Applications of Information Policy Principles from Auction Theory in the Deregulated Electricity Market

by

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Abstract

Deregulation and restructuring in the energy industry have forced electric utilities that once owned their own generation in a vertically integrated environment into a paradigm where they are securing power for their customers from third party suppliers. Competitive solicitations or requests for proposal (RFPs) for energy and capacity have become prominent vehicles for utilities to secure their power needs from independent power producers (IPPs) and other third-party suppliers in the US and abroad. These are very similar in many respects to sealed bid auctions used in other industries, where qualified bidders submit bids that are only seen by the entity soliciting (e.g., the utility or auctioneer).

The success of an RFP is highly dependent on its design components. Information dissemination protocols are just starting to be recognized as a pivotal element in the design of these competitive solicitation processes. While much theoretical work has been done on the proper application of information theory to auctions in other markets and industries, little of this work has focused on these types of electricity markets. This paper outlines the theoretical principles regarding information policies, explains why additional information can improve competitive solicitations for generation by helping to secure the optimal price, and discusses how utilities can apply them to their energy and capacity RFPs.

1 Introduction

As deregulation and restructuring continue to take hold in jurisdictions across the US and worldwide in the energy industry, electric utilities that once owned their own generation in a vertically integrated environment are finding themselves in a paradigm where they are securing power for their customers from third party suppliers. Competitive solicitations, known more generally in North America as requests for proposal (RFPs) or requests for offers (RFOs) for energy and capacity – both short term and long term – have become prominent vehicles for electric utilities to secure their power needs from independent power producers (IPPs) and other third-party suppliers. These are very similar – in many respects – to sealed

bid auctions used in other industries.[1] The RFP process – or competitive tendering as it is referred to in other parts of the world – has in fact become a fairly common tool for procurement of energy, capacity, ancillary services, and other related products (like renewable energy credits and transmission-related rights) in the electricity sector. An RFP allows a buyer, in the case of the utility, to create a temporary "market" environment where multiple sellers compete against each other to provide the product or service being solicited. The soliciting utility can analyze multiple bids simultaneously and select the bid or bids that meet its objectives. With such competition, and assuming a fair and efficient process, the buyer is assured that he can acquire the product or service based on the lowest possible competitive price, and the sellers are assured that the lowest cost supplier will be awarded a contract. The contract will document the supplier's obligation and commitment to provide the utility with the stated product (e.g., electricity) for the stated period of time (e.g., for the next 12 months or next 10 years) and at the stated terms and conditions.

Typically in an RFP, only the utility soliciting (and in some cases an independent monitor or the regulator) gets to review the bids submitted by potential suppliers. This is the primary reason that RFPs are characterized as "sealed bid" auction processes. Some utilities are in fact experimenting with open, multi-round auction formats, for the procurement of some energy products. The success of any auction, including an RFP, is highly dependent on its design components, such as the degree of flexibility in determining what qualifies as a winning bid (for example, in government auctions of assets, non-pecuniary benefits to the state may be considered), whether or not the issuer will engage in *ex post* negotiations with winners, and the level of transparency among competing bidders (who else is participating, what their respective bids are, etc). Information dissemination protocols are just starting to be recognized as a pivotal element in the design of these solicitation processes. Information dissemination protocols attempt to lay out the methodology by which information should be released in order to achieve an optimal outcome. Protocols may describe what information should be released, to whom, in what context and by what method, as well as when and in what order.

The theoretical work on information policies for common value auctions is most appropriate for analysis of RFPs for electricity and related products. A common value auction is one where if all bidders hold the same information, they will set the value at which they sell their product equally. Procurement of energy and related products can be thought of as a common value auction because of the nature of the commodity and market mechanisms.

The energy and capacity that the utility acquires through an RFP can be used by the utility to meet its load obligations or re-sold at any point in the future prior to consumption (indeed, utilities constantly arbitrage over time their portfolio of commitments, contracts, and hedges). This re-sale condition is one element that suggests that the theory of common value auctions is applicable. In addition, there are a lot of common uncertainties and risks regarding the future market value of electricity, capacity and related products, which each individual bidder in an RFP may have private conjectures about. The value of the commitments that the utility is

[1] Milgrom, Paul Putting Auction Theory to Work (Cambridge University Press) 2004, pg. 211-212.

buying from the bidder (supplier) in an RFP is based on the market value of electricity in the future. And the purchase and sale of electricity and capacity (as well as other energy-related products) generally could be viewed as occurring in a market where there is a single, standardized product (the electron that represents that "MW" of power, although some will argue that congestion issues may reduce fungibility of electrons). Moreover, in almost all markets for electricity around the world (even where there is substantial or only bilateral trading), there is an effective market clearing price for electricity based on the bid of the marginal supplier needed to meet system demand. That marginal supplier and demand may change each hour, or even each minute, but nevertheless at a single point in time, all operating resources are being paid on the basis of one price. Therefore, suppliers' bids are not solely a function of their own costs because the market effectively settles on or converges to a single market-clearing price for all units of electricity transacted at any point in time.

