 2004-6 *(Data extracted by Author from Hilton Environmental Reporting System (HER) software courtesy of Bohdanowicz, Hilton, 2007)*

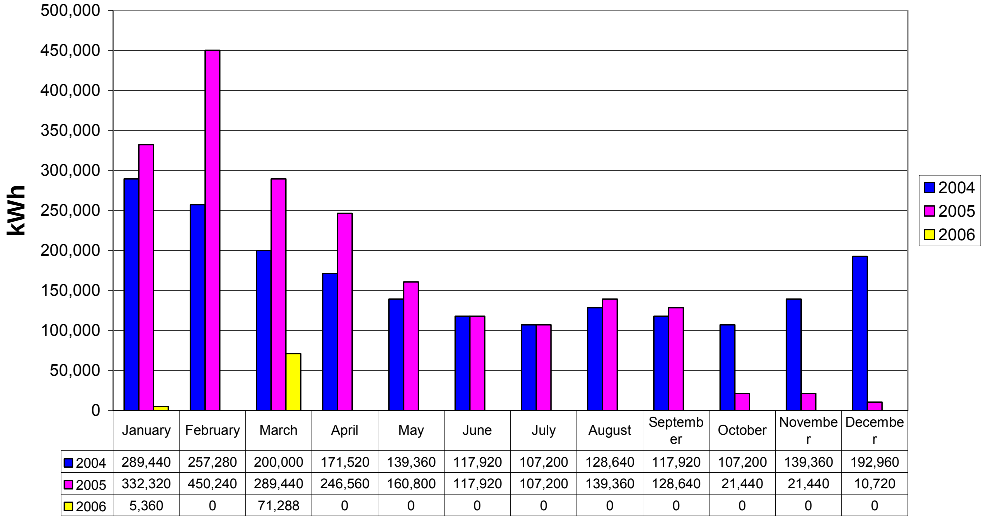
The electricity shows a different profile when calculated on a per night basis. In this case the number of guest nights include 'sleepers' only as per the HER database. Figure 5.4.4 and 5.4.6 show a 10% reduction in electricity consumption and a reduction in total annual electricity consumption from 53 to 48 kWh/gn for the period 2004-6.


Delivered Electricity per guest night (kWh/gn)

	January	February	March	April	May	June	July	August	September	October	November	December
■ 2004	74	73	53	45	49	47	43	44	51	55	75	81
■ 2005	88	72	47	49	42	47	38	50	52	55	71	67
□ 2006	82	71	50	38	39	40	42	36	48	46	64	90

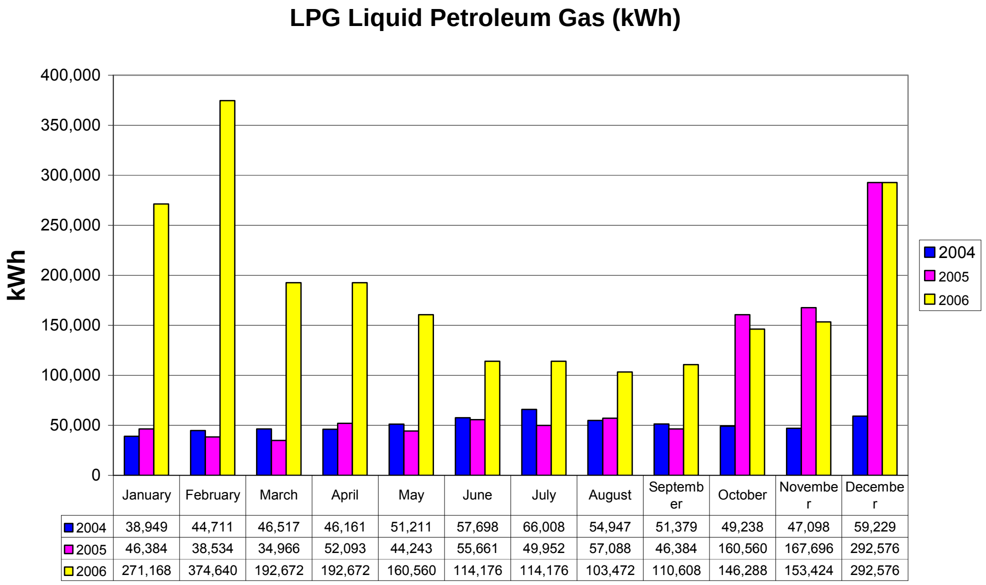
Figure 5.4.6 Monthly Total Electricity per guest night(kWh/gn): 2004-6 *(Data extracted by Author from Hilton Environmental Reporting System (HER) software courtesy of Bohdanowicz, Hilton, 2007)*

From the data extracted from HER database (Appendix 5.4B) there is a reduction in diesel oil consumption from 14 to 1 kWh/gn and an increase in LPG consumption is seen from 4 to 16 kWh/gn during the period 2004 to 2006, as explained by the switch to LPG in 2004 as below.


Gas/Diesel Oil (kWh)

	January	February	March	April	May	June	July	August	September	October	November	December
■ 2004	289,440	257,280	200,000	171,520	139,360	117,920	107,200	128,640	117,920	107,200	139,360	192,960
■ 2005	332,320	450,240	289,440	246,560	160,800	117,920	107,200	139,360	128,640	21,440	21,440	10,720
□ 2006	5,360	0	71,288	0	0	0	0	0	0	0	0	0

Figure 5.4.7 Monthly Total Diesel consumption per guest night (kWh/gn): 2004-6
(Data extracted by Author from Hilton Environmental Reporting System (HER) software courtesy of Bohdanowicz, Hilton, 2007).



	January	February	March	April	May	June	July	August	Septemb er	October	Novembe r	Decembe r
■ 2004	38,949	44,711	46,517	46,161	51,211	57,698	66,008	54,947	51,379	49,238	47,098	59,229
■ 2005	46,384	38,534	34,966	52,093	44,243	55,661	49,952	57,088	46,384	160,560	167,696	292,576
■ 2006	271,168	374,640	192,672	192,672	160,560	114,176	114,176	103,472	110,608	146,288	153,424	292,576

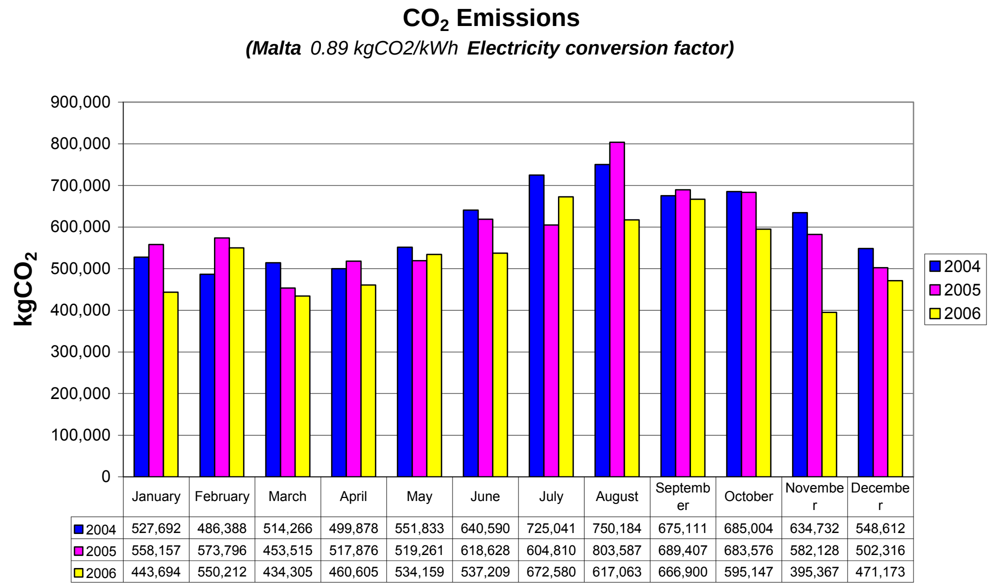
Figure 5.4.8 Monthly Total LPG consumption per guest night(kWh/gn): 2004-6 *(Data extracted by Author from Hilton Environmental Reporting System (HER) software courtesy of Bohdanowicz, Hilton, 2007).*

These graphs coupled with the information from the database (Appendix 5.4E) clearly indicate that the heating consumption (LPG and formerly diesel oil consumption) and cooling consumption (Electricity consumption for air-conditioning) are sensitive to climatic conditions and number of guest nights.

It should be noted that only the number of 'sleepers' are accounted for in the calculation of energy consumption (kWh) per guest night extracted from the HER database. The CO_2 emissions ($kgCO_2$) per guest night are also calculated on this basis due to the available of data in the database. A more accurate and reflective calculation would account for the conference delegates (day guests), restaurant and leisure centre guests as well as the *sleepers* in the total calculation of the figure for guest nights.

CO_2 Emissions

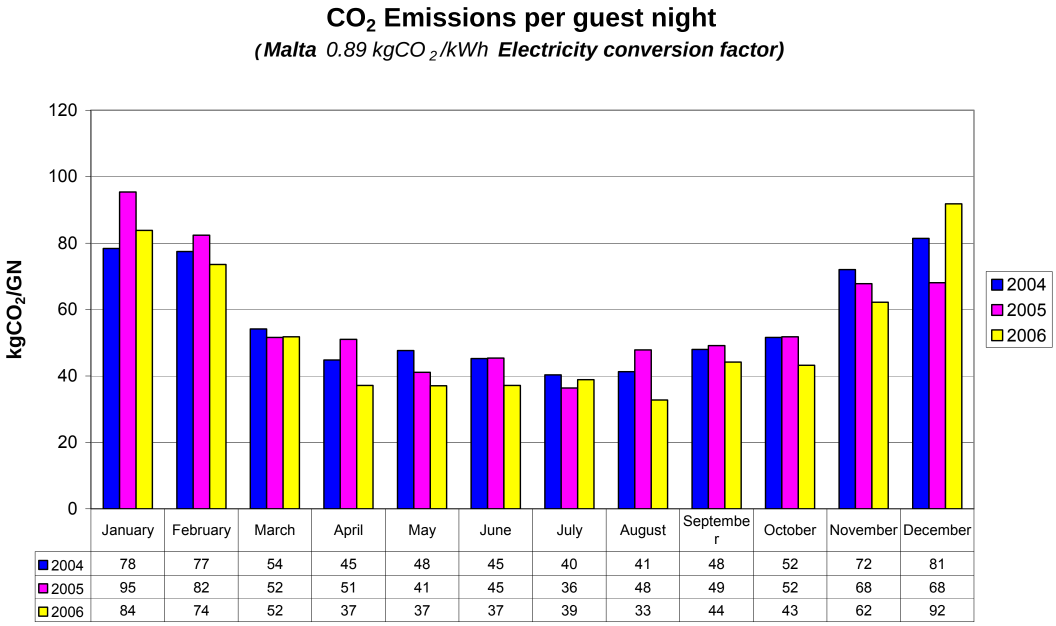
The CO_2 emissions have been calculated in $kgCO_2$ for the whole hotel and on a per guest night $kgCO_2$/gn. Figures 5.4.9 and 5.4.10 below show the results using the carbon emission factor for Malta (0.89kg CO_2/kwh) for the period 2004-6. (UNEMG, 2009) By selecting the Malta emission factor, we are presenting the actual emissions scenario, which I consider to be reasonably justified due to Malta's isolation from the European continent. (IERN, 2009)



	January	February	March	April	May	June	July	August	September	October	November	December
2004	527,692	486,388	514,266	499,878	551,833	640,590	725,041	750,184	675,111	685,004	634,732	548,612
2005	558,157	573,796	453,515	517,876	519,261	618,628	604,810	803,587	689,407	683,576	582,128	502,316
2006	443,694	550,212	434,305	460,605	534,159	537,209	672,580	617,063	666,900	595,147	395,367	471,173

Figure 5.4.9 Time series analysis of CO_2 emissions for the electricity fuel mix for Malta for Study 4 hotel in St. Julian's, Malta after certification in 2004 (kg CO_2) *(Source: Author).*

The graph shown below (Figure 5.4.10) shows the CO_2 emissions on a per guest night basis when we apply the electricity fuel mix for Malta (0.89 kg CO_2 /kwh) to the data for 2004-6 giving a more realistic account of actual emissions per guest night.



	January	February	March	April	May	June	July	August	September	October	November	December
2004	78	77	54	45	48	45	40	41	48	52	72	81
2005	95	82	52	51	41	45	36	48	49	52	68	68
2006	84	74	52	37	37	37	39	33	44	43	62	92

Figure 5.4.10 Time series analysis of CO_2 emissions per guest night for the electricity fuel mix for Malta for Study 4 hotel in St. Julian's, Malta after certification in 2004 (kg CO_2/gn) *(Source: Author).*

From the graphs and the data extracted from the authors calculation from the data from the HER database (Appendix 5.4E) there is a 11% reduction in total annual CO_2 emissions from 7,239,330 to 6,378,414 kgCO_2/gn and in emissions per guest night from 53 to 46 kg CO_2/gn during the period 2004 to 2006 after the hotel became certified. This reduction is probably as a result of the switch from diesel oil to LPG rather than due to certification alone. The emissions calculated using the EU emission factor would be 53% smaller but is not applicable in this case.

Results

Clearly the possession of a certificate itself does not alter CO_2 emissions but measures which allow them to achieve it, may have, and will then continue to reduce emissions if they continue the measures. In the paragraph above, one of these was the switch to LPG.

The results of the analysis show that the CO_2 emissions, for the whole hotel or on a per guest night are extremely high for a certified hotel and brings into question the credibility of a scheme awarding a hotel a logo which implies the hotel has a low environmental impact. These results also bring into question the effectiveness of the very detailed and onerous requirements of the verification documentation (152 pages to be completed based on points requirements and mandatory requirements - MSA, 2004) in bringing about actual reductions in CO_2 emissions or indeed awarding certification to hotels with such high emissions. The results of the analysis show an 11% reduction in emissions but this is more likely to be as a result of the switch over to LPG from the gas/diesel rather than due to certification.

Key Findings

The key findings of this study are listed below and set out in Appendix 5.4H.

- **Accounting of Conference delegates and guests, restaurant guests, leisure guests**

There is also the recurring problem, as seen in the other studies, with the proper accounting of guest nights. In this study, the available data in the HER database was for guest nights (sleepers only). It is not clear at this stage if the data included in the database includes consumption for the convention centre which accounts for 8% of the overall area of the hotel as this will have considerable impact on the overall energy consumption and emissions. It is known that conference guests and restaurant and leisure guests are not included in the number of guest nights which clearly will impact the calculation of the energy consumption (and emissions) on a per night basis. Particularly, when other schemes like Nordic Swan and Green Globe account for these guests in their calculations. If they were accounted for, it would reduce the emissions per (equivalent) guest night.

- **No sub-metering**

There is no sub-metering of the hotel which means energy intensive areas of the hotel cannot be monitored and improved where necessary. It is very important to monitor energy consumption in energy intensive areas of the hotel such as the convention centre, leisure centre, and kitchen and guest rooms, in a hotel of this size. It would be very useful for the hotel to develop separate energy (and emissions) benchmarks for these zones in the hotel.

- **Weighting of measures that have a high impact on reducing energy consumption and related emissions in EU Flower certification;**

On balance the fact that energy accounts for 10 (out of 37 mandatory requirements) and 17 out of 47 optional criteria (See Chapter 4, Table 4.3), EU Flower has a better weighting of energy than the other schemes. Secondly, the fact that the verification forms require detailed knowledge of the hotels operations and maintenance is good. However, as a result of being a process based scheme, as long as the hotel can provide proof for non-compliance of certain mandatory criterion then this is deemed satisfactory by the scheme. The hotel can then choose which optional criteria to satisfy, then the hotel can effectively get away with not having to score highly in the optional criteria section. Also, as a result of being a process based scheme, the hotel does not have to meet energy performance benchmarks nor can it compare its performance with other like hotels.

There is still a problem with the weighting of measures that have a high impact on emissions reduction such as on-site electricity (2 optional pts) and heating from renewable energy sources (1.5 optional pts), boiler efficiency (1 optional pt), CHP (1.5 optional pt) compared to composting (2 optional pts), disposable drink cans (2 optional pts), breakfast packaging (2 optional pts), environmental communication to guests (1.5 optional pts) etc.

- ***Bioclimatic architecture***

Two points can be achieved if the hotel complies with criterion n.50 in the optional energy criteria category. At least 6 of 19 steps must be achieved in order to comply with this criterion.

Discussion

The environmental performance of a large chain certified hotel in St. Julian's, Malta was investigated, with respect to CO_2 emissions, to study the effect of certification.

The effectiveness of certification should be shown by hotels reducing their emissions prior to submitting for certification however the data for the period prior to certification was unreliable therefore a before-and-after comparison was not possible. The results of the analysis show an 11% reduction in CO_2 emissions per guest night after 2004, the year the hotel became certified. However, the emissions were found to be very high for the hotel as a whole and on a per guest night basis.

This may be explained by two facts, firstly, the hotel has a large area/guest ratio consistent with the five star standard vacation hotel Secondly, the fuel mix for electricity generation in Malta is almost all fossil derived and the heating requirements of the hotel have been diesel oil based before the switch to LPG.

However, despite the resulting high emissions, the hotel is still awarded EU Flower certification. The level of facilities offered or the electricity fuel mix does not justify a hotel being 'eco-certified' with high levels of emissions and energy consumption. This level of emissions clearly means the hotel has significant environmental impact despite the message conveyed by Eco-certification, namely that a hotel is sustainable.

The problem with the scheme is clearly a result of not including mandatory energy and/or CO_2 performance benchmarks or in the weighting of energy and/or emissions related points in the overall weighting in the scheme.

There has been considerable interest in certification schemes and the detail included in their criteria and requirements (mandatory and otherwise) is very impressive yet despite this level of detail the results still mean a hotel can become certified with very high energy consumption and emissions (for the hotel as a whole and on a per night basis).

5.4.7 Recommendations to Hotel for Improvement

Appendix 5.4I presents a summary list of recommendations for improvement adapted and developed from the Hospitality Saving energy without compromising service, CTV013, Carbon Trust, Environmental Management for Hotels (ITP, 2008), the EU Flower Criteria Document and Study 4 EU Flower Verification Forms. The strategy for reducing the energy consumption at the hotel involves cooling and lighting efficiency measures as well as a focus on a switch to low carbon energy supply.

1. **Energy Supply:** The hotel should focus on the gradual replacement of electricity from the grid and oil for fuel with renewable energy sources such as solar thermal for domestic hot water and solar pv to provide a percentage of onsite electricity generation. Feasibility studies could be conducted to the most appropriate sources of renewable energy to ensure more integrated and sustainable energy management.
2. **Reduce energy consumption.** This could be achieved by replacing the existing 60% of lighting with more energy efficient lighting (Class A) systems fixtures particularly in public areas such as the foyer. It is also recommended that automatic switching off of lights in guest rooms be installed in at least 80% of the rooms. Daylight sensors could be installed to control artificial lighting where there in sufficient lighting and these could be combined with time switches to ensure more precise control. It is also recommended that lighting levels are decreased in general and/or at specified times (using timers or occupancy related demand controls). Ensure shading control on windows to reduce unwanted solar gain.
3. **Reduce cooling load:** The heating/cooling load could be reduced by match source to load (HVAC). This could be achieved by zoning the hotel for heating and cooling where separate time and temperature controls could then be installed. Zoning should be considered where there area) different occupancy patterns b) different temperature requirements c) a number of floors (e.g. where top floors poorly insulated.) The hotel could zone its building to take into account the different temperature requirements of the main restaurant, kitchen and storage areas.
4. **Sub-metering** should be installed in energy intensive areas such as conference centre, guest bedrooms and sauna areas. A demand controlled system should be installed and linked to the existing timer controls in the sauna. The kitchen energy consumption is already sub-metered which is good. It is recommended that kitchen equipment is used properly, replace any equipment over 15 years old with 'A' rated equipment and ensure this switches off automatically.
5. **A regular maintenance** schedule should be installed to ensure potential problems are identified early on. Ensure a regular housekeeping schedule is in place i.e. have a specific member of staff to conduct regular walk round using checklist and check window panes and frames, roof lights, roofs, skirting and eaves.

6

Multi-Hotel Data Analysis

This chapter presents two analyses, one which compares the *calculated* emissions per guest night for 8 hotels certified in *different* schemes and another which compares the *reported* emissions for 28 hotels *certified* within the same scheme. The purpose of these analyses is to demonstrate the wide range of emissions permitted *between* schemes and those permitted within the *same* scheme. Reported emissions are those emissions calculated by the certification scheme and published in their benchmarking assessment reports whilst *calculated* emissions are those calculated by the authors approved method (as described in Chapter 5) which includes the use of average conversion factors for delivered electricity.

6.1 An Example of Calculated CO_2 Emissions for 2006 for Eight Certified Hotels in Different Schemes

This study compares the *calculated* CO_2 emissions per guest night for eight selected hotels certified in different schemes for the year 2006.

Data Collection

The data was collected directly from the hotel. The consumption data for delivered fuels, electricity and heat was extracted from invoices, meter readings and monitoring data. (Appendix 6.A-H) Due to the fact the data is collected from hotels worldwide, the delivered fuels consumption data differed in units and was converted to CO_2 emissions using the published conversion factors from The Carbon Trust, BERR, IPCC and government and academic sources for each respective country.

Information was also collected on the physical and operational parameters of the building including: date of certification, total number of guest nights, size, structure, age, design of the building, number of bedrooms, floors, total area, number of facilities and level of services offered, geographical and climatic location, the type of energy system installed together with information (where available) on how they are operated and maintained. A summary table of this information is shown in Table 6.1 and 6.2.

From the data collected from seventy hotels, eight hotels (certified in different schemes) were selected to demonstrate the range of emissions per guest night permitted between schemes. The hotels were selected for the following reasons;

Hotel 1 certified under EU Flower (53.0[1] $kgCO_2$/gn) in Malta was selected to demonstrate the high *reported* emissions permitted within this scheme. (Appendix 6A)

Hotel 2 certified under Green Hospitality Award (16.0[2] $kgCO_2$/gn) in Ireland was selected as an example of a hotel awarded 'Gold Standard' level of certification. (Appendix 6B)

Hotel 3 certified under Green Tourism Business Scheme (29.5[3] $kgCO_2$/gn) in Scotland, UK was selected as an example of a hotel awarded 'Gold' level of certification. (Appendix 6C)

Hotel 4 certified under ISO 14001 (16.8[4] $kgCO_2$/gn) was selected as the first ISO certified hotel in the UK. (Appendix 6D)

Hotel 5 is an example of a non-certified *business-as-usual* hotel in the UK. (Appendix 6E)

Hotel 6 was selected as an example of LEED certified hotel in the US. (18.3[5] $kgCO_2$/gn) (Appendix 6F)

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[1] Conversion factor: 0.89 $kgCO_2$/kWh (UNEMG, 2008)

[2] Average EU Conversion factor: 0.475 $kgCO_2$/kWh of electricity (Åf, 2006)

[3] Average UK Conversion factor: 0.475 $kgCO_2$/kWh of electricity (Carbon Trust, 2008)

[4] Average UK Conversion factor: 0.475 $kgCO_2$/kWh of electricity (Carbon Trust, 2008)

Hotel 7a is an example of the Nordic Swan certified hotel in Sweden. (6.8[6] $kgCO_2/gn$) (Appendix 6G)

Hotel 7b is for same Nordic Swan certified hotel in Stockholm, Sweden but instead the 'claimed' *reported* emissions are used in this example. (0.1 $kgCO_2/gn$)

Hotel 8 certified under Green Globe (73.0[7] $kgCO_2/gn$) in Australia was selected to demonstrate the high *reported* emissions permitted within this scheme. (Appendix 6H)

Hotel 5, the non-certified *business-as-usual* city chain hotel uses delivered electricity and natural gas for its energy supply. The hotel does not hold any 'green' certification. It does not use any renewable energy sources nor does it purchase 'green' electricity. The electricity is used for cooling in the summer months and gas for space heating, domestic hot water, the cooking equipment and to heat the swimming pool 24/7. The hotel is cooled by a chiller (the chilled water is supplied to the fan coil units through a circuit). A BMS analyses the outside air temperature to determine whether the system should be heating or cooling.

Data Limitation

For the purposes of this analysis, only hotels providing complete monthly reports on energy consumption data and guest nights for 2006 were selected. The key performance indicator is measured in carbon dioxide (CO_2) produced per guest night. This value has been assessed on a per annum (12 months) basis from the energy consumption data sent directly by the respective hotel. Hotels missing at least one monthly data input were rejected, as were those reporting identical values for electricity, or fuels use each month. Also, if the magnitude of values reported was in disagreement with common sense, the data was rejected in this analysis. For example, as seen in Appendix 6I, the data input for November and December 2007 is incomplete and not consistent with consumption patterns in previous months. This data was therefore rejected and not used in the analysis.

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[5] Average US Conversion factor: 0.619 $kgCO_2/kWh$ of electricity *(UNEMG, 2009)*
[6] Average EU Conversion factor: 0.475 $kgCO_2/kWh$ of electricity (*AF, 2006)*
[7] Average Australian Conversion factor: 1.0 $kgCO_2/kWh$ of electricity *(AGO, 2004)*

Hotel	CO_2 Emissions *(kgCO2/gn)*	Certification Scheme	Location	Area (m^2)	Star Rating	Swimming Pool	In House Laundry	Leisure Facilities	Conference Facilities	A/C	Restaurant
1	**53.0**	EU Flower	Malta	41,100	5	✓	✓	✓	✓	✓	✓
2	**16.0**	Green Hospitality Award	Ireland	5,728	4	X	✓	✓	✓	X	✓
3	**29.5**	GTBS *Gold* UK	UK	8,964	4	✓	X	✓	✓	✓	✓
4	**16.8**	ISO14001 UK	UK	7,000	4	X	X	✓	✓	✓	✓
5	**17.5**	Not Certified UK	UK	0	4	✓	?	✓	✓	✓	✓
6	**24.4**	LEED-*EB* US	US	6,317	3.5	X	?	✓	✓	✓	✓
7a	***6.8***	*Nordic Swan SWE*	Sweden	16,000	4	X	X	✓	✓	X	✓
7b	***0.1***	*Nordic Swan SWE* *	Sweden	Same Hotel							
8	**73.3**	Green Globe Australia	Australia	41,100	4	✓	?	✓	✓	✓	✓

✓ = On-site Laundry* *? = Unknown*

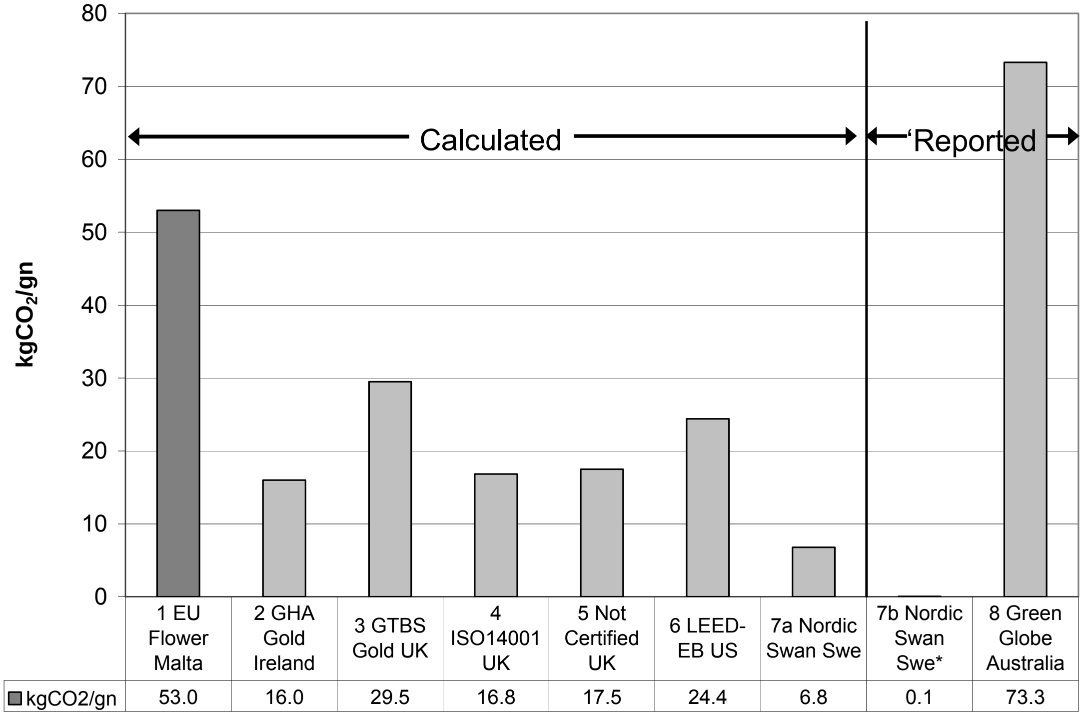
Table 6.1 Summary sheet of energy intensive facilities for hotels (1-8) certified in different schemes. *(Source: Author)*

Hotel	CO_2 Emissions *(kgCO2/gn)*	Certification Scheme	Location	Electricity		Fuels					
				Grid	On-site	District Heating	Gas/Diesel Oil	Diesel	Oil(fuel)	Nat. Gas	LPG
					Renewable						
1	**53.0**	EU Flower	Malta	✓			✓				✓
2	**16.0**	Green Hospitality Award	Ireland	✓					✓		✓
3	**29.5**	GTBS *Gold* UK	UK	✓						✓	
4	**16.8**	ISO14001 UK	UK	✓						✓	
5	**17.5**	Not Certified UK	UK	✓						✓	
6	**24.4**	LEED-*EB* US	US	✓						✓	
7a	***6.8***	*Nordic Swan SWE*	Sweden	✓		✓					
7b	***0.1***	*Nordic Swan SWE* *	Sweden	Same Hotel							
8	**73.3**	Green Globe Australia	Australia	✓				✓		✓	

Table 6.2 Summary sheet of fuels source for hotels (1-8) certified in different schemes. *(Source: Author)*

Results

Comparison of *Calculated* CO_2 Emissions for Eight Selected Hotels Certified in *Different* Schemes



	1 EU Flower Malta	2 GHA Gold Ireland	3 GTBS Gold UK	4 ISO14001 UK	5 Not Certified UK	6 LEED-EB US	7a Nordic Swan Swe	7b Nordic Swan Swe*	8 Green Globe Australia
■ kgCO2/gn	53.0	16.0	29.5	16.8	17.5	24.4	6.8	0.1	73.3

* National Conversion Factor for *'Green'* Electricity
■ Malta Conversion Factor for Electricity
□ National Average Conversion Factor for Electricity

Figure 6.1 A series of CO_2 emissions, calculated by authors approved method using national average[8] conversion factors, for eight selected hotels certified in *different* schemes for 2006. *(Source: Author)*

Figure 6.1 above compares the *calculated* CO_2 emissions per guest night for the eight selected hotels certified under different schemes for 2006. This graph shows a wide variance of performance for hotels certified under different schemes. The key finding is that despite the wide range in CO_2 emissions, all have been awarded certification.

In one case, there is almost no difference in emissions between a certified (ISO 14001 certified hotel - 16.8 kgCO$_2$/gn) and non-certified city hotel (Chain Hotel - 17.5 kgCO$_2$/gn) both located in city locations in the UK. The energy supply for both hotels is the same and they both offer similar facilities and are of similar size. This raises the question of whether certification has any effect on emissions reduction if the emissions of the certified hotel are no lower than that of the non-certified hotel. This also seems to be the case when a

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[8] National conversion factor used for Malta since Malta does not import European electricity.

comparison is made with a Green Hospitality Award *Gold* certified hotel certified in Ireland (16.0 $kgCO_2$/gn). In another case, a UK city hotel having achieved Green Tourism Business Scheme *Gold* certification actually emits almost double (29.5 $kgCO_2$/gn in 2006) the CO_2 emissions of the non-certified *business-as-usual* UK city hotel (Chain Hotel - 17.5 $kgCO_2$/gn in 2007) despite the energy source being the same i.e. electricity and gas. A possible explanation for the difference in emissions is the presence of a spa and gym in hotel 3. However, both hotels have swimming pools. The key point is that a hotel can become 'GOLD' certified despite having emissions double that of uncertified hotel which brings into questions the credibility of certification in being a reliable measure of a hotels environmental impact in terms of CO_2 emissions.

In another case a hotel is awarded EU Flower certification to a hotel which emits 53 $kgCO_2$/gn. The reason for these high emissions are explained by the fact that Malta has no domestic production of energy sources and depends totally on oil imports resulting in high energy costs. Electricity is currently completely generated by a nationally owned corporation. The fuel mix for the electricity generation in 2006/07 consisted of 92% heavy fuel oil and 8% gas oil. Moreover, the high emissions can also be explained by the fact that the hotel is a five star hotel offering a high level of facilities whose high energy demands are met by the high emission energy supply previously described. Another example is the Green Globe certification scheme which certifies a hotel in Australia which emits 73.3. $kgCO_2$/gn. In this case the sole energy supply is grid electricity (coal). The point to be made is that both of these hotels certified under different schemes are still awarded 'green or eco' certification despite very high CO_2 emissions regardless of the reasons for these levels of emissions.

The final comparison is for a hotel located in Stockholm, Sweden which is certified under Nordic Swan. The results show that there is an almost seven fold difference in emissions between the calculated emissions using the average EU emission factor for electricity (6.8 $kgCO_2$/GN) and the 'claimed' emissions if we accept the 'green' electricity argument. In order to accept this argument then one must assume that 'additionality' has been for proven in which case the Swedish conversion factor for 'green' electricity (0.004 $kgCO_2$/kWh) is applied resulting in emissions of 0.1$kgCO_2$/gn.

Discussion

All the selected certification schemes imply that they guarantee green or sustainable practice, and yet as shown in Figure 6.1, we see one certified hotel with 73.7$kgCO_2$/gn whilst another certified hotel claiming to be zero carbon. This shows how erratically CO_2 is treated and begs the question - is it justified that some certified hotels are decimating their CO_2 emissions overnight by simply buying non-accredited, ”green” electricity, yet are still awarded certification? It is questionable how can a hotel become certified (with all the associated implications of green or sustainable practice) when it emits over 50kgCO_2/gn? In this sample of eight certified hotels we can see that only the Nordic Swan certified hotel has fewer emissions per guest night than the non-certified *business-as-usual* hotel.

6.2 An Example of *Reported* CO_2 Emissions for 2006 for 29 Hotels Certified within the Same Scheme

This analysis presents an example of CO_2 emissions for 28 certified hotels for 2006 to demonstrate the range of *reported* CO_2 emissions allowed within the same scheme with the same level of certification. *Reported* emissions are the emissions per guest night for a certified hotel as published in the confidential benchmarking assessment report issued by the scheme to the hotel.

Data Collection

In order to demonstrate the range of emissions allowed within the same scheme to hotels awarded the same level of certification, the *reported* emissions were used i.e. the emissions calculated by the certification scheme and published in the benchmarking assessment report as shown in Figure 6.4. The key performance indicator is measured in carbon dioxide (CO_2) produced per guest night. This value has been assessed on a per annum (12 months) basis from the reported energy consumption data submitted by the hotel. The reporting period is given for the year in question e.g. for the period 2005-2006 (1/04/05 – 31/03/06). It should be noted from the assessment report that the value for CO_2 given is for guidance only and does not affect the overall benchmarking evaluation.

Firstly, a list of certified hotels (as available on the schemes’ website) was compiled. Then, the hotels were contacted directly by the researcher outlining the purpose and objective of the research and to assure that any data received would be for academic purposes only and would be treated with the utmost confidence. In cases where there was no environmental manager responsible for certification, then an e-mail was sent to front desk to seek the proper contact person. A total of approximately 100 hotels were contacted on an individual basis via e-mail. E-mail was used due to time and financial constraints. The choice of individual hotels was thus limited by the availability of the internet and working e-mail addresses.

Out of approximately 100 hotels contacted, approximately 50 responded either positively (supplying both the hotel’s excel data and the scheme’s benchmarking assessment report), or to indicate they did not wish to participate (or to indicate they no longer subscribed to the certification scheme) or there was no response to my e-mail request. Of the data received from the participating hotels, a number were rejected due to incomplete or unrepresentative data. Of all the reports received, 28 hotels were chosen with data available for the complete twelve months in 2006.

The collected data was then summarized in Table 6.3 to present information on the respective hotel's location, hotel type, reported CO_2 emissions (kgCO2/gn), area, star rating and energy intensive facilities such as swimming pool, leisure and/or conference facilities, on site laundry, air-conditioning and restaurant. This is followed by Table 6.4 summarizes the electricity and fuel supply for hotels (1-28) all certified within the same scheme.

Data Limitation

There were serious difficulties involved in obtaining consistent and accurate data from both from the certification scheme itself and in the data collected directly from the certified hotels.

Access to Data

The certifiers would not grant access to the individual benchmarking assessment reports. In addition there were difficulties in obtaining information from the certification schemes about the process or method used by the scheme to award certification as well as a lack of transparency in the benchmarks used since the reports could not be accessed. As a result of these difficulties, the individual hotels had to be contacted directly in order to receive any data to analyze.

Lack of Transparency

Difficulties in obtaining data occurred at the certification level and not so much at the hotel level. The benchmarking assessment reports issued to the hotel from the scheme are confidential and not available in the public domain. Access was only granted after direct contact was made with the respective hotel. In this case, the scheme is a private, for-profit organization and as a result there is limited available information on the process, its limitations and data collection methods. Due to the lack of transparency in the method used in this certification scheme and the lack of information in the public domain there was great difficulty is obtaining information from the scheme about the benchmarks used to award certification or other key information.

Numerical Errors

Differences were also found between the authors CO_2 emissions calculations and those reported in the benchmarking assessment report. Since the accounting method was not disclosed in the reports, it was not possible to verify the differences in calculations of emissions. (Appendix 6J)

Errors in Reporting

Secondly, errors in reporting were found between the data collected sent to me directly by the hotel which differed for example in the former it states LPG whereas in the report it says it is supplied by natural gas and These errors in reporting undermine confidence in the scheme. This is demonstrated in Appendix 6I.

Adding together of delivered electricity and fuels without first converting to primary energy or converting to $kgCO_2$. Even though this scheme is to be commended for providing a breakdown of energy supply i.e. electricity and fuels data reported separately, these are added together to give a total energy consumption figure (typically in MJ or MJ/gn) which is used as a performance indicator despite this has been erroneously calculated. (Appendix 6I)

Hotel	Location	Type	kgCO$_2$/gn	Star Rating	Area (m^2)	Swimming Pool	In house Laundry	Leisure Facilities	Conference Facilities	A/C	Rest.
1	Loas	Guest House	1.0	N/R	N/S	X	√	X	X	X	X
2	Indonesia	Resort & Spa	4.5	5	62,911	√	√	√	√	√	√
3	Indonesia	Boutique Resort	9.1	5	3,536	√	√	√	X	√	√
4	Indonesia	Boutique Resort	7.1	5	N/S	√	√	√	X	√	√
5	Iceland	Small hotel	1.3	N/R	772	X	√	X	X	X	X
6	Australia	Mountain Lodge	5.0	3	17,981	√	?	√	√	X	√
7	Australia	Guesthouse	9.8	4	N/S	√	√ *	√	X	√	√
8	Adelaide, Australia	Chain Hotel - Suites	61.5	4	4,356	X	√	X	X	√	√
9	Perth, Australia	Chain Hotel - Suites & rooms	18.3	4	28,940	√	√	X	√	√	√
10	Chatswood, Australia	Chain Hotel - Suites	73.7	4	20,564	√	?	√	√	√	√
11	Melbourne, Australia	Chain Hotel - Studio 1&2	23.0	4	N/S	√	√	√	√	√	√
12	Canberra, Australia	Chain Hotel - Suites & rooms	23.8	4	1,119	√	√	√	√	√	√
13	Darwin, Australia	Chain Hotel - Studio 1,2,3 & rooms	19.9	4	12,896	√	√	√	√	√	√
14	Australia	Chain Hotel - Studio's	4.6	3	3,280	X	√ *	X	X	√	X
15	Jamaica	Chain Resort	27.0	4	19,029	√	√	√	X	√	√
16	Jamaica	Chain Resort & Spa	21.7	4	2,700	√	√	√	X	√	√
17	Jamaica	Chain Resort & Spa	26.6	5	178,804	√	√	√	X	√	√
18	Jamaica	Resort	12.5		3,112	√	√	√	X	√	√
19	Jamaica	Chain Resort	9.7	5	3,838	√	√	√	X	√	√
20	Jamaica	Chain Resort	23.9	5	11,448	√	√	√	X	√	√
21	Jamaica	Resort	68.5	5	32,924	√	√	√	X	√	√
22	Jamaica	Chain Resort & Golf Club	24.2	4	53,419	√	√	√	X	√	√
23	Jamaica	Chain Resort & Golf Club	39.3	5	7,178	√	√	√	X	√	√
24	St Lucia	Chain Resort	11.1	N/R	2,700	√	√	√	X	√	√
25	St Lucia	Chain Golf Resort & Spa	20.1	5	20,234	√	√	√	X	√	√
26	St Lucia	Chain Resort & Spa	18.9	N/R	N/S	√	√	√	X	√	√
27	Antigua	Chain Resort & Spa	13.8	N/R	N/S	√	√	√	X	√	√
28	Dominica	Ecolodge	6.3	N/R	336	X	√	X	X	X	X

✓ = On-site Laundry* *? = Unknown* *N/S = Not Supplied* *N/R = Not Rated* *N/A = Not Applicable*

Table 6.3 Summary sheet of energy intensive facilities for hotels (1-29) certified within the same scheme. *(Source: Author)*

Hotel	Location	Type	*kgCO$_2$/gn*	% Renewable	Electricity *(On Site)*				Grid		Fuels						
					Hydro	Wind	Solar	Diesel Generator		Coal	Charcoal	LPG	Nat. Gas	Gas (*Auto*)	Oil (*fuel*)	Diesel	Solar Thermal
1	Loas	Guest House	1.0	16					√		√		√	√			
2	Indonesia	Resort & Spa	4.5	65					√			√			√		
3	Indonesia	Boutique Resort	9.1	N/S				√				√			√		
4	Indonesia	Boutique Resort	7.1	N/S				√				√				√	
5	Iceland	Small hotel	1.3	81					√					√		√	
6	Australia	Mountain Lodge	5.0	N/S					√	√		√		√		√	
7	Australia	Guesthouse	9.8	N/S					√	√		√		√		√	
8	Australia	Chain Hotel	61.5	N/S					√	√							
9	Australia	Chain Hotel	18.3	2					√	√			√				
10	Australia	Chain Hotel	73.7	N/S					√	√			√			√	
11	Australia	Chain Hotel	23.0	N/S					√	√			√				
12	Australia	Chain Hotel	23.8	7					√	√			√				
13	Australia	Chain Hotel	19.9	30								√	√			√	√
14	Australia	Chain Hotel	4.6	N/S					√	√			√				
15	Jamaica	Chain Resort	27.0	N/S								√			√	√	
16	Jamaica	Chain Resort & Spa	21.7	N/S								√			√	√	
17	Jamaica	Chain Resort & Spa	26.6	N/S								√			√	√	
18	Jamaica	Resort	12.5	N/S								√			√	√	
19	Jamaica	Chain Resort	9.7					√				√			√		
20	Jamaica	Chain Resort	23.9	N/S								√		√	√	√	
21	Jamaica	Resort	68.5	N/S								√			√	√	
22	Jamaica	Chain Resort & Golf Club	24.2	N/S								√		√	√	√	
23	Jamaica	Chain Resort & Golf Club	39.3	N/S					√			√				√	
24	St Lucia	Chain Resort	11.1	N/S				√				√		√		√	
25	St Lucia	Chain Golf Resort & Spa	20.1	0.3				√				√		√		√	
26	St Lucia	Chain Resort & Spa	18.9	N/S				√				√		√		√	
27	Antigua	Chain Resort & Spa	13.8	N/S				√				√		√		√	
28	Dominica	Ecolodge	6.3				√					√		√		√	

Table 6.4 Summary sheet for electricity and fuel supply for hotels (1-28) certified within the same scheme. *(Source: Author)*

Results

Figure 6.2 below shows the range of reported CO_2 emissions permitted within the same scheme which have all received the same level of certification.

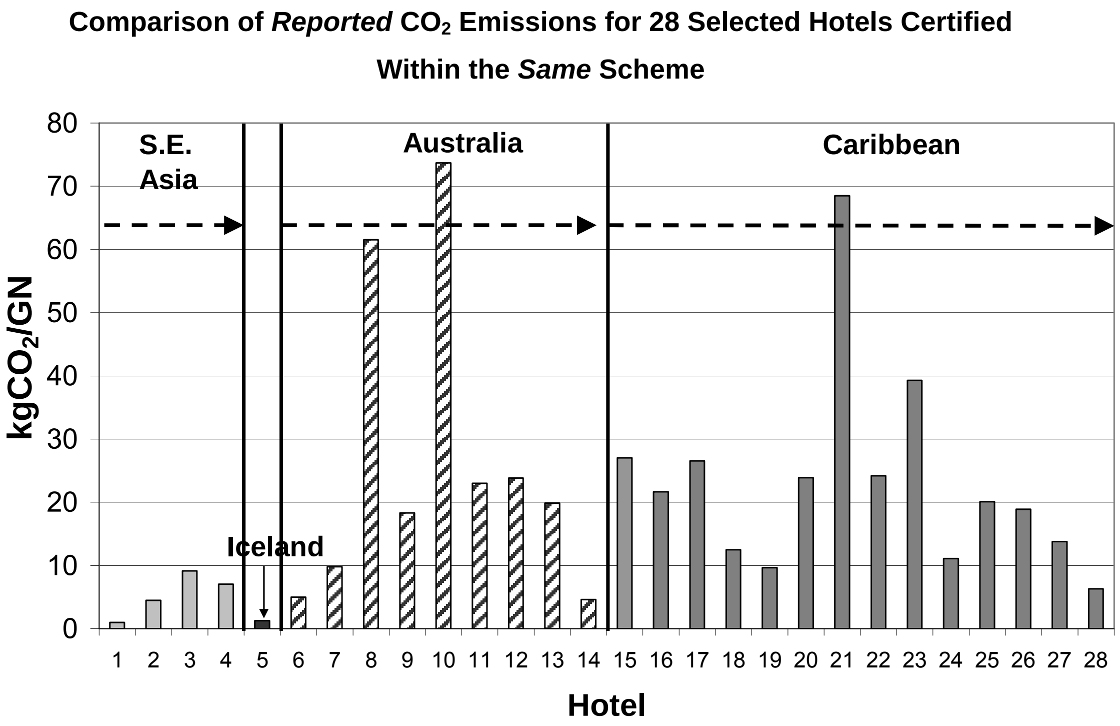

Figure 6.2 A Range of *reported* CO_2 emissions for 28 hotels certified within the same certification scheme (Note: All hotels awarded the same level of certification.) *(Source: Author)*

The results from this analysis are unacceptable considering all 28 hotels have been awarded the same level of certification within the same scheme, Green Globe. Hotels (8, 10 and 21) produce 61, 73 and 68kgCO_2/gn respectively which in itself bring the credibility of this certification scheme into question. It is questionable how hotels emitting such high CO_2 emissions can be awarded certification and how a hotel which has such high CO_2 emissions market itself as a ‘green’ hotel and have a low environmental impact as suggested by the logo ‘Green Globe’?

The main fuel and electricity end uses in Table 6.4 above is important to explain some of the reasons for the wide range in emissions observed in Figure 6.2. Hotels 8, 10 and 21 are all high emitters producing CO_2 emissions in excess of 60 kgCO_2 per guest night. Hotel

8 is classed a 4 star[9] apartment hotel located in South Australia and Hotel 10 is classed a 4.5 star[10] self-catering apartment hotel located in New South Wales, Australia and both belong to the same hotel chain. Hotel 21 is a 4 star[11] non chain hotel located in Ochos Rios, Jamaica. Hotels 8 to 13 are all 4 star hotels offering similar levels of facilities (albeit in different locations in Australia) yet there is a three fold difference in emissions. In terms of area, Hotel 21 is about seven times the area of hotel 8 yet they both have about the same amount of emissions. Hotel 10 and 21 offer similar facilities i.e. swimming pool, laundry, leisure facilities, air-conditioning and restaurant. They differ in that Hotel 21 does not offer conference facilities. However, Hotel 8 only offers air-conditioning and restaurant and in terms of laundry services it provides washing machine in the kitchenettes. The conclusion is that neither the star rating, location, level of services offered provide an explanation for these excessive emissions rather it was found that the fuel mix of the energy supply is the key driver for high emissions.

Hotel 8 Hotel 10 Hotel 21

Figure 6.3 Photographs of hotels 8, 10 and 21 *(Source: Confidential)*

As seen in Table 6.4 and Figure 6.4 below, the sole energy source for Hotel 8 is from delivered electricity (black coal). Hotel 8 is located in South Australia and therefore the CO$_2$ emissions factor of 0.875 kgCO2/kWh could be applied (Appendix 6K). Hotel 10 is located in New South Wales and therefore the CO$_2$ emissions factor of 0.893kgCO$_2$/kWh could be applied in this case (Appendix 6K). The energy supply for this hotel includes delivered grid electricity (black coal), natural gas and a fraction of diesel.

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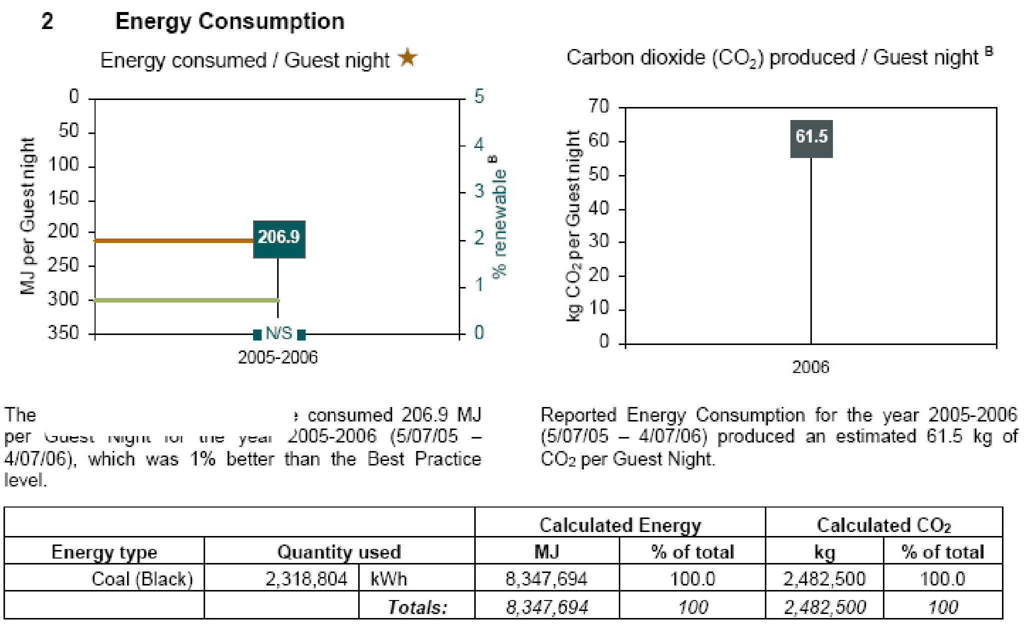
[9] Official Australia STAR Rating provided by AAA Tourism Pty Ltd (AAA, 2009)
AAA Tourism Pty Ltd assigns an official STAR Rating for accommodations in Australia. This Apartment Hotel property is rated 4-stars.

[10] Ibid., 2009.

[11] Each establishment has been rated using data gathered from multiple sources. The ratings are derived from data published by Zagat's Survey and AAA, and from interviews hotel personnel. [www.jamaica-guide.info]. (AAA, 2009)

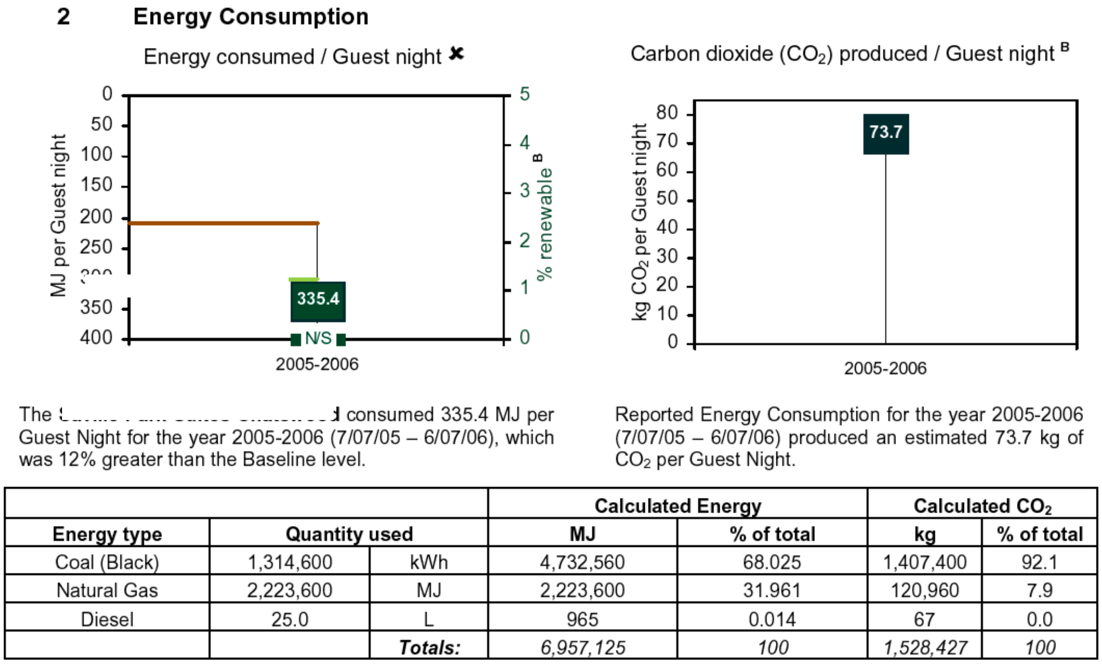


The [redacted] consumed 206.9 MJ per Guest Night for the year 2005-2006 (5/07/05 – 4/07/06), which was 1% better than the Best Practice level.

Reported Energy Consumption for the year 2005-2006 (5/07/05 – 4/07/06) produced an estimated 61.5 kg of CO_2 per Guest Night.

			Calculated Energy		Calculated CO_2	
Energy type	Quantity used		MJ	% of total	kg	% of total
Coal (Black)	2,318,804	kWh	8,347,694	100.0	2,482,500	100.0
		Totals:	*8,347,694*	*100*	*2,482,500*	*100*

Figure 6.4 Extract from Benchmarking Assessment Report for Hotel 8 showing energy consumption and CO_2 emissions per guest night. *(Green Globe, 2007b)*



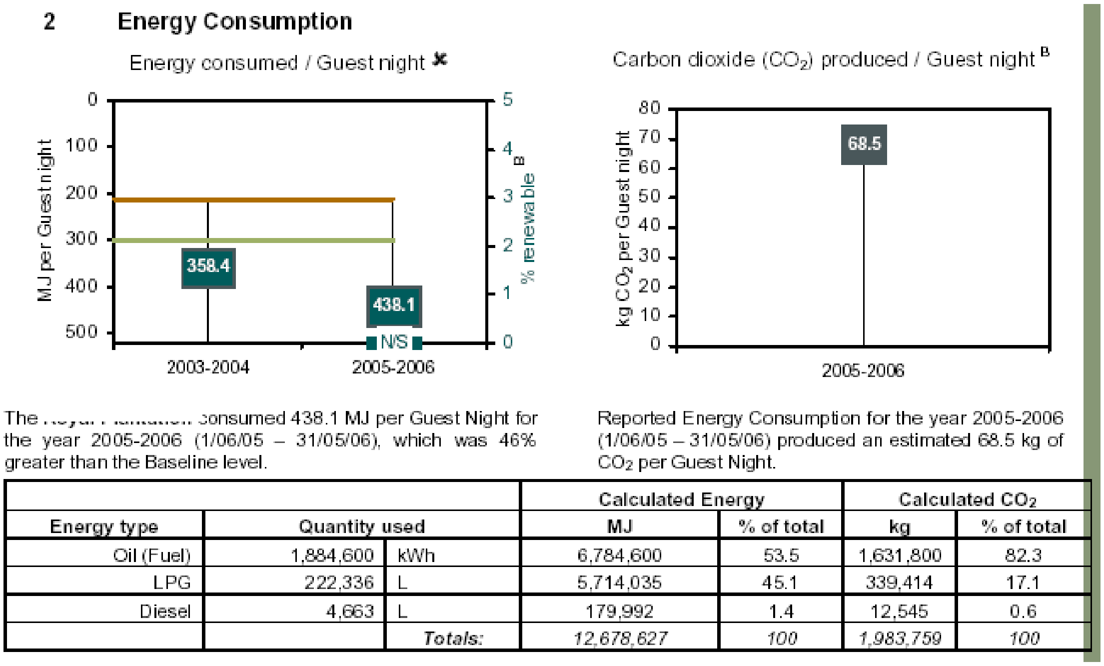
The [redacted] consumed 335.4 MJ per Guest Night for the year 2005-2006 (7/07/05 – 6/07/06), which was 12% greater than the Baseline level.

Reported Energy Consumption for the year 2005-2006 (7/07/05 – 6/07/06) produced an estimated 73.7 kg of CO_2 per Guest Night.

			Calculated Energy		Calculated CO_2	
Energy type	Quantity used		MJ	% of total	kg	% of total
Coal (Black)	1,314,600	kWh	4,732,560	68.025	1,407,400	92.1
Natural Gas	2,223,600	MJ	2,223,600	31.961	120,960	7.9
Diesel	25.0	L	965	0.014	67	0.0
		Totals:	*6,957,125*	*100*	*1,528,427*	*100*

Figure 6.5 Extract from Benchmarking Assessment Report for Hotel 10 showing energy consumption and CO2 emissions per guest night *(Green Globe, 2007c).*

In contrast Hotel 21 is located in Ochos Rios, Jamaica and its energy source comprises oil, LPG and a fraction of diesel.



The [illegible] consumed 438.1 MJ per Guest Night for the year 2005-2006 (1/06/05 – 31/05/06), which was 46% greater than the Baseline level.

Reported Energy Consumption for the year 2005-2006 (1/06/05 – 31/05/06) produced an estimated 68.5 kg of CO_2 per Guest Night.

			Calculated Energy		Calculated CO_2	
Energy type	Quantity used		MJ	% of total	kg	% of total
Oil (Fuel)	1,884,600	kWh	6,784,600	53.5	1,631,800	82.3
LPG	222,336	L	5,714,035	45.1	339,414	17.1
Diesel	4,663	L	179,992	1.4	12,545	0.6
		Totals:	*12,678,627*	*100*	*1,983,759*	*100*

Figure 6.6 Extract from Benchmarking Assessment Report for Hotel 21 showing energy consumption and CO2 emissions per guest night *(Green Globe, 2007d).*

The energy consumption of Hotel 21 was 46% greater and Hotel 10 was 12% greater than the baseline benchmark respectively in Green Globe and as a consequence both hotels failed to pass the energy consumption benchmark yet both still became certified. Despite hotel 8 emitting 61.5 $kgCO_2$/gn, the hotels energy consumption was above the best practice benchmark for certification and was *'highly commended'* for this achievement in it benchmarking assessment report issued by Green Globe. It can be concluded that the delivered electricity and fuel source have more of an impact on the resulting emissions of a hotel rather the star rating and level of facilities offered. In this case, the climatic location of the hotels is not the key determinant of the resulting emissions.

On the other end of the scale, hotel 1 and 4 emit only 1$kgCO_2$/gn. Hotel 1 is a small family run guest house (10 rooms) with independent villas located in Laos as seen in Figure 6.7. The focus of this small scale hotel is on local operations. There is no swimming pool, leisure and conference facilities and air-conditioning; however, there is a small restaurant and laundry on site. In the area where Hotel 1 is located, there was no grid electricity until April 2003, which made it easy for the hotel to meet the measures for energy consumption. The energy supply is now supplied by grid electricity (hydro) and fuels include diesel, natural gas and charcoal.

Hotel 1 Hotel 4

Figure 6.7 Photographs of Hotel 1 and 4. *(Source: Confidential)*

Hotel 4 is also a small family run hotel containing 20 en-suite rooms and is located in Snaefellsnes, in the west of Iceland as seen in Figure 6.7. There is no swimming pool, leisure and conference facilities nor air-conditions. The only facilities include a small dining room and simple laundry facilities on site. The hotel energy supply is grid electricity (hydro) (89,063kWh) and diesel (421L). The hotel uses electricity for space heating and hot water.

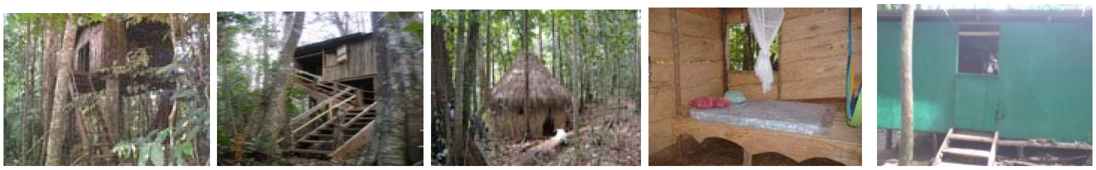
Hotel 4 (89,063 kWh) uses ten times as much electricity as hotel 1 (8,197 kWh) which has three times as many guest nights (11,968 gn) compared to hotel 4 (3,918 gn). The high energy consumption of hotel 4 occurs as a result of the Icelandic climate which results in higher electricity use particularly in the winter. However, despite this high energy consumption the hotel has low CO_2 emissions as a result of the hydroelectric power supply. It can be concluded that both hotels emissions are low as a result of using hydroelectric power even if it actual energy consumption is high as seen in the case of Hotel 1. The high consumption in this case is driven by the use of electricity for space heating and hot water and not as a result of its size or level of facilities offered.

This example demonstrates that energy consumption is not always the most reliable performance indicator of environmental impact as shown by its high energy consumption yet low CO_2 emissions. This is also evident in the case of hotel 8 in South Australia which performed better than the Best Practice energy consumption benchmark despite the fact it emitted 61.5kgCO_2/gn. These high emissions are a result of it source of energy in this case delivered grid electricity (coal). These cases demonstrate the importance of energy supply and end use in terms of emissions. This exposes a weakness in the Green Globe scheme which allows high emitting hotels to become certified; one because the energy consumption benchmark and not the CO_2 emissions affect the overall benchmark evaluation and secondly because energy is not even a mandatory category for certification.

In a third comparison we will look at hotel 2 which is a 4-5 star luxury Resort & Spa located in Bali, Indonesia and hotel 28 which is a small scale Ecolodge in Dominica, both of which have emissions in the same range i.e. 4.5kgCO_2/gn for hotel 2 and 6.3kgCO_2/gn for Hotel 28, despite a stark difference in size and facilities offered. Hotel 2 has 243,817 guest nights per year compared to hotel 28 which has 3,353 guest nights.

The accommodation offered in Hotel 28 comprises a small number of self-contained cottages, two tree houses, a lodge, cabin and a dormitory as seen below in Figure 6.8.

Self-contained cottage *Typical layout of guest cottages*



Tree House *Tree House 2* *Cabin* *Lodge* *Dormitory*

Figure 6.8 Examples of the range of guest accommodation types in Hotel 28 *(Source: Confidential).*

Figure 6.9 Interior of Tree House accommodation in Hotel 28 *(Source: Confidential).*

The energy supply for hotel 28 comprises solar (705 kWh), diesel (453 gallons) and LPG (500kg). An array of ten solar panels gives a maximum power of 800 watts. Although this is limited, the power is supplemented with another 1000 watts supplied by the onsite micro hydro turbine (LH-1000, low head, high flow turbine). The 24 volt solar slow pump is powered by two panels and is capable of pumping 1000 gallons of water in less than four hours of moderate sunshine. Each cottage has its own simple solar thermosyphon hot water system. Water is heated in a collector on the lower end of the roof, and as it heats up it rises to a hot water cylinder on the top of the roof (hot water rises naturally). As this hot water cools down it circulates back through the system to the collector so that it can always remain hot. The tree houses are located away from the resort deep in the rainforest and are supplied by a (Air-X 400) wind turbine, located above the tree canopy which supplies up to 400 watts, and was installed using two 90 amp hour batteries providing power to each room in tree house. (Figure 6.10)

Solar hot water solar PV wind turbine micro hydro

Figure 6.10 Renewable energy supplies for Hotel 28 *(Source: Confidential).*

By contrast, Hotel 2 is a large hotel 62,911m^2 comprising 388 Superior rooms, 110 Split Level Suites with 2 Executive Suites and 10 Garden Villas with private pool. The hotel facilities include a large swimming pool, fitness centre, onsite laundry and air-conditioning. It also includes banquet and conference facilities which include a ballroom (seating capacity for 200 delegates) with an open air pre-function area. Six multi purpose banquet and meeting room with state-of-the-art conference equipment as seen in Figure 6.11 below.

Main Swimming Pool *Meeting Rooms* *Guest Bedroom*

Foyer *Aerial View*

Figure 6.11 Example of some of the range of facilities in Hotel 2 *(Source: Confidential).*

The energy supply for hotel 2 is delivered electricity (hydro) 97,984,800 kWh, oil (fuel) (309,286L) and LPG (56,850kg). The hotel's energy consumption was 46% better than the Best Practice level. No other information on the energy performance was available on the hotels website or from direct contact with the hotel.

Despite the lack of specific information for Hotel 2, the emissions achieved by this hotel are low for a luxury hotel offering such a high level of facilities. As can be seen in the photograph of the foyer, the main public space is naturally ventilated which leads to considerable energy consumption savings. From the information provided it can be deduced that the high electricity consumption is delivered from hydroelectricity. It is very interesting to see how two hotels offering such a stark contrast in facilities and level of service offered can both have the same level of emissions however this is clearly explained by choice of energy source which is supplied by grid electricity (hydro) in the case of hotel 2 and generated onsite to meet the hotels actual consumption demands in the case of hotel 28.

As previously described in Chapter 4 (Section 4.1.1 and Figure 4.3), Green Globe have recently introduced different stages of certification and the Gold level of certification awarded to Hotel 2 is on the basis of five years continuous certification. However, as previously pointed out this Gold level of certification suggests the hotel has a higher level of environmental performance than a Silver or Bronze award, when this is not the case. This is misleading for the public and guests.

6.3 Findings

The reported CO_2 emissions per guest night published in the schemes benchmarking assessment report are presented showing a wide variance of performance for hotels certified under the same scheme. The overall conclusion is this scheme does not properly account for CO_2 emissions and does not in general lead to a reduction in emissions.

Adding delivered units of electricity to delivered fuels

The most serious error in all schemes analyzed is the adding together of delivered electricity to heating without first converting the figures to primary energy (or CO_2 emissions) before adding together. As a result, the energy performance indicators used by this scheme are unreliable.

Lack of Transparency

The Benchmarking Assessment Reports issued by the scheme to the hotel are confidential and not available in the public domain. Difficulties in obtaining data occurred at the certification level and not so much at the hotel level. Access was only granted after lengthy correspondence with each hotel and in many cases only after assurances that the information was for academic purposes only. In this case, the scheme is a private, for-profit organization and as a result there is limited available information on the process, its limitations and data collection methods. Due to the lack of transparency in the method used in this certification scheme and the lack of information in the public domain there was great difficulty is obtaining information from the scheme about the benchmarks used to award certification or other key information.

Accounting of CO_2 emissions and energy consumption

The scheme under investigation in section 6.2 is commendable since it is the only scheme to calculate CO2 emissions however this is included in a non-mandatory category for certification and does not effect overall benchmarking evaluation. As a result, as seen in the case of hotel 8, a hotel could in fact have high CO_2 emissions yet still become certified or as evident in hotel 10 have high CO_2 emissions and fail the energy consumption benchmark and still become certified.

Another problem uncovered was that in some cases, the reported CO_2 emissions have included guest and employee nights, others night and day/conference guests whilst others have only included guest nights. This has a direct impact on the CO_2 emissions calculations, although it is acknowledged that this is an *apparent* effect on performance rather than a *'real'* [12] effect on emissions. However, it is important in obtaining certification since the number of guest nights submitted to the certifiers in order to calculate the CO_2 emissions to compare to be benchmark will result in the hotel passing or failing the consumption benchmark. For example if a hotel includes 'guest and employee nights' then the resulting CO_2 emissions would be 20 $kgCO_2/gn$ but without the employee nights would be 96 $kgCO_2/gn$!

Numerical Errors

Differences were also found between the author's CO_2 emissions calculations and those reported in the benchmarking assessment report. Since the accounting method was not disclosed in the reports, it was not possible to verify the differences in calculations of emissions. As discussed in Chapter 2 and 5, it was found that the actual calculations of CO_2 emissions are dependant on the assumptions about electricity production emissions.

Errors in Reporting

Secondly, errors in reporting were found between the data collected sent to me directly by the hotel which differed for example in the former it states LPG whereas in the report it says it is supplied by natural gas and in another case. These numerical errors in reporting undermine confidence in the scheme.

Award of Logo

Despite the wide range in CO_2 emissions (1 to 73 $kgCO_2/gn$) all hotels were awarded the same level of certification which is grossly misleading and undermines the credibility of the scheme. Some hotels such as hotel 28 are going to great lengths to ensure their actual energy consumptions demands are made by on-sites renewables and hotel 4 which uses

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[12] Such as implementation of XCO2 proposals which includes capturing waste heat from diesel generator or increasing the use of renewable energy sources.

hydroelectricity to meet all of its electricity demands whereas for other hotels such as hotel 10 it is clearly a case of business-as-usual and they are still awarded certification.

It is acknowledged that the scheme in question has been upgraded and now awards three levels of awards, bronze, silver and gold awarded however this does not affect the fact that using the method for certification in 2006 and based on the reported emissions published in the benchmarking assessment reports, all 28 hotels were awarded the same level of certification despite the wide range in emissions. The revised scheme awards bronze, silver and gold certification on the basis of length of certification and not on increasing performance level. For example, hotels certified for over five years are awarded gold certification which is misleading to the guest since a gold award would imply that its energy performance is better than a bronze hotel.

Discussion

When the reported CO_2 emissions for 28 hotels certified within the same scheme are examined, a seven fold divergence in hotel emissions were found this brings into question the value of certification in bringing about a reduction in emissions. Can it be justified to certify a hotel *sustainable* that emits over 70 kg CO_2 per guest night and moreover, to give it the same level of certification to a hotel that emits only 1 kg CO_2 per guest night? This point is even more poignant when it is consider that this occurred within the same scheme.

When the CO_2 emissions for 8 hotels certified within different schemes are calculated by the author's CO_2 accounting method, a similar divergence in hotel emissions were found with no systematic reduction in emissions brought about by certification. All the selected certification schemes imply that they guarantee green or sustainable practice, and yet as shown in Figure 6.1, we see one certified hotel with 73.7kgCO_2/gn whilst another certified hotel claiming to be zero carbon. This shows how erratically CO_2 is treated.

One of the arguments of this thesis is that it is not justified for hotels to claim to be zero carbon as a result of buying non-accredited, "green" electricity nor is it acceptable that a hotel is allowed to become certified (with all the associated implications of green or sustainable practice) when it emits over 50kgCO_2/gn.

This importance of analyzing the actual consumption data for certified hotels has been key to revealing whether or not many scheme which seem very rigorous when examined on their criteria and method i.e. *the 152 page verification forms required to be completed for EU Flower certification,* yet despite this, the hotel (hotel 1) was found to emit over

50kgCO2/gn one of the top two highest emitters of all eight certified hotels under different schemes. This exposes a gap between the complexity and sheer number of criteria required to be satisfied for certification and the actual emissions of the hotel being certified. It also brings into question the credibility of a scheme that certifies a hotel with such a high level of emissions.

Recommendations for Improvements

Certification is commendable for addressing a wide range of impacts but it does not account for CO_2 emissions. In order to make the selected certification schemes a reliable guarantee of green or sustainable practice it must make the calculation of emissions (and energy) a mandatory category which has got to be properly computed. The weighting of this and other categories must be rigorous and reflect the level of impact on global CO_2 emissions.

A simple, accurate method of CO_2 emissions calculation needs to be developed which can be adopted universally. It is argued here that a universal CO_2 conversion factor should be applied to electricity (with the exception of countries like Malta which does import electricity from Europe). It is also recommended that emissions are calculated on per guest night basis which would enable comparisons between different size hotels.

The most appropriate metric for monitoring energy consumption and data collection is kWh which is most familiar for hoteliers responsible for data collection and reporting in order to submit to the certification schemes. This can be assessed on a per square metre or per guest night basis. To enable comparability between different certified hotels (either within the same scheme or within different schemes) then there must be consistent normalization. To assess the effect (if any) of certification on CO_2 emissions then this must be measured in $kgCO_2$ on either a per square metre or per guest night basis. Since the focus of this research is on emissions on a global scale accountability should be on per capita basis. In addition, the ‘per guest night’ is the ‘currency’ or unit most commonly used by hoteliers and the people formulating the certification schemes. As demonstrated in this thesis, there are clearly problems associated with what should be included and excluded from the ‘guest night’ and the author has proposed recommendations in Chapter 3, 5 and 7 to address these issues.

The calculation method and benchmarks used for certification need be made transparent to ensure accountability and make the certification more credible. As a result of this lack of transparency, the benchmarking assessment reports appear to be publishing generic conclusions sections in the reports which only became evident after access was granted to these confidential reports. (Appendix 5.2C). The recommendations need to be a more detailed together with a specific list of recommendations for improvement rather than the vague and general comments found in current reports.

Specific recommendation to the scheme reviewed in section 6.2, include the introduction of a rigorous system of mandatory and optional points as required by other schemes in addition to the use of benchmarks (baseline and best practice) currently being used as indicators of performance. This would make the scheme more robust and rigorous.

Also, energy should be made a mandatory category and the CO_2 produced per guest night ($kgCO_2/gn$) and the percentage of renewable energy used should affect the overall benchmarking evaluation.

The introduction of different stages of certification with the award of bronze, silver and gold logo is misleading to the guest who would not be aware that the logo was awarded to hotels with high CO_2 emissions hence high environmental impact. Consideration should be given by the scheme to award different levels of certification reflecting different levels of environmental performance such that the logo reflects the energy consumption and emissions of the hotel becoming certified.

7

Conclusions and Recommendations

The problem addressed in this research is to do with certification, the hotel sector and global CO_2 emissions. The results have confirmed that current methods of environmental certification (specific for the hotel sector) are flawed allowing hotels to become certified despite having high CO_2 emissions. In this concluding chapter, what has been achieved in this research is evaluated and how far the aims set out in the Introduction have been realized is examined. In summarizing these achievements, there is also a discussion about further research including recommendations for improvement.

7.1 Key Findings and Conclusions

The research examined the effect of certification on emissions in the hotel sector and whether the schemes correctly accounted for CO_2 emissions. The research also examined whether certification schemes are rigorous and whether the results are credible. The factors that cause the variance in CO_2 emissions were explored including causal (physical, operational or behavioural) differences. The way in which emissions from electricity, including so-called ‘green’ electricity, are accounted for was examined, since it was found that in obtaining certification, this often plays an important part.

These questions were examined by a thorough literature review of the current state of certification as well as an investigation of the key criteria and methods employed in the selected certification schemes used in this study. In addition, the environmental performance of certified hotels, with respect to CO_2 emissions, was investigated to study the effectiveness of certification in reducing global CO_2 emissions in the hotel sector.

