The Role of Distribution Network Operators in Promoting Cost-Effective Distributed Generation: Lessons from the United States of America for Europe

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By

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Abstract

This paper explores the different competitive mechanisms applied by electric utilities from the US in promoting cost-effective Distribution Energy Resources (DER) - with a focus on Distributed Generation (DG) - and the challenges that electric utilities are facing due to the increase in DG connections. Cases studies from California, Oregon, Colorado and New York have been selected. The case studies refer to two kinds of competitive mechanisms: Request for Proposals (RFP) and auctions (Renewable Auction Mechanism). A similar behaviour is observed across electric utilities in the way in which competitive auction mechanisms are being managed; however the more sophisticated auction designs are observed in the RFPs. The study proposes a set of auction design elements with a focus on the UK context and examines the role of energy regulators in the design of well-structured auction mechanisms. We think that the experience cited in the four case studies can be replicated by the Distribution System Operators (DSOs) from Europe; however unbundling rules established in the European Commission third energy package need to be taken into consideration.

Key words: electricity auctions, distributed generation, renewable energy, third energy package

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1. Introduction

The achievement of renewable targets is one of the main drivers influencing the design of specific mechanisms for procuring renewable Distributed Generation (DG). Different procurement mechanisms respond to different needs, requirements and policy objectives. Electric utilities are (or should be) searching for cost-efficient methods that allow them greater flexibility in meeting their specific needs and future demands. Some of these mechanisms are based on competitive solicitations and auctions and others are based on specific subsidies.

In addition, based on the European Commission's (EC) third energy package about unbundling (Directive 2009/72/EC- Electricity Directive), the members are required to ensure the separation of the vertically integrated energy firms. This means that the Distribution System Operators (DSOs), serving more than 100,000 customers, shall be independent from other activities not relating to distribution (generation, transmission and supply). Following [1], the majority of countries have fully implemented the third package. Great Britain is among the countries that has transposed into national the Article 28 of the Directive and has completed the unbundling mandate[3]. Thus, its Distribution Network Operators (DNOs)[4] are not allowed to procure DG. The distribution licences require (DNOs) to connect generators on a first-come first-served basis without any discrimination between different types of generation. One of the main problems that DNOs are facing now is the significant increase in the number of connection applications and the low rate of acceptance of DG connections. The elimination of the up-front assessment and design fees has contributed to this increase [3].

The current regulatory framework in Great Britain mandates common national policies for the connection of DG customers (set in the Distribution Licence). DNOs are not encouraged to lead specific competitive processes for the connection of more DG with a focus on small size DG projects. We are aware of the transaction costs that this kind of mechanism may add, especially to small-scale projects, however we are also aware of the benefits that competitive mechanism may provide in the integration of DG to the distribution grid. The implementation of this mechanism can help the DNO deal with the increase of DG queries and the low rate of connection offer acceptance, and can encourage more efficient use of the electric infrastructure. This approach may require detailed negotiations between the DNOs and each project that helps to fit the needs of both parties and to reduce unnecessary transaction costs. However this has worked successfully elsewhere. Even though Feed-in Tariff and quota systems are the most popular support mechanisms, with the number of states, provinces and countries that have respectively adopted them as of 2013 being 98 and 79; the global trend in feed-in schemes is centered on reduction (or even removal) of support [4]. Tendering or auctions are becoming more important: a total of 55 countries have turned to public auctions as of early 2014, in comparison with 9 countries in 2009. Central and South American countries remain the global leaders in renewable energy tenders [4].

This study explores different experiences that promote the connection of cost-effective energy projects (with a focus on DG) by electric utilities and identifies the advantages and disadvantages of the different competitive methods applied. The paper focuses on competitive mechanisms and

[3] Around 50% of the countries have already transposed this article into national law [2].
[4] This term refers to DSO in Great Britain. DNOs hold a licence that enables them to operate in a monopoly regional distribution service area.

evaluates the design elements and the associated regulatory framework. In contrast with other studies, which mainly refer to centralised auctions including those related to system adequacy [5,6], this one refers to decentralised competitive mechanisms; those carried out by electric utilities instead of government or energy regulators. This study contributes to the literature of decentralised competitive mechanisms applied to small scale DG. We discuss four case studies from the US. The US is one of the few countries where the actual competitive mechanisms for the procurement of distributed energy resources[5] are well-documented. The case studies refer to competitive mechanisms with a focus on small and medium size renewable generators. Based on the evaluation of the US experience, we identify and discuss the lessons from competitive mechanisms and the way DNOs in Great Britain – as an example of an EU country - may implement a similar approach while taking into account the EU third package mandate.

The structure of the paper is as follows. Section two describes the most common competitive mechanism practices for the procurement of renewable generation. Section three explores four different case studies from the US with a focus on competitive mechanisms. Section four discusses the main findings and lessons of the case studies and proposes the design elements of the competitive mechanism applicable to Great Britain which can also be replicated by other European countries following the EC third package rules. The last section sets the conclusions of this study.

2. Current Procurement Strategies for Distributed Energy Resources

This section introduces the most common practices for the procurement of distributed energy resources by electric utilities using competitive mechanisms. A description of the main opportunities and challenges that each approach offers is presented. Two categories of procurement methods have been identified: Request for Proposals (RFP) and auctions. The RFP is the category that applied most widely in the US. The Feed-in-Tariff (FIT) is also among the most popular schemes for allocating renewable generation capacity. Even though its advantages (e.g. guaranteed payment, certainty to generators, lower administrative costs) one of its main drawbacks is that FIT prices do not necessarily represent the most cost-efficient projects. This may have a negative impact on electricity customers. FIT prices are set administratively, thus the chance of overcompensation is high. An extended explanation of additional categories, including FIT, can be found at [7].