This implies that electricity is a product that has a common value basis.[2] This characterization is important to keep in mind when considering whether information release could resolve common uncertainties of bidders and therefore improve competitive results.

Leaving theory aside for the moment, conventional thinking in the utility sector has typically resulted in very limited information disclosure by the utility running the RFP. Utilities tend to be protective of the various methods, inputs, forecasts and projections they use internally to develop their market valuation, which then guides the bid evaluation process. Utilities may fear that their forecasting and analytical approach, if made public, could be discredited. They may also worry they would be at a disadvantage should they find themselves competing directly with a bidder in the future under a different context (as these are "repeated" markets with various dimensions, a supplier can become a buyer in the future). Finally, there is a general concern that bidders may use information provided to take advantage of the utility soliciting offers by pricing in a non-competitive manner. For example, if a utility publishes their own opportunity cost for securing supplies through other means, bidders may target that opportunity cost when they make their offer, instead of their own expectations and marginal costs. This concern would only be valid if there is truly an insufficient level of competition. If there is sufficient competition, suppliers will bid based on their marginal cost (which may not necessarily be their physical production cost, but should represent their marginal opportunity cost), even if they know the buyer's reference purchase price, because they can do no better by bidding below their costs (why take on a commitment that is unprofitable?) or bidding above their costs (they may risk not being selected at all because of more competitive bids from other suppliers). In our experience consulting on these matters, we have observed that utilities may not be in a position to accurately estimate a priori the level of competition in an RFP process, or may simply be naturally inclined to assume that competition is lacking. This position creates a general unwillingness to provide anything but the minimum set of information to bidders.

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[2] A common value is one that is known by all interested parties (here, the bidders). This may be contrasted with private value, where each bidder knows their own valuation of the good in question, but not the value that other bidders assign to this same good.

In fact, both theory and experience from competitive solicitations involving the gas and oil sectors in the energy industry suggests that additional information about the soliciting entity's views on the economic value of the product being sought could be helpful in motivating competition amongst the bidders. While much theoretical work has been done on the proper application of information theory to auctions in other markets, little of this work has focused on applications of the theory to emerging competitive solicitations and auction processes in electricity markets.[3]

This objective of this paper is to present the theoretical principles regarding information policies, and then suggest, through case studies, why and what type of additional information could improve competitive solicitations in the electricity sector and aid utilities in securing the most efficient price in such RFP processes.

2 Theory

In auction theory, auction mechanisms and equilibrium outcomes are distinguished by the type of information that participants have access to regarding the value of the product being transacted: public information and private information. Public information is available to all parties, and private information is available to only a limited number of parties or one single party.

Information dissemination that reduces private information is generally efficiency-enhancing and profit-enhancing for the buyers (i.e., theory hypothesizes that such information returns prices to pre-"market failure" levels). This is especially the case if the information revealed by the buyers to all suppliers substitutes for the "private information" developed by certain suppliers and/or reduces uncertainties. Such information release then catalyzes more aggressive competition among bidders. Increasing access to information gives bidders (i.e., suppliers) more confidence that their valuation is correct, letting them bid more aggressively to beat out the competition.[4]

Auction theory establishes a number of conditions which, if met, indicate that the price the auction arrives at is efficient – that is, the price is an accurate assessment of the market value of the product being transacted. Paul Klemperer summarized these conditions as follows: "What really matters in auction design are the same issues that any industry regulator would recognise as key concerns: discouraging collusive, entry-deterring and predatory behaviour."[5] An efficient procurement process has a number of desirable characteristics: it allocates transactions to the lowest cost suppliers, it provides buyers with the lowest available prices,

[3] Economists have applied the principles of auction theory to many questions, including wage determination (see Margaret Stevens "Labour Contracts and Efficiency in On-the-Job Training" Economic Journal 1994), political economy (Feddersen and Pesendorfer "The Swing Voter's Curse" American Economic Review 1996), and takeover battles (Bulow, Huang, and Klemperer "Toeholds and Takeovers" Journal of Political Economy 1999). Indeed, electricity markets have been specifically identified as auction markets in numerous academic publications.

[4] Bulow, Jeremy and Paul Klemperer "Prices and the Winner's Curse" Rand Journal of Economics 2002.

[5] Klemperer, Paul "What Really Matters in Auction Design" Journal of Economic Perspectives 2002, pg. 169-189.

and the prices themselves account for all the information available in the market. Thus, the ability of an auction market to incorporate all the available information has serious implications for the efficiency of the market outcome and also attainable equilibrium between buyers and sellers.

To understand how the availability information may affect the outcome of an auction, it will help to have a better picture of how bidders approach the auction process. Suppliers propose bids based on their perceived value of the product in question, which may be based in turn on some combination of their own private estimates of value and public information on the same.