This was accomplished as follows. From the data collected from 70 hotels, the *actual* energy consumption was analysed to ascertain energy usage and CO_2 emissions data and how this corresponds to environmental certification. Three levels of analyses were carried out. Chapter 5 presented the results of four illustrative in-depth studies, each hotel being certified under each of the selected schemes. Chapter 6 presented two analyses, one which compared the *calculated* emissions per guest night for 8 hotels certified in *different* schemes and another which compared the *reported* emissions for 28 hotels *certified* within the same scheme.

The link between CO_2 and Global warming is unequivocal. If the purpose of certification is to provide an award to a hotel that has good environmental performance then one would expect that certification schemes includes CO_2 criteria and that the hotel is actually reducing its CO_2 emissions. The results have shown that although certification is commendable for addressing a wide range of impacts, it does not account for CO_2 emissions in certification. This research has also uncovered serious shortcomings in many of the quantitative accounting methods as well as the dependence of practices such as carbon off-setting, which are ethically and technically doubtful.

The author estimates that in the UK hotels are on average four times more CO_2 intensive than people living at home yet CO_2 emissions are not accounted for in certification schemes.[1] There are several factors that might explain this four fold increase. First, the essence of the hotel service is one of luxury and overprovision, as manifest by decorative lighting, large under populated foyer areas, frequently changed linen, overheated (and overcooled) rooms, and food provision that is both extravagant in food and energy. Secondly, unlike the normal domestic situation, there is no link between the energy used and the cost to the guest. Additionally, the inclusion of gyms, restaurants and kitchens, gift shops, business centers, conference rooms, and other energy using spaces and people other than guests use these amenities.

It is relevant, that for business use usually involving one individual from a household, it is unlikely that there will be a significant saving in domestic emissions due to the individuals hotel stay. Thus the person’s total emissions would be around four times their domestic value. In the case of tourism, involving families, however, we would expect all or most of the domestic emission to be saved if the home energy consuming devices are turned off – refrigerators, heating systems, which they will not be, although heat can be turned down.

Despite all the hype surrounding certification (Chapter 3, Sustainable Tourism and Tourism Certification), the results of the research make it clear that, despite certification and various initiatives to minimize a hotel’s ecological footprint, not much progress has been made in terms of actual CO_2 emissions reduction as evident in the results from the individual in depth studies (Chapter 5, In depth Study of Four Certified Hotels) and analysis of the raw operational data collected from the selected hotels (Chapter 6, Multi-hotel data analysis). These results have shown no direct reduction in CO_2 emissions attributable to certification alone.

A criticism of the all the selected certification schemes is that they do not measure / account for the CO_2 emissions from the hotels. (Chapter 4, Comparison of Five Certification Schemes) The author does not support the argument that since certification does not currently consider CO_2 as one of the criteria then hotels are not

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1 Apart from one scheme Green Globe, however even in this one instance where emissions are accounted for they are not included as a mandatory category in certification nor does it affect the overall benchmarking evaluation.

accountable for their CO_2 emissions. The research criticizes the hotels for not reducing their CO_2 emissions despite becoming certified. It is acknowledged that a certified hotel will have fulfilled all of the other criteria required by the certification scheme and that this would have involved big changes in the mentality and management structure which is an obvious step forward within the industry.

Only one certification scheme, Green Globe, calculates CO_2 emissions but this is included in a non-mandatory category for certification. (Chapter 4, Comparison of Five Certification Schemes) Most schemes involve five or more assessment categories yet success in only one or two categories enables a hotel to become certified despite having poor environmental performance. In some cases energy is not even a mandatory category so it raises the questions of how such schemes can reliably be a measure of a hotels impact on the environment. (Chapter 3 Sustainable Tourism and Tourism Certification, Chapter 4 Comparison of Five Certification Schemes, Chapter 5 In depth Study of Four Certified Hotels and Chapter 6, Multi-Hotel Analysis) A deficiency of the certification schemes is the awarding of the same level of certification to hotels despite having a wide range of CO_2 emissions. (Chapter 6, Multi-Hotel Analysis)

The author found there is a widespread problem of false accounting in certification where hotels are claiming reduced or zero CO_2 emissions through the purchase of ‘green’ electricity certificates as seen in Study 1 hotel, Sweden (Chapter 5, In depth Study of Four Certified Hotels) and subscription to carbon offsetting schemes which cannot be properly validated as in the case of the Hotel 4, London, UK (Chapter 6, Multi-Hotel Analysis)

The results of the analyses show no clear pattern. (Chapter 5, In-depth Study of Four Certified Hotels and Chapter 6, Multi-Hotel Analysis) In some cases, emissions reduced after certification, in others no change. The results of the research found that certified hotels do not necessarily have lower emissions than uncertified hotels and a comparison of before – and after – certification shows no significant improvement. (Chapter 5, In-depth Study of Four Certified Hotels)

Most dramatically, emissions from certified hotels widely vary by a factor of 7. (Chapter 5, in depth Study of Four Certified Hotels) Although it is arguable a number of corrections should be made to account for different climates, the research highlights that hotels with high CO_2 emissions are being awarded certification and it questions what message ‘certification’ gives to guests and other stakeholders. At worst it appears ‘business as usual’ can achieve certification with no obvious improvement in performance. (Chapter 5, in depth Study of Four Certified Hotels and Chapter 6, Multi-Hotel Analysis)

The findings of the literature review (Chapter 2, Policies Response to Climate Change and Chapter 3, Sustainable Tourism and Tourism Certification) and the data analysis (Chapter 4 Comparison of Five Certification Schemes, Chapter 5, In depth Study of Four Certified Hotels and Chapter 6, Multi-Hotel Analysis) identified several fundamental weaknesses in certification as listed below and are explained in more detail in the subsequent sections:

1) Impact of fuel mix chosen (and the choice of CO_2 conversion factor applied) on *actual* CO_2 emissions
2) Lack of CO_2 criteria - No benchmarking of CO_2 emissions in schemes (*except one*)
3) Energy not mandatory category for certification
4) Adding together of different types of energy i.*e. delivered electricity and fuels.*
5) False accounting of CO_2
6) Errors in reporting and Numerical errors in calculations
7) No sub-metering
8) Accounting of ‘guest nights’ used in calculations
9) Weighting of categories in the overall awarding of credits for certification.
10) Confusing logo
11) Lack of Transparency
12) Wide range of calculated emissions between different schemes and reported emissions within the same scheme.
13) Potential for integration of regulatory instruments with voluntary initiatives such as tourism certification.

1) Impact of Fuel Mix Chosen

The results of Chapter 5 (In depth study of Four Certified Hotels) and Chapter 6 (Multi-Data Analysis) show that depending on the fuel mix chosen (and the choice of

CO_2 conversion factor applied), the resulting CO_2 emissions per guest night can vary by a factor of 7 as seen for example in Chapter 5, Study 1 hotel in Sweden.

2) Lack of CO_2 Criteria

The results of Chapter 4 (Comparison of Five Certification Schemes) and Chapter 6 (In depth studies for four certified hotels) found that certification cannot imply good levels of CO_2 emissions since the levels of emissions are not measured in the first place for the award of certification (in the case of EU Flower, Nordic Swan and Green Hospitality Award) and where they are measured in the case of Green Globe, it does not affect the benchmarking evaluation.

3) Energy Not Mandatory Category for Certification

The results of Chapter 4 (Five Certification Schemes) and Chapter 5 (In depth study of Four Certified Hotels) found that energy is not a mandatory category in any of the schemes (apart from Nordic Swan as of 2007) which effectively allows a hotel with high energy consumption and emissions (53 $kgCO_2/gn$ as seen in Study 4 hotel, Malta) to become certified which is grossly misleading considering the logo implies the hotel is ‘sustainable or green.’ In Study 3 hotel, Ireland the hotel had a very high electrical base load throughout the year irrespective of the occupancy of the hotel due to the hotels continued operations to keep it functioning. The hotel also had high gas consumption (due to over sizing of boilers) yet the hotel was awarded ‘Gold’ level of certification. In this scheme, passing of the energy benchmark is not necessary for certification. The award of Gold level certification to a hotel with high base load brings the credibility of the scheme into question.

4) Adding Together Of Different Types of Energy

In another example, the analysis of the consumption data in Chapter 5 (In depth study of Four Certified Hotels) revealed that in all four study hotels different types of energy were added together i.e. delivered electricity and fuels giving an erroneous performance indicator to be used for comparison with the benchmark used in the certification scheme. These are not isolated cases as evident in the analysis of Study hotel 1, Sweden which raises issues about the Scandic Utility System (SUS) database particularly as the delivered electricity values are added to the heating values giving an erroneous energy performance figure as this was found to be a problem across all hotel data in the database. This was also evident in the Hilton Environmental Reporting (HER) database and across the board in all schemes and databases.

5) False Accounting of CO_2

The results of Chapter 5 (In depth study of Four Certified Hotels) show that Study 1 hotel, Sweden claims its electricity is ‘carbon free’ as a result of purchasing ‘green’ electricity. This argument could be accepted if the ‘green’ electricity supplier can validate its electricity by proving ‘additionality’ (as discussed in Chapter 5). The supplier is certified by ‘Bra Miljöval[2]’ but ‘additionality’ is not part of the criteria for certification so it is not accepted that this electricity is carbon free. The author argues that the European conversion factor (0.475 $kgCO_2/kWh$) should be applied which results in an almost seven fold difference in emissions depending on the factor applied and whether or not the ‘green’ electricity argument is accepted.

6) Errors in Reporting and Numerical Errors

Several examples of errors in reporting and numerical errors were uncovered in Chapter 5 (In depth study of Four Certified Hotels). Careful analysis of the data sent by the Study hotel 3, Ireland was required as inaccuracies were uncovered in the input of the consumption data which raised questions as to the credibility of a scheme which awards Gold Standard level of certification to a hotel with incomplete and inaccurate energy consumption data.

The analysis of Study hotel 1, Sweden raises issues about the Scandic Utility System (SUS) database particularly as there are discrepancies between the district heating fuel mix provided in the database and the mix provided by the district heating supplier. This difference has an impact on the CO_2 conversion factor applied in the calculations. Considerable ‘detective’ work had to be done to establish the true energy supply to Study 1 hotel, Sweden in order to establish the fuel mix for the delivered electricity. This was further complicated by the nature of the tenancy/ownership arrangements of the hotel building.

In Study 4 hotel, Malta some data from the Hilton Environmental Reporting (HER) database had to be rejected since there was not continuous 12 month monitoring period or in another example the same input data appeared for repeated entries which were not considered reliable.

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[2] Green electricity supplier in Sweden.

7) No sub-metering

It was found in Chapter 4 (Comparison of Five Certification Schemes) and Chapter 5 (In depth study of Four Certified Hotels) that sub-metering is not mandatory in any of the schemes despite it being a key diagnostic tool to identify problem and energy intensive areas which would enable recommendations for improvement to be made. Due to the lack of sub-metering (apart from kitchen in Study 1 hotel, Sweden), it was not possible to calculate if, for example, the 'Eco-room' (Study 1 hotel, Sweden) had any real impact on the hotel's energy consumption and/or emissions as claimed in Bohdanowicz et al., 2005b.

For example, as seen in Study hotel 3, Ireland (Chapter 5, In depth Study of Four Certified Hotels), the results of the analysis of this data shows that the hotel has a high electricity base load irrespective of the occupancy of the hotel due to the hotels continued operations to keep it functioning. However, since the hotel is not sub-metered it was not possible to identify the exact cause of the high base load.

Another example was found in Study 2 hotel, Maldives (Chapter 5, in depth Study of Four Certified Hotels) which also had a high electricity base load due to the resort's continued operations to keep it functioning and partly due to the large number of resident employees. However, as seen in the Study 2 hotel, Ireland, since the hotel is not sub-metered it was not possible to identify the exact causes of consumption. Although in this case, many of the reasons were easily identified through observation, such as cooling losses from air-conditioning through open louvers in the fabric of the building and the exposed thatch roof in each villa, no automatic lighting controls not to mention the pool pumps running continuously which is a probable reason since there are 36 pools within the resort.

8) Accounting of 'guest nights' in calculations

It was found in Chapter 5 (In depth study of Four Certified Hotels) there is a lack of transparency in the way the accounting of numbers of people *i.e. night, day, resident staff* and areas included which was found to be the case of Study 1,2,3,4 hotels.[3] In all these cases, the indicator is measured on a per night basis but in the case of Study 1 hotel, Sweden this figure includes weighted values for day guests which

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[3] In some cases there is some confusion between the equivalence of a day and overnight guests. However, Green Globe certification accounts for this and allows one day guest equivalent to 1/3 guest night and Nordic Swan allows one day guest equivalent to ½ guest night.

accounts for conference delegates which is significant since this is a business hotel. In the case of Study 2 hotel, Maldives, this '*per guest night'* figure includes a large number of resident staff plus guests who can result in a four fold difference in emissions. In Study 3 hotel, Ireland this figure includes *'guest nights, total (staff and guest) food covers and leisure spa users'* resulting in a four fold difference in CO_2 emissions per guest night (at least on paper) depending on what numbers are included in the figure for *'guest nights'*. In study 4 hotel, Malta the guest night figure includes *'guest nights only'* or *'sleepers'* despite the calculation in the database being based on an area which includes the energy consumption of the large leisure centre A more accurate and reflective calculation would account for the conference delegates (day guests), restaurant and leisure centre guests as well as the *sleepers* in the total calculation of the figure for guest nights.

It must be made clear which figures are included by applying weighting factors which accurately reflect the relative energy consumption. The accounting of guest nights doesn't itself effect *actual* emission, whereas *'real'* proposals such as those recommended for Study 2 hotel, Maldives by energy consultants XCO_2 and for Study 3 hotel, Ireland by Sustainable Energy Ireland (SEI), would result in actual emissions reductions. Nevertheless, the accounting of guest nights is important for certification where the numbers included in the 'guest nights' can make a difference between passing the energy consumption benchmark or not or on 'claims' made by the hotels in their marketing profile.

To make clear the importance of proper accounting, let us take the example of Study 2 and 4 hotels. This argument is expanded in the 'Discussion' section of this chapter. If we were to compare emissions on the same basis i.e. guest nights (sleepers) only, then as previously calculated Study 4 hotel produces 53 kg CO_2/gn whereas on this 'like-for-like' basis, Study 2 hotel would emits 96 kgCO_2/gn! This shows how the lack of transparency in accounting methods helps to mask serious problems and enable high emitting hotels to use creative accounting to reduce their emissions.

9) Weighting of energy (CO_2) related points in overall award of points for certification

Where information was available from the data submitted for certification, it was possible to establish how the hotel scored points (or equivalent) to achieve certification. (Chapter 5, In depth study of Four Certified Hotels) For example, Study 1 hotel sent the author the document submitted to Nordic Swan, Study 2 hotel sent their Green Globe Benchmarking Assessment Report and Study 4 hotel, EU flower (152 pages of verification forms). Study 3 hotel, Green Hospitality Award sent the author the energy consumption files but at the time of writing they could not locate the submitted forms for certification.

The findings of the literature review, Chapter 4 (Comparison of Five Certification Schemes), (Chapter 5, In depth study of Four Certified Hotels and Chapter 6 (In depth studies for four certified hotels) showed that a certification scheme may be detailed and look impressive when examined on one level but when the actual emissions from the certified hotel are calculated, the results are not very impressive. For example, Study 4 hotel, Malta (53 $kgCO_2/gn$) is certified under EU Flower. The energy category accounts for 10 out of 37 Mandatory points and 17 out of 47 optional points (*at least 16.5 points must be achieved in this section*). The hotel complied with four out of the ten criterions in the mandatory category for energy. The hotel fulfilled the required Declaration of non-applicability for the remaining six mandatory criteria. In the optional criteria section, the hotel achieved thirteen out of 17 optional points in the energy category although not all the optional points are applicable to the hotel.

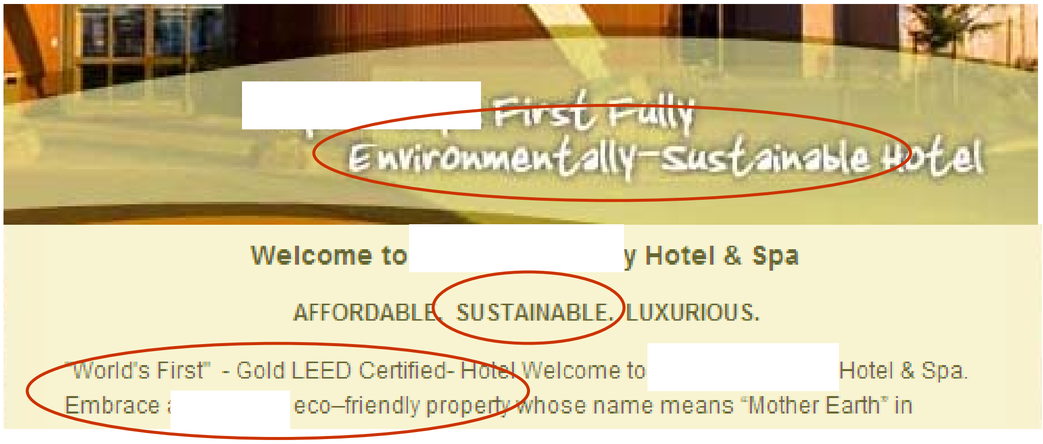
However, the results of the analysis show that the CO_2 emissions, for the whole hotel (and emissions per guest night) are extremely high for a certified hotel and brings into question the credibility of a scheme awarding a hotel a logo which implies the hotel has a low environmental impact whilst at the same time having very high levels of emissions. These results also bring into question the effectiveness of the very detailed and onerous requirements of the verification documentation (152 pages to be completed based on points requirements and mandatory requirements - MSA, 2004) in bringing about actual reductions in CO_2 emissions or indeed awarding certification to hotels with such high emissions.

Study hotel 2 (22 $kgCO_2/gn$) is certified under Green Globe where energy consumption is one of eight criteria for Green Globe certification. This is the only scheme which measures CO_2 emissions (and percentage of renewables used) but this does not affect the overall benchmarking evaluation. From the analysis of the criteria satisfied for Green Globe certification, it is seen that energy consumption is not mandatory to become certified and the weighting of the energy related criteria is very low compared to the total criteria being only one of eight criteria assessed.

As evident in the literature review of Chapter 4 (Comparison of Five Certification Schemes), (Chapter 5, In depth study of Four Certified Hotels) and Chapter 6 (In depth studies for four certified hotels) low weighting of measures that have a high impact on reducing energy consumption (and associated emissions) was found cross the board. This does not offer any incentive to the hotel to invest in emissions reductions, lower energy efficiency and conservation measures. The lack of mandatory criteria, and not awarding any additional points to passive design techniques, bioclimatic design features (or changes in lifestyle or behaviour[4]) in the hotel does not motivate the hotels nor the management and staff.

10) Use of Logo

The awarding of a ‘green’ certified logo to hotels with high CO_2 emissions and environmental impact is confusing to the guest since the logo implies ‘green’ performance by virtue of its name i.e. Green Globe, Green Hospitality Award or the image on the logo of for example, a green globe. The use of the logo is either explicit on the home page of the hotel website as seen in Figure 7.1 or in other cases it is found on a separate webpage dedicated to their environmental commitments.



[redacted] First Fully Environmentally-Sustainable Hotel

Welcome to [redacted]y Hotel & Spa

AFFORDABLE. SUSTAINABLE. LUXURIOUS.

"World's First" - Gold LEED Certified- Hotel Welcome to [redacted] Hotel & Spa. Embrace [redacted] eco–friendly property whose name means "Mother Earth" in

Figure 7.1 Screen shot of hotel homepage. *(Source: Confidential)*

In other cases the marketing for the selected the hotel implies the hotel is ‘carbon free’ and ‘to offset all its emissions’ as seen in Figure 7.2 below. However, a site visit to the hotel and interview with the environmental manager, Ms. Tracy Arnold in October 2008, uncovered that only the conference facilities have been ‘offset’. Furthermore, due to the lack of transparency in accounting methods and the fact there was no sub-metering, it is impossible to validate the claims made for that

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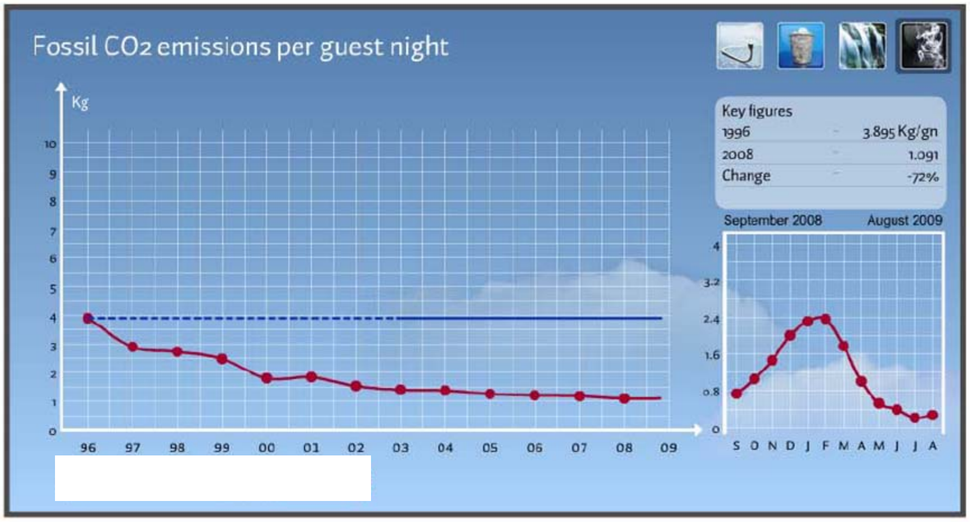
[4] This has not been included in the scope of this research although it is acknowledged to play an important part.

improvement and to explain how the energy consumption and CO_2 emissions of that area has been distinguished from the overall area.

> **"Environmental responsibilities – we have ISO 14001, are carbon-free and offset all emissions."**
>
> *Source:http://www.n[redacted]o.uk/meetingsandevents/eventplanning.html*

Figure 7.2 Example of marketing of certification on hotel website. *(Source: Confidential)*

Although it is encouraging to see hotels are now focussing on measuring emissions per guest night which is a recent development as seen in Figure 7.3 below. This appears to the public under 'sustainability live report' which is advertised on the hotel chain home page. There are concerns, as identified in Chapter 2, 4 and 5, about the calculations which use 'green' electricity in its accounting method as demonstrated below. It is confirmed on the website that the hotel chain purchases 'green' electricity from the grid and this has been factored into the calculations that underlie the graph below. As previously found, unless 'additionality' is proven then these claims are misleading.



Fossil CO2 emissions per guest night

Key figures

1996	3.895 Kg/gn
2008	1.091
Change	-72%

[redacted]

Figure 7.3 Screenshot of Sustainability Report *(Source: Confidential)*

11) Lack of Transparency

Lack of transparency was found in numerous situations as follows;

- In the publication of benchmarks in the public domain which allows a wide range of emissions to occur within the same scheme. (See Chapter 6, Multi-hotel data analysis)

- In the declaration of the criteria used by the certifying bodies to judge the data from the hotels. For example, they may be using out of date benchmarks and there may be some occasions where they are using average rather than good / best practice for comparison e.g. Green Hospitality Award based on the benchmarks used in Guide 36 benchmark which was published in1993. (See Chapter 4, Comparison of Five Certification Schemes and Chapter 5, In depth Study of Four Certified Hotels)
- In the way the data is collected and sent to the certifying body and the accounting of numbers of people *i.e. night, day, resident staff* and areas included e.g. Study 1,2,3,4 hotels[5] (See Chapter 5, In depth Study of Four Certified Hotels)
- in identifying different parts of the hotel that may have different performance and identifying the difference between where an improvement is made and claims are made for that improvement (if there is no sub-metering.) e.g. *Hotel 4 , London, UK* (See Chapter 6, section 6.2).
- In the identification of final energy use *i.e. is it representative of the whole building; does it include the conference hall? e.g. Study 4 hotel, Malta* (See Chapter 5, In depth Study of Four Certified Hotels)
- Unclear as to what kind of building is being used to establish the benchmarks against which the subject hotel is being judged *i.e. LEED* (Chapter 4, Comparison of Five Certification Schemes)
- Lack of disclosure to the public that the certification has been awarded for design intent or for operational performance *i.e. LEED, BREEAM is for design and simulated data whereas Green Globe, Nordic Swan is based on operational data.* (Chapter 4, Comparison of Five Certification Schemes)

***12) Wide Range of calculated emissions permitted between schemes and reported* emissions permitted within the *same* scheme.**

The certification schemes selected for analysis in Chapter 6 (Multi-Data Analysis, section 6.1) imply that they guarantee green or sustainable practice, and yet the results found that one certified hotel with 73.7kgCO_2/gn whilst another certified hotel

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[5] In some cases there is some confusion between the equivalence of a day and overnight guests. However, Green Globe certification accounts for this and allows one day guest equivalent to 1/3 guest night and Nordic Swan allows one day guest equivalent to ½ guest night.

claiming to be zero carbon. This shows how erratically CO_2 is treated and begs the question - is it justified that some certified hotels are obliterate their CO_2 emissions overnight by simply buying non-accredited, ”green” electricity, yet are still awarded certification? Hotels should not be able to become certified (with all the associated implications of green or sustainable practice) when it emits over 50kgCO_2/gn. Study 3 hotel, Ireland emits 16.3 kgCO_2/gn which is almost three times *less* than the EU Flower certified hotel in Malta (53 kgCO_2/gn) and less then the Green Glob certified hotel in The Maldives (22 kgCO_2/gn). When compared with the other case study hotels, this hotel performs considerably better despite emitting about the same as the *business-as-usual* hotel at 17.5 kgCO_2/gn and about two and half times the emissions ‘at home’ (6.7 kgCO_2/gn). In this sample of eight certified hotels we can see that only the Nordic Swan certified hotel has fewer emissions per guest night than the non-certified business-as-usual hotel.

The results of the second analysis in Chapter 6 (Multi-Data Analysis, section 6.2) are grossly misleading considering all 28 hotels have been awarded the same level of certification within the same scheme, Green Globe. Three hotels produce 61, 73 and 68kgCO_2/gn respectively which in itself bring the credibility of this certification scheme into question. A hotel which has such high CO_2 emissions should not be allowed to market itself as a ‘green’ hotel as suggested by the logo ‘Green Globe’. The overall conclusion is this scheme does not properly account for CO_2 emissions and does not in general lead to a reduction in emissions.

13) Potential for Integration of Regulatory Instruments with Voluntary Initiatives Such As Tourism Certification.

The results of the literature review (Chapter 2, Policy Response to Climate Change) review propose that economic instruments and voluntary information tools, such as eco labels and certification, could enhance each other’s effectiveness if they were appropriately combined with each other. For example, voluntary initiatives (such as ecolabels and tourism certification) could become much more effective if combined with regulatory instruments (such as display energy certificates for CO_2 emissions performance). The results of this research conclude that this integration would make tourism certification more robust and therefore a more reliable measure of environmental impact.

Main Conclusions

1) **Simple, accurate method of CO_2 emissions calculation**
   - Adopted Universally
   - Transparent and standardized
   - A mandatory requirement of any performance analysis
   - Calculate CO_2 emissions on per guest night basis ($kgCO_2$/gn)

2) **Individual CO_2 benchmarks** should be set for energy intensive parts of the hotel i.e. kitchens, guest bedrooms, public areas, swimming pools.

To conclude, the results of this research found there is a confusing proliferation of a wide range of certification schemes with varying criteria and methods. In most cases methods of calculation, data about baseline indicators and algorithms for use in performance assessments are not disclosed to the hotel operator or available in the public domain. There is also concern that the complexity and cost of certification systems preclude smaller businesses. The overall conclusion is that existing schemes do not properly account for CO_2 emissions.

If certification is to become a reliable measure of a hotel's environmental impact or 'greenness' then certification must make the calculation of energy (and emissions) a mandatory category which has got to be properly computed. The weighting of this and other categories must be rigorous and reflect the level of impact on global CO_2 emissions. The author concludes a simple, accurate method of CO_2 emissions calculation needs to be developed which can be adopted universally and individual CO_2 benchmarks should be set for different energy intensive parts of the hotel. The merits of this are discussed at the end of this chapter.

The author has concentrated on accurate CO_2 accounting and the comparison with the proposed properly derived CO_2 benchmarks. The accounting method uncovers the energy consuming processes and thereby offers diagnostic support in existing buildings, and design and operational guidance for new designs. The outcome of this research is highly relevant to reducing CO_2 emissions in commercial buildings, as well as hotels.

7.2 Discussion (I)

The existence of a good certification scheme is proven to be attractive to hoteliers as demonstrated by the existence of over 100 certification ecolabels and certification schemes available worldwide with 60 in Europe alone. The results of this thesis have shown that they are ineffective in terms of CO2 emissions reduction. To make the certification schemes more effective will also make them more costly. The use of fiscal instruments can help reduce these costs for hotels and therefore maintain the attractiveness of and increase the effectiveness of certification. Fiscal instruments can be used to do two things; reduce energy consumption through tax exemptions, subsidies, grants, loans and rebates and increase the use of renewable energy through the introduction of Feed-in Tariffs. For example, a hotel may decide to cover its roof in photo-voltaics to increase its renewable energy supply and benefit from the Feed In Tariff whilst at the same time this will improve the hotels ‘green’ image from a marketing perspective. Secondly, in order for the hotel to meet the more stringent energy and CO_2 criteria, the hotel will also need to reduce its energy demand which might require, for example, installing a more efficient boiler which will prove costly for which there may be grants or loans available.

The use of fiscal instruments and voluntary instruments such as certification could increase each others effectiveness if they were appropriately combined with each other. For example, fiscal instruments such as tax exemptions, grants and loan could be combined with, for example, the Feed-in tariff. These instruments have the potential to play a pivotal role in making voluntary instruments such as certification more effective in terms of emissions reduction whilst at the same time offsetting the costs of achieving this level of more robust certification. The next step in making certification more effective would be to make certification mandatory as currently seen with the introduction of Display Energy Certificates for public buildings over 1000 m^2.

The stakeholders targeted by this thesis include scientists, policymakers and the people responsible for formulating the certification schemes. For these stakeholders, it has been established from the data collected for this research that the ‘guest night’ denominator is the most commonly used unit for measuring consumption in either kWh or MJ (and in the case of Green Globe – $kgCO_2$).

In order to make hotel certification a more robust and reliable indicator of environmental impact in terms of CO_2 emissions reduction, it is necessary for certification to include mandatory CO_2 criteria which will necessitate the calculation of CO_2 emissions in $kgCO_2$. Since the focus of this research is targeted at the scientists and people responsible for formulating the certification schemes who are familiar with the unit $kgCO_2$ and since the certification schemes are targeted at hoteliers and hotel environmental managers, it makes sense to use the ‘currency’ they are most familiar with which is the unit ‘per guest night.’ Therefore, in order to address the specific research question set out in this research in particular, if certification is effective at reducing emissions in the hotel sector, the author recommends that emissions are related to occupancy and on a per capita basis i.e. per guest night.

The merit for including a measure for energy consumption in kWh/m^2 in addition, is that it has the potential for influencing stakeholders other than those specifically targeted in this thesis e.g. hotel owners, environmental managers, architects, engineers, guests, the public etc. However, each of these target audiences is familiar with a particular unit, for example, hoteliers and environmental managers are more familiar with energy consumption ‘per guest night’ i.e. kWh/gn or $kgCO_2/gn$, whilst engineers and architects are more familiar consumption on an area basis i.e. kWh/m^2.

An energy benchmark is measurable and widely understood and a CO_2 benchmark involves a calculation related to fuel mix using the appropriate published conversion factor. Bordass also argues for the use of both energy (kWh/m^2) and CO_2 ($kgCO_2/m^2$). The presentation of both units of measurement i.e. kWh/m^2 and $kgCO_2/gn$ (or even $kgCO_2/m^2$) would render the results of the thesis applicable to a wider audience. It is expected that the certification scheme operators and specialists would assist hoteliers and other interested parties experiencing difficulties in calculating their CO_2 emissions per guest night.

However, a focus on energy performance alone does not provide information on the environmental impact of a building in terms of CO_2 emissions reduction. This is evidenced in the case of Green Globe where it was shown that the hotel may have passed the energy consumption benchmark (MJ/m^2) but **has** high levels of emissions as a result of a high carbon energy supply. In this case, the hotel may have good energy performance but still have a high environmental impact in terms of CO_2 emissions. This reinforces the need for CO_2 accountability for certified hotels.

A focus on energy consumption can lead to overall increase in building performance in terms of energy efficiency however it can also be counterproductive since there are more buildings being built as a result which can lead to an increase rather than a decrease in overall CO_2 emissions. For example, if the area of a room in hotel A is $40m^2$ and a room in hotel B is $100m^2$ then the overall energy consumption and CO_2 emissions per room in hotel B is going to be 2.5 times that of hotel A, even though when compared on a per metre basis using the metric, kWh/m^2, hotel room B may be more efficient than hotel A. This is why a focus on energy consumption on an area basis can be misleading from an overall energy consumption (and emissions) perspective.

This research is concerned with the significance of hotel emissions on a global scale and a more enlightened approach would be to measure $kgCO_2$ relating to the occupancy metric which is per guest night. Putting the universal CO_2 unit ($kgCO_2$) with most commonly used hotel unit which is per guest night proposes that the most appropriate unit for the purposes of this research (which is addressed at scientists who are familiar with the use of this CO_2 unit) is $kgCO_2/gn$ which ensures that the efficiency of providing the service i.e. accommodation is credited, rather than simply providing space, which may be over provided due to poor planning and design, or serviced unnecessarily due to poor controls and management.

The author acknowledges there are difficulties associated with the choice of ‘per guest night’ particularly if considered together with energy consumption which vary on a monthly basis and is not strongly correlated as evidenced in the analysis results of the in-depth studies presented in Chapter 5. For example, comparison with the Swedish hotel further highlights the difficulties of using ‘guest-nights’ as it becomes further complicated with the addition of restaurant covers or spa users. This issue is further compounded with the hotel in Ireland (Figure 5.3.4 and 5.3.5). In this case, the results also suggest that the hotel has a high electricity base load irrespective of occupancy. Again for the hotel in Malta, if Tables 5.4.4. and 5.4.6. are compared they show that the pattern of energy use/guest-night inverts the seasonally related demand for energy.

However, this difficulty associated with energy use/guest night can be overcome if the energy consumption of these facilities are separately monitored, and could themselves be subject to certification, but not applied to the standard hotel benchmark as discussed in more detail in Chapter 3 and the Introduction section of Chapter 5.

Moreover, as discussed in Chapter 3 and 5, the author recommends that if a hotel has live-in staff that uses the hotel as their residence, and has no other home, then they could be counted as a guest night. A separate consumption and emissions benchmark could be used for hotels with truly live-in staff, i.e. where they do not have alternative accommodation, and could be normalized in order to facilitate comparison between hotels in the same scheme. To account for the live-in staff, the author recommends the introduction of a ‘staff night’ which should be weighted to relate to the standard of hotel the staff member enjoys. The weighting applied should be reasonably universal, for example, a weighted staff night for a 2 star hotel might be in 0.25 whereas that for a 5 star might be 0.5. This should be developed in any further work.

In chapter 6, the reported emissions from 28 hotels certified within the same scheme (Green Globe) are compared. The results of the analysis of the data using the performance indicator (kgCO_2/gn) identifies that the fuel mix of the high carbon energy supply is accountable for the high CO_2 emissions. This reason would not have been identified if only an energy performance indicator (in this case MJ/gn) had been solely relied upon. However, it is also acknowledged that this information alone is not very useful for a designer or hotel manager who may want to make improvements to a hotel. It would therefore seem worthwhile to also present the data expressed in terms of delivered energy (kWh/m^2) as well as emissions (kgCO_2/gn). In this multi-hotel analysis, a comparison of disaggregated energy use in the 28 hotels expressed in both metrics would have allowed meaningful comparisons between hotels in terms of their inherent characteristics and could thus lead to potential reductions in CO_2 emissions. This should be included in any further work.

Mandatory CO_2 certification – a way forward?

It is clear that if environmental certification is to become a reliable and robust measure of a hotels environmental impact then measuring and benchmarking of CO_2 needs to be made a mandatory part. The author proposes introducing CO_2 certification as a mandatory requirement for environmental certification. An analogy is that certification should be approached in a similar fashion to M.O.T. testing of vehicles in the UK. A crucial part of the CO_2 certification process is that recommendations for improvement could be made available after ‘testing’ if a hotel fails its ‘M.O.T.’ test i.e. *its CO_2 audit*. It could be made illegal to operate the hotel unless it has a valid, up to date CO_2 certificate. Possession of an up-to-date CO_2 certificate could be a pre-requisite for obtaining, for example, environmental certification. Advertising of the hotel might state how many months are left to run on the current CO_2 certificate.

When a hotel ‘fails’ its ‘M.O.T.’ test i.e. *CO_2 audit*, it could be re-tested (at a reduced cost) by the independent third party auditors after implementing their recommendations for improvement, provided of course these were completed within the specified time frame. If it is not completed within this time frame then the full cost of testing can be charged again. This would ensure the listed ‘failure items’ would be addressed as soon as possible since the hotel could not operate without a valid CO_2 certificate which would result in lost revenue. Failure to comply with the ‘failure list’ would result in a type of penalty which would grow until compliance is met. The CO_2 certificate could become a legal requirement enforceable by law.

Behavioural and/or Lifestyle Changes

Apart from the more technical aspects discussed in relation to certification, this discussion would not be complete without reference to the impact of non-technical aspects such as behavioural and lifestyle changes.

The nature of hotels is to ‘please’ the guest and meet their expectations. However, there is conflict between tourist expectations of comfort and Ecolodge accommodation. For example, a guest expects to stay in a vernacular style Ecolodge yet expects the comfort of 6 star luxury hotel (for which they have paid for) including air-conditioning and private swimming pool. Yet this provision of comfort and luxury would require the design of a sealed highly insulated building, which would in turn conflict with the tourist expectation of an ‘Eco-vacation.’

In order to start ‘greening’ our hotels, there needs to be a fundamental shift in our attitude towards our ‘green’ lifestyle and behavioural choices which will influence the choice of holiday destination, the choice of ‘certified or non-certified’ hotel and the behavioural choices during their holiday stay. As pointed out by Gössling (2008) *”Cash-rich/time-poor travellers […] are indulging in ever more ambitious mini-breaks to wildly exotic locations. […] these ”breakneck breaks” will increase by more than a third this year, with the number of Brits travelling to destinations including Hong*

Kong, New York and Rio de Janeiro for just a few days rising from 3.7 m to 4.9 m in 2008."

At home, we are aware of our energy use because we have to pay the bill. On holiday, we somehow feel justified in wasting energy because we have paid for it i.e. we are not directly responsible paying for then energy we use.

According to the co-founder of Responsibletravel.com, Mr. Justin Francis*, "Already people are a lot more aware of the effects their lifestyle choices have on the environment and local communities and travel is a significant part of that."* If a guest starts to alter his/her behavioural choices and expectations of their hotel, then hotels will have to adapt to suit these changing needs which will have a knock on effect on the approach of the industry. This may eventually affect approaches in hotel design to meet these new expectations, lifestyle and behavioural choices of these more eco-conscious guests. The importance of changes in our lifestyle is acknowledged by the Executive Director of the IEA at a recent conference address where he stated

"I know that a considerable share of sustainability politics meets political, social, economic and psychological hinders, and of top of this demands changes in our lifestyles. But ignoring this is no longer an option. It is time to act." [6]

In terms of changes in behaviour, we should ask ourselves, if a guest arrives at their 'green' hotel, do they really want to see their room all lit up and air-conditioned upon arrival or would they prefer to enter a dark room with perhaps the place to insert their key card lit up by a single low energy light and once inserted the lighting and cooling is activated. Would the 'green' guest prefer to see that energy was not being wasted on under water lighting for their unoccupied private pool? Would the 'green' guest even want to have a private pool with a pump running continuously?

A limitation of this research is that it did not involve research into the impact of behavioural and lifestyle changes and it is proposed that this is studied in further research. Attempts have already been made to quantify the contribution of occupant factors on performance and these could be built upon in any further work. Baker and Steemers (2000) found that these factors account for at least a two fold variation in performance and there is a growing evidence that the three factors, buildings, services and occupants, do not operate independently and that certain low-energy

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[6] Nobuo Taneka, IEA, in Dagen Næringsliv 8 November 2007.

strategies for building design are more likely to result in better system performance and more favourable occupant behaviour. In order to make certification a more reliable indicator of performance, these ‘human’ factors need to be accounted for in the design of the criteria in tourism certification.

7.3 Recommendations for Improvement

Summary of Key Recommendations for Hotels

1) **Compulsory sub-metering**
    - To monitor consumption in energy intensive facilities i.e. kitchens, guest bedrooms, public areas, swimming pools.

2) **An Independent Assessor** would be party to decisions on the specification of monitoring points and specify or install sub-meters on site.

3) **Three levels of Assessment** could be made:
    - Calculation of CO_2 emissions based on fuel bills.
    - Separation of architectural *e.g. space heating/cooling and lighting* and domestic *e.g. hot water, laundry* energy use and identification of fuel use for each function.
    - Sub-division and domestic energy categories. For example, is the laundry outsourced or in-house? Is the tumble dryer electric or gas driven with (or without timer and humidity control?

In terms of achieving *real or actual* emissions reduction the author recommends a focus on energy and CO_2 emissions, which would make it simpler for a hotel to assess its performance without the constraints of time and costs. In order to make certification an effective, accurate and reliable measure of environmental impact in terms of emissions reduction, the calculation of emissions needs to be properly computed and included as a mandatory category. The weighting of this and other categories needs to be rigorous and reflect the level of impact on global CO_2 emissions.

A simple CO_2 accounting method is proposed as the first step of a diagnostic process leading to a solution *i.e. reduced emissions*, to the problem *i.e. high energy consumption and/or emissions*, thus reducing the environmental impact (in terms of emissions reduction) of the hotel. This method would enable a series of *'cause and effect'* scenarios to be tested in order to find a solution to reduce emissions and be awarded the CO_2 certificate to satisfy the proposed mandatory CO_2 criteria for certification. This certificate could be a used on its own as a reliable and truthful measure of a hotel environmental impact or it could be used to satisfy the proposed mandatory CO_2 criteria in existing tourism certification thus making it more reliable. The fact that the CO_2 accounting method uses a universal or Regional conversion factor (0.5 kg CO_2/kWh) for delivered electricity and published factors for heating fuels means that the method could be applied on a global level. This method of accounting can easily be transferable to other commercial buildings and offers diagnostic support in existing buildings, and design and operational guidance for new designs.

A key factor in this accounting method is the application of the European Conversion factor (0.475 kgCO_2/kWh) to delivered electricity which gives a more realistic account of emissions as a result of cross border trade of electricity within the European Union. In the case of The United States (0.61 kgCO_2/kWh) and Australia (0.95 kgCO_2/kWh), the national average figures should be applied to the delivered electricity. It is debatable if in fact it would be more accurate to apply a Universal Conversion Factor (0.55 kgCO_2/kWh) to delivered electricity to enable global comparison of hotel emission. For heating fuels, the published conversion factor (kgCO_2/unit) is applied although attention should be made to some particular rules for CO_2 accounting as previously described in the Introduction of Chapter 5.

1) Mandatory sub-metering

A key requirement of the CO_2 method is mandatory sub-metering which would identify exceptional or unusual patterns of energy consumption. Monitoring consumption in energy intensive facilities such as kitchens, laundries or swimming pools, would be a pre-requisite to ensure accurate data collection and feedback.

2) Independent Assessor

An independent assessor would decide the monitoring points and specify or install the sub-meters on site to ensure accurate data collection and feedback. The data could then be collected automatically by independent loggers or from utility bills from utility companies.

3) Three levels of Assessment could be made;

a) Calculation of global CO_2 emissions based on fuel bills

Emissions would be calculated using the CO_2 accounting method (as describe in Chapter 5) which will not only provide a method to make comparisons with valid benchmarks and subsequent certification, but will also provide a diagnostic tool for hotels to identify the causes of poor performance. It can be used on its own as a simple measure of a hotels environmental impact or can be used to satisfy the proposed mandatory CO_2 criteria in existing certification scheme to make them more robust, reliable and effective measure of environmental impact in terms of emissions reduction.

b) Separation of architectural *e.g. space heating/cooling and lighting,* and domestic energy use *e.g. hot water, laundry etc.* and identification of associated fuel use for each separated function.

c) Sub-division within architectural and domestic energy categories. For example, is the laundry outsourced or in-house? Is the tumble dryer electric or gas driven with or without timer and humidity control?

Additional Recommendations for Certification

4) Energy and CO_2 Mandatory Category

Improvements to any existing scheme should make energy a mandatory category. The CO_2 produced per guest night ($kgCO_2/gn$) and the percentage of renewable energy used should affect the overall benchmarking evaluation. The scheme needs to introduce a rigorous system of mandatory and optional points as required by other schemes in addition to the use of benchmarks (baseline and best practice) currently being used as indicators of performance. This would make the scheme more robust and rigorous.

A focus on just energy benchmarks could result in cases where a hotel fails the energy benchmark when in fact the hotel had low emissions and environmental impact. These benchmarks need to be revised and updated regularly to accommodate improvements in performance of buildings or technological advances. For example, it was found in Chapter 2 (Policy Response to Climate Change) that decarbonised electricity may result in an increase in electricity use in hotels even though the hotel would in fact produce lower emissions. The weighting and design of the energy criteria in all schemes would need to be reviewed and updated to accommodate this change in the future. The introduction of CO_2 benchmark is critical to ensure certification becomes a robust and reliable measure of environmental impact.

5) Individual Energy (and CO_2) Emissions Benchmarks

Instead of a single energy benchmark (typically measured in kWh/m^2) for the whole hotel, as is currently the case, individual CO_2 emissions benchmarks could be set for individual zones[7] within hotels i.e. *energy intensive zones such as the kitchen and restaurant, laundries, guest rooms, conference facilities, swimming pools, leisure and spa facilities*.

The introduction of sub-metering would enable the energy consumption for these energy intensive zones to be measured and monitored. This will be discussed in the next section. The emissions could be calculated from this data (using the CO_2 accounting method) and compared with CO_2 benchmarks for each zone. For example, Hotel 4 (Green Tourism Business Scheme) has recently separated the energy consumption of the Spa from the consumption for the whole hotel. This hotel was found to emit $30kgCO_2/gn$ which would be in Band F of the CO_2 certificate. For example, the CO_2 benchmark, for example, Band 'D – 16 $kgC0_2/gn$' may be sub-divided into individual CO_2 emissions benchmark for the identified energy intensive zones in the hotel. Individual spa benchmarks have already been set up in Green Globe.

6) CO_2 emissions calculation on a per guest night basis

If hotels are to be accountable for their emissions then they should be compared on the same 'per guest night' basis with the same 'rules' being applied across schemes. If the method is being used as part of certification and certain hotels choose not to use this method then this should be reflected in the award of certification. For example, it may be a more realistic measure of environmental impact (and emissions) for a hotel in a remote island location with a large number of resident staff to include 'resident staff' as well as 'guest nights' in its CO_2 calculation.

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[7] Bohdanowicz (2006) originally proposed to disaggregate hotels into modules with individual energy indicators rather than a single indicator for whole hotel as currently the case.

7) ***Mandatory CO_2 certification***

The introduction of mandatory CO_2 certificates would be instrumental in transforming existing tourism certification into an effective indicator of environmental impact. This could be done in two ways, either as a simple, independent and inexpensive target for hotels to measure their performance as previously proposed or they could become a mandatory and integral requirement for environmental certification.

The author proposed in Chapter 2 (Policy Response to Climate Change) that regulatory instruments and voluntary initiatives, such as certification, could enhance each other's effectiveness if they were appropriately combined with each other. For example, tourism certification could become much more robust if combined with for example, Display Energy Certificates[8] for CO_2 emissions performance providing of course that their validity is proven. The CO_2 accounting method could be used by the hotel to measure its actual CO_2 emissions. The Display Energy Certificate could be used to satisfy the proposed mandatory CO_2 criteria for tourism certification.

Instead of a single pass/fail baseline benchmark as seen in the Green Globe, there would be a scale of CO_2 performance using for example, a scale ranging from A-G where A is the lowest CO_2 emissions (best) and G is the highest CO_2 emissions (worst). This new CO_2 criteria could use the scale to specify the maximum permissible emissions from a hotel for certification. The scale could also specify for example, best practice 'A' (zero emissions hotel) and typical hotel CO_2 performance which might be rated 'D' as seen in Figure 7.4 on the next page. The banding is created in the first instance from the calculated emissions for hotels used in this research. The CO_2 performance indicator would be measured in kgCO_2 per guest night. In this way, a hotel could use the CO_2 accounting method to calculate its *actual* emissions per guest night.

The CO_2 benchmark would be an International benchmark which would be continuously reviewed. The benchmark could be calculated using the Regional, European or Universal Conversion factor for delivered electricity to ensure global applicability. If a CO_2 performance indicator (kgCO_2per guest night) is to be

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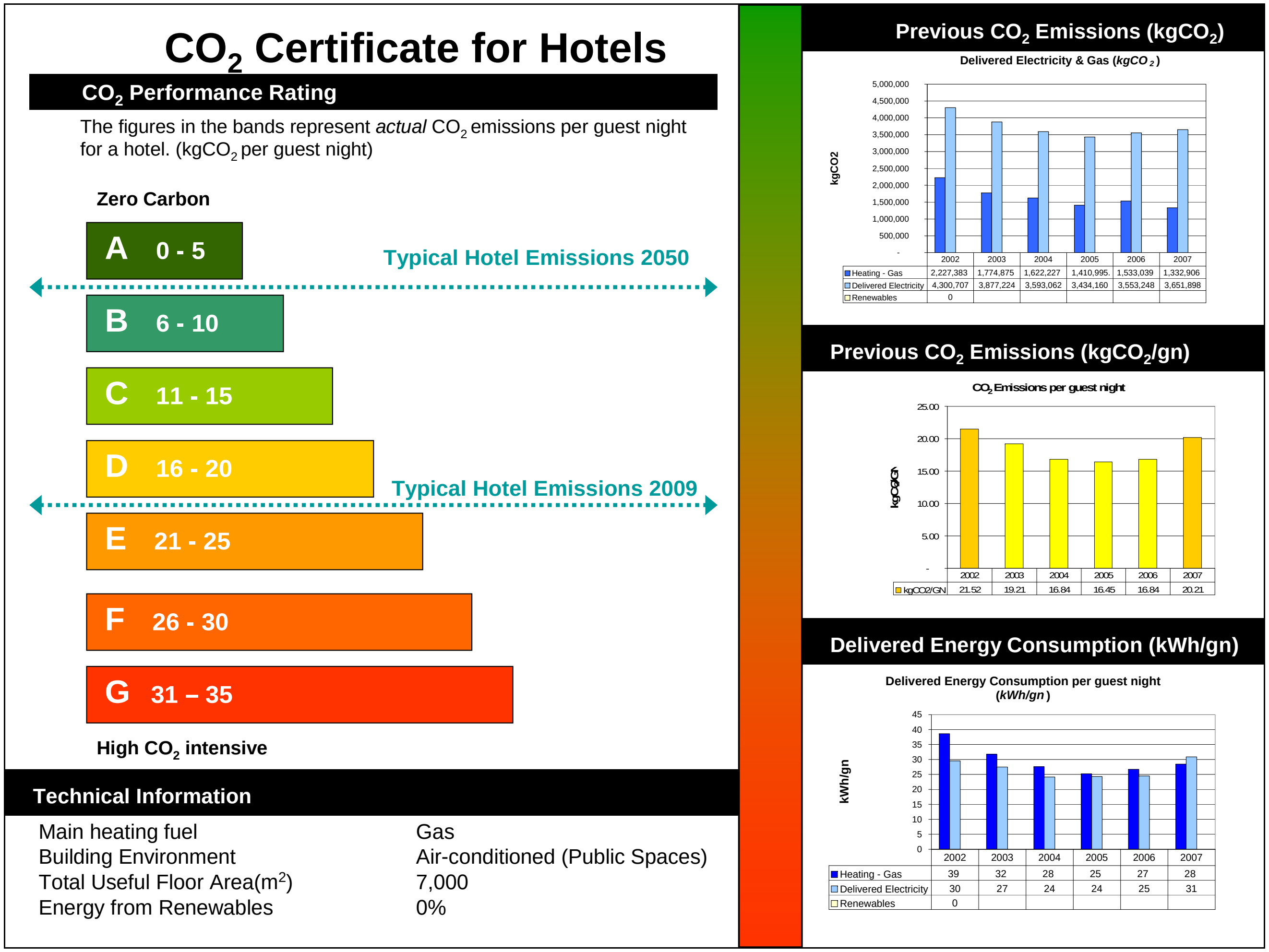
[8] As explained in Chapter 2 (Policy Response to Climate Change) a Display Energy Certificate shows the energy performance of a building based on actual energy consumption as recorded annually over periods up to the last three years (the Operational Rating - OR). The Operational Rating (OR) is a numerical indicator of the actual annual carbon dioxide emissions from the building and is based on the amount of energy consumed during the occupation of the building over a period of 12 months from meter readings and is compared to a hypothetical building with performance equal to one typical of its type (the benchmark).

developed then the calculation method needs to be transparent and standardized. This should be made a compulsory requirement of any performance analysis. Consideration will need to be given to establish how to account for different levels of service and amenity – in terms of what services must be supported and also what levels of amenity are demanded at “one star” vs. “five star” hotels.



CO_2 Certificate for Hotels

CO_2 Performance Rating

The figures in the bands represent *actual* CO_2 emissions per guest night for a hotel. ($kgCO_2$ per guest night)

Zero Carbon

A	0 - 5
B	6 - 10
C	11 - 15
D	16 - 20
E	21 - 25
F	26 - 30
G	31 – 35

Typical Hotel Emissions 2050

Typical Hotel Emissions 2009

High CO_2 intensive

Technical Information

Main heating fuel	Gas
Building Environment	Air-conditioned (Public Spaces)
Total Useful Floor Area(m^2)	7,000
Energy from Renewables	0%

Previous CO_2 Emissions ($kgCO_2$)

Delivered Electricity & Gas (*$kgCO_2$*)

	2002	2003	2004	2005	2006	2007
Heating - Gas	2,227,383	1,774,875	1,622,227	1,410,995.	1,533,039	1,332,906
Delivered Electricity	4,300,707	3,877,224	3,593,062	3,434,160	3,553,248	3,651,898
Renewables	0					

Previous CO_2 Emissions ($kgCO_2$/gn)

CO_2 Emissions per guest night

	2002	2003	2004	2005	2006	2007
kgCO2/GN	21.52	19.21	16.84	16.45	16.84	20.21

Delivered Energy Consumption (kWh/gn)

Delivered Energy Consumption per guest night (*kWh/gn*)

	2002	2003	2004	2005	2006	2007
Heating - Gas	39	32	28	25	27	28
Delivered Electricity	30	27	24	24	25	31
Renewables	0					

Figure 7.4 Proposed example of how a mandatory co_2 certificate for hotels might look like.

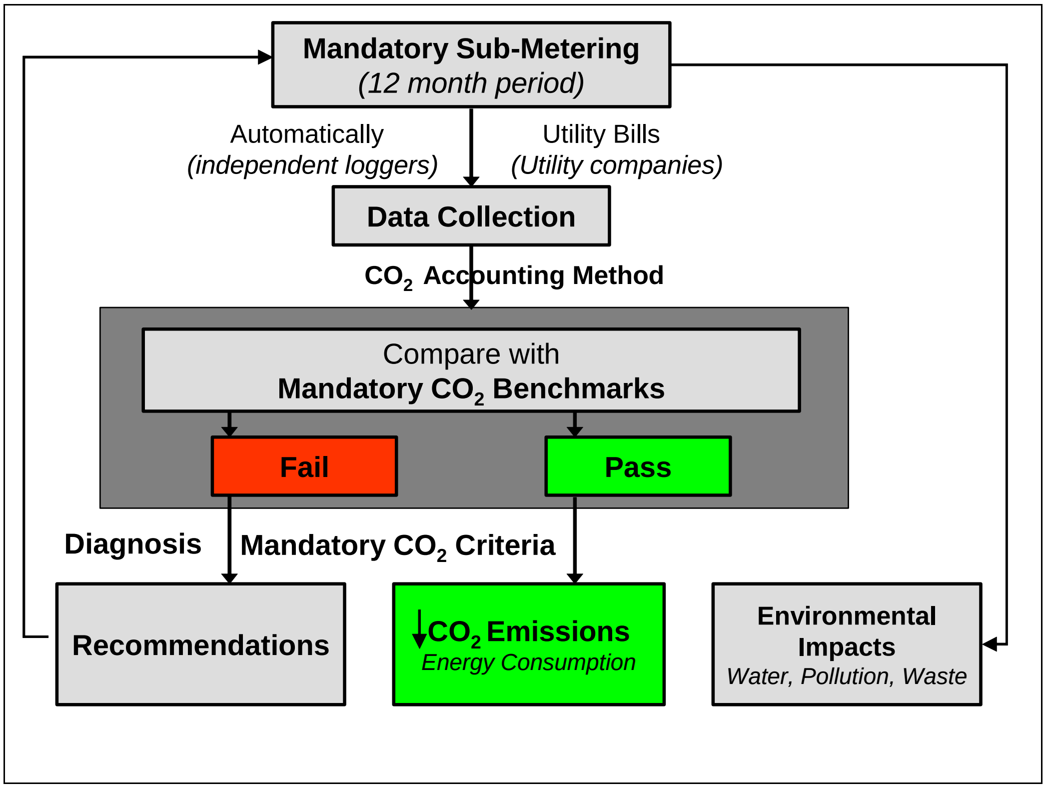


Figure 7.5 A diagram of the recommendations for improvement to certification

The diagram above (Figure 7.5) summarizes the recommendations for improvement to certification including the introduction of mandatory sub-metering, comparison of mandatory CO_2 benchmarks in the new CO_2 criteria to be included in existing methods of certification to make it a more robust and reliable measure of emissions reduction and environmental impact of hotels.

Discussion

Concerning the proposal of individual CO_2 benchmarks for hotels there are several issues that should be discussed. The first issue is that sub-metering would indeed allow individual targets to be set, and not meeting them would be part of the diagnostic process, narrowing down the causes of the overall high emissions.

The second issue is that, even if, for example, the hotel target is met and the spa target is not, should the certification be based on the total emissions, or just the part associated with the accommodation. A scenario could be imagined where a guest, if offered an in-house spa, would stay and enjoy it for the day, whereas if it were not available they might go elsewhere and consume more energy at another spa, and including transport. On the other hand, it could easily be imagined that the presence of a spa is used as a marketing bonus, and would encourage a guest to carry out this energy intensive activity because it is available.

Therefore, in terms of compromise, both should be presented – individual ratings for identifiable extra features - usually indoor snow slopes and spas, but the conventional accommodation package (including kitchens) should be calculated, and used for comparison purposes. This would give an incentive for energy saving in both the conventional and extra features.

The third issue - low carbon electricity is interesting. Should a hotel be allowed to use large amounts of energy just because it's low or zero carbon? It is probably not a good idea since firstly it sets a bad example for management behaviour; secondly it is a waste of green energy which could be used to displace high carbon energy. In other words even if it is green, it should not be wasted!

However there will be exceptions - if a hotel built over a hot spring wanted to have a heated outdoor swimming pool operating all the winter, then clearly it should be able to without penalty.

This argument of what should be taken into account with benchmarks is also addressed by Bordass (2005) who questions that with the drive to cut the worlds' CO_2 emissions, why should an office get a considerably greater allowance because it happens to be air-conditioned? He even adds that this may even result in people wanting to add air-conditioning just to get a better grade! He suggests that perhaps allowances should only be made on the basis of proven need at say Level 3, and then at modest levels to reflect the best systems and the best management only. (Bordass, 2005)

Further Work

Further work is required to create a strong theoretical framework for CO_2 emissions accounting in the hotel sector which would then enable sensible benchmarks to be set and monitored. Any framework needs to be tested and promoted and links have recently been established with a group that has the resources to do this and possible access to their database of over 1000 hotels located throughout Europe.

This research has implications for the sustainable development of the tourism sector however, the work could be usefully applied retrospectively to existing or new build projects using simple techniques which when applied on a large scale would result in significant emissions reduction.

Although this work did not develop the CO_2 certificate in detail, it is proposed that this should be developed as further work. A starting point for this work should build upon work done by The Usable Building Trust (UBT) and Professor Bill Bordass who report that the European Commission's Energy Performance of Building Directive is encouraging visibility by requiring buildings to have energy performance certificates starting in 2006. Bordass (2005) in his paper 'Onto the Radar' explores ways in which statutory requirements and voluntary enhancements might be combined in non-domestic buildings. Grounded in work in the UK – in particular a study for the Sustainability Forum – it attempts to take a broader view and incorporates comments of many people in the UK and Europe[9].

The UBT outline a stepwise approach which would allow people to progress from very easy entry levels (e.g. just reporting their energy use systematically), through simple benchmarking, to more customized assessments. They suggest that such an approach could help statutory systems for energy certification of buildings in use to get going quickly without heavy resourcing and training implications: first encouraging people to get a few facts straight and then to progress to more detailed levels of assessment and improvement, either through their own motivations or under pressure from stakeholders. Bordass (2005) showed how energy reporting and assessment might be approached in a series of Levels as set out in his paper. The development of the CO2 certificate may build upon and incorporate these findings.

The scope of this research did not include a study of the behavioural and lifestyle changes in the context of emissions reduction although the author acknowledges the important contribution to be made by these changes. Further work should include a study of these how these changes may lead to emissions reduction. Research should also be undertaken into the development of lifestyle and behavioural criteria to include into future certification schemes. The potential for the integration of

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[9] Through the EPLabel project (www.eplabel.org) under the Intelligent Energy for Europe research programme. This started in January 2005 and involves nineteen countries in developing a common platform for operational ratings. (Bordass et al., 2004b)

mandatory energy certificates into tourism certification needs to be further researched as this plays a key part in emissions reduction.

In order to establish if certification just makes people them feel good about themselves, then a questionnaire should be developed and sent to the residents and employees living on the island. Useful insights could be gained from conducting Interviews with the home owners and it is therefore suggested questionnaires should be developed and interviews held with hoteliers and guest to address this question.

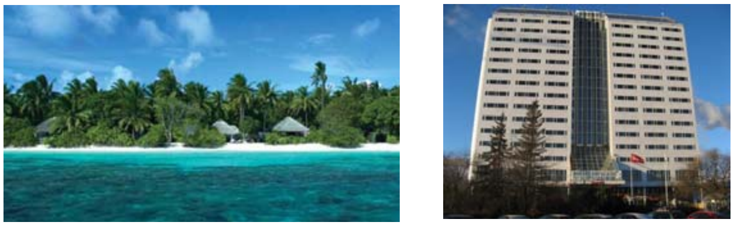
Further work should develop the method in order to provide material for design and operational guidance. This should involve testing the response of the selected Certification Schemes and in order to do that an imaginary hotel should be defined, together with a range of plausible performance data for energy, water, waste etc. The *base case* test hotel data will be chosen to suggest a marginal candidate for successful certification. It would then be used in three ways –

1. The base case hotel is applied to each scheme and the outcome compared
2. The robustness of the certification scheme to varying levels of data will be tested
3. The test hotel will be used to test scenarios of environmental measures that actually lead to significant CO_2 reductions, and other environmental impacts, as calculated by the author's calculation methods. This would provide material for design and operational guidance.

This further work will involve the development of a methodological framework for CO_2 accounting based on in the first instance the data already collected from the 70 hotels. This data could be analyzed using statistical methods to establish a frequency distribution curve (not dissimilar to the Building Use Study) which could serve to create CO_2 performance benchmarks for hotels incorporating a single target (and/or individual benchmarks) that will be continuously reviewed as more data is entered into the database. Five star hotels will have to become accountable for their emissions and will not be justified in emitting more than say a two star hotel just because they offer more facilities. The emphasis of this further work should focus not on benchmarking only but on the rigorous, diagnostic process.

In closing

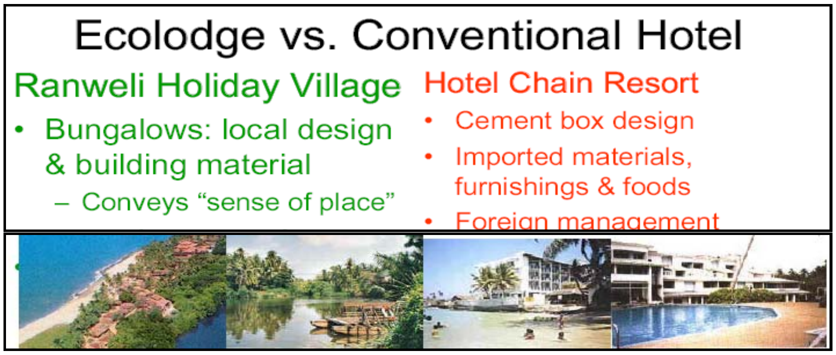
One of the findings of this research challenges our traditional notion of a ‘green’ hotel as shown in the tropics (Study 2 Hotel, Maldives) which actually emits three times as much CO_2 per guest night as an urban chain hotel in Scandinavia (Study 1 Hotel, Sweden). This was a result of the low carbon (district heating - CHP) energy supply for the ‘Conventional’ hotel and a high carbon (diesel generator for electricity) energy supply coupled with a high energy demand (air-conditioning and pool pumps running continuously) and poor energy efficiency (poorly insulated) for the ‘Green’ Hotel.



‘Green’ hotel	v	Conventional Hotel
53 $kgCO_2/gn$		**7** $kgCO_2/gn$
High Carbon Energy Supply High Energy Demand Low Energy Efficiency		Low Carbon Energy Supply High Energy Demand High Energy Efficiency

Figure 7.6 ‘Green’ versus Conventional Hotel. *(Source, Author)*

This finding is at odds with the promotion of the ‘Ecolodge’ as a low impact ‘face’ of sustainable tourism compared to high impact ‘conventional’ hotel as seen below in a presentation by Dr. Martha Honey of The International Ecotourism Society in 2006.



Ecolodge vs. Conventional Hotel

Ranweli Holiday Village
- Bungalows: local design & building material
  - Conveys “sense of place”

Hotel Chain Resort
- Cement box design
- Imported materials, furnishings & foods
- Foreign management

Figure 7.7 Ecolodge versus Conventional Hotel *(Source: Honey,TIES)*

In relation to the proper calculation of energy and CO_2 emission, sub-metering is a key factor, and with current technological developments, realistic and affordable. Furthermore, apart from certification itself, an essential quality with any monitoring system is that the user can obtain results easily and understandably, in order to get feedback from their actions. This could be facilitated by incorporating sub-metering as part of the building environmental management system software. This ensures that the certification activity is not simply a benchmark, but is also part of a diagnostic and educational process, which will continue to drive emissions down. Only then should it be ethically justified to use as a marketing tool providing diagnostic information and advice.

8

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An Analysis Of The Performance Of Certification Schemes In The Hotel Sector In Terms Of CO_2 Emissions Reduction

APPENDICES

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Appendices

Appendix 2A Energy technology supply side: *global and local*

1) Supply Side Global

Carbon Capture and Storage (CCS) power generation

Carbon capture and storage involves the capture of CO_2 from a large-scale stationary power source or industrial emission process, its transportation via pipeline or ship and injection into suitable underground geological layers. Globally, this is likely to be essential technology for use in combination with fossil fuel electricity plants. CCS is therefore almost certain to play an important role in the decarbonisation of electricity and industrial processes. The IEA BLUE Map scenario envisages fossil fuels with CCS producing 26% of global electricity in 2050. But it cannot be a sufficient solution in itself as it has not yet been demonstrated on large production scale and cost estimates are therefore uncertain. (CCC, 2008)

The feasibility of CCS also depends on the availability and capacity of CO_2 storage sites around the world. It is also likely to be of greater importance in countries such as India and China where there is rapid growth in coal-fired power stations. If it requires the construction of pipelines, it may be subject to local opposition and planning delays similar to those that hold up nuclear and wind deployment. And if many countries simultaneously attempted to deploy CCS on a large scale, it would be highly likely to be subject to the similar supply bottlenecks and cost increases to those that have recently been observed in nuclear, wind and solar PV. (CCC, 2008)

Unlike nuclear and renewable technologies, which under optimistic assumptions might in future deliver electricity more cheaply than fossil fuels, adding CCS to fossil fuel plants must add cost. But reasonable estimates suggest a modest cost penalty. The IEA presents estimates that CCS could add 2-4¢/kWh to new gas and coal-fired generation costs[1]. Estimates for the UK suggest costs of around 2-3p/kWh. (CCC, 2008)

Conventional fossil fuels

If the efficiency (amount of electricity generated per unit of energy contained in the fuel) of fossil fuel-fired generation can be improved, then even coal or gas-powered stations could help reduce emissions. Average efficiency of a coal-powered station between the years 1992-2005 was 35%, whilst best available plants today can achieve efficiency of

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[1] IEA (2008), Op. cit., p270. (CCC, 2008)

47% and super critical plants of the future might achieve 55%. For gas-fired power plants, maximum future efficiency is likely to be around 60%[2]. Best practice carbon efficiency could therefore come down to around 700 g/kWh for hard coal, and 350 g/kWh for gas[3]. Switching from coal to gas can also achieve a significant one off reduction in emissions. Improving the fuel efficiency of conventional fossil fuel plants will therefore be an important element in a global abatement strategy. But there are immovable limits to what can be achieved through these improvements: without CCS, fossil fuel generation cannot achieve the radical improvements in carbon efficiency which will be needed. (CCC, 2008)

Nuclear

Nuclear power is a long established and proven low carbon technology, with further improvements in efficiency and safety likely to be achieved by a new generation of reactors; nuclear could supply 23% of global electricity in 2050 under the IEA BLUE Map scenario. Nuclear power is likely to be one of the most cost-effective ways of decarbonising electricity supplies, at a cost comparable to fossil fuels. This form of energy is not without controversy; concerns include long-term waste disposal and weapons proliferation. But the economics of nuclear power are clearly favourable. (CCC, 2008)

- Cost estimates from a wide variety of sources suggest that it is highly likely to be cost competitive with fossil fuels once a significant carbon price is in place, and may be competitive even without a carbon price if fossil fuel prices are at the levels seen in mid-2008. Typical cost estimates for nuclear have increased over the last four years from about 3 to 5 cents per kWh to 6 to 8 cents per kWh, but costs of fossil fuel generation and wind power have also increased significantly in that period, keeping the relative position unchanged.
- Supplies of fuel do not place serious constraints on the feasible growth of nuclear power, given proven and likely uranium supplies, alternative potential fuel sources, and in the longer term the potential for fast breeder fuel recycling.
- Given the constraints, on nuclear’s contribution to decarbonisation, even the IEA's high nuclear BLUE scenario does not envisage nuclear contributing more

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[2] IEA (2008), Op. cit., p256/7. (CCC, 2008)
[3] IEA (2008), Op. cit.,p257. (CCC, 2008)

than 35% of global electricity by 2050[4], and many estimates suggest considerably less.