2.1 Requests for Proposal (RFP)

RFP is one of the main mechanisms in the US used to achieve a state level mandatory Renewable Portfolio Standard (RPS) in the promotion of renewable energy generation. RPS, a quota system support scheme, is the main regulatory instrument that promotes generation of electricity from renewable resources in the US. As of March 2013, 29 states have adopted RPS, 8 states and 2 territories have adopted renewable portfolio goals[6]. Other countries such as the UK, Belgium, Chile and Italy have also adopted this mechanism [8]. RFP involves a bidding process that can take different forms (e.g. pre-qualification following by single round of sealed bids and then selection

[5] Distributed energy resources is a broad concept that includes not only small scale off-grid power generation (distributed generation) but also energy storage and energy management.
[6] See: http://www.dsireusa.org/documents/summarymaps/RPS_map.pdf

based on "Least-cost/Best-Fit"[7] basis). Its design and requirements vary across states, and different renewable targets have been established which reflect their particular needs. RFP is usually associated with the procurement of renewable generation of large-scale generators. The bidding process may involve energy and capacity payments and the purchase of Renewable Energy Certificates (RECs). Some requirements also involve a combination of projects (technology neutral or specific) and the option of ownership by the electric utilities after their implementation.

The procurement process is generally managed by the electric utility or a group of electric utilities that operate within the same jurisdiction or the state government or local authorities. However, an independent evaluator may be required for the evaluation of offers. The periodicities of these competitions and the delivery time for the procured products also vary across states (from months to years). RFP encourages the selection of the most cost-efficient projects securing lower costs to ratepayers (bill payers). However, the option of under-bidding or over-bidding is also a possibility. Following [7], under-bidding is a choice due to the competitiveness nature of this approach and over-bidding also may occur if developers include in their offers transactions costs and a risk premium. However, the high transaction costs associated with this mechanism may limit the participation of small projects including those from independent generators and from local community initiatives. Among the countries that faced high transaction and administrative costs in energy auctions are Ireland (Alternative Energy Requirement – AER), France (EOLE Programme) and the UK (Non-Fossil Fuel Obligation - NFFO) [6].

The use of standard contracts, which are usually published in advance (by electric utilities, local authorities or independent evaluators) in the pro forma power purchase agreement (PPA), accelerates the evaluation of the different offers. The pro forma needs to be approved by the relevant regulatory authority before its publication. Skilled developers are usually the most representative bidders in this kind of competitive mechanism, this fact along with the oversight of the regulatory authority and the use of a standard RFP helps to reduce the contract failure rate. Even though the chances of contract failures are lower in comparison with other approaches, there is still a risk. For instance, one of the major problems that the NFFO scheme in the UK (a bidding mechanism that was replaced by the Renewables Obligation scheme) had was the absence of penalties when generators failed to installed the agreed capacity, along with other significant, but fixable, drawbacks that also involved delays in building a project [9]. A report from the California Energy Commission [10] shows this rate is around 30% regarding the long term RPS contracts (10 years or more), since the start of the RPS program. This rate increases to 40% if delayed contracts are considered[8].

2.2 Auctions

Similar to RFP, auctions are competitive mechanisms that are in search of the most cost-efficient projects and are generally subject to the same advantages and disadvantages already discussed in section 2.1. However, in contrast with RFP, auctions usually are more focused on small and medium

[7] The Least-cost best-fit is specific RPS statute applicable in California that helps to rank the selection of least cost and best fit renewable resources. Least cost bids are those with the lowest costs (direct and indirect including those for the integration of the resource and transmission investment) that fit the best to their system needs. See D.04-07-029 at http://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/38287.htm

[8] Data obtained from the Energy Commission's IOU contract database.

scale generators – in the US context. In addition, one of the main differences between RFP and auctions is that the RFP are subject to a set of non-price criteria and in auctions the selection of bids is mainly driven by price alone [7]. The evaluation of the four case studies confirms this statement. The transaction costs associated with this mechanism can be seen as a limitation to small sized generators; however the introduction of online auction platforms mitigates these costs.

The success of auctions is also subject to the existence of enough competition in the market and homogeneity. Competition depends on the number of players, on market concentration and the types of products to be offered and on regulation [8]. The stakeholder engagement is also a key point that can help with the success of an auction process. Well-informed bidders make the auction process much easier for all the parties involved. Workshops and seminars also provide the opportunity for small generators to ask for any clarification of the auction (regulatory, economics, technical) and the provision of training sessions (e.g. use of excel sheets for estimating the bidding price). The appointment of independent evaluators also helps.

Auctions also allow electric utilities to define the conditions of the procurement that reflect their particular needs. Auction designs vary and the selection of one or other option would depend on the conditions that better fit with the involved parties (e.g. bidders, electric firms, regulators). Similar to the RFP, the auction design is subject to many issues in terms of the type of auction (sealed-bid auction, clock auction), type of product (electricity and/or capacity contracts, certificates), centralised versus decentralised auctions, dedicated versus non- dedicated auctions.

In the US, Renewable Auction Mechanism (RAM) in California is the initiative that represents this kind of mechanism well. RAM allows the allocation of renewable generation projects from 3 to 20 MW by the three major IOUs in California. Further details regarding this initiative are given in Section 3.1. Brazil is also an interesting case study of procuring renewable and non-renewable generation open to all generator sizes. This is an example of a centralised auction in which distribution firms determine their future demands (for regulated customers) and aggregate them in a large block that represent their electricity requirements. A comparison between the installed capacity and associated costs regarding two different renewable energy support mechanisms (ProInfa[9] and renewable energy auctions) suggests that the cost of both mechanisms has been the same; however the auction scheme has delivered 20% more total capacity. In addition, the average energy cost showed a reduction of 25% when auctions were used [8]. Another interesting experience is in Peru where electric utilities are allowed to carry out the auctions (or to make joint auctions) for supplying regulated customers. However, the auction process is subject to strong regulatory supervision and to the application of a price cap (set by the energy regulator). Chile has launched an auction scheme which allows generators (wind and solar PV) to compete for supplying electricity to local electric utilities (regulated customers). The National Energy Commission has recently approved the terms of the new energy auctions which targets around 1,000 GWh for 2016 and 2017, 6,000 GWh for 2018 and 5,000 GWh for 2019[10]. For further details about auction mechanisms in different countries see [5,6].