As discussed in the introduction, suppliers in energy markets are remunerated based on a single market clearing price (MCP) rather than their own marginal costs – even where there is a bilateral trading institution (rather than centralized auction), there will be a convergence to an effective single market-clearing price at any given time, to the extent that there is sufficient competition and liquidity. Energy products, therefore, have a common value.

However, given market uncertainties (and electricity markets are very volatile and also dependent on other very volatile commodities, like oil and gas) and level of sophistication of bidders, it is unlikely that all bidders will hold the same information. Assume there are two bidders, one sophisticated, who holds what they consider to be good internal estimates (or private values) for the product in question (in this case, let's say, delivery of a specified quantity, 10 MW, of electricity into the California power market for the next five years during defined peak hours), and an unsophisticated supplier who feels they do not hold enough information to make an informed bid. The sophisticated bidder is able to use their private information to make excess profits – a form of market inefficiency.[6] In the case of unsophisticated bidder, however, incorrect information may lead the winner to ultimately lose money, because they have won the RFP based on an incorrect estimation of the actual value of the product (the 10 MW of electricity delivered into California over the next five years during defined peak hours). That bidder faces the "winner's curse," where he may win the RFP but then be obligated to deliver the electricity at below market value and therefore suffer in terms of profit.[7] Risk averse bidders, faced with the "winner's curse" (e.g., being awarded a contract which is in fact not as profitable), may choose to simply sit out the process all together. Information that overcomes the "winner's curse" may therefore increase bidder activity in an RFP.

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[6] Milgrom, Paul and Robert Webber "The Value of Information in a Sealed Bid Auction" Journal of Mathematical Economics 1982, pg. 105-114.

[7] Academic work on the winner's curse has been extensive, and highlights include Jeremy Bulow and Paul Klemperer "Prices and the Winner's Curse" RAND Journal of Economics 2002; Paul Milgrom and Robert Weber "A Theory of Auctions and Competitive Bidding" Econometrica 1982; T.J. Feddersen and W Pesendorfer "The Swing Voter's Curse" The American Economic Review 1996; Paul Milgrom "Auctions and Bidding: A Primer," Journal of Economic Perspectives 1989; Richard H. Thaler The Winner's Curse (Princeton University Press) 1991. John H. Kagel and Dan Levin Common Value Auctions and the Winner's Curse (Princeton University Press) 2002.

In addition to the implications for competitive interaction discussed above, the winner's curse also directly impacts the auction clearing price. If the auction is based on unbiased estimates of value of the product, it will result in an award of the supply contract to the most over-optimistic seller, who is then destined to make losses. Suppliers, knowing this is the case, incorporate a risk premium in their offers. The result is that the risk of unresolved winner's curse increases their offer prices and, in consequence, the final sale price.[8] The risk-reduction benefits of additional information can reduce the uncertainty and therefore the risk premium that bidders include in their offer. All else equal, this creates a lower price for the buyer.

In addition, additional information can expand the horizon of bidders (statically, by lowering the threshold cost of participation, and also dynamically, through incentives for new entrants).

While classic economics holds that "the value of information cannot be negative"[9], additional insights from game theory suggest that information can hurt a party by altering the way others behave. Therefore, the key to determining the likely impact of information is to define the value of the "new" information in relation to participants' motivations and pre-existing information positions. If the revelation of "new" information by the utility (the buyer) reduces private information held by certain suppliers, it will encourage more intense competition and increase the expected returns for the buyer (this is known as the *publicity effect* in auction theory). Moreover, if the buyer's revelation of information on expected market value of the product being procured is a substitute for the supplier's pre-existing private information on the value of the product, then it also motivates competition and reduces bidders' (suppliers') profits to the benefit of the buyer(s) (this is referred to as the *weighting effect*).[10] In concept, these two effects may work in opposition to each other, and so it is not immediately clear whether the release of information will be an improvement. To the extent, however, that the new data is a refinement of existing private information held by some sellers, it will improve outcomes for the buying utility in the RFP (i.e. *ceteris paribus*, it will lead to a lower auction clearing price,).

When bidders in an auction (i.e., the suppliers in a utility procurement process) are risk-averse, revealing information may further reduce their private risk premiums, which they incorporated into their offers and thus reduce the price at which they are willing to transact.

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[8] Risk-aversion classically defined by Von Newmann and Morgenstern basically explains why individuals seek out insurance. (Von Neumann, John and Oskar Morgenstern The Theory of Games and Economic Behavior (Princeton University Press) 1944). The dictionary definition of risk-aversion explains this concept in terms of preferences: risk-averse entities are those who are "willing to pay money to avoid playing a risky game, even when the expected value of the game is in [their] favor."(See http://hadm.sph.sc.edu/COURSES/ECON/RiskA/RiskA.html)

[9] Milgrom, Paul *Putting Auction Theory to Work* (Cambridge University Press) 2004, pg. 175.