Whether nuclear power should be deployed to the maximum extent possible is of course a contentious issue: opposition in principle is based on concerns about weapons proliferation (civil to military leakage) and the environmental consequences from the long-term disposal of high-level waste. However, if nuclear power is acceptable in principle, it is likely to be a cost effective low-carbon technology playing a significant role in decarbonisation. It is not in itself a sufficient solution. (CCC, 2008)

Biomass

Biomass consists of organic material grown, collected or harvested for energy use. It can play a role in reducing CO2 emissions in three applications: a) as a fuel source in power generation, either on its own or co-firing; b) as a fuel source for heat, either alone or in combined heat and power (CHP) applications; or c) as a feedstock to produce liquid bio fuels or hydrogen for transport. (CCC 2008)

Presently, total biomass use is uncertain but it probably accounts for around 10% of energy consumption[5]. Most is consumed in developing countries as traditional, non-commercial, biomass for domestic cooking and heating. However it currently provides about 1% of power generation globally and by 2050, with a supportive policy environment this could increase significantly. However concerns over its impact on wider sustainability and food supply objectives could limit its use. It is therefore essential that biomass is used as efficiently as possible; this probably implies its use in direct heat production (where transformation losses are small) or in applications (e.g. aviation fuel) where no alternative low-carbon fuels are available. (CCC, 2008)

The costs of using biomass in power generation are uncertain, as there is wide variation in the cost and performance of plants. The IEA estimate current costs at 6-18 cents/kWh and suggest that costs could fall to 5-12 cents/kWh by 2050[6]. (CCC, 2008)

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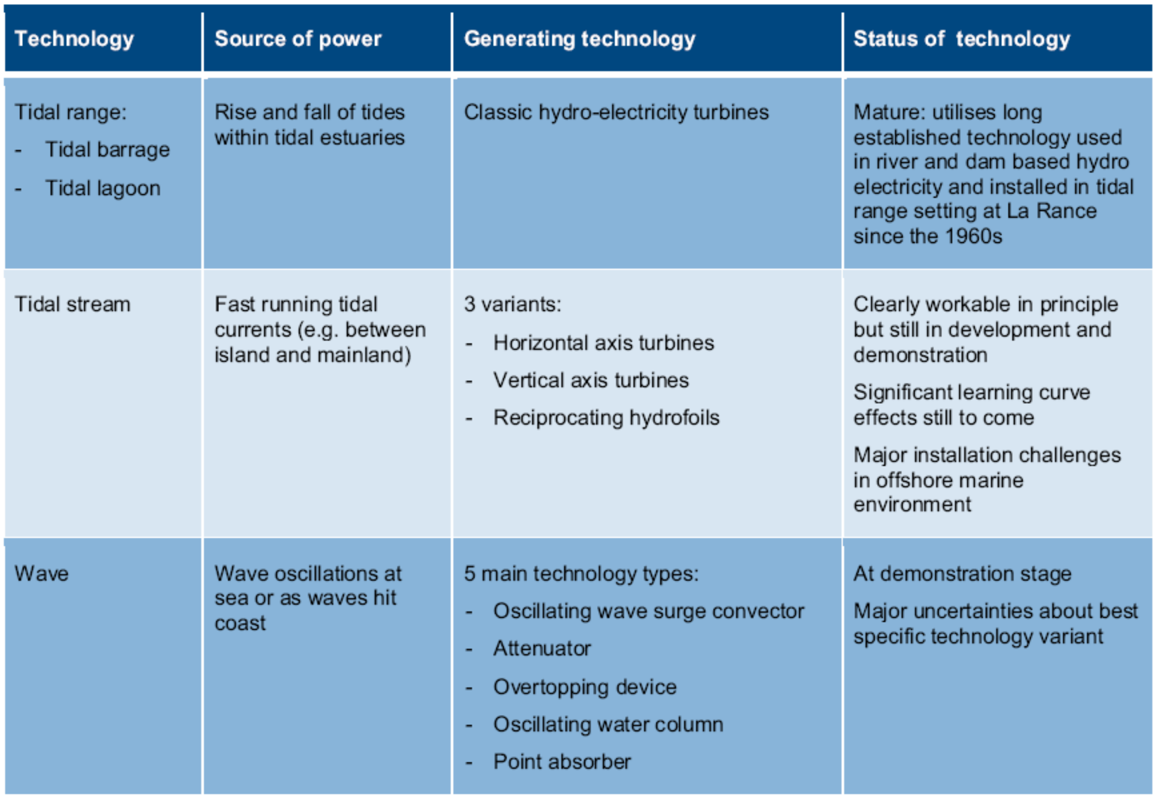
[4] IEA (2008), Op. cit., p85. (CCC, 2008)
[5] IEA (2008), Op. cit., p308. (CCC, 2008)
[6] IEA (2008), Op. cit., p311. (CCC, 2008)

2^{nd} generation bio fuels

The current debate over bio fuels produced from food crops has pinned a lot of hope on "2nd-generation bio fuels" produced from crop and forest residues and from non-food energy crops. (CCC, 2008)

Marine Renewables

Across the world, the potential wave power resource is far greater than tidal range or tidal stream resource, with the latter highly dependent on specific geography. The IEA BLUE Map scenario envisages only a small role for wave and tidal power combined by 2050, providing only around 1% of global electricity generation. If other technologies were more expensive than envisaged, a far larger role for wave and tidal would be possible, but on present estimates alternative low-carbon technologies (wind, solar, nuclear and CCS) are likely to play much larger roles. In the UK, however, wave and tidal may play a far more important role. For example, the Severn Barrage might provide up to around 5% of total UK power generation at a cost of 11p/kWh. (CCC, 2008) Three different categories of marine power are distinguished as seen in Table A1. (CCC, 2008)



Technology	Source of power	Generating technology	Status of technology
Tidal range: - Tidal barrage - Tidal lagoon	Rise and fall of tides within tidal estuaries	Classic hydro-electricity turbines	Mature: utilises long established technology used in river and dam based hydro electricity and installed in tidal range setting at La Rance since the 1960s
Tidal stream	Fast running tidal currents (e.g. between island and mainland)	3 variants: - Horizontal axis turbines - Vertical axis turbines - Reciprocating hydrofoils	Clearly workable in principle but still in development and demonstration Significant learning curve effects still to come Major installation challenges in offshore marine environment
Wave	Wave oscillations at sea or as waves hit coast	5 main technology types: - Oscillating wave surge convector - Attenuator - Overtopping device - Oscillating water column - Point absorber	At demonstration stage Major uncertainties about best specific technology variant

Table A1 Tidal and wave power: technology status *(IEA (2008)*

- **Tidal range power** which exploits the rise and fall of the tide in estuaries. This energy can be harnessed using either a tidal barrage (a dam across the estuary) or tidal lagoons (barriers which enclose a particular area within the estuary). In either case, the electricity generating process uses the mature technology of water driven turbines, as used for over a century in the hydro-electricity industry and therefore there are no associated technological uncertainties. Instead, the crucial issues relate to the costs of construction after taking account of measures to offset local environmental impacts, and the appropriate discount rate to use for extremely long-lived projects (>100 years). (CCC, 2008)
- **Tidal stream power** which derives kinetic energy from fast-flowing tidal currents. The electricity generating process here can either utilize turbines similar in form to those used in classic hydro projects or tidal barrages (i.e. circular turbines mounted horizontally), or a variety of alternative structures (e.g. reciprocating hydrofoil). Uncertainties over the best generating system design, together with the challenges of installation, maintenance and transmission connection in difficult offshore marine environments, place tidal stream at an earlier stage of technology development than tidal barrage. The Carbon Trust estimated that early tidal stream plants might generate electricity at about 9-18p/kWh. The IEA suggests that costs of 4.5–8 US¢/kWh might be possible by 2050[7]. (CCC, 2008)
- **Wave power,** which captures energy from wave movement, either out at sea or as waves hit the coast. There are a wide range of possible generating devices which are quite different from those familiar from classic hydro generation as seen for example in Figure A1. Significant development work is still required to identify the most effective variants with cost estimates necessarily uncertain. Estimates for 2020 suggest possible costs of 11.5p/kWh (i.e. significantly above tidal barrage costs even if a full commercial discount rate is used), but IEA estimates suggest as low as 4.5–9 US¢/kWh will be possible as early as 2030. (CCC, 2008)

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[7] IEA (2008), Op. cit., p400. (CCC, 2008)

Figure A1. Example of wave power device; Pelamis, Ocean Power Delivery (OPD) *(BWEA, 2009)*

Large Scale Wind power

Wind power is considered to be one of the most feasible and cost-effective renewable options in electricity generation and can be supplied to hotels through the purchase of 'green' electricity or on a smaller scale as medium or micro turbines on site.

Figure A2 Example of large scale wind turbines *(Windpower, 2008)*

The UK has the largest wind resource of any country in Europe, making it the ideal choice for a renewable source of energy. Across the world, the IEA anticipates in its BLUE Map scenario that wind could deliver 12% of all the electricity by 2050[8], but in the UK the percentage could be over 20% of current UK electricity demand. (CCC, 2008) Wind turbines convert the power in the wind into electrical energy using a generator that is powered by the rotating blades. They can either be grid connected or in the case of small or micro scale turbines, can be used to charge batteries for on-site use. Wind velocities are the key factor in the location of wind turbines as a result of the cube

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[8] IEA (2008), Op. cit., p85. (CCC, 2008)

relationship between the wind velocity and the energy generated. Favourable locations for wind turbines can harness the wind from sea breezes or mountain valley winds. (BWEA, 2009)

There are two types of turbine; horizontal axis wind turbine (HAWT) as seen in Figure A2 and vertical axis wind turbine (VAWT) All grid-connected commercial wind turbines today are built with a propeller-type rotor on a horizontal axis (HAWT) in which the tracking of the wind direction is necessary. Turbines have a cut in and shut down wind speed in between which the turbine is able to generate power. These usually range from 3m/s cut in to 25m/s shut down with optimum output around 15m/s. Wind turbines capacities can range from small domestic turbines producing hundreds of watts to large 70m offshore turbines with capacities of 3MW. A typical life span of turbines is between 20 -25 yrs. (BWEA, 2009)

2) Supply Side: Local

Wind (Medium & micro scale)

It is currently projected that the cost of small scale wind will be competitive with fossil fuels by as early as 2010. (QuietRevolution, 2009) Small wind turbines are suitable for decentralized applications mainly in rural and remote areas and for building (houses, hotels, etc). They can be of horizontal or vertical rotor axis, must be of low cut-in wind speed and flexible in installation and operation, considering their limits in height, weight, range of effective wind speed and aesthetic integration. (QuietRevolution, 2009)

Vertical axis Wind Turbine (VAWT) are practical, as they use a fixed rotation axis with their motor–generator at low position as seen in Figure A3, but they are still of higher cost compared to Horizontal axis Wind Turbine HAWT. (QuietRevolution, 2009) The helical (twisted) design of VAWT ensures a robust performance even in turbulent winds. It is also responsible for virtually eliminating noise and vibration. At five metres high and three metres in diameter, it is compact and easy to integrate, and with just one moving part, maintenance can be limited to an annual inspection. (QuietRevolution, 2009)

Figure A3 Photomontage of proposed *quietrevolution* small wind turbines in guest and staff areas of Study 2 Hotel, Maldives. *(quietrevolution, 2007)*

The Energy Systems Research Unit (ESRU) at Strathclyde University present some sample calculations for some typical turbine sizing, cost and outputs for hotel exemplars as seen in Table A2 below.

1500 Watt wind turbine/generator £3,655 **Diameter 3.5m** **Output** 769kWh/m2 Total 7400kWh- **£0.49 per kWh per year**	600 Watt wind turbine/generator £1,845 **Diameter 2.55m** **Output** 450kWh/m2 Total 2300kWh – **£0.80 per kWh per year**	6000 Watt wind turbine/generator £7,765 **Diameter 5.5m** **Output** 816kWh/m2 Total 19400kWh- **£0.40 per kWh per year**	15000 Watt wind turbine/generator £14,900 **Diameter 9m** Output 762kWh/m2 Total 48500kWh- **£0.31 per kWh per year**

Table A2 Some examples of small wind turbine hotel exemplars *(ESRU, 2009)*

Solar power

In the long run, solar power technologies enjoy enormous inherent advantages, and it is possible that by the late 21st century solar power will play a very major role in a low-carbon economy at a minimal cost penalty. According to CCC however, its role in the UK emissions reduction programme, however, is likely to be more limited, at least for several decades and perhaps permanently. (CCC, 2008)

Solar energy can be converted to electrical energy via two different categories of technology: solar photovoltaics (PV) as seen in Figure A4, which directly convert solar energy to electrical energy; and Concentrated Solar Power (CSP), which uses direct sunlight to generate heat that is used to operate a conventional power cycle (e.g. a steam turbine). In addition solar thermal energy can be captured directly to heat water or air.

Figure A4 Example of roof mounted Solar Photovoltaic system *(Segen, 2009)*

Almost any building with a flat or sloping roof is likely to be capable of having a solar PV system. Systems can be supplied to almost any size and shape making it an ideal solution where a small wind turbine may not be practical. Systems can be supplied to be retrofitted to existing buildings, or can be incorporated in the design stages of a new build or renovation project. (Segen, 2009)

- A solar photovoltaic system can be mounted onto almost any type of commercial building to help reduce the carbon footprint and deliver on-site renewable generation targets.
- A south facing roof can have panels mounted onto the roof to maximise the energy capture, panels can be mounted onto a flat roof using low weight mounting structures that enable the panels to be angled and orientated in the most optimal direction or used as building cladding where appropriate
- In a new build application the roof material itself can comprise of solar tiles offering the best possible appearance.
- A typical 10kWp commercial system will generate 8,000kWh per year saving nearly 5 tonnes of CO_2.
- Prices vary by the type of the installation, but will typically be £5,000 - £5,500 per kWh.

- An SME may be eligible for an interest free loan from the Carbon Trust to help fund the system.

Solar energy reaching the earth each day is around 10,000 times current total human energy consumption: as a result, the land area requirement for solar energy to meet a large proportion (and in the long run perhaps all) human energy needs, even at already feasible energy yields, is relatively small. Solar photovoltaic cells and Concentrated Solar Power (CSP) could meet all 2050 global electricity needs with a land use of less than 0.4% global land surface area. This compares very favourably with for instance bio fuels. In its solar PV form, moreover, the technology can use roof space in urban areas. It is deployable on a small as well as a large scale. When locally deployed, it cuts out transmission and distribution requirements and cost; and it is totally clean and noiseless. For these reasons solar technology deployment is uncontroversial, raising none of the environmental concerns which create opposition to wind or nuclear deployment. And the challenges of intermittency and imperfect predictability, while present, are significantly less important than for wind. (CCC, 2008)

Solar PV today is far from being cost competitive. Estimates vary widely, but all estimates are several times the cost of producing electricity from fossil fuels, nuclear, or wind. Over the last three years, moreover, costs have increased significantly as a result of severe bottlenecks in manufacturing and in silicon purification. But unlike wind and nuclear there are strong reasons for believing that radical cost reductions will be achieved, either via the improvement of the existing crystalline silicon technology, or via next generation technologies, such as thin film.

Concentrated solar power (CSP) as shown in Figure A5 is lower cost than PV and could be cost-effective in sunny countries at lower latitudes, e.g. North Africa and southern Spain. Given these characteristics and cost potential, it is possible that in the very long term solar power will be the most important of all the new technologies but it will take several decades to achieve the required cost reductions. CSP is unlikely to be a feasible option except in the lower latitudes but it may however be possible for solar thermal-based electricity to be generated in these lower latitudes and then to be transmitted to Europe via high voltage DC lines. While solar PV does produce electricity even on cloudy days at middle latitudes, yields in the UK are likely to be less than half of that achieved in southern Spain resulting in a two times increase in cost per kWh. (CCC, 2008)

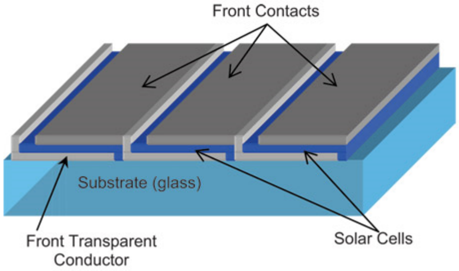

Figure A5 Integrally interconnected thin-film module (*SolarThinFilms Inc. 2007)*

Globally, at today's costs neither solar PV nor CSP are competitive without large subsidy but there is potential for dramatic cost reduction in both. Estimates of solar PV costs in the UK do not therefore suggest that it will become close to cost competitive, at least for many decades. (CCC, 2008)

Building Integrated Photovoltaics – BIPV

The acronym (Building Integrated Photovoltaics) refers to systems and concepts in which photovoltaics, as well as having the function of producing electricity, also takes on the role of building element as seen in Figure A6. By building element we mean the parts of the envelope of buildings (roof cover, wall facing, glazed surfaces), solar protection devices (sun shadings), additional architectural elements (canopies, balcony parapets, etc.) and any other architectural element necessary for the good functioning of a building (visual and acoustic shielding). In order to take advantage of obtained energy from the Photovoltaics modules attention needs to be paid to correct orientation, shading and the ventilation. (BIPV, 2008)

Figure A6 Example of BIPV at the Academy Mont-Cenis Gebäudemanagement Herne. *(BIPV, 2008)*

Appendix 2B WhichGreen league table 2008 and *WhichGreen* five year average league table 2008 *(Whichgreen, 2009)*

The figures shown in Table A3 below are for 2008.

Supplier	**£/Customer**
Ecotricity	£401.49
Scottish Power	£102.66
Centrica	£38.00
Scottish & Southern	£16.31
EDF Energy	£10.69
npower	£4.38
E.On	£0
Green Energy UK	£0
Good Energy	£0

Table A3 *WhichGreen* League Table 2008 *(Whichgreen, 2009a)*

Of the small independents, Good Energy and Green Energy spent nothing whilst Ecotricity spent over £400 per customer in the same year. The average money spent by each of the electricity companies (excluding Ecotricity) was £26.51 per customer which is an increase from the average spend of just £7.47 in 2007. Based on these investment figures the UK will fail to meet even half of the EU's 2020 renewable energy target.

The figures seen in Table A4 show that apart from Ecotricity (at the top end) and the small independents (at the bottom end) that none of the suppliers spend more than on average £10 from each typical annual electricity bill of £1000 they issue to their domestic customers. These results define the range in actual investment of each supplier to green electricity.[9]

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[9] The figures are calculated by taking the total number of customers each supplier has in any year and divide into that their total spending on building new sources of green electricity, in the same year. That gives spending in 'pounds per customer'. Customer numbers for each supplier are sourced from the suppliers own publications. Their expenditure on building new renewables comes either from them or (if they are unwilling to provide) from figures published by OFGEM (the industry regulator). OFGEM figures show the ownership, start date, and size of all new renewable generators in the UK, each year. We take the size figures and multiply them by the average cost to build - for that form of renewable generation − and that gives the total spent by each company (Sources are Ofgem; BWEA; Enviros 2005).

Supplier	**£/Customer**
Ecotricity	£450.14
Scottish Power	£27.65
Centrica	£13.28
Scottish & Southern	£9.61
npower	£6.75
E.On	£5.37
EDF Energy	£4.14
Green Energy UK	£0
Good Energy	£0

Table A4 *WhichGreen* Five Year Average League Table 2008 *(Whichgreen, 2009b)*

However, the question remains, how ‘green’ are the UK’s ’green’ electricity suppliers who are claiming green credentials? As previously discussed in the earlier part of chapter 2, the only green electricity that does anything to reduce CO_2 emissions and our dependence on fossil fuels is electricity that is ‘additional’ to that already required by the government. If the supplier is not producing ‘additional’ green electricity it is not actually achieving anything ‘green’ at all. However, information on whether or not this ‘additionality’ criteria has been achieved is not available on the supplier’s respective website which makes it impossible to ascertain if the ‘green’ electricity offered is additional or not.

Appendix 2C League table for 14 UK green electricity suppliers (ranking by CO_2 emissions) for the period April 2007 - March 2008. *(Fuel Mix, 2009)*

Information on the fuel mix and resulting CO_2 emissions ($kgCO_2$/kWh) of selected 'green' electricity suppliers is shown in Table A5 below. It should be noted that declaration of fuel mix provides evidence of supply only and unless requirements of the *'additonality'* and *'volume tests'* are met, then this alone cannot be relied upon as evidence of 'green' electricity. The table shows the range in 'green' electricity emissions between suppliers.

Supplier	**Renewable**	**Nuclear**	**Gas**	**Coal**	**Other**	**CO2 emissions**
	(%)	**(%)**	**(%)**	**(%)**	**(%)**	**(kgCO2 per kWh)**
Green Energy (UK) plc	100	0	0	0	0	0
Good Energy	100	0	0	0	0	0
Ecotricity	37.4	18	24.1	18.3	2.2	0.2667
British Gas	6.2	13.2	65.6	13.4	1.6	0.36818
Atlantic Electric & Gas	8.9	5.5	59.1	25	1.5	0.45
Southern Electric	8.9	5.5	59.1	25	1.5	0.489
Equigas						0.489
Scottish Hydro Electric	8.9	5.5	59.1	25	1.5	0.489
SWALEC	8.9	5.5	59.1	25	1.5	0.489
Telecom Plus	3	11	46	38	2	0.519
npower	3	11	46	38	2	0.543
EDF Energy	6	12	31	49	2	0.569
E.ON	11.2	24.8	35.7	25.2	3.1	0.614
ScottishPower	7.6	0	41.9	50.2	0.3	0.63
U.K Average	**5.5**	**16.1**	**43.5**	**33**	**1.9**	**0.48**

Table A5 League Table for 14 UK Green Electricity Suppliers (Ranking by CO_2 Emissions) for the period April 2007 - March 2008. *(Fuel Mix, 2009)*

Appendix 2D Range in CO_2 emissions per guest night for delivered electricity for 14 different energy suppliers in the UK. *(Fuelmix, 2009)*

In order to demonstrate the difference in resulting emissions, a scenario is presented whereby a consumer switches to 'green' electricity using the CO_2 conversion factors for the 14 different 'green' electricity suppliers shown in Table A5.

The 'customer' in this scenario is a large, purpose built 4 star chain hotel located in Central London. The 630 bedroom hotel includes facilities such as 2 bars, 2 restaurants with approximately 200 combined covers, a fitness centre and a conference centre (5,000 m2) catering for up to 2000 people. The hotel was built in 1975 and has seen several refurbishments – the most recent of which was completed in 2001 with all public areas being refurbished from the basement to 2nd floor. The energy consumption data and total number for guest nights for the 2007 is shown below.

	Delivered Energy Supply (2007)
Gas	7,015,293 kWh (1,332,902 $kgCO_2$[10])
Delivered Electricity	7,608,120 kWh (See Figure 4.x)
Guest Nights	246,661

Table A6 Energy Consumption data and total number of guest nights for test hotel, London. *(Source: Author).*

The calculated CO_2 emissions for delivered electricity for the test hotel are shown in Figure A7. below.

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[10] Published Conversion factor: 0.19 kgCO2/kWh gas (Carbon Trust, 2008).

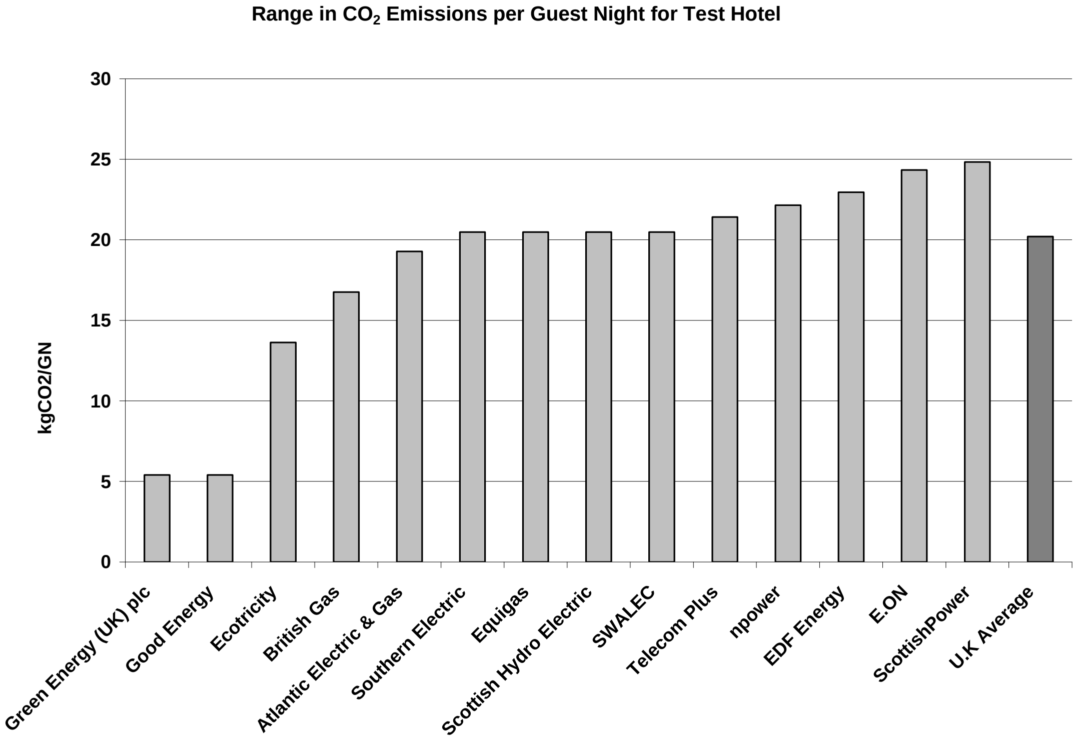
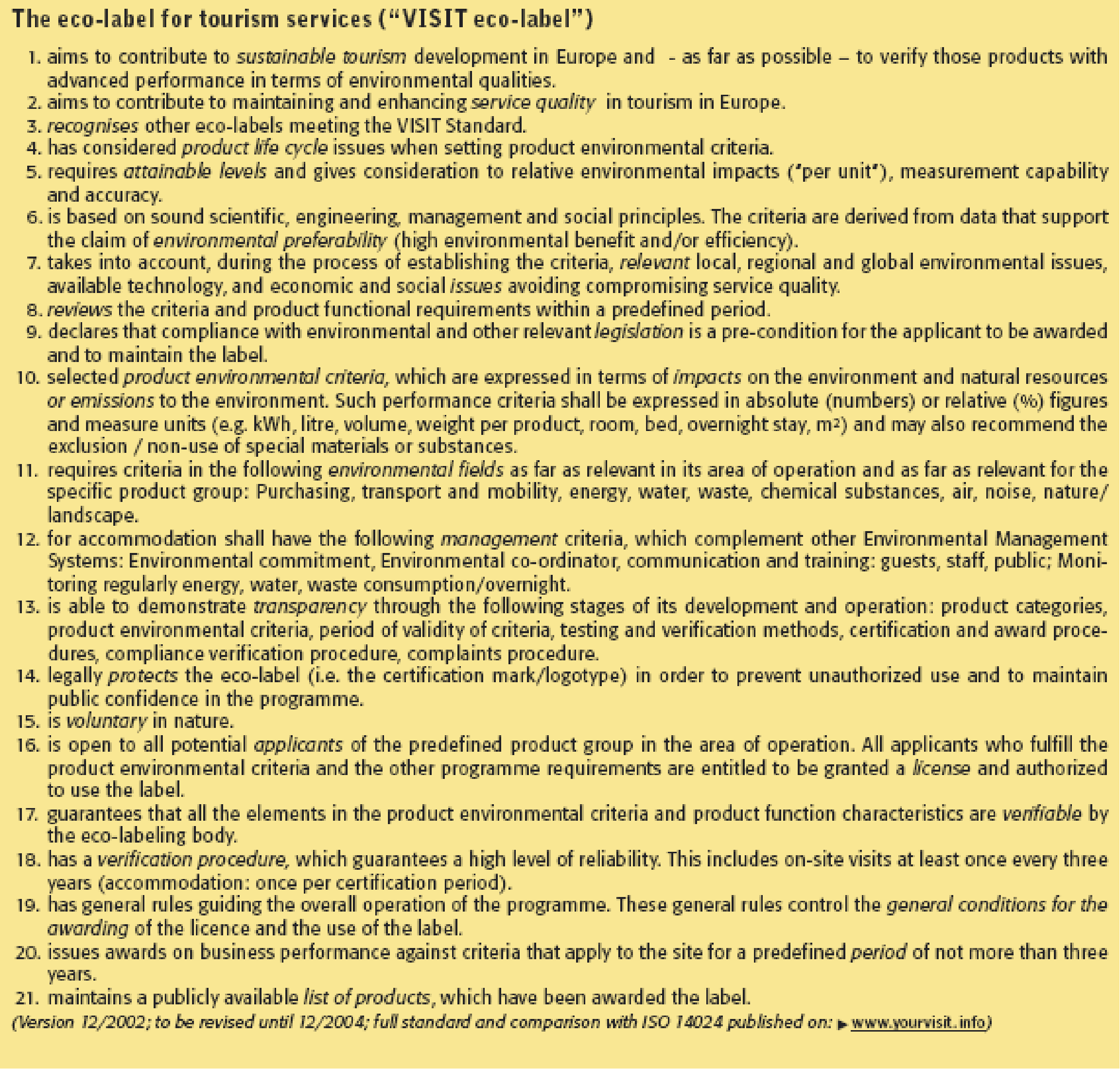


Figure A7 Range in CO_2 emissions per guest night for delivered electricity for 14 different energy suppliers in the UK. *(Fuelmix, 2009)*

There is a five fold difference in resulting emissions depending on which ‘green’ energy supplier the test hotel subscribes with which demonstrates the sensitivity of calculated CO_2 emissions to choice of ‘green’ electricity supplier.

Appendix 2E VISIT Eco label criteria *(VISIT, 2006)*



The eco-label for tourism services ("VISIT eco-label")

1. aims to contribute to *sustainable tourism* development in Europe and - as far as possible – to verify those products with advanced performance in terms of environmental qualities.
2. aims to contribute to maintaining and enhancing *service quality* in tourism in Europe.
3. *recognises* other eco-labels meeting the VISIT Standard.
4. has considered *product life cycle* issues when setting product environmental criteria.
5. requires *attainable levels* and gives consideration to relative environmental impacts ("per unit"), measurement capability and accuracy.
6. is based on sound scientific, engineering, management and social principles. The criteria are derived from data that support the claim of *environmental preferability* (high environmental benefit and/or efficiency).
7. takes into account, during the process of establishing the criteria, *relevant* local, regional and global environmental issues, available technology, and economic and social *issues* avoiding compromising service quality.
8. *reviews* the criteria and product functional requirements within a predefined period.
9. declares that compliance with environmental and other relevant *legislation* is a pre-condition for the applicant to be awarded and to maintain the label.
10. selected *product environmental criteria*, which are expressed in terms of *impacts* on the environment and natural resources *or emissions* to the environment. Such performance criteria shall be expressed in absolute (numbers) or relative (%) figures and measure units (e.g. kWh, litre, volume, weight per product, room, bed, overnight stay, m^2) and may also recommend the exclusion / non-use of special materials or substances.
11. requires criteria in the following *environmental fields* as far as relevant in its area of operation and as far as relevant for the specific product group: Purchasing, transport and mobility, energy, water, waste, chemical substances, air, noise, nature/ landscape.
12. for accommodation shall have the following *management* criteria, which complement other Environmental Management Systems: Environmental commitment, Environmental co-ordinator, communication and training: guests, staff, public; Monitoring regularly energy, water, waste consumption/overnight.
13. is able to demonstrate *transparency* through the following stages of its development and operation: product categories, product environmental criteria, period of validity of criteria, testing and verification methods, certification and award procedures, compliance verification procedure, complaints procedure.
14. legally *protects* the eco-label (i.e. the certification mark/logotype) in order to prevent unauthorized use and to maintain public confidence in the programme.
15. is *voluntary* in nature.
16. is open to all potential *applicants* of the predefined product group in the area of operation. All applicants who fulfill the product environmental criteria and the other programme requirements are entitled to be granted a *license* and authorized to use the label.
17. guarantees that all the elements in the product environmental criteria and product function characteristics are *verifiable* by the eco-labeling body.
18. has a *verification procedure*, which guarantees a high level of reliability. This includes on-site visits at least once every three years (accommodation: once per certification period).
19. has general rules guiding the overall operation of the programme. These general rules control the *general conditions for the awarding* of the licence and the use of the label.
20. issues awards on business performance against criteria that apply to the site for a predefined *period* of not more than three years.
21. maintains a publicly available *list of products*, which have been awarded the label.

(Version 12/2002; to be revised until 12/2004; full standard and comparison with ISO 14024 published on: ▶ www.yourvisit.info*)*

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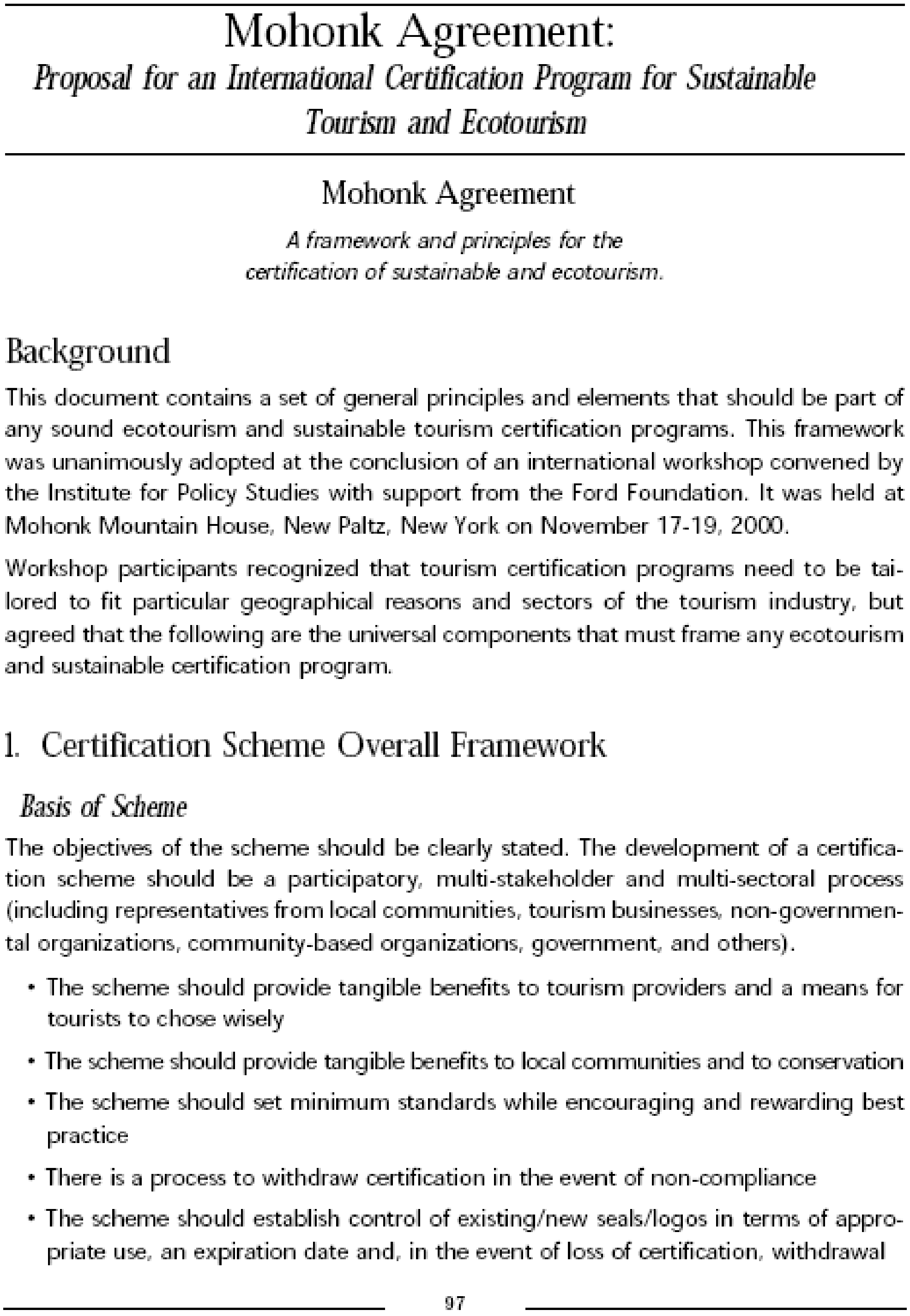
Appendices

Appendix 3A The Mohonk Agreement *(Mohonk Agreement, 2000)*



Mohonk Agreement:

Proposal for an International Certification Program for Sustainable Tourism and Ecotourism

Mohonk Agreement

A framework and principles for the
certification of sustainable and ecotourism.

Background

This document contains a set of general principles and elements that should be part of any sound ecotourism and sustainable tourism certification programs. This framework was unanimously adopted at the conclusion of an international workshop convened by the Institute for Policy Studies with support from the Ford Foundation. It was held at Mohonk Mountain House, New Paltz, New York on November 17-19, 2000.

Workshop participants recognized that tourism certification programs need to be tailored to fit particular geographical reasons and sectors of the tourism industry, but agreed that the following are the universal components that must frame any ecotourism and sustainable certification program.

1. Certification Scheme Overall Framework

Basis of Scheme

The objectives of the scheme should be clearly stated. The development of a certification scheme should be a participatory, multi-stakeholder and multi-sectoral process (including representatives from local communities, tourism businesses, non-governmental organizations, community-based organizations, government, and others).

- The scheme should provide tangible benefits to tourism providers and a means for tourists to chose wisely
- The scheme should provide tangible benefits to local communities and to conservation
- The scheme should set minimum standards while encouraging and rewarding best practice
- There is a process to withdraw certification in the event of non-compliance
- The scheme should establish control of existing/new seals/logos in terms of appropriate use, an expiration date and, in the event of loss of certification, withdrawal

- The scheme should include provisions for technical assistance
- The scheme should be designed such that there is motivation for continual improvement—both of the scheme and of the products/companies to be certified

Criteria Framework

- Criteria should provide the mechanism(s) to meet the stated objective(s)
- Criteria used should meet and preferably exceed regulatory compliance
- Criteria should embody global best practice environmental, social and economic management
- Criteria should be adapted to recognizing local/regional ecological, social and economic conditions and local sustainable development efforts
- Criteria should be subject to a periodic review
- Criteria should be principally performance-based and include environmental, social and economic management process elements

Scheme Integrity

- The certification program should be transparent and involve an appeals process
- The certification body should be independent of the parties being certified and of technical assistance and assessment bodies (i.e., administrative structures for technical assistance, assessment and auditing should avoid conflicts of interest)
- The scheme should require audits by suitably trained auditors
- The scheme should require mechanisms for consumer and local community feedback

2. Sustainable Tourism Criteria

Sustainable tourism is tourism that seeks to minimize ecological and socio-cultural impacts while providing economic benefits to local communities and host countries. In any certification scheme, the criteria used to define sustainable tourism should address at least minimum standards in the following aspects (as appropriate):

Overall

- Environmental planning and impact assessment has been undertaken and has considered social, cultural, ecological and economic impacts (including cumulative impacts and mitigation strategies)
- Environmental management commitment by tourism business

- Staff training, education, responsibility, knowledge and awareness in environmental, social and cultural management
- Mechanisms for monitoring and reporting environmental performance
- Accurate, responsible marketing leading to realistic expectations
- Consumer feedback

Social/Cultural

- Impacts upon social structures, culture and economy (on both local and national levels)
- Appropriateness of land acquisition/access processes and land tenure
- Measures to protect the integrity of local community's social structure
- Mechanisms to ensure rights and aspirations of local and/or indigenous people are recognized

Ecological

- Appropriateness of location and sense of place
- Biodiversity conservation and integrity of ecosystem processes
- Site disturbance, landscaping and rehabilitation
- Drainage, soils and stormwater management
- Sustainability of energy supply and minimization of use
- Sustainability of water supply and minimization of use
- Sustainability of wastewater treatment and disposal
- Noise and air quality (including greenhouse emissions)
- Waste minimization and sustainability of disposal
- Visual impacts and light
- Sustainability of materials and supplies (recyclable and recycled materials, locally produced, certified timber products, etc.)
- Minimal environmental impacts of activities

Economic

- Requirements for ethical business practice
- Mechanisms to ensure labor arrangements and industrial relations procedures are not exploitative, and conform to local laws and international labor standards (whichever are higher)
- Mechanisms to ensure negative economic impacts on local communities are minimized and preferably there are substantial economic benefits to local communities

- Requirements to ensure contributions to the development/maintenance of local community infrastructure

3. Ecotourism Criteria

Ecotourism is sustainable tourism with a natural area focus, which benefits the environment and communities visited, and fosters environmental and cultural understanding, appreciation, and awareness. In any ecotourism certification scheme, the criteria should address standards (preferably mostly best practice) for sustainable tourism (as per above) and at least minimum standards for:

- Focus on personal experiences of nature to lead to greater understanding and appreciation
- Interpretation and environmental awareness of nature, local society, and culture
- Positive and active contributions to conservation of natural areas or biodiversity
- Economic, social, and cultural benefits for local communities
- Fostering of community involvement, where appropriate
- Locally appropriate scale and design for lodging, tours and attractions
- Minimal impact on and presentation of local (indigenous) culture

Appendix 3B Sustainable Tourism Stewardship Council (STSC)

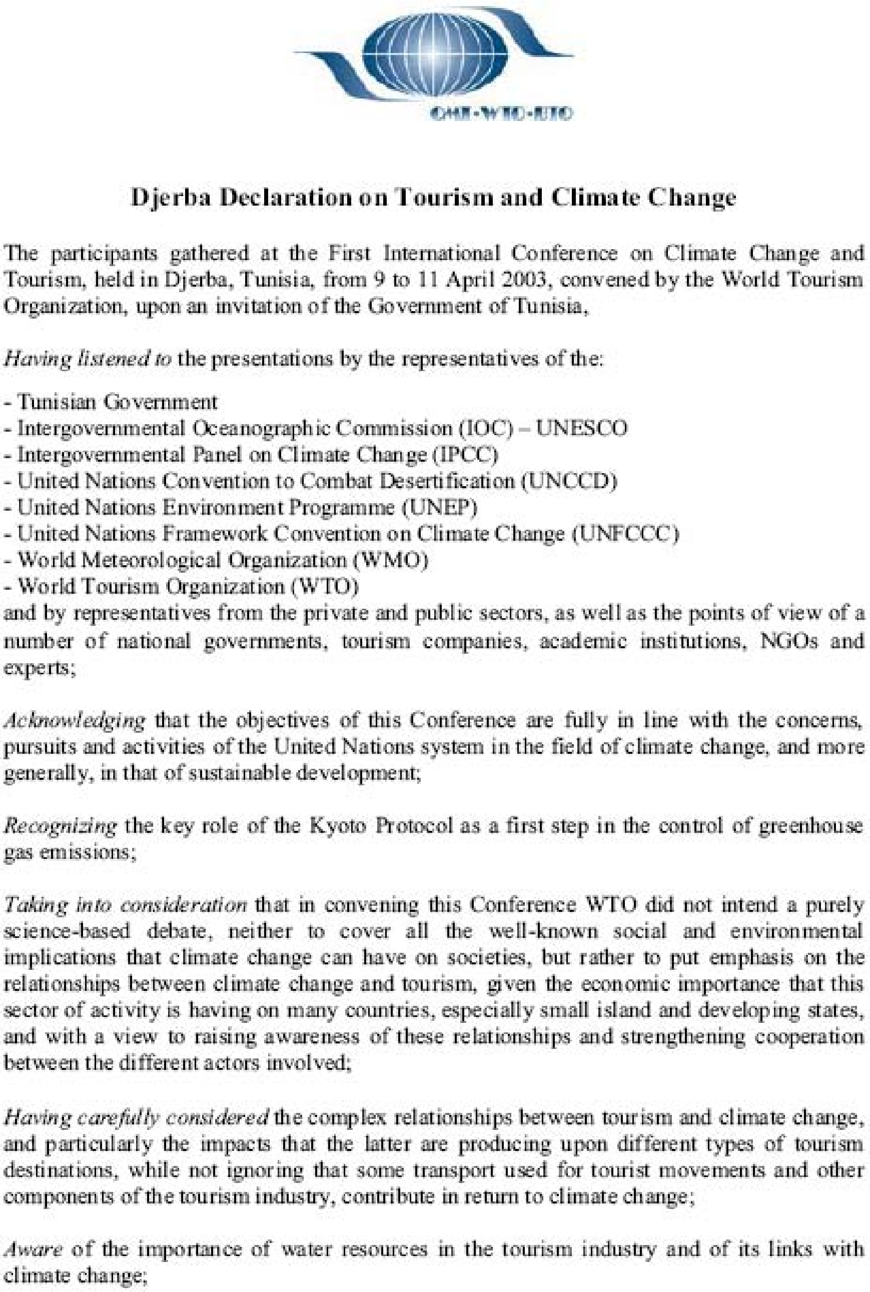
1) *Stakeholder Consultation.* Involving a wide range of stakeholders, including representatives from certifiers, industry, governments, non-governmental organizations and multilateral funding agencies to have a direct input in the establishment of the project's feasibility. This aims to ensure that participation is open and transparent, yet ensuring confidentiality.

2) *Market Demand.* The assessment of the demand for accreditation services and analyse the causes that are affecting the demand. This aims to determine benefits, needs and drawbacks for each stakeholder group.

3) *Financial Sustainability.* The preparation of a financial feasibility plan including funding sources, pricing strategies, start-up and operating costs, based on stakeholder participation and experiences in other accreditation bodies.

4) *Organization and implementation.* The development of proposals of an organisational structure in line with the financing model, and recommendations on operating procedures and international accreditation standards.

Appendix 3C Djerba Declaration *(UNWTO, 2003)*



Djerba Declaration on Tourism and Climate Change

The participants gathered at the First International Conference on Climate Change and Tourism, held in Djerba, Tunisia, from 9 to 11 April 2003, convened by the World Tourism Organization, upon an invitation of the Government of Tunisia,

Having listened to the presentations by the representatives of the:

- Tunisian Government
- Intergovernmental Oceanographic Commission (IOC) – UNESCO
- Intergovernmental Panel on Climate Change (IPCC)
- United Nations Convention to Combat Desertification (UNCCD)
- United Nations Environment Programme (UNEP)
- United Nations Framework Convention on Climate Change (UNFCCC)
- World Meteorological Organization (WMO)
- World Tourism Organization (WTO)

and by representatives from the private and public sectors, as well as the points of view of a number of national governments, tourism companies, academic institutions, NGOs and experts;

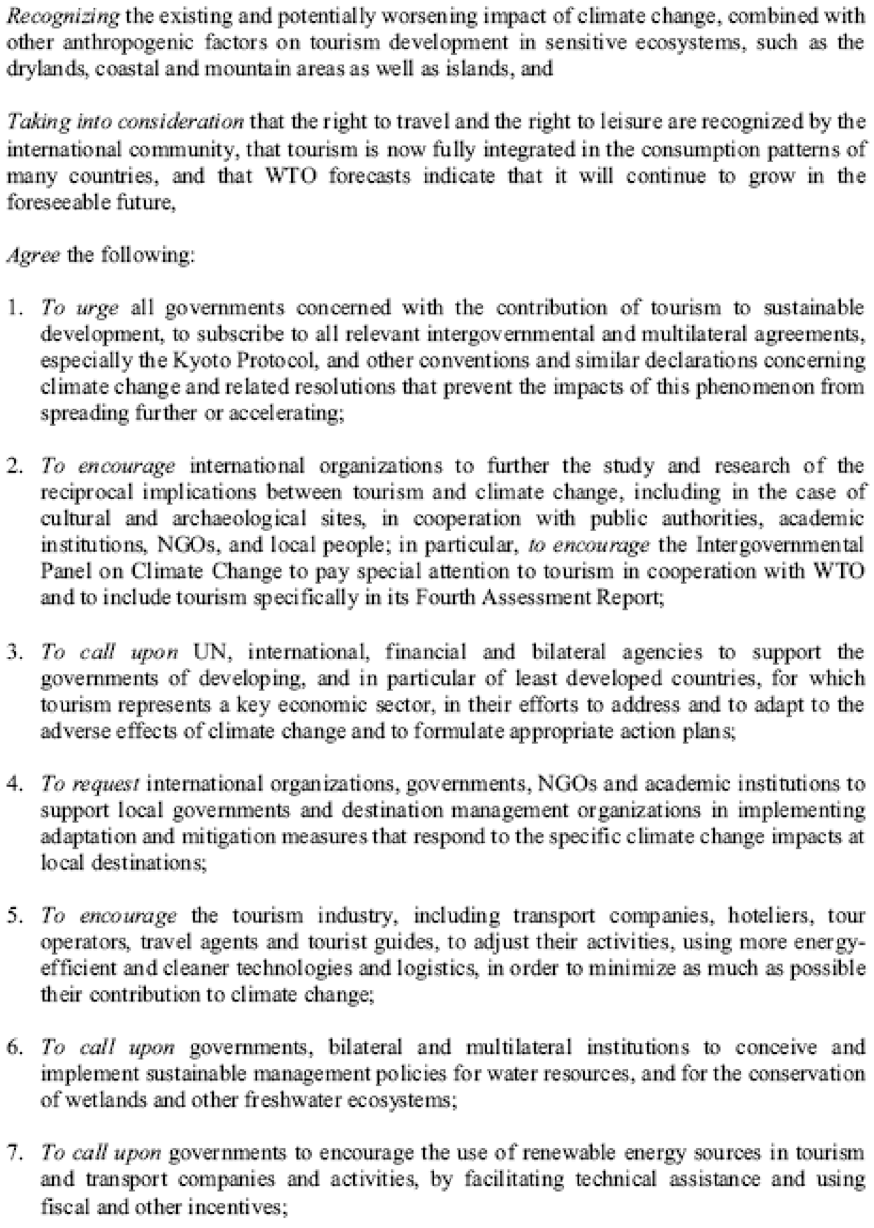
Acknowledging that the objectives of this Conference are fully in line with the concerns, pursuits and activities of the United Nations system in the field of climate change, and more generally, in that of sustainable development;

Recognizing the key role of the Kyoto Protocol as a first step in the control of greenhouse gas emissions;

Taking into consideration that in convening this Conference WTO did not intend a purely science-based debate, neither to cover all the well-known social and environmental implications that climate change can have on societies, but rather to put emphasis on the relationships between climate change and tourism, given the economic importance that this sector of activity is having on many countries, especially small island and developing states, and with a view to raising awareness of these relationships and strengthening cooperation between the different actors involved;

Having carefully considered the complex relationships between tourism and climate change, and particularly the impacts that the latter are producing upon different types of tourism destinations, while not ignoring that some transport used for tourist movements and other components of the tourism industry, contribute in return to climate change;

Aware of the importance of water resources in the tourism industry and of its links with climate change;



Recognizing the existing and potentially worsening impact of climate change, combined with other anthropogenic factors on tourism development in sensitive ecosystems, such as the drylands, coastal and mountain areas as well as islands, and

Taking into consideration that the right to travel and the right to leisure are recognized by the international community, that tourism is now fully integrated in the consumption patterns of many countries, and that WTO forecasts indicate that it will continue to grow in the foreseeable future,

Agree the following:

1. *To urge* all governments concerned with the contribution of tourism to sustainable development, to subscribe to all relevant intergovernmental and multilateral agreements, especially the Kyoto Protocol, and other conventions and similar declarations concerning climate change and related resolutions that prevent the impacts of this phenomenon from spreading further or accelerating;

2. *To encourage* international organizations to further the study and research of the reciprocal implications between tourism and climate change, including in the case of cultural and archaeological sites, in cooperation with public authorities, academic institutions, NGOs, and local people; in particular, *to encourage* the Intergovernmental Panel on Climate Change to pay special attention to tourism in cooperation with WTO and to include tourism specifically in its Fourth Assessment Report;

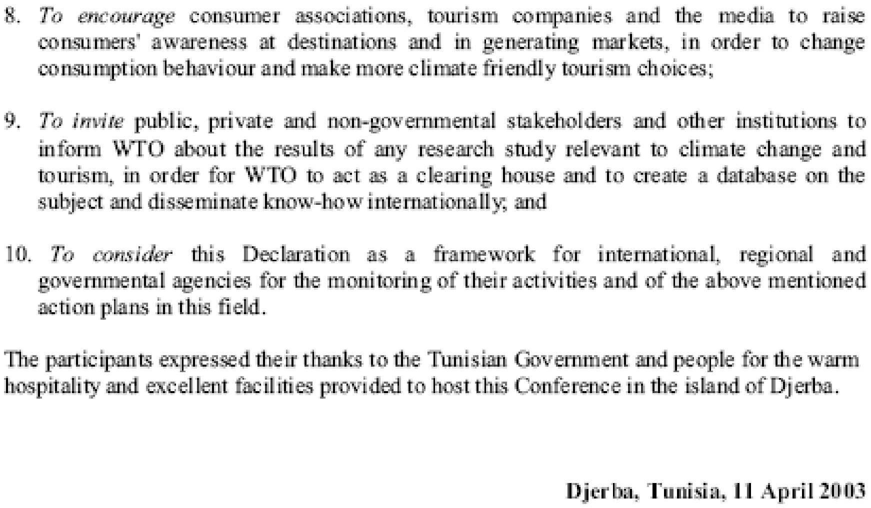
3. *To call upon* UN, international, financial and bilateral agencies to support the governments of developing, and in particular of least developed countries, for which tourism represents a key economic sector, in their efforts to address and to adapt to the adverse effects of climate change and to formulate appropriate action plans;

4. *To request* international organizations, governments, NGOs and academic institutions to support local governments and destination management organizations in implementing adaptation and mitigation measures that respond to the specific climate change impacts at local destinations;

5. *To encourage* the tourism industry, including transport companies, hoteliers, tour operators, travel agents and tourist guides, to adjust their activities, using more energy-efficient and cleaner technologies and logistics, in order to minimize as much as possible their contribution to climate change;

6. *To call upon* governments, bilateral and multilateral institutions to conceive and implement sustainable management policies for water resources, and for the conservation of wetlands and other freshwater ecosystems;

7. *To call upon* governments to encourage the use of renewable energy sources in tourism and transport companies and activities, by facilitating technical assistance and using fiscal and other incentives;



8. *To encourage* consumer associations, tourism companies and the media to raise consumers' awareness at destinations and in generating markets, in order to change consumption behaviour and make more climate friendly tourism choices;

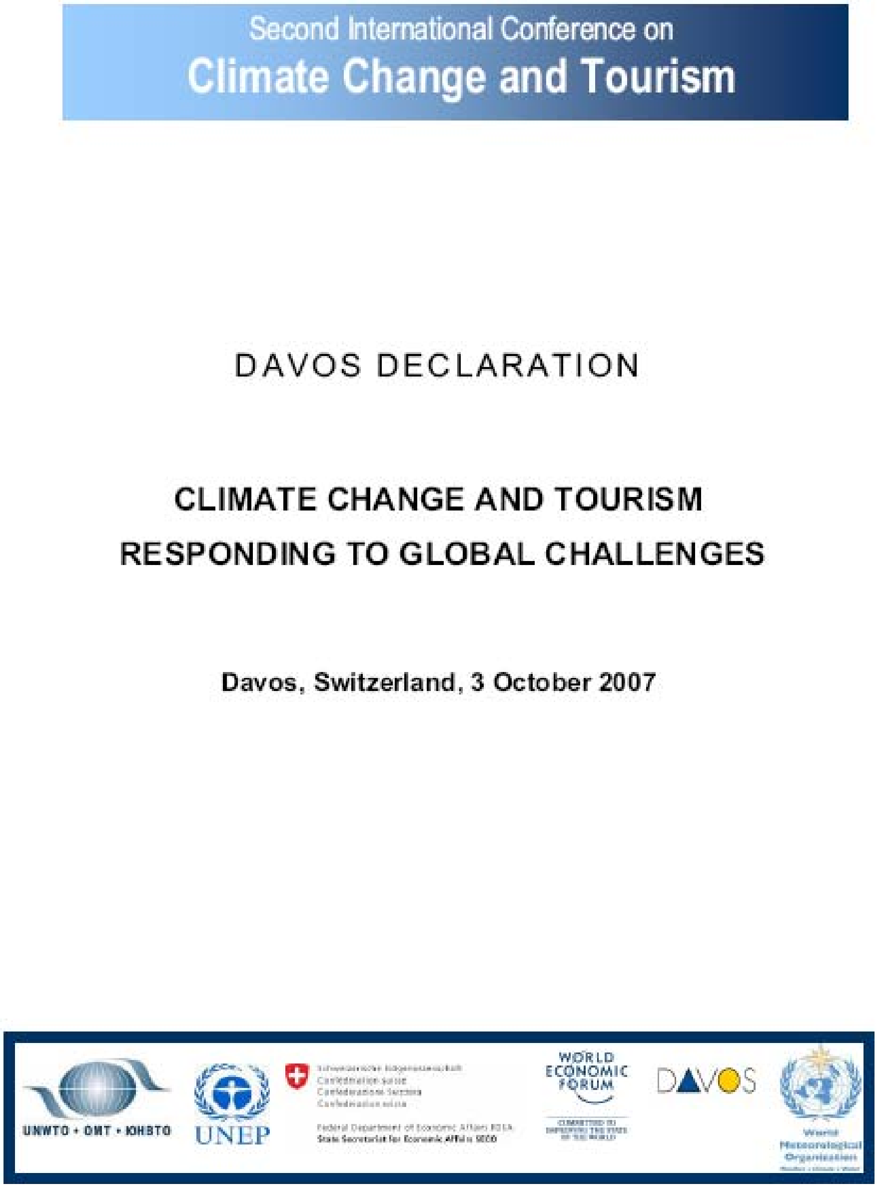
9. *To invite* public, private and non-governmental stakeholders and other institutions to inform WTO about the results of any research study relevant to climate change and tourism, in order for WTO to act as a clearing house and to create a database on the subject and disseminate know-how internationally; and

10. *To consider* this Declaration as a framework for international, regional and governmental agencies for the monitoring of their activities and of the above mentioned action plans in this field.

The participants expressed their thanks to the Tunisian Government and people for the warm hospitality and excellent facilities provided to host this Conference in the island of Djerba.

Djerba, Tunisia, 11 April 2003

Appendix 3D Davos Declaration *(UNWTO, 2007)*

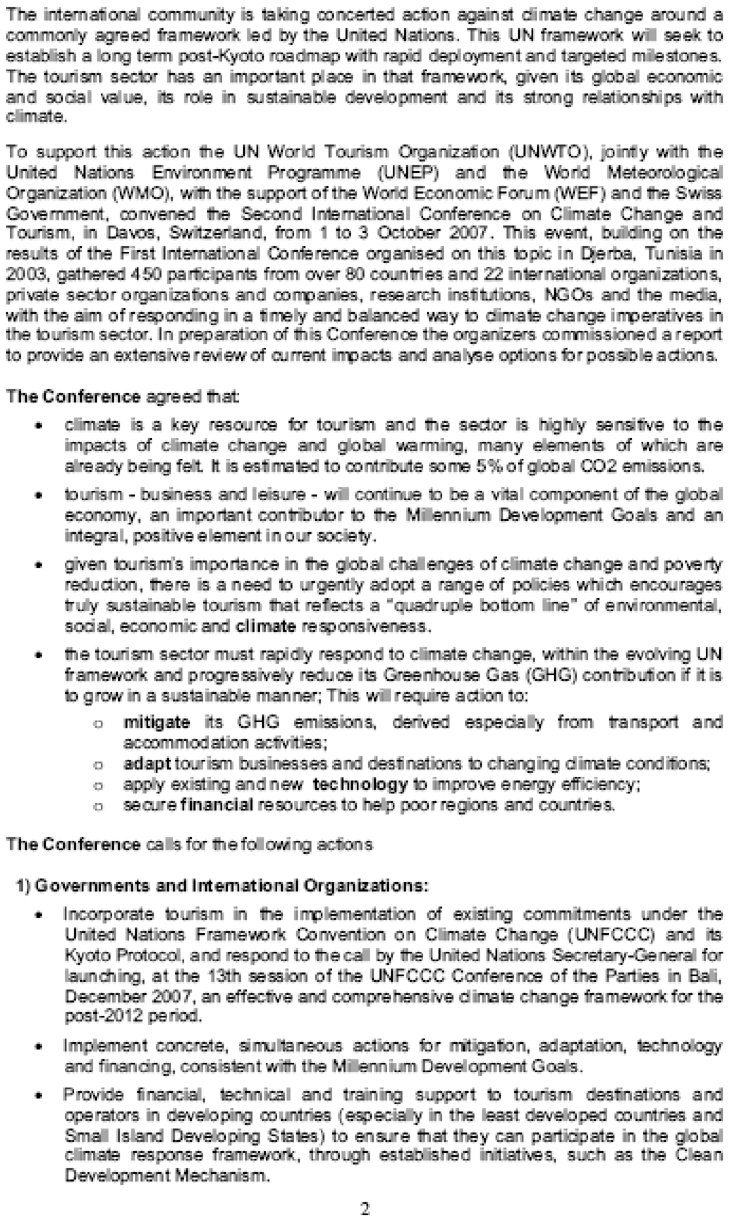


Second International Conference on
Climate Change and Tourism

DAVOS DECLARATION

CLIMATE CHANGE AND TOURISM
RESPONDING TO GLOBAL CHALLENGES

Davos, Switzerland, 3 October 2007



The international community is taking concerted action against climate change around a commonly agreed framework led by the United Nations. This UN framework will seek to establish a long term post-Kyoto roadmap with rapid deployment and targeted milestones. The tourism sector has an important place in that framework, given its global economic and social value, its role in sustainable development and its strong relationships with climate.

To support this action the UN World Tourism Organization (UNWTO), jointly with the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO), with the support of the World Economic Forum (WEF) and the Swiss Government, convened the Second International Conference on Climate Change and Tourism, in Davos, Switzerland, from 1 to 3 October 2007. This event, building on the results of the First International Conference organised on this topic in Djerba, Tunisia in 2003, gathered 450 participants from over 80 countries and 22 international organizations, private sector organizations and companies, research institutions, NGOs and the media, with the aim of responding in a timely and balanced way to climate change imperatives in the tourism sector. In preparation of this Conference the organizers commissioned a report to provide an extensive review of current impacts and analyse options for possible actions.

The Conference agreed that:

- climate is a key resource for tourism and the sector is highly sensitive to the impacts of climate change and global warming, many elements of which are already being felt. It is estimated to contribute some 5% of global CO2 emissions.
- tourism - business and leisure - will continue to be a vital component of the global economy, an important contributor to the Millennium Development Goals and an integral, positive element in our society.
- given tourism's importance in the global challenges of climate change and poverty reduction, there is a need to urgently adopt a range of policies which encourages truly sustainable tourism that reflects a "quadruple bottom line" of environmental, social, economic and **climate** responsiveness.
- the tourism sector must rapidly respond to climate change, within the evolving UN framework and progressively reduce its Greenhouse Gas (GHG) contribution if it is to grow in a sustainable manner; This will require action to:
  - **mitigate** its GHG emissions, derived especially from transport and accommodation activities;
  - **adapt** tourism businesses and destinations to changing climate conditions;
  - apply existing and new **technology** to improve energy efficiency;
  - secure **financial** resources to help poor regions and countries.

The Conference calls for the following actions

1) Governments and International Organizations:

- Incorporate tourism in the implementation of existing commitments under the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol, and respond to the call by the United Nations Secretary-General for launching, at the 13th session of the UNFCCC Conference of the Parties in Bali, December 2007, an effective and comprehensive climate change framework for the post-2012 period.
- Implement concrete, simultaneous actions for mitigation, adaptation, technology and financing, consistent with the Millennium Development Goals.
- Provide financial, technical and training support to tourism destinations and operators in developing countries (especially in the least developed countries and Small Island Developing States) to ensure that they can participate in the global climate response framework, through established initiatives, such as the Clean Development Mechanism.

- Promote, at all levels, interdisciplinary partnerships, networks and information exchange systems essential to sustainable development of the sector.
- Collaborate in international strategies, policies and action plans to reduce GHG emissions in the transport (in cooperation with ICAO and other aviation organizations), accommodation and related tourism activities.
- Introduce education and awareness programs for all tourism stakeholders – public and private sector – as well as consumers.
- Develop regional and local climate information services tailored to the tourism sector and promote their use among tourism stakeholders. Build capacities for interpretation and application of this information, strengthening collaboration with WMO's National Meteorological Services.
- Implement policy, regulatory, financial, managerial, educational, behavioural, diversification, research and monitoring measures, for effective adaptation and mitigation.

2) Tourism Industry and Destinations

- Take leadership in implementing concrete measures (such as incentives) in order to mitigate climate change throughout the tourism value chain and to reduce risk to travellers, operators and infrastructure due to dynamic climate variability and shift. Establish targets and indicators to monitor progress.
- Promote and undertake investments in energy-efficiency tourism programmes and use of renewable energy resources, with the aim of reducing the carbon footprint of the entire tourism sector.
- Integrate tourism in the formulation and implementation of regional, national and local level adaptation and mitigation strategies and implementation plans. The Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change, coordinated by UNFCCC, represents an important opportunity for the tourism sector to enhance knowledge, increase capacities and stimulate action.
- Strive to conserve biodiversity, natural ecosystems and landscapes in ways which strengthen resilience to climate change and ensure a long-term sustainable use of the environmental resource base of tourism - in particular those that serve as "earth lungs" (carbon sinks), sequestering GHGs through forest management and other biological programmes, or that protect coastlines (e.g. mangroves and coral reefs).
- Seek to achieve increasingly carbon free environments by diminishing pollution through design, operations and market responsive mechanisms.
- Implement climate-focused product diversification, to reposition destinations and support systems, as well as to foster all-season supply and demand.
- Raise awareness among customers and staff on climate change impacts and engage them in response processes.

3) Consumers:

- In their choices for travel and destination, tourists should be encouraged to consider the climate, economic, societal and environmental impacts of their options before making a decision and, where possible to reduce their carbon footprint, or offset emissions that cannot be reduced directly.
- In their choices of activities at the destination, tourists should also be encouraged to opt for environmentally-friendly activities that reduce their carbon footprint as well as contribute to the preservation of the natural environment and cultural heritage.

Appendix 3E Global Sustainable Tourism Criteria *(GSTC, 2008)*

A. Demonstrate effective sustainable management.
A.1. The company has implemented a long-term sustainability management system that is suitable to its reality and scale, and that considers environmental, sociocultural, quality, health, and safety issues.
A.2. The company is in compliance with all relevant international or local legislation and regulations (including, among others, health, safety, labor, and environmental aspects).
A.3. All personnel receive periodic training regarding their role in the management of environmental, sociocultural, health, and safety practices.
A.4. Customer satisfaction is measured and corrective action taken where appropriate.
A.5. Promotional materials are accurate and complete and do not promise more than can be delivered by the business.
A.6. Design and construction of buildings and infrastructure:
A.6.1. comply with local zoning and protected or heritage area requirements;
A.6.2. respect the natural or cultural heritage surroundings in siting, design, impact assessment, and land rights and acquisition;
A.6.3 use locally appropriate principles of sustainable construction;
A.6.4 provide access for persons with special needs.
A.7. Information about and interpretation of the natural surroundings, local culture, and cultural heritage is provided to customers, as well as explaining appropriate behavior while visiting natural areas, living cultures, and cultural heritage sites.
B. Maximize social and economic benefits to the local community and minimize negative impacts.
B.1. The company actively supports initiatives for social and infrastructure community development including, among others, education, health, and sanitation.
B.2. Local residents are employed, including in management positions. Training is offered as necessary.
B.3. Local and fair-trade services and goods are purchased by the business, where available.
B.4. The company offers the means for local small entrepreneurs to develop and sell sustainable products that are based on the area’s nature, history, and culture (including food and drink, crafts, performance arts, agricultural products, etc.).
B.5. A code of conduct for activities in indigenous and local communities has been developed, with the consent of and in collaboration with the community.
B.6. The company has implemented a policy against commercial exploitation, particularly of children and adolescents, including sexual exploitation.
B.7. The company is equitable in hiring women and local minorities, including in management positions, while restraining child labor.
B.8. The international or national legal protection of employees is respected, and employees are paid a living wage.
B.9. The activities of the company do not jeopardize the provision of basic services, such as water, energy, or sanitation, to neighboring communities.

C. Maximize benefits to cultural heritage and minimize negative impacts.

C.1. The company follows established guidelines or a code of behavior for visits to culturally or historically sensitive sites, in order to minimize visitor impact and maximize enjoyment.

C.2. Historical and archeological artifacts are not sold, traded, or displayed, except as permitted by law.

C.3. The business contributes to the protection of local historical, archeological, culturally, and spiritually important properties and sites, and does not impede access to them by local residents.

C.4 The business uses elements of local art, architecture, or cultural heritage in its operations, design, decoration, food, or shops; while respecting the intellectual property rights of local communities.

D. Maximize benefits to the environment and minimize negative impacts.

D.1. Conserving resources

D.1.1. Purchasing policy favors environmentally friendly products for building materials, capital goods, food, and consumables.

D.1.2. The purchase of disposable and consumable goods is measured, and the business actively seeks ways to reduce their use.

D.1.3. Energy consumption should be measured, sources indicated, and measures to decrease overall consumption should be adopted, while encouraging the use of renewable energy.

D.1.4. Water consumption should be measured, sources indicated, and measures to decrease overall consumption should be adopted.

D.2. Reducing pollution

D.2.1. Greenhouse gas emissions from all sources controlled by the business are measured, and procedures are implemented to reduce and offset them as a way to achieve climate neutrality.

D.2.2. Wastewater, including gray water, is treated effectively and reused where possible.

D.2.3. A solid waste management plan is implemented, with quantitative goals to minimize waste that is not reused or recycled.

D.2.4. The use of harmful substances, including pesticides, paints, swimming pool disinfectants, and cleaning materials, is minimized; substituted, when available, by innocuous products; and all chemical use is properly managed.

D.2.5. The business implements practices to reduce pollution from noise, light, runoff, erosion, ozone-depleting compounds, and air and soil contaminants.

D.3. Conserving biodiversity, ecosystems, and landscapes

D.3.1. Wildlife species are only harvested from the wild, consumed, displayed, sold, or internationally traded, as part of a regulated activity that ensures that their utilization is sustainable.

D.3.2. No captive wildlife is held, except for properly regulated activities, and living specimens of protected wildlife species are only kept by those authorized and suitably equipped to house and care for them.

D.3.3. The business uses native species for landscaping and restoration, and takes measures to avoid the introduction of invasive alien species.

D.3.4. The business contributes to the support of biodiversity conservation, including supporting natural protected areas and areas of high biodiversity value.
D.3.5. Interactions with wildlife must not produce adverse effects on the viability of populations in the wild; and any disturbance of natural ecosystems is minimized, rehabilitated, and there is a compensatory contribution to conservation management.

Appendix 3F Sustainable Building Alliance *(SB Aliiance, 2008)*

The objectives of the SB Alliance include;

- To provide increased certainty for the development industry and community on the delivery of a sustainable built environment;

- To establish a common core of issues that should be covered by any building assessment system and therefore provide confidence to the users of systems across a number of countries that there is a degree of commonality in approach, and to give them the confidence to use the relevant national scheme without having to back a single system.

- To provide the development industry with a consistent (common metrics) sustainability assessment method(s);

- To develop strategic performance benchmarks for the development/construction industry; and increase the sustainability performance of the development/construction industry;

- To make assessment tools increasingly more challenging as fast as the market will bear, and appreciate the difference in the countries that form the SB alliance;

- To facilitate research and practical case study examples on the benefits of sustainability assessment methods.

- To cooperate in identifying, and share the costs of, suitable joint research and development projects with the aim of further developing and promoting the environmental assessment and certification of buildings.

Appendix 3G Making Tourism More Sustainable: A Guide for Policy Makers, Twelve aims of sustainable tourism*. (UNEP WTO, 2005)*

Economic Viability: To ensure the viability and competitiveness of tourism destinations and enterprises, so that they are able to continue to prosper and deliver benefits in the long term.

Local Prosperity: To maximize the contribution of tourism to the economic prosperity of the host destination, including the proportion of visitor spending that is retained locally.

Employment Quality: To strengthen the number and quality of local jobs created and supported by tourism, including the level of pay, conditions of service and availability to all without discrimination by gender, race, disability or in other ways.

Social Equity: To seek a widespread and fair distribution of economic and social benefits from tourism throughout the recipient community, including improving opportunities, income and services available to the poor.

Visitor Fulfillment: To provide a safe, satisfying and fulfilling experience for visitors, available to all without discrimination by gender, race, disability or in other ways.

Local Control: To engage and empower local communities in planning and decision making about the management and future development of tourism in their area, in consultation with other stakeholders.

Community Wellbeing: To maintain and strengthen the quality of life in local communities, including social structures and access to resources, amenities and life support systems, avoiding any form of social degradation or exploitation.

Cultural Richness: To respect and enhance the historic heritage, authentic culture, traditions and distinctiveness of host communities.

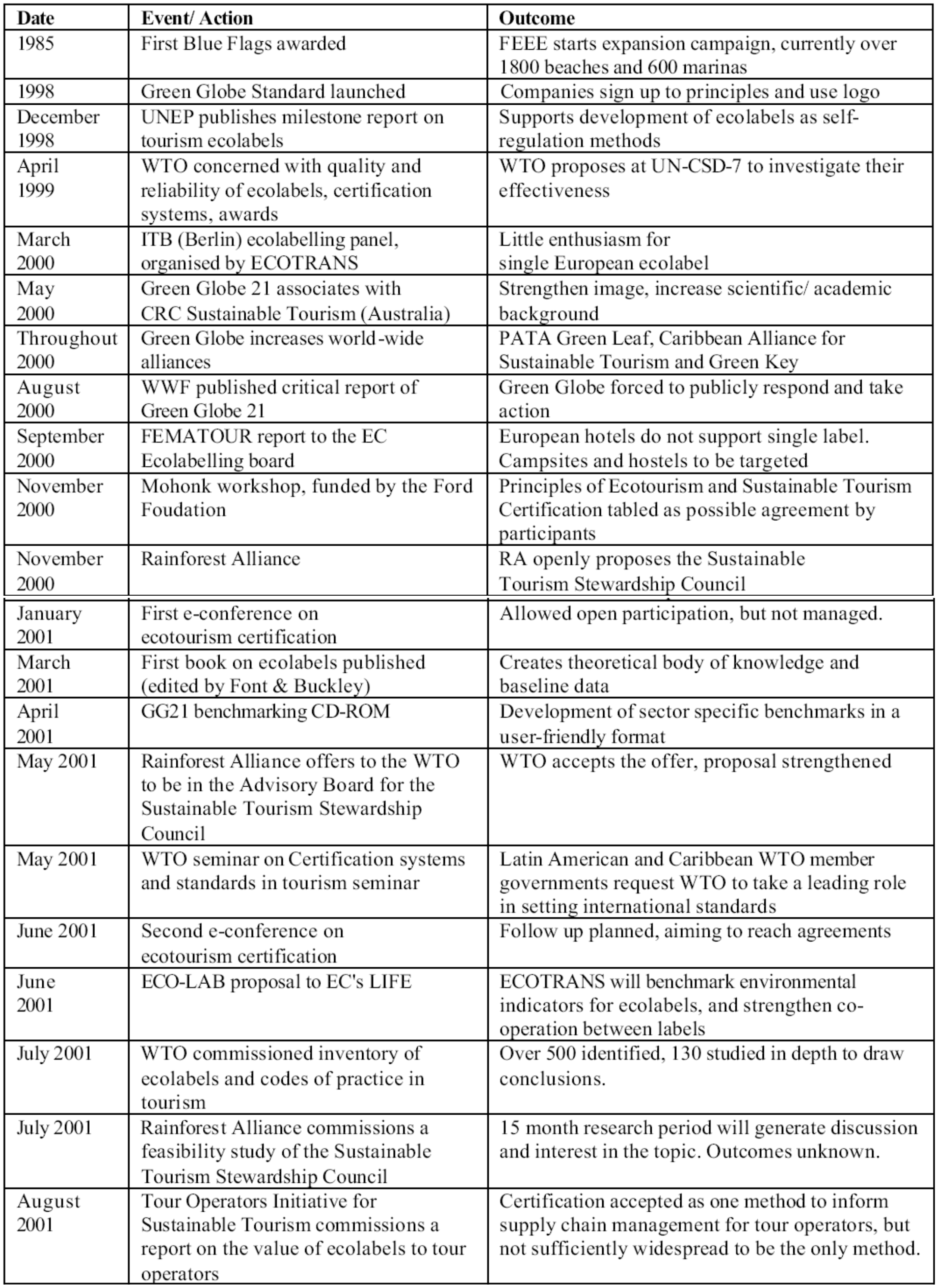
Physical Integrity: To maintain and enhance the quality of landscapes, both urban and rural, and avoid the physical and visual degradation of the environment.

Biological Diversity: To support the conservation of natural areas, habitats and wildlife, and minimize damage to them.

Resource Efficiency: To minimize the use of scarce and non-renewable resources in the development and operation of tourism facilities and services.

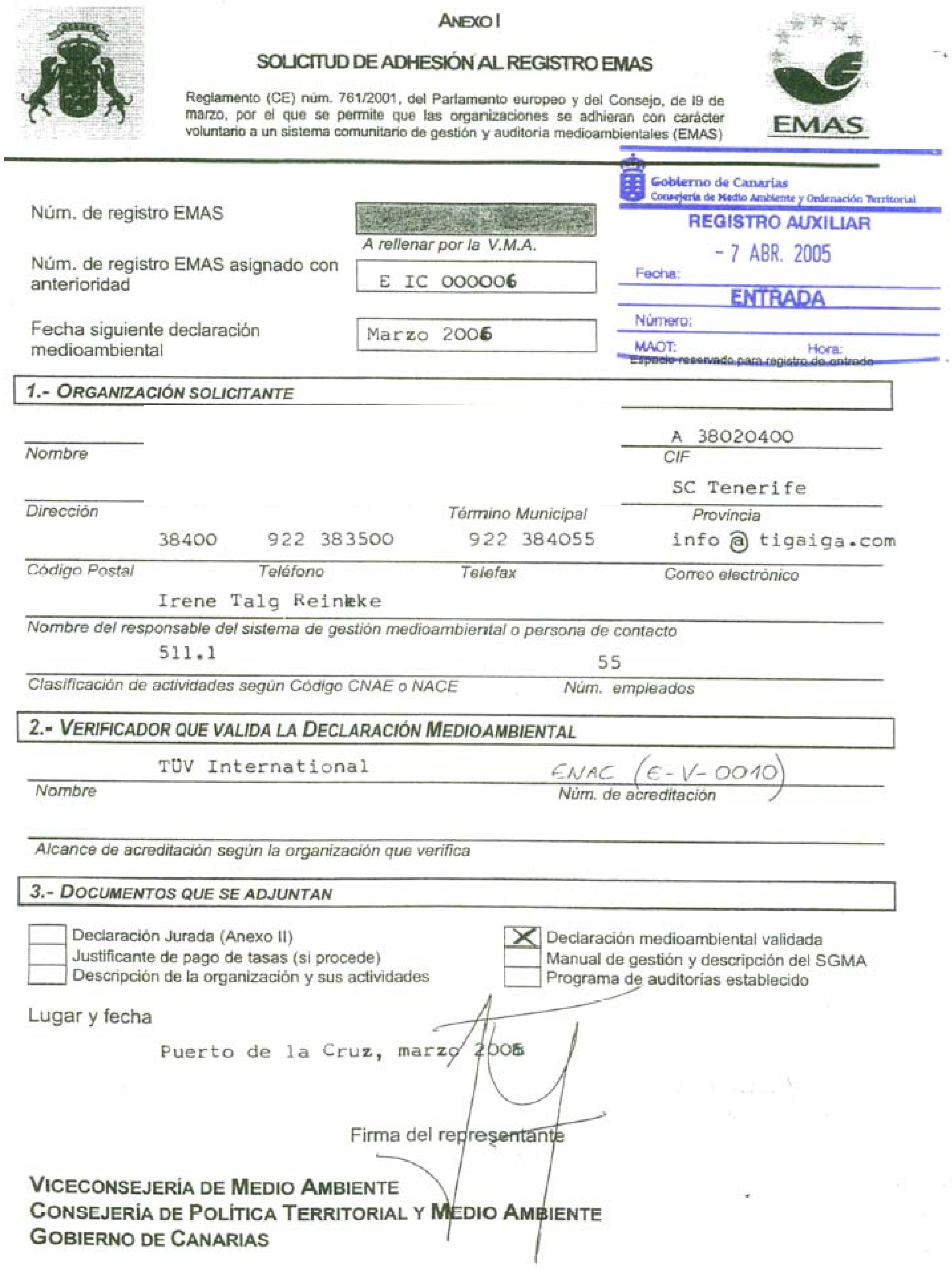
Environmental Purity: To minimize the pollution of air, water and land and the generation of waste by tourism enterprises and visitors.