[9] Proinfa, created in 2002, was the first scheme that supported Renewable Energy Sources in Brazil.
[10] See: http://renewables.seenews.com/news/chile-expects-wind-solar-projects-at-next-energy-auctions-report-438648

3. US Practice for the Procurement of Distributed Energy Resources by Electric Utilities: Cases studies from California, Colorado, Oregon and New York

Four case studies from the US have been selected. The four cases refer to wholesale DG (WDG) which relates mainly to the sale of energy to the electric utility. Our selection is based on the extensive experience that the US has in the procurement of renewable and non-renewable distributed energy resources conducting by electric utilities (decentralised auctions). We have focused only on competitive solicitations across the states of California, Colorado, Oregon and New York that target small and medium sized generators (with a minimum project size of 2 MW). We explore solicitations from different jurisdictions due to the diversity of programmes/initiatives that the respective energy regulators (represented by Public Utilities Commissions) mandate in order to increase production of energy from renewable energy sources. The four states are among the ones with the highest rates for their RPS. The initiatives allow competition between technologies within the same category (i.e. wind versus solar PV) and between different technologies (i.e. non-renewable versus renewable). In addition, one of the initiatives is a simplified market- based procurement mechanism, while the other three relate to the well-known RFP approach. This study concentrates on the competitive solicitations carry out by Southern California Edison (Renewable Auction Mechanism), Public Service Company of Colorado (RFP), Portland General Electric Company (RFP) and Long Island Power Authority (RFP). A detailed comparison is made in Appendix 1. Some figures regarding these electric utilities are shown in Table 1, which also includes as a European reference, figures from UK Power Networks, the largest DNO in Great Britain.

[Insert Table 1 about here]

3.1 Renewable Auction Mechanism (RAM) in California

In December 2010, the Californian Public Utilities Commission (CPUC) adopted a simplified market-based procurement mechanism, the Renewable Auction Mechanism (RAM), in order to procure renewable energy from projects with a capacity between 3 and 20 MW. The initial starting capacity was 1 MW but it was extended to 3 MW later. The three Investor-Owned Utilities (IOUs) are required to implement this programme in their respective service territories. A total capacity of 1,330 MW has to be procured over a two-year period by competitive auctions. Two auctions per year (one every six months) were initially required, however an additional auction (RAM 5) was authorised in order to meet the authorised RAM capacity allocation (up to 1,330 MW) and to replace any executed RAM contract which may fail or may be terminated. The RAM 5 auction took June 27, 2014 and the total capacity to be procured by the IOUs is 464.7 MW. Table 2 shows the capacity bid and contracted and also the number of contracts regarding each IOU for the latest four auctions. Figures suggest that 75.6% of the total capacity allocated to the IOUs (1,330 MW) has already been contracted in the first four auctions.

[Insert Table 2 about here]

According to [13], offer prices have shown a download trend from RAM 1 to RAM 4. The weighted average price (post-time-of-delivery adjusted) in relation to the first two auctions was less than US$90/MWh (excluding transmission costs) and in the third auction was less than US$80/MWh [15]. Auctions by each utility are held simultaneously in order to promote competition across bidders.

Individual or multiple offers can be submitted. RAM allows three types of products. The products are: (1) baseload – geothermal, biomass, (2) peaking as-available – solar PV, and (3) non-peaking as available – wind, hydro; and can accommodate full buy/sell or excess sales options. IOUs have set specific targets for each type of product based on their portfolio needs. Solar PV is the one with the highest share of total capacity. SCE, the biggest IOU, has already procured a total of 529.3 MW in the first four auctions.

A pro forma PPA is available before the due date of the bidding and has to be approved by the CPUC. IOUs are responsible for elaborating their own pro forma based on the mandated RAM framework [16]. In relation to contractual terms and conditions, generators can select from three options for contract length: 10, 15 or 20 years. However, the length can be extended in the presence of banked curtailed energy (classed as curtailed return term). The banked energy curtailed refers to the cumulative quantity in any Term Year of curtailed product that exceeds the curtailment cap and for which it is paid the product price. For further details about the payments given to generators associated with the curtailment cap see [17]. The commercial operation deadline has been set in 24 months from the date of the CPUC approval.

Generators can bid their projects based on Energy Only (EO) or Full Capacity Deliverability Status (FCDS) interconnection. The last one is eligible to provide Resource Adequacy (RA) which represents the ability of the electric system to ensure adequate resources as required for reliability in the future. Interactive maps with relevant information about the status of the distribution network are also available for potential bidders free of charge.

Regarding price, the offer price includes not only the product price but also any transmission upgrade costs required for the connection. This means that the evaluated price includes all the costs to build, interconnect and operate the generating facility for a specific period. If a generator bids as FCDS, then the RA benefits are estimated by the utility and are taken into account for elaborating the ranking (per type of product). The ranking is done by the IOUs based on a CPUC approved ranking methodology. In terms of the evaluation process, an Independent Evaluator (IE) is required.

3.2 Renewable Resources Request for Proposal - Public Service Company of Colorado (All-Source Solicitation process)

The Public Service Company of Colorado (PSCo), an Xcel Energy subsidiary, is the largest IOU in Colorado. PSCo retail electricity and gas sales represent 60% and 70% respectively of the total sales in Colorado [18].

The 2013 All-Source Solicitation process was proposed in the PSCo Electric Resource Plan (ERP)[19]. Four RFPs have been included in this Solicitation: (1) Dispatchable Resources RFP, (2) Renewable Resources RFP, (3) Semi-Dispatchable Renewable Capacity Resources RFP and (4) Production Tax Credit – Wind Resources RFP. All these are issued simultaneously by PSCo. The purpose of the All-Source Solicitation process is to acquire enough resources in order to meet the utility's forecasted electric demand (plus a 16.3% planning reserve) over the 7-year Resource Acquisition Period –RAP - (2012-2018). The total capacity to be filled is around 250 MW over this period. This assumes the continued operation of the Arapahoe 4 (109 MW summer capacity) and Cherokee 4 (352 MW summer capacity) units on natural gas. However, without this assumption the required capacity would be around 719 MW by 2018 [20].

Only with some exceptions, the All Source Solicitation RFPs across the different categories are very similar. This mechanism allows, along with the purchase of energy, the option of acquiring the generation facility during or at the end of the contract term. Additionally, proposals shall be for a new, existing or to-be-built resource. The nameplate capacity of the project must be greater than or equal to 10 MW. This value also helps to restrict the number of unwarranted number of bid submissions [19]. Figure 1 depicts the number of bids received and the nameplate capacity per type of product.