[10] For a summary of the formal discussion of the publicity and weighting effects, see pg. 157-207 in Paul Migrom's *Putting Auction Theory to Work*. See also Paul Milgrom and Robert Weber "The Value of Information in a Sealed-Bid Auction" Journal of Mathematical Economics 1982; Richard Wngelbrecht-Wiggans, Paul Milgrom and Robert Weber "Competitive Bidding with Proprietary Information" Journal of Mathematical Economics 1983; Robert Wilson "Competitive Bidding with Disparate Information" Management Science 1969; Zvika Neeman "The Relevance of Private Information in Mechanism Design" BU Working Paper 2001.

This interplay of risk and information policy is analyzed by Milgrom and Weber.[11] That market participants within the electricity sector are risk averse is evident from the fact that utilities are generally willing to buy electricity forward and lock in prices for future energy needs rather than buy on the spot market. Similarly, suppliers are generally willing to sell their supplies forward. This suggests that information dissemination which reduces uncertainty would have beneficial repercussions for the utilities that are the buyers on behalf of their customers and, thus, result in lower energy costs for utility ratepayers.

Uncertainty may also reduce overall participation in electricity market auctions. Smaller suppliers with fewer resources available to develop their own sophisticated forecasting models may choose to forego participation in an RFP knowing that their competitors are more informed. Such suppliers will typically believe that given their competition, they will likely overbid (and thereby not win the RFP) or if they win RFP, they will presume that they won because they underbid (and therefore will be taking on below market commitments at the expense of future profits). So long as the information being released substitutes for both the private information held by more sophisticated bidders and the smaller, less sophisticated suppliers, greater information dissemination will lead to greater market participation and, as a result, more efficient prices.

We can demonstrate how this uncertainty may affect an RFP process with the following illustrative example involving a single buyer and a single seller (this example is easily extendable to multiple sellers). Let us assume that a buyer and a seller are potentially interested in trading some object. The object has quality θ that is commonly believed to be uniformly distributed on the interval [0,100]. Suppose that the object is worth θ to the seller and $3\theta/2$ to the buyer.

Pareto efficiency requires that for any quality $\theta > 0$, the object be transferred from the seller to the buyer. What would happen in a market? The answer depends on the information the buyer and seller have in the market. We distinguish among the following three cases:

1. If both the buyer and seller know θ, then following the logic of the so called "Coase Theorem"[12] we expect the seller to sell to the buyer at some price p between θ and $3\theta/2$[13].

2. If neither the buyer nor the seller know θ, then again, assuming that both the buyer and seller are expected utility maximizers and following the logic of the "Coase Theorem," we expect the seller to sell to the buyer at some price p between 50 and 75.

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[11] Milgrom, Paul and Robert J. Weber "A Theory of Auctions and Competitive Bidding" Econometrica 1982, pg. 1089-1122.

[12] The Coast Theorem says that, assuming no transactions costs and the ability to trade, the initial ownership has no affect on the value of an item. See http://law.gsu.edu/wedmundson/Syllabi/Coase.htm

[13] This is because, so long as the legal right to ownership is clear, the party that values the item less will choose to sell that right (assuming they are the initial owner) to the party that values it more. If the party that values it more holds the right to ownership, they will choose not to sell, and the final effect is the same.

3. The more interesting case is where the seller knows θ, but the buyer only knows (or believes) that θ is uniformly distributed on the interval [0,100]. We check the prices at which a transaction between the buyer and seller can take place. The maximum price that the buyer is willing to pay is 75. Would the seller agree to sell at that price? Only if $\theta \leq 75$. But the buyer realizes this, and therefore values an object that sells for 75 at only $(3/2)\times(75+0)/2 = 56.25 < 75$. In the same way, the buyer values an object that sells for a price p at $(3/2) \times (p + 0)/2 = (3/4)p$ which is strictly smaller than p for every $p > 0$. It follows that the only price at which a transaction can take place is $p = 0$, and only objects of the lowest possible quality may be traded, if at all.[14]

What does this example imply with respect to the release of information before auctions for electricity? If we believe that the current situation is such that the buyer of electricity has an informational advantage relative to the sellers, then the situation is similar to the one depicted in scenario (3) above. (The fact that in scenario (3) the seller has the informational advantage is unimportant. It is easy to describe a similar example where the buyer is the one who has an informational advantage over the seller.) If so, in the same way that the revelation of information transforms the inefficient case (scenario (3)) into the efficient case (scenario (1)), the revelation of information in electricity markets may increase efficiency in such markets. As noted in case (3), in a situation where information asymmetries exist, it is possible that no trade will actually occur. Transactions are therefore more likely to occur if information is released that encourages trade by "leveling" the playing field.

Scenario (3) also provides an example of how having private information can actually hurt efficiency. In scenario (3) the seller's private information leads to a very inefficient outcome. If we compare this to scenario (2), where neither party has information and the outcome is efficient, we see the potential negative implications of releasing information that benefits only one supplier out of the competitive group.