Appendix 3H Ecolabels: calendar of events. *(Font, 2001b)*



Date	**Event/ Action**	**Outcome**
1985	First Blue Flags awarded	FEEE starts expansion campaign, currently over 1800 beaches and 600 marinas
1998	Green Globe Standard launched	Companies sign up to principles and use logo
December 1998	UNEP publishes milestone report on tourism ecolabels	Supports development of ecolabels as self-regulation methods
April 1999	WTO concerned with quality and reliability of ecolabels, certification systems, awards	WTO proposes at UN-CSD-7 to investigate their effectiveness
March 2000	ITB (Berlin) ecolabelling panel, organised by ECOTRANS	Little enthusiasm for single European ecolabel
May 2000	Green Globe 21 associates with CRC Sustainable Tourism (Australia)	Strengthen image, increase scientific/ academic background
Throughout 2000	Green Globe increases world-wide alliances	PATA Green Leaf, Caribbean Alliance for Sustainable Tourism and Green Key
August 2000	WWF published critical report of Green Globe 21	Green Globe forced to publicly respond and take action
September 2000	FEMATOUR report to the EC Ecolabelling board	European hotels do not support single label. Campsites and hostels to be targeted
November 2000	Mohonk workshop, funded by the Ford Foudation	Principles of Ecotourism and Sustainable Tourism Certification tabled as possible agreement by participants
November 2000	Rainforest Alliance	RA openly proposes the Sustainable Tourism Stewardship Council
January 2001	First e-conference on ecotourism certification	Allowed open participation, but not managed.
March 2001	First book on ecolabels published (edited by Font & Buckley)	Creates theoretical body of knowledge and baseline data
April 2001	GG21 benchmarking CD-ROM	Development of sector specific benchmarks in a user-friendly format
May 2001	Rainforest Alliance offers to the WTO to be in the Advisory Board for the Sustainable Tourism Stewardship Council	WTO accepts the offer, proposal strengthened
May 2001	WTO seminar on Certification systems and standards in tourism seminar	Latin American and Caribbean WTO member governments request WTO to take a leading role in setting international standards
June 2001	Second e-conference on ecotourism certification	Follow up planned, aiming to reach agreements
June 2001	ECO-LAB proposal to EC's LIFE	ECOTRANS will benchmark environmental indicators for ecolabels, and strengthen co-operation between labels
July 2001	WTO commissioned inventory of ecolabels and codes of practice in tourism	Over 500 identified, 130 studied in depth to draw conclusions.
July 2001	Rainforest Alliance commissions a feasibility study of the Sustainable Tourism Stewardship Council	15 month research period will generate discussion and interest in the topic. Outcomes unknown.
August 2001	Tour Operators Initiative for Sustainable Tourism commissions a report on the value of ecolabels to tour operators	Certification accepted as one method to inform supply chain management for tour operators, but not sufficiently widespread to be the only method.

Appendix 3I Extract of typical EMAS Declaraçion Ambiental, 2005



ANEXO I

SOLICITUD DE ADHESIÓN AL REGISTRO EMAS

Reglamento (CE) núm. 761/2001, del Parlamento europeo y del Consejo, de 19 de marzo, por el que se permite que las organizaciones se adhieran con carácter voluntario a un sistema comunitario de gestión y auditoría medioambientales (EMAS)

EMAS

Gobierno de Canarias
Consejería de Medio Ambiente y Ordenación Territorial
REGISTRO AUXILIAR
Fecha: - 7 ABR. 2005
ENTRADA
Número:
MAOT: Hora:
Espacio reservado para registro de entrada

Núm. de registro EMAS
A rellenar por la V.M.A.

Núm. de registro EMAS asignado con anterioridad: E IC 000006

Fecha siguiente declaración medioambiental: Marzo 2006

1.- ORGANIZACIÓN SOLICITANTE

Nombre
A 38020400 — CIF
Dirección
Término Municipal
SC Tenerife — Provincia
38400 — Código Postal
922 383500 — Teléfono
922 384055 — Telefax
info @ tigaiga.com — Correo electrónico
Irene Talg Reinkke — Nombre del responsable del sistema de gestión medioambiental o persona de contacto
511.1 — Clasificación de actividades según Código CNAE o NACE
55 — Núm. empleados

2.- VERIFICADOR QUE VALIDA LA DECLARACIÓN MEDIOAMBIENTAL

TÜV International — Nombre
ENAC (E-V-0010) — Núm. de acreditación
Alcance de acreditación según la organización que verifica

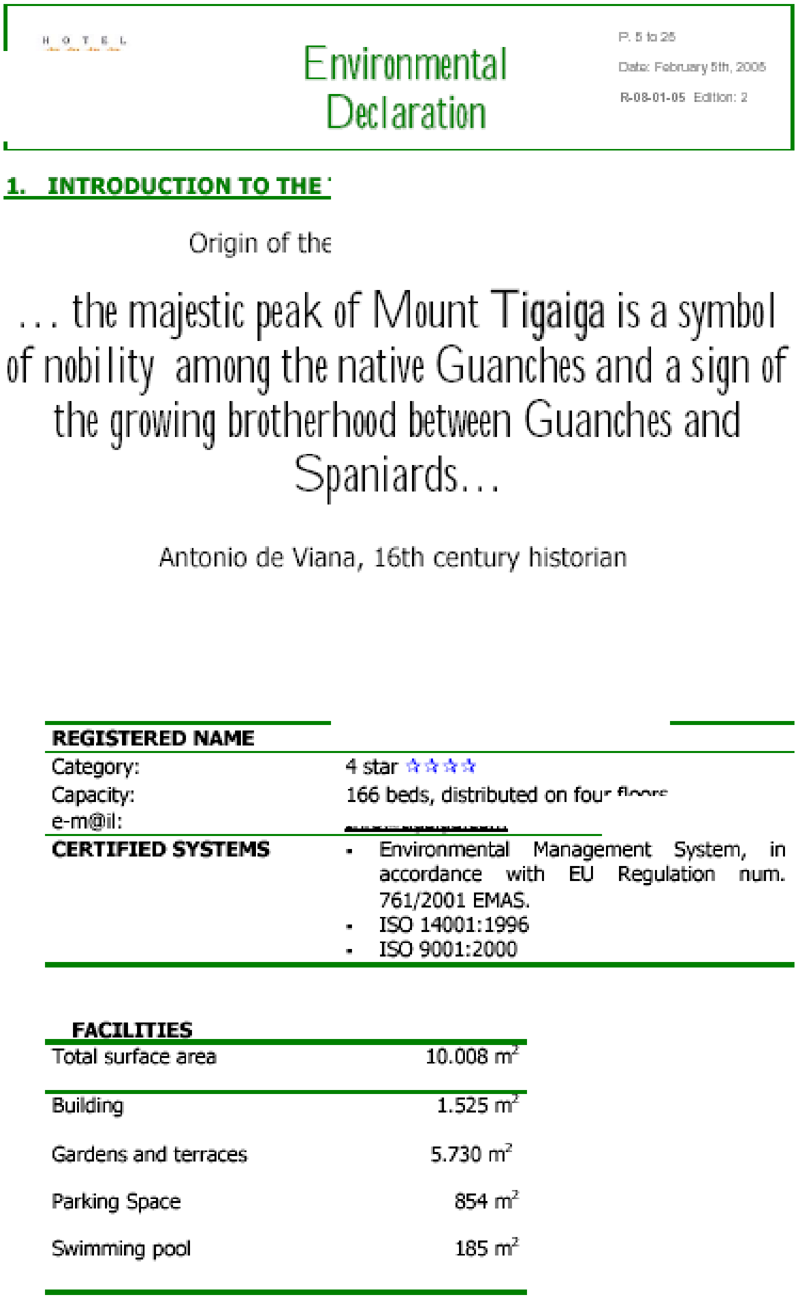
3.- DOCUMENTOS QUE SE ADJUNTAN

☐ Declaración Jurada (Anexo II)
☐ Justificante de pago de tasas (si procede)
☐ Descripción de la organización y sus actividades
☒ Declaración medioambiental validada
☐ Manual de gestión y descripción del SGMA
☐ Programa de auditorías establecido

Lugar y fecha
Puerto de la Cruz, marzo 2006

Firma del representante

VICECONSEJERÍA DE MEDIO AMBIENTE
CONSEJERÍA DE POLÍTICA TERRITORIAL Y MEDIO AMBIENTE
GOBIERNO DE CANARIAS



H O T E L

Environmental Declaration

P. 5 to 25
Date: February 5th, 2005
R-08-01-05 Edition: 2

1. INTRODUCTION TO THE

Origin of the

> … the majestic peak of Mount Tigaiga is a symbol of nobility among the native Guanches and a sign of the growing brotherhood between Guanches and Spaniards…
>
> Antonio de Viana, 16th century historian

REGISTERED NAME	
Category:	4 star ☆☆☆☆
Capacity:	166 beds, distributed on fou
e-m@il:	
CERTIFIED SYSTEMS	▪ Environmental Management System, in accordance with EU Regulation num. 761/2001 EMAS. ▪ ISO 14001:1996 ▪ ISO 9001:2000

FACILITIES	
Total surface area	10.008 m^2
Building	1.525 m^2
Gardens and terraces	5.730 m^2
Parking Space	854 m^2
Swimming pool	185 m^2

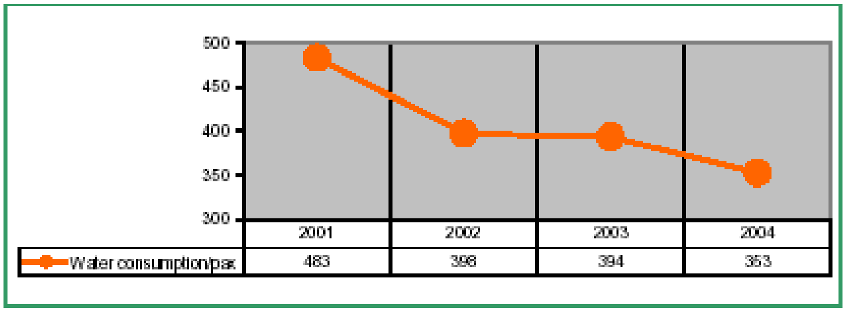
HOTEL

Environmental Declaration

P. 12 to 25
Date: February 5th, 2005
R-08-01-05 Edition: 2

Indicator	**2001**	**2002**	**2003**	**2004**
Water consumption per overnight stay	481 m^3/pax	398 m^3/pax	394m^3/pax	353m^3/pax

Source: Internal



2. Electricity consumption

Impact	Consumption and use of non-renewable resources
Areas of use and methods applied to reduce consumption	Rooms: General lighting using energy-efficient bulbs. TV, mini bars, hairdryer. All rooms have a switch to disconnect the electricity supply when the occupant is not in the room. Windows are fitted with blinds to help prevent heat from entering. Air conditioning: includes individual temperature regulators and an automatic cut-off device, which disconnects the air conditioning when the windows of the room are opened. General guest service areas: All rooms have large windows to take advantage of natural daylight, in addition to a general electrical lighting system. There are three lifts available to guests. Corridors on accommodation floors and public bathrooms are equipped with presence sensing devices. Kitchen, Restaurant and Café: All facilities take advantage of natural daylight in addition to a general electrical lighting system. The restaurants and kitchen are equipped with industrial cold stores, ovens, extractor fans, bottle cellars and dishwashing facilities for glasses and crockery. In the kitchen, freezer facilities have been renovated (the old equipment had become obsolete and consumed excessive electricity). Air conditioning in the restaurant and café. Refrigerated buffet, hot buffet and toasters.

HOTEL

Environmental Declaration

P. 13 to 25
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Laundry: General lighting with fluorescent tubes. Equipment includes one industrial washing machine, one domestic washing machine and an industrial dryer. In 2004, the clothes washed in the hotel itself increased (which also implied an increase in electricity consumption).

Heated swimming pool and gardens: Water chlorination and filtering machinery. The swimming pool is equipped with a thermic cover which protects it during the nights of the winter season in order to avoid unnecessary heat loss. In 2003, we relayed the swimming pool water pipes (thereby minimising the electrical energy required for maintaining the established water temperature) and installed new electrical cabinets in the changing rooms. Lighting in the gardens is supplied by energy-efficient bulbs. The number of bulbs lit is reduced during specified periods.
Sauna: Newly installed in 2002 (coinciding with an increase in energy consumption).

Machine Room: The greatest peak in electrical energy consumption takes place when the heat pump is switched on. This occurs when the solar energy panels are unable to heat the sanitary water to the required temperature. The installations for the warm water system are well insulated. The condition of the boilers is inspected periodically.

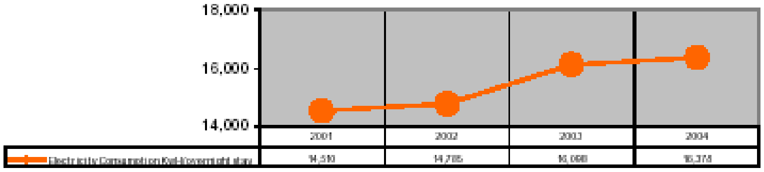
The internal service areas which are continuously lit (more than five hours daily) are equipped with compact tri-phosphorous fluorescent lamps.

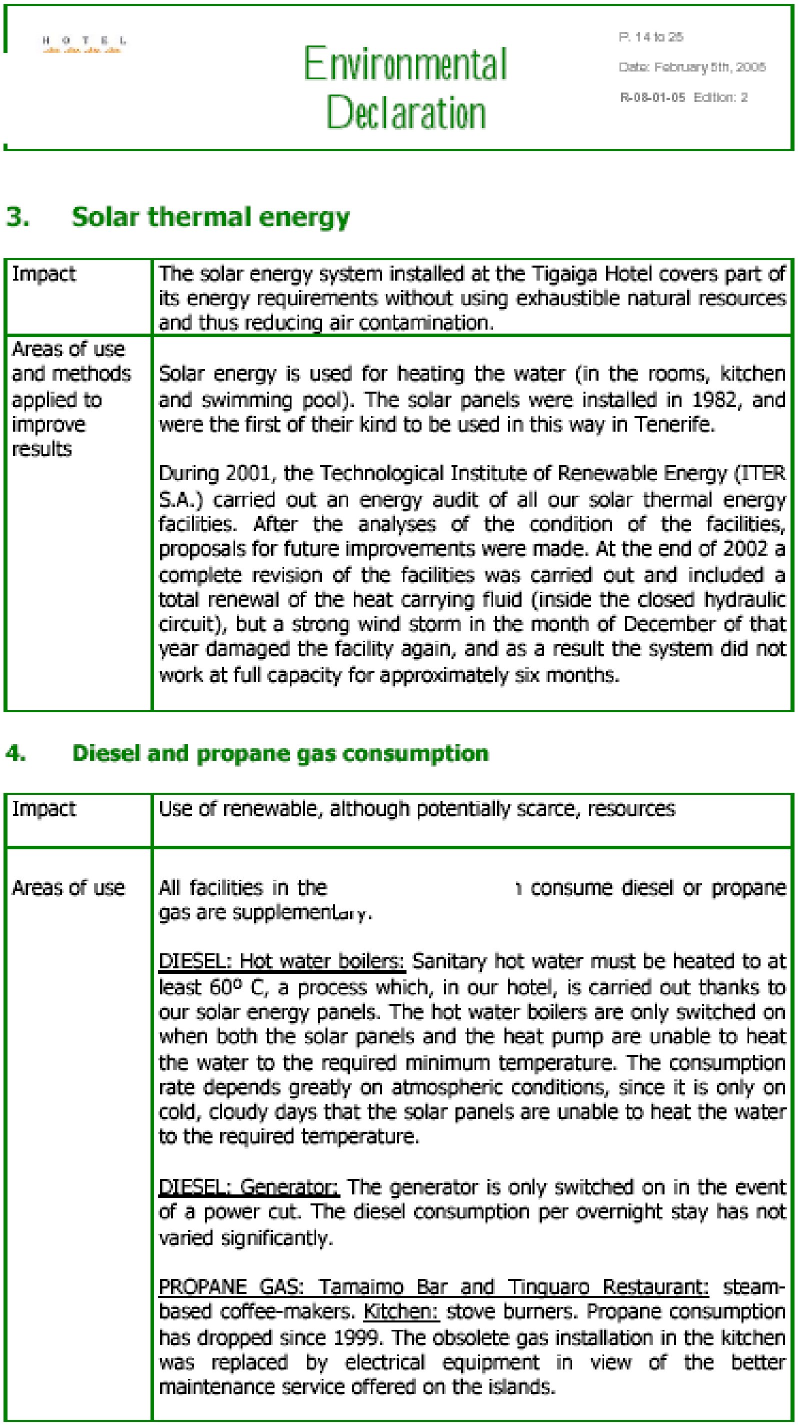
The hotel records energy consumption every month and makes year to year comparisons in order to assess the improvement obtained and to detect any unusual consumption.

Indicator	2001	2002	2003	2004
Electricity consumption per overnight stay	14,510 kwH per overnight stay	14,785 kwH per overnight stay	16,098 kwH per overnight stay	16,378 kwH per overnight stay

Note: the main causes for the increase in electricity consumption are explained on page 20

Source: Electricity Company Invoices and Inte





HOTEL

Environmental Declaration

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Date: February 5th, 2005
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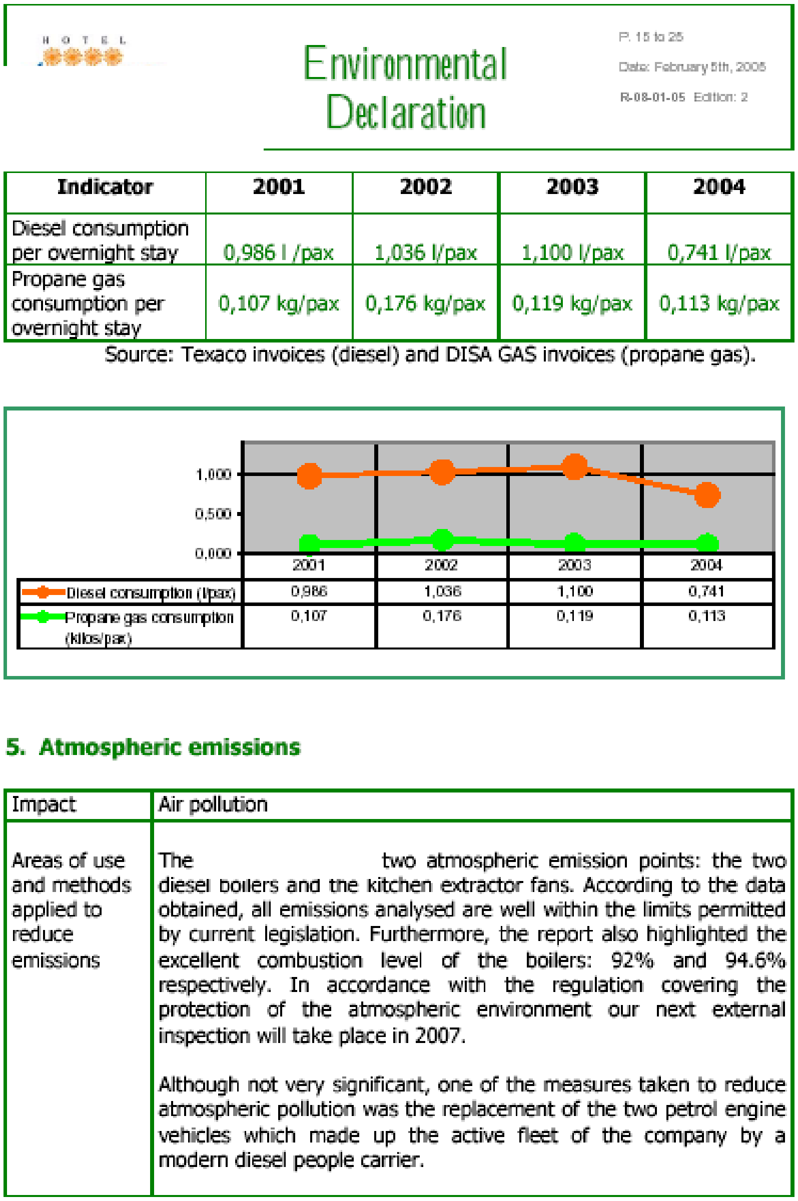
3. Solar thermal energy

Impact	The solar energy system installed at the Tigaiga Hotel covers part of its energy requirements without using exhaustible natural resources and thus reducing air contamination.
Areas of use and methods applied to improve results	Solar energy is used for heating the water (in the rooms, kitchen and swimming pool). The solar panels were installed in 1982, and were the first of their kind to be used in this way in Tenerife. During 2001, the Technological Institute of Renewable Energy (ITER S.A.) carried out an energy audit of all our solar thermal energy facilities. After the analyses of the condition of the facilities, proposals for future improvements were made. At the end of 2002 a complete revision of the facilities was carried out and included a total renewal of the heat carrying fluid (inside the closed hydraulic circuit), but a strong wind storm in the month of December of that year damaged the facility again, and as a result the system did not work at full capacity for approximately six months.

4. Diesel and propane gas consumption

Impact	Use of renewable, although potentially scarce, resources
Areas of use	All facilities in the ı consume diesel or propane gas are supplementary. DIESEL: Hot water boilers: Sanitary hot water must be heated to at least 60º C, a process which, in our hotel, is carried out thanks to our solar energy panels. The hot water boilers are only switched on when both the solar panels and the heat pump are unable to heat the water to the required minimum temperature. The consumption rate depends greatly on atmospheric conditions, since it is only on cold, cloudy days that the solar panels are unable to heat the water to the required temperature. DIESEL: Generator: The generator is only switched on in the event of a power cut. The diesel consumption per overnight stay has not varied significantly. PROPANE GAS: Tamaimo Bar and Tinguaro Restaurant: steam-based coffee-makers. Kitchen: stove burners. Propane consumption has dropped since 1999. The obsolete gas installation in the kitchen was replaced by electrical equipment in view of the better maintenance service offered on the islands.



HOTEL

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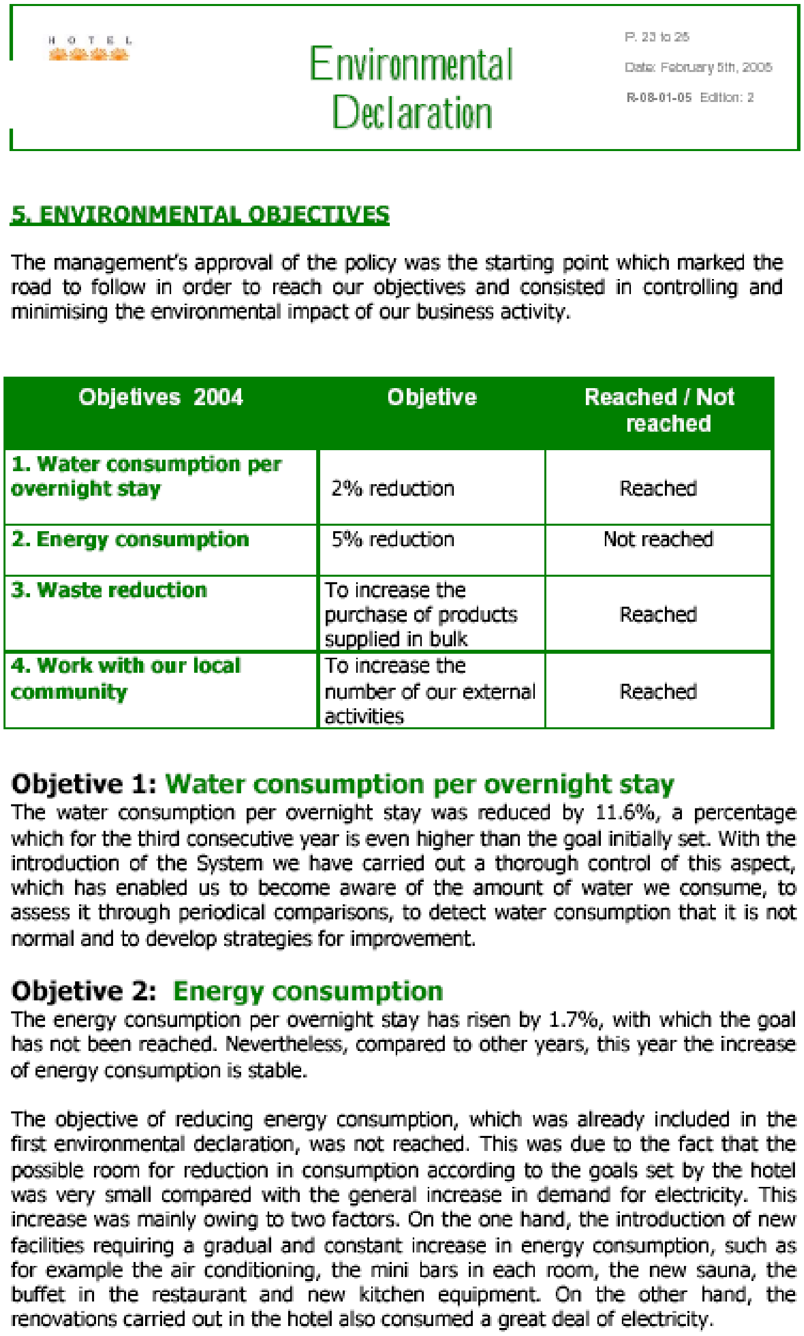
Indicator	**2001**	**2002**	**2003**	**2004**
Diesel consumption per overnight stay	0,986 l /pax	1,036 l/pax	1,100 l/pax	0,741 l/pax
Propane gas consumption per overnight stay	0,107 kg/pax	0,176 kg/pax	0,119 kg/pax	0,113 kg/pax

Source: Texaco invoices (diesel) and DISA GAS invoices (propane gas).

	2001	2002	2003	2004
Diesel consumption (l/pax)	0,986	1,036	1,100	0,741
Propane gas consumption (kilos/pax)	0,107	0,176	0,119	0,113

5. Atmospheric emissions

Impact	Air pollution
Areas of use and methods applied to reduce emissions	The two atmospheric emission points: the two diesel boilers and the kitchen extractor fans. According to the data obtained, all emissions analysed are well within the limits permitted by current legislation. Furthermore, the report also highlighted the excellent combustion level of the boilers: 92% and 94.6% respectively. In accordance with the regulation covering the protection of the atmospheric environment our next external inspection will take place in 2007. Although not very significant, one of the measures taken to reduce atmospheric pollution was the replacement of the two petrol engine vehicles which made up the active fleet of the company by a modern diesel people carrier.



HOTEL

Environmental Declaration

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Date: February 5th, 2005
R-08-01-05 Edition: 2

5. ENVIRONMENTAL OBJECTIVES

The management's approval of the policy was the starting point which marked the road to follow in order to reach our objectives and consisted in controlling and minimising the environmental impact of our business activity.

Objetives 2004	Objetive	Reached / Not reached
1. Water consumption per overnight stay	2% reduction	Reached
2. Energy consumption	5% reduction	Not reached
3. Waste reduction	To increase the purchase of products supplied in bulk	Reached
4. Work with our local community	To increase the number of our external activities	Reached

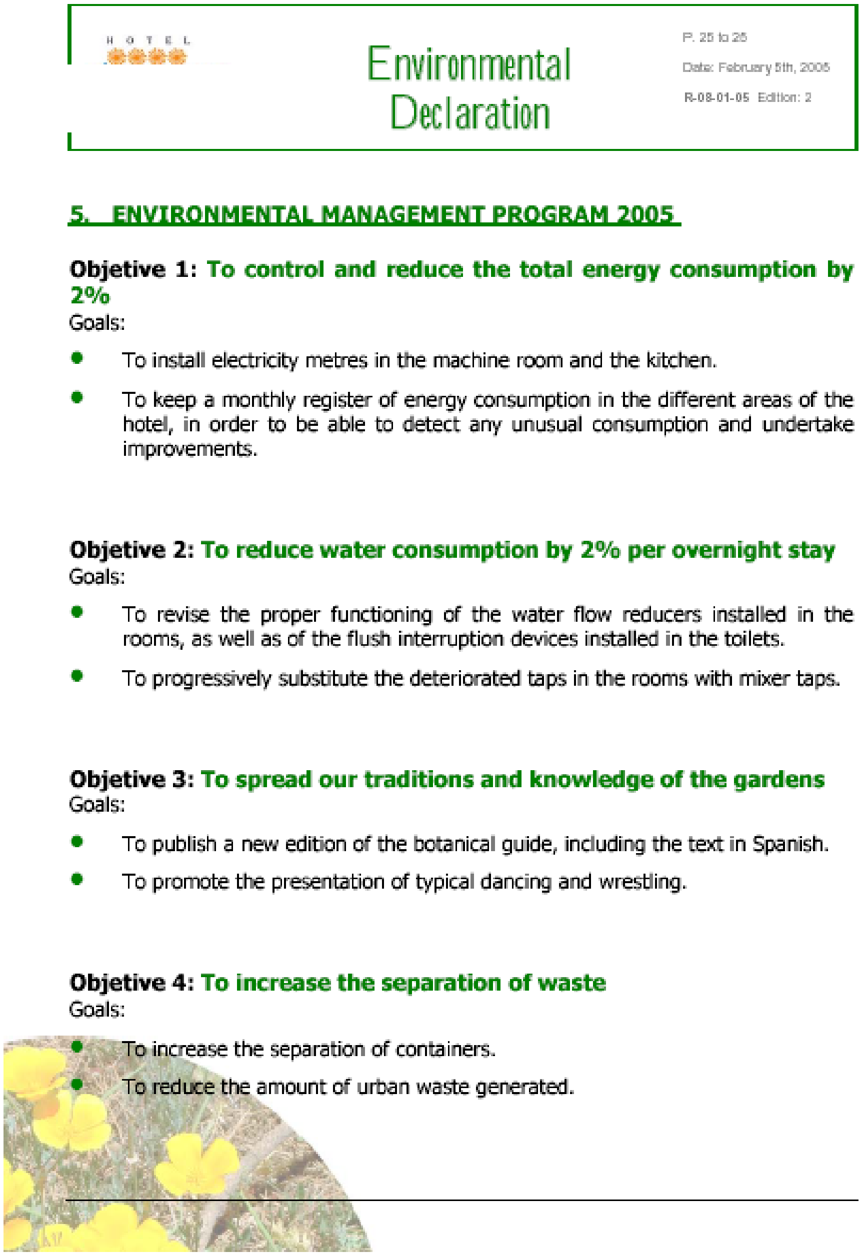
Objetive 1: Water consumption per overnight stay

The water consumption per overnight stay was reduced by 11.6%, a percentage which for the third consecutive year is even higher than the goal initially set. With the introduction of the System we have carried out a thorough control of this aspect, which has enabled us to become aware of the amount of water we consume, to assess it through periodical comparisons, to detect water consumption that it is not normal and to develop strategies for improvement.

Objetive 2: Energy consumption

The energy consumption per overnight stay has risen by 1.7%, with which the goal has not been reached. Nevertheless, compared to other years, this year the increase of energy consumption is stable.

The objective of reducing energy consumption, which was already included in the first environmental declaration, was not reached. This was due to the fact that the possible room for reduction in consumption according to the goals set by the hotel was very small compared with the general increase in demand for electricity. This increase was mainly owing to two factors. On the one hand, the introduction of new facilities requiring a gradual and constant increase in energy consumption, such as for example the air conditioning, the mini bars in each room, the new sauna, the buffet in the restaurant and new kitchen equipment. On the other hand, the renovations carried out in the hotel also consumed a great deal of electricity.



HOTEL

Environmental Declaration

P. 25 to 25
Date: February 5th, 2005
R-08-01-05 Edition: 2

5. ENVIRONMENTAL MANAGEMENT PROGRAM 2005

Objetive 1: To control and reduce the total energy consumption by 2%

Goals:

- To install electricity metres in the machine room and the kitchen.
- To keep a monthly register of energy consumption in the different areas of the hotel, in order to be able to detect any unusual consumption and undertake improvements.

Objetive 2: To reduce water consumption by 2% per overnight stay

Goals:

- To revise the proper functioning of the water flow reducers installed in the rooms, as well as of the flush interruption devices installed in the toilets.
- To progressively substitute the deteriorated taps in the rooms with mixer taps.

Objetive 3: To spread our traditions and knowledge of the gardens

Goals:

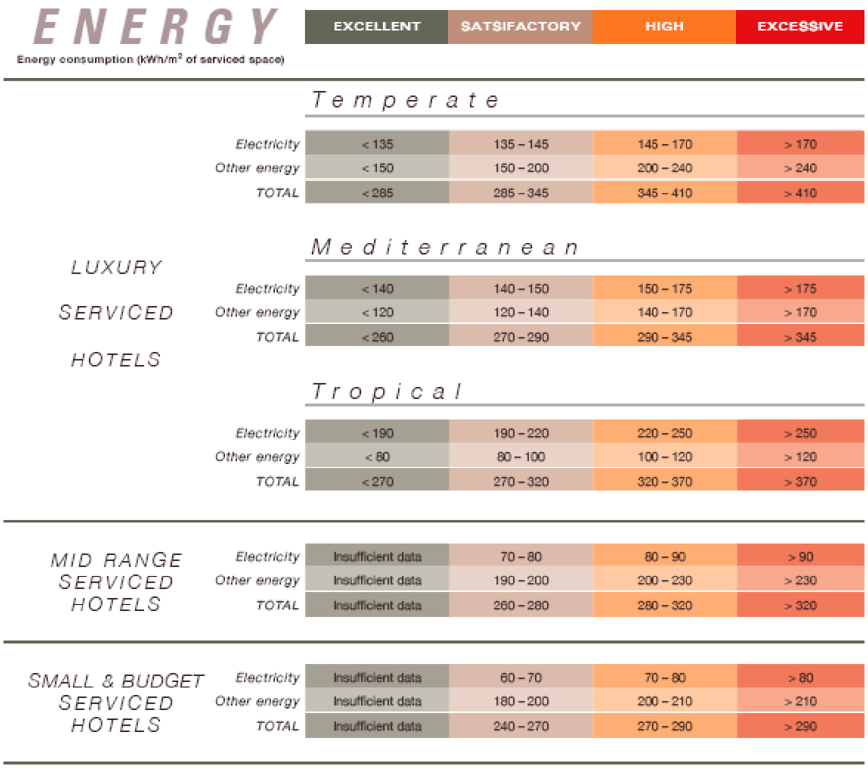
- To publish a new edition of the botanical guide, including the text in Spanish.
- To promote the presentation of typical dancing and wrestling.

Objetive 4: To increase the separation of waste

Goals:

- To increase the separation of containers.
- To reduce the amount of urban waste generated.

Appendix 3J Benchmark values for energy consumption In typical hotels *(IBLF, 2005)*



ENERGY Energy consumption (kWh/m^2 of serviced space)		EXCELLENT	SATSIFACTORY	HIGH	EXCESSIVE
LUXURY SERVICED HOTELS	Temperate				
	Electricity	< 135	135 – 145	145 – 170	> 170
	Other energy	< 150	150 – 200	200 – 240	> 240
	TOTAL	< 285	285 – 345	345 – 410	> 410
	Mediterranean				
	Electricity	< 140	140 – 150	150 – 175	> 175
	Other energy	< 120	120 – 140	140 – 170	> 170
	TOTAL	< 260	270 – 290	290 – 345	> 345
	Tropical				
	Electricity	< 190	190 – 220	220 – 250	> 250
	Other energy	< 80	80 – 100	100 – 120	> 120
	TOTAL	< 270	270 – 320	320 – 370	> 370
MID RANGE SERVICED HOTELS	Electricity	Insufficient data	70 – 80	80 – 90	> 90
	Other energy	Insufficient data	190 – 200	200 – 230	> 230
	TOTAL	Insufficient data	260 – 280	280 – 320	> 320
SMALL & BUDGET SERVICED HOTELS	Electricity	Insufficient data	60 – 70	70 – 80	> 80
	Other energy	Insufficient data	180 – 200	200 – 210	> 210
	TOTAL	Insufficient data	240 – 270	270 – 290	> 290

Source: www.benchmarkhotel.com

Appendix 3K Correction factors for electricity, other energy and heating energy for luxury hotels *(ITP, 2008)*

Electricity	**Temperate**	**Mediterranean**	**Tropical**	
Occupancy	7	8	15	kWh/OCRM*
Laundry	0.12	0.12	0.12	KwH/KG
Covers				
If electrical equipment	3	3	3	kWh/cover
If gas equipment	1	1	1	kWh/cover
If no pool	-3	-3	-3	kWh/m^2
No electric chiller	-10	-12	-18	kWh/m^2

* OCRM Occupied Room.

4

Appendices

Appendix 4A: Breakdown of Nordic Swan points score system *(Nordic Ecolabelling, 2007)*

		Max Point Score
1 General Description		
01	Description of hotel[1]	√ or X
2 Limit Values		
	2.1 Class Division[2]	**Class A,B,C**
	2.2 Energy Consumption[3]* *Option 1:* El & heat per m^2 per year *Option 2:* El & heat/fuels per guest night per year	**Energy Consumption** kWh/gn kWh/m^2
	2.3 Water Consumption	L/gn
	2.4 Chemical products	g/gn
	2.5 Waste management	kg/gn
Total Obligatory requirements ***Limit Values***		**1** **(max 4)**
3 Environmental Requirements[4]		
	3.1 Operation and maintenance	
02	Refrigerants	√
03	**Outdoor Lighting*** [5]	√
04	**Sauna*[6]**	√
P1	**Energy Analysis*[7]**	**3 p**
P2	**Heat Consumption*[8]**	**3 p**

---

[1] Nordic Ecolabelling, 2007, p. 6.

[2] Class A – If at least one of the following parameters is satisfied:
l The establishment has a restaurant turnover greater than 45% of the total turnover for restaurant and lodging.
l Lodging occupancy is greater than 60%.
Class B – If A is not satisfied, but at least one of the following parameters is satisfied:
l The establishment has a restaurant turnover of between 15-45% of the total turnover for restaurant and lodging.
l Lodging occupancy is between 40-60%
l There is a pool.
Class C – Other establishments (Nordic Ecolabelling, 2007)

[3] Nordic Ecolabelling, 2007, p. 9.

[4] Ibid.,2007. p. 12.

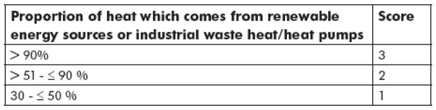
[5] All external lighting must be timer controlled or demand-controlled. If lighting is on during the night, low energy lamps must be used, with the exception of the hotel's entrance area and any electric signs. (Ibid., 2007)

[6] All sauna units must be timer or demand-controlled.

[7] An energy analysis has been carried out by an independent energy expert within the last five years with the objective of reducing the amount of energy used and/or to make the facility carbon dioxide neutral: 3p
An analysis has been ordered and will be carried out within six months: 2p
The hotel buildings are maximum three years old: 3p
Note: Additional note see Nordic Ecolabelling, 2007, p. 12.

[8]

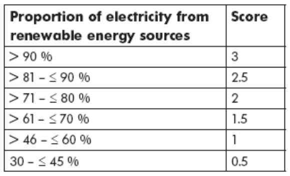
P3	**Electricity Consumption***[9]	**3 p**
P4	Refrigerants	2 p
P5	**Heat Recovery ***[10]	**3 p**
P6	**Control of ventilation and interior lighting***[11]	**3 p**
P7	**Low energy lamps***[12]	**3 p**



Proportion of heat which comes from renewable energy sources or industrial waste heat/heat pumps	Score
> 90%	3
> 51 - ≤ 90 %	2
30 - ≤ 50 %	1

Heat from direct-acting electricity is not acceptable in P2.
Heating: The energy used for heating the hotel's rooms and other areas.
The proportion of heat contributed by heat pumps is counted as supplied output in relation to the total heat consumption.
Renewable energy: See Glossary.
Waste heat: See Glossary. Example calculations can be found under "Heat and electricity consumption" in the glossary. (Nordic Ecolabelling, 2007,p.13).

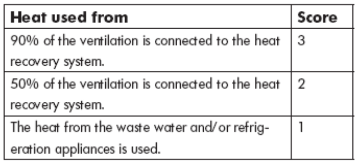
[9]



Proportion of electricity from renewable energy sources	Score
> 90 %	3
> 81 – ≤ 90 %	2.5
> 71 – ≤ 80 %	2
> 61 – ≤ 70 %	1.5
> 46 – ≤ 60 %	1
30 – ≤ 45 %	0.5

Ecolabelled electricity is included as 100% renewable energy. The electricity supplier's specification in the general mix minus the sale of renewable energy is acceptable. Merely referring to the national energy mix is not acceptable.
Example calculations can be found under "Heat and electricity consumption" in the glossary (Ibid., 2007, p.13)

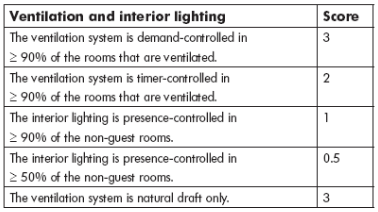
[10]



Heat used from	Score
90% of the ventilation is connected to the heat recovery system.	3
50% of the ventilation is connected to the heat recovery system.	2
The heat from the waste water and/or refrigeration appliances is used.	1

Note: Describe the ventilation system with regard to heat recovery. Ventilation is calculated on air flow. (Ibid., 2007, p.14).

[11]



Ventilation and interior lighting	Score
The ventilation system is demand-controlled in ≥ 90% of the rooms that are ventilated.	3
The ventilation system is timer-controlled in ≥ 90% of the rooms that are ventilated.	2
The interior lighting is presence-controlled in ≥ 90% of the non-guest rooms.	1
The interior lighting is presence-controlled in ≥ 50% of the non-guest rooms.	0.5
The ventilation system is natural draft only.	3

Exceptions: Interior lighting required for safety reasons, for example emergency lighting. Cooker hood fans are not included.
Demand-control means that the ventilation system/lighting is adapted to the number of individuals in the room. Note: Specify how the ventilation fans, units and lighting are controlled. (Ibid., 2007, p.14)

[12] ≥ 80% of the light sources in the establishment are low-energy lamps: 3p
≥ 60 - < 80% of the light sources in the establishment are low-energy lamps: 2p
≥ 40 - < 60% of the light sources in the establishment are low-energy lamps: 1p
(Note: Summary of the use of low-energy lamps. See Glossary for a definition of low-energy lamps. LEDs score points here and under P8.
(Ibid., 2007, p.14)

P8	**LED lamps***[13]	**1 p**
P9	Toilets	0 p[14]
P10	Toilets	0 p[15]
P11	Water saving taps	1 p[16]
Total Energy Related points score ***Operation and maintenance***		**19 p** (max 25 p)
Total Obligatory requirements ***Operation and maintenance***		**2** **(max 3)**
	3.2 Hotel Premises and purchased products	
05	Fittings and fixtures	√
06	New purchase of textiles	√
07	**New purchase of low energy lamps and fluorescent tubes***[17]	√
08	Kitchen rolls, paper towels and toilet paper	√
P12	Toner cartridges	0.5 p
P13	**Office Machines***[18]	**1 p**
P14	Ecolabelled Printed matter	2 p
P15	Ecolabelled soap and shampoo	2 p
P16	Dispensers for soap and shampoo	1 p
P17	Reusable Drinking glasses and mugs	0 p
P18	Returnable bottles or barrels/tanks	2 p
P19	Work Clothes	0.5p
P20	Ergonomic Working Environment	0 p
P21	Purchase of ecolabelled consumables	3.5 p
P22	Ecolabelled durable goods/infrequently bought commodities	2 p
P23	Ecolabelled services	1 p
Total Energy Related points score ***Hotel Premises and purchased products***		**1 p** (max 20 p)

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[13] ≥ 20% of the spotlights in the establishment are LEDs or similar products: 1p
10 - < 20% of the spotlights in the establishment are LEDs or similar products: 0.5p.
(*Note: Include Summary of the use of LEDs. LED refers to Light Emitting Diode. Nordic Ecolabelling can approve of other light sources that do not contain Hg and at the same time are low energy and long life.*) (Ibid., 2007, p.14)

[14] Less than 50% of WCs use a maximum of 6 litres of water per flush. (Ibid., 2008)

[15] Less than 20% of WCs provide two flush options. (Ibid., 2008)

[16] At least 90% of the mixer taps for the wash basins have a maximum flow rate of 8-10 litres / minute. (Ibid., 2007, p.14)

[17] Newly purchased low-energy lamps/fluorescent tubes (single socket) must have a service live of at least 10 000 hours.

Newly purchased fluorescent tubes (double socket) must have a service live of at least 20 000 hours.

Alternatively, the light sources shall be ecolabelled.
(Note: Include a description of how the requirement is fulfilled (most packaging is marked with the service life in hours). (Ibid., 2007, p.16)

18 ≥ 90% of office machines (computers, faxes, copiers, etc.) are operated with the standby function activated: 1p

50 - < 90% of office machines (computers, faxes, copiers, etc.) are operated with the standby function activated: 0.5p

≥ 50% of office machines are connected to an auto power-off socket: 0.5p
(Note: Specify the proportion of office machines that have a standby function. (Ibid., 2007, p.16).

Total Obligatory requirements ***Hotel Premises and purchased products***		**1** **(max 4)**
	3.3 Guest Rooms	
O3	Smoke free rooms	√
P25	Ecolabelled bedlinen and towels	0 p
P26	**Lighting***[19]	**1 p**
P27	**Television Sets***[20]	**1 p**
P28	**Minibars***[21]	**1.5 p**
P29	**Water saving showers***[22]	**2 p**
P30	**Single lever mixer taps***[23]	**1 p**
P31	Disposable Items	1 p
P32	Waste Sorting	1 p
P33	Waste Paper Bin	0 p
P34	Rooms for physically disabled or allergy sufferers	1 p
Total Energy Related points score **Guest Rooms**		**6.5 p** (max 12.5 p)
	3.4 Kitchen and dining room	
O10	Disposable Items	√
O11	Ecolabelled dishwashing chemicals	√
O12	Non-ecolabelled products for washing up	√
O13	No-smoking dining rooms	√
P35	Organic foodstuffs and beverages	0.5 p
P36	Fairtrade products	1 p
P37	Ecolabelled dishwashing chemicals	1 p
P38	Dosage of dishwashing chemicals	1 p

---

[19] ≥ 90% of the lighting in the guest rooms is presence-controlled: 1p
Between 50 < 90% of the lighting is presence-controlled: 0.5p
(*Note: Description of the presence-controlled lighting.*
Example of a presence-controlled system includes a card holder for the key card.) (Ibid., 2007, p.20)

[20] ≥90% of the television sets have a passive standby setting of maximum 1 W, and if applicable, an active standby setting max 9 W: 1p
Cleaning staff procedures include switching of television sets: 0.5p
Guest rooms do not have television sets: 1p
(*Note: Declaration from supplier or technical description, alternatively procedures in environmental management system, and specification of the number of television sets which comply with requirements. See Glossary for an explanation of what is meant by passive and active standby*) (Ibid., 2007, p.20)

[21] ≥ 90% of the minibars consume at most 0.8 kWh/day: 1.5p
≥ 90% of the minibars consume at most 1.0 kWh/day: 1p
≥ 90% of the minibars consume at most 1.3 kWh/day: 0.5p
Guest rooms do not have minibars: 1.5p
At least half of the guest rooms do not have minibars: 1p (Ibid., 2007, p.20)

[22] ≥ 90% of shower heads are of the water-saving type, with a flow rate of at most 10 litres/minute: 2p
≥ 90% of shower heads are of the water-saving type, with a flow rate of 10-12 litres/minute: 1p
(Note: *Specify the proportion of shower heads with a flow rate of maximum 10 respective 12 litres/minute*.) (Ibid., 2007, p.21)

[23] ≥ 90% of the mixer taps are single lever mixer taps alternatively sensor controlled: 1p
(Note: *Specify the proportion of mixer taps that are of the single-lever type.*) (Ibid., 2007, p.21)

Total Energy Related points score ***Kitchen and dining room***		**0 p** (max 7.5 p)
	3.5 Extra requirements for hotels with restaurant	
P39	Swan-labelled restaurant	1
P40	Regional foodstuffs and beverages	0.5
P41	Vegetarian food	0.5
P42	Declaration of GMO content	0.5
P43	Origin of main ingredients	0
P44	Foods with significant environmental impact	0.5
P45	**Energy and water saving action***[24]	4.5
Total Energy Related points score ***Extra requirements for hotels with restaurant***		**4.5 p** (max 7.5 p)
	3.6 Cleaning and Laundry	
O14	Reactive chlorine compounds	√
O15	Ecolabelled laundry detergents	√
O16	Non-ecolabelled laundry detergents	√
O17	Ecolabelled cleaning products	√
O18	Non-ecolabelled cleaning products	√
P46	Dry cleaning methods	2 p
P47	Ecolabelled laundry products	2 p
P48	Ecolabelled cleaning products	1 p
P49	**Bed Linen and Towels***[25]	**2 p**
P50	Exact dosing	2 p
P51	Chemical products	0 p
Total Energy Related points score for Cleaning and laundry		**2 p** (max 11 p)
	3.7 Waste	
019	Environmentally dangerous waste	√
020	Waste Sorting	√
021	Batteries	√
P52	Further Waste Sorting	4 p
P53	Returnable packaging	1 p
P54	Organic Waste	1 p
Total Energy Related points score for Waste		**0 p**

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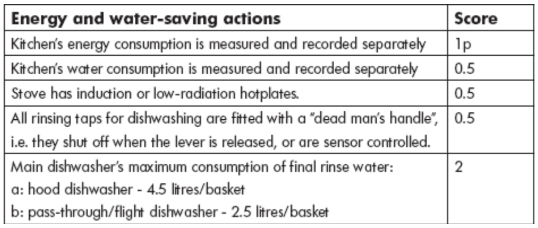
[24]



Energy and water-saving actions	Score
Kitchen's energy consumption is measured and recorded separately	1p
Kitchen's water consumption is measured and recorded separately	0.5
Stove has induction or low-radiation hotplates.	0.5
All rinsing taps for dishwashing are fitted with a "dead man's handle", i.e. they shut off when the lever is released, or are sensor controlled.	0.5
Main dishwasher's maximum consumption of final rinse water: a: hood dishwasher - 4.5 litres/basket b: pass-through/flight dishwasher - 2.5 litres/basket	2

(Note: *Include Summary and description of the actions. Submit technical information about the dishwasher's water consumption. Energy and water consumption are recorded at least 4 times per year.* (Ibid., 2007, p.25)

[25] Bed linen and towels are cleaned at a Nordic Ecolabelled laundry: 2p
Bed linen or towels are cleaned at a Nordic Ecolabelled laundry: 1p
Bed linen and towels are washed by the hotel: 1p
Bed linen or towels are washed by the hotel: 0.5p
(Note: *Invoice or declaration from the laundry*. (Ibid., 2007, p.27)

		(max 6 p)
	3.8 Transport and distribution	
P55	Own vehicles	1 p
P56	Public Transport	1 p
P57	Bicycles and horses	1 p
Total Energy Related points score for transport and distribution		**0 p** (max 3 p)
	3.9 Extra Points from the limit values[26]	
P58	**Limit values (max 4 p) ***[27]	**4 p (2p energy)**
P59	**Energy Consumption lower than the limit value (max. 4 p) ***[28]	**4 p**
Total Energy Related points score for extra points from the limit values and energy consumption		**8 p** (max 8 p)
	3.10 Extra Points for hotels with conference facilities	
022	Waste sorting	√
P60	Waste sorting	0p
P61	Conference pads	1 p
P62	Flip charts and pens (max 2 p)	2 p
P63	Drinking glasses	1 p
P64	Organically grown fruit	0 p
Total Energy Related points score for extra points for hotels with conference facilities		**0 p** (max 6 p)
	3.11 Extra Requirements for hotels with pool/hot springs	
P65	Pool disinfection	N/A
P66	Pool cleaning chemicals	N/A
P67	**Pool facilities/Jacuzzi/hot springs***[29]	**1 p**
P68	Pool temperature (max 1 p)	N/A
Total Energy Related points score for extra points for hotels with pool/hot springs		**1 p** **(max 4 p)**
	3.12 Extra Requirements for hotels	

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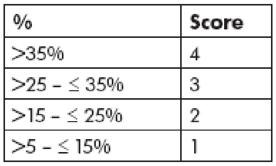
[26] The hotel can score extra points if it exceeds more than two of the limit values in 2.3, 2.4 and 2.5 or has considerably better values regarding energy. (Ibid., 2007, p.30)

[27] The hotel satisfies all four limit values: 4p
The hotel satisfies three limit values: 2p
(Note: *Can be determined from the documentation for Section 2*.) (Ibid., 2007, p.30)

[28] The establishment's total energy consumption is X% lower than the limit value for energy (see calculation in Section 1.2):



%	Score
>35%	4
>25 – ≤ 35%	3
>15 – ≤ 25%	2
>5 – ≤ 15%	1

(Note: *Can be determined from the documentation for the calculation of the energy limit value, Section 2.2*.) (Ibid., 2007, p.30)

[29] Water and energy consumption are metered separately for the pool facilities: 1p
Water or energy consumption is metered separately for the pool facilities: 0.5p
Energy consumption for hot springs is regulated and optimised: 1p (applies only for Iceland)
(Note: *Specification of which meters there are specifically for the pool facilities*.) (Ibid., 2007, p.32)

	with garden	
O23	Biocides	√
O24	Composting	√
Total Energy Related obligatory requirements for extra points for hotels with garden		**0 (max 2)**
	3.13 Extra Requirements and adaptations for youth hostels	
O25	Dishwashing detergents and cleaning chemicals	N/A
O26	Waste	N/A
Total Energy Related obligatory requirements for extra points for hotels with garden		**0 (max 2)**
	3.14 Environmental management	
O27	Organisation and responsibility	√
O28	**Actions to reduce environmental impact***[30]	√
O29	Legislation and regulatory requirements	√
O30	Information about Swan for employees	√
O31	Guest information	√
O32	**Continuous measurements***[31]	√
O33	Documentation of Swan requirements	√
O34	**Energy-demanding equipment and service log***[32]	√
O35	Handling of chemical products	√
O36	Annual follow-up	√
Total Energy Related obligatory requirements for extra points for environmental management		**3 (max 10)**

***** Denotes direct impact on reducing energy consumption (emissions)***

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[30] reduce its environmental impact. The action plan must include the following:
I At least two measurable, scheduled targets within the areas of energy, chemicals, water or waste with actions that lead to concrete environmental improvements. Measures taken by possible energy analysis may be included, see P1.
I Person responsible for the activity has been chosen.
I The action plan must be revised when there are operational changes and when new goals are established.
(Note: See separate appendix for an example of an action plan.
(Specification of actions to be taken. See appendix for assistance.) (Ibid., 2007, p.35)

[31] There must be procedures for measuring and documenting the limit values for the Swan license for water, energy, waste and chemical products as follows:
I energy use – monthly when the establishment is open.
I water consumption – monthly when the establishment is open.
I quantity of chemical products – yearly.
I quantity of waste – yearly.
Checked on site. (Ibid., 2007, p.36)

[32] The hotel must maintain a list of energy-demanding technical equipment and their service intervals along with a list of the individuals responsible for servicing the equipment. Energy-demanding equipment includes for example refrigeration units, heating systems, ventilation systems and pool facilities.
The employees responsible at the hotel will ensure that services are carried out as planned.
The hotel must keep a service log which shall include the date, signature and action taken which shows that the technical service has been carried out (see appendix for assistence).
The service log shall be kept for at least 2 years.
(List of energy-demanding equipment. See appendix for assistance.
Service log, checked on site. (Ibid., 2007, p.37)

Appendix 4B EU Flower - energy mandatory requirements & optional score criteria (EC, 2003)

Energy mandatory requirements:

- 22% electricity from renewable resources.
- No oil with Sulphur content > 0.2% and no coal as energy source.
- Boiler efficiency > 90% as measured according to Directive 92/42/EEC.
- Air conditioning with class B efficiency according to Directive 2002/31/EC.
- Appropriate window insulation.
- Sauna with timer control.

Energy optional criteria (point score):

1. Photovoltaic and wind generation of electricity (2 points)
2. Heating from renewable energy sources (1,5 points)
3. Boiler energy efficiency (1 point)
4. Boiler NOx emissions (1,5 points)
5. District heating (1 point)
6. Combined heat and power (1,5 points)
7. Heat pump (1,5 points)
8. Heat recovery (2 points)
9. Thermoregulation (1,5 points)
10. Insulation of existing buildings (2 points)
11. Air conditioning (1,5 points)
12. Automatic switching-off of air conditioning (1 point)
13. Bioclimatic architecture (2 points)
14. Energy efficient refrigerators (1 point), dishwashers (1 point), washing machines (1 point) and office equipment (1 point)
15. Refrigerator positioning (1 point)
16. Automatic switching off lights in guest rooms (1 point)
17. Automatic switching off outside lights (1 point)

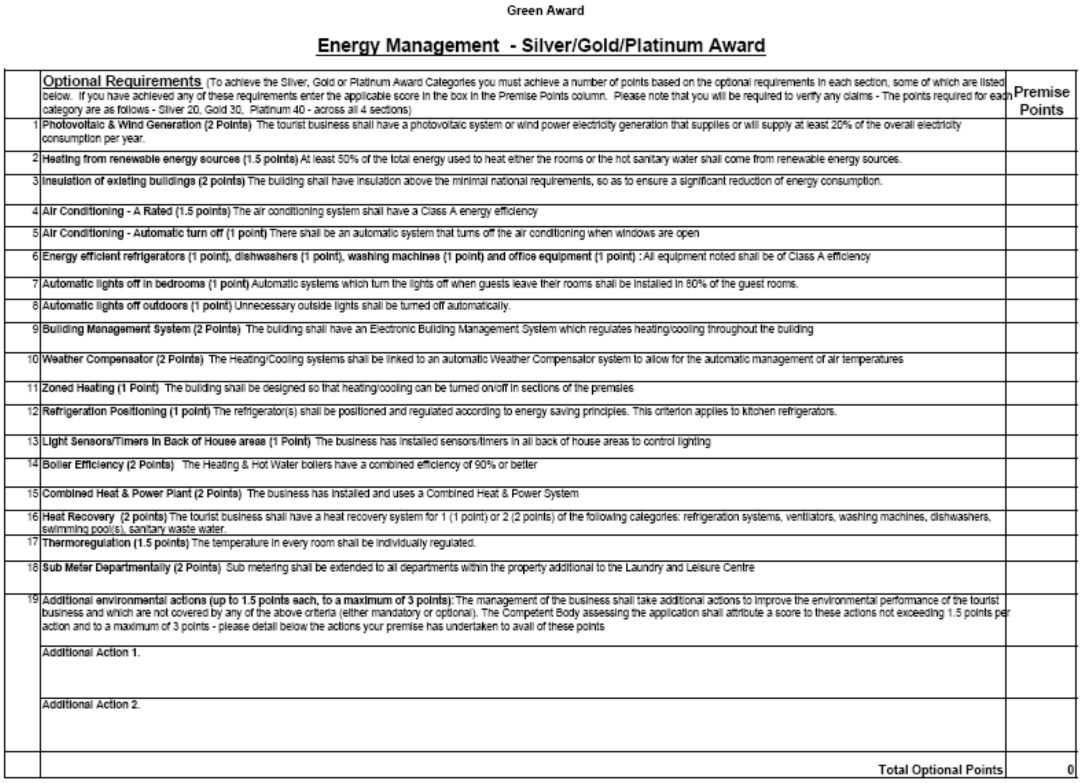
Appendix 4C Green Hospitality Award *mandatory* requirements for silver/gold/platinum energy management *(GHA, 2008)*

Green Award

Energy Management - Silver/Gold/Platinum Award

	Mandatory Requirements (Depending on the Award Category your business is aiming to achieve you must deliver some, or all, of the mandatory requirements listed below. The columns on the right identify the requirements for each category. If you have achieved any of these requirements place a Y in the box in the Premise Action column)	Award Level			Premise Action (Y/N)
		Silver	Gold	Platinum	
1	**Boiler Efficiency (New)** The efficiency of any new boiler (heat generator) purchased within the duration of the Green Fáilte award shall be at least 90%	Y	Y	Y	
2	**Air Conditioning Purchase** Any air conditioning system purchased within the duration of the Green Fáilte award shall have at least a Class B energy efficiency	Y	Y	Y	
3	**Window Insulation** All windows in rooms shall have an appropriately high degree of thermal insulation, according to local climate, and shall provide an appropriate degree of acoustic insulation. (excepting where planning restrictions apply)	Y	Y	Y	
4	**Control - A/C & Heating** If the heating or the air conditioning does not switch off automatically when windows are open, there shall be easily available information reminding the guest to close the window(s) if the heating or the air conditioning is on.	Y	Y	Y	
5	**Switching off lights** If there is no automatic off switch(or electronic key card) for lights in the room, there will be easily available information to the guests asking them to turn off the light when leaving the room	Y	Y	Y	
6	**Energy Efficient Light Bulbs** Within one year from the date of application, at least 60% of all light bulbs in the accommodation shall have an energy efficiency of Class A	Y	Y	Y	
7	**Maintenance & Servicing of Equipment** All main equipment used to provide the tourist business service shall be serviced and maintained in compliance with the law and when otherwise necessary, and the work shall be carried out by qualified personnel only.	Y	Y	Y	
8	**Maintenance & Servicing of Boilers** Maintenance and servicing of boilers shall be carried out at least yearly and Management must know the % efficiency of each main hot water or heating boiler in use.	Y	Y	Y	
9	**Sub Metering** Major Energy using departments shall be sub metered - specifically Laundries and Leisure Centres - and the data monitored monthly and entered into the data workbooks		Y	Y	
10	**Electricity from renewable sources** At least 22% of the electricity shall come from renewable energy sources			Y	
11	**Control - Air Conditioning** - The air conditioning in bedrooms switches off automatically when windows are open			Y	
12	**Control - Air Conditioning and Heating.** Any heating or air conditioning system installed in a new bedroom block development during the Green Fáilte Award status shall be designed so that they turn off if the windows are opened.		Y	Y	
13	**Energy Efficient Light Bulbs** At least 80% of all light bulbs in the business that are situated where they are likely to be turned on for more than 5 hours a day shall have an energy efficiency of Class A			Y	

Green Failte Award *Optional* Point Requirements for Silver/Gold/Platinum Award – Energy Management

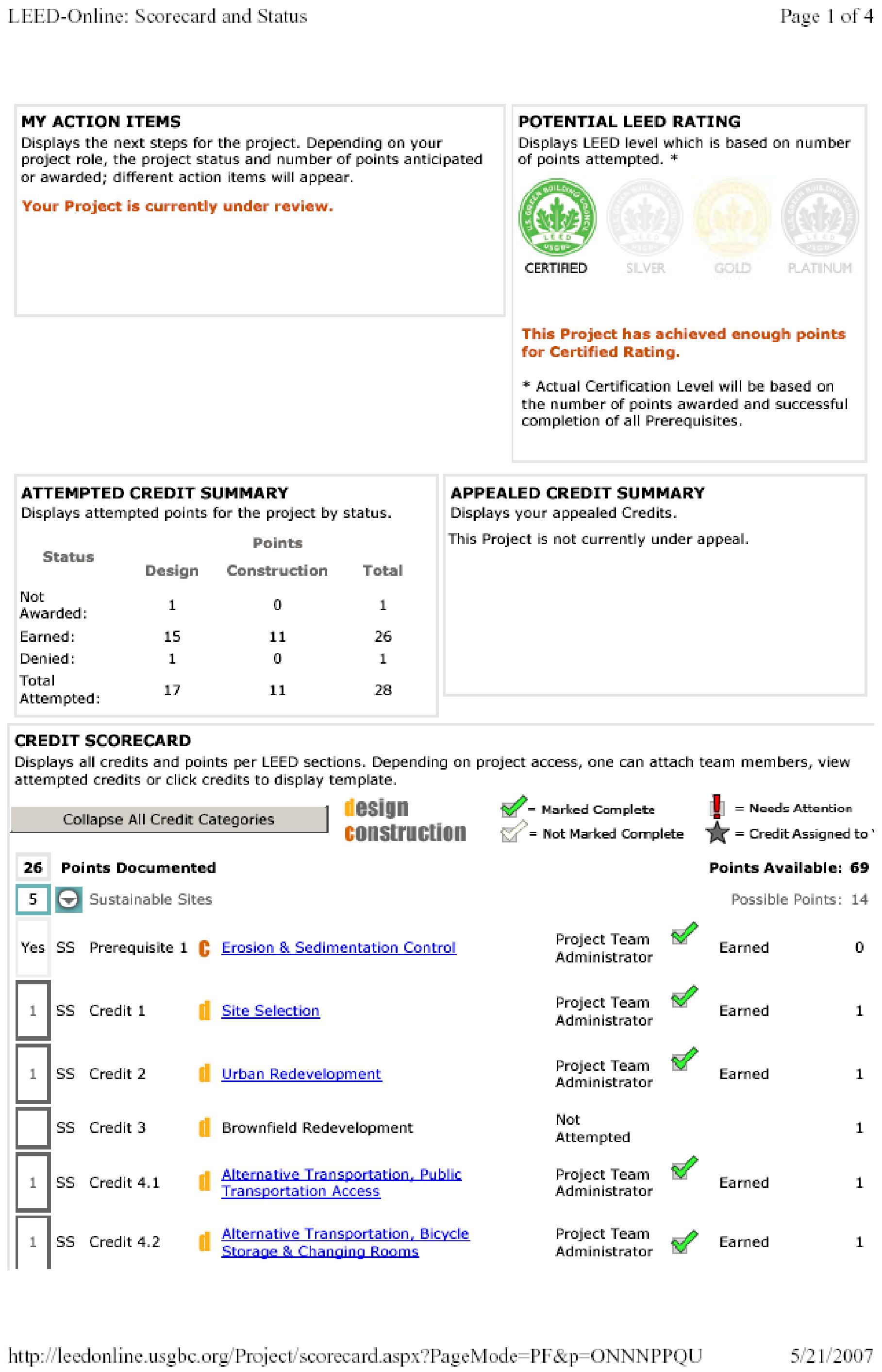


Green Award

Energy Management - Silver/Gold/Platinum Award

	Optional Requirements (To achieve the Silver, Gold or Platinum Award Categories you must achieve a number of points based on the optional requirements in each section, some of which are listed below. If you have achieved any of these requirements enter the applicable score in the box in the Premise Points column. Please note that you will be required to verify any claims - The points required for each category are as follows - Silver 20, Gold 30, Platinum 40 - across all 4 sections)	Premise Points
1	**Photovoltaic & Wind Generation (2 Points)** The tourist business shall have a photovoltaic system or wind power electricity generation that supplies or will supply at least 20% of the overall electricity consumption per year.	
2	**Heating from renewable energy sources (1.5 points)** At least 50% of the total energy used to heat either the rooms or the hot sanitary water shall come from renewable energy sources.	
3	**Insulation of existing buildings (2 points)** The building shall have insulation above the minimal national requirements, so as to ensure a significant reduction of energy consumption.	
4	**Air Conditioning - A Rated (1.5 points)** The air conditioning system shall have a Class A energy efficiency	
5	**Air Conditioning - Automatic turn off (1 point)** There shall be an automatic system that turns off the air conditioning when windows are open	
6	**Energy efficient refrigerators (1 point), dishwashers (1 point), washing machines (1 point) and office equipment (1 point)** : All equipment noted shall be of Class A efficiency	
7	**Automatic lights off in bedrooms (1 point)** Automatic systems which turn the lights off when guests leave their rooms shall be installed in 80% of the guest rooms.	
8	**Automatic lights off outdoors (1 point)** Unnecessary outside lights shall be turned off automatically.	
9	**Building Management System (2 Points)** The building shall have an Electronic Building Management System which regulates heating/cooling throughout the building	
10	**Weather Compensator (2 Points)** The Heating/Cooling systems shall be linked to an automatic Weather Compensator system to allow for the automatic management of air temperatures	
11	**Zoned Heating (1 Point)** The building shall be designed so that heating/cooling can be turned on/off in sections of the premsies	
12	**Refrigeration Positioning (1 point)** The refrigerator(s) shall be positioned and regulated according to energy saving principles. This criterion applies to kitchen refrigerators.	
13	**Light Sensors/Timers in Back of House areas (1 Point)** The business has installed sensors/timers in all back of house areas to control lighting	
14	**Boiler Efficiency (2 Points)** The Heating & Hot Water boilers have a combined efficiency of 90% or better	
15	**Combined Heat & Power Plant (2 Points)** The business has installed and uses a Combined Heat & Power System	
16	**Heat Recovery (2 points)** The tourist business shall have a heat recovery system for 1 (1 point) or 2 (2 points) of the following categories: refrigeration systems, ventilators, washing machines, dishwashers, swimming pool(s), sanitary waste water.	
17	**Thermoregulation (1.5 points)** The temperature in every room shall be individually regulated.	
18	**Sub Meter Departmentally (2 Points)** Sub metering shall be extended to all departments within the property additional to the Laundry and Leisure Centre	
19	**Additional environmental actions (up to 1.5 points each, to a maximum of 3 points):** The management of the business shall take additional actions to improve the environmental performance of the tourist business and which are not covered by any of the above criteria (either mandatory or optional). The Competent Body assessing the application shall attribute a score to these actions not exceeding 1.5 points per action and to a maximum of 3 points - please detail below the actions your premise has undertaken to avail of these points	
	Additional Action 1.	
	Additional Action 2.	
	Total Optional Points	0

Appendix 4D Example of LEED-online scorecard for LEED-NC certified hotel *(USGBC, 2007a)*



LEED-Online: Scorecard and Status Page 1 of 4

MY ACTION ITEMS
Displays the next steps for the project. Depending on your project role, the project status and number of points anticipated or awarded; different action items will appear.

Your Project is currently under review.

POTENTIAL LEED RATING
Displays LEED level which is based on number of points attempted. *

CERTIFIED SILVER GOLD PLATINUM

This Project has achieved enough points for Certified Rating.

* Actual Certification Level will be based on the number of points awarded and successful completion of all Prerequisites.

ATTEMPTED CREDIT SUMMARY
Displays attempted points for the project by status.

Status	Points		
	Design	Construction	Total
Not Awarded:	1	0	1
Earned:	15	11	26
Denied:	1	0	1
Total Attempted:	17	11	28

APPEALED CREDIT SUMMARY
Displays your appealed Credits.
This Project is not currently under appeal.

CREDIT SCORECARD
Displays all credits and points per LEED sections. Depending on project access, one can attach team members, view attempted credits or click credits to display template.