[Insert Figure 1 about here]

Regarding contractual terms, PSCo required developers to start commercial operation prior to May 1, 2018 In relation to the length of contract, the bidders may select between short-term bids or long-term bids. Short-term bids attract the attention of existing facilities, and it is expected that these are in a position to offer a lower bid in comparison with the new or to-be-built generation facilities. Bidders, for a single bid fee, may propose up to two contract term lengths for each proposal (short-term and long-term with same commercial operation date). A fixed non-refundable fee has been set for each proposal submitted. The RFP Rules also required the appointment of an Independent Evaluator (IE).The evaluation process includes an assessment of non-economic and economic criteria and involves a multi-stage process. Only those proposals that meet the minimum requirements are eligible for evaluation. The non-economic criteria involve different factors, among these are financial strength, development, construction and operational experience, etc. In terms of the economic evaluation, this has two stages. In the first one, the "all-in" levelised cost of energy (LEC) is estimated. LEC should reflect the proposed price; any cost associated with any new or upgraded interconnection facilities and network upgrade costs, and any applicable resource integration costs. PSCo will incur the costs of upgrading or reinforcing the utility's transmission system beyond the Point of Delivery. These costs are usually socialised. Figure 2 illustrates the levelised prices of wind and solar PV generation units[11].

[Insert Figure 2 about here]

The second stage involves a computer modelling (Strategist™) and portfolio development. The aim of this stage is to capture the interaction between a bid or group of bids (portfolio) with the utility's existing generation resources to serve the system needs over time. The computer model is used to develop portfolios that minimise the net present value of revenue requirements over the forty year planning period (i.e. 2011-2050) [19]. Results from the computer-based modelling suggested a core set of bids across varying technologies (preferred portfolio) that amounts to 809 MW of firm capacity comprised of existing gas-fired (25%), existing natural gas (35%), new solar PV (13%) and wind (27%) generation units. This considers the continued operation of Cherokee 4 generation unit.

3.3 Renewable Energy Resources Request for Proposal – Portland General Electric Company

[11] Bid information disclosure is required by the RFP Rules after the completion of the competitive acquisition process (i.e. after the execution of all PPAs) [20]. Data was provided by PSCo.

Portland General Electric Company (PGE), a vertically-integrated electric utility, is the largest IOU in Oregon in terms of retail electricity sales (36%) and serves around 0.8m customers. In October 2012, PGE issued the Renewable Energy Resource RFP [22] as a response to the resource needs for future demand established in the 2009 Integrated Resource Plan (IRP). The Action Plan involved a mix of new energy efficiency, renewable resources and efficient natural gas generation for energy and capacity needs [23].

In the RFP, PGE was seeking to acquire around 101 MWa (average dispatch capacity over year) of viable renewable energy resources including, but not limited to biomass, wind, geothermal and solar, which must meet the requirements of Oregon's RPS. Two kinds of products were defined: (1) firm physical energy purchase – with a minimum of 10 MW;; and (2) ownership position in a renewable energy resource, which allowed different mechanisms for the acquisition of existing plants, projects, or hybrid structures. The start date of operation has been set not earlier than January 2013 and no later than 2017 with a preference by the end of 2015. The length of the contract was for a minimum of 10 years with a target of 20+ years. In addition, a non-refundable bid fee was mandated in order to encourage high quality bids and bidders. The same bid fee applied to a base proposal along with two alternatives proposals for the same resource.

There were two kinds of bids under this RFP: (1) a benchmark bid and (2) a third party bid. Regarding the first one, this refers to site-specific and self-built proposals (benchmark resources) presented by PGE and may represent a potential cost-based alternative for customers. The second one represents proposals received from third parties. If the bidder did not provide adequate performance assurance, ancillary services or integration services, PGE retained the right to include in the bid price the costs to PGE of services. Integration costs regarding wind and solar have been estimated in US$9.15/MWh (2014 prices) and in US$6.35/MWh (2009 prices) respectively.

In terms of the evaluation process, bids were evaluated using a two-step process: (1) assessment of pre-qualifications and (2) evaluation of scoring factors. In the first one the evaluation took into account pre-established qualifying criteria. In the second one, PGE scored bids that have met the pre-qualification standards using non-price factors that comprise 40% of the evaluation criteria and price factors the other 60%.

The selection of an initial shortlist of bids was made based on price and non-price factors. The final shortlist of bids was based on the results of the portfolio modelling. On March 11, 2013 the IE completed the evaluation of bids and provided to the OPUC the final assessment of the bid scoring and the final shortlist selection, comprised of seven projects [24]. PGE selected the Lower Snake River Phase 2 wind farm[12] (with a nameplate capacity of 266.8 MW), which had the lowest cost and lowest risk project for customers and the utility [25]. Table 3 shows the winner project characteristics.

[Insert Table 3 about here]

3.4 Renewable Capacity and Energy Requests for Proposals – Long Island Power Authority

[12] PGE changed the name to Tucannon River Wind Farm.

The Long Island Power Authority (LIPA) is a municipal electric provider that owns the electric transmission and distribution system on Long Island (New York) and provides electricity to around 1.1m customers in Nassau, Suffolk and the Rockaway Peninsula (Queens). LIPA is the second largest municipal electric utility in the US in terms of electric revenues and the third largest in terms of number of customers. In this RFP, LIPA was looking for proposals for 280 MW of new, on-island, renewable capacity and energy [27]. Proposal submissions were expected by end of March 2014. Among the technologies accepted are solar PV, wind, biomass, fuel cells, hydroelectric, tidal and wave energy, others. The minimum project size is 2 MW and the maximum is 280 MW. The maximum capacity awarded to fuel-based renewables in this RFP is 40 MW. Developers or generators must specify the type of technology and the estimated average annual/hourly of net energy production to be delivered to LIPA at the interconnection point. The RFP requires the execution of a 20-year PPA with LIPA. Similar to the rest of the case studies, a draft of the PPA is also available at the utility's website. An independent evaluator is not involved in this competitive solicitation. LIPA is in charge of managing and evaluating the proposal and all the related documents posted in its website are accessible to anyone without the need of registering. Similar to the previous case studies, there is a submission fee which depends on the project size. The fee is a non-refundable but it can be returned only if the proposal is not submitted by the proposal submission deadline. In addition, this RFP does not offer the option of purchasing ownership (LIPA only provides transmission and distribution services).