The theoretical issues described above were raised in the context of multiple bidders in Wilson's Drainage Tract Model, developed in 1969, which is based on observed experiences from the auction of drilling rights for oil. In this case, there were multiple bidders (buyers) for the right to drill for oil on a tract on the outer continental shelf of the United States (in contrast to an RFP for energy, these auctions were selling rights. Therefore, there was one seller and multiple buyers; the seller was seeking to maximize the price of the rights and the buyers were therefore competing on who would offer the highest price). If one bidder knows more about the value of the oil than other bidders (because of "private" information about the quantity of oil in the tracts being sold), that informed bidder will choose to signal to the other bidders that it holds superior knowledge. If other bidders believe that they are relatively poorly informed, they will likely choose to lower their bids, to avoid the possibility of suffering the "winners curse". Conversely, bidders that know they are poorly informed would choose to advertise

[14] Observe that in this example, the buyer and seller are indifferent between trading an object that has quality $\theta = 0$ and not, and the ex-ante probability that an object has quality $\theta = 0$ is zero.

that fact as well, and so leading the better informed bidders to bid less aggressively.[15] The overall effect is that the winning bids are likely to be undervalued relative to the real market value of the drilling rights.

3 Case Studies

Many utilities that sell generation are still obligated by their regulators to secure supplies of electricity from the market to meet the needs of their customers. In this case, the utility will solicit proposals for new generation from which they will buy energy and related outputs (such as capacity, renewable attributes, etc.) under a power purchase agreement (PPA) or otherwise acquire the entire project (through a "Build, Own, Transfer"). Typically, state regulators have required competitive solicitations in lieu of a utility simply proposing to build its own (regulated, cost-of-service) regulation. For example, since 2002 the Florida Public Service Commission (PSC) has required that all utilities seeking to build new capacity do so via a competitive procurement process.[16] In 2007, Tampa Electric, a subsidiary of TECO Energy, issued an RFP for the construction of a new coal-fired power plant and a 600 MW "solid-fuel fired" power plant.[17] Another example is Pacificorp, in Washington State. In 2007 it issued an RFP seeking 1,700 MW of base load capacity, and in 2008, it issued an RFP seeking PPAs for up to 500 MW or five viable offers of renewable generation.[18]

In other certain jurisdictions that have completely segregated the distribution function from generation, the distribution utilities may remain actively involved in meeting the power supply needs of their retail customers (For example, customers there are "captive" to the utility and could not choose independently an alternate supplier, or customers that choose not leave their incumbent utility's service). Distribution utilities have also sought to meet these needs through competitive solicitations for retail load in the form of auctions and RFPs. These have taken place in many jurisdictions, including: New Jersey (in the form of open-bid, Basic Generation Service, or BGS, auctions); Connecticut (Transitional Standard Offer Service from 2004 to 2006, and Standard Offer Service Since); Delaware, District of Columbia, and Maryland (Standard Offer Service), Illinois (initially covered by the Illinois Auction in 2006, and now divided into Standard Products in the ComEd region, and BGS under Ameren), Massachusetts (Basic or Default Service), and New Hampshire (Default Service). Indeed, more states are moving towards this form or competitive procurement for retail customers (for example, Pennsylvania utilities are being required by new state legislation passed in 2008 to design default service plans that involve competitive procurement elements).

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[15] For a more detailed discussion of the theory behind this, see: Milgrom, Paul *Putting Auction Theory to Work* (Cambridge University Press) 2004, pg. 166

[16] Susan F. Tierney and Todd Schatzki, "Competitive Procurement of Retail Electricity Supply: Recent Trends in State Policies and Utility Practices"

[17] http://www.reuters.com/article/bondsNews/idUSN2517423320070125

[18] See: http://www.pacificorp.com/Navigation/Navigation31203.html

In the U.S. alone, there are numerous real-world examples that illustrate the applicability of information theory to electricity procurements. To give just one, since deregulation in 2000, Connecticut required its two main distribution companies (Connecticut Light & Power (CL&P) and United Illuminating) to adjust the cost of the electricity commodity in its customer bills based on competitive market rates which reflect the actual cost of retail service provision. CL&P and United Illumination had separate procurement processes, part of which involved releasing significant amounts of historical load data, and to some degree also educating potential bidders on the various products being sought in its "full-services" RFPs. United Illuminating, for example, posts 11 years of historical load profiles (from 1998 to 2007) and historical load data going back to 2003 (though they do require a non-disclosure agreement for access to the load data for the first three months of 2009). [19] For its most recent RFP, CL&P has released historical load data from 2000 through 2009. Moreover, unlike United Illuminating, CL&P does not require an NDA for data as recent as the prior business day.[20] It has generally been accepted that these procurements were successful in resulting in prices for electricity that represented New England's wholesale market conditions at the time.

In this paper we discuss in greater detail some specific examples from the California market. California investor-owned utilities have been under a "no-build" obligation since deregulation in 1998, and therefore have had to contract for energy and capacity for future needs as demand within their service territories continues to grow. The states' three major investor owned electricity utilities (IOUs) have repeatedly held Request for Offers (RFOs) for the energy, capacity (and renewable) needs, as summarized in the table below.