Collapse All Credit Categories

design
construction

✓ = Marked Complete
✓ = Not Marked Complete
! = Needs Attention
★ = Credit Assigned to '

26 **Points Documented** **Points Available: 69**

5 Sustainable Sites Possible Points: 14

Yes	SS	Prerequisite 1	C	Erosion & Sedimentation Control	Project Team Administrator ✓	Earned	0
1	SS	Credit 1		Site Selection	Project Team Administrator ✓	Earned	1
1	SS	Credit 2		Urban Redevelopment	Project Team Administrator ✓	Earned	1
	SS	Credit 3		Brownfield Redevelopment	Not Attempted		1
1	SS	Credit 4.1		Alternative Transportation, Public Transportation Access	Project Team Administrator ✓	Earned	1
1	SS	Credit 4.2		Alternative Transportation, Bicycle Storage & Changing Rooms	Project Team Administrator ✓	Earned	1

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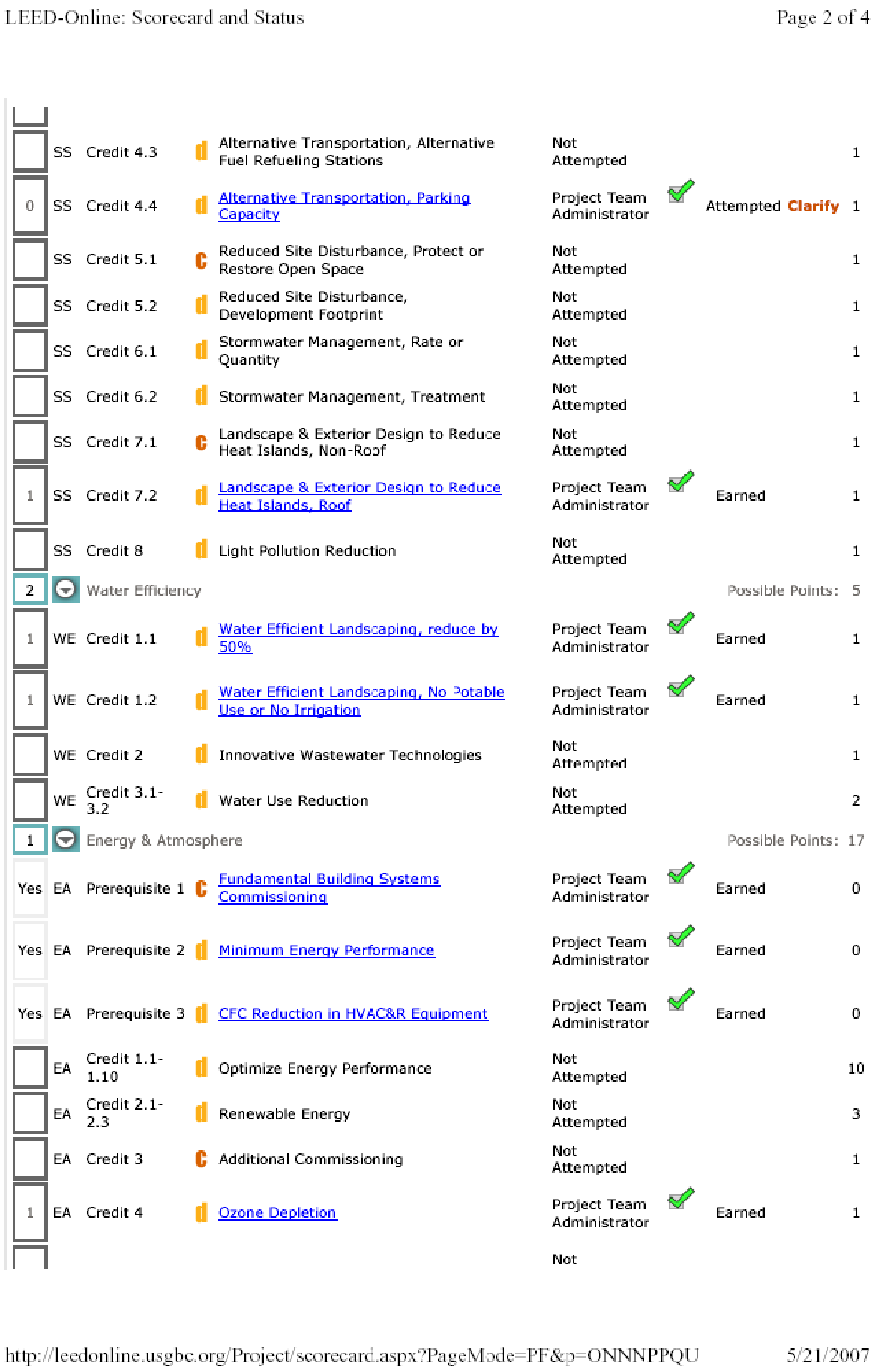
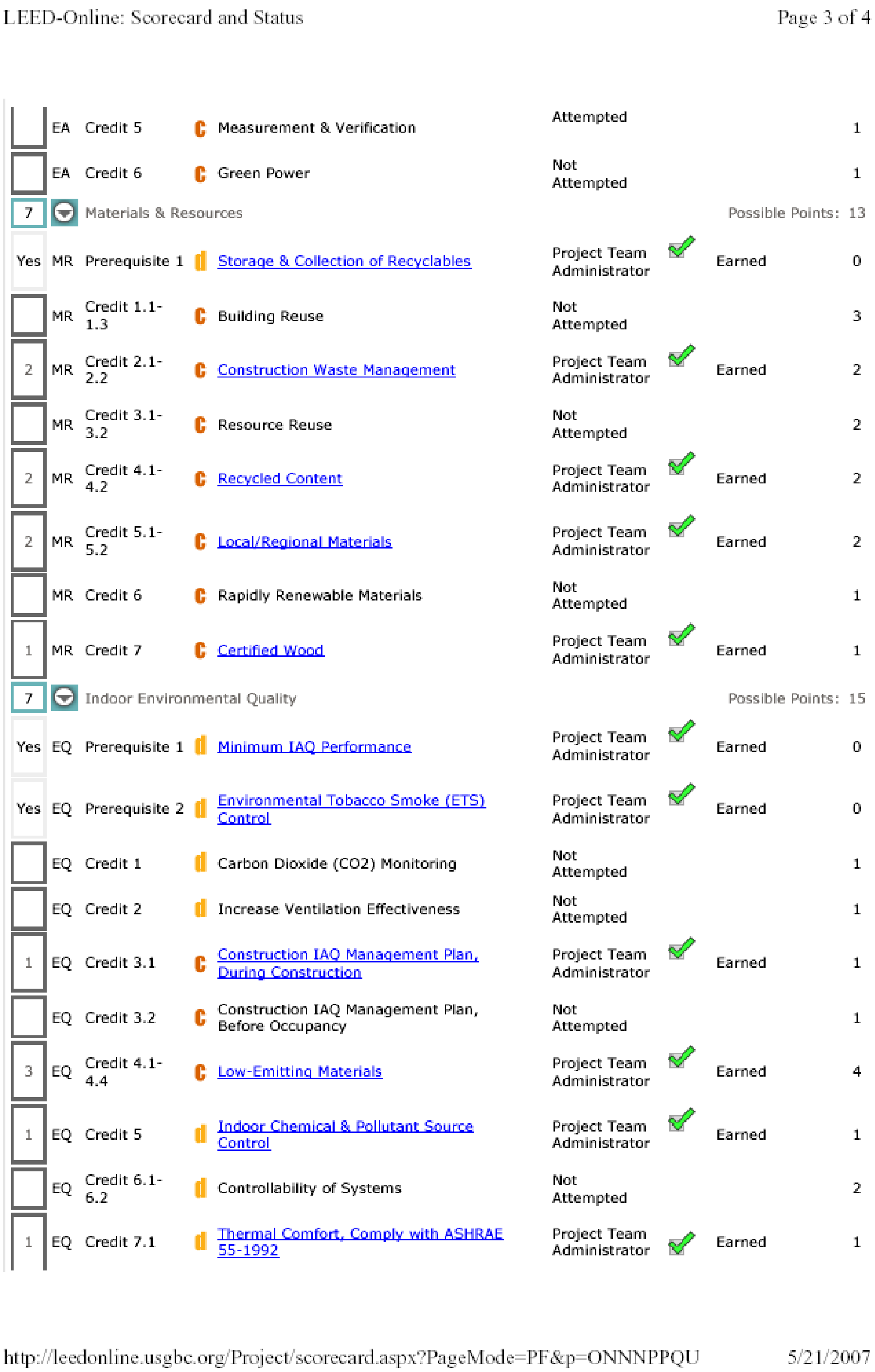


LEED-Online: Scorecard and Status Page 2 of 4

	SS	Credit 4.3	▮	Alternative Transportation, Alternative Fuel Refueling Stations	Not Attempted			1
0	SS	Credit 4.4	▮	Alternative Transportation, Parking Capacity	Project Team Administrator	✓	Attempted **Clarify**	1
	SS	Credit 5.1	C	Reduced Site Disturbance, Protect or Restore Open Space	Not Attempted			1
	SS	Credit 5.2	▮	Reduced Site Disturbance, Development Footprint	Not Attempted			1
	SS	Credit 6.1	▮	Stormwater Management, Rate or Quantity	Not Attempted			1
	SS	Credit 6.2	▮	Stormwater Management, Treatment	Not Attempted			1
	SS	Credit 7.1	C	Landscape & Exterior Design to Reduce Heat Islands, Non-Roof	Not Attempted			1
1	SS	Credit 7.2	▮	Landscape & Exterior Design to Reduce Heat Islands, Roof	Project Team Administrator	✓	Earned	1
	SS	Credit 8	▮	Light Pollution Reduction	Not Attempted			1
2	⊖	Water Efficiency					Possible Points:	5
1	WE	Credit 1.1	▮	Water Efficient Landscaping, reduce by 50%	Project Team Administrator	✓	Earned	1
1	WE	Credit 1.2	▮	Water Efficient Landscaping, No Potable Use or No Irrigation	Project Team Administrator	✓	Earned	1
	WE	Credit 2	▮	Innovative Wastewater Technologies	Not Attempted			1
	WE	Credit 3.1-3.2	▮	Water Use Reduction	Not Attempted			2
1	⊖	Energy & Atmosphere					Possible Points:	17
Yes	EA	Prerequisite 1	C	Fundamental Building Systems Commissioning	Project Team Administrator	✓	Earned	0
Yes	EA	Prerequisite 2	▮	Minimum Energy Performance	Project Team Administrator	✓	Earned	0
Yes	EA	Prerequisite 3	▮	CFC Reduction in HVAC&R Equipment	Project Team Administrator	✓	Earned	0
	EA	Credit 1.1-1.10	▮	Optimize Energy Performance	Not Attempted			10
	EA	Credit 2.1-2.3	▮	Renewable Energy	Not Attempted			3
	EA	Credit 3	C	Additional Commissioning	Not Attempted			1
1	EA	Credit 4	▮	Ozone Depletion	Project Team Administrator	✓	Earned	1
					Not			

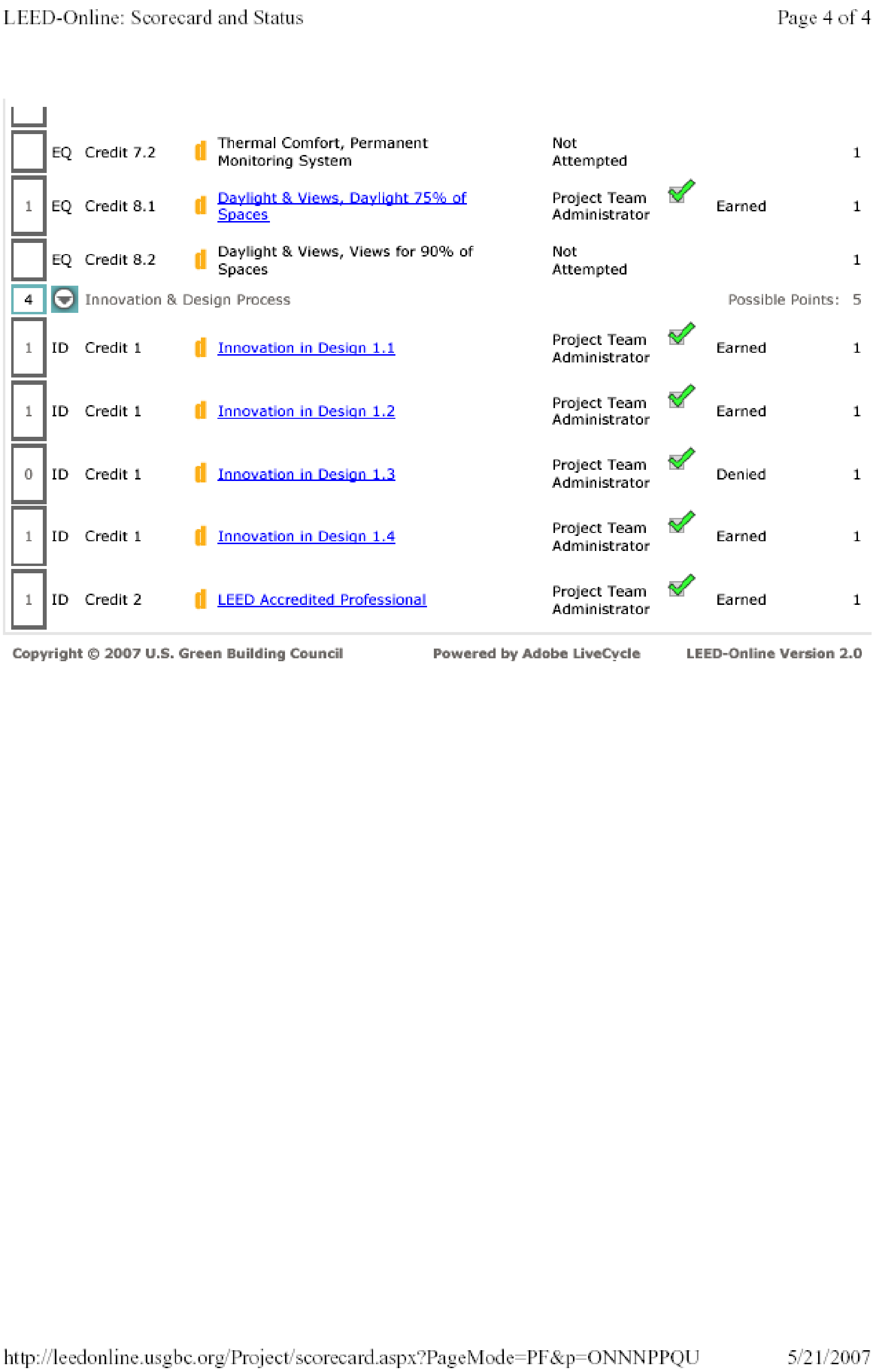
http://leedonline.usgbc.org/Project/scorecard.aspx?PageMode=PF&p=ONNNPPQU 5/21/2007



LEED-Online: Scorecard and Status — Page 3 of 4

☐	EA	Credit 5	C	Measurement & Verification	Attempted			1
☐	EA	Credit 6	C	Green Power	Not Attempted			1
7	▼	Materials & Resources					Possible Points:	13
Yes	MR	Prerequisite 1	▮	Storage & Collection of Recyclables	Project Team Administrator	✓	Earned	0
☐	MR	Credit 1.1-1.3	C	Building Reuse	Not Attempted			3
2	MR	Credit 2.1-2.2	C	Construction Waste Management	Project Team Administrator	✓	Earned	2
☐	MR	Credit 3.1-3.2	C	Resource Reuse	Not Attempted			2
2	MR	Credit 4.1-4.2	C	Recycled Content	Project Team Administrator	✓	Earned	2
2	MR	Credit 5.1-5.2	C	Local/Regional Materials	Project Team Administrator	✓	Earned	2
☐	MR	Credit 6	C	Rapidly Renewable Materials	Not Attempted			1
1	MR	Credit 7	C	Certified Wood	Project Team Administrator	✓	Earned	1
7	▼	Indoor Environmental Quality					Possible Points:	15
Yes	EQ	Prerequisite 1	▮	Minimum IAQ Performance	Project Team Administrator	✓	Earned	0
Yes	EQ	Prerequisite 2	▮	Environmental Tobacco Smoke (ETS) Control	Project Team Administrator	✓	Earned	0
☐	EQ	Credit 1	▮	Carbon Dioxide (CO2) Monitoring	Not Attempted			1
☐	EQ	Credit 2	▮	Increase Ventilation Effectiveness	Not Attempted			1
1	EQ	Credit 3.1	C	Construction IAQ Management Plan, During Construction	Project Team Administrator	✓	Earned	1
☐	EQ	Credit 3.2	C	Construction IAQ Management Plan, Before Occupancy	Not Attempted			1
3	EQ	Credit 4.1-4.4	C	Low-Emitting Materials	Project Team Administrator	✓	Earned	4
1	EQ	Credit 5	▮	Indoor Chemical & Pollutant Source Control	Project Team Administrator	✓	Earned	1
☐	EQ	Credit 6.1-6.2	▮	Controllability of Systems	Not Attempted			2
1	EQ	Credit 7.1	▮	Thermal Comfort, Comply with ASHRAE 55-1992	Project Team Administrator	✓	Earned	1

http://leedonline.usgbc.org/Project/scorecard.aspx?PageMode=PF&p=ONNNPPQU 5/21/2007



LEED-Online: Scorecard and Status　　Page 4 of 4

	EQ	Credit 7.2	Thermal Comfort, Permanent Monitoring System	Not Attempted			1
1	EQ	Credit 8.1	Daylight & Views, Daylight 75% of Spaces	Project Team Administrator	✓	Earned	1
	EQ	Credit 8.2	Daylight & Views, Views for 90% of Spaces	Not Attempted			1
4		Innovation & Design Process				Possible Points:	5
1	ID	Credit 1	Innovation in Design 1.1	Project Team Administrator	✓	Earned	1
1	ID	Credit 1	Innovation in Design 1.2	Project Team Administrator	✓	Earned	1
0	ID	Credit 1	Innovation in Design 1.3	Project Team Administrator	✓	Denied	1
1	ID	Credit 1	Innovation in Design 1.4	Project Team Administrator	✓	Earned	1
1	ID	Credit 2	LEED Accredited Professional	Project Team Administrator	✓	Earned	1

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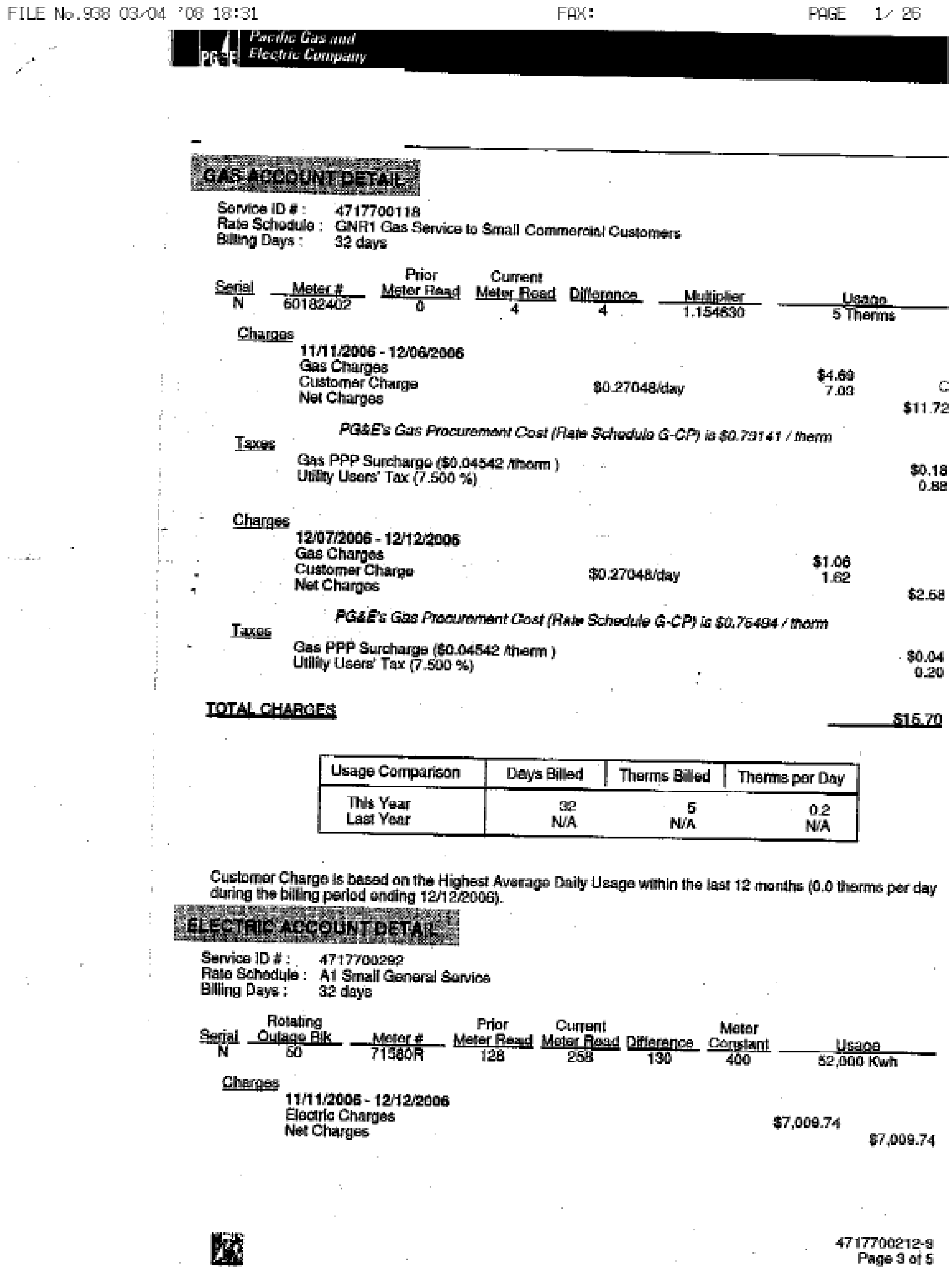
http://leedonline.usgbc.org/Project/scorecard.aspx?PageMode=PF&p=ONNNPPQU　5/21/2007

Appendix 4E Example of Pacific Gas and Electric Company invoice for LEED-NC certified hotel



FILE No.938 03/04 '08 18:31 FAX: PAGE 1/ 26

PG&E Pacific Gas and Electric Company

GAS ACCOUNT DETAIL

Service ID # : 4717700118
Rate Schedule : GNR1 Gas Service to Small Commercial Customers
Billing Days : 32 days

Serial	Meter #	Prior Meter Read	Current Meter Read	Difference	Multiplier	Usage
N	60182402	0	4	4	1.154630	5 Therms

Charges

11/11/2006 - 12/06/2006			
Gas Charges		$4.69	
Customer Charge	$0.27048/day	7.03	C
Net Charges			$11.72

PG&E's Gas Procurement Cost (Rate Schedule G-CP) is $0.79141 / therm

Taxes

Gas PPP Surcharge ($0.04542 /therm)	$0.18
Utility Users' Tax (7.500 %)	0.88

Charges

12/07/2006 - 12/12/2006			
Gas Charges		$1.06	
Customer Charge	$0.27048/day	1.62	
Net Charges			$2.68

PG&E's Gas Procurement Cost (Rate Schedule G-CP) is $0.75494 / therm

Taxes

Gas PPP Surcharge ($0.04542 /therm)	$0.04
Utility Users' Tax (7.500 %)	0.20

TOTAL CHARGES $15.70

Usage Comparison	Days Billed	Therms Billed	Therms per Day
This Year	32	5	0.2
Last Year	N/A	N/A	N/A

Customer Charge is based on the Highest Average Daily Usage within the last 12 months (0.0 therms per day during the billing period ending 12/12/2006).

ELECTRIC ACCOUNT DETAIL

Service ID # : 4717700292
Rate Schedule : A1 Small General Service
Billing Days : 32 days

Serial	Rotating Outage Blk	Meter #	Prior Meter Read	Current Meter Read	Difference	Meter Constant	Usage
N	50	71580R	128	258	130	400	52,000 Kwh

Charges

11/11/2006 - 12/12/2006		
Electric Charges	$7,009.74	
Net Charges		$7,009.74

4717700212-9
Page 3 of 5

Appendix 4F Raw data for LEED-NC certified hotel

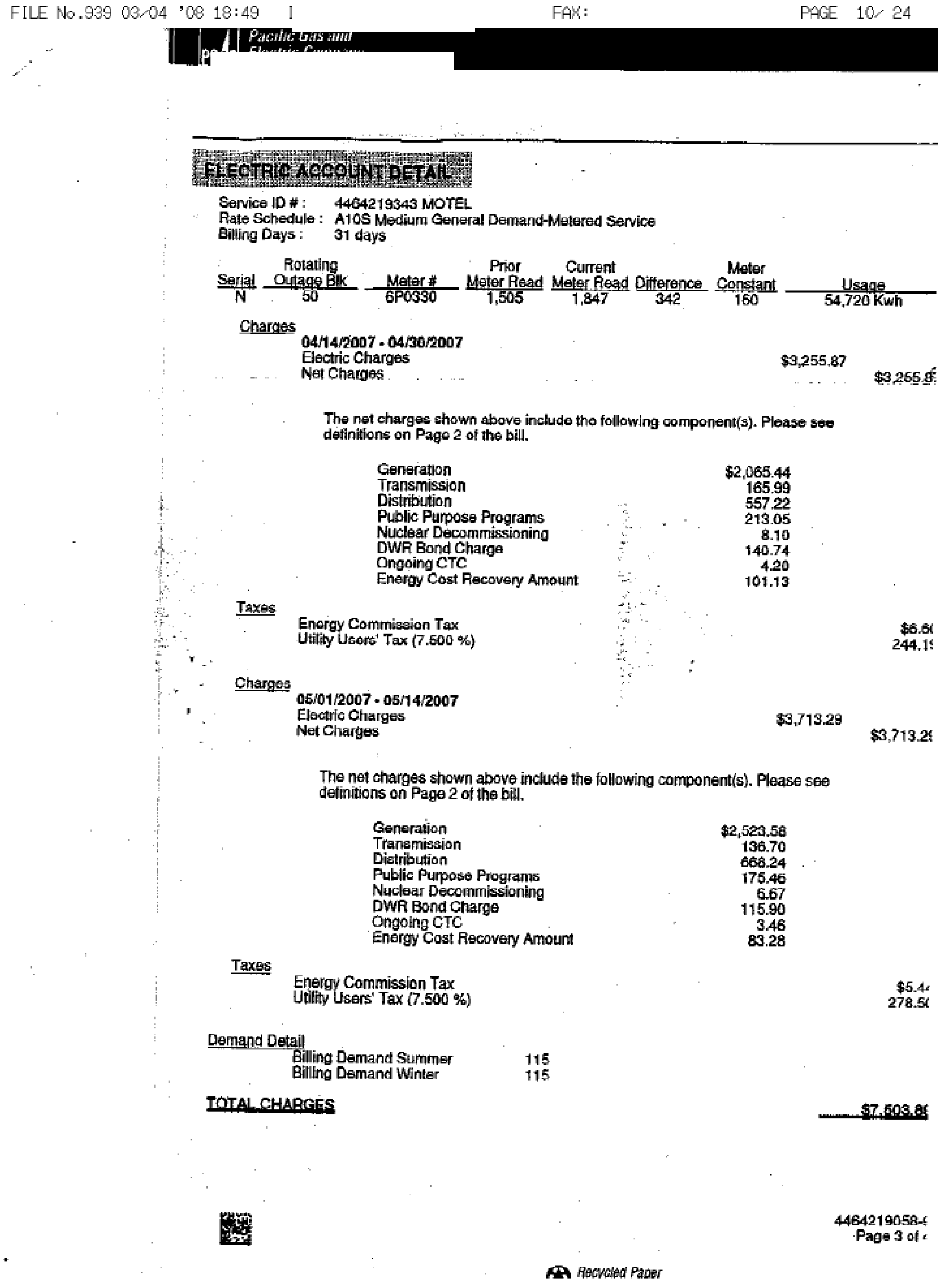
SAN FRANCISCO
TOTAL SQUARE AREA: 60,000 SQ.FT. (5,574 M2)

	Gas		Period	Days Billed	Total Gas (kgCO2)	Electricity	Period	Days Billed	Total Electricity (kgCO2) *Av. US*	Total Electricity (kgCO2) *PG&E*	Total Electricity & Gas (kgCO2) *Av. US*	Total Electricity & Gas (kgCO2) *PG&E*	Total Electricity & Gas (kgCO2/GN) *Av. US*	Total Electricity & Gas (kgCO2/GN) *PG&E*
	therms	*kWh*	2007			*kWh*	2006/7		0.619 kgCO2/kWh	0.208 kgCO2/kWh				
	5	147	(2006) 11/11 - 06/12; 07/12 - 12/12	32	28	52,000	11/11 - 12/12	32	32,188	10,816	32,216	10,844		
	2328	68,234	(2006) 07/12 - 12/12	38	12,964			38	0	0	12,964	12,964		
Total	**2,333**	**68,380**			**12,992**	**52,000**			**32,188**	**10,816**	**45,180**	**23,808**		
	376	11,021	13/12 - 31/12 (*2006*); 01/01 - 10/01(*2007*)	30	2,094	53,600	13/12 - 31/12 (2006) 01/01 - 10/01	30	33,178	11,149	35,272	13,243		
	2815	82,508	13/12 - 31/12 (*2006*); 01/01 - 11/01(*2007*)	30	15,676	0	13/12 - 31/12 (2006)	30	0	0	15,676	15,676		
Total	**3,191**	**93,528**			**17,770**	**53,600**			**33,178**	**11,149**	**50,949**	**28,919**		
	540	15,827	12/01 - 06/02; 07/02 - 12/02	32	3,007	58,400	12/01 - 12/02	32	36,150	12,147	39,157	15,154		
	3267	95,756	07/02 - 12/02	32	18,194	0	12/01 - 12/02	32	0	0	18,194	18,194		
Total	**3,807**	**111,583**			**21,201**	**58,400**			**36,150**	**12,147**	**57,350**	**33,348**		
	593	17,381	13/02 - 28/02; 01/03 - 14/03	30	3,302	55,200	13/02 - 28/02	30	34,169	11,482	37,471	14,784		
	3062	89,747	13/02 - 28/02; 01/03 - 14/03	30	17,052	0	13/02 - 28/02	30	0	0	17,052	17,052		
Total	**3,655**	**107,128**			**20,354**	**55,200**			**34,169**	**11,482**	**54,523**	**31,836**		
	578	16,941	15/03 - 31/03; 01/04 - 13/04	30	3,219	56,400	15/03 - 13/04	30	34,912	11,731	38,130	14,950		
	2986	87,520	01/04 - 13/04	30	16,629	0	15/03 - 13/04	30	0	0	16,629	16,629		
Total	**3,564**	**104,461**			**19,848**	**56,400**			**34,912**	**11,731**	**54,759**	**31,579**		
	635	18,612	14/04 - 30/04; 01/05 - 14/05	31	3,536	61,600	14/04 - 30/04	31	38,130	12,813	41,667	16,349		
	3155	92,473	14/04 - 30/04; 01/05 - 14/05	31	17,570	0	14/04 - 30/04	31	0	0	17,570	17,570		
Total	**3,790**	**111,085**			**21,106**	**61,600**			**38,130**	**12,813**	**59,237**	**33,919**		

Appendix 4F Raw Data for LEED-NC Certified Hotel *(continued)*

Total	**3,790**	**111,085**			**21,106**	**61,600**			**38,130**	**12,813**	**59,237**	**33,919**		
	658	19,286	15/05 - 06/06; 07/06 - 13/06	30	3,664	57,600	15/05 - 31/05	30	35,654	11,981	39,319	15,645		
	2881	84,442	15/05 - 06/06; 07/06 - 13/06	30	16,044	0	15/05 - 31/05	30	0	0	16,044	16,044		
Total	**3,539**	**103,728**			**19,708**	**57,600**			**35,654**	**11,981**	**55,363**	**31,689**		
	573	16,795	17/07 - 31/07; 01/08 - 13/08	28	3,191	59,600	17/07 - 13/08	28	36,892	12,397	40,083	15,588		
	2743	80,397	14/07 - 31/07; 01/08 - 13/08	28	15,275	0	17/07 - 13/08	28	0	0	15,275	15,275		
Total	**3,316**	**97,192**			**18,466**	**59,600**			**36,892**	**12,397**	**55,359**	**30,863**		
	618	18,114	14/08 - 09/09; 10/09 - 12/09	30	3,442	64,400	?	30	39,864	13,395	43,305	16,837		
	2645	77,525	14/08 - 09/09; 10/09 - 12/09	30	14,730	1,200	14/08 - 09/09	30	743	250	15,473	14,979		
Total	**3,263**	**95,639**			**18,171**	**65,600**			**40,606**	**13,645**	**58,778**	**31,816**		
	609.00	17849.79	13/09 - 04/10; 05/10 - 11/10	29.00	3,391	61200.00	14/09 - 11/10	29.00	37882.80	12729.60	41274.26	16121.06		
	2750.00	80602.50	13/09 - 04/10; 05/10 - 11/10	29.00	15,314	0.00	14/08 - 11/10	59.00	0.00	0.00	15314.48	15314.48		
Total	**3,359**	**98,452**			**18,706**	**61,200**			**37,883**	**12,730**	**56,589**	**31,436**		
	639	18,729	12/10 - 31/10; 01/11 - 09/11	29	3,559	61,600	?	29	38,130	12,813	41,689	16,371		
	3032	88,868	12/10 - 31/10; 01/11 - 09/11	29	16,885				0	0	16,885	16,885		
Total	**3,671**	**107,597**			**20,443**	**61,600**			**38,130**	**12,813**	**58,574**	**33,256**		
	697	20,429	10/11 - 06/12; 07/12 - 12/12	33	3,882	62,800	?	33	38,873	13,062	42,755	16,944		
	3657	107,187	10/11 - 06/12; 07/12 - 12/12	33	20,365	0	10/11 - 11/12	32	0	0	20,365	20,365		
Total	**4,354**	**127,616**			**24,247**	**62,800**			**38,873**	**13,062**	**63,120**	**37,309**		
	639	18,729	13/12 - 31/12(*2007*); 01/01 - 11/01 (*2008*)	30	3,559	55,200		30	34,169	11,482	37,727	15,040		
	3968	116,302	13/12 - 31/12 (*2007*); 01/01 - 11/01 (*2008*)	30	22,097				0	0	22,097	22,097		
Total	**4,607**	**135,031**			**25,656**	**55,200**			**34,169**	**11,482**	**59,825**	**37,138**		
Total Gas (kWh)		**1,199,512**	**Total Gas (kgCO2)** ***12/01/07 - 11/01/08***		**227,907**	**655,200**	**Total Electricity (kgCO2)** ***12/01/07 - 11/01/08***		**405,569**	**136,282**	**633,476**	**364,189**	**18.3**	**10.5**

Appendix 4G Example of Pacific Gas and Electric Company invoice for LEED-EB certified hotel



FILE No.939 03/04 '08 18:49 I FAX: PAGE 10/ 24

Pacific Gas and [redacted]

ELECTRIC ACCOUNT DETAIL

Service ID # : 4464219343 MOTEL
Rate Schedule : A10S Medium General Demand-Metered Service
Billing Days : 31 days

Serial	Rotating Outage Blk	Meter #	Prior Meter Read	Current Meter Read	Difference	Meter Constant	Usage
N	50	6P0330	1,505	1,847	342	160	54,720 Kwh

Charges

04/14/2007 - 04/30/2007

Electric Charges	$3,255.87	
Net Charges		$3,255.8

The net charges shown above include the following component(s). Please see definitions on Page 2 of the bill.

Generation	$2,065.44
Transmission	165.99
Distribution	557.22
Public Purpose Programs	213.05
Nuclear Decommissioning	8.10
DWR Bond Charge	140.74
Ongoing CTC	4.20
Energy Cost Recovery Amount	101.13

Taxes

Energy Commission Tax	$6.6
Utility Users' Tax (7.500 %)	244.1

Charges

05/01/2007 - 05/14/2007

Electric Charges	$3,713.29	
Net Charges		$3,713.2

The net charges shown above include the following component(s). Please see definitions on Page 2 of the bill.

Generation	$2,523.58
Transmission	136.70
Distribution	668.24
Public Purpose Programs	175.46
Nuclear Decommissioning	6.67
DWR Bond Charge	115.90
Ongoing CTC	3.46
Energy Cost Recovery Amount	83.28

Taxes

Energy Commission Tax	$5.4
Utility Users' Tax (7.500 %)	278.5

Demand Detail

Billing Demand Summer	115
Billing Demand Winter	115

TOTAL CHARGES $7,503.8

4464219058-
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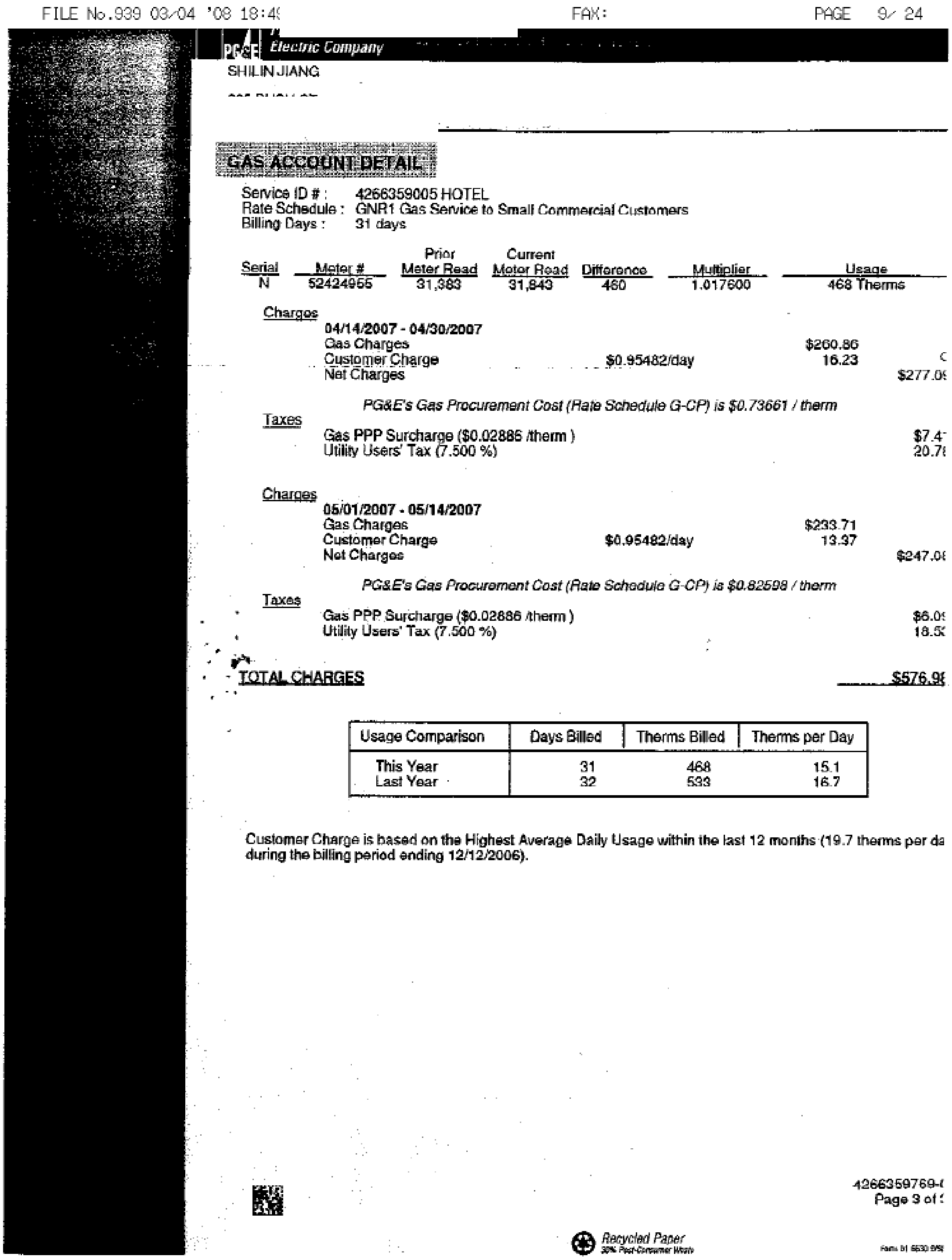


FILE No.939 03/04 '08 18:4 FAX: PAGE 9/ 24

PG&E Electric Company

SHILIN JIANG

GAS ACCOUNT DETAIL

Service ID # : 4266359005 HOTEL
Rate Schedule : GNR1 Gas Service to Small Commercial Customers
Billing Days : 31 days

Serial	Meter #	Prior Meter Read	Current Motor Read	Difference	Multiplier	Usage
N	52424955	31,383	31,843	460	1.017600	468 Therms

Charges

04/14/2007 - 04/30/2007			
Gas Charges		$260.86	
Customer Charge	$0.95482/day	16.23	
Net Charges			$277.0

PG&E's Gas Procurement Cost (Rate Schedule G-CP) is $0.73661 / therm

Taxes

Gas PPP Surcharge ($0.02886 /therm)	$7.4
Utility Users' Tax (7.500 %)	20.7

Charges

05/01/2007 - 05/14/2007			
Gas Charges		$233.71	
Customer Charge	$0.95482/day	13.37	
Net Charges			$247.0

PG&E's Gas Procurement Cost (Rate Schedule G-CP) is $0.82598 / therm

Taxes

Gas PPP Surcharge ($0.02886 /therm)	$6.0
Utility Users' Tax (7.500 %)	18.5

TOTAL CHARGES $576.9

Usage Comparison	Days Billed	Therms Billed	Therms per Day
This Year	31	468	15.1
Last Year	32	533	16.7

Customer Charge is based on the Highest Average Daily Usage within the last 12 months (19.7 therms per da during the billing period ending 12/12/2006).

4266359769-
Page 3 of

Recycled Paper
30% Post-Consumer Waste

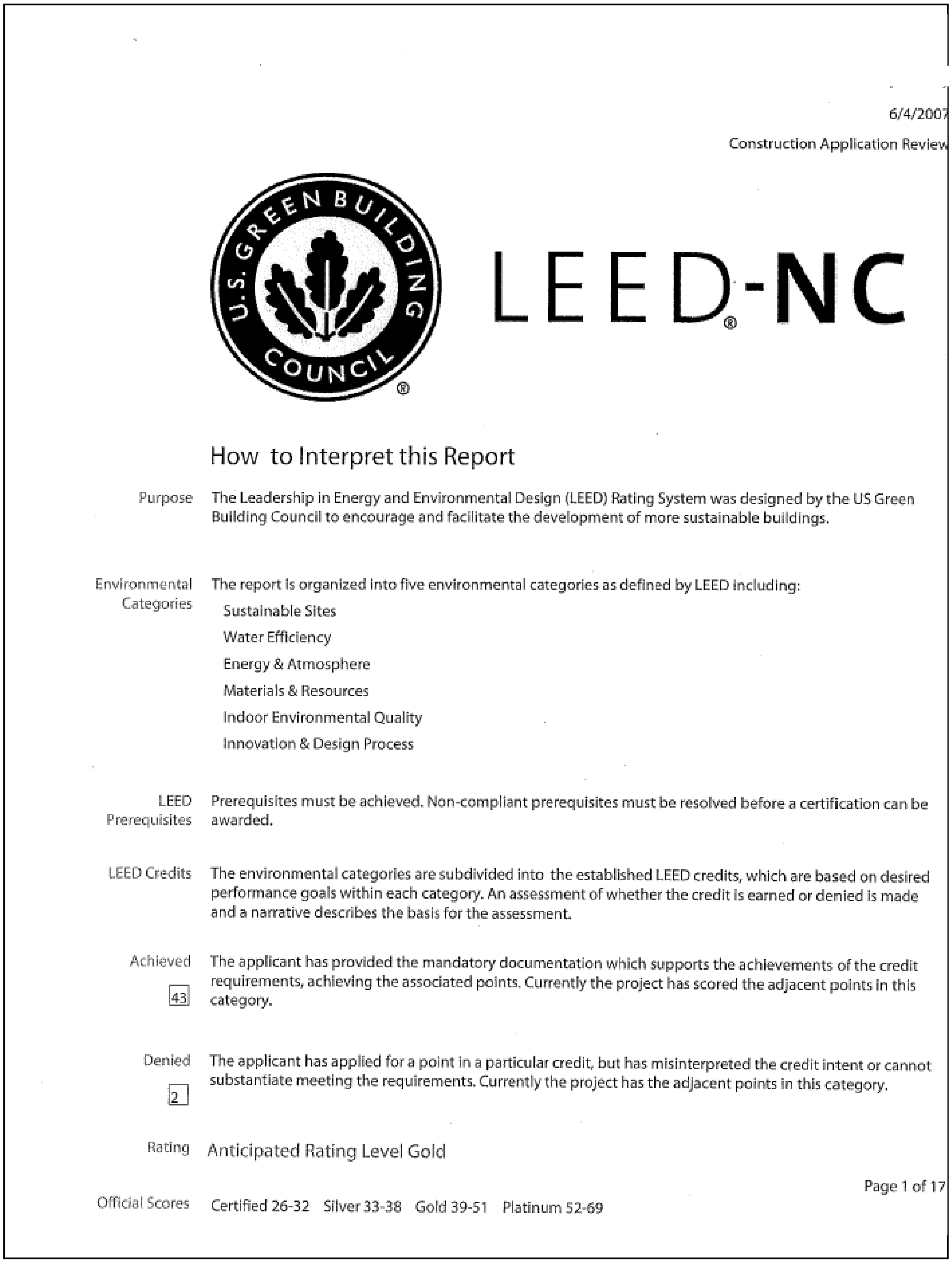
Appendix 4H Raw data for LEED-EB certified hotel

SAN FRANCISCO

TOTAL SQUARE AREA: 68,000 SQ.FT. (6,317 M2)

	Gas		**Period**	**Days Billed**	**Total Gas (kgCO2)**	**Electricity**	**Period**	Days Billed	**Total Electricity (kgCO2) *Av. US***	**Total Electricity (kgCO2) *PG&E***	**Total Electricity & Gas (kgCO2) *Av. US***	**Total Electricity & Gas (kgCO2) *PG&E***	**Total Electricity & Gas (kgCO2/GN) *Av. US***	**Total Electricity & Gas (kgCO2/GN) *PG&E***
Total	*therms*	*kWh*	2007			*kWh*	2006/7		**0.619 kgCO2/kWh**	**0.208 kgCO2/kWh**				
	562	16,472	12/01 - 06/02; 07/02 - 12/02	32	3,130	52,480	12/01 - 12/02	32	32,485	10,916	35,615	14,046		
	526	15,417	13/02 - 28/02; 01/03 - 14/03	30	2,929	51,040	13/02 - 28/02	30	31,594	10,616	34,523	13,546		
	477	13,981	15/03 - 31/03; 01/04 - 13/04	30	2,656	50,720	15/03 - 13/04	30	31,396	10,550	34,052	13,206		
	468	13,717	14/04 - 30/04; 01/05 - **14/05**	31	2,606	54,720	14/04 - **30/04**	31	33,872	11,382	36,478	13,988		
	431	12,633	**13/06** - 30/06; 01/07 - 13/07	31	2,400	57,440	**13/06** - 30/06; 01/07 - 13/07	31	35,555	11,948	37,956	14,348		
	152	4,455	14/07 - 31/07; 01/08 - 13/08	31	846	56,000	14/07 - 13/08	31	34,664	11,648	35,510	12,494		
	198	5,803	14/08 - 09/09; 10/09 - 13/09	31	1,103	56,480	14/08 - 13/09	31	34,961	11,748	36,064	12,850		
	247	7,240	14/09 - 04/10; 05/10 - 11/10	28	1,376	53,280	14/09 - 11/10	28	32,980	11,082	34,356	12,458		
	342	10,024	12/10 - 31/10; 01/11 - 09/11	29	1,905	52,160	12/10 - 31/10; 01/11 - 09/11	29	32,287	10,849	34,192	12,754		
	416	12,193	10/11 - 06/12; 07/12 - 12/12	33	2,317	55,520	10/11 - 12/12	33	34,367	11,548	36,684	13,865		
	430	12,603	13/12 - 31/12 (*2007*); 01/01 - 10/01 (*2008*)	29	2,395	46720	13/12 - 31/12 (*2007*); 01/01 - 10/01 (*2008*)	29	28,920	9,718	31,314	12,112		
Total Gas (kWh)		**24,796**	**Total Gas (kgCO2)** ***12/01/07 - 10/01/08***		**23,662**	**586,560**	**Total Electricity (kgCO2)** ***12/01/07 - 10/01/08***		**363,081**	**122,004**	**386,743**	**145,667**	**24.4**	**9.2**

Appendix 4I LEED-NC report for LEED-NC hotel example 2



6/4/2007

Construction Application Revie

LEED®-NC

How to Interpret this Report

Purpose — The Leadership in Energy and Environmental Design (LEED) Rating System was designed by the US Green Building Council to encourage and facilitate the development of more sustainable buildings.

Environmental Categories — The report is organized into five environmental categories as defined by LEED including:

- Sustainable Sites
- Water Efficiency
- Energy & Atmosphere
- Materials & Resources
- Indoor Environmental Quality
- Innovation & Design Process

LEED Prerequisites — Prerequisites must be achieved. Non-compliant prerequisites must be resolved before a certification can be awarded.

LEED Credits — The environmental categories are subdivided into the established LEED credits, which are based on desired performance goals within each category. An assessment of whether the credit is earned or denied is made and a narrative describes the basis for the assessment.

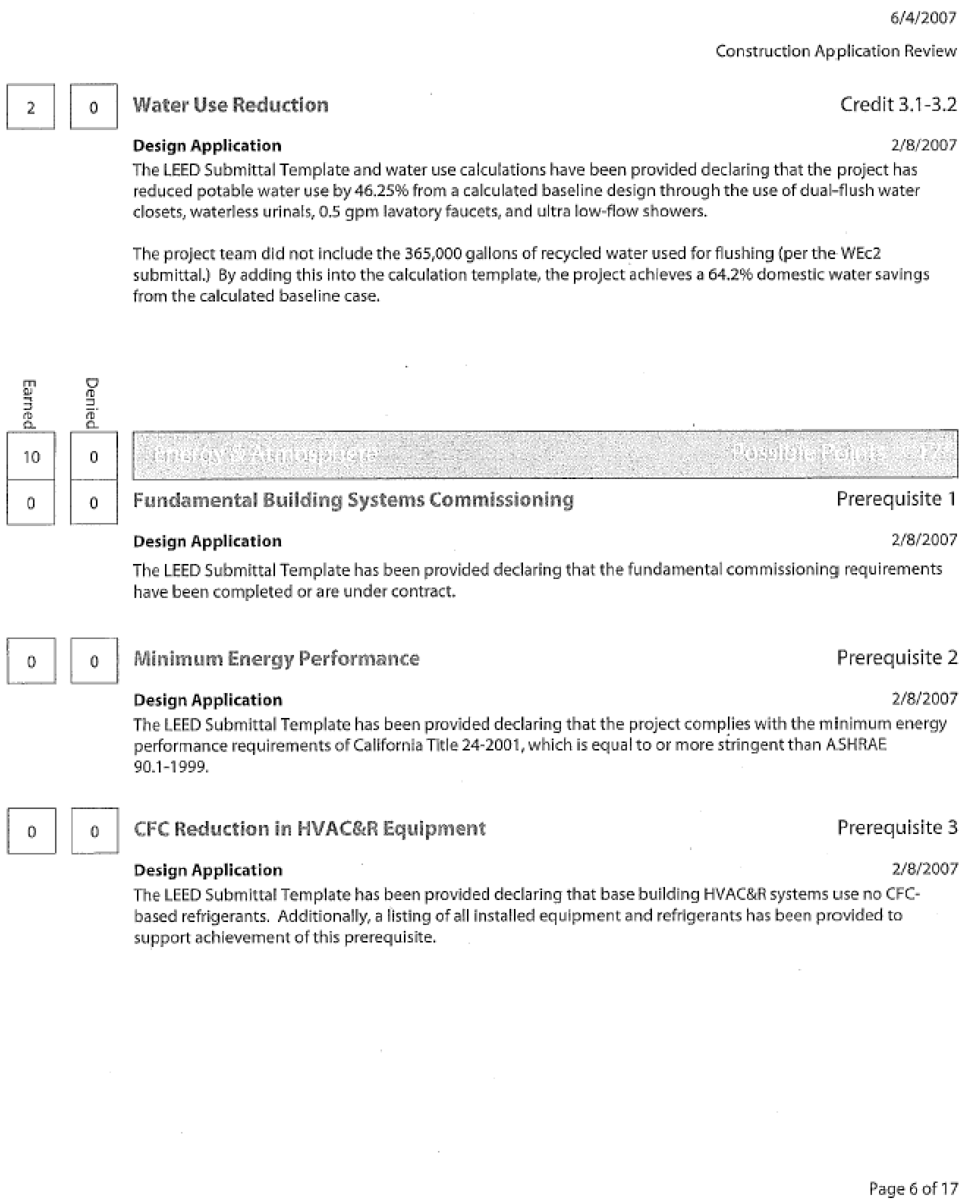
Achieved 43 — The applicant has provided the mandatory documentation which supports the achievements of the credit requirements, achieving the associated points. Currently the project has scored the adjacent points in this category.

Denied 2 — The applicant has applied for a point in a particular credit, but has misinterpreted the credit intent or cannot substantiate meeting the requirements. Currently the project has the adjacent points in this category.

Rating — Anticipated Rating Level Gold

Official Scores — Certified 26-32 Silver 33-38 Gold 39-51 Platinum 52-69

Page 1 of 17



6/4/2007
Construction Application Review

2 | 0 **Water Use Reduction** Credit 3.1-3.2

Design Application 2/8/2007

The LEED Submittal Template and water use calculations have been provided declaring that the project has reduced potable water use by 46.25% from a calculated baseline design through the use of dual-flush water closets, waterless urinals, 0.5 gpm lavatory faucets, and ultra low-flow showers.

The project team did not include the 365,000 gallons of recycled water used for flushing (per the WEc2 submittal.) By adding this into the calculation template, the project achieves a 64.2% domestic water savings from the calculated baseline case.

Earned | Denied

10 | 0 Energy & Atmosphere Possible Points 17

0 | 0 **Fundamental Building Systems Commissioning** Prerequisite 1

Design Application 2/8/2007

The LEED Submittal Template has been provided declaring that the fundamental commissioning requirements have been completed or are under contract.

0 | 0 **Minimum Energy Performance** Prerequisite 2

Design Application 2/8/2007

The LEED Submittal Template has been provided declaring that the project complies with the minimum energy performance requirements of California Title 24-2001, which is equal to or more stringent than ASHRAE 90.1-1999.

0 | 0 **CFC Reduction in HVAC&R Equipment** Prerequisite 3

Design Application 2/8/2007

The LEED Submittal Template has been provided declaring that base building HVAC&R systems use no CFC-based refrigerants. Additionally, a listing of all installed equipment and refrigerants has been provided to support achievement of this prerequisite.

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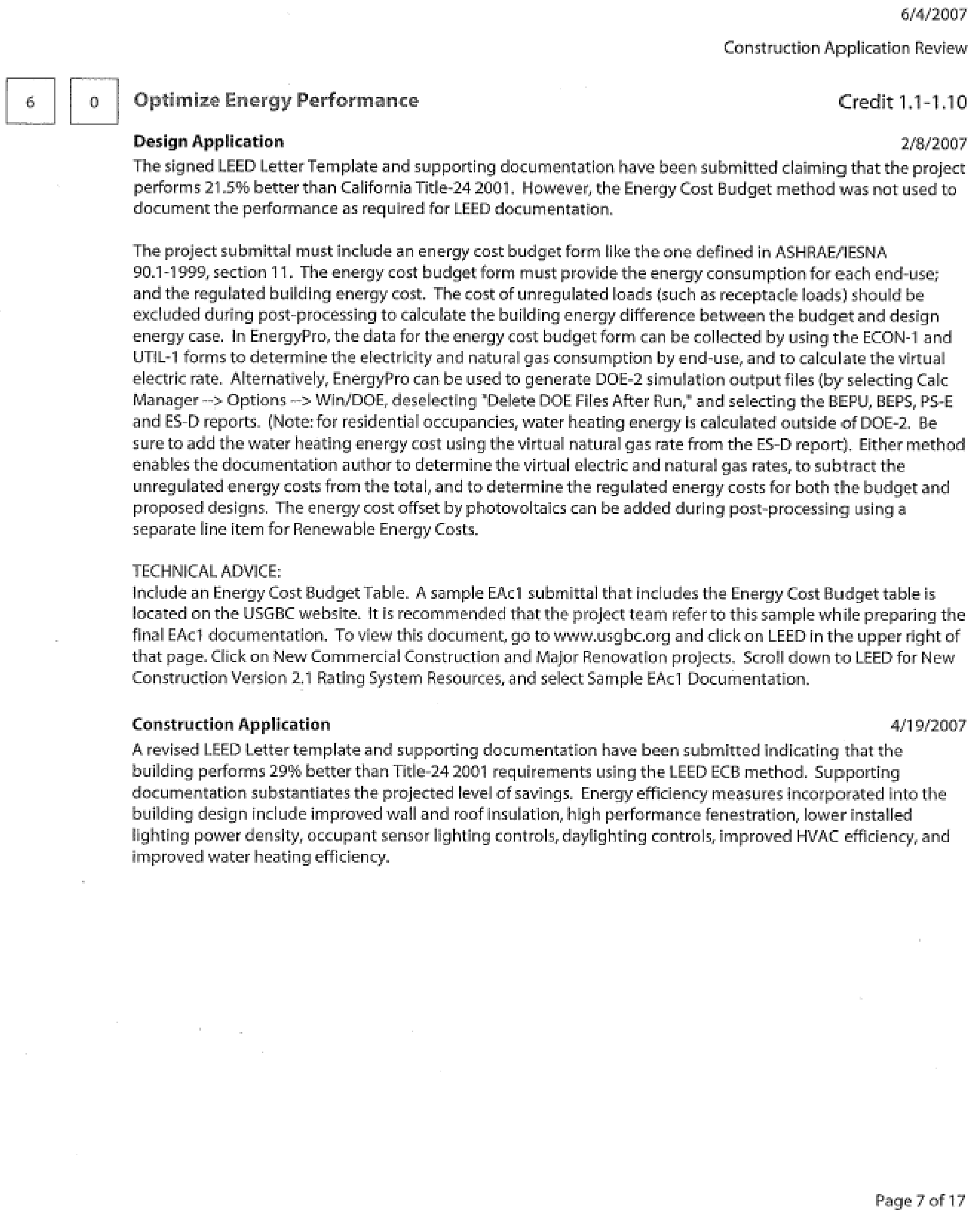

6/4/2007

Construction Application Review

6 0 **Optimize Energy Performance** Credit 1.1-1.10

Design Application 2/8/2007

The signed LEED Letter Template and supporting documentation have been submitted claiming that the project performs 21.5% better than California Title-24 2001. However, the Energy Cost Budget method was not used to document the performance as required for LEED documentation.

The project submittal must include an energy cost budget form like the one defined in ASHRAE/IESNA 90.1-1999, section 11. The energy cost budget form must provide the energy consumption for each end-use; and the regulated building energy cost. The cost of unregulated loads (such as receptacle loads) should be excluded during post-processing to calculate the building energy difference between the budget and design energy case. In EnergyPro, the data for the energy cost budget form can be collected by using the ECON-1 and UTIL-1 forms to determine the electricity and natural gas consumption by end-use, and to calculate the virtual electric rate. Alternatively, EnergyPro can be used to generate DOE-2 simulation output files (by selecting Calc Manager --> Options --> Win/DOE, deselecting "Delete DOE Files After Run," and selecting the BEPU, BEPS, PS-E and ES-D reports. (Note: for residential occupancies, water heating energy is calculated outside of DOE-2. Be sure to add the water heating energy cost using the virtual natural gas rate from the ES-D report). Either method enables the documentation author to determine the virtual electric and natural gas rates, to subtract the unregulated energy costs from the total, and to determine the regulated energy costs for both the budget and proposed designs. The energy cost offset by photovoltaics can be added during post-processing using a separate line item for Renewable Energy Costs.

TECHNICAL ADVICE:
Include an Energy Cost Budget Table. A sample EAc1 submittal that includes the Energy Cost Budget table is located on the USGBC website. It is recommended that the project team refer to this sample while preparing the final EAc1 documentation. To view this document, go to www.usgbc.org and click on LEED in the upper right of that page. Click on New Commercial Construction and Major Renovation projects. Scroll down to LEED for New Construction Version 2.1 Rating System Resources, and select Sample EAc1 Documentation.

Construction Application 4/19/2007

A revised LEED Letter template and supporting documentation have been submitted indicating that the building performs 29% better than Title-24 2001 requirements using the LEED ECB method. Supporting documentation substantiates the projected level of savings. Energy efficiency measures incorporated into the building design include improved wall and roof insulation, high performance fenestration, lower installed lighting power density, occupant sensor lighting controls, daylighting controls, improved HVAC efficiency, and improved water heating efficiency.

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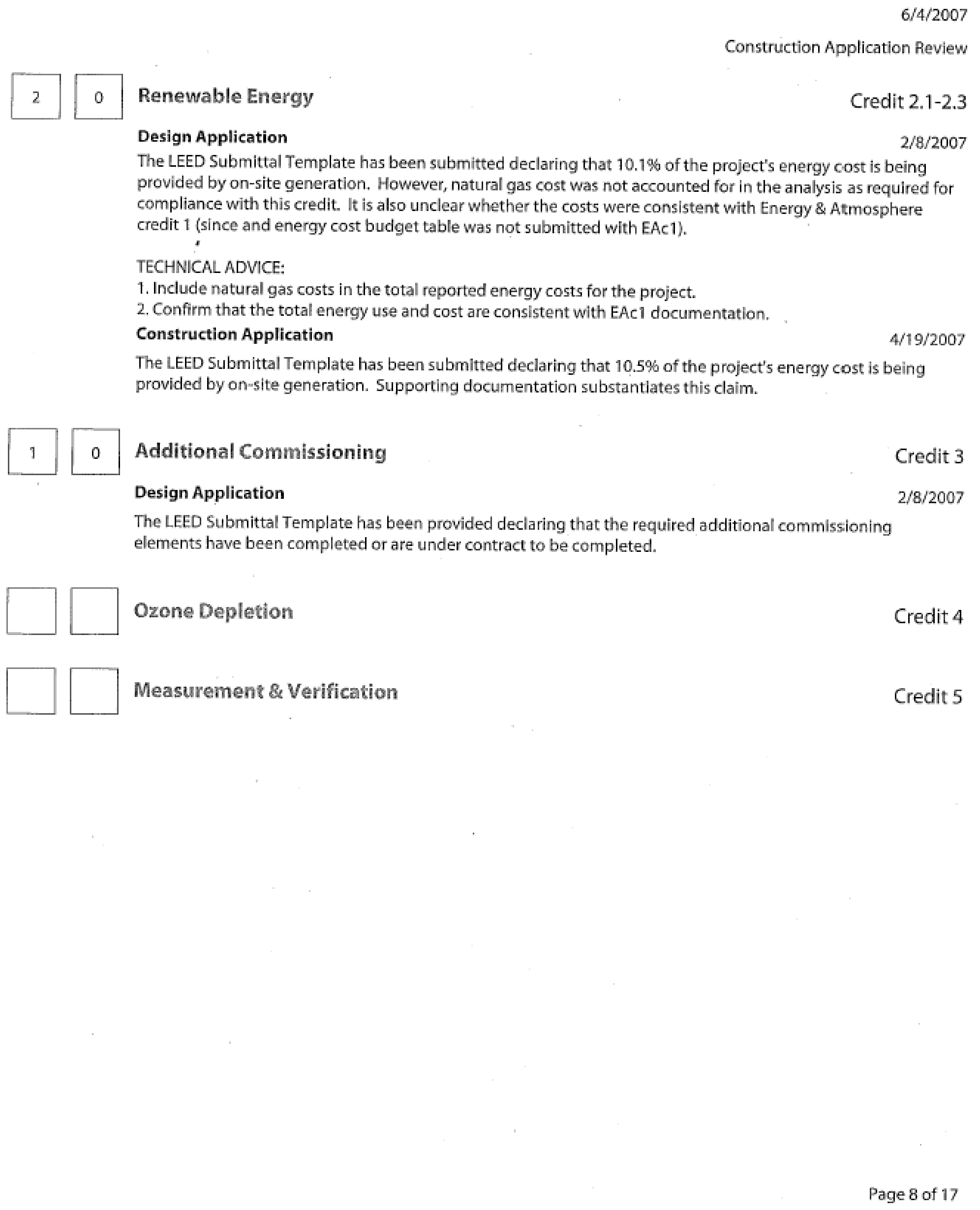

6/4/2007

Construction Application Review

2 0 **Renewable Energy** Credit 2.1-2.3

Design Application 2/8/2007

The LEED Submittal Template has been submitted declaring that 10.1% of the project's energy cost is being provided by on-site generation. However, natural gas cost was not accounted for in the analysis as required for compliance with this credit. It is also unclear whether the costs were consistent with Energy & Atmosphere credit 1 (since and energy cost budget table was not submitted with EAc1).

TECHNICAL ADVICE:
1. Include natural gas costs in the total reported energy costs for the project.
2. Confirm that the total energy use and cost are consistent with EAc1 documentation.

Construction Application 4/19/2007

The LEED Submittal Template has been submitted declaring that 10.5% of the project's energy cost is being provided by on-site generation. Supporting documentation substantiates this claim.

1 0 **Additional Commissioning** Credit 3

Design Application 2/8/2007

The LEED Submittal Template has been provided declaring that the required additional commissioning elements have been completed or are under contract to be completed.

☐ ☐ **Ozone Depletion** Credit 4

☐ ☐ **Measurement & Verification** Credit 5

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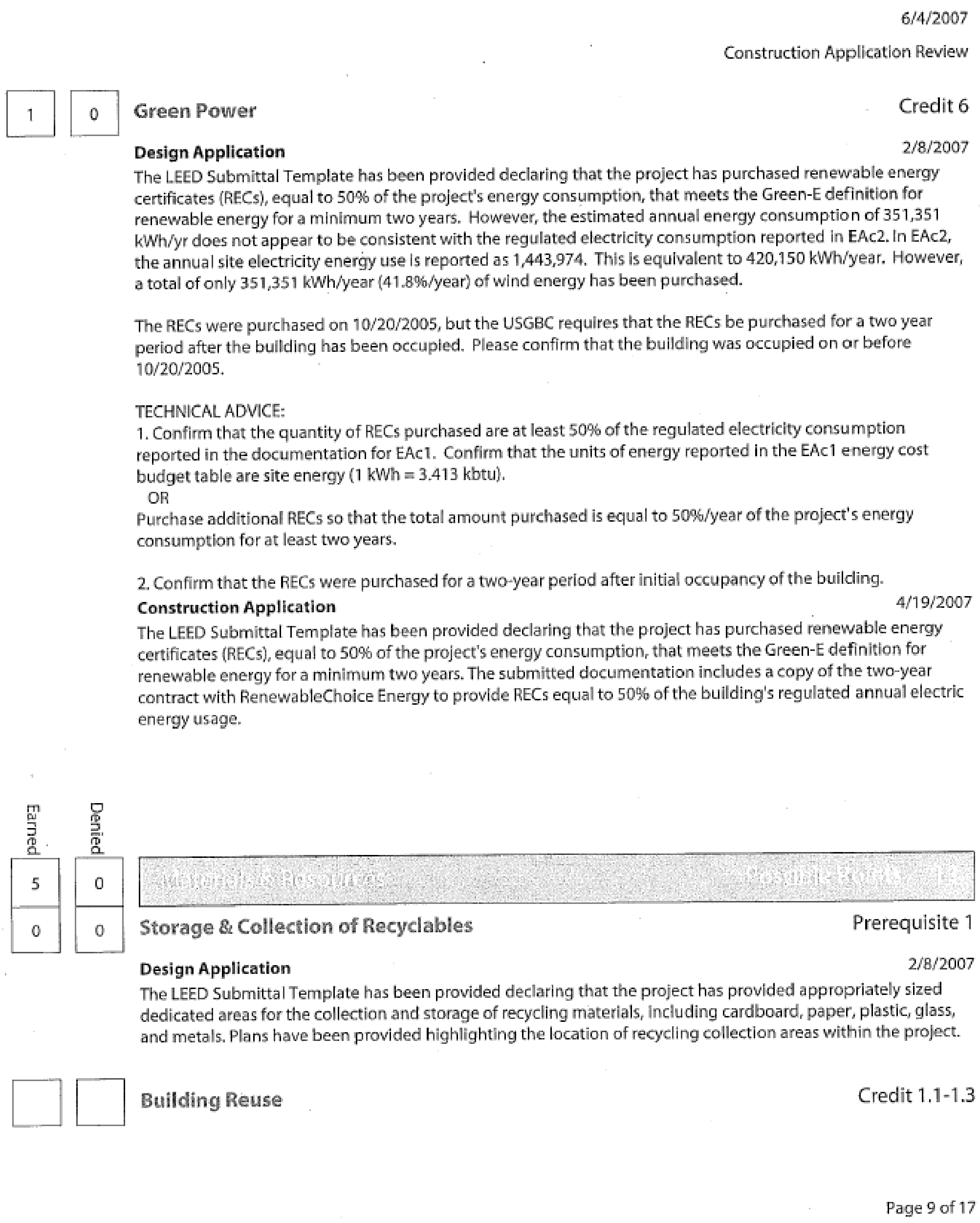

6/4/2007
Construction Application Review

1	0

Green Power Credit 6

Design Application 2/8/2007

The LEED Submittal Template has been provided declaring that the project has purchased renewable energy certificates (RECs), equal to 50% of the project's energy consumption, that meets the Green-E definition for renewable energy for a minimum two years. However, the estimated annual energy consumption of 351,351 kWh/yr does not appear to be consistent with the regulated electricity consumption reported in EAc2. In EAc2, the annual site electricity energy use is reported as 1,443,974. This is equivalent to 420,150 kWh/year. However, a total of only 351,351 kWh/year (41.8%/year) of wind energy has been purchased.

The RECs were purchased on 10/20/2005, but the USGBC requires that the RECs be purchased for a two year period after the building has been occupied. Please confirm that the building was occupied on or before 10/20/2005.

TECHNICAL ADVICE:
1. Confirm that the quantity of RECs purchased are at least 50% of the regulated electricity consumption reported in the documentation for EAc1. Confirm that the units of energy reported in the EAc1 energy cost budget table are site energy (1 kWh = 3.413 kbtu).
OR
Purchase additional RECs so that the total amount purchased is equal to 50%/year of the project's energy consumption for at least two years.

2. Confirm that the RECs were purchased for a two-year period after initial occupancy of the building.

Construction Application 4/19/2007

The LEED Submittal Template has been provided declaring that the project has purchased renewable energy certificates (RECs), equal to 50% of the project's energy consumption, that meets the Green-E definition for renewable energy for a minimum two years. The submitted documentation includes a copy of the two-year contract with RenewableChoice Energy to provide RECs equal to 50% of the building's regulated annual electric energy usage.

Earned	Denied
5	0
0	0

Materials & Resources Possible Points [illegible]

Storage & Collection of Recyclables Prerequisite 1

Design Application 2/8/2007

The LEED Submittal Template has been provided declaring that the project has provided appropriately sized dedicated areas for the collection and storage of recycling materials, including cardboard, paper, plastic, glass, and metals. Plans have been provided highlighting the location of recycling collection areas within the project.

Building Reuse Credit 1.1-1.3

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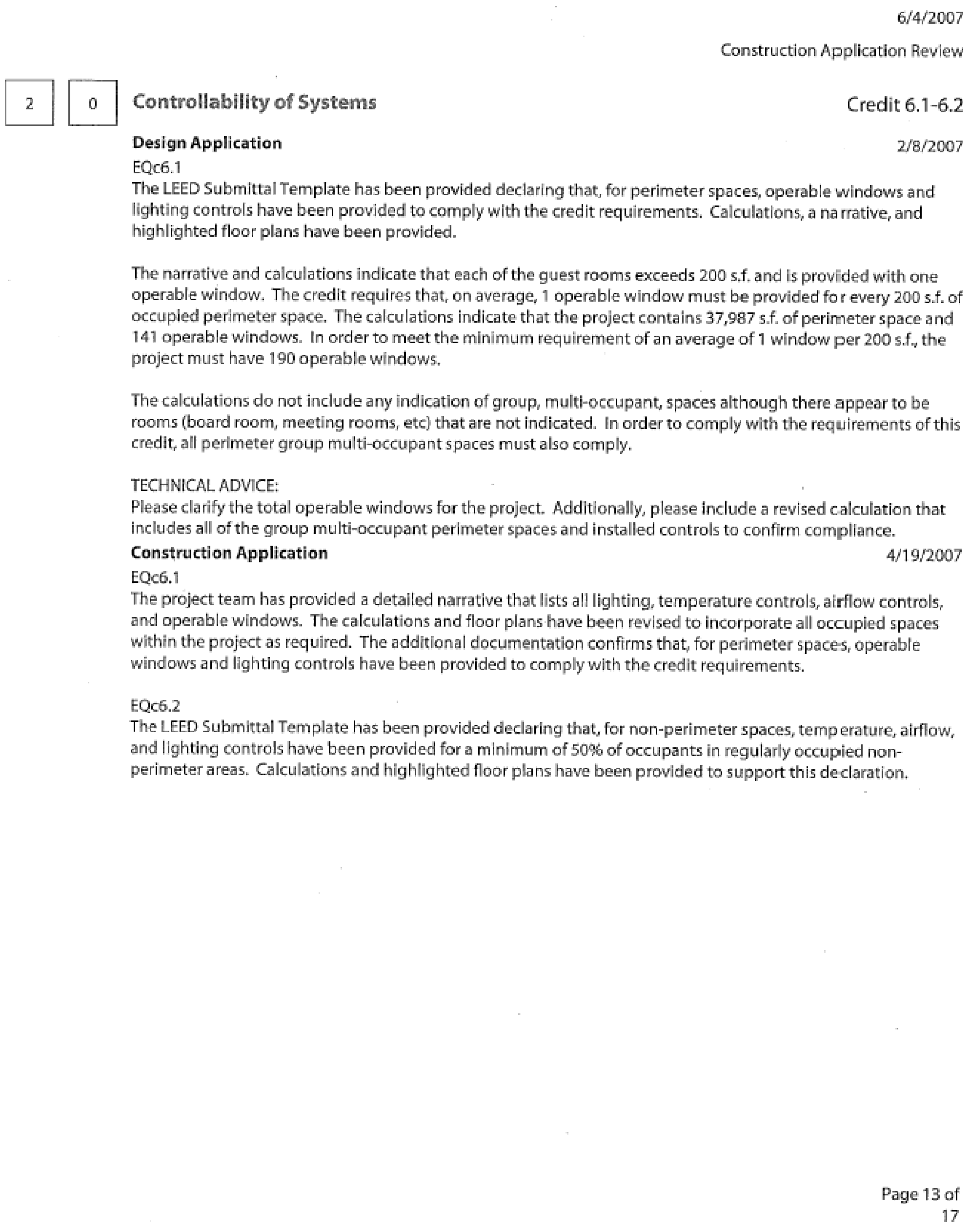

6/4/2007

Construction Application Review

2	0

Controllability of Systems Credit 6.1-6.2

Design Application 2/8/2007

EQc6.1

The LEED Submittal Template has been provided declaring that, for perimeter spaces, operable windows and lighting controls have been provided to comply with the credit requirements. Calculations, a narrative, and highlighted floor plans have been provided.

The narrative and calculations indicate that each of the guest rooms exceeds 200 s.f. and is provided with one operable window. The credit requires that, on average, 1 operable window must be provided for every 200 s.f. of occupied perimeter space. The calculations indicate that the project contains 37,987 s.f. of perimeter space and 141 operable windows. In order to meet the minimum requirement of an average of 1 window per 200 s.f., the project must have 190 operable windows.

The calculations do not include any indication of group, multi-occupant, spaces although there appear to be rooms (board room, meeting rooms, etc) that are not indicated. In order to comply with the requirements of this credit, all perimeter group multi-occupant spaces must also comply.

TECHNICAL ADVICE:
Please clarify the total operable windows for the project. Additionally, please include a revised calculation that includes all of the group multi-occupant perimeter spaces and installed controls to confirm compliance.

Construction Application 4/19/2007

EQc6.1

The project team has provided a detailed narrative that lists all lighting, temperature controls, airflow controls, and operable windows. The calculations and floor plans have been revised to incorporate all occupied spaces within the project as required. The additional documentation confirms that, for perimeter spaces, operable windows and lighting controls have been provided to comply with the credit requirements.

EQc6.2

The LEED Submittal Template has been provided declaring that, for non-perimeter spaces, temperature, airflow, and lighting controls have been provided for a minimum of 50% of occupants in regularly occupied non-perimeter areas. Calculations and highlighted floor plans have been provided to support this declaration.