Regarding pricing, LIPA is asking for a firm price (price is not open to negotiation). Price is all-inclusive (including fuel price in US$/MWh, if applicable). The costs associated with attachment facilities and system upgrades constructed and owned by LIPA should be reimbursed by respondents. These costs may be recovered by respondents through PPA charges.

Proposals are evaluated based on two criteria: (1) the quantitative evaluation criteria and (2) the qualitative evaluation criteria. The quantitative evaluation considers the all-in costs of the proposal. It includes the PPA charges (including fuel costs, if applicable), transmission reinforcement costs, system impacts (e.g. impact on operating reserve requirements, transmission transfer capability, NYISO capacity requirements, ancillary services, etc.), beneficial system impacts if Commercial Operation Date (COD) is met in advance, among others. The qualitative criteria include different factors such as site control and characteristics, community acceptance, proposal quality, etc. The RFP does not specify any specific weight for these criteria.

Based on the RFP schedule, the selection of the proposals and the execution of contracts are planned by the end of December 2014 and by the first quarter of 2016 respectively. This means that LIPA will not be signing contracts with developers until 2016 even if the project is awarded in December 2014. This is explained by the fact that according to the New York Public Service Law, a PPA can be effective only after receiving a certificate of environmental compatibility and public need from the New York State Board on Electric Generation Siting and the Environment.

4. Discussion of cases studies, lessons and proposal for a competitive mechanism design

The case studies refer to vertically-integrated utilities which are allowed to produce and procure distribution energy resources with a focus on DG by competitive mechanisms regardless of the firm size. The capacity allocated to each competition varies across the four cases. In general, the size of the capacity (total capacity or product capacity) is in line with the RPS targets that the Public Utilities Commissions have set in their respective jurisdictions. Three out of four of the cases studies refer to a more sophisticated auction process (RFP) subject to qualitative and quantitative evaluation criteria, including the use of computer modelling in order to develop and identify the most cost-efficient portfolio (especially when the ownership option is offered). In comparison with the auction schemes, the scope of RFP is wider and may include a group of renewable energy resources, a specific renewable energy resource or a combination of both renewable and non-renewable energy resources.

The evaluation criteria across the four case studies mandated in general the selection of those projects with the lowest prices (US$/MWh) after the inclusion of additional costs such as transmission upgrade costs (memo: transmission voltages start at 66kV in the US), O&M, ancillary services, and some other costs. The selection of those projects with the lowest energy prices or most cost-efficient portfolios is supported by the fact that electric utilities are entitled to purchase electricity in order to meet the customer demand. Even though the transmission costs are usually socialised among all the grid users (or initially born by generators which are refunded later on), it makes sense to add these costs to the total offer. This encourages the selection and implementation of the least expensive projects not only in terms of generation costs but also in terms of connection costs (sole use assets and reinforcement costs, if applicable). The bid price is usually non-negotiable in order to guarantee a fair treatment among all bidders and to simplify the process; however, negotiations were allowed by PGE only on the top-rated bid. Following [25], this encourages bidders to submit their best offers and to compare resources and select the short list based on the project's true costs. Excluding RAM, all solicitations have asked for a bid evaluation fee. This helps to reduce the number of speculative offers and to increase the chance of better evaluations to be carried out by the Independent Evaluator (IE) / electric utilities. Deposits have been also required by electric utilities (against development and performance assurance). As previously mentioned, the absence of penalties was one of the major problems of the Non Fossil Fuel Obligations scheme in the UK, which was based on a bidding mechanism [9].

4.1 Applying a DG procurement auction in Europe

The RAM and RFPs schemes analysed in this study represent two different well-developed competitive mechanisms that have contributed to the selection of the most cost-efficient energy projects. Results from consecutive auctions with similar products (e.g. RAM), have shown that the average bid price has decreased over time regarding the first four auctions. The two schemes also represent well-documented decentralised auction mechanisms carried out by electric utilities. Most of the relevant documentation is on the utilities and IE websites. Even though, these have been applied by vertically-integrated electric firms, we think that a similar auction design can be put in practice by the DSOs from Europe taking into consideration the EC third energy package. As already mentioned, DSOs with more than 100,000 customers, which are around 253 [2], are not allowed to purchase electricity. However, this fact does not prevent these DSOs from implementing similar competitive mechanisms. One way is to allow DSOs to allocate only generation capacity, where the cost of connection is bid. The other way is by conducting a competitive mechanism in association with a local supplier where the bid price will include not only the connection costs but also the purchase of energy by a third party supplier (which could be a licensed electricity supplier or a national government energy procurement authority). Thus the difference between our case studies and this specific case is the nature of the counterparty to the contract (three instead of two). For vertically integrated DSOs with less than 100,000 customers, which are around 2,347 [2], a similar approach such as the RAM can be followed, which represents the most straightforward approach. In agreement with the rules given by the energy Public Utilities Commissions in relation to the auction mechanisms, national energy regulators from the member states should be involved in promoting this kind of initiative not only as trials but as business as usual. The implementation of competitive mechanisms is also in line with the aim of the EC third package, especially in keeping prices as low as possible.

Competitive mechanisms, not only help to the selection of the most cost-efficient projects and depending on their periodicity (i.e. two auctions every year), might also help the DSOs to manage the increase in the number of DG connection enquiries and related issues (i.e. large number of speculative connections and low rate of connection offer acceptance). For instance in Great Britain DNOs are required to connect DG facilities on a first-come first-serve basis and to facilitate competition in supply by allowing licensed suppliers to use their distribution network for the transport of energy from the transmission system (or DG) to customers. UK Power Networks, the largest DNO in Great Britain, indicates that the number of DG connection enquiries has increased significantly, from 208 in 2008 to 6,879 in 2013. Most part of enquiries refers to photovoltaic technology (87.8%) followed by wind (6.2%). Another GB DNO, Northern Powergrid (NPG), has also shown a large increase in the number of enquiries, from 1,300 in 2010 to 5,300 in 2012 [28]. This demonstrates the challenge that DNOs are facing in providing quotes within the timelines set in the Guarantee Standards of Practice (GSoP). UK Power Networks is also the DNO with the lowest rate of acceptance of DG connections, 5.5% and 7% in 2012 and 2013 respectively. Scottish Power has a rate above 80% and Scottish and Southern Energy a rate of 40% [3]. In other European countries, a similar behaviour would be expected, especially in those countries where renewable energy sources have priority connection to the grid system. Among these countries are Germany, Italy, Portugal, Belgium and Spain [29].