[19] See: http://www.uinet.com/uinet/connect/UINet/Power+Procurement/UI+RFP+Load+Data/

[20] See: http://www.cl-p.com/datafeed/wholesale.aspx

Figure 1. Summary of RFOs for PG&E, SCE, and SDG&E

Company	Year	Product sought	PPA or BOT?	Term of PPA
PG&E	2004	RPS	PPA	N/A
	2005	Peaking and/or shaping	PPA	5 to 10 years
	2005	RPS	PPA	10, 15, or 20 years
	2006	RPS	PPA	10, 15, or 20 years
	2007	RPS	PPA	10, 15, or 20 years
	2008	RPS	PPA	10, 15, or 20 years
	2008	Peaking and/or shaping	PPA	Up to 10 years
SCE	2007	Capacity	PPA	Up to 20 years
	2008	Renewable power	PPA	10, 50, or 20 years
SDG&E	2005	Renewable power	Either	10, 15, or 20 years
	2006	(1) Demand Response; (2) Renewable Capacity and Energy; (3) Daily Fixed Strike Call Option; (4) Tolling Agreement for Energy and Capacity	PPA	One, two or three years of the 2007-2009 period.
	2006	Renewable power	Either	10, 15, or 20 years
	2007	(1)Demand Response; (2) At least 200 MW of new generation capacity; (3) Approximately 500 MW of new or existing	(1) PPA (2) PPA (3) Either	(1) 15 years (2) 15, 20, or 25 years (3) Minimum of 20 years
	2007	Renewable power	Either	10, 15, or 20 years
	2007	Renewable power	Either	Short term (up to 5 years)
	2008	Renewable power	PPA	Short term (5 years) or long term (10, 15, or 20

The information component of the RFOs issued by the California utilities has been criticized by the IPP community, representing the suppliers responding to those RFOs. The California Public Utility Commission (CPUC) is the state regulator that approves the resulting proposed contract awards, and therefore allows for the costs of the selected projects to be recovered from ratepayers. Interestingly, the CPUC has also commented on the lack of information:

> Regarding transparency, the IPP community desires more information in the RFO process to ensure that (1) developers can put their 'best foot forward' in their bids and (2) the IOUs cannot put a thumb on the scale in the bid development and/or evaluation process in favor of [utility-owned renewable generation] or affiliate bids... Generally we concur with… the IOUs that too much information can result in undesirable outcomes. However, in some instances the RFO information provided by IOUs has been sufficiently short on details… The Commission believes that the RFO process would benefit from additional rigor… in scoping, reviewing, and revising RFO bid documents to help identify data gaps, confirm the fairness of the components of the RFO that the IOU indentifies as confidential, and ensure that both the letter and spirit of the RFO are consistent with… Commission policies…[21]

[21] CPUC, D0712052 Opinion Adopting PG&E, SCE's, and SDG&E's Long-Term Procurement Plans, http://docs.cpuc.ca.gov/published/FINAL_DECISION/76979-02.htm

From the industry perspective, there is a perception that some of the RFOs have suffered from limited interest – insufficient supplier response. The IOUs have noted that such outcomes may be related to creditworthiness issues and other technical matters related to project development in the state (like the complexity and speed of permitting new generation). We postulate that some of the perceived low level of RFO response may be due to insufficient information regarding the magnitude of the IOUs' procurement needs and other uncertainties. More information released by the IOUs could resolve some of the market uncertainty and alleviate the winner's curse problem for potential bidders.

California offers an interesting contrast to RFP processes in other states that seek energy and associated products for their retail load. In Connecticut, the transition standard offer and standard offer RFPs tend to solicit a combined energy, capacity and ancillary services product (also known as "full requirements" service) to meet a specified share of their load for one to three years outward. RFPs for "full requirements" load following service in other "unbundled" states are also typically for only a few years out. In California, the state's IOUs – like their counterparts in much of the rest of the US that are not managed by an Independent System Operation (ISO) – tend to solicit longer term contracts. Uncertainty about the long term value of a commodity that would be produced and sold by the generator is obviously much greater than the value of the "full requirements" commodity for only one to three years out.

Although the issue of illiquidity may have multiple underlying causes, we hypothesize that one of the leading sources of the problem relates to future energy market uncertainties and insufficient information. We analyzed 15 RFOs released by California utilities over the past four years in order to get a clearer picture of what types of information are being released. Our researched focused on San Diego Gas & Electric (SDG&E), Southern California Edison (SCE), and Pacific Gas and Electric (PG&E).

We focus our discussion going forward mainly on SDG&E, as the three IOUs' RFOs are very similar in many respects. In discussing the specific case of SDG&E, we are able to hypothesize generalizations that are applicable to RFOs issued by all three utilities in question. We also draw specific parallels as applicable to the other utilities further below.

SDG&E released six RFOs from 2005 to 2007. Of these, four were related to expansion of SDG&E's renewable portfolio in order to meet their target of 20% renewables by 2020. Of the remaining two, one was for a minimum of 500 MW of new generation, and the other was for a combination of new generation and new demand response.