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17

1	0

Thermal Comfort, Comply with ASHRAE 55-1992 Credit 7.1

Design Application 2/8/2007

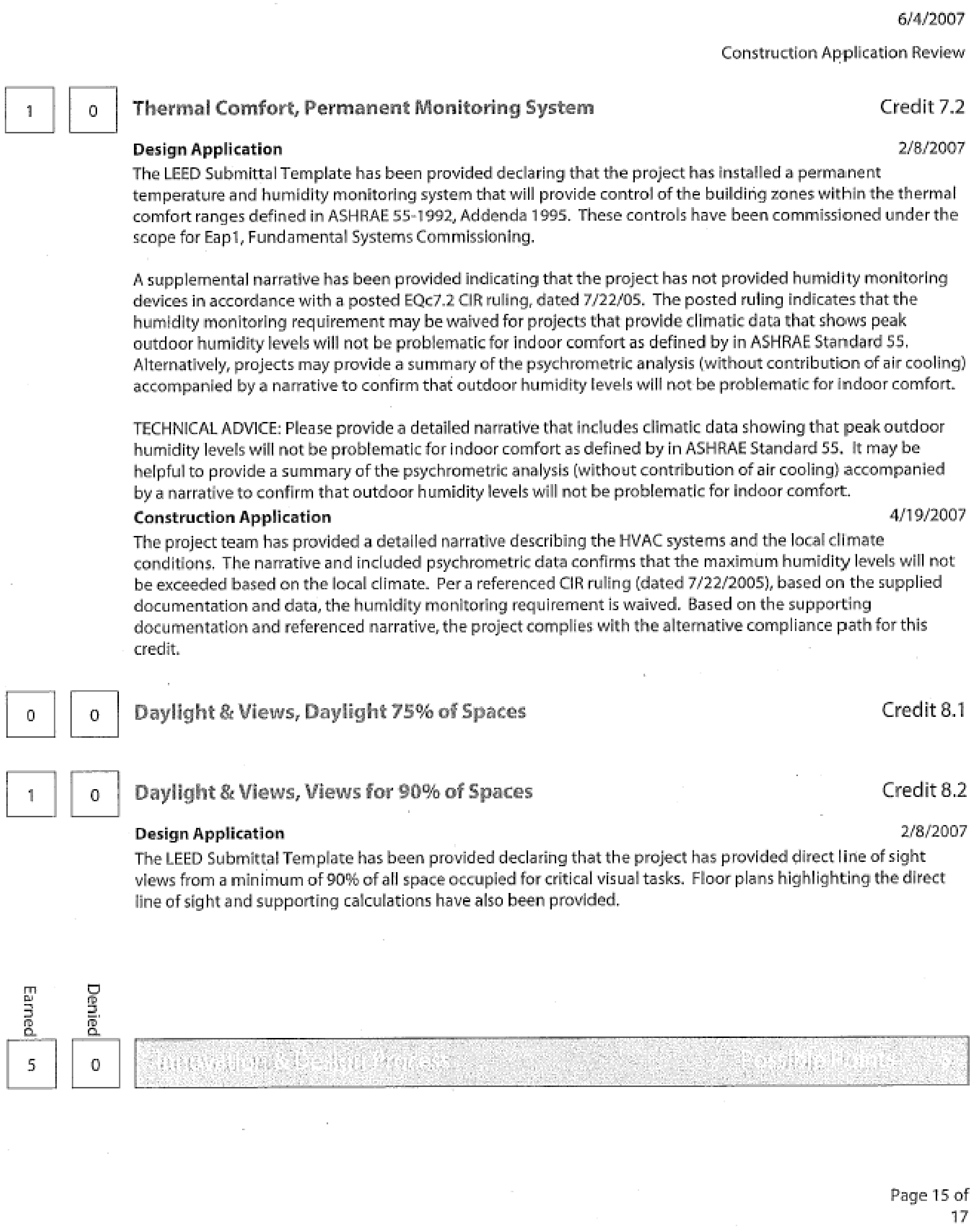
The LEED Submittal Template has been provided declaring that the project has been designed to maintain indoor comfort within the ranges established by ASHRAE Standard 55-1992, Addenda 1995. A table listing the control ranges and installed control methods has been provided. The summary table indicates that the humidity control range is N/A and there is no narrative provided to explain this.

In order to demonstrate compliance with this credit, projects must address both the temperature and humidity ranges for the occupied spaces.

TECHNICAL ADVICE:
Please provide a detailed narrative describing the HVAC systems design. Please include specific information regarding compliance with the temperature and humidity ranges provided in the referenced ASHRAE Standard for thermal comfort for the following conditions: Heating; Cooling; Swing Season. Additionally, please provide psychrometric charts for each of the typical thermal control zones to confirm that the design complies with the referenced standard.

Construction Application 4/19/2007

The project team has provided a detailed narrative describing the HVAC systems and the local climate conditions. The narrative and included psychrometric data confirms that the installed HVAC systems have been designed to maintain indoor comfort within the ranges listed by ASHRAE Standard 55-1992.



6/4/2007

Construction Application Review

1 0 **Thermal Comfort, Permanent Monitoring System** Credit 7.2

Design Application 2/8/2007

The LEED Submittal Template has been provided declaring that the project has installed a permanent temperature and humidity monitoring system that will provide control of the building zones within the thermal comfort ranges defined in ASHRAE 55-1992, Addenda 1995. These controls have been commissioned under the scope for Eap1, Fundamental Systems Commissioning.

A supplemental narrative has been provided indicating that the project has not provided humidity monitoring devices in accordance with a posted EQc7.2 CIR ruling, dated 7/22/05. The posted ruling indicates that the humidity monitoring requirement may be waived for projects that provide climatic data that shows peak outdoor humidity levels will not be problematic for indoor comfort as defined by in ASHRAE Standard 55. Alternatively, projects may provide a summary of the psychrometric analysis (without contribution of air cooling) accompanied by a narrative to confirm that outdoor humidity levels will not be problematic for indoor comfort.

TECHNICAL ADVICE: Please provide a detailed narrative that includes climatic data showing that peak outdoor humidity levels will not be problematic for indoor comfort as defined by in ASHRAE Standard 55. It may be helpful to provide a summary of the psychrometric analysis (without contribution of air cooling) accompanied by a narrative to confirm that outdoor humidity levels will not be problematic for indoor comfort.

Construction Application 4/19/2007

The project team has provided a detailed narrative describing the HVAC systems and the local climate conditions. The narrative and included psychrometric data confirms that the maximum humidity levels will not be exceeded based on the local climate. Per a referenced CIR ruling (dated 7/22/2005), based on the supplied documentation and data, the humidity monitoring requirement is waived. Based on the supporting documentation and referenced narrative, the project complies with the alternative compliance path for this credit.

0 0 **Daylight & Views, Daylight 75% of Spaces** Credit 8.1

1 0 **Daylight & Views, Views for 90% of Spaces** Credit 8.2

Design Application 2/8/2007

The LEED Submittal Template has been provided declaring that the project has provided direct line of sight views from a minimum of 90% of all space occupied for critical visual tasks. Floor plans highlighting the direct line of sight and supporting calculations have also been provided.

Earned Denied

5 0 **Innovation & Design Process** Possible Points: 5

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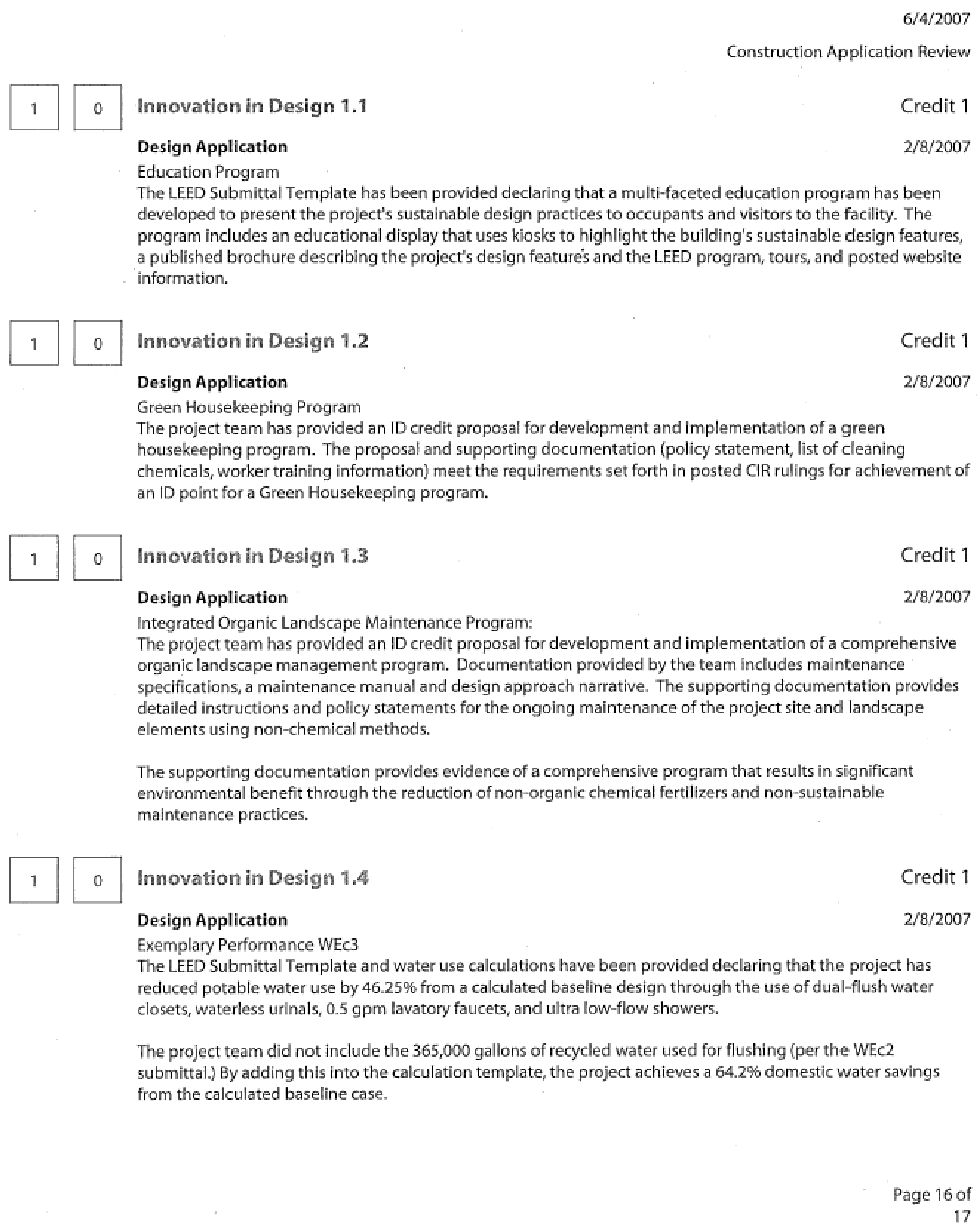


6/4/2007

Construction Application Review

1 0

Innovation in Design 1.1

Credit 1

Design Application 2/8/2007

Education Program

The LEED Submittal Template has been provided declaring that a multi-faceted education program has been developed to present the project's sustainable design practices to occupants and visitors to the facility. The program includes an educational display that uses kiosks to highlight the building's sustainable design features, a published brochure describing the project's design features and the LEED program, tours, and posted website information.

1 0

Innovation in Design 1.2

Credit 1

Design Application 2/8/2007

Green Housekeeping Program

The project team has provided an ID credit proposal for development and implementation of a green housekeeping program. The proposal and supporting documentation (policy statement, list of cleaning chemicals, worker training information) meet the requirements set forth in posted CIR rulings for achievement of an ID point for a Green Housekeeping program.

1 0

Innovation in Design 1.3

Credit 1

Design Application 2/8/2007

Integrated Organic Landscape Maintenance Program:

The project team has provided an ID credit proposal for development and implementation of a comprehensive organic landscape management program. Documentation provided by the team includes maintenance specifications, a maintenance manual and design approach narrative. The supporting documentation provides detailed instructions and policy statements for the ongoing maintenance of the project site and landscape elements using non-chemical methods.

The supporting documentation provides evidence of a comprehensive program that results in significant environmental benefit through the reduction of non-organic chemical fertilizers and non-sustainable maintenance practices.

1 0

Innovation in Design 1.4

Credit 1

Design Application 2/8/2007

Exemplary Performance WEc3

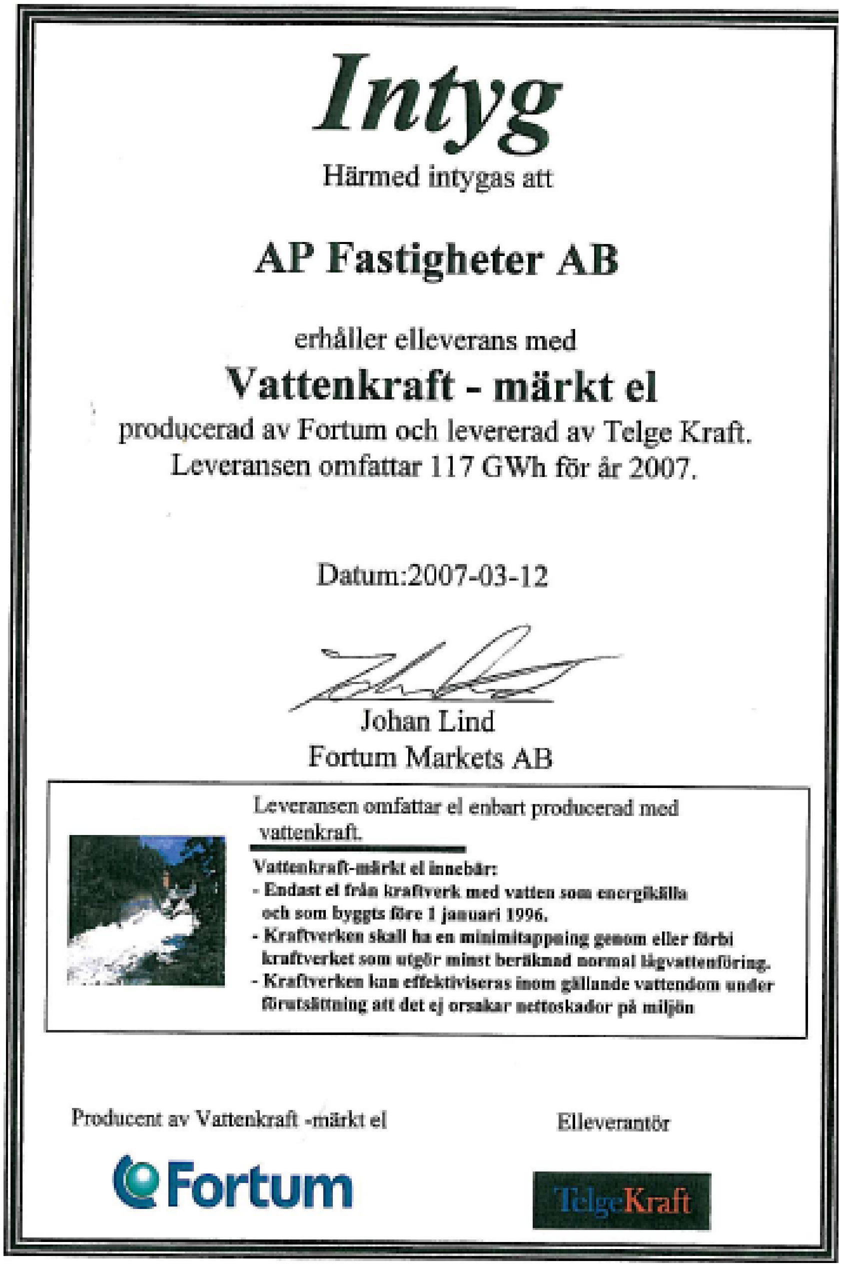
The LEED Submittal Template and water use calculations have been provided declaring that the project has reduced potable water use by 46.25% from a calculated baseline design through the use of dual-flush water closets, waterless urinals, 0.5 gpm lavatory faucets, and ultra low-flow showers.

The project team did not include the 365,000 gallons of recycled water used for flushing (per the WEc2 submittal.) By adding this into the calculation template, the project achieves a 64.2% domestic water savings from the calculated baseline case.

5.1

Appendices

Appendix 5.1A Example of 'green' electricity certificate**.**



Intyg

Härmed intygas att

AP Fastigheter AB

erhåller elleverans med

Vattenkraft - märkt el

producerad av Fortum och levererad av Telge Kraft.
Leveransen omfattar 117 GWh för år 2007.

Datum:2007-03-12

Johan Lind
Fortum Markets AB

Leveransen omfattar el enbart producerad med vattenkraft.

Vattenkraft-märkt el innebär:

- **Endast el från kraftverk med vatten som energikälla och som byggts före 1 januari 1996.**
- **Kraftverken skall ha en minimitappning genom eller förbi kraftverket som utgör minst beräknad normal lågvattenföring.**
- **Kraftverken kan effektiviseras inom gällande vattendom under förutsättning att det ej orsakar nettoskador på miljön**

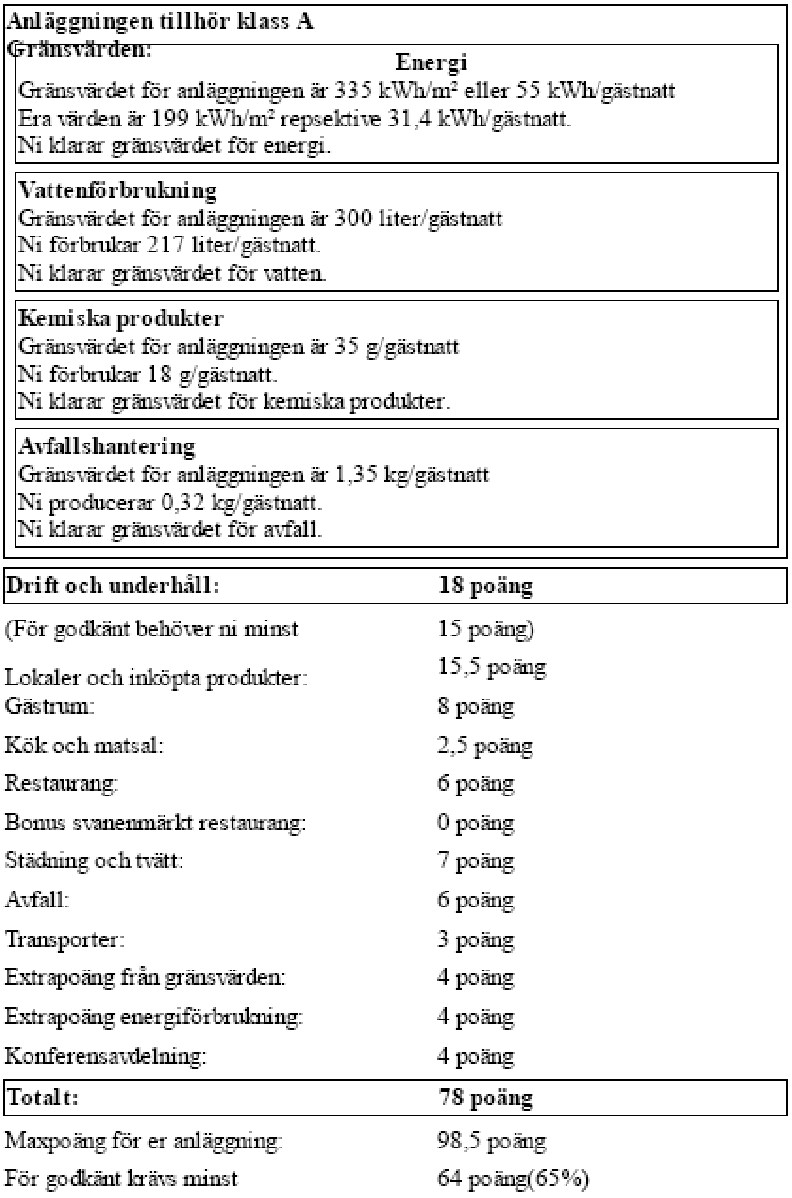
Producent av Vattenkraft -märkt el

Fortum

Elleverantör

TelgeKraft

Appendix 5.1B Summary sheet of Study 1 checklist for Nordic Swan certification *(Nordic Ecolabelling, 2007)*



Anläggningen tillhör klass A
Gränsvärden:

Energi
Gränsvärdet för anläggningen är 335 kWh/m² eller 55 kWh/gästnatt
Era värden är 199 kWh/m² repsektive 31,4 kWh/gästnatt.
Ni klarar gränsvärdet för energi.

Vattenförbrukning
Gränsvärdet för anläggningen är 300 liter/gästnatt
Ni förbrukar 217 liter/gästnatt.
Ni klarar gränsvärdet för vatten.

Kemiska produkter
Gränsvärdet för anläggningen är 35 g/gästnatt
Ni förbrukar 18 g/gästnatt.
Ni klarar gränsvärdet för kemiska produkter.

Avfallshantering
Gränsvärdet för anläggningen är 1,35 kg/gästnatt
Ni producerar 0,32 kg/gästnatt.
Ni klarar gränsvärdet för avfall.

Drift och underhåll:	**18 poäng**
(För godkänt behöver ni minst	15 poäng)
Lokaler och inköpta produkter:	15,5 poäng
Gästrum:	8 poäng
Kök och matsal:	2,5 poäng
Restaurang:	6 poäng
Bonus svanenmärkt restaurang:	0 poäng
Städning och tvätt:	7 poäng
Avfall:	6 poäng
Transporter:	3 poäng
Extrapoäng från gränsvärden:	4 poäng
Extrapoäng energiförbrukning:	4 poäng
Konferensavdelning:	4 poäng
Totalt:	**78 poäng**
Maxpoäng för er anläggning:	98,5 poäng
För godkänt krävs minst	64 poäng(65%)

Appendix 5.1C Breakdown of the mandatory requirements and point scores: Study 1

- ***Denotes direct impact on reducing energy consumption (emissions)***

1 General Description		
01	Description of hotel	√
2 Limit Values		
	2.1 Class Division	**Class A**
	2.2 Energy Consumption * *Option 1:* El & heat per m2 per year *Option 2:* El & heat/fuels per guest night per year	**Del. Electricity** 15 kWh/gn 94 kWh/m^2 **District Heating** 18 kWh/gn 104 kWh/m^2
	2.3 Water Consumption	217 L/gn
	2.4 Chemical products	18 g/gn
	2.5 Waste management	0.32 kg/gn
3 Environmental Requirements		
	3.1 Operation and maintenance	
02	Refrigerants	√
03	**External Lighting** *	√[1]
04	**Sauna** *	√
P1	**Energy Analysis** *	2 p
P2	**Heat Consumption** *	2 p[2]
P3	**Electricity Consumption** *	3 p[3]
P4	Refrigerants	2 p
P5	**Heat Recovery** *	3 p[4]
P6	**Control of ventilation and interior lighting** *	2 p[5]
P7	**Low energy lamps** *	3 p[6]
P8	**LED lamps** *	0 p [7]
P9	Toilets	0 p[8]
P10	Toilets	0 p [9]
P11	Water saving taps	1 p [10]
Total score Operation and maintenance		**18 p** (max 25 p)

---

[1] All external lighting must be timer controlled or demand-controlled. If lighting is on during the night, low energy lamps must be used, with the exception of the hotel's entrance area and any electric signs. (Ibid., 2000).

[2] 51-90% of heat comes from renewable energy sources or waste industrial heat/heat pumps. (Scandic Ariadne Nordic Swan, 2008).

[3] More than 90% of electricity comes from renewable sources (Ibid., 2008)

[4] Heat used from ventilation for at least 90% of requirements. (Ibid., 2008)

[5] The ventilation system is timer-controlled in at least 90% of the rooms that are ventilated. (Ibid., 2008)

[6] 80% or more of the light sources are low-energy lamps (Ibid., 2008)

[7] Less than 10% of the spotlights in the hotel are LED or similar. (Ibid., 2008)

[8] Less than 50% of WCs use a maximum of 6 litres of water per flush. (Ibid., 2008)

[9] Less than 20% of WCs provide two flush options. (Ibid., 2008)

[10] At least 90% of the mixer taps for the wash basins have a maximum flow rate of 8-10 litres / minute. (Ibid., 2008)

	3.2 Hotel Premises and purchased products	
05	Fittings and fixtures	√
06	New purchase of textiles	√
07	**New purchase of low energy lamps and fluorescent tubes***	√
08	Kitchen rolls, paper towels and toilet paper	√
P12	Toner cartridges	0.5 p
P13	**Office Machines***	0 p[11]
P14	Ecolabelled Printed matter	2 p
P15	Ecolabelled soap and shampoo	2 p
P16	Dispensers for soap and shampoo	1 p
P17	Reusable Drinking glasses and mugs	0 p
P18	Returnable bottles or barrels/tanks	2 p
P19	Work Clothes	0.5p
P20	Ergonomic Working Environment	0 p
P21	Purchase of ecolabelled consumables	3.5 p
P22	Ecolabelled durable goods/infrequently bought commodities	2 p
P23	Ecolabelled services	1 p
Total score Hotel Premises and purchased products		**14.5 p** (max 20 p)
	3.3 Guest Rooms	
O3	Smoke free rooms	√
P25	Ecolabelled bedlinen and towels	0 p
P26	**Lighting***	1 p[12]
P27	**Television Sets***	1 p[13]
P28	**Minibars***	0 p[14]
P29	**Water saving showers***	2 p[15]
P30	**Single lever mixer taps***	1 p[16]
P31	Disposable Items	1 p
P32	Waste Sorting	1 p
P33	Waste Paper Bin	0 p
P34	Rooms for physically disabled or allergy sufferers	1 p
Total score Guest Rooms		**8 p** (max 12.5 p)
	3.4 Kitchen and dining room	
O10	Disposable Items	√
O11	Ecolabelled dishwashing chemicals	√
O12	Non-ecolabelled products for washing up	√

---

[11] Less than 50% of office machines are connected to an auto power-off socket. (Ibid., 2008)

[12] At least 90% of the lighting in the guest rooms is presence controlled. (Ibid., 2008)

[13] At least 90% of the television sets have a passive standby setting of maximum 1W, and if applicable, an active standby setting of 9W. (Ibid., 2008)

[14] Minibar consumes 1.48 kWh per day. (Ibid.,2008)

[15] At least 90% of shower heads are of the water saving type, with a flow rate of at most 10 litres/minute. (Ibid., 2008)

[16] At least 90% of the mixer taps are sensor controlled. (Ibid., 2008)

O13	No-smoking dining rooms	√
P35	Organic foodstuffs and beverages	0.5 p
P36	Fairtrade products	1 p
P37	Ecolabelled dishwashing chemicals	1 p
P38	Dosage of dishwashing chemicals	1 p
Total score Kitchen and dining room		**3.5 p** (max 7.5 p)
	3.5 Extra requirements for hotels with non Swan-labelled restaurant	
P39	Swan-labelled restaurant	1
P40	Regional foodstuffs and beverages	0.5
P41	Vegetarian food	0.5
P42	Declaration of GMO content	0.5
P43	Origin of main ingredients	0
P44	Foods with significant environmental impact	0.5
P45	**Energy and water saving action***	4.5
Total score Extra requirements for hotels with non Swan-labelled restaurant		**7.5p** (max 7.5 p)
	3.6 Cleaning and Laundry	
O14	Reactive chlorine compounds	√
O15	Ecolabelled laundry detergents	√
O16	Non-ecolabelled laundry detergents	√
O17	Ecolabelled cleaning products	√
O18	Non-ecolabelled cleaning products	√
P46	Dry cleaning methods	2 p
P47	Ecolabelled laundry products	2 p
P48	Ecolabelled cleaning products	1 p
P49	**Laundry***	0 p[17]
P50	Exact dosing	2 p
P51	Chemical products	0 p
Total score for Cleaning and laundry		**7 p** (max 11 p)
	3.7 Waste	
019	Environmentally dangerous waste	√
020	Waste Sorting	√
021	Batteries	√
P52	Further Waste Sorting	4 p
P53	Returnable packaging	1 p
P54	Organic Waste	1 p
Total score for Waste		**6 p** (max 6 p)
	3.8 Transport and distribution	
P55	Own vehicles	1 p
P56	Public Transport	1 p
P57	Bicycles and horses	1 p
Total score for transport and distribution		**3 p** (max 3 p)
	3.9 Extra Points from the limit values	

---

[17] 2 points are awarded for sheets and linen cleaned at a Swan-labeled laundry and 1 point if cleaned at the hotel. (Ibid., 2007)

P58	**Limit values (max 4 p)** *	4 p[18]
P59	**Energy Consumption lower than the limit value (max. 4 p)** *	4 p[19]
Total score for extra points from the limit values		**8 p** [20] (max 8 p)
	3.10 Extra Points for hotels with conference facilities	
022	Waste sorting	√
P60	Waste sorting	0p
P61	Conference pads	1 p
P62	Flip charts and pens (max 2 p)	2 p
P63	Drinking glasses	1 p
P64	Organically grown fruit	0 p
Total score for extra points for hotels with conference facilities		**4 p** (max 6 p)
	3.11 Extra Requirements for hotels with pool/hot springs	
P65	Pool disinfection	N/A
P66	Pool cleaning chemicals	N/A
P67	**Pool facilities/Jacuzzi/hot springs***[21]	N/A
P68	Pool temperature (max 1 p)	N/A
Total score for extra points for hotels with pool/hot springs		N/A (max 4 p)
	3.12 Extra Requirements for hotels with garden	
O23	Biocides	√
O24	Composting	√
	3.13 Extra Requirements and adaptations for youth hostels	
O25	Dishwashing detergents and cleaning chemicals	N/A
O26	Waste	N/A
	3.14 Environmental management	
O27	Organisation and responsibility	√
O28	**Actions to reduce environmental impact***	√
O29	Legislation and regulatory requirements	√
O30	Information about Swan for employees	√
O31	Guest information	√
O32	**Continuous measurements***	√
O33	Documentation of Swan requirements	√
O34	**Energy-demanding equipment and service log***	√
O35	Handling of chemical products	√
O36	Annual follow-up	√

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[18] The hotel satisfies all four limit values (Ibid., 2007)
[19] The hotel's energy consumption is 43% lower than the limit value for energy. (Ibid., 2007)
[20] These points shall not be included in the total maximum area. (Ibid., 2007)
[21] 1 point for water + energy consumption metered separately for the pool facilities; 0.5 point for energy consumption metered separately for the pool facilities. (Ibid., 2007)

Appendix 5.1D Weighting of energy related points in the overall award of points in *Section 3 - environmental requirements.*

Total score	**Hotel's Score**	**Max. possible score (points)**
Operations and maintenance	18	25
Hotel Premises and purchased products	15.5	20
Guest Rooms	8	12.5
Kitchen and dining room	2.5	7.5
Cleaning and Laundry	7	11
Waste	6	6
Transport	3	3
Total	**60**	**85**
Extra requirements for hotels with restaurants	6	7.5
Extra requirements for hotels with conference facilities	4	6
Extra requirements for hotels with pools	0	4
Total	**10**	**17.5**
Extra points from the limit values	*4*	*8*
Extra points energy consumption	*4*	
Bonus points, Swan labelled restaurant	*0*	*1*
Total[22]	*8*	*9*
TOTAL POINTS SCORE Study 1	**78**	**98.5**

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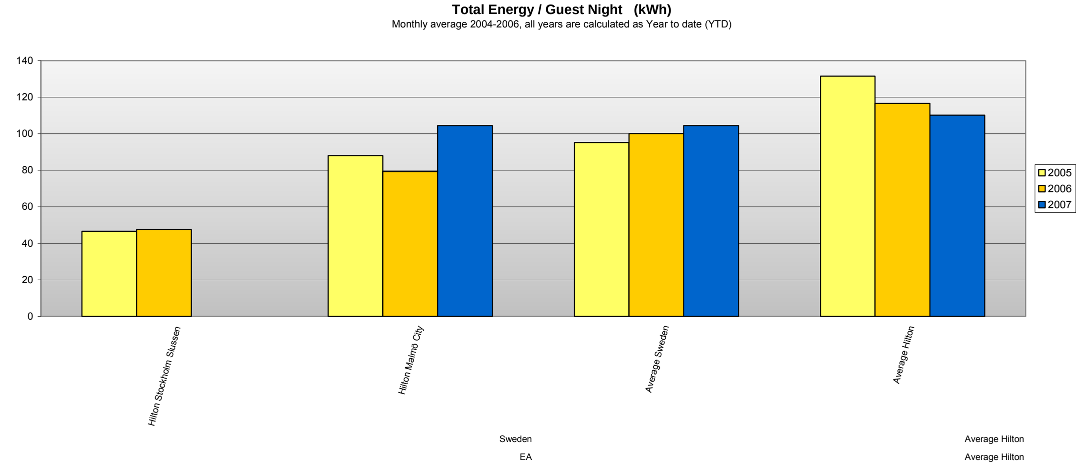
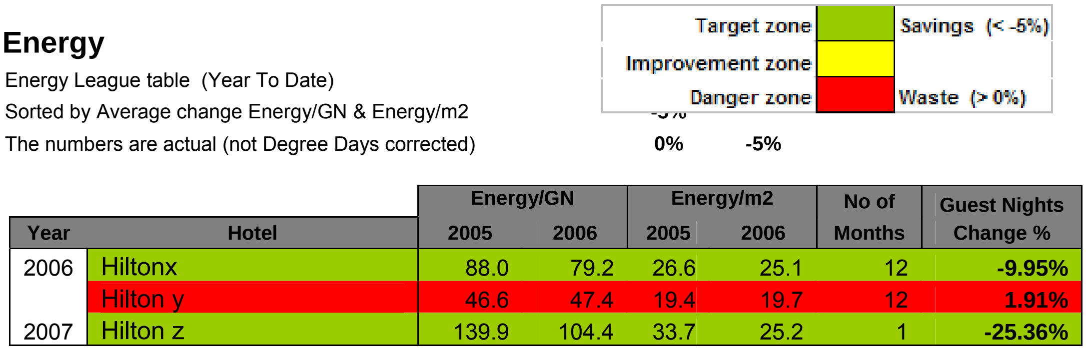
[22] These points shall not be included in the total maximum score. (Nordic Ecolabelling, 2007)

Appendix 5.1E Typical screenshots from HER database (SUS carbon copy of HER)



Typical ‘Total Energy (kWh) per Guest night’ Comparison Chart for Hilton hotels in Sweden (HER, 2006)

Note: The SUS database is a carbon copy of the Hilton (HER) database to which access was granted for all hotels worldwide.



Energy

Energy League table (Year To Date)

Sorted by Average change Energy/GN & Energy/m2

The numbers are actual (not Degree Days corrected)

Target zone	🟩	Savings (< -5%)
Improvement zone	🟨	
Danger zone	🟥	Waste (> 0%)

0% **-5%**

		Energy/GN		Energy/m2		No of	Guest Nights
Year	**Hotel**	**2005**	**2006**	**2005**	**2006**	**Months**	**Change %**
2006	Hiltonx	88.0	79.2	26.6	25.1	12	**-9.95%**
	Hilton y	46.6	47.4	19.4	19.7	12	**1.91%**
2007	Hilton z	139.9	104.4	33.7	25.2	1	**-25.36%**

Typical ‘League Table’ for Hilton hotels in Sweden (HER, 2006)

Note: The SUS database is a carbon copy of this database.

Appendix 5.1F Data extracted from Scandic Utility Systems (SUS).

Region	Country	City	Hotel	Year	Year Built	Floor Area	All Floors including basements	No. of Guest Bed Rooms	No. of Meeting Rooms	No. of Function Rooms
EA	Sweden	Stockholm	Case Study Hotel 1	2002	1989	16,000	0	283	17	0
EA	Sweden	Stockholm	Case Study Hotel 1	2003	1989	16,000	0	283	17	0
EA	Sweden	Stockholm	Case Study Hotel 1	2004	1989	16,000	0	283	17	0
EA	Sweden	Stockholm	Case Study Hotel 1	2005	1989	16,000	0	283	17	0

No. of Restaurants	Total Restaurant Seating Capacity	No. of Kitchens	Health Club Yes/No	On site Laundry Yes/No	Extent of landscaped grounds in m2	AC Public areas Yes/No	AC Meeting room Yes/No	AC Guest bed rooms Yes/No	CHP Unit Yes/No	Cooling tower Yes/No	Solar energy unit Yes/No	Water softener Yes/No
1	600	1	0	0	200	0	0	0	0	0	0	0
1	600	1	0	0	200	0	0	0	0	0	0	0
1	600	1	0	0	200	0	0	0	0	0	0	0
1	600	1	0	0	200	0	0	0	0	0	0	0

Jacuzzi	Total Number of Guest Nights (Sleepers)	Unsorted waste	Unsorted waste Unit	Sorted waste	Sorted waste Unit	Hazardous waste	Hazardous waste Unit
0	101,275	76,800	kg	-	kg	-	kg
0	98,286	53,856	kg	-	kg	-	kg
0	105,247	62,478	kg	35,923	kg	-	kg
0	106,911	56,093	kg	70,979	kg	1,558	kg

Total Mains Supply	District Heating	Water	kWh/gn	kWh/m2	litre/gn	kg waste/gn
1,810,011	1,823,700	20,639	35.88	227.11	203.79	0.76
1,766,168	1,806,000	17,736	36.34	223.26	180.45	0.55
1,744,576	1,861,700	18,200	34.26	225.39	172.93	0.59
1,651,197	1,753,877	18,239	31.85	212.82	170.60	0.52

Appendix 5.1G: Extract of SUS Data inputted to author's excel file database

Case Study Hotel 1 - Stockholm, Sweden. **SUS Database– DELIVERED ELECTRICITY, kWh**

YEARS	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
January	173,689	165,947	172078	160,071	147,494	144,735	142,701	140,853	136,191
February	161,578	158,458	163911	146,882	131,886	134,123	133,571	132,788	120,530
March	180,341	176,178	174649	165,486	150,704	**152,303**	146,183	138,000	136,149
April	168,980	168,985	164236	154,106	142,886	142,829	138,386	130,343	129,226
May	180,290	172,498	170524	163,738	146,855	152,177	144,283	143,838	137,781
June	178,574	173,678	163463	155,474	151,764	147,833	142,525	137,145	135,459
July	181,515	176,246	164121	164,300	160,713	154,984	153,357	146,636	139,123
August	179,738	179,284	168443	161,911	160,342	152,433	155,815	145,225	152,164
September	180,567	174,944	168690	156,101	155,212	144,926	148,691	141,995	144,877
October	185,884	176,582	173681	159,093	161,890	148,576	152,241	148,226	144,024
November	177,322	177,587	170058	155,548	152,953	145,633	143,778	141,422	138,312
December	174,137	178,419	162259	145,347	147,312	145,616	143,044	133,778	128,082
	2,122,615	**2,078,806**	**2,016,113**	**1,888,057**	**1,810,011**	**1,766,168**	**1,744,575**	**1,680,249**	**1,641,918**

Case Study Hotel 1 - Stockholm, Sweden. **SUS Database - DISTRICT HEATING, kWh**

	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
January	161,000	175,000	127,000	165,000	328,000	371,000	387,000	268,000	332,000
February	158,000	145,000	119,000	174,000	180,000	310,000	273,000	325,000	338,000
March	159,000	120,000	99,000	180,000	185,000	190,000	233,300	291,000	377,000
April	116,000	55,000	58,000	133,000	137,000	184,000	138,200	141,000	146,000
May	45,000	27,000	13,000	41,000	52,000	66,000	73,500	89,000	101,000
June	21,000	3,000	9,000	8,000	7,200	20,000	23,900	43,000	22,000
July	14,000	2,000	5,000	3,000	3,400	5,000	5,900	6,000	4,000
August	21,000	4,000	5,000	6,000	3,100	18,000	8,100	12,000	6,000
September	31,000	7,000	14,000	19,000	43,000	39,000	44,600	56,000	27,000
October	71,000	45,000	29,000	93,000	220,000	174,000	120,500	133,000	138,000
November	147,000	80,000	76,000	236,000	295,000	182,000	252,000	224,000	238,000
December	146,000	159,000	101,000	268,000	370,000	247,000	302,000	319,000	207,000
Total	**1,090,000**	**822,000**	**655,000**	**1,326,000**	**1,823,700**	**1,806,000**	**1,862,000**	**1,907,000**	**1,936,000**

Appendix 5.1H: Key findings

Key 'Green' Features	**Actual CO_2 Impact**	**Findings**
Nordic Swan Certification	*Low*	The time series analysis reflects emissions before and after certification. The analysis showed a 10-15% reduction from 1998 to 2005 due to energy conservation measures resulting from the Scandic Environmental campaign and not necessarily from the drive to achieve certification. The hotel would operate efficiently with or without certification. The most dramatic reduction was after the switch to 'green' electricity in 2006. However, the authenticity of green electricity, unless generated on site is discussed in chapter 2.
Building Design	*Medium*	The purpose built design takes good account of its location and orientation. The day lit atrium has the potential to reduce lighting and heating load but this cannot be verified since no sub-metering is installed. The position of the air intake ducts for the ventilation system faces north which means that air has to be warmed to a higher degree than if it faced another direction.
District Heating (CHP)	*High*	Two points have been awarded for 51-90% of heat comes from renewable energy sources or waste industrial/heat pumps.
Sea-water Cooling System	*Medium*	The seawater cooling system is claimed to reduce the mechanical comfort cooling energy consumption by 30%. There is no provision in the Nordic Swan criteria to award points for this reduction in cooling load.

Heat Recovery	*Medium/high*	Heat used from ventilation for at least 90% of requirements. The heat is recovered and recirculated into air supply system to guest bedrooms, meeting rooms etc.
Ventilation and interior lighting	*High*	*Ventilation;* The ventilation system is timer-controlled in at least 90% of the rooms that are ventilated. *Lighting;* 80% or more of the light sources in the establishment are low-energy lamps. 20% of the spotlights are LEDs or similar. At least 90% of the lighting in the guest rooms is presence controlled. I
'Green' Electricity Certificates	*Low*	Three points are awarded for ecolabelled or 'green' electricity even though unless electricity is generated on site or 'additionality' is proven, the emissions reductions of 'green' electricity cannot be verified. (See Chapter 2).
'Eco Room'	*Low*	Due to a lack of sub-metering it was not possible to verify that Eco-rooms have resulted in actual emissions reductions or energy consumption. Any savings are lost in the data for the whole hotel without sub-metering.
Weighting of energy related points in overall award of points	*Low*	The weighting of obligatory requirements and awarding of points in relation to total score as discussed in section 5.1.4. Four points are awarded if the hotel satisfies all four limit values (2p if three are met) and up to four points awarded if more than 35% of the total energy consumption is less than the limit value for energy. Yet, these points are not included in the calculation of the total score. In effect, the hotel is not awarded points for exceeding the energy consumption limit value.

		In addition, measures that have a high impact on energy consumption (emissions) reduction are awarded the same number of points as low impact measures. For example, 1 point is awarded if more than 90% of the lighting in the guest rooms (283 bedrooms) is presence controlled whereas 4 points are awarded for further waste sorting. The percentage of renewables used in delivered electricity or heating is only awarded 1 -3 points (increases with increasing percentage) and is not included as an obligatory requirement. No energy related obligatory requirements or points awarded in extra requirements for hotels with restaurant, conference and/or pool facilities.
Laundry	*High*	The laundry is out sourced but received no points in this category. One point is awarded if the laundry is done in-house and would be awarded 2 points from Nordic Swan criteria if it was sent to a Swan labelled laundry. No points are awarded for the fact the laundry is outsourced even though this has a big impact on reducing the hotels energy consumption (and emissions) of the hotel.
Sauna	*Medium*	All sauna units are timer controlled.
Extra Points from limit values	*N/A*	According to the Nordic Swan criteria document, the total score that can be achieved **is not** affected by any extra points from the limit values. The case study hotel satisfied all four limit values and was awarded four extra points. The hotel also was awarded four extra points for having energy consumption more than the required 35%. In fact the hotel was 43% under the limit value.

		These extra 8 points have been included in the total score for the hotel submitted by the hotel to Nordic Swan for certification despite the criteria document stating that; *'the total score that can be achieved* ***is not*** *affected by any extra points from the limit values.'*
Extra requirements for hotels with conference facilities	*Zero*	Four points were awarded out of six in this category however no points relate to energy consumption.
Extra requirements for hotels with non-swan labeled restaurant.	*Zero*	If the restaurant is Swan labelled then it is awarded one point and therefore all requirements in this section are considered fulfilled. The max. points available (7.5p) were awarded out of in this category however no points relate to energy consumption.
Atrium space	*Zero*[23]	No sub-metering and monitoring of energy consumption and heat/cooling load in this space. No climate controlled window opening sensors. There did not appear to be any high level window openings or any provision for heat recovery at the top of the atrium.

Sourced by Author from Nordic Swan criteria document and Case Study 1 Nordic Swan Checklist –Case Study 1, 2008.

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[23] Potential to have greater CO_2 impact if integrated in building monitoring system.

Appendix 5.1l: Recommendations for improvement

Opportunity	**Benefit**	**CO_2 Impact**		**Additional Information**
Match source to load (MVHR[24])	Reduce energy consumption and associated emissions.	High	Technical	• Ensure controls match building occupancy[25] • Consider demand-controlled ventilation system in at least 90% of the rooms that are ventilated. Demand–control means that the ventilation system /lighting is adapted to the number of individuals in the room. • Check position of thermostats so they are not influenced by draughts, sunlight or internal heat sources like radiators or fireplaces. They should be regularly checked to make sure they are working correctly. Some hotels use separate room thermometers to double check thermostats are turning the heating on when required. • Thermostatic radiator valves (TRV) used to control the heat output from a radiator by adjusting water flow providing efficient, localized control. In common areas of a hotel, TRVs will reduce the amount of heat output from radiators as the space fills with people – and their own body heat. • Upgrade old, inefficient heating system controls. The heating systems can adjust themselves in line with changeable weather conditions. A *compensator* automatically regulates the heating temperature based on outside conditions. • Night setback controls can set back space temperatures during specific time periods. For example, hotels can make savings by allowing temperatures in common areas such as corridors and stairwells to fall to 16C between midnight and 5am when most guests will be in their rooms. • Review the capacity of central equipment relative to the actual load as oversized equipment operates less efficiently. Successful energy conservation can often result in the existing equipment then becoming too large for the connected load. • Operate MVHR with actual load and shut off equipment when not required. • Do not allow simultaneous heating and cooling. This can be avoided by setting a temperature ‘dead band’ – a wide gap between the temperatures at which heating and cooling cut in between 19C and 24C (ITP, 2008) • Schedule HVHR systems according to time of day, week operation. Install timers. Shut off individual units in unoccupied areas. (ITP, 2008) • Depending on the season, housekeeping staff can shut off or maintain room

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[24] Mechanical Ventilation Heat Recovery System

[25] More information available in Carbon Trust technology guide on Heating control CTG002 (ITP, 2008)

				temperature by resetting thermostats when making up rooms after check-out. (ITP, 2008 • Recover heat from exhaust air by re-circulating a proportion of the exhaust air along with incoming fresh air to maintain air quality. The ratio of re-circulated air to incoming fresh air will be dependant on the air quality requirements which can be controlled using an indoor air quality sensor. • Variable speed drives (VSDs) enable the output speed of the fans to match requirements at different times of day which saves energy and corresponding heating and cooling savings. They can be used where a fan or motor is used for example in a large ventilation system in a large hotel. • BEMS already in operation.
Decrease Heating and Cooling Load	Reduce energy consumption and associated emissions.	High	Technical, Management	**Lighting** • Daylight sensors; light sensors or 'photocells' can be used to control artificial lighting when there is sufficient day lighting. Photocells can be effectively combined with time switches to ensure more precise control. Decrease lighting levels in general and/or at specified times (using timers or occupancy related demand) • Install energy efficient lamps in remaining 20% of the hotel which could be significant if this remaining area was in the public areas of hotel such as lobby. • Use light reflective surfaces and reflection in order to reduce wattage. • Keep lights and windows clean to reduce wattage. Identify and replace failing lights. • Introduce lighting maintenance schedule **Glazing** • Provide shade control on windows to reduce unwanted solar gain particularly in atrium area. **Specific Modifications where applicable** • Check for infiltration of outside air in the form of negative pressure, leaking windows or draughts. • Reduce excessive supply and exhaust air. • Improve insulation of pipes. • Shut down areas and equipment not in use.
Zoning for heating/cooling	Zoning to match different occupancy			• A solution is to create 'zones' in the building where separate time and temperature controls are installed. Zoned areas will provide closer, more efficient heating/cooling control which can improve comfort conditions. Zoning should be considered where there area) different occupancy patterns b) different temperature requirements c) a number of floors (e.g. where top floors poorly insulated.)

				• The hotel could zone its building to take into account the different temperature requirements of the main restaurant, kitchen and storage areas.
Install sub-meters: guest rooms, sauna and conference areas of the hotel.	Identify energy (and high emissions) intensive areas in hotel.	High	Technical	Sub-metering of kitchen already installed. Daily or weekly sub-metering readings in guest rooms, sauna and conference areas would: • Identify exceptional or unusual patterns of energy consumption. Inefficiencies can be traced at source. • Enable separation of *architectural e.g.* space heating/cooling, lighting and *domestic* energy use e.g. hot water and identification of associated fuel use for each separated function. This will provide vital information for monitoring and targeting energy consumption and CO_2 emissions. • Provides reliable information for the proper sizing of new or replacement equipment. • Provide immediate feedback on the results of specific energy conservation measures that would otherwise be lost in the overall energy consumption of the building. (ITP, 2008) Sub-metering would help diagnose the cause enabling recommendations to be made to rectify the problem thus reducing the environmental impact of the hotel.
Monitoring and target energy consumption	Monitor and target performance in energy intensive (and high emissions) areas	High	Organizational	Monitoring at regular intervals will reveal unexpected changes in consumption (perhaps due to the faulty operation of equipment, leaks, poorly set controls or other sources of waste) can be detected rapidly and corrective action taken. Regular monitoring provides a flow of detailed and comprehensive operating information, vital to good management. (ITP, 2008)
Check and improve pump, fan and motor efficiency	Energy consumption can increase by 60% if regular maintenance is not undertaken.	medium	Management	• Compare actual performance with the design. • Modify the pump impeller if required. • Replace burnt motors with a high efficiency type. • Consult a maintenance technician to assess performance of whole system reviewed annually and replacements parts ordered as necessary.

Adjust thermostatic controls and time clocks	Controls can help prevent the waste of fuel and electricity	high	management	• Time switches ensure the systems operate only when they are needed. • Optimum start and stop controllers connected to internal and external sensors and calculate the optimum time to switch on (to bring the building to optimum temperature in the morning) and off (taking into account the heat stored in the building) • Weather compensators which control the temperature of the water flowing through the radiators and adjust it according to external temperatures. • Zone controls which enable different parts of a building to be heated at different times or to different temperatures, according to factors such as occupancy and solar gain. • Room thermostats and thermostatic radiator valves to regulate temperatures in the spaces in which they are sited and prevent overheating. • Set-back controls which reduce temperatures at which heated spaces are maintained overnight or during unoccupied times.
Install occupancy-linked Controls: switches, timers, motion detectors	Control part or all of the room lighting, heating or cooling and power outlets.			• Unoccupied rooms or corridor spaces can with appropriate controls be kept at a set-back temperature which is a good few degrees below or above full comfort temperature depending on the season or geographic location. The set-back temperature enables comfortable conditions to be met in a reasonably short time as well as, for example, avoiding the build up of condensation and it also reduces energy/electricity use. • Occupancy sensors could be installed which detect the presence of an occupant and control all services accordingly. Careful selection and design are required if these systems are to be fool proof in use. For example, install presence controlled lighting in at least 90% of the rooms which are not intended for guests such as in corridor areas or in conference where there is only intermittent use.
Hot Water	Appropriate hot water temperatures and installation of water conserving devices			• Set appropriate hot water temperatures (optimum 60C). • Wasted heated water can be avoided by tap controls which switch taps off after a certain time useful in communal areas. • Spray taps and water efficient showerheads which reduce the volume of water reducing consumption. At least 90% of shower heads are of the water saving type, with a flow rate of at most 10 litres/minute, At least 90% of mixer taps are single lever alternatively sensor controlled. Consider installing same in remaining 10%.

Maintain building fabric i.e. walls, floors, ceilings	Make improvements prior to any refurbishment and/or replacing or upgrading any existing heating system.			• Maintenance will lead to potential issues being identified early on. Establish housekeeping and maintenance schedule i.e. have a specific member of staff to conduct regular walk round using checklist and check window panes and frames, roof lights, roofs, skirting and eaves. • Deal with fabric issues immediately particularly if there are gaps or holes, install draught stripping to windows and doors, check for signs of damp or damage and replace when required. • Regularly check building for damp • Ensure windows and doors are closed as much as possible when heating is on and encourage guests to do the same. • Check insulations levels and increase where practical. • Insulate hot water pipes where required. • Improve glazing e.g. upgrade to triple glazing during any future refurbishment particularly in north/east façade. • Consider separation between restaurant and atrium to prevent heat loss in winter and to ensure better heating / cooling control.
Kitchen	Area of high energy consumption and waste			In some kitchens as little as 40% energy consumed is used for the preparation and storage of food; much of the wasted energy is dispersed into the kitchen as heat. Currently, the kitchen's energy and water consumption is measured and recorded separately and the stove has induction or low-radiation hotplates. Al rinsing taps for dishwashing are fitted with a 'dead man's handle' i.e. they shut off when the lever is released or are sensor controlled. **Equipment** • Switching for savings • Clean and maintain cooking equipment • Use kitchen equipment properly e.g. shortening the drying times in dishwasher cycles and using the residual heat in the dishwasher to dry the contents instead of using expensive power drying cycles., use dishwasher at full load, keep chiller and freezer doors open to a minimum, label equipment with minimum warm up times, use correct size equipment and switch off unnecessary kitchen equipment and lights. • Consider replacing any kitchen equipment over 15 years old with newer, more efficient models. • Use equipment that automatically switches off. • Always look for 'A' rated category equipment. **Refrigeration** • Establish a simple equipment maintenance schedule i.e. Defrosting every two

				months. • Avoid over cooling e.g. energy consumption can be reduced by 2-4% if set cooling temperature increased by 1C. • Keep non-perishables cool. • Can specific cooking operations be combined in order to run less equipment? • Maintain kitchen extract ventilation which can increase efficiency by as much as 50% compared with unmaintained systems. • Consider heat recovery – an air to water recovery device can be used to preheat hot water, providing a year round use for the recovered heat. • By sub-metering kitchen can identify energy use to activity. • Consider installing passive solar panels for pre-heating water or photovoltaic panels to produce some of the electricity to heat your water. • Install motion detectors/occupancy sensors in store rooms & walk-in refrigerators. • Turn off lights in cold storage rooms.
Guest Rooms				• Once sub-metering is installed, analyze hourly consumption to identify where the peaks are during the day and whether there are any leaks. • During periods of low occupancy, group the rooms in which you put your guests relative to the mechanical and electrical systems and shut off unoccupied areas. During the heating season, occupy the rooms in the sunny side of the building first and during the cooling season on the opposite side.
Laundry				• Laundry outsourced. Consider sending sheets, linen and towels to be cleaned at a Swan-labeled laundry.
Sauna				Depending on whether the sauna units are timer or demand-controlled, then consider one and/or other in addition to improve performance. • *Styrs via tidur med standby function och närvarofunktion*.

Conference Facilities				• No mention in criteria document of whether or not the ventilation system is timer or demand controlled. If not installed, then consider installing one of the above systems. All conference facilities benefit from daylight from windows and the option for natural ventilation through the use of operable windows which should be maximized where possible. Close curtain, blinds to reduce solar gain.
Energy management and People Solutions	Within control of staff			• Walk around hotel at different times of the day and during different seasons to see how and when heating and cooling systems are working. Check time and temperature settings. • Assign a member of staff to switch off all non-essential lighting and equipment. Install timers or sensors to help with this. • Have maids vacate rooms as early as possible in order to switch off lights, ventilation and turn down thermostats. • During hot or cold weather, keep curtains, blinds, shades closed to reduce heating and cooling gains and losses. • Raising awareness amongst kitchen staff and providing energy management training can reduce catering energy use by up to 25%.

Adapted and developed from Hospitality Saving energy without compromising service, CTV013, Carbon Trust, Environmental Management for Hotels by the ITP, 2008, Nordic Swan Criteria Document 2007 and Case Study 1 Nordic Swan Checklist –Case Study.

5.2

Appendices

Appendix 5.2A Breakdown of benchmarks and checklist achieved by Study 2 hotel for Green Globe certification.

1 **Sustainability Policy**		√√
2 Energy Consumption		
	Energy consumed / Guest night*	√
	Carbon dioxide (CO_2) produced / Guest night *	**N/A**[1]
3 Water Consumption		
	Water consumed / Guest night	√√
	Water saving	√
4 Waste Sent to Landfill		
	Waste landfilled / Guest night	√√
	Waste recycling	√
5 Community Commitment		
	Employees living within 20 km of operation / Total employees	√√
	Community contributions	√√
6 Paper Products		
	Product types used	√
7 Cleaning Products		
	Product types used	√
8 Pesticide Products		
	Product types used	√

√√	At or above best practice
√	At or above baseline
X	Below baseline

***** ***Energy Related benchmark or checklist***

Table 7.3 Breakdown on the benchmarks and checklist achieved by the Study 2 hotel for Green Globe certification

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[1] These criteria are for guidance only and do not affect the overall benchmarking evaluation.(Green Globe, 2007).

Appendix 5.2B *Extract of e-mail correspondence Ms. Anke Hofmeister*[2]

- Which accommodation buildings are included in this consumption data? What are the total square meters included?
  All facilities like kitchens, the spa, the dive school, guest villas, staff accommodations etc. are included in this data. The total area under roof is 18650 square metres.

- What does 'host numbers and host nights' mean?
  Host = staff. We have about 380 people employed full time at the resort. On average, this is also the number of people living at the resort. The host night values mean the host numbers multiplied by the days of the month.

Electricity

So far, all electricity has been generated on-site with diesel generators, but we are hoping to change to renewable energy sources in the near future. The data given is for all facilities and buildings on the resort. We have submetres too, but not for all major facilities. The total guest accommodation was calculated to make up around 35 % of the total energy consumption. All data is in kWh, as can be seen in the first column of the data sheet.

Diesel

All diesel that I sent the data for is used for electricity generation and also for the boats and vehicles on the island. In the attached sheet, you can see the amount of diesel that is purely used for the generators. Most of it is actually used in electricity generation. All figures are in litres.

Petrol

The petrol is used mainly for the boats; they have two- and fourstroke engines. The figures are in litres.

Canned heat consumption

The canned heat is used for keeping food items like stews and pasta hot. I'm not sure the exact term for the fuel that is in the can. The cans are small (250 g) and really only used for that purpose. The unit is kg.

Charcoal consumption

The charcoal is used for barbecues. The unit is kg.

LPG consumption

The LPG is used in the kitchens for cooking. The figures are in kg.

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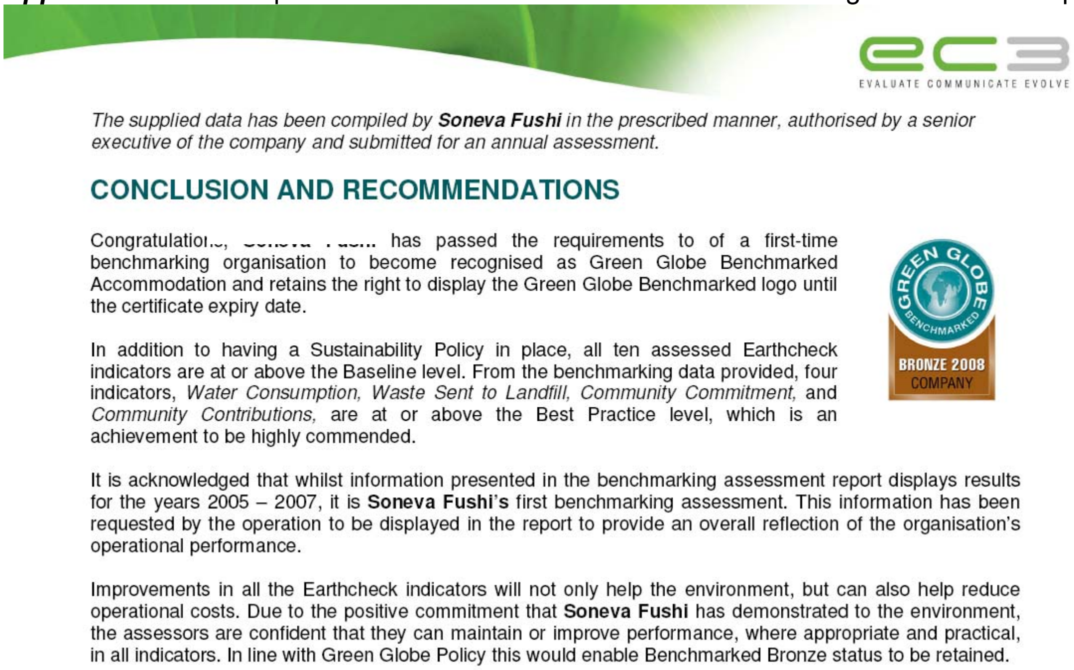
[2] E-mail correspondence March 10, 2008).

Appendix 5.2C Example of recommendations from the Benchmarking Assessment Report



*The supplied data has been compiled by **Soneva Fushi** in the prescribed manner, authorised by a senior executive of the company and submitted for an annual assessment.*

CONCLUSION AND RECOMMENDATIONS

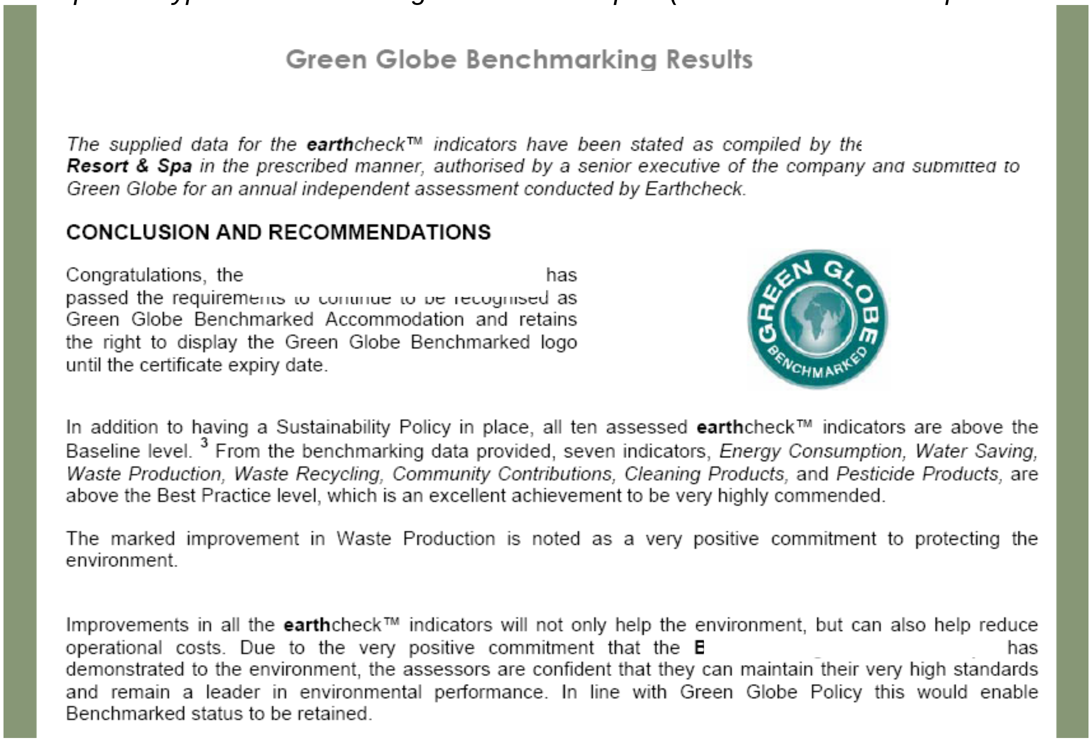
Congratulatio[redacted] has passed the requirements to of a first-time benchmarking organisation to become recognised as Green Globe Benchmarked Accommodation and retains the right to display the Green Globe Benchmarked logo until the certificate expiry date.

In addition to having a Sustainability Policy in place, all ten assessed Earthcheck indicators are at or above the Baseline level. From the benchmarking data provided, four indicators, *Water Consumption, Waste Sent to Landfill, Community Commitment,* and *Community Contributions,* are at or above the Best Practice level, which is an achievement to be highly commended.

It is acknowledged that whilst information presented in the benchmarking assessment report displays results for the years 2005 – 2007, it is **Soneva Fushi's** first benchmarking assessment. This information has been requested by the operation to be displayed in the report to provide an overall reflection of the organisation's operational performance.

Improvements in all the Earthcheck indicators will not only help the environment, but can also help reduce operational costs. Due to the positive commitment that **Soneva Fushi** has demonstrated to the environment, the assessors are confident that they can maintain or improve performance, where appropriate and practical, in all indicators. In line with Green Globe Policy this would enable Benchmarked Bronze status to be retained.

Example of atypical Benchmarking assessment report (before Green Globe update in 2007)



Green Globe Benchmarking Results

*The supplied data for the **earth**check™ indicators have been stated as compiled by the [redacted] **Resort & Spa** in the prescribed manner, authorised by a senior executive of the company and submitted to Green Globe for an annual independent assessment conducted by Earthcheck.*

CONCLUSION AND RECOMMENDATIONS

Congratulations, the [redacted] has passed the requirements to continue to be recognised as Green Globe Benchmarked Accommodation and retains the right to display the Green Globe Benchmarked logo until the certificate expiry date.

In addition to having a Sustainability Policy in place, all ten assessed **earth**check™ indicators are above the Baseline level. [3] From the benchmarking data provided, seven indicators, *Energy Consumption, Water Saving, Waste Production, Waste Recycling, Community Contributions, Cleaning Products,* and *Pesticide Products,* are above the Best Practice level, which is an excellent achievement to be very highly commended.

The marked improvement in Waste Production is noted as a very positive commitment to protecting the environment.

Improvements in all the **earth**check™ indicators will not only help the environment, but can also help reduce operational costs. Due to the very positive commitment that the E[redacted] has demonstrated to the environment, the assessors are confident that they can maintain their very high standards and remain a leader in environmental performance. In line with Green Globe Policy this would enable Benchmarked status to be retained.

Appendix 5.2D Resort Data inputted to author's excel file database

HEMP Benchmarking and Key Sustainability Indicator Report

	Jan 2007	Feb 2007	Mar 2007	Apr 2007	May 2007	Jun 2007	Jul 2007	Aug 2007	Sep 2007	Oct 2007	Nov 2007	Dec 2007	TOTAL
ACCOMMODATION	**1860 SQUARE METRES** - ALL FACILITIES KITCHEN, SPA, DIVE SCHOOL, GUEST VILLAS, STAFF ACCOMMODATIONS ETC.												
Occupancy status													
Occupied rooms	1747	1682	1635	1568	1117	1012	1146	1569	999	1555	1798	1868	
Guest nights (2.3 guests per room?)	4029	3964	3300	4097	2799	2161	2671	3959	2363	3686	3828	4402	**41,259**
Average length of stay	8.0	7.2	6.0	6.0	7.0	6.2	6.0	6.0	6.0	6.4	9.5	8.4	
Host numbers	380.0	375.0	376.0	374.0	379.0	374.0	372.0	373.0	375.0	376.0	374.0	378.0	HOST = STAFF
Host nights	11780	10500	11656	11220	11749	11220	11532	11563	11250	11656	11220	11718	HOST # X DAYS MONTH
Total guest/host nights	**15809**	**14464**	**14956**	**15317**	**14548**	**13381**	**14203**	**15522**	**13613**	**15342**	**15048**	**16120**	**178,323**
KSI 2 – Energy usage and greenhouse gas emissions													
Electricity consumption	**ELECTRICITY GENERATED ON-SITE USING DIESEL GENERATOR GUEST ACCOMMODATION CALC. 35% TOTAL ENERGY CONSUMPTION**												
[kWh total] **NOT INCLUDED?????**	397257.00	337617.64	398245.20	401921.24	400453.00	350228.00	360538.00	388456.00	349808.00	375238.20	376647.70	382789.00	**4,519,199**
[kWh per occupied room]	227.39	200.72	243.58	256.33	358.51	346.08	314.61	247.58	350.16	241.31	209.48	204.92	**3,201**
[kWh per guest night]	98.60	85.17	120.68	98.10	143.07	162.07	134.98	98.12	148.04	101.80	98.39	86.96	**1,376**
Diesel consumption	**USED FOR ELECTRICITY GENERATION and for boats vehicles (L)**												**0**
[l total]	127200.00	114200.00	127500.00	130100.00	122717.00	112683.00	114000.00	133900.00	108130.00	119970.00	120300.00	123700.00	**1,454,400**
[l per occupied room]	72.81	67.90	77.98	82.97	109.86	111.35	99.48	85.34	108.24	77.15	66.91	66.22	**1,026**
[l per guest night]	31.57	28.81	38.64	31.75	43.84	52.14	42.68	33.82	45.76	32.55	31.43	28.10	**441**
Carbon emissions [t] **0.00268**	340.90	306.06	341.70	348.67	328.88	301.99	305.52	358.85	289.79	321.52	322.40	331.52	**3,898**
[$]	86724.96	77317.49	85253.17	86022.12	81226.38	75689.17	76893.00	90497.37	73160.76	82448.62669	90697.98	96733.40	**1,002,664**
[l total for generator]	110149.70	96757.30	113773.10	115159.70	111997.70	95960.50	94410.00	109101.90	95308.50	103822.50	105196.20	105858.50	**1,257,496**
Accom. CO2 emissions [kg] **2.630 kgCO2/KG**	289693.71	254471.70	299223.25	302870.01	294553.95	252376.12	248298.30	286938.00	250661.36	273053.18	276666.01	278407.86	**3,307,213**

Petrol consumption	**USED FOR BOAT ENGINES**												**0**
[l total]	18489.00	15012.00	19185.00	18920.00	13790.00	9975.00	8213.00	12643.00	9570.00	11106.00	13777.00	13168.00	**163,848**
[l per occupied room]	10.58	8.93	11.73	12.07	12.35	9.86	7.17	8.06	9.58	7.14	7.66	7.05	**112**
[l per guest night]	4.59	3.79	5.81	4.62	4.93	4.62	3.07	3.19	4.05	3.01	3.60	2.99	**48**
Carbon emissions [t] **0.00231**	42.71	34.68	44.32	43.71	31.85	23.04	18.97	29.21	22.11	25.65	31.82	30.42	**378**
[$]	13175.26	10605.29	13505.84	13393.468	10006.02	7415.42	6118.69	9428.91	7141.13	8288.05	10713.83	10770.11	**120,562**
Canned heat consumption	**USED KEEP FOOD ITEMS HOT**												**0**
[kg total]	414.00	360.00	468.00	468.00	396.00	378.00	450.00	522.00	432.00	450.00	522.00	450.00	**5,310**
[kg per occupied room]	0.24	0.21	0.29	0.30	0.35	0.37	0.39	0.33	0.43	0.29	0.29	0.24	**4**
[kg per guest night]	0.10	0.09	0.14	0.11	0.14	0.17	0.17	0.13	0.18	0.12	0.14	0.10	**2**
Carbon emissions [t] **0.00312**	1.29	1.12	1.46	1.46	1.24	1.18	1.40	1.63	1.35	1.40	1.63	1.40	**17**
Carbon emissions [kg]													
[$]	811.69	740.17	988.90	960.69	831.62	793.82	887.21	1101.30	906.28	927.02	1089.50	958.09	**10,996**
Charcoal consumption	**BBQ**												**0**
[kg total]	0.00	2100.00	0.00	3630.00	2118.00	0.00	2100.00	288.00	3360.00	0.00	2808.00	2250.00	**18,654**
[kg per occupied room]	0.00	1.25	0.00	2.32	1.90	0.00	1.83	0.18	3.36	0.00	1.56	1.20	**14**
[kg per guest night]	0.00	0.53	0.00	0.89	0.76	0.00	0.79	0.07	1.42	0.00	0.73	0.51	**6**
Carbon emissions [t] **0.00312**	0.00	6.55	0.00	11.33	6.61	0.00	6.55	0.90	10.48	0.00	8.76	7.02	**58**
CO2 emissions [kg] 2.548 kgCO2/kg	0.00	5350.80	0.00	9249.24	5396.66	0.00	5350.80	733.82	8561.28	0.00	7154.78	5733.00	**47,530**
[$]	0.00	2439.93	0.00	3774.84	2505.59	0.00	2652.30	451.76	4095.44	0.00	3609.91	4272.53	**23,802**
LPG consumption	**USED IN KITCHENS COOKING**												**0**
[kg total]	4200.00	3575.00	3324.00	4030.00	3445.00	3421.00	3819.00	4425.00	4486.00	3838.00	4644.00	4433.00	**47,640**
[kg per occupied room]	2.40	2.13	2.03	2.57	3.08	3.38	3.33	2.82	4.49	2.47	2.58	2.37	**34**
[kg per guest night]	1.04	0.90	1.01	0.98	1.23	1.58	1.43	1.12	1.90	1.04	1.21	1.01	**14**
Carbon emissions [t] **0.00151**	6.34	5.40	5.02	6.09	5.20	5.17	5.77	6.68	6.77	5.80	7.01	6.69	**72**
CO2 emissions [kg] 2.82 kgCO2/kg	11844.00	10081.50	9373.68	11364.60	9714.90	9647.22	10769.58	12478.50	12650.52	10823.16	13096.08	12501.06	**134,345**
[$]	5058.19	4396.59	4059.46	4936.84	4049.28	4014.97	4383.98	5178.48	4825.50	4450.88	4694.56	5154.81	**55,204**
Carbon emissions													**0**
[t total]	391.24	353.81	392.50	411.24	373.78	331.38	338.21	397.27	330.50	354.37	371.63	377.05	**4,423**
CO2 emissions Accommodation[kgCC	301537.71	269904.00	308596.93	323483.85	309665.52	262023.34	264418.68	300150.32	271873.16	283876.34	296916.87	296641.92	**3,489,089**
kgCO$_2$/Guest Night	74.84	68.09	93.51	78.96	110.63	121.25	99.00	75.81	115.05	77.01	77.56	67.39	**85**
KgCO$_2$/Guest Night + Host Night	19.07	18.66	20.63	21.12	21.29	19.58	18.62	19.34	19.97	18.50	19.73	18.40	**20**

Developed and Adapted from Resource Consumption Database. (Courtesy of Ms. Anke Hofmesiter, 2007)
CO_2 calculations by author.

Appendix 5.2E Summary of XCO2 Zero Emissions Plan

The XCO2 *Zero Emissions Plan* proposes; Energy efficiency, efficient lighting, heat recovery with absorption chillers and the use of renewables, as solution to the main energy end use consumers. Their strategy to reduce emissions is three fold; (XCO2, 2006)
Strategy 1: Reduce CO_2 emissions from the resort itself
Strategy 2: Encourage offset of flight emissions
Strategy 3: Influence the influencers! i.e. many of the guests are well connected and can 'spread the word'.

The XCO2 report investigates ways to achieve energy efficiency and to use renewable energy systems, in order to reduce greenhouse gas emissions. XCO2 has proposed a three staged process to reach the 60% and 100% targets. (XCO2, 2006)

1. Energy Efficiency
    - Programme of measures agreed with staff incentives for further ideas.
2. Small scale renewables. Start to introduce installations.
    A- Hidden solar thermal in staff accommodation,laundry & selected properties.[3]
    B- Demonstration projects. e.g. Small scale wind on lookout towers, PV canopy to jetty
3. Large scale renewables.

One key energy efficiency task is to minimise the need for A/C and two different environmental modes are proposed: (XCO2, 2006)
1) Air-Conditioned (Active) Mode and 2) Natural Ventilation (Passive) Mode

Air-Conditioned (Active) Mode

Used when occupants cannot adapt to passively cooled environments. Currently, XCO2 observed that air-conditioners are located over double-height spaces and, as the cool air moves down, it goes directly to the louvers, where it passes through the gaps and escapes to the exterior as seen in Figure 5.4A and 5.4B (XCO2, 2006)

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[3] The suggestion of the solar thermal installation may raise the question why is this necessary if there is all the waste heat from the diesel generators? According to XCO2, this was really just a balance of infrastructure costs i.e. is it more expensive for some locations on the island to install an insulated hote water main than the solar panels? There was also a discussion regarding a large wind turbine. If this went ahead, systems relying on the generator waste heat would then become redundant.