4.2 A Proposal of Competitive Mechanism Design for Connection Only

Another option to accelerate lower cost connection in Europe, in the context of the third package, is to simply have an auction for connection to the DNO network. This takes existing subsidy regimes for renewable generation as given (e.g. the presence of a national FIT). An auction process is then used to allocate the available capacity for connection of new DG at a particular Point of Connection (POC). Each DG bids a maximum willingness to pay per MW of connected capacity, subject to a minimum value which covers the cost of connection. Scarce connection capacity can be allocated on the basis of the highest firm bids for connection at each POC. An example of such a competitive mechanism design elements applicable to the UK context[13] is shown in Table 4.

[Insert Table 4 about here]

[13] A related auction initiative has already been proposed by Northern Powergrid in the RIIO-ED1 Business Plan. The DNO has proposed the implementation of a reverse capacity auction for Demand Side Response via online [30].

In relation to the product, the process is open to any kind of technology (renewable or non-renewable). There is no specific requirement in terms of the generator size. This mainly will depend on the available capacity at each POC, pre-determined site, to be specified by the DNO. Regarding the counterparties, they would be the DNO and the DG customers and a connection agreement would be required. By contrast, if the energy price is also included in the bid price, a third party (e.g. suppliers, trading party, system operator) would be required because DNOs are not allowed to purchase energy from generators and a PPA would be also necessary [31]. In terms of the evaluation and selection criteria, and in agreement with the case studies analysed, we also recommend a set of pre-qualification criteria (without scoring) in order to select those generators with the highest chance of actually connecting. In the existence of network constraints, generators may be subject to the reduction of their generation output (curtailment).

There are different curtailment methods (called Principle of Access), among there are last in first out (LIFO), Pro Rata and Market-Based [17]. If a market-based approach is selected, an incentive to generators should be defined in the connection agreement[14]. Similar to the RAM scheme, we would suggest to carrying out 2 auctions per year and also to give preference to those projects that are able to connect within the two or three years of the connection agreement. The appointment of an independent evaluator provides more transparency to the bidding process, equal treatment among bidders, sets standard evaluation criteria, and provides equal access to relevant information and documents (online). We think the experience of SCE, PSCo and PGEC suggests an independent evaluator is a good idea. The collection of bid evaluation fees would reduce speculative DG connection proposals. We suggest a payment based on the nameplate capacity (£/MW) with the possibility of refund if generators place winning bids. Deposits (for development security and performance assurance) should also be required to increase the chance of selecting the DG customers that can meet their obligations to generate as set out in the connection agreement. We also observe that online submissions and the provision of relevant information (excel sheets, pro-forma contracts, interactive maps) that may facilitate the proposal submissions and evaluations.

Even though the example given is in relation to the UK electricity market, we believe that a similar approach can be replicated by other DSOs from Europe taking into consideration the third package rules. In terms of the auction methods, from the cases studies, a sealed non-negotiable bid is the method selected in the majority of cases with the option of negotiation in only one case. However, [6] suggest that for renewable auctions a hybrid approach composed of descending-clock phase (price discovery) followed by sealed-bid (for preventing collusion) is the most recommended. The advantages and disadvantages of these or additional methods are considered elsewhere. For further details about the different methods see [33].

5. Final Remarks

Four cases studies from California, Colorado, Oregon and New York have been selected in order to gain a better understanding of the way in which competitive mechanisms for the procurement of energy resources have been implemented and to explore different options for the application of competitive mechanisms for the acceleration of DG connections in a cost-efficient way. Public

[14] This study is only focused on the implementation of a competitive mechanism for allocating DG capacity. However, competitive mechanisms can also been applied to the management of generation output (curtailment). For further details about commercial models that cover different options of active management of DG see [32].

Utilities Commissions (which enforce the state-level regulation at distribution and transmission level) play an important role in the development of different competitive or non- competitive approaches that electric utilities have implemented to achieve the RPS targets for each jurisdiction. We have observed a similar behaviour across electric utilities (private and public) in the way in which competitive competitions such as RFP or auctions (e.g. RAM) are being managed.

One of the main advantages of competitive mechanisms, in comparison with those where the tariffs are set administratively (e.g. FIT), is the possibility given to the market to define the price; this is then translated into lower bid prices and lower costs to customers (by selecting the most cost-efficient energy projects). Transmission or distribution upgrades, if required, might impact importantly the bid price due to the increase in marginal transmission or distribution costs (e.g. when a generator is an out-state generator and/or the system cannot handle the new capacity due to system issues). In order to capture any additional costs and to make appropriate comparisons among competitors, the bid price should reflect the total costs/benefits (connection, reinforcement, additional services). The four case studies have followed the same pattern by suggesting the inclusion of all the related costs in the bid.

Even though the four experiences explored refer to vertically integrated electric utilities, the method can be applied to DSOs taking into consideration the EU third package rules. The example provided in relation to the auction design elements focused on the UK electricity context, by defining the bid price based only on the capacity required (£/MW). This approach can be applied to any DSO in Europe with more than 100,000 customers. However, suppliers could also run the auction process would be very similar to the one applied by the electric utilities from the US, where connection and energy are bid. For European DSOs with less than 100,000 customers and that are vertically integrated, a third party purchaser of the energy would not necessarily be required. In addition, well-designed competitive mechanisms would also help DSOs (such as those in the UK) to manage more efficiently issues related to DG connection enquiries (e.g. large number of speculative connections, low rate of connection offer acceptance).

Similar to the Public Utilities Commissions from the US, energy regulators in Europe would be very involved in the design of the new competitive mechanisms discussed in this paper. They already regulate national auction regimes and could readily oversee more decentralised competitive strategies that allow DSOs to manage more efficiently the increase of DG connections taking into account the EU third package rules.