SDG&E announced in each of these cases that it would selecting the winning bid based on least-cost/best-fit (LCBF) criteria established by the CPUC. They caveat this by noting that least cost does not necessarily mean "low priced", and that best fit may include consideration of items such as the location and other attributes of the energy, capacity, and ancillary services being offered, as well as other reliability requirements. In addition to quantitative criteria, the CPUC permits utilities to consider "qualitative" criteria, such as historical performance, perceived viability of the proposed project and any development risks (such as inability to get

proper permits, or environmental considerations), the diversity of the proposed resource mix, the availability of fuel, and the location of the project. Because of the subject nature of the LCBF criteria and its application by SDG&E, there was not a lot of concrete guidance for bidders in terms of how the project evaluation would play out. Although some qualitative analysis is probably inevitable in a complex RFO such as this, the subjectivity of qualitative analysis can lead to some bidder apprehension, and could likely cause some bidders to drop out of the process even before it started. The IOUs would argue that the particular RFP process is better offer without "under-prepared" (possibly less qualified) potential bidders. Indeed, if a bidder was truly unqualified, he would eventually be eliminated from the bid evaluation process, even if he chose to participate in the initial stages of the RFO. However, this type of uncertainty created by vague and subjective bid evaluation parameters is likely to create dynamic, longer term effects that discourage new investors from seeking to participate. Notably, very little information about the bid selection process is made available publicly (even after the conclusion of the RFP), as much of the evaluation is completed through confidential Peer Review Groups ("PRGs").[22] Therefore, potential future participants cannot "acquire" information that will allow them to "learn" to become qualified competitors in the future. In business terms, this lack of information is a very significant initial investment hurdle to overcome.

SDG&E releases little information on demand and supply conditions. In one case, SDG&E did release historical summer peak demand for the most recent year, in response to a question from a bidder on that subject. However, they released no internal projections for demand. Nor did they indicate if they thought the summer demand number released was historically typical, or if they felt it was representative of expected demand going forward. In no case did they release information on supply conditions, either historical or projected. In the absence of this information, utilities could have relied on the Integrated Energy and Policy Report, prepared annually by the CEC. This report presents forecasts on future supply-demand conditions for all of California.[23]

Bidders were required to provide information such as anticipated delivery date, technology type and location, the term (in years) of the bid, and proposed energy or capacity prices

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[22] The CPUC defines Peer Review Groups as a "subset of the Program Advisory Group consisting of non-financially interested members who will review utility submittals to the Commission, assess overall portfolio plans, plans for bidding out pieces of the portfolio, and the bid evaluation criteria for selecting third-party programs". Source http://docs.cpuc.ca.gov/Published/Comment_decision/44727.htm

[23] Notably, the publication of supply-demand forecasts by the CEC has been subject to dispute with then IOUs in California and is further evidence of reluctance on the part of California IOUs to release information. In 2005, when the CEC declared their intent to release projections of supply-demand statistics in their bi-annual Integrated Energy Planning Report, California IOUs objected strenuously. They claimed that the information – even in aggregated form – was commercially sensitive and so they were therefore entitled to the "trade secret" exemption from disclosure under the Public Records Act (see CEC order instituting rulemaking (OIR) R.05-06-040 and CEC document 04-IEP-1D). Release of this information, they claimed, would undermine the RFO process by allowing suppliers to manipulate negotiations with the IOUs, harming ratepayers in the process. The information in question, however, was generally available publicly in various other forms. The tables the CEC intended to release served essentially to refine existing public knowledge. In essence, they would act only as a substitute for already available information. The CEC won the case on appeal (Case No. 05CS01482, Superior Court of California).

(depending on the offer type).[24] Respondents were allowed to offer multiple bids. Although some of the information that bidders had to provide in their offer is of the technical nature and unique to a project, the proposed energy and capacity prices that reflect the financial portion of the bid package should be based on the expected future market value of these commodities in California, rather than project specific attributes. Future capacity and energy prices will be influenced by natural gas prices and future supply and demand conditions in the California market, and to some degree the local area of delivery (if there are congestion and deliverability constraints).

SDG&E does not reveal internal estimates for fuel prices, market conditions in the regions in question, or transmission congestion or other constraints. The lack of congestion information is especially interesting, as in at least one RFO, SDG&E clearly notes that congestion will be taken into account when deciding on the winning bid. The implication is that bidders should rely on information released by the California ISO (CAISO) or by the CPUC, which is typically limited to historical information rather than forward-looking estimates of future congestion.[25] SDG&E does not indicate, however, whether or not they are also using this data. In the specific instance of fuel price projections, they do explicitly declare in at least one RFO that projections are proprietary, and so will not be released. They offer no suggestions as to what publicly available fuel price projections to use as an alternative, though such forecasts are available[26], which could create information asymmetries amongst potential suppliers.