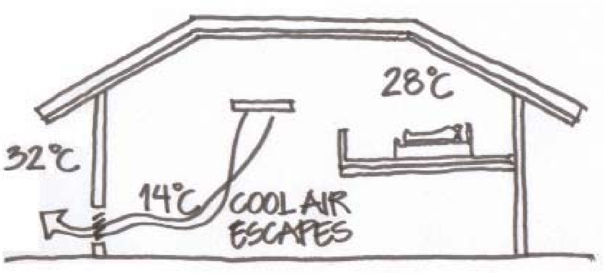


Figure 5.4A XCO2 sketch of existing problem: cold air escapes through leaky louvers. (XCO2, 2006)

Figure 5.4B Current louver configuration with gaps (right) and well-sealed design (left) (XCO2, 2006)

They propose that there is scope for efficiency improvements by: (XCO2, 2006)

- Installing draftstops at the bottom of doors;
- Improvement of user behaviour: education of guests so they turn off AC units when they are not in occuation may decrease consumption by up to 30%.
- Airtightness enhanced by careful sealing of openings and gaps on the building fabric;
- Louvers could be carefully sealed with cork strips, which do not interfere with the rustic character of the design. Actuators can be used to shut louvers; the actuator may be hidden in a bamboo cylindrical case to go with the aesthetics (Figure 5.4C)

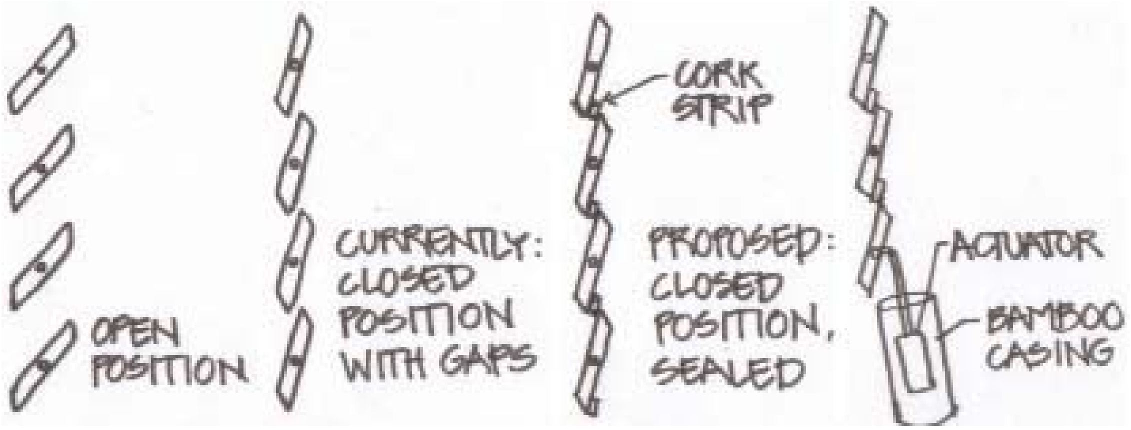


Figure 5.4C XCO2 sketch proposing strategies to reduce cold air leakages. (XCO2, 2006)

Instead, XCO2 suggest a displacement ventilation approach may be taken, in which air is supplied at the bottom level, where occupants are, heated by them, and then rises to be exhausted at the top. This way, the air is allowed to cool the space before it leaves as seen in Figure 5.4D (XCO2, 2006)

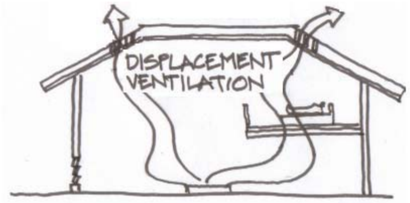
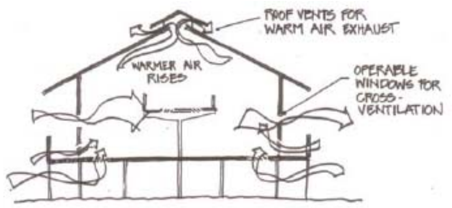


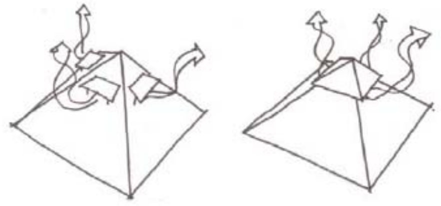
Figure 5.4D XCO2 sketch of displacement ventilation (XCO2, 2006)

Natural Ventilation (Passive) Mode:

XCO2 propose the performance of the spaces can be improved by the use of passive cooling strategies. Buildings can be cross-ventilated through the location of openings in opposite facades, preferably perpendicular to prevailing wind directions (mostly west and east-northeast). Detaching the building from the ground enhances ventilative cooling. Additionally, stack ventilation can be used, taking advantage of buoyancy characteristics of hot air and pressure differentials to drive air in through the lower levels of the building and warmer air (after lighting and occupants' heat gains) out through the top. This would require vents at low levels and at the roof as seen in figure 5.4Ebelow. (XCO2, 2006)



Passively ventilated Eco-Lodge proposal



Roof opening options

Figure 5.4E XCO2 sketches for passively ventilated Eco-lodge proposal. (XCO2, 2006)

Hybrid Passive-Active Mode

In addition to the previous air-conditioning efficiency measures, the building performance could be further improved. To decrease air-conditioning cooling loads, the building's exterior surfaces could be cooled down by ventilation. Interior cavity roofs and elevated floors would allow for convective cooling as shown in Figure 5.4F

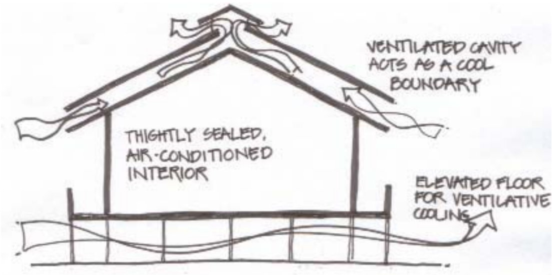


Figure 5.4F XCO2 sketches for hybrid passive-active Eco-lodge proposal. (XCO2, 2006)

Eco-Lodge zone conditioning proposal

XCO2 go on to suggest that future resorts it may be worthwhile to consider a further approach where only the central area, tightly sealed, is air-conditioned, while the surrounding spaces are passively cooled as seen in Figure 5.4G (XCO2, 2006)

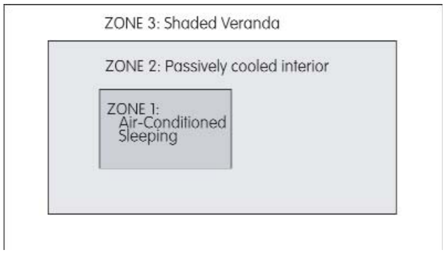


Figure 5.4G XCO2 sketches for zone conditioned Eco-lodge proposal. (XCO2, 2006)

Other strategies:

- The use of tin roofs (right) in service buildings and host accommodations is an extremely bad choice for this climate, as they absorb solar heat and transfer most of it to the interior of the buildings; XCO2 suggest better options would be to use thatch or local vegetation roofs, or ventilated clay roof tiles, which absorb less heat and allow cooling by ventilation through their small openings. (XCO2, 2006)
- The use of daylighting decreases energy use and increases occupancy satisfaction. However are must be taken to minimise solar gains from windows, by using canopies and avoiding openings on the west side of buildings, where heat gains occur during the hottest part of the day and at low angles. (XCO2, 2006)

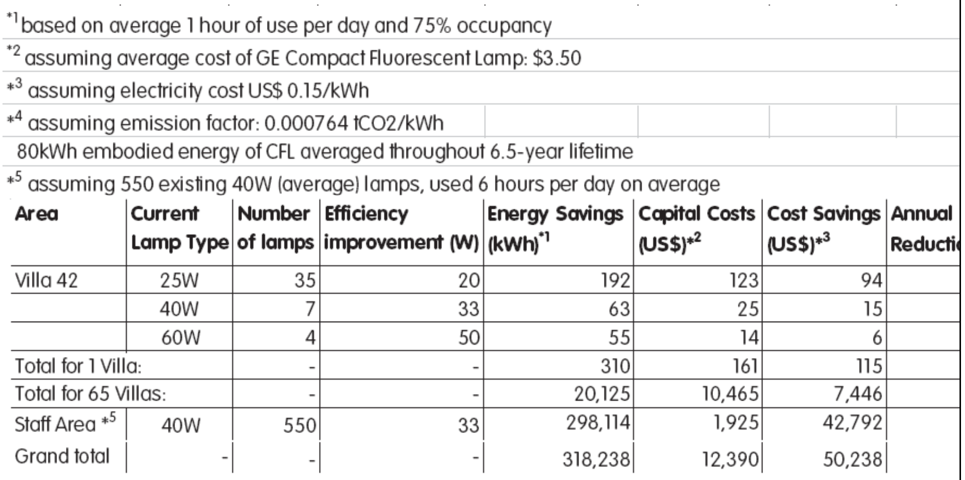
They stress that when using passive ventilation methods, care must be taken to avoid insects by using nets and screens. (XCO2, 2006)

- XCO2 suggest carbon offsetting as a method to offset the emissions created by their guests from air travel however, the credibility of carbon offsetting schemes is discussed in chapter 2.

Appendix 5.2F *Recommendations for improvement*

Opportunity	Benefit	CO_2 Impact	Additional Information
Passive Demand Reduction			
Demand Efficiency Strategies Lighting Efficiency	Reducing demand by 30% with cooling, lighting and water efficiency measures		**Cooling efficiency measures** • Proper sealing of louvers in guest areas • Assuming use of 24 hrs/day and 75% occupancy • Additional 10% cut through opening controls • Annual energy savings: 282,790 kWh *Controls:* Controls used to limit the loss of cooled air through openings; Systems to switch off the AC when guests are away or preferably to slow down air-conditioning and adjust set-point temperature slightly. Passive Infra-Red (PIR) sensors may be more appropriate as they would require no user intervention. There is a risk that while sleeping, the detectors assume that the room is empty however there are now "Presence Detectors" which will still register a motionless person using an "Electric Field Proximity Sensor". *Replacement of AC Units* The resort has up to 8 AC units replaced each year. More efficient, modern DX units may be used. Inverter control and variable modulation compressors will achieve COPs of up to 3.7 for cooling. **User Behaviour** • Turning AC off when user is not in • Additional savings of 30% (204,700 kWh) **Lighting efficiency measures** • Annual energy savings: 318,238 kWh

<table>
<tr><td></td><td></td><td></td><td>
The table below prepared by XCO2 considers the effect of replacing the incandescent lamps currently being used with more efficient, fluorescent lamps. 83 tCO2 can be avoided per year with the efficiency improvement:



[*1] based on average 1 hour of use per day and 75% occupancy
[*2] assuming average cost of GE Compact Fluorescent Lamp: $3.50
[*3] assuming electricity cost US$ 0.15/kWh
[*4] assuming emission factor: 0.000764 tCO2/kWh
80kWh embodied energy of CFL averaged throughout 6.5-year lifetime
[*5] assuming 550 existing 40W (average) lamps, used 6 hours per day on average

<table>
<tr><th>Area</th><th>Current Lamp Type</th><th>Number of lamps</th><th>Efficiency improvement (W)</th><th>Energy Savings (kWh)[*1]</th><th>Capital Costs (US$)[*2]</th><th>Cost Savings (US$)[*3]</th><th>Annual Reducti</th></tr>
<tr><td>Villa 42</td><td>25W</td><td>35</td><td>20</td><td>192</td><td>123</td><td>94</td><td></td></tr>
<tr><td></td><td>40W</td><td>7</td><td>33</td><td>63</td><td>25</td><td>15</td><td></td></tr>
<tr><td></td><td>60W</td><td>4</td><td>50</td><td>55</td><td>14</td><td>6</td><td></td></tr>
<tr><td colspan="2">Total for 1 Villa:</td><td>-</td><td>-</td><td>310</td><td>161</td><td>115</td><td></td></tr>
<tr><td colspan="2">Total for 65 Villas:</td><td>-</td><td>-</td><td>20,125</td><td>10,465</td><td>7,446</td><td></td></tr>
<tr><td>Staff Area [*5]</td><td>40W</td><td>550</td><td>33</td><td>298,114</td><td>1,925</td><td>42,792</td><td></td></tr>
<tr><td>Grand total</td><td>-</td><td>-</td><td>-</td><td>318,238</td><td>12,390</td><td>50,238</td><td></td></tr>
</table>

(XCO2, 2006)
</td></tr>
<tr><td>**Supply Efficiency**</td><td>**Waste Heat Recovery**

Absorption Chillers and District Cooling

Incinerator</td><td></td><td>
Waste Heat Recovery
A waste recovery connection would be simple, and the heat from two of the four generators would provide for all of the heating needs. This would take advantage of the close proximity between the the laundry room and the generators, by simply turning them around. Tumble drying could continue to be used at the later stages of drying. Waste heat for generators is already being used to provide hot water needs for staff

Absorption Chillers and District Cooling
If heat from the four generators is recovered, the heat remaining from the applications above could be transformed into cooling by absorption chillers, producing 4,217,900 kWh, at 75% efficiency.
</td></tr>
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			Total air-conditioning demand in guest areas is 1,917,300 kWh, assuming 75% occupancy and 8hrs/day of usage. This would require 2,556,500 kWh of heat assuming 75% efficient chillers. **Incinerator** Heat could be extracted from the incinerators and be used for the same functions as described above. The incinerators are used 5 hours a day, and an estimated 850,000 kWh of heat are lost every year. A heat recovery unit could be attached to the flue of the incinerator.
Roof design			Better options would be to use thatch or local vegetation roofs, or ventilated clay roof tiles (instead of current tin roof) which absorb less heat and allow cooling by ventilation through their small openings. Increase the use of daylighting which decreases energy use and increases occupancy satisfaction. However care must be taken to minimise solar gains from windows, by using canopies and avoiding openings on the west side of buildings, where heat gains occur during the hottest part of the day and at low angles. When using passive ventilation methods, care must be taken to avoid insects by using nets and screens.
Energy System Approaches Renewables - Biodiesel			XCO2 propose backup / residual electricity needs (after efficiency and renewables) are met from biodiesel generators. 1) The most common form of biomass is woody residues such as tree thinnings and willow coppice but it is possible to use waste refuse. There are several ways of harnessing the power in biomass fuels that range from burning in situ to forms of chemical and biological processing such as pyrolysis and anaerobic digestion which can transform the initial fuel into a more durable and transportable form. Based on XCO2 calculations on an average figure of 75% greenhouse gas emission reductions, while biodiesel can reduce other pollutants as well. 2) Waste vegetable oil from cooking can be used to power the generators after being filtered. This could be done without any modifications to the engines. However, if the content of waste of oil is more than 5% of the total fuel mix, dewatering and deacidifying will be necessary. This would mean a portion of the electricity fuel would

			be virtually free, and the greenhouse gas emissions would be significantly lower, since the oil will not come from fossil sources. 3) Use biogas from sewage and waste. Burning of the biogas can generate electricity and heat, which can then be converted into cooling through the use of absorption chillers. Biogas digesters would have a higher initial cost and require a sewage distribution network, but energy would come at a lower price later (costs are limited to maintenance, since the fuel is free). Due to the resorts limited sewage generation, the electricity yield would be 1/3 of total demand. Alternatively, the bottled gas demand for cooking can easily be met with the implementation of a limited sewage network around the central part of the island, where staff accommodations are located. This would decrease the capital costs of a complete sewage network. However, a more limited sewage network can be implemented in the central part of the island, around staff and back-of-house areas, in order to reduce capital costs.
Renewables - Wind			XCO2 propose a high proportion of final electricity needs met from wind energy if possible. Wind velocities in the SFR are around 5 m/s most of the year, which is suitable for wind turbines. Total electrical supply from wind would require approx 1.5 MW of wind. If ten turbines are used, they should be of 20m-diameter each. If one turbine is used, 70m diameter. The months of March and April, which are some of the busiest in the resort, are the ones with lowest wind levels. Sizing of the system should provide for the base load while not wasting much of the electricity generated. Therefore, storage devices may need to be used if electricity is to be provided mostly from wind. Additionally, other complementary technologies may need to be used in order to provide for the difference between demand and generation. XC02 feel that wind current energy is one of the strongest options due to its reliability, high electricity generation, short storage periods (6 to 12 hours) and visual concealment.

Renewables - PV			XCO2 propose use of a demonstration shading canopy with PV solar arrays. Solar radiation levels at the Maldives are high at 2.15 MWh/m2 annually, which are favourable to solar energy use. However, due to their relatively low efficiency, 16,000 m2 of collectors would be necessary to provide for the resort's current electricity demand. Collectors could be placed either at an unobtrusive location on the roof or as an architectural feature. Photovoltaic panels are produced regionally in India. Some regional manufacturers are: Microsol, Rajasthan Electronics, Tata BP Solar and Bharat Heavy Electricity.
Renewables - Solar Thermal			XCO2 propose use of solar thermal energy to provide for most of the hot water needs, with careful consideration of visual impact. Flat plate collectors[4] would be a good localized solution for the hot water needs of guests at the resort. Care must be taken so that panels are not overshadowed by adjacent trees. Since the climate in the Maldives is warm, storage losses can be reduced.
Renewables - Deep Seawater Cooling			This technology could be used to provide for the cooling needs of SFR. XCO2 confirm that the island's specific ocean depths will need to be investigated. This technology uses cold water from the bottom of the ocean, brought to the land via long pipes. There, it runs through heat exchange coils, providing cold water which is distributed via a district cooling system, for refrigeration purposes. The slightly warmer water is then returned to the ocean at a similar-temperature level. The only required electricity is for water pumping, which is estimated to correspond to about 10% of what a conventional air-conditioning system would consume. The advantage of the Maldives' archipelago configuration is the absence of a continental shelf, which makes the necessary horizontal run of pipes much shorter, with significant cost savings. 10.8°C water can be reached at a 400m depth; 8.8°C at 700m; and 6.7°C at 1,000m. The 1,000m depth can be reached within 1kw to 10kw of the coast.

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[4] Flat plate collectors may be glazed or unglazed. They work by exposing a broad, flat expanse of absorber which transfers its heat directly to water. While they are less expensive than evacuated tube collectors, they are slightly less efficient and subject to convective and conductive losses.

Renewables - Tidal Current	Reliable and unobstructive technology		Tidal current can be a reliable energy source with limited visual impact, as many of the technologies available are located mostly or entirely undervwater. The distance from the shore needs to be a result of the balance between transmission losses and aesthetic preoccupations, since the bottom of the ocean is usually visible through the translucent waters of the Maldives. Two options:. 1)The MCT tidal current turbine is unidirectional, and its lifetime is expected to be longer than 20 years. It has been installed in Devon, UK, in 2003 and produces electricity at around 0.10 US$/kWh. 2) The Rotech tidal current turbine is currently under development, due to be commercially available after 2006. It is completely submerged and has 15m of diameter. A number of turbine designs are currently being developed. Some have rigid masts with turbines mounted on movable arms while others have tethered connections. The rigid systems offer greater reliability and simpler servicing while the tethered turbines should be cheaper and have less impact on the reefs.
Renewables - Other Technologies			**Ocean Thermal Energy Conversion** OTEC uses the vertical temperature differential (thermocline) in oceans to produce electricity. Heat is transferred from the top layer of the ocean to vapourise water or a refrigerant, which turns a turbine, generating electricity. The vapour is then condensed by the cold deep ocean water, and the process continues. The minimum necessary thermocline for economic feasibility is 15°C (in the Maldives, temperature differentials are around 19°C). **Other Renewable Technologies** - Wave turbine systems: promising technology, but somewhat visually obstructive, with oscillating, floating columns

Integration of Renewables			Renewable technologies can be integrated into the architecture unobtrusively At the large scale, the Eco-Cluster provides clean energy supply, while the Eco-Unit at the individual scale integrates passive and active systems. Solar thermal collectors provide hot water. Wind turbine to provide all lighting and appliance power. Eco-lookout towers could provide an opportunity to gain distant views as well as demonstrate wind and photovoltaics.
Match source to load (MVHR[5])	Reduce energy consumption and associated emissions.	High	• Ensure controls match building occupancy[6] • Check position of thermostats so they are not influenced by draughts, sunlight or internal heat sources like radiators or freplaces. They should be regularly checked to make sure they are working correctly. Some hotels use separate room thermometers to double check thermostats are turning the heating on when required. • Thermostatic radiator valves (TRV) used to control the heat output from a radiator by adjusting water flow providing efficient, localized control. In common areas of a hotel, TRVs will reduce the amount of heat output from radiators as the space fills with people – and their own body heat. • Upgrade old, inefficient heating system controls. The heating systems can adjust themselves in line with changeable weather conditions. A *compensator* automoatically regulates the heating temperature based on outside conditions. • Night setback controls can set back space temperatures during specific time periods. For example, hotels can make savings by allowing temperatures in common areas such as corridors and stairwells to fall to 16C between midnight and 5am when most guests will be in their rooms. • Review the capacity of central equipment relative to the actual load as oversized equipment operates less efficiently. Successful energy conservation can often result in the existing equipment then becoming too large for the connected load. • Operate MVHR with actual load and shut off equipment when not required. • Do not allow simulataneous heating and cooling. This can be avoided by setting a temperature 'dead band' – a wide gap between the temperatures at which heating and cooling cut in between 19C and 24C (ITP, 2008) • Schedule HVHR systems according to time of day, week operation. Install timers.

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[5] Mechanical Ventilation Heat Recovery System
[6] More information available in Carbon Trust technology guide on Heating control CTG002 (ITP, 2008)

			Shut off individual units in unoccupied areas. (ITP, 2008) • Depending on the season, housekeeping staff can shut off or maintain room temperature by resetting thermostats when making up rooms after check-out. (ITP, 2008 • Recover heat from exhaust air by re-circulating a proportion of the exhaust air along with incoming fresh air to maintain air quality. The ratio of re-circulated air to incoming fresh air will be dependant on the air quality requirements which can be controlled using an indoor air quality sensor. • Variable speed drives (VSDs) enable the output speed of the fans to match requirements at different times of day which saves energy and corresponding heating and cooling savings. They can be used where a fan or motor is used for example in a large ventilation system in a large hotel. • BEMS already in operation.

A summary list for other recommendations for improvement adapted and developed from the XCO2 Case Study 2 feasibility study, Hospitality Saving energy without compromising service, CTV013, Carbon Trust, Environmental Management for Hotels by the ITP, 2008.

5.3

Appendices

Appendix 5.3A Extract from Master Workbook 2008 – Sheet 1 area

BUSINESS NAME **Carlton Atlantic Coast Hotel**

Total Square Meters of Serviced Space within Hotel **5728**

Information Provided By: **Lynda Foley**

Year under Review **5728**

Measure the total area of the Business which is serviced by Central Heating
When doing so include sub-measurements of the following areas, if possible to allow for future departmental benchmarks

AREA		**Square Metres**
Leisure Centre/ Spa		**673**
Banqueting Rooms		**226**
Bedrooms incl Corridors		**3713**
Bars/ Restaurants		**376**
Back of House/ Kitchens		**588**
Front of House Public Areas		**152**
Other - Specify		

Enter Data into the Shaded Areas

Appendix 5.3B Extract from Master Workbook 2008 – Sheet 2 benchmark data

BUSINESS NAME

	Accommodation Data			**Guest Data**				
5728	**Rooms Available**	**Rooms Sold**	**Sleeper Nights Sold**	**Customer Food Covers**	**Staff Food Covers**	**Total Food Covers**	**Leisure/Spa Users**	**Total Guests**
January	2,635	1,107	2,243	3,278	1,640	4,918	883	**8,044**
February	2,465	1,462	2,858	4,685	1,742	6,427	1,085	**10,370**
March	2,635	2,259	4,627	8,741	1,980	10,721	1,465	**16,813**
April	2,550	1,699	3,153	4,743	1,890	6,633	1,298	**11,084**
May	2,635	1,970	3,862	5,745	1,810	7,555	1,370	**12,787**
June	2,550	2,472	4,800	7,327	2,080	9,407	1,730	**15,937**
July	2,635	1,999	4,328	6,247	2,065	8,312	1,622	**14,262**
August	2,635	2,135	4,877	6,899	2,043	8,942	1,892	**15,711**
September	2,550	2,427	4,607	7,481	1,920	9,401	1,812	**15,820**
October	2,635	1,675	3,325	4,932	1,830	6,762	1,387	**11,474**
November	2,550	1,406	2,801	5,412	1,730	7,142	1,120	**11,063**
December	1,530	743	1,140	3,132	1,240	4,372	411	**5,923**
Totals	**30,005**	**21,354**	**42,621**	**68,622**	**21,970**	**90,592**	**16,075**	**149,288**

Food Covers: A cover is deemed to include every main meal served - Breakfast, Lunch, Dinner, Banqueting, Staff Meals etc….
Sleepers: All sleepers must be included - Adults and children but exclude babies
Leisure/Spa Users: Total number of guests (hotel & members) entering area daily. Every entry counts as one use

ONLY ENTER DATA INTO THE SHADED AREAS

Appendix 5.3C Extract from Master Workbook 2008 – Sheet 6 electricity

Electricity Calculator

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Day Units - 1st Set	No of units	22422	21144	23687	24323	22784	22049	23146	23869	39845	39866	33919		297054
	Cost per Unit €c	15.10	15.17	13.31	13.31	13.31	13.31	13.31	13.31	19.62	19.62	21.70		16.23
	Total Cost	3386	3208	3153	3237	3033	2935	3081	3177	7818	7822	7360	0	48208
Day Units - 2nd Set	No of units	16499	17669	21384	16783	21203	19310	20833	20055	0	0	0		153736
	Cost per Unit €c	14.670	14.670	12.650	12.650	12.650	12.650	12.650	12.650	0.000	0.000	0.000		13.10
	Total Cost	2420	2592	2705	2123	2682	2443	2635	2537	0	0	0	0	20138
Total Day Units		38921	38813	45071	41106	43987	41359	43979	43924	39845	39866	33919	0	450790
Total Day Cost		5806	5800	5858	5360	5715	5377	5716	5714	7818	7822	7360	0	68346
	Day Unit Price	14.92	14.94	13.00	13.04	12.99	13.00	13.00	13.01	19.62	19.62	21.70	#DIV/0!	15.16
Night Units	No of units	11560	10680	11937	11524	12059	11428	12173	12819	12159	11276	110360		227975
	Cost per Unit €c	7.90	7.99	7.99	7.99	7.99	7.99	7.99	7.99	12.25	12.25	12.25		10.49
	Total Cost	913	853	954	921	964	913	973	1024	1489	1381	13519	0	23904.47
Total Units		50481	49493	57008	52630	56046	52787	56152	56743	52004	51142	144279	0	678765
Night Units %		22.9%	21.6%	20.9%	21.9%	21.5%	21.6%	21.7%	22.6%	23.4%	22.0%	76.5%	#DIV/0!	33.6%
Total Unit Costs		6719	6653	6812	6281	6678	6291	6689	6738	9307	9203	20880	0	92250.35
Total Other Charges		525	515	548	0	78	0	78	0	0	0	0	0	1742.73
Total Monthly Costs		7244	7168	7359	6281	6756	6291	6766	6738	9307	9203	20880	0	93993.08
Average Unit Cost		14.35	14.48	12.91	11.93	12.05	11.92	12.05	11.87	17.90	18.00	14.47	#DIV/0!	13.85

Appendix 5.3D Extract from Master Workbook 2008 – Sheet 9 LPG

LPG Calculator

Year	Total Litres	Total Cost	Average Cost per Litre €.c
5728			
Jan	598	0.36	0.06
Feb	1917	0.39	0.02
Mar	1647	0.00	0.00
Apr	1936	0.00	0.00
May	1653	0.00	0.00
Jun	1786	0.00	0.00
Jul	1706	0.00	0.00
Aug	2517	0.00	0.00
Sep	1755	0.00	0.00
Oct	1655	0.00	0.00
Nov	1641	0.00	0.00
Dec	800	0.00	0.00
Total	**19,611**	**1**	**0.00**

	Total Litres	kWh	Average Cost per kWh €c
Jan	598	4162	0.01
Feb	1917	13342	0.00
Mar	1647	11463	0.00
Apr	1936	13475	0.00
May	1653	11505	0.00
Jun	1786	12431	0.00
Jul	1706	11874	0.00
Aug	2517	17518	0.00
Sep	1755	12215	0.00
Oct	1655	11519	0.00
Nov	1641	11421	0.00
Dec	800	5567	0.00
Total	19,611	136,492	0.00

Appendix 5.3E Extract from Master Workbook 2008 – Sheet 10 OIL

OIL Calculator

Year 5728	Total Litres	Total Cost	Average Cost per Litre €.c
Jan	12000	0.61	0.01
Feb	15000	0.00	0.00
Mar	15000	0.00	0.00
Apr	12000	0.00	0.00
May	6000	0.00	0.00
Jun	10607	0.00	0.00
Jul	6000	0.00	0.00
Aug	6000	0.00	0.00
Sep	6000	0.00	0.00
Oct	12000	0.00	0.00
Nov	6000	0.00	0.00
Dec	9000	0.00	0.00
Total	**115,607**	**1**	**0.00**

	Total Litres	kWh	Average Cost per kWh €c
Jan	12000	122640	0.00
Feb	15000	153300	0.00
Mar	15000	153300	0.00
Apr	12000	122640	0.00
May	6000	61320	0.00
Jun	10607	108404	0.00
Jul	6000	61320	0.00
Aug	6000	61320	0.00
Sep	6000	61320	0.00
Oct	12000	122640	0.00
Nov	6000	61320	0.00
Dec	9000	91980	0.00
Total	115,607	1,181,504	0.00

Appendix 5.3F Extract from author's CO_2 calculations

2008	LPG (litres)	$kgCO_2$ (1.495kgCO_2/L)	OIL (litres)	$kgCO_2$ (3.179kgCO_2/L)	Elec (kWh)	$kgCO_2$ (0.475)	Total kgCO2	Total kgCO2 PER GN	Total kgCO2 per guest night+total food covers+leisure spa users	Total Guests	Guest Nights only
January	598	894	12,000	38,148	50,481	23,978	63,020	**28.1**	**7.8**	8,044	2,243
February	1,917	2,866	15,000	47,685	49,493	23,509	74,060	**25.9**	**7.1**	10,370	2,858
March	1,647	2,462	15,000	47,685	57,008	27,079	77,226	**16.7**	**4.6**	16,813	4,627
April	1,936	2,894	12,000	38,148	52,630	24,999	66,042	**20.9**	**6.0**	11,084	3,153
May	1,653	2,471	6,000	19,074	56,046	26,622	48,167	**12.5**	**3.8**	12,787	3,862
June	1,786	2,670	10,607	33,720	52,787	25,074	61,464	**12.8**	**3.9**	15,937	4,800
July	1,706	2,550	6,000	19,074	56,152	26,672	48,297	**11.2**	**3.4**	14,262	4,328
August	2,517	3,763	6,000	19,074	56,743	26,953	49,790	**10.2**	**3.2**	15,711	4,877
Septembe	1,755	2,624	6,000	19,074	52,004	24,702	46,400	**10.1**	**2.9**	15,820	4,607
October	1,655	2,474	12,000	38,148	51,142	24,292	64,915	**19.5**	**5.7**	11,474	3,325
November	1,641	2,453	6,000	19,074	50,500	23,988	45,515	**16.2**	**4.1**	11,063	2,801
December	800	1,196	9,000	28,611	44,000	20,900	50,707	**44.5**	**8.6**	5,923	1,140
TOTAL	**19,611**	**29,318**	**115,607**	**367,515**	**628,986**	**298,768**	**695,601**	**16.3**	**4.7**	**149,288**	**42,621**

Appendix 5.3G Opportunities for energy savings (SEI, 2007)

Ref	Opportunity	Indicative Benefits	Cost Range	Category	Target Date	Additional Information
01	Insulate all hot water pipe work.	€2,472.00	No / Low	Technical	3 Months	Thermal shorts are occurring through the use of uni-strut metalwork which supports the distribution of hot and cold water pipe work. In addition heating pipe work was found with no insulation. Copper pipes T-off supplying heat to two rooms in the control cupboard are not lagged. Water pipe work in the car park area requires further insulation.
02	Reduce heat loss from lack of insulation, water leaks, controls, boiler maintenance frequency	€2,472.00	No / Low	Technical	3 Months	There are a number of issues within the boiler house such as; 1. Boiler house is very warm due to lack of insulation on flanges and values. Improve insulation of boiler and associated pipe work. 2. There is significant evidence of serious hot water leakages, causing other pipes to rust. 3. Boiler house is very untidy and does not lend itself to safe working environment. 4. Boiler service period should be reduced from one a year to 6 monthly. 5. Isolate inoperative boilers. 6. Ensure that the boiler can only run when there is a heat demand. Hence avoid boiler idling due to standing losses. Retrofitting dampers, either on the burner inlet or flue outlet, to yield significant reductions in heat losses caused by air purging through the boiler. 7. Consider a dedicated gas boiler (when natural gas is available) for domestic hot water which will allow the main boiler to be completely shut-down during the summer months.

03	Install boiler interlock to prevent boiler cycling – Boiler interlock will ensure that boiler will not operate when there is no heat demand Install weather compensation control	Reduce heat load and improve control	No / Low	Technical	3 Months	Reduce energy consumption when there is no demand for heat Reduce heat delivery during periods of mild weather
04	Recover the currently expelled heat from the laundry area through the use of a heat exchanger	€143.00	No / Low	Organisational	3 Months	Energy recovery and hence reduction of overall heat load on the boilers
05	Monitoring and target energy consumption per boiler	Understanding how the boilers are performing	No / Low	Organisational	3 Months	It is important that the volume of oil consumed per boiler is known, which will show what boilers are fully loaded and which are running part load and for what time duration. This will also be vital information in determining the base heat load for the facility when considering a CHP plant From this fuel/heat demand the correct boiler size can be accurately determined by considering the following information; • Boiler efficiencies at full and part load • Controls (actual or planned) such as; Time, optimum start, weather compensation, Room thermostats, zone control, thermostatic radiator valves, and Building Management System controls. • Thermal demand profile for both hot water, Swimming pool & space heating
06	Connect the boilers in sequence. Based on the analysis the 450KW boiler should satisfy the hotels heating and hot water requirements for both the hotel and the swimming pool, except possibly for peak periods. Hence have the first 450KW Chappee boiler as the master boiler and the second as the slave and rotate at set time intervals	€7,416.15	Medium	Technical	3 Months	The savings are based on an estimated increased efficiency of 15%. Moreover if all of the actions identified in this report are implemented a smaller boiler will suffice. This will reduce running costs and more importantly allow for smaller and cheaper CHP or Gas boilers, if the Hotel management decides to change to cheaper gas fuel i.e. a natural gas boiler or gas run CHP once gas is available in Westport (in March 2008). The potential heat capacity of the site is 3,100kW; however alternations have been made too two of the bigger boilers with one of the jets disabled and the existing jet capacity reduced from 9.5 gallons per

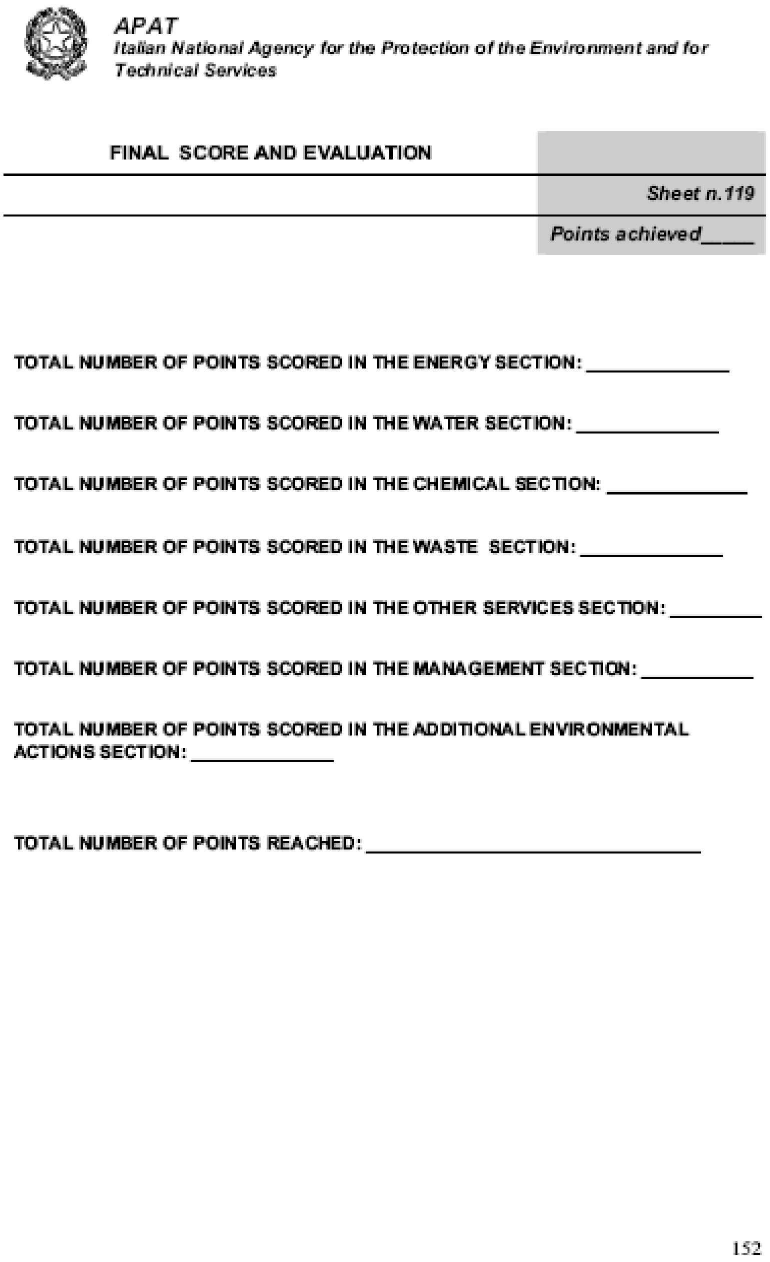
						hour to 8.5 gallons per hour, which in effect has reduced the capacity of the larger boiler by 55%. The two smaller 450kW boilers service the swimming pool with the two larger boilers servicing the main hotel for both hot water and heat requirements. It is not best practice to have a separate boiler providing space heating and hot water as space heating boiler can be completely shut-down during the summer months. The above action will also reduce maintenance costs on excess boilers.
07	Install solar panels to supply hot water to the swimming and domestic hot water to the hotel. The existing hot water buffer tanks are adequate to accommodate solar panel.	Reduce heat load on boilers for both hot water and heating	Medium	Organisational	6 Months	Avail of the cost effective renewable heat source which will possibly provide 80% of hot water during the summer and 20% during the winter with an over all heat supply of 60%, demands on the solar panel surface area and available roof top space. The ReHeat Programme provides grant assistance for the deployment of solar thermal systems. Support is available for feasibility studies and capital projects. Further analysis and feasibility study will be required to correctly size the square meter area of solar panel required and their location. Solar heat is suitable for both hot water and for the swimming pool. Contact SEI under the ReHeat Programme at clare.sullivan@sei.ie for details on how to apply for a feasibility grant and capital grant. Solar heat will be supplemented by the existing oil burners.
08	Install a correctly sized CHP plant	Cost effective heat and electricity supply	No / Low	Organisational	6 Months	The base heat requirement needs to be known for correct sizing of CHP plant. The base heat load will determine if a CHP plant is suitable for the Hotel. Thereafter the base electricity load will be looked at for a final suitability test. The average expected cost of a CHP plant is ~€2,000 per kW For a CHP plant to be viable it needs to be running at least 4,500 hours per year. Funding is available through SEI under the 'CHP

						Deployment Program'. The Programme provide grant support to assist the deployment of small-scale (<1mWe) CHP systems. Funding for feasibility studies is also available. Criteria to be satisfied are; • At least 4,500 full load running hours per year • Size to base heat load • Best sites have all year round heat and electricity demand • CHP should always be the lead boiler
09	Hotel requires Boiler Management Training	Better knowledge on site	No / Low	Organisational	3months	
10	Install a weather compensator/optimiser to ensure that heating only operates within set range of external/internal temperatures	Reduce heating load/frequency	No / Low	Technical	3months	
11	Train staff and develop induction programme further	Capacity building	No / Low	Organisational	3months	
12	Consider installing correctly sized gas Boilers when natural gas arrives in Westport in April 2008. At this stage consideration should be given to separate boilers for Hotel heating, Hot water and the Swimming pool.	Use most cost effective fuel and Boiler. Gas verus Oil cost	Medium	Organisational	6 Months	This will provide the opportunity to correctly size new gas boilers

5.4

Appendices

Appendix 5.4A Final page of 152 page document **'***Verification Forms for the European Eco-label for Tourist Accommodation Service EU Eco-label.*' *(MSA, 2004)*



APAT
Italian National Agency for the Protection of the Environment and for Technical Services

FINAL SCORE AND EVALUATION	
	Sheet n.119
	Points achieved_____

TOTAL NUMBER OF POINTS SCORED IN THE ENERGY SECTION: _____________

TOTAL NUMBER OF POINTS SCORED IN THE WATER SECTION: _____________

TOTAL NUMBER OF POINTS SCORED IN THE CHEMICAL SECTION: _____________

TOTAL NUMBER OF POINTS SCORED IN THE WASTE SECTION: _____________

TOTAL NUMBER OF POINTS SCORED IN THE OTHER SERVICES SECTION: _________

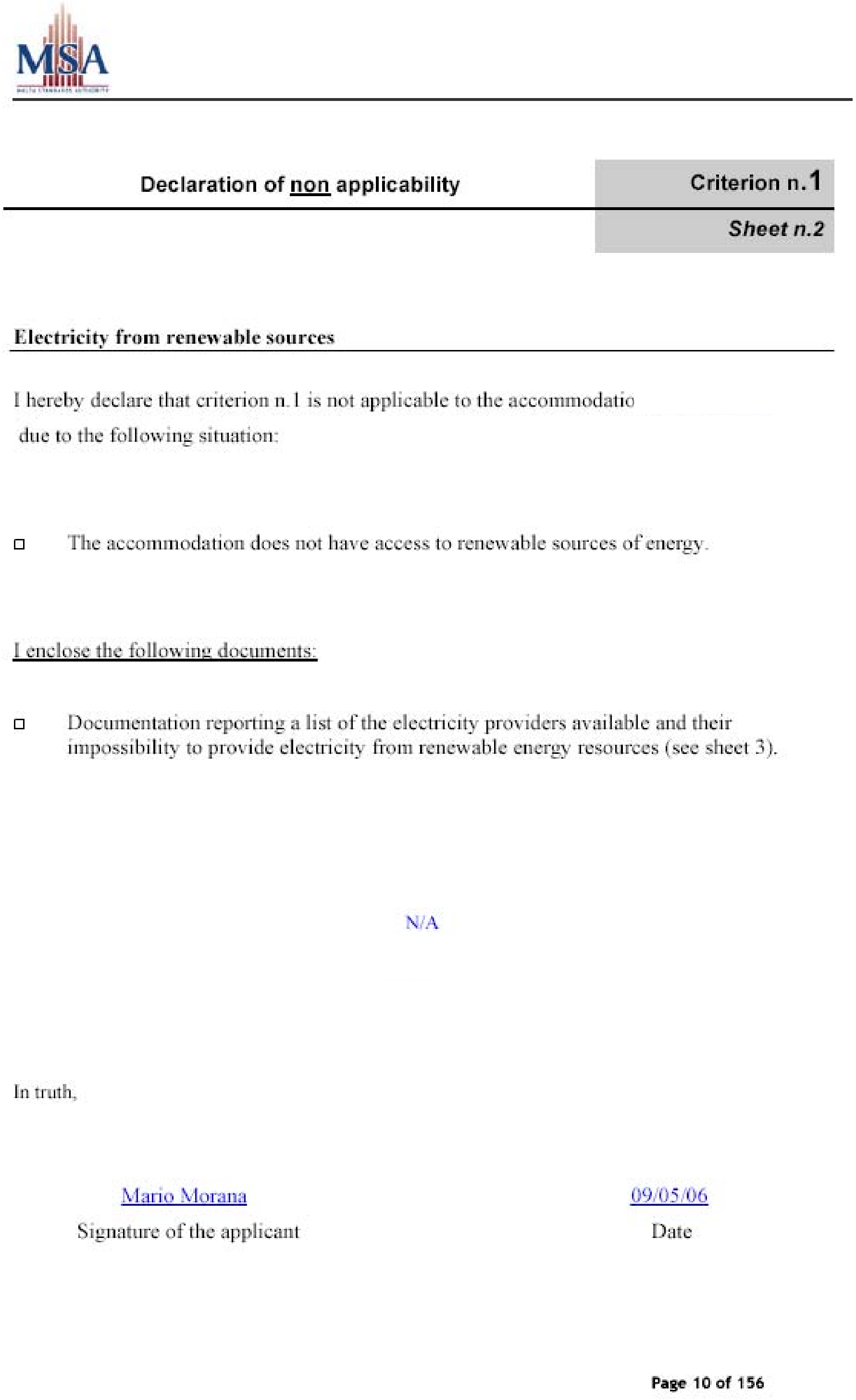
TOTAL NUMBER OF POINTS SCORED IN THE MANAGEMENT SECTION: __________

TOTAL NUMBER OF POINTS SCORED IN THE ADDITIONAL ENVIRONMENTAL ACTIONS SECTION: _____________

TOTAL NUMBER OF POINTS REACHED: _______________________________

152

Appendix 5.4B Declaration of Non Applicability of Electricity from Renewable Sources *(MSA, 2004)*



MSA

Declaration of non applicability | **Criterion n.1**

Sheet n.2

Electricity from renewable sources

I hereby declare that criterion n.1 is not applicable to the accommodatio
due to the following situation:

☐ The accommodation does not have access to renewable sources of energy.

I enclose the following documents:

☐ Documentation reporting a list of the electricity providers available and their impossibility to provide electricity from renewable energy resources (see sheet 3).

N/A

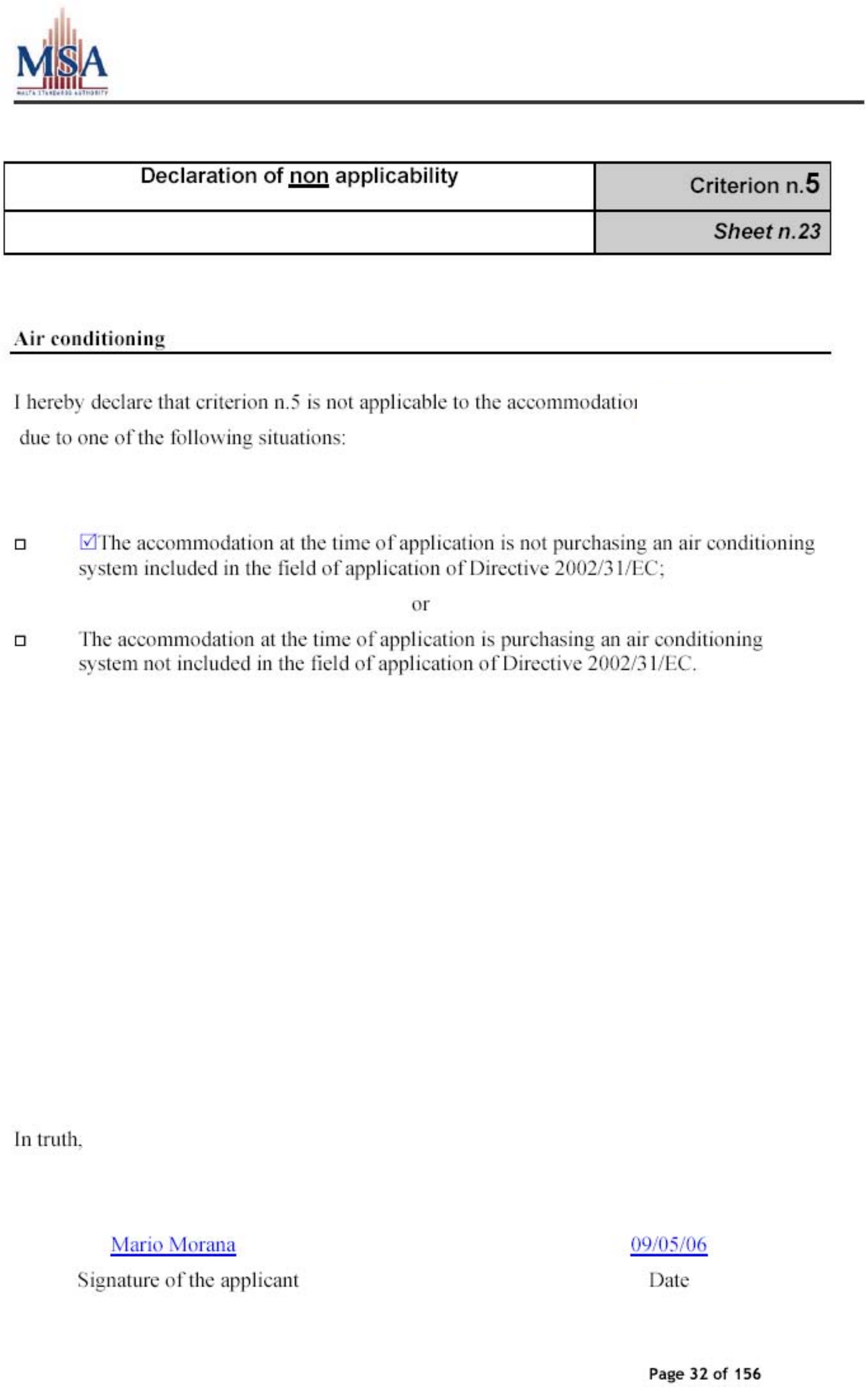
In truth,

Mario Morana
Signature of the applicant

09/05/06
Date

Page 10 of 156

Appendix 5.4C Declaration of Non Applicability of Air-Conditioning and Switching off heating or air conditioning *(MSA, 2004)*



MSA

Declaration of non applicability	Criterion n.**5**
	Sheet n.23

Air conditioning

I hereby declare that criterion n.5 is not applicable to the accommodatio

due to one of the following situations:

☐ ☑The accommodation at the time of application is not purchasing an air conditioning system included in the field of application of Directive 2002/31/EC;

or

☐ The accommodation at the time of application is purchasing an air conditioning system not included in the field of application of Directive 2002/31/EC.

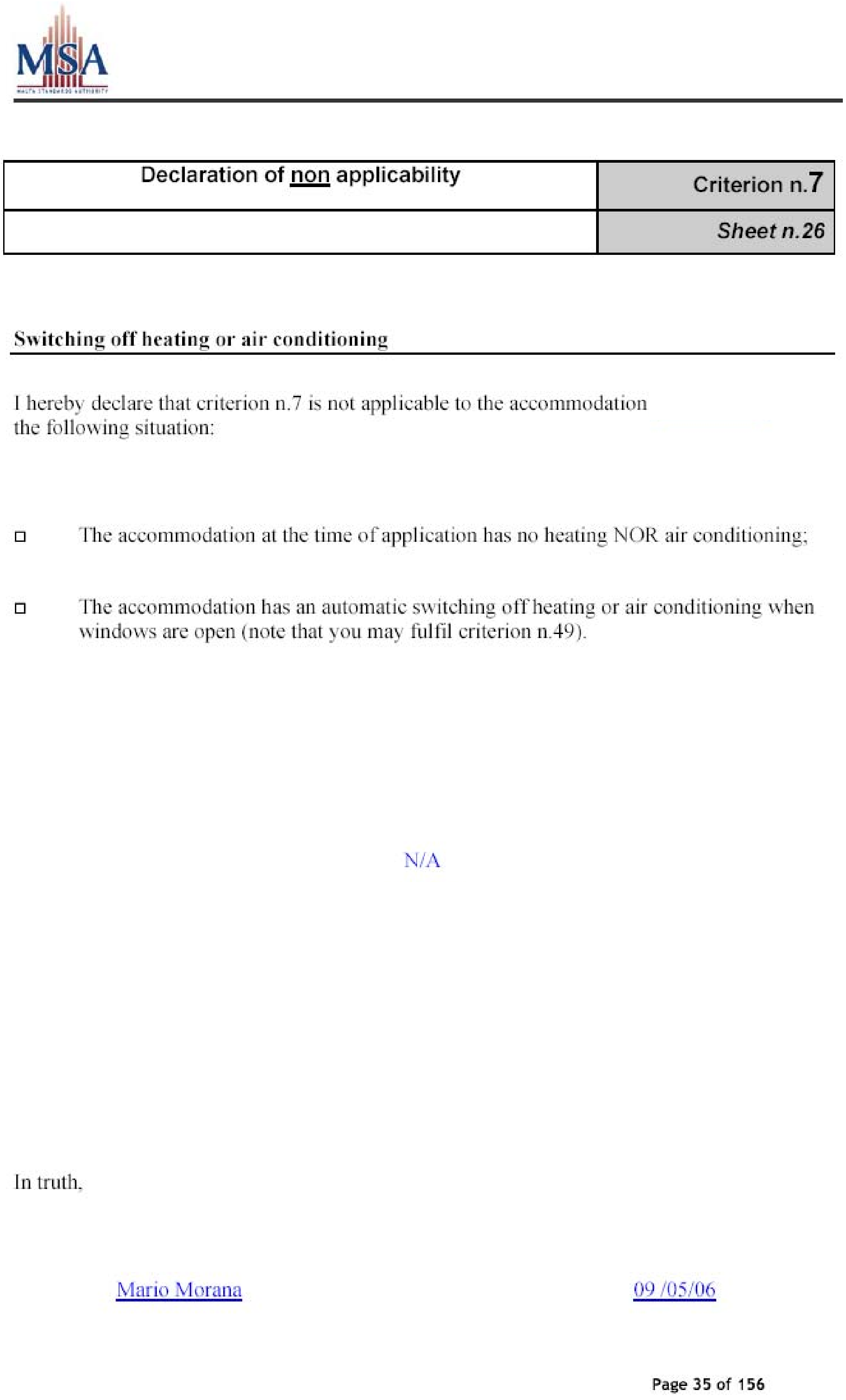
In truth,

Mario Morana
Signature of the applicant

09/05/06
Date

Page 32 of 156

Appendix 5.4C: *(MSA, 2004) Continued.*



Declaration of <u>non</u> applicability	**Criterion n.7**
	Sheet n.26

Switching off heating or air conditioning

I hereby declare that criterion n.7 is not applicable to the accommodation
the following situation:

☐ The accommodation at the time of application has no heating NOR air conditioning;

☐ The accommodation has an automatic switching off heating or air conditioning when windows are open (note that you may fulfil criterion n.49).

N/A

In truth,

Mario Morana 09 /05/06

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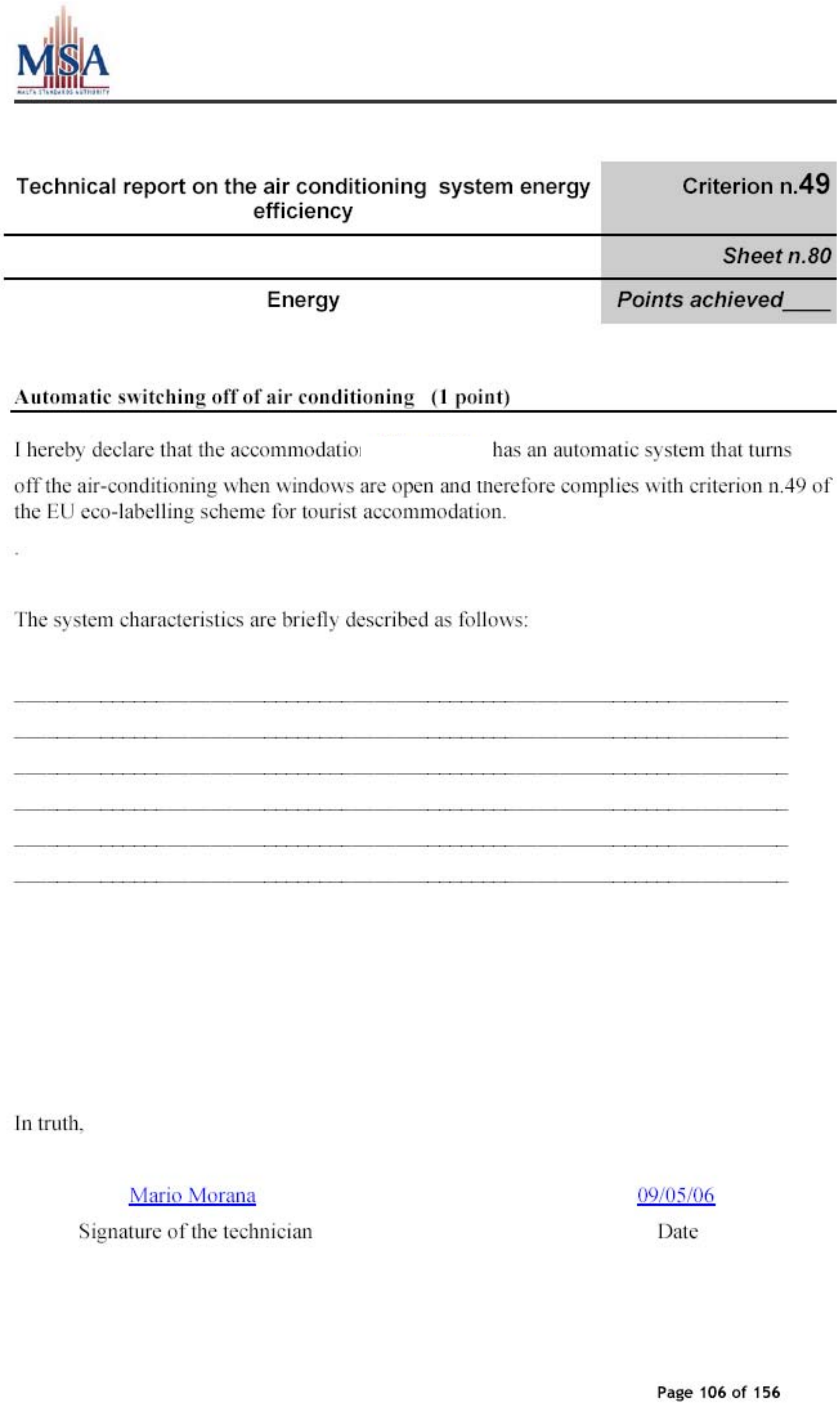
Appendix 5.4D Technical report on the air conditioning system energy efficiency *(MSA, 2004)*



MSA

Technical report on the air conditioning system energy efficiency	**Criterion n.49**
	Sheet n.80
Energy	***Points achieved____***

Automatic switching off of air conditioning (1 point)

I hereby declare that the accommodatio has an automatic system that turns off the air-conditioning when windows are open and therefore complies with criterion n.49 of the EU eco-labelling scheme for tourist accommodation.

.

The system characteristics are briefly described as follows:

____

____

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____

____

____

In truth,

Mario Morana	09/05/06
Signature of the technician	Date

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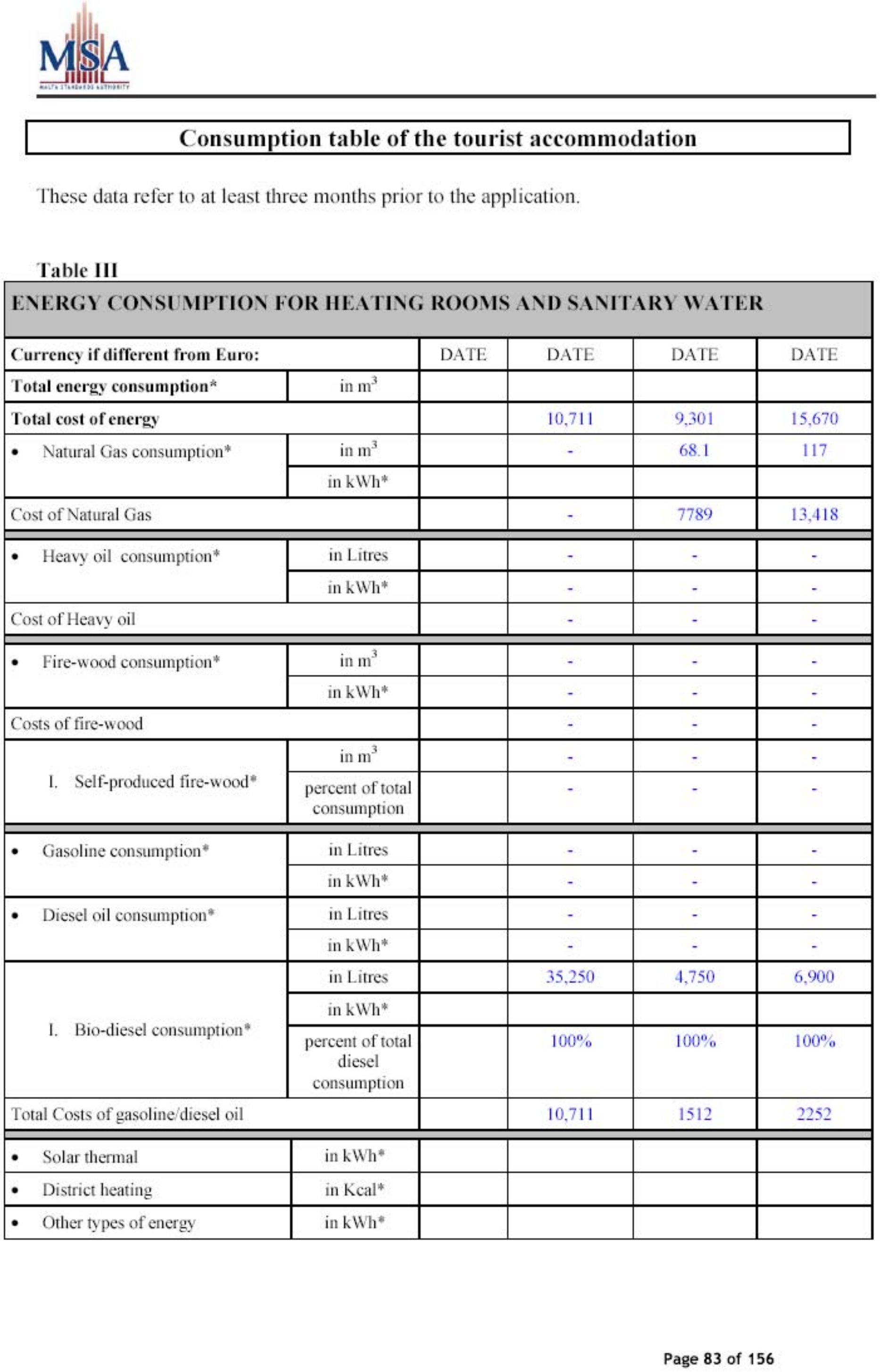
Appendix 5.4E Extract of HER Data input into author's excel file database

Region	Country	City	Hotel	Year	Month	Total Number of Guest Nights (Sleepers)	Total Mains Supply	kwh per guest night	KGCO2 (av. EU 0.475)	Gas/Diesel oil in kWh	KGCO2 (0.269)	LPG (Liquefied Petroleum gas) in kWh	KGCO2 (0.21)	Total KGCO2	Total KGCO2/
EA	Malta	Malta		2000	April	11824	693941		329,622	199366	53,629				
EA	Malta	Malta		2000	May	11824	693941		329,622	199366	53,629				
EA	Malta	Malta		2000	June	11824	693941		329,622	199366	53,629				
EA	Malta	Malta		2000	July	11824	693941		329,622	199366	53,629				
EA	Malta	Malta		2000	August	11824	693941		329,622	199366	53,629				
EA	Malta	Malta		2000	September	11824	693941		329,622	199366	53,629				
EA	Malta	Malta		2000	October	11824	693941		329,622	199366	53,629				
EA	Malta	Malta		2000	November	11824	693941		329,622	199366	53,629				
EA	Malta	Malta		2000	December	11824	693941		329,622	199366	53,629				
	TOTAL								0		0				
EA	Malta	Malta		2001	January	11210	620622		294,795	197310	53,076				
EA	Malta	Malta		2001	February	11210	620622		294,795	197310	53,076				
EA	Malta	Malta		2001	March	11210	620622		294,795	197310	53,076				
EA	Malta	Malta		2001	April	11210	620622		294,795	197310	53,076				
EA	Malta	Malta		2001	May	11210	620622		294,795	197310	53,076				
EA	Malta	Malta		2001	June	11210	620622		294,795	197310	53,076				
EA	Malta	Malta		2001	July	11210	620622		294,795	197310	53,076				
EA	Malta	Malta		2001	August	11210	620622		294,795	197310	53,076				
EA	Malta	Malta		2001	September	11210	620622		294,795	197310	53,076				
EA	Malta	Malta		2001	October	11210	620622		294,795	197310	53,076				
EA	Malta	Malta		2001	November	11210	620622		294,795	197310	53,076				
EA	Malta	Malta		2001	December	11210	620622		294,795	197310	53,076				
	TOTAL					**134,520**			**3,537,545**		**636,917**			**4,174,462**	**31.0**
EA	Malta	Malta		2002	January	11881	571531		271,477	186459	50,157				
EA	Malta	Malta		2002	February	11881	571531		271,477	186459	50,157				
EA	Malta	Malta		2002	March	11881	571531		271,477	186459	50,157				
EA	Malta	Malta		2002	April	11881	571531		271,477	186459	50,157				
EA	Malta	Malta		2002	May	11881	571531		271,477	186459	50,157				
EA	Malta	Malta		2002	June	11881	571531		271,477	186459	50,157				
EA	Malta	Malta		2002	July	11881	571531		271,477	186459	50,157				
EA	Malta	Malta		2002	August	11881	571531		271,477	186459	50,157				
EA	Malta	Malta		2002	September	11881	571531		271,477	186459	50,157				
EA	Malta	Malta		2002	October	11881	571531		271,477	186459	50,157				
EA	Malta	Malta		2002	November	11881	571531		271,477	186459	50,157				
EA	Malta	Malta		2002	December	11881	571531		271,477	186459	50,157				
	TOTAL					**142,572**	**6,858,372**		**3,257,727**	**2,237,508**	**601,890**			**3,859,616**	**27.1**
EA	Malta	Malta		2003	January	12489	623012		295,931	195335	52,545				
EA	Malta	Malta		2003	February	12489	623012		295,931	195335	52,545				
EA	Malta	Malta		2003	March	12489	623012		295,931	195335	52,545				
EA	Malta	Malta		2003	April	12489	623012		295,931	195335	52,545				
EA	Malta	Malta		2003	May	12489	623012		295,931	195335	52,545				
EA	Malta	Malta		2003	June	12489	623012		295,931	195335	52,545				
EA	Malta	Malta		2003	July	12489	623012		295,931	195335	52,545				
EA	Malta	Malta		2003	August	12489	623012		295,931	195335	52,545				
EA	Malta	Malta		2003	September	12489	623012		295,931	195335	52,545				
EA	Malta	Malta		2003	October	12489	623012		295,931	195335	52,545				
EA	Malta	Malta		2003	November	12489	623012		295,931	195335	52,545				
EA	Malta	Malta		2003	December	12489	623012		295,931	195335	52,545				
	TOTAL					**149,868**	**7,476,144**		**3,551,168**	**2,344,020**	**630,541**			**4,181,710**	**27.9**

EA	Malta	Malta	2004 January	6733	496240	73.7	235,714	289440	77,859	38949	8,179	**321,753**	**47.8**
EA	Malta	Malta	2004 February	6278	458191	73.0	217,641	257280	69,208	44711	9,389	**296,238**	**47.2**
EA	Malta	Malta	2004 March	9496	506402	53.3	240,541	200000	53,800	46517	9,769	**304,110**	**32.0**
EA	Malta	Malta	2004 April	11154	498927	44.7	236,990	171520	46,139	46161	9,694	**292,823**	**26.3**
EA	Malta	Malta	2004 May	11587	565832	48.8	268,770	139360	37,488	51211	10,754	**317,012**	**27.4**
EA	Malta	Malta	2004 June	14167	670509	47.3	318,492	117920	31,720	57698	12,117	**362,329**	**25.6**
EA	Malta	Malta	2004 July	17984	766677	42.6	364,172	107200	28,837	66008	13,862	**406,870**	**22.6**
EA	Malta	Malta	2004 August	18156	791057	43.6	375,752	128640	34,604	54947	11,539	**421,895**	**23.2**
EA	Malta	Malta	2004 September	14059	710787	50.6	337,624	117920	31,720	51379	10,790	**380,134**	**27.0**
EA	Malta	Malta	2004 October	13280	725649	54.6	344,683	107200	28,837	49238	10,340	**383,860**	**28.9**
EA	Malta	Malta	2004 November	8812	659948	74.9	313,475	139360	37,488	47098	9,891	**360,854**	**41.0**
EA	Malta	Malta	2004 December	6740	544121	80.7	258,457	192960	51,906	59229	12,438	**322,802**	**47.9**
	TOTAL			**138,446**	**7,394,340**	**53.4**	**3,512,312**	**1,968,800**	**529,607**		**128,760**	**4,170,679**	**30.1**
EA	Malta	Malta	2005 January	5852	515755	88.1	244,984	332320	89,394	46384	9,741	**344,118**	**58.8**
EA	Malta	Malta	2005 February	6967	499538	71.7	237,281	450240	121,115	38534	8,092	**366,487**	**52.6**
EA	Malta	Malta	2005 March	8795	413835	47.1	196,572	289440	77,859	34966	7,343	**281,774**	**32.0**
EA	Malta	Malta	2005 April	10146	495069	48.8	235,158	246560	66,325	52093	10,940	**312,422**	**30.8**
EA	Malta	Malta	2005 May	12635	524399	41.5	249,090	160800	43,255	44243	9,291	**301,636**	**23.9**
EA	Malta	Malta	2005 June	13631	646313	47.4	306,999	117920	31,720	55661	11,689	**350,408**	**25.7**
EA	Malta	Malta	2005 July	16614	635374	38.2	301,803	107200	28,837	49952	10,490	**341,129**	**20.5**
EA	Malta	Malta	2005 August	16799	847315	50.4	402,475	139360	37,488	57088	11,988	**451,951**	**26.9**
EA	Malta	Malta	2005 September	14034	724789	51.6	344,275	128640	34,604	46384	9,741	**388,620**	**27.7**
EA	Malta	Malta	2005 October	13196	723698	54.8	343,757	21440	5,767	160560	33,718	**383,242**	**29.0**
EA	Malta	Malta	2005 November	8589	608027	70.8	288,813	21440	5,767	167696	35,216	**329,796**	**38.4**
EA	Malta	Malta	2005 December	7379	492125	66.7	233,759	10720	2,884	292576	61,441	**298,084**	**40.4**
	TOTAL			**134,637**	**7,126,237**	**52.9**	**3,384,963**	**2,026,080**	**545,016**		**219,689**	**4,149,667**	**30.8**

Appendix 5.4F Energy Consumption *(Sourced from Study 4 EU Flower Verification Forms, MSA, 2004)*



Consumption table of the tourist accommodation

These data refer to at least three months prior to the application.

Table III

ENERGY CONSUMPTION FOR HEATING ROOMS AND SANITARY WATER					
Currency if different from Euro:		DATE	DATE	DATE	DATE
Total energy consumption*	in m^3				
Total cost of energy			10,711	9,301	15,670
• Natural Gas consumption*	in m^3		-	68.1	117
	in kWh*				
Cost of Natural Gas			-	7789	13,418
• Heavy oil consumption*	in Litres		-	-	-
	in kWh*		-	-	-
Cost of Heavy oil			-	-	-
• Fire-wood consumption*	in m^3		-	-	-
	in kWh*		-	-	-
Costs of fire-wood			-	-	-
I. Self-produced fire-wood*	in m^3		-	-	-
	percent of total consumption		-	-	-
• Gasoline consumption*	in Litres		-	-	-
	in kWh*		-	-	-
• Diesel oil consumption*	in Litres		-	-	-
	in kWh*		-	-	-
I. Bio-diesel consumption*	in Litres		35,250	4,750	6,900
	in kWh*				
	percent of total diesel consumption		100%	100%	100%
Total Costs of gasoline/diesel oil			10,711	1512	2252
• Solar thermal	in kWh*				
• District heating	in Kcal*				
• Other types of energy	in kWh*				

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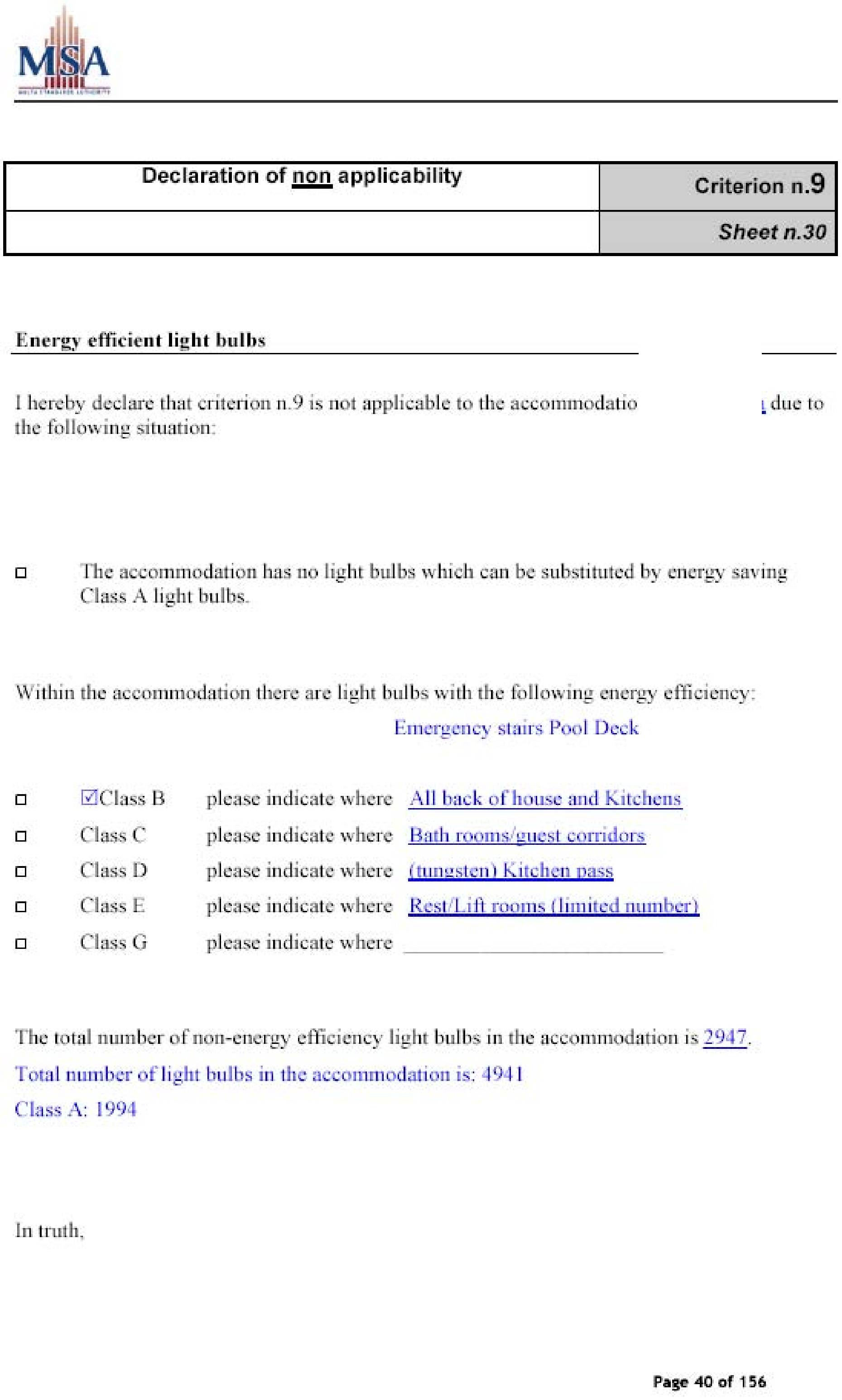
Appendix 5.4G Lighting *(Sourced from Study 4 EU Flower Verification Forms, MSA, 2004)*



Declaration of <u>non</u> applicability	**Criterion n.9**
	Sheet n.30

Energy efficient light bulbs

I hereby declare that criterion n.9 is not applicable to the accommodatio due to the following situation:

☐ The accommodation has no light bulbs which can be substituted by energy saving Class A light bulbs.