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Appendix 1: Auction/RFPs Design - Comparison table

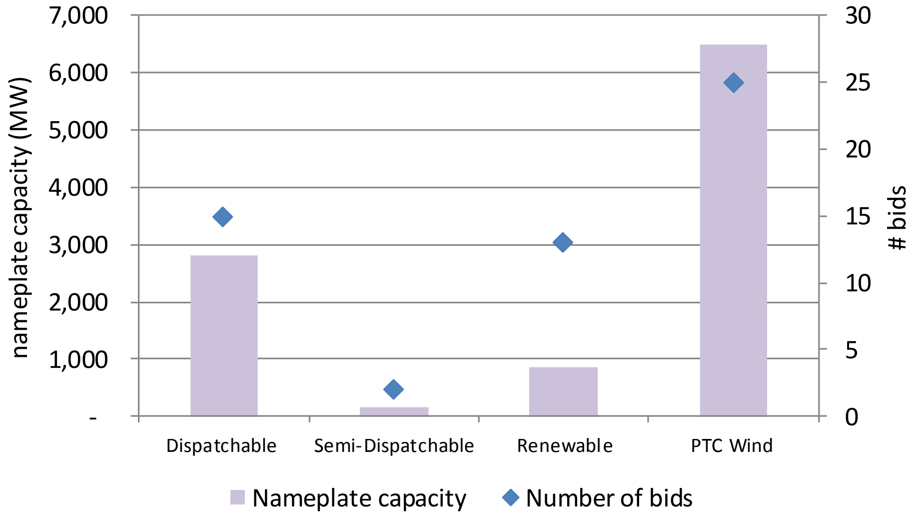
GENERAL				PRODUCT				CONTRACTUAL TERMS			
ty Name	Utility Activities	Regulatory framework	RFP Release	Technologies/type of products	Total capacity	Ownership	Capacity cap per project	Length of contract	Operation date	PPA Pro-Forma	Deposits
hern ornia on (IOU)	G, T, D	[16]	RAM 1: 19/09/2011 RAM 2: 30/04/2012 RAM 3: 15/11/2012 RAM 4: 16/05/2013	Eligible Renewable Resource (ERR). Products: (1) baseload, (2) non-peaking as available, (3) peaking as available. New or existing generating facility. Full Buy/Sell or Excess Sales options	1,330 MW (full programme) 529.3 MW (produred by SCE across all RAMs)	No option	Between 3 and 20 MW. In RAM4 - SCE the capacity cap per type of product has been set at: 15, 20 and 146 MW respectively	5, 10, 20 years. Extension may be an option (curtailed return term)	Within two years from the date of CPUC approval with maximum extension of 6 months	Yes, one for all products	(1) Development security - US$60/kW for as-available and US$ 90kW for baseload and (2) Performance assurance - 5% of expected total project revenues
ic ice pany of rado)	G, T, D	[19], Decision No. C13-0094	01/03/2013	Renewable and non-renewable. Acceptable renewable technologies are: wind, solar (with/without storage or fuel backup), hydro, biomass, recycled energy	Up to 250 MW (period 2012-2018) but for All-Source Solicitation (up to 719 MW, including production of the two existing natural gas plants)	Option to acquire the generation facility during or at the end of the contract term	Greater than or equal to 10 MW	Two contract terms: (1) short-term proposal and (2) long-term proposal. In summary between 1 and 25 years	Prior to May 1, 2018 (short-term bids), June 1, 2018 (long-term bids). Seven year resource acquisition period (2012-2018)	Yes, one per type of technology	N/A
land eral tric pany)	G,T, D	[23], OPUC competitive bidding guidelines	01/10/2012	Wind, solar, hydro, geothermal, biomass, biogas	Up to 101 MWa	Different mechanisms for the acquisition of existing plants, projects, or hybrid structures	Greater than or equal to 10 MW	Minimum 10 years, target 20+ years	Between 2013 and 2017	Yes, one for all products	Performance assurance. Amounts and methodology vary across the different stages (submission of bid, between contract execution and COD, after COD).
Island er ority nicipal ty)	T, D	[27], LIPA's 2010-2020 Elecrric Resource Plan	18/10/2013	Wind, solar PV, biomass, fuel-cells	Up to 280 MW	No option (LIPA is a transmission and distribution utility only)	From 2 MW to 280 MW (up to 40 MW to biomass and fuel-cells)	20 year contract	By 2018 at worst (around 5 years after the RFP release)	Yes, one for all products	N/A

Appendix 1: Auction/RFPs – Design Comparison table (*cont.)*

PRICES, BIDDING PROCESS AND EVALUATION				INTERCONNECTION (CONNECTION) AND OPERATIONAL ISSUES			
Selection criteria	Competition among technologies	Independent evaluator	Bid evaluation fee	Interconnection	Transmission upgrades	Network Maps	Curtailment cap (year)
n the lowest prices are selected. Total price is of: bid price (levelised) + network upgrade - resource adequacy (optional)	Different technologies (from different products) do not compete against one another due to the set of a capacity cap per type of product	Yes. Accion Group	No	Transmission and/or distribution grid. SCE requires complete System Impact Study or Phase I Interconnection study or passed Fast Tract Screen. Energy Only or Full Capacity Deliverability Status (FCDS) interconnection	Should be reflected in the offer These are refunded to generators over a five-year period	Yes (Google earth)	50 h - MWh (if this amount is exceed generators are compensated under specific conditions)
of projects that meet the resource needs in reliable ffective manner. Assessment of economic and non-criteria. The economic evaluation has to stages: (1) all-d cost of energy (LEC) and (2) computer modelling lio development. Rank each bid based on "all cost of energy" (LEC). Includes interconnection costs, pgrade costs, resource integration costs. Project to ct to the distribution grid will be credited with ne losses in their LEC calculations. The utility may esource integration costs (e.g. wind) based on udies.	All types of technologies (renewable and non-renewable) compete against one another. RFPs to be issued simultaneously: 2013 Dispatchable Resources RFP, 2013 Renewable Resources RFP, 2013 Semi-dispatchable renewable capacity resources RFP	Yes	US$ 10,000 (per proposal submitted). Non-refundable	Transmission and/or distribution grid. PSCo estimates the interconnection requirement costs if the bidder does not have an interconnection agreement or interconnection queue position	Should be reflected in the offer Cost of transmission upgrade to be incurred by utility only with certificate of public convenience	N/A	Curtailment assumptions included in the computer modelling (Strategist). The RFP does not specify any curtailment cap
approach: (1) assessment of pre-qualifications and ion of scoring factors. In the last one PGE scores bids ed) based on: Pricing (60%) and Non-Pricing (40%)	Yes but from the same category (renewables only)	Yes. Accion Group	US$ 100/MW. Maximum US$ 10,000	Transmission grid	Transmission service costs may be added to the price (ancillary services, losses, wheeling) and any other incremental costs for transmission or distribution system upgrades required to deliver the energy to the utility's load	N/A	N/A
ation criteria: (1) quantitative and (2) qualitative. In e quantitive evaluation, pricing are all-inclusive the cost of fuel, if applicable)	Yes but from the same category (renewables only)	No	US$ 5,000 (below 20 MW), US$ 20,000 (20 MW or more) Refundable only if the proposal is not submitted	Transmission and/or distribution grid	Should be reflected in the offer	N/A	N/A