Within the accommodation there are light bulbs with the following energy efficiency:

Emergency stairs Pool Deck

☐ ☑Class B please indicate where <u>All back of house and Kitchens</u>
☐ Class C please indicate where <u>Bath rooms/guest corridors</u>
☐ Class D please indicate where <u>(tungsten) Kitchen pass</u>
☐ Class E please indicate where <u>Rest/Lift rooms (limited number)</u>
☐ Class G please indicate where ____________________

The total number of non-energy efficiency light bulbs in the accommodation is <u>2947</u>.

Total number of light bulbs in the accommodation is: 4941

Class A: 1994

In truth,

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Appendix 5.4H Key findings *(Sourced from EU Flower criteria document and Study 4 EU Flower Verification Forms)*

Key 'Green' Features	**Actual CO_2 Impact**	**Findings**
EU Flower Certification	*Low*	The results of the analysis show an 11% reduction in emissions but this is more likely to be as a result of the switch over to LPG from the gas/diesel rather than due to certification.
Building Design	*High*	The hotel has four swimming pools, a large convention centre, a leisure centre and in house laundry which contribute to its high energy consumption and emissions.
Heating		• The changeover from two diesel burners (warm water boilers) to liquefied petroleum gas has led to a 60 % reduction in heating costs, while the burner's efficiency increased at the same time reducing emissions significantly. The gas condensing gas boiler is serviced once a year and its efficiency is checked to ensure it the requirement of 90% boiler efficiency. • Thermoregulation *(Awarded 1.5 points in criterion no.46)*
Heat Recovery		• Presence of heat recovery system *(Awarded 2 points in criterion no.45)*
Ventilation and Cooling		There is a Heating, Ventilation and air-conditioning (HVAC) system which is serviced and maintained three times a year.In addition to natural ventilation (operable windows in guest bedrooms, meeting rooms and some public areas) there is air-conditioning provided in the guest bedrooms, meeting rooms and public areas. The hotel has an automatic system that turns off the air-conditioning when windows are open.
Interior lighting		The hotel has submitted a declaration of non-compliance with Criterion 9 of the verification forms for energy efficient light bulbs. From the information submitted for criterion 9 of the EU verification forms that 60% of the light bulbs are non-energy efficiency light bulbs (2947 out of a total number 4941 of light bulbs in the accommodation) Class B light bulbs are used in back of house and kitchens.

‘Green’ Electricity Certificates	*N/A*	No ‘green’ electricity certificates in operation in Malta.
Weighting of energy related points in overall award of points		Energy accounts for 10 (out of 37 mandatory requirements) and 17 out of 47 optional criteria which is good. However, still a there is still a problem with the weighting of measures that have a high impact on emissions reduction such as on-site electricity (2 optional pts) and heating from renewable energy sources (1.5 optional pts), boiler efficiency (1 optional pt), CHP (1.5 optional pt) compared to composting (2 optional pts), disposable drink cans (2 optional pts), breakfast packaging (2 optional pts), environmental communication to guests (1.5 optional pts) etc.
Leisure Centre		No specific information
Guest Rooms		There is an automatic system in guest bedrooms for switching off air-conditioning and lighting however this is only awarded one point.
Laundry		There is an energy metre for laundry services
Sauna		Timer Controlled
Convention Centre		No sub-metering and monitoring of neither energy consumption nor information on the heat/cooling load in this space.

Appendix 5.4I Recommendations for improvement *(Adapted and developed by Author from Hospitality Saving energy without compromising service, CTV013, Carbon Trust, Environmental Management for Hotels by the ITP, 2008 and the EU Flower Criteria Document and Study 4 EU Flower Verification Forms)*

Opportunity	**Benefit**	**CO_2 Impact**		**Additional Information**
Match source to load (MVHR[1])	Reduce energy consumption and associated emissions.	High	Technical	• Ensure controls match building occupancy[2] • Consider demand-controlled ventilation system in at least 90% of the rooms that are ventilated. Demand–control means that the ventilation system /lighting are adapted to the number of individuals in the room. • Check position of thermostats so they are not influenced by draughts, sunlight or internal heat sources like radiators or fireplaces. They should be regularly checked to make sure they are working correctly. Some hotels use separate room thermometers to double check thermostats are turning the heating on when required. • Thermostatic radiator valves (TRV) used to control the heat output from a radiator by adjusting water flow providing efficient, localized control. In common areas of a hotel, TRVs will reduce the amount of heat output from radiators as the space fills with people – and their own body heat. • Upgrade old, inefficient heating system controls. The heating systems can adjust themselves in line with changeable weather conditions. A *compensator* automatically regulates the heating temperature based on outside conditions. • Night setback controls can set back space temperatures during specific time periods. For example, hotels can make savings by allowing temperatures in common areas such as corridors and stairwells to fall to 16C between midnight and 5am when most guests will be in their rooms. • Review the capacity of central equipment relative to the actual load as oversized equipment operates less efficiently. Successful energy conservation can often result in the existing equipment then becoming too large for the connected load. • Operate MVHR with actual load and shut off equipment when not required. • Do not allow simultaneous heating and cooling. This can be avoided by setting a temperature 'dead band' – a wide gap between the temperatures at which heating and

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[1] Mechanical Ventilation Heat Recovery System
[2] More information available in Carbon Trust technology guide on Heating control CTG002 (ITP, 2008)

				cooling cut in between 19C and 24C (ITP, 2008) • Schedule HVHR systems according to time of day, week operation. Install timers. Shut off individual units in unoccupied areas. (ITP, 2008) • Depending on the season, housekeeping staff can shut off or maintain room temperature by resetting thermostats when making up rooms after check-out. (ITP, 2008 • Recover heat from exhaust air by re-circulating a proportion of the exhaust air along with incoming fresh air to maintain air quality. The ratio of re-circulated air to incoming fresh air will be dependant on the air quality requirements which can be controlled using an indoor air quality sensor. • Variable speed drives (VSDs) enable the output speed of the fans to match requirements at different times of day which saves energy and corresponding heating and cooling savings. They can be used where a fan or motor is used for example in a large ventilation system in a large hotel. • BEMS already in operation.
Decrease Heating and Cooling Load	Reduce energy consumption and associated emissions.	High	Technical, Management	**Lighting** • Daylight sensors; light sensors or 'photocells' can be used to control artificial lighting when there is sufficient day lighting. Photocells can be effectively combined with time switches to ensure more precise control. Decrease lighting levels in general and/or at specified times (using timers or occupancy related demand) • Install energy efficient lamps in remaining 20% of the hotel which could be significant if this remaining area was in the public areas of hotel such as lobby. • Use light reflective surfaces and reflection in order to reduce wattage. • Keep lights and windows clean to reduce wattage. Identify and replace failing lights. • Introduce lighting maintenance schedule **Glazing** • Provide shade control on windows to reduce unwanted solar gain particularly in atrium area. **Specific Modifications where applicable** • Check for infiltration of outside air in the form of negative pressure, leaking windows or draughts. • Reduce excessive supply and exhaust air. • Improve insulation of pipes. • Shut down areas and equipment not in use.

Zoning for heating/cooling	Zoning to match different occupancy			• A solution is to create 'zones' in the building where separate time and temperature controls are installed. Zoned areas will provide closer, more efficient heating/cooling control which can improve comfort conditions. Zoning should be considered where there area) different occupancy patterns b) different temperature requirements c) a number of floors (e.g. where top floors poorly insulated.) • The hotel could zone its building to take into account the different temperature requirements of the main restaurant, kitchen and storage areas.
Install sub-meters: guest rooms, sauna and conference areas of the hotel.	Identify energy (and high emissions) intensive areas in hotel.	High	Technical	Sub-metering of kitchen already installed. Daily or weekly sub-metering readings in guest rooms, sauna and conference areas would: • Identify exceptional or unusual patterns of energy consumption. Inefficiencies can be traced at source. • Enable separation of *architectural e.g.* space heating/cooling, lighting and *domestic* energy use e.g. hot water and identification of associated fuel use for each separated function. This will provide vital information for monitoring and targeting energy consumption and CO_2 emissions. • Provides reliable information for the proper sizing of new or replacement equipment. • Provide immediate feedback on the results of specific energy conservation measures that would otherwise be lost in the overall energy consumption of the building. (ITP, 2008) Sub-metering would help diagnose the cause enabling recommendations to be made to rectify the problem thus reducing the environmental impact of the hotel.
Monitoring and target energy consumption	Monitor and target performance in energy intensive (and high emissions) areas	High	Organizational	Monitoring at regular intervals will reveal unexpected changes in consumption (perhaps due to the faulty operation of equipment, leaks, poorly set controls or other sources of waste) can be detected rapidly and corrective action taken. Regular monitoring provides a flow of detailed and comprehensive operating information, vital to good management. (ITP, 2008)
Check and improve pump, fan and motor efficiency	Energy consumption can increase by 60% if regular maintenance is not undertaken.	medium	Management	• Compare actual performance with the design. • Modify the pump impeller if required. • Replace burnt motors with a high efficiency type. • Consult a maintenance technician to assess performance of whole system reviewed annually and replacements parts ordered as necessary.

Adjust thermostatic controls and time clocks	Controls can help prevent the waste of fuel and electricity	high	management	• Time switches ensure the systems operate only when they are needed. • Optimum start and stop controllers connected to internal and external sensors and calculate the optimum time to switch on (to bring the building to optimum temperature in the morning) and off (taking into account the heat stored in the building) • Weather compensators which control the temperature of the water flowing through the radiators and adjust it according to external temperatures. • Zone controls which enable different parts of a building to be heated at different times or to different temperatures, according to factors such as occupancy and solar gain. • Room thermostats and thermostatic radiator valves to regulate temperatures in the spaces in which they are sited and prevent overheating. • Set-back controls which reduce temperatures at which heated spaces are maintained overnight or during unoccupied times.
Install occupancy-linked Controls: switches, timers, motion detectors	Control part or all of the room lighting, heating or cooling and power outlets.			• Unoccupied rooms or corridor spaces can with appropriate controls be kept at a set-back temperature which is a good few degrees below or above full comfort temperature depending on the season or geographic location. The set-back temperature enables comfortable conditions to be met in a reasonably short time as well as, for example, avoiding the build up of condensation and it also reduces energy/electricity use. • Occupancy sensors could be installed which detect the presence of an occupant and control all services accordingly. Careful selection and design are required if these systems are to be fool proof in use. For example, install presence controlled lighting in at least 90% of the rooms which are not intended for guests such as in corridor areas or in conference where there is only intermittent use.
Hot Water	Appropriate hot water temperatures and installation of water conserving devices			• Set appropriate hot water temperatures (optimum 60C). • Wasted heated water can be avoided by tap controls which switch taps off after a certain time useful in communal areas. • Spray taps and water efficient showerheads which reduce the volume of water reducing consumption. At least 90% of shower heads are of the water saving type, with a flow rate of at most 10 litres/minute, At least 90% of mixer taps are single lever alternatively sensor controlled. Consider installing same in remaining 10%.

Maintain building fabric i.e. walls, floors, ceilings	Make improvements prior to any refurbishment and/or replacing or upgrading any existing heating system.			• Maintenance will lead to potential issues being identified early on. Establish a housekeeping and maintenance schedule i.e. have a specific member of staff to conduct regular walk round using checklist and check window panes and frames, roof lights, roofs, skirting and eaves. • Deal with fabric issues immediately particularly if there are gaps or holes, install draught stripping to windows and doors, check for signs of damp or damage and replace when required. • Regularly check building for damp • Ensure windows and doors are closed as much as possible when heating is on and encourage guests to do the same. • Check insulations levels and increase where practical. • Insulate hot water pipes where required. • Improve glazing e.g. upgrade to triple glazing during any future refurbishment particularly in north/east façade. • Consider separation between restaurant and atrium to prevent heat loss in winter and to ensure better heating / cooling control.
Kitchen	Area of high energy consumption and waste			In some kitchens as little as 40% energy consumed is used for the preparation and storage of food; much of the wasted energy is dispersed into the kitchen as heat. Currently, the kitchen's energy and water consumption is measured and recorded separately and the stove has induction or low-radiation hotplates. Al rinsing taps for dishwashing are fitted with a 'dead man's handle' i.e. they shut off when the lever is released or are sensor controlled. **Equipment** • Switching for savings • Clean and maintain cooking equipment • Use kitchen equipment properly e.g. shortening the drying times in dishwasher cycles and using the residual heat in the dishwasher to dry the contents instead of using expensive power drying cycles., use dishwasher at full load, keep chiller and freezer doors open to a minimum, label equipment with minimum warm up times, use correct size equipment and switch off unnecessary kitchen equipment and lights. • Consider replacing any kitchen equipment over 15 years old with newer, more efficient models. • Use equipment that automatically switches off. • Always look for 'A' rated category equipment. **Refrigeration** • Establish a simple equipment maintenance schedule i.e. Defrosting every two

				months. • Avoid over cooling e.g. energy consumption can be reduced by 2-4% if set cooling temperature increased by 1C. • Keep non-perishables cool. • Can specific cooking operations be combined in order to run less equipment? • Maintain kitchen extract ventilation which can increase efficiency by as much as 50% compared with unmaintained systems. • Consider heat recovery – an air to water recovery device can be used to preheat hot water, providing a year round use for the recovered heat. • By sub-metering kitchen can identify energy use to activity. • Consider installing passive solar panels for pre-heating water or photovoltaic panels to produce some of the electricity to heat your water. • Install motion detectors/occupancy sensors in store rooms & walk-in refrigerators. • Turn off lights in cold storage rooms.
Guest Rooms				• Once sub-metering is installed, analyze hourly consumption to identify where the peaks are during the day and whether there are any leaks. • During periods of low occupancy, group the rooms in which you put your guests relative to the mechanical and electrical systems and shut off unoccupied areas. During the heating season, occupy the rooms in the sunny side of the building first and during the cooling season on the opposite side.
Laundry				• Laundry outsourced. Consider sending sheets, linen and towels to be cleaned at a eco-labeled laundry if operating locally
Sauna				Consider demand-controlled system in addition to timer control to improve performance. •

Conference Facilities				• No mention in criteria document of whether or not the ventilation system is timer or demand controlled. If not installed, then consider installing one of the above systems. All conference facilities benefit from daylight from windows and the option for natural ventilation through the use of operable windows which should be maximized where possible. Close curtain, blinds to reduce solar gain.
Energy management and People Solutions	Within control of staff			• Walk around hotel at different times of the day and during different seasons to see how and when heating and cooling systems are working. Check time and temperature settings. • Assign a member of staff to switch off all non-essential lighting and equipment. Install timers or sensors to help with this. • Have maids vacate rooms as early as possible in order to switch off lights, ventilation and turn down thermostats. • During hot or cold weather, keep curtains, blinds, shades closed to reduce heating and cooling gains and losses. • Raising awareness amongst kitchen staff and providing energy management training can reduce catering energy use by up to 25%.

6

Appendices

Appendix 6A Example of data collection – Hotel 1 *(Adapted and developed by Author from Hilton HER database, 2008)*

Year	Month	Total Number of Guest Nights (Sleepers)	Total Mains Supply	kwh per guest night	KGCO2 (av. EU *0.475)	KGCO2 (Malta *0.89)	Gas/Diesel oil in kWh	KGCO2 (0.269)	LPG (Liquefied Petroleum gas) in kWh	KGCO2 (0.21)	Total KGCO2 (av.EU)	Total KGCO2/gn(AV.eu)	Total KGCO2 (Malta)	Total KGCO2/gn(Malta)
2005	January	5852	515755	88.1	244,984	459,022	332320	89,394	46384	9,741	344,118	58.8	558,157	95
2005	February	6967	499538	71.7	237,281	444,589	450240	121,115	38534	8,092	366,487	52.6	573,796	82
2005	March	8795	413835	47.1	196,572	368,313	289440	77,859	34966	7,343	281,774	32.0	453,515	52
2005	April	10146	495069	48.8	235,158	440,611	246560	66,325	52093	10,940	312,422	30.8	517,876	51
2005	May	12635	524399	41.5	249,090	466,715	160800	43,255	44243	9,291	301,636	23.9	519,261	41
2005	June	13631	646313	47.4	306,999	575,219	117920	31,720	55661	11,689	350,408	25.7	618,628	45
2005	July	16614	635374	38.2	301,803	565,483	107200	28,837	49952	10,490	341,129	20.5	604,810	36
2005	August	16799	847315	50.4	402,475	754,110	139360	37,488	57088	11,988	451,951	26.9	803,587	48
2005	September	14034	724789	51.6	344,275	645,062	128640	34,604	46384	9,741	388,620	27.7	689,407	49
2005	October	13196	723698	54.8	343,757	644,091	21440	5,767	160560	33,718	383,242	29.0	683,576	52
2005	November	8589	608027	70.8	288,813	541,144	21440	5,767	167696	35,216	329,796	38.4	582,128	68
2005	December	7379	492125	66.7	233,759	437,991	10720	2,884	292576	61,441	298,084	40.4	502,316	68
		134,637	**7,126,237**	**52.9**	**3,384,963**	**6,342,351**	**2,026,080**	**545,016**	**1,046,137**	**219,689**	**4,149,667**	**30.8**	**7,107,055**	**53**

Appendix 6B Example of data collection – Hotel 2 *(Green Hospitality Award Master Workbook, 2008)*

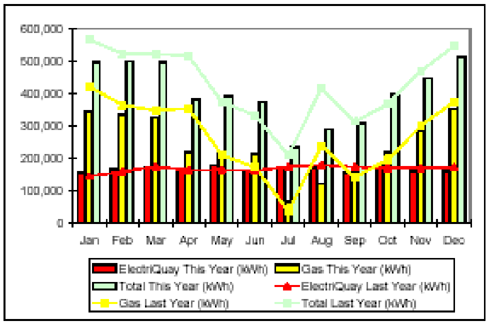
Electricity Calculator

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Day Units - 1st Set	No of units	22422	21144	23687	24323	22784	22049	23146	23869	39845	39866	33919		297054
	Cost per Unit €c	15.10	15.17	13.31	13.31	13.31	13.31	13.31	13.31	19.62	19.62	21.70		16.23
	Total Cost	3386	3208	3153	3237	3033	2935	3081	3177	7818	7822	7360	0	48208
Day Units - 2nd Set	No of units	16499	17669	21384	16783	21203	19310	20833	20055	0	0	0		153736
	Cost per Unit €c	14.670	14.670	12.650	12.650	12.650	12.650	12.650	12.650	0.000	0.000	0.000		13.10
	Total Cost	2420	2592	2705	2123	2682	2443	2635	2537	0	0	0	0	20138
Total Day Units		38921	38813	45071	41106	43987	41359	43979	43924	39845	39866	33919	0	450790
Total Day Cost		5806	5800	5858	5360	5715	5377	5716	5714	7818	7822	7360	0	68346
	Day Unit Price	14.92	14.94	13.00	13.04	12.99	13.00	13.00	13.01	19.62	19.62	21.70	#DIV/0!	15.16
Night Units	No of units	11560	10680	11937	11524	12059	11428	12173	12819	12159	11276	110360		227975
	Cost per Unit €c	7.90	7.99	7.99	7.99	7.99	7.99	7.99	7.99	12.25	12.25	12.25		10.49
	Total Cost	913	853	954	921	964	913	973	1024	1489	1381	13519	0	23904.47
Total Units		50481	49493	57008	52630	56046	52787	56152	56743	52004	51142	144279	0	678765
Night Units %		22.9%	21.6%	20.9%	21.9%	21.5%	21.6%	21.7%	22.6%	23.4%	22.0%	76.5%	#DIV/0!	33.6%
Total Unit Costs		6719	6653	6812	6281	6678	6291	6689	6738	9307	9203	20880	0	92250.35
Total Other Charges		525	515	548	0	78	0	78	0	0	0	0	0	1742.73
Total Monthly Costs		7244	7168	7359	6281	6756	6291	6766	6738	9307	9203	20880	0	93993.08
Average Unit														

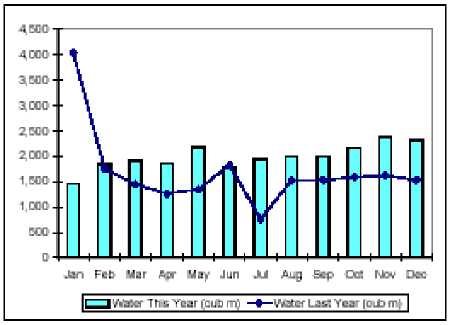
Appendix 6C Example of data collection – Hotel 3 *(Extract Utility Bureau Service, 2008)*

Utility Data

Energy (kWh)



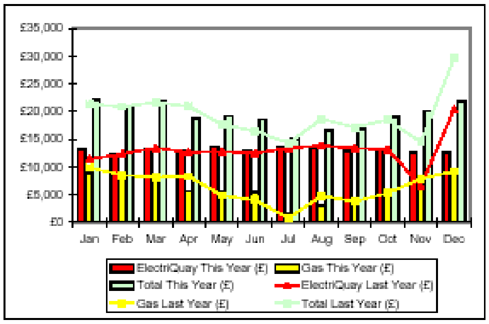
Water (cub m)



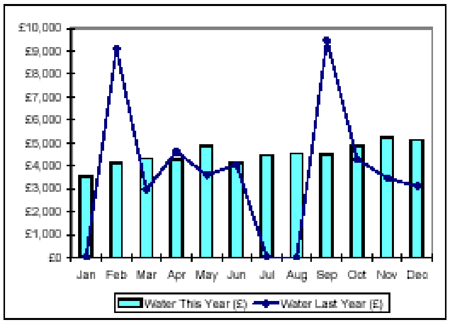
	Jan 07	Feb 07	Mar 07	Apr 07	May 07	Jun 07	Jul 07	Aug 07	Sep 07	Oct 07	Nov 07	Dec 07	Y.T.D.
ElectriQuay This Year (kWh)	155,200	165,440	170,080	164,430	178,350	159,520	170,570	170,140	154,880	177,910	159,090	160,610	1,986,220
Gas This Year (kWh)	343,688	335,896	326,987	218,491	213,484	214,285	64,222	119,817	154,337	218,773	288,002	353,443	2,851,425
Total This Year (kWh)	**498,888**	**501,336**	**497,067**	**382,921**	**391,834**	**373,805**	**234,792**	**289,957**	**309,217**	**396,683**	**447,092**	**514,053**	**4,837,645**
ElectriQuay Last Year (kWh)	145,042	157,963	174,363	162,776	164,685	160,932	173,554	179,160	173,150	170,940	169,960	171,510	2,004,035
Gas Last Year (kWh)	422,458	364,369	348,790	354,135	209,279	172,001	36,392	238,507	140,488	195,880	300,632	375,839	3,158,770
Total Last Year (kWh)	**567,500**	**522,332**	**523,153**	**516,911**	**373,964**	**332,933**	**209,946**	**417,667**	**313,638**	**366,820**	**470,592**	**547,349**	**5,162,805**
Water This Year (cub m)	1,456	1,842	1,907	1,862	2,167	1,770	1,946	1,988	1,986	2,156	2,376	2,313	23,769
Water Last Year (cub m)	4,027	1,757	1,438	1,260	1,342	1,819	757	1,521	1,523	1,583	1,620	1,521	20,168

Percentage change	Jan 07	Feb 07	Mar 07	Apr 07	May 07	Jun 07	Jul 07	Aug 07	Sep 07	Oct 07	Nov 07	Dec 07	Y.T.D.
Electricity (kWh)	7.0%	4.7%	-2.5%	1.0%	8.3%	-0.9%	-1.7%	-5.0%	-10.6%	4.1%	-6.4%	-6.4%	-0.9%
Gas (kWh)	-18.6%	-7.8%	-6.3%	-38.3%	2.0%	24.6%	76.5%	-49.8%	9.9%	11.7%	-4.2%	-6.0%	-9.7%
Total Energy (kWh)	**-12.1%**	**-4.0%**	**-5.0%**	**-25.9%**	**4.8%**	**12.3%**	**11.8%**	**-30.6%**	**-1.4%**	**8.1%**	**-5.0%**	**-6.1%**	**-6.3%**
Water (cub m)	-63.8%	4.8%	32.6%	47.8%	61.5%	-2.7%	157.1%	30.7%	30.4%	36.2%	46.7%	52.1%	17.9%

Energy (£)



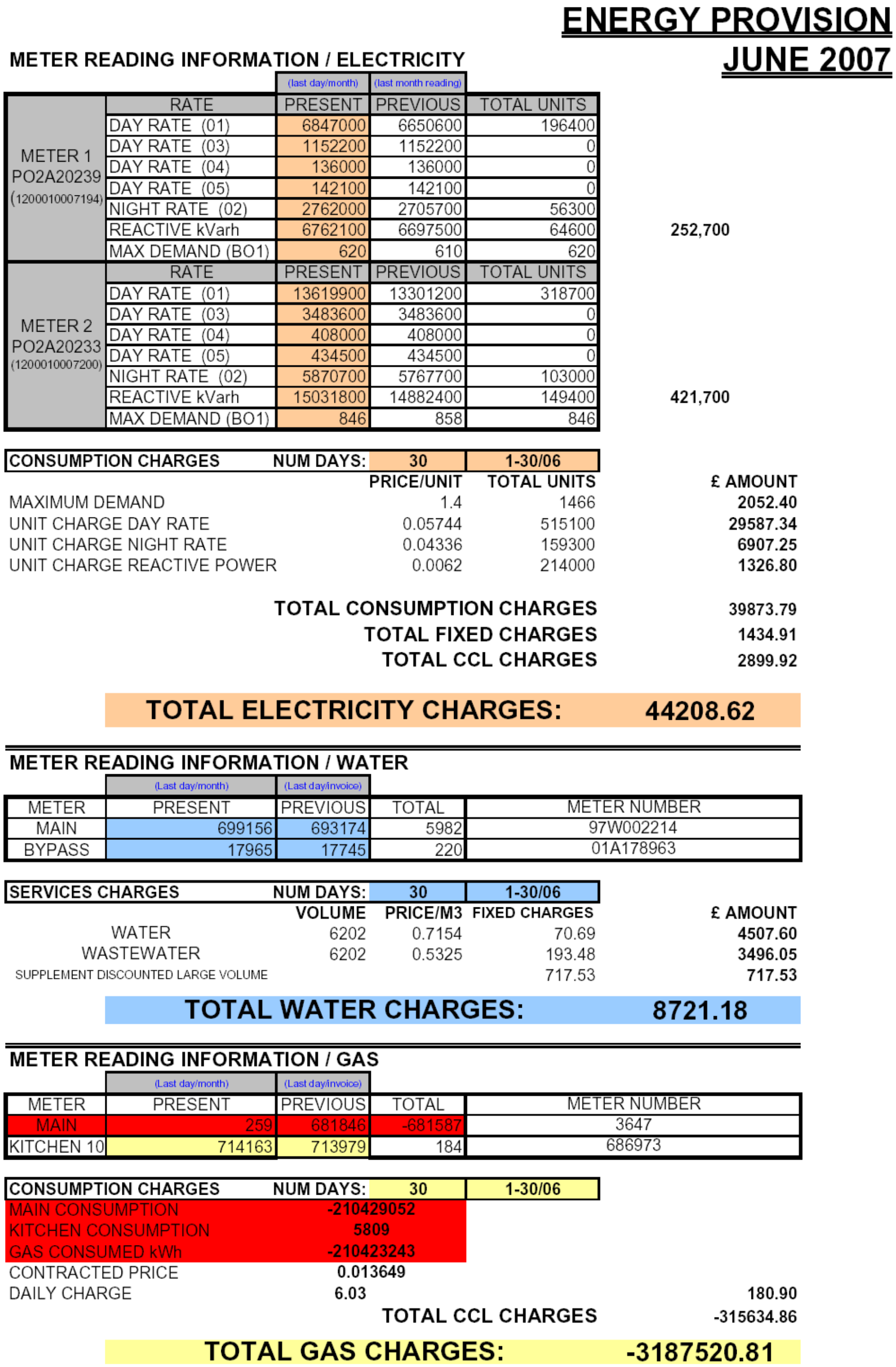
Water (£)



	Jan 07	Feb 07	Mar 07	Apr 07	May 07	Jun 07	Jul 07	Aug 07	Sep 07	Oct 07	Nov 07	Dec 07	Y.T.D.
ElectriQuay This Year (£)	£13,145	£12,304	£13,330	£13,109	£13,650	£13,042	£13,472	£13,447	£12,933	£13,410	£12,644	£12,598	£157,085
Gas This Year (£)	£8,919	£8,713	£8,465	£5,677	£5,525	£5,570	£1,666	£3,121	£4,058	£5,713	£7,467	£9,163	£74,057
Total This Year (£)	**£22,064**	**£21,017**	**£21,795**	**£18,786**	**£19,175**	**£18,613**	**£15,138**	**£16,568**	**£16,991**	**£19,123**	**£20,111**	**£21,762**	**£231,142**
ElectriQuay Last Year (£)	£11,371	£12,351	£13,454	£12,638	£12,776	£12,504	£13,436	£13,851	£13,390	£13,183	£6,583	£20,327	£155,864
Gas Last Year (£)	£9,890	£8,530	£8,165	£8,290	£4,899	£4,027	£852	£4,780	£3,766	£5,317	£7,891	£9,244	£75,652
Total Last Year (£)	**£21,260**	**£20,881**	**£21,619**	**£20,929**	**£17,675**	**£16,530**	**£14,288**	**£18,632**	**£17,156**	**£18,500**	**£14,474**	**£29,571**	**£231,515**
Water This Year (£)	£3,519	£4,123	£4,327	£4,291	£4,878	£4,124	£4,474	£4,551	£4,517	£4,857	£5,228	£5,143	£54,032
Water Last Year (£)	£0	£9,090	£2,954	£4,609	£3,592	£4,032	£0	£0	£9,472	£4,281	£3,453	£3,109	£44,591

Percentage change	Jan 07	Feb 07	Mar 07	Apr 07	May 07	Jun 07	Jul 07	Aug 07	Sep 07	Oct 07	Nov 07	Dec 07	Y.T.D.
Electricity (£)	15.6%	-0.4%	-0.9%	3.7%	6.8%	4.3%	0.3%	-2.9%	-3.4%	1.7%	92.1%	-38.0%	0.8%
Gas (£)	-9.8%	2.2%	3.7%	-31.5%	12.8%	38.3%	95.6%	-34.7%	7.8%	7.4%	-5.4%	-0.9%	-2.1%
Total Energy (£)	**3.8%**	**0.7%**	**0.8%**	**-10.2%**	**8.5%**	**12.6%**	**6.0%**	**-11.1%**	**-1.0%**	**3.4%**	**38.9%**	**-26.4%**	**-0.2%**
Water (£)	0.0%	-54.6%	46.5%	-6.9%	35.8%	2.3%	0.0%	0.0%	-52.3%	13.5%	51.4%	65.4%	21.2%

Appendix 6D Example of data collection – Hotel 4 *(Meter reading sent from hotel 4)*



ENERGY PROVISION
JUNE 2007

METER READING INFORMATION / ELECTRICITY

	RATE	PRESENT (last day/month)	PREVIOUS (last month reading)	TOTAL UNITS	
METER 1 PO2A20239 (1200010007194)	DAY RATE (01)	6847000	6650600	196400	
	DAY RATE (03)	1152200	1152200	0	
	DAY RATE (04)	136000	136000	0	
	DAY RATE (05)	142100	142100	0	
	NIGHT RATE (02)	2762000	2705700	56300	
	REACTIVE kVarh	6762100	6697500	64600	**252,700**
	MAX DEMAND (BO1)	620	610	620	
	RATE	PRESENT	PREVIOUS	TOTAL UNITS	
METER 2 PO2A20233 (1200010007200)	DAY RATE (01)	13619900	13301200	318700	
	DAY RATE (03)	3483600	3483600	0	
	DAY RATE (04)	408000	408000	0	
	DAY RATE (05)	434500	434500	0	
	NIGHT RATE (02)	5870700	5767700	103000	
	REACTIVE kVarh	15031800	14882400	149400	**421,700**
	MAX DEMAND (BO1)	846	858	846	

CONSUMPTION CHARGES	NUM DAYS: 30	1-30/06	
	PRICE/UNIT	**TOTAL UNITS**	**£ AMOUNT**
MAXIMUM DEMAND	1.4	1466	**2052.40**
UNIT CHARGE DAY RATE	0.05744	515100	**29587.34**
UNIT CHARGE NIGHT RATE	0.04336	159300	**6907.25**
UNIT CHARGE REACTIVE POWER	0.0062	214000	**1326.80**

TOTAL CONSUMPTION CHARGES	**39873.79**
TOTAL FIXED CHARGES	**1434.91**
TOTAL CCL CHARGES	**2899.92**

TOTAL ELECTRICITY CHARGES: 44208.62

METER READING INFORMATION / WATER

METER	PRESENT (Last day/month)	PREVIOUS (Last day/invoice)	TOTAL	METER NUMBER
MAIN	699156	693174	5982	97W002214
BYPASS	17965	17745	220	01A178963

SERVICES CHARGES	NUM DAYS: 30	1-30/06		
	VOLUME	**PRICE/M3**	**FIXED CHARGES**	**£ AMOUNT**
WATER	6202	0.7154	70.69	**4507.60**
WASTEWATER	6202	0.5325	193.48	**3496.05**
SUPPLEMENT DISCOUNTED LARGE VOLUME			717.53	**717.53**

TOTAL WATER CHARGES: 8721.18

METER READING INFORMATION / GAS

METER	PRESENT (Last day/month)	PREVIOUS (Last day/invoice)	TOTAL	METER NUMBER
MAIN	259	681846	-681587	3647
KITCHEN 10	714163	713979	184	686973

CONSUMPTION CHARGES	NUM DAYS: 30	1-30/06
MAIN CONSUMPTION	**-210429052**	
KITCHEN CONSUMPTION	**5809**	
GAS CONSUMED kWh	**-210423243**	
CONTRACTED PRICE	**0.013649**	
DAILY CHARGE	**6.03**	**180.90**
TOTAL CCL CHARGES		**-315634.86**

TOTAL GAS CHARGES: -3187520.81

Appendix 6E Example of data collection – Hotel 5 *(Adapted and developed by Author from Excel file sent by hotel, 2007)*

HOTEL		**MONTHLY ENERGY RECORD**	**YEAR 2007**

ELECTRICITY	JANUARY	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
present day reading	111261	121297	132019	143669	155581	168179	180566	193176	205606	217130	227866	238157	
previous day reading	100633	111261	121297	132019	143669	155581	168179	180566	193176	205606	217130	227866	
day units total	106280	100360	107220	116500	119120	125980	123870	126100	124300	115240	107360	102910	
present night reading	37718	40633	43611	46899	50305	53960	57678	61350	64999	68308	71289	74459	
previous night reading	34542	37718	40633	43611	46899	50305	53960	57678	61350	64999	68308	71289	
night units total	31760	29150	29780	32880	34060	36550	37180	36720	36490	33090	29810	31700	
total electricity consumption (kWh)	**138,040**	**129,510**	**137,000**	**149,380**	**153,180**	**162,530**	**161,050**	**162,820**	**160,790**	**148,330**	**137,170**	**134,610**	**1,774,410**
kWh/gn	**31.8**	**30.0**	**28.6**	**35.6**	**32.8**	**30.7**	**26.6**	**27.0**	**27.3**	**25.9**	**23.9**	**23.0**	**343**
kgCO2 (av.uk)	**66,259**	**62,165**	**65,760**	**71,702**	**73,526**	**78,014**	**77,304**	**78,154**	**77,179**	**71,198**	**65,842**	**64,613**	**851,717**
kgCO2/gn (av.uk)													14
total cost	11,641.69	10,974.08	11,618.59	12,611.66	12,908.47	13,653.27	13,499.45	13,673.11	13,500.51	12,510.84	11,632.67	11,338.52	£149,563

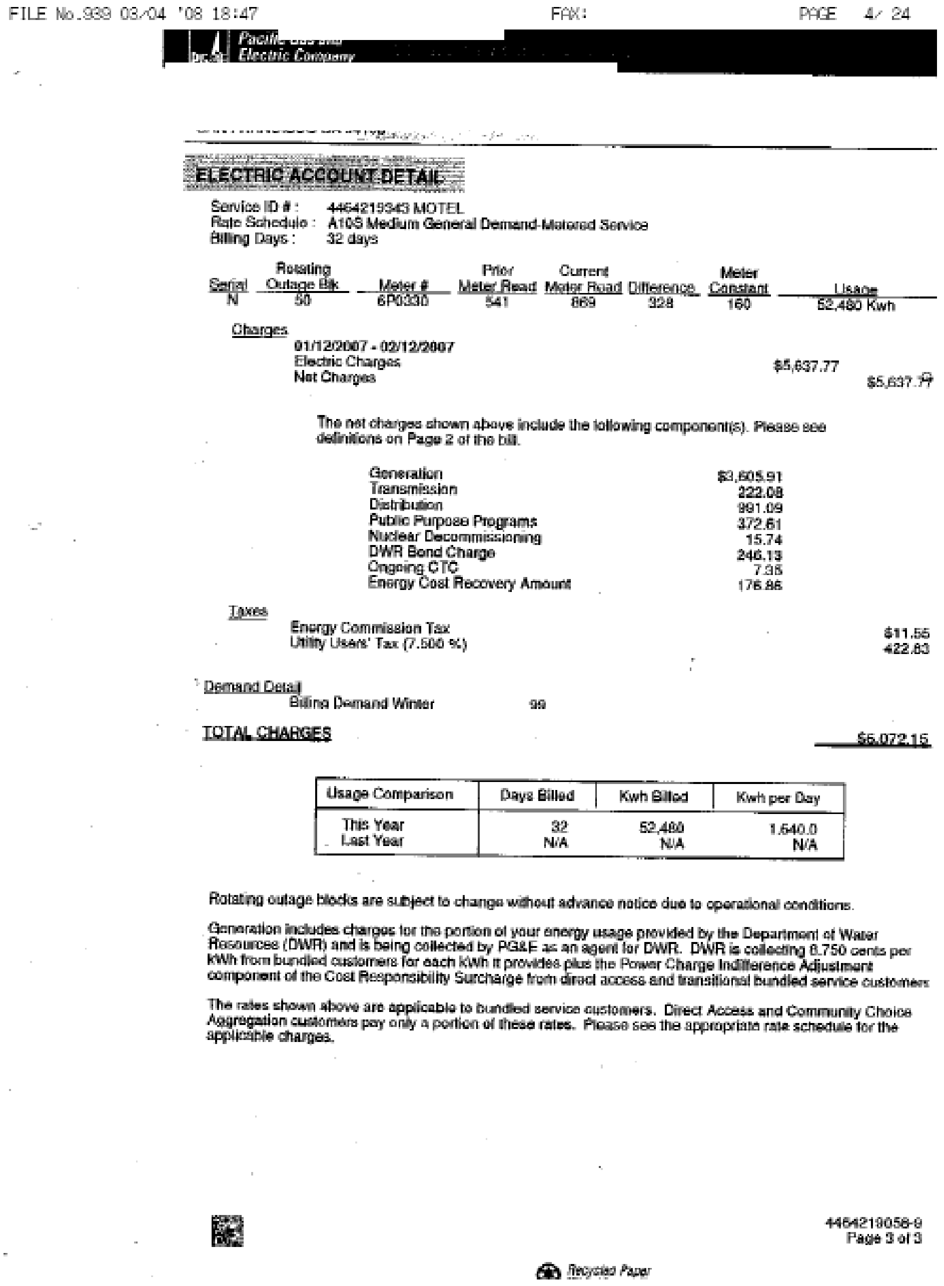
Fixed charge tariff	
standing charge	14.52
Line/meter operator/ data charges	19.25
availability charge	436.50
total fixed charges	470.27
Variable charge tariff	
night rate charge (£/kWh)	0.04951
day rate charge (£/kWh)	0.08459
climate change levy (£/kWh)	0.0044

GAS Hotel / Kitchen	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
PRESENT READING Hotel	94107	112254	129325	141483	153240	162380	171632	180469	190369	202777	219304	238333	
PREVIOUS READING Hotel	75644	94107	112254	129325	141483	153240	162380	171632	180469	190369	202777	219304	
PRESENT READING Kitchen	5348	7190	9061	10963	12854	14752	16516	18397	20149	22030	23813	25601	
PREVIOUS READING Kitchen	3589	5348	7190	9061	10963	12854	14752	16516	18397	20149	22030	23813	
CONSUMPTION KWh	**145,378**	**142,890**	**134,417**	**95,732**	**92,575**	**71,969**	**72,850**	**69,583**	**77,953**	**112,512**	**144,173**	**163,913**	**1,323,946**
kWh/gn	**33.5**	**33.1**	**28.0**	**22.8**	**19.8**	**13.6**	**12.0**	**11.6**	**13.2**	**19.7**	**25.1**	**28.1**	**261**
kgCO2	**27,622**	**27,149**	**25,539**	**18,189**	**17,589**	**13,674**	**13,842**	**13,221**	**14,811**	**21,377**	**27,393**	**31,144**	**251,550**
kgCO2/gn													**4**
total cost	£2,208.15	£2,170.35	£2,041.67	£1,634.98	£1,593.05	£1,274.03	£1,293.46	£1,243.82	£1,364.93	£1,895.87	£2,370.75	£2,676.61	£21,767.66

contracted price (p/kWh)	1.3649	Daily charge	£6.03
climate change levy(p/kwh)	0.154		

TOTAL KGCO2	**93,881**	**89,314**	**91,299**	**89,892**	**91,116**	**91,688**	**91,146**	**91,374**	**91,990**	**92,576**	**93,235**	**95,756**	**1,103,266**
TOTAL KGCO2/GN	**21.7**	**20.7**	**19.0**	**21.4**	**19.5**	**17.3**	**15.0**	**15.2**	**15.6**	**16.2**	**16.2**	**16.4**	**17.5**

Appendix 6F Example of data collection – Hotel 6 *(PG&E invoice, 2008)*



FILE No.939 03/04 '08 18:47 FAX: PAGE 4/ 24

Pacific [redacted]
Electric Company

ELECTRIC ACCOUNT DETAIL

Service ID # : 4464219343 MOTEL
Rate Schedule : A10S Medium General Demand-Metered Service
Billing Days : 32 days

Serial	Rotating Outage Blk	Meter #	Prior Meter Read	Current Meter Road	Difference	Meter Constant	Usage
N	50	6P0330	541	869	328	160	52,480 Kwh

Charges

01/12/2007 - 02/12/2007		
Electric Charges	$5,637.77	
Net Charges		$5,637.77

The net charges shown above include the following component(s). Please see definitions on Page 2 of the bill.

Generation	$3,605.91
Transmission	222.08
Distribution	991.09
Public Purpose Programs	372.61
Nuclear Decommissioning	15.74
DWR Bond Charge	246.13
Ongoing CTC	7.35
Energy Cost Recovery Amount	176.86

Taxes

Energy Commission Tax	$11.55
Utility Users' Tax (7.500 %)	422.83

Demand Detail

Billing Demand Winter	99

TOTAL CHARGES $5,072.15

Usage Comparison	Days Billed	Kwh Billed	Kwh per Day
This Year	32	52,480	1,640.0
Last Year	N/A	N/A	N/A

Rotating outage blocks are subject to change without advance notice due to operational conditions.

Generation includes charges for the portion of your energy usage provided by the Department of Water Resources (DWR) and is being collected by PG&E as an agent for DWR. DWR is collecting 8.750 cents per kWh from bundled customers for each kWh it provides plus the Power Charge Indifference Adjustment component of the Cost Responsibility Surcharge from direct access and transitional bundled service customers.

The rates shown above are applicable to bundled service customers. Direct Access and Community Choice Aggregation customers pay only a portion of these rates. Please see the appropriate rate schedule for the applicable charges.

4464219058-9
Page 3 of 3

Recycled Paper

Appendices 6G Example of data collection – Hotel 7 *(Scandic Utility System SUS, 2007)*

Region	**Country**	**City**	**Hotel**	**Year**	**Year Built**	**Floor Area**	**All Floors including basements**	**No. of Guest Bed Rooms**	**No. of Meeting Rooms**	**No. of Function Rooms**
EA	Sweden	Stockholm	Case Study Hotel 1	2002	1989	16,000	0	283	17	0
EA	Sweden	Stockholm	Case Study Hotel 1	2003	1989	16,000	0	283	17	0
EA	Sweden	Stockholm	Case Study Hotel 1	2004	1989	16,000	0	283	17	0
EA	Sweden	Stockholm	Case Study Hotel 1	2005	1989	16,000	0	283	17	0

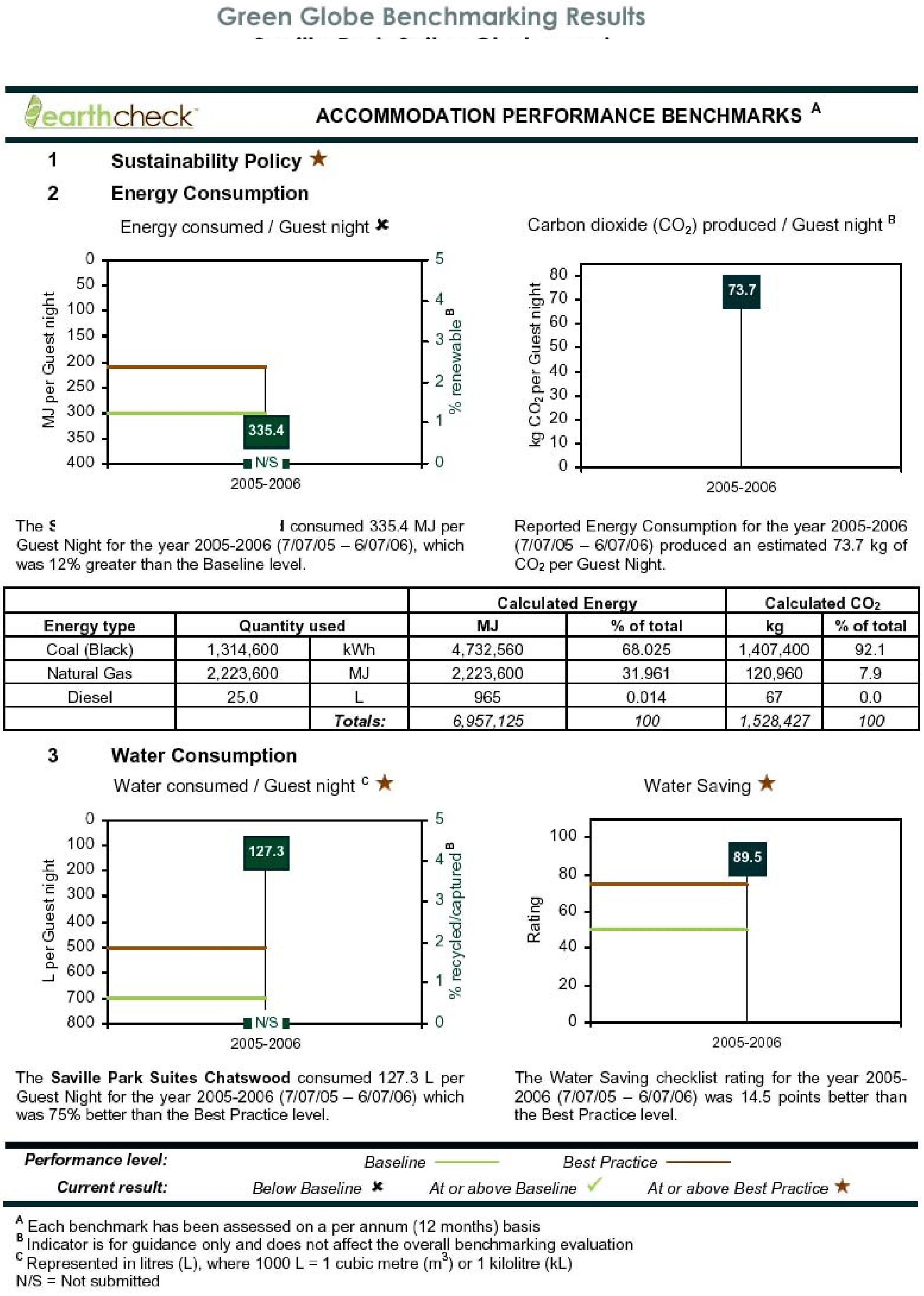
No. of Restaurants	**Total Restaurant Seating Capacity**	**No. of Kitchens**	**Health Club Yes/No**	**On site Laundry Yes/No**	**Extent of landscaped grounds in m2**	**AC Public areas Yes/No**	**AC Meeting room Yes/No**	**AC Guest bed rooms Yes/No**	**CHP Unit Yes/No**	**Cooling tower Yes/No**	**Solar energy unit Yes/No**	**Water softener Yes/No**
1	600	1	0	0	200	0	0	0	0	0	0	0
1	600	1	0	0	200	0	0	0	0	0	0	0
1	600	1	0	0	200	0	0	0	0	0	0	0
1	600	1	0	0	200	0	0	0	0	0	0	0

Appendices 6G Example of Data Collection – Hotel 7 *(Scandic Utility System SUS, 2007) Continued*

Jacuzzi	**Total Number of Guest Nights (Sleepers)**	**Unsorted waste**	**Unsorted waste Unit**	**Sorted waste**	**Sorted waste Unit**	**Hazardous waste**	**Hazardous waste Unit**
0	101,275	76,800	kg	-	kg	-	kg
0	98,286	53,856	kg	-	kg	-	kg
0	105,247	62,478	kg	35,923	kg	-	kg
0	106,911	56,093	kg	70,979	kg	1,558	kg

Total Mains Supply	**District Heating**	**Water**	**kWh/gn**	**kWh/m2**	**litre/gn**	**kg waste/gn**
1,810,011	1,823,700	20,639	35.88	227.11	203.79	0.76
1,766,168	1,806,000	17,736	36.34	223.26	180.45	0.55
1,744,576	1,861,700	18,200	34.26	225.39	172.93	0.59
1,651,197	1,753,877	18,239	31.85	212.82	170.60	0.52

Appendix 6H Example of data collection – Hotel 8 *(Green Globe, 2007)*



Green Globe Benchmarking Results

[redacted]

earthcheck

ACCOMMODATION PERFORMANCE BENCHMARKS A

1 Sustainability Policy ★

2 Energy Consumption

Energy consumed / Guest night ✖

Carbon dioxide (CO_2) produced / Guest night B

The [redacted] consumed 335.4 MJ per Guest Night for the year 2005-2006 (7/07/05 – 6/07/06), which was 12% greater than the Baseline level.

Reported Energy Consumption for the year 2005-2006 (7/07/05 – 6/07/06) produced an estimated 73.7 kg of CO_2 per Guest Night.

			Calculated Energy		Calculated CO_2	
Energy type	**Quantity used**		**MJ**	**% of total**	**kg**	**% of total**
Coal (Black)	1,314,600	kWh	4,732,560	68.025	1,407,400	92.1
Natural Gas	2,223,600	MJ	2,223,600	31.961	120,960	7.9
Diesel	25.0	L	965	0.014	67	0.0
		Totals:	*6,957,125*	*100*	*1,528,427*	*100*

3 Water Consumption

Water consumed / Guest night C ★

Water Saving ★

The **Saville Park Suites Chatswood** consumed 127.3 L per Guest Night for the year 2005-2006 (7/07/05 – 6/07/06) which was 75% better than the Best Practice level.

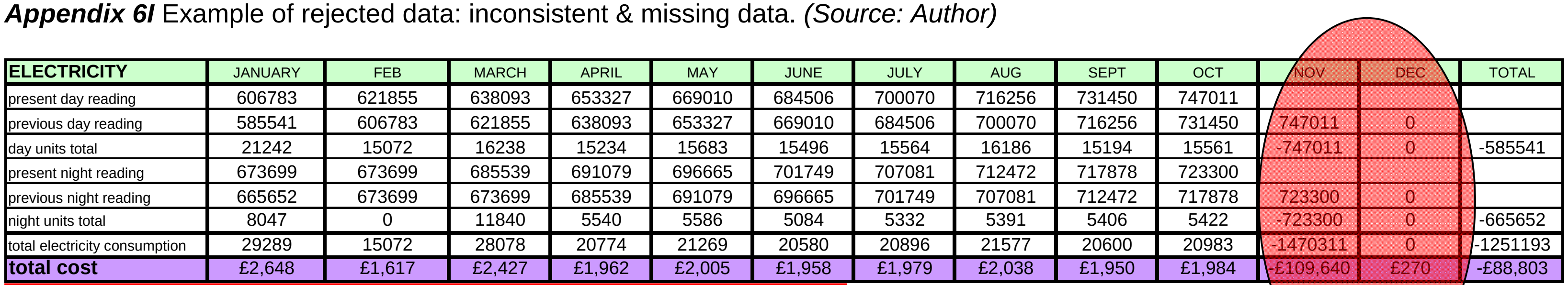
The Water Saving checklist rating for the year 2005-2006 (7/07/05 – 6/07/06) was 14.5 points better than the Best Practice level.

Performance level: *Baseline* ― *Best Practice* ―

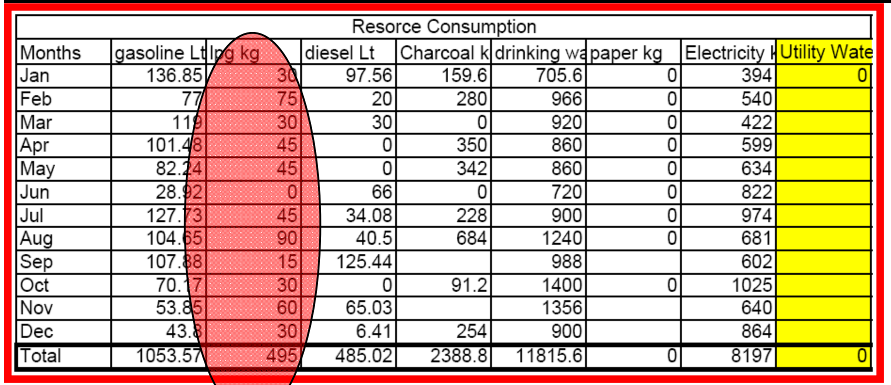
Current result: *Below Baseline* ✖ *At or above Baseline* ✓ *At or above Best Practice* ★

[A] Each benchmark has been assessed on a per annum (12 months) basis
[B] Indicator is for guidance only and does not affect the overall benchmarking evaluation
[C] Represented in litres (L), where 1000 L = 1 cubic metre (m^3) or 1 kilolitre (kL)
N/S = Not submitted

Appendix 6I Example of rejected data: inconsistent & missing data. *(Source: Author)*

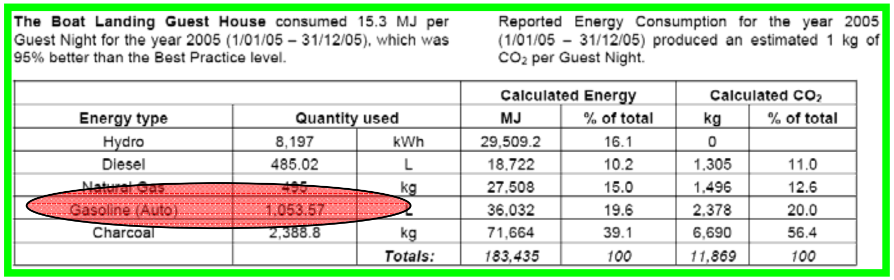


ELECTRICITY	JANUARY	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
present day reading	606783	621855	638093	653327	669010	684506	700070	716256	731450	747011			
previous day reading	585541	606783	621855	638093	653327	669010	684506	700070	716256	731450	747011	0	
day units total	21242	15072	16238	15234	15683	15496	15564	16186	15194	15561	-747011	0	-585541
present night reading	673699	673699	685539	691079	696665	701749	707081	712472	717878	723300			
previous night reading	665652	673699	673699	685539	691079	696665	701749	707081	712472	717878	723300	0	
night units total	8047	0	11840	5540	5586	5084	5332	5391	5406	5422	-723300	0	-665652
total electricity consumption	29289	15072	28078	20774	21269	20580	20896	21577	20600	20983	-1470311	0	-1251193
total cost	£2,648	£1,617	£2,427	£1,962	£2,005	£1,958	£1,979	£2,038	£1,950	£1,984	-£109,640	£270	-£88,803



Resorce Consumption								
Months	gasoline Lt	lpg kg	diesel Lt	Charcoal k	drinking wa	paper kg	Electricity k	Utility Wate
Jan	136.85	30	97.56	159.6	705.6	0	394	0
Feb	77	75	20	280	966	0	540	
Mar	119	30	30	0	920	0	422	
Apr	101.48	45	0	350	860	0	599	
May	82.24	45	0	342	860	0	634	
Jun	28.92	0	66	0	720	0	822	
Jul	127.73	45	34.08	228	900	0	974	
Aug	104.65	90	40.5	684	1240	0	681	
Sep	107.88	15	125.44		988		602	
Oct	70.17	30	0	91.2	1400	0	1025	
Nov	53.85	60	65.03		1356		640	
Dec	43.8	30	6.41	254	900		864	
Total	1053.57	495	485.02	2388.8	11815.6	0	8197	0

Extract from excel data sent directly to author from hotel 8 *(Note: LPG)*



The Boat Landing Guest House consumed 15.3 MJ per Guest Night for the year 2005 (1/01/05 – 31/12/05), which was 95% better than the Best Practice level.

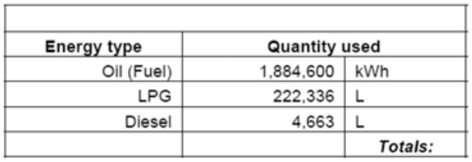
Reported Energy Consumption for the year 2005 (1/01/05 – 31/12/05) produced an estimated 1 kg of CO_2 per Guest Night.

			Calculated Energy		Calculated CO_2	
Energy type	**Quantity used**		**MJ**	**% of total**	**kg**	**% of total**
Hydro	8,197	kWh	29,509.2	16.1	0	
Diesel	485.02	L	18,722	10.2	1,305	11.0
Natural Gas	495	kg	27,508	15.0	1,496	12.6
Gasoline (Auto)	1,053.57	L	36,032	19.6	2,378	20.0
Charcoal	2,388.8	kg	71,664	39.1	6,690	56.4
		Totals:	*183,435*	*100*	*11,869*	*100*

Extract from Benchmark Assessment Report sent directly by Hotel 8 to author. *(Note: Natural Gas)*

Appendix 6J Example of numerical error *(Source: Author)*

Hotel 21
Report Date: 29 August 2006
Benchmarked Certificate Expiry: 31 August 2007
PERIOD BENCHMARKED: 1 June 2005 – 31 May 2006



Energy type	Quantity used	
Oil (Fuel)	1,884,600	kWh
LPG	222,336	L
Diesel	4,663	L
		Totals:

<u>Calculations of kg CO2 emissions:</u>

Oil (Fuel):1,884,600 kWh x 0.26 kgCO2/kWh = **156,928.75** kg CO2
(GG = 1,631,800 kg CO2)

LPG: 222,336 L x 1.51 kgCO2/L = 335,727.36 kg CO2
(GG = 339,414 kg CO2)

Diesel: *(4,663 L x 0.2642 = 1231.96 gallons)*
1231.96 gallons x 12.1 kgCO2 / gallon = 14,906.77 kg CO2
(GG = 12,545 kg CO2)

TOTAL = 507,562.88 kg CO2
(GG = 1,983,759 kg CO2)

Total per guest night = 507,562.88 kg CO2 / 28,942 gn

= 17.53 kg CO2 per guest night
(GG = ***68.5*** *kg CO2)*

<u>Calculations of Total energy (useful) kWh:</u>

Oil (Fuel): 1,884,600 kWh = 1,884,600 kWh

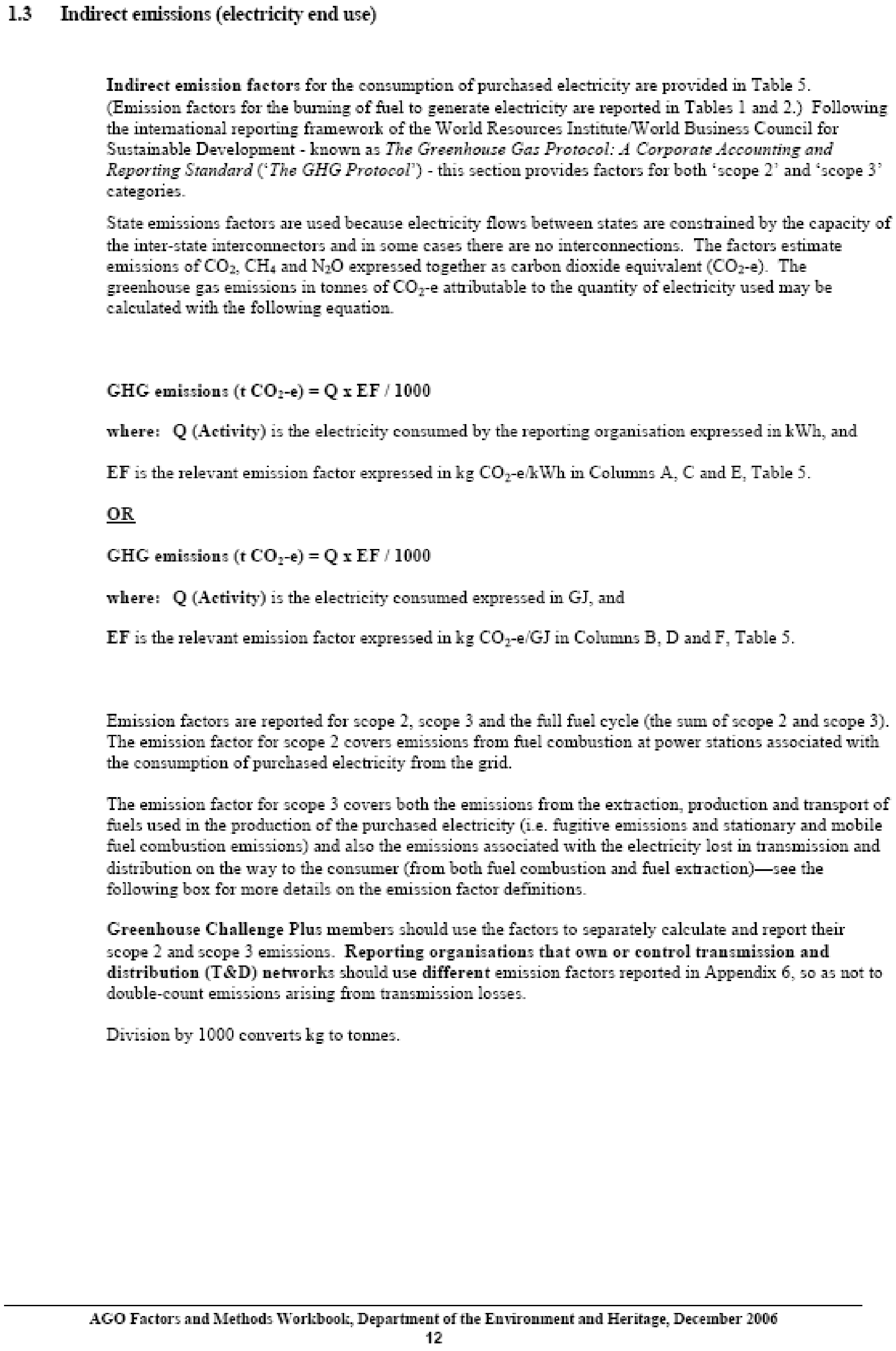
LPG: 222,336 L x 7.4 kWh/L = 1,645,286 kWh

Diesel: 4,663 L x 10.4 kWh/L = 48,495 kWh

TOTAL = 3,578,381 kWh

Total useful energy consumption per guest night = 3,578,381 kWh / 28,942 gn
= 123.6 kWh per guest night

Appendix 6K Example of Calculation Method for Australian Conversion Factor *(AGO, 2006)*



1.3 Indirect emissions (electricity end use)

Indirect emission factors for the consumption of purchased electricity are provided in Table 5. (Emission factors for the burning of fuel to generate electricity are reported in Tables 1 and 2.) Following the international reporting framework of the World Resources Institute/World Business Council for Sustainable Development - known as *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* ('*The GHG Protocol*') - this section provides factors for both 'scope 2' and 'scope 3' categories.

State emissions factors are used because electricity flows between states are constrained by the capacity of the inter-state interconnectors and in some cases there are no interconnections. The factors estimate emissions of CO_2, CH_4 and N_2O expressed together as carbon dioxide equivalent (CO_2-e). The greenhouse gas emissions in tonnes of CO_2-e attributable to the quantity of electricity used may be calculated with the following equation.

GHG emissions (t CO_2-e) = Q x EF / 1000

where: **Q (Activity)** is the electricity consumed by the reporting organisation expressed in kWh, and

EF is the relevant emission factor expressed in kg CO_2-e/kWh in Columns A, C and E, Table 5.

<u>OR</u>

GHG emissions (t CO_2-e) = Q x EF / 1000

where: **Q (Activity)** is the electricity consumed expressed in GJ, and

EF is the relevant emission factor expressed in kg CO_2-e/GJ in Columns B, D and F, Table 5.

Emission factors are reported for scope 2, scope 3 and the full fuel cycle (the sum of scope 2 and scope 3). The emission factor for scope 2 covers emissions from fuel combustion at power stations associated with the consumption of purchased electricity from the grid.

The emission factor for scope 3 covers both the emissions from the extraction, production and transport of fuels used in the production of the purchased electricity (i.e. fugitive emissions and stationary and mobile fuel combustion emissions) and also the emissions associated with the electricity lost in transmission and distribution on the way to the consumer (from both fuel combustion and fuel extraction)—see the following box for more details on the emission factor definitions.

Greenhouse Challenge Plus members should use the factors to separately calculate and report their scope 2 and scope 3 emissions. **Reporting organisations that own or control transmission and distribution (T&D) networks** should use **different** emission factors reported in Appendix 6, so as not to double-count emissions arising from transmission losses.

Division by 1000 converts kg to tonnes.

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Appendix 6K Example of Calculation Method for Australian Conversion Factor *(AGO, 2006) Continued*

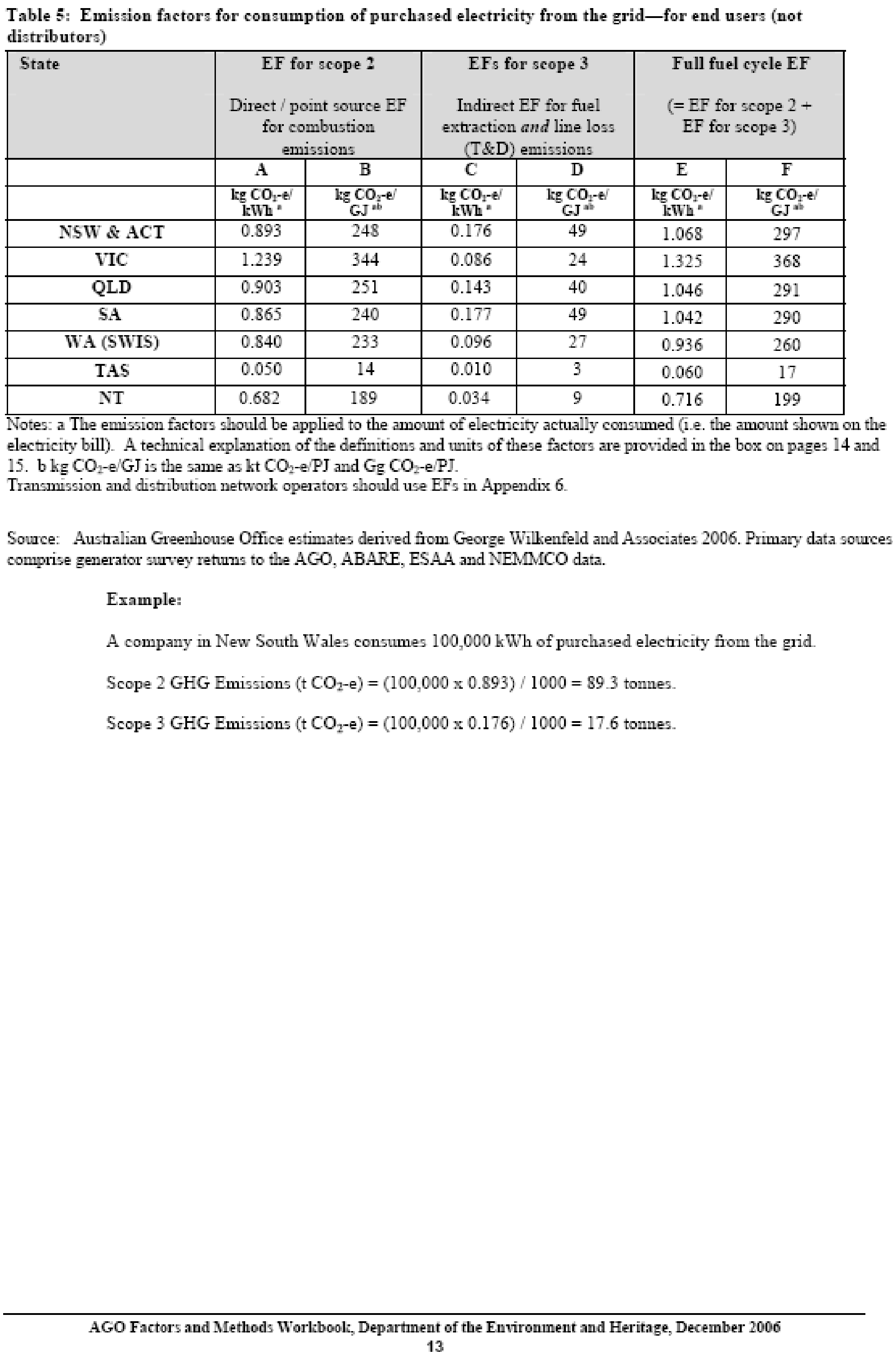

Table 5: Emission factors for consumption of purchased electricity from the grid—for end users (not distributors)

State	EF for scope 2 Direct / point source EF for combustion emissions		EFs for scope 3 Indirect EF for fuel extraction *and* line loss (T&D) emissions		Full fuel cycle EF (= EF for scope 2 + EF for scope 3)	
	A	B	C	D	E	F
	kg CO_2-e/ kWh [a]	kg CO_2-e/ GJ [ab]	kg CO_2-e/ kWh [a]	kg CO_2-e/ GJ [ab]	kg CO_2-e/ kWh [a]	kg CO_2-e/ GJ [ab]
NSW & ACT	0.893	248	0.176	49	1.068	297
VIC	1.239	344	0.086	24	1.325	368
QLD	0.903	251	0.143	40	1.046	291
SA	0.865	240	0.177	49	1.042	290
WA (SWIS)	0.840	233	0.096	27	0.936	260
TAS	0.050	14	0.010	3	0.060	17
NT	0.682	189	0.034	9	0.716	199

Notes: a The emission factors should be applied to the amount of electricity actually consumed (i.e. the amount shown on the electricity bill). A technical explanation of the definitions and units of these factors are provided in the box on pages 14 and 15. b kg CO_2-e/GJ is the same as kt CO_2-e/PJ and Gg CO_2-e/PJ.
Transmission and distribution network operators should use EFs in Appendix 6.

Source: Australian Greenhouse Office estimates derived from George Wilkenfeld and Associates 2006. Primary data sources comprise generator survey returns to the AGO, ABARE, ESAA and NEMMCO data.

Example:

A company in New South Wales consumes 100,000 kWh of purchased electricity from the grid.

Scope 2 GHG Emissions (t CO_2-e) = (100,000 x 0.893) / 1000 = 89.3 tonnes.

Scope 3 GHG Emissions (t CO_2-e) = (100,000 x 0.176) / 1000 = 17.6 tonnes.

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Appendix 6K Australian electricity conversion factor *(AGO, 2006) continued*

Box: Electricity emission factor definitions

The estimated electricity emission factors in this workbook have been aligned with the definitions used in *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* of the WRI and WBCSD for the first time in this edition (the Protocol is available at www.ghgprotocol.org/).

This box provides more detailed explanation and the definitions of these electricity emission factors, but this is not necessary information for readers simply wishing to apply the factors.

The emission factors are calculated as financial year averages based on electricity generation within each state/territory and taking into account inter-state electricity flows (where they exist) and the emissions attributable to those flows. Both the electricity emissions estimates in the NGGI prepared by George Wilkenfeld and Associates and the emission factors for consumption of purchased electricity use data from ESAA, NEMMCO, the ABARE Fuel and Electricity Survey, AGO surveys and advice from the WA Sustainable Energy Development Office.

Emission factor for scope 2 Scope 2 emissions result from the generation of purchased electricity from each state's electricity grid (or steam or heating/cooling). The Emission Factor at Generation ($EFG\ scope2^t_i$) is used to calculate scope 2 emissions and is defined for state i and financial year t as:

$$EFG\ scope2^t_i = \frac{Combustion\ emissions\ from\ electricity\ consumed\ from\ the\ grid\ in\ state\ i\ (CE\_C^t_i)}{Electricity\ sent\ out\ consumed\ from\ the\ grid\ in\ state\ i\ (ESO\_C^t_i)}$$

where 'combustion emissions from electricity consumed from the grid in state i' ($CE\_C^t_i$) and 'electricity sent out consumed from the grid in state i' ($ESO\_C^t_i$) are defined in terms of the state's electricity grid production, imports and exports as follows:

$$CE\_C^t_i = CE\_P^t_i + \sum^{j}\left(\frac{ESO\_M^t_{j,i}}{ESO\_P^t_j} \bullet CE\_P^t_j\right) - \sum^{k}\left(\frac{ESO\_X^t_{i,k}}{ESO\_P^t_i} \bullet CE\_P^t_i\right)$$

$$ESO\_C^t_i = ESO\_P^t_i + \sum^{j} ESO\_M^t_{j,i} - \sum^{k} ESO\_X^t_{i,k}$$

where $CE\_P^t_i$ = total CO_2-e emissions from fuel combustion at generation attributed to the electricity generated/produced for the grid in state i in financial year t,

$CE\_P^t_j$ = total CO_2-e emissions from fuel combustion at generation attributed to the electricity generated/produced for the grid in state j in financial year t,

$ESO\_M^t_{j,i}$ = imports of electricity sent out from state j to state i in financial year t,

$ESO\_P^t_j$ = total electricity sent out on the grid that is generated/produced within state j in financial year t,

$ESO\_X^t_{i,k}$ = exports of electricity sent out from state i to state k in financial year t, and

$ESO\_P^t_i$ = total electricity sent out on the grid that is generated/produced within state i in financial year t.

The emission factor for scope 2 is defined in terms of **electricity sent out on the grid** rather than electricity delivered so that end users of electricity are allocated only the emissions attributable to the electricity they consume and not the emissions attributable to electricity lost in transmission and distribution (T&D). This follows *The GHG Protocol* guidance that scope 2 emissions be reported by the organisation owning or controlling the plant or equipment where the electricity is consumed. Companies that own or control T&D networks should report their T&D loss emissions under scope 2, while end users should report the share of these T&D loss emissions attributable to their electricity consumption under scope 3. Further explanation of these issues can be found on pp 27-29 and pp 86-87 of *The GHG Protocol*.

Emission factor for scope 3 Specific 'scope 3' emission factors are provided in this workbook for purchased electricity from the grid that cover indirect emissions attributable to the extraction, production and transport of fuel burned at generation and to the electricity lost in delivery in the T&D network.

AGO Factors and Methods Workbook, Department of the Environment and Heritage, December 2006
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