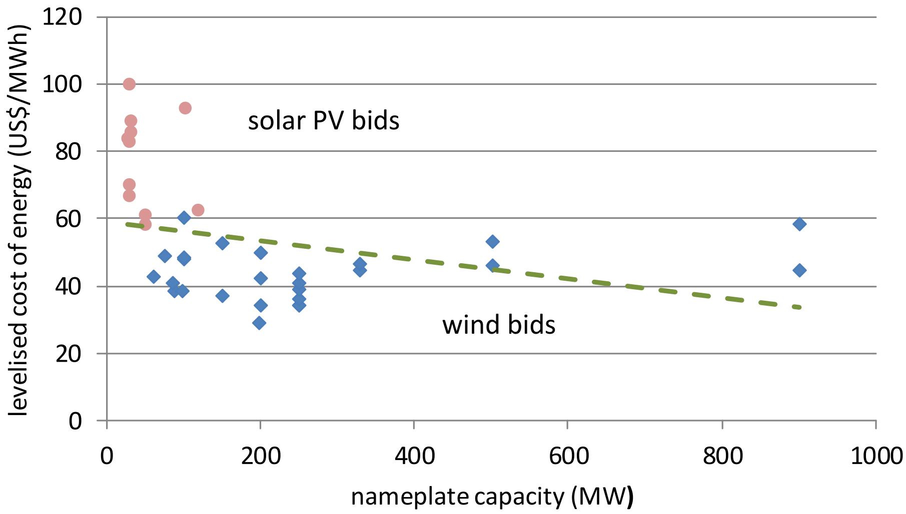
Figures

Figure 1: Aggregated bidders' nameplate capacity and number of bids



Source: [21]

Figure 2: Levelised Price - wind and solar PV only



Source: Data provided by PSCo.

Tables

Table 1: Electric Utilities' Characteristics

Company name	State	Customers (m)	Service territory (square mile)	Lines (miles)
Southern California Edison	California	4.9	50,000	103,000 (distribution lines) 12,000 (transmission lines)
Public Service Company of Colorado	Colorado	1.4	32,000	10,000 (distribution lines) 4,000 (transmission lines)
Portland General Electric Company	Oregon	0.8	4,000	25,000 (distribution and transmission lines)
Long Island Power Authority	New York	1.1	1,230	8,950 (overhead), 4,661 (underground)
UK Power Networks	East of England, South East and London	8.1	11,261	Only distribution: 28,583 (overhead) 85,749 (underground)

Sources: Companies's websites.

Table 2: Offers (capacity) and number of contracts for each IOU under the RAM

Utility	Total capacity allocated to each IOU (MW)	RAM 1 (Nov-11)			RAM 2 (May-12)			RAM 3 (Dec-12)			RAM 4 (Jun-13)		
		Capacity (MW)		#	Capacity (MW)		#	Capacity (MW)		#	Capacity (MW)		#
		Bid	contracted	contracts	Bid	contracted	contracts	Bid	contracted	contracts	Bid	contracted	contracts
SCE	754.4	1,260	67	7	2,133	97	6	1,928	201.5	13	2,021	163.8	10
PG&E	420.9	1,537	62.7	4	1,678	120.1	7	1,444	115	6	1,546	73.3	5
SDG&E	154.7	221	15	2	719	22.9	2	1,162	41.7	4	1,179	25.5	4
Total	1,330	3,018	144.7	13	4,530	240	15	4,534	358.2	23	4,746	262.6	19

Source: [11,12,13,14]

Table 3: Summary of bid winner – Lower Snake River Phase 2 Wind Farm

Project Name	*Lower Snake River Phase II*	**Project Costs (US$ m)**	
Number of turbines	*116*	Capex	*500*
Nameplate capacity/t	*2.3 MW*	Opex	*7.5*
Turbine manufacturer	*Siemens*	Insurances and A&G costs	*0.4*
Capacity factor	*36.80%*	Net variable power costs	*-22.3*
Ownership option	*Yes*	Depreciation (30 year)	*23.7*
Project lifetime	*20 years*	Property taxes	*6.9*
Initial operation	*first half of 2015*	Production Tax Credits	*-19.8*
Interconnection	*At transmission level (230 kV)*	**Net revenue requirement (US$ m)**	*40.4*

Source: [25, 26]. Costs and revenues updated to July 2014.

Table 4: Competitive Mechanism Auction Design

Concept	Competitive Mechanism
Product	Only DG connections All technologies (renewable and non-renewable) Generator size: subject to the capacity estimated at each Point of Connection (POC)

Counterparties	DG and DNO
Evaluation/selection criteria	Based on pre-qualification criteria and connection cost (£/MW) Highest offers (connect now) or bids are the ones selected first (subject to available capacity at POC) Operational date: no more than 2/3 years
Curtailment [1/]	Methods: LIFO/Pro Rata (FPP), no compensation In case of Market-based (compensation schemes/incentives) If generators are part of the BM, they may be compensated in case of curtailment
Number of auctions/year	2
Independent evaluator	Yes
Evaluation fee	Yes (£/MW) with option of refund to those that bid at least once (but are no winners) Online payment
Deposits	Yes (development security, performance assurance)
Submission	Proposal to be submitted online
Online material/requirements	Excel sheet: As reference for estimation of potential revenues Pro Forma Connection Agreement Interactive network connection map with potential POCs Documentation: Specifications of minimum documentation to be provided by the respondents to the DNO

[1/] There are different methods for reducing generation output: LIFO (last-in first-out: the last on the list is the first to be curtailed), Pro rata (curtailment is equally allocated among all generators), Market-based (generators compete to be curtailed by offering a price based on market mechanism). For further details see [17].