SDG&E's 2007 RFO sought three main products: new demand response for a period of 15 years starting around 2010, 200 MW of new peak capacity, and a generation facility capable of delivering 500 MW of new base capacity. In this third case, SDG&E noted that they were considering purchasing the 480 MW El Dorado plant for approximately $189 million, and therefore that served as a sort of "benchmark" for third parties of the opportunity cost to SDG&E. SDG&E released information on the El Dorado plant, including fixed and variable O&M costs, technological specifications, historical generation and fuel consumption, information on the purchase agreement, and a disclosure schedule. This is very similar to the approaches taken by other utilities across the Western portion of the US in their long term RFPs – benchmark portfolios are released beforehand to inform potential bidders about the utilities' alternatives, although this forms more of a cost-based benchmark rather than a market-value position and makes the most amount of sense in a vertically-integrated

[24] SDG&E required bidders to note the extent to which fuel costs would be fixed or variable, but they did not require that the bidders reveal their own fuel cost assumptions. In contrast, PG&E, did require that any bidders in their RFOs that were offering either turnkey (BOTs) projects or PPAs with buyout options reveal their 20-year fuel cost projections. For PPA agreements, PG&E's requirements varied depending on the solution in question. For bidders offering natural gas solutions, for example, PG&E preferred a fuel conversion, or tolling, structure, where PG&E provides the fuel themselves; therefore, there was no need to bidders to supply their own forecast. For non-gas options, bidders were again required to report their own fuel costs.

[25] The exception to this is transmission planning case studies done by CAISO and publicly released for certain transmission projects being evaluated. In some cases, future expected congestion is reported.

[26] For example, the Energy Information Administration (EIA) provides 20 year price forecasts for natural gas, oil, and coal, in addition to forecasts for national electricity prices and energy use. The California Energy Commission (CEC) has in the past provided ten-year natural gas price forecasts, most recently in 2007.

paradigm rather than in an environment where there is a wholesale market for electricity. In addition to serving as a benchmark, the El Dorado project was considered to be a competing project – a variant on the "self-build" option. In effect, SDG&E was a "bidder" in its own RFO. Leaving aside the additional considerations about affiliate bidding, this particular approach employed by SDG&E with release of El Dorado project provides by far the most detailed information as to the sorts of bids SDG&E would consider appropriate.

SDG&E eventually chose the El Dorado plant, and the CPUC approved the decision.[27] Notably, excluding the El Dorado option, SDG&E received only one other conforming bid. While they do not provide specific information as to the nature of the competing bid, they do argue in their final report to the CPUC that over a 25 year horizon the El Dorado plant would bring benefits as high as $378 million, on a Net Present Value basis, above that projected for the competing bid. It is unclear whether the Net Present Value analysis utilized solely the costs of the El Dorado plant or also considered the opportunity cost of the future market value of its output.

SCE, in the two RFOs released over the past two years, released a similar amount of information to SDG&E. SCE's assumptions as to fuel price projections, demand and market supply conditions, and transmission congestion are not mentioned in any of their public information. Unlike SDG&E, they do give time-of-day (ToD) adjustment factors[28] for power prices that all bidders must use when calculating their final bid prices in their response to the RFO (these ToD factors are also documented in the Power Purchase Agreement (PPA) which winning bidders will execute with SCE).

PG&E also released ToD factors in each of the seven RFOs they issued over the past four years. Again, these factors are only given for the year of the RFO, with no indication as to PG&E's assumptions about how they may change in the future. Demand and market conditions and transmission constraints, as with SDG&E and SCE, are not provided, and fuel price projections are considered "proprietary", and so not released, though PG&E does suggest using the IntercontinentalExchange (ICE) index, or some other equivalent, as a benchmark for fuel prices. No specific recommendations are made for public forecasts of supply-demand conditions.

It is worth emphasizing the fact that both SDG&E and PG&E specifically declined bidders' requests to release their own assumptions as to future fuel prices (if similar requests were made of SCE, they were not made public). As fuel price projections can be extremely variable, especially over the long-term, this creates the potential for significant differences in expectations of the future market value of the commodity of electricity. Suppliers that choose to rely on fuel price projections that are relatively high given market expectations may lose out in the RFO to those suppliers that elect to use lower fuel forecasts to develop their bid.

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[27] CPUC Decision 07-11-046, November 16, 2007

28 ToD factors describe the relative price differences between peak, off-peak, and "shoulder" periods during the day. These give an idea as to relative shifts in demand over the course of a day, though they do not provide information on absolute demand levels. Moreover, these factors are based on historical information, and so are not necessarily accurate reflections of future supply-demand conditions.

Alternatively, suppliers that choose to use fuel projections that are too low relative to market expectations in developing their bid may be burdened with a contract that is not economic. Although there are publicly available resources on the market's current forward expectations for natural gas, the release of the utility's fuel price forecast can provide a common denominator for suppliers to develop their bid and therefore resolve some of the uncertainty regarding the future market value of the product being procured. Contract design, for example, allowing for some indexed-based pass through of fuel costs, can also facilitate some leveling of the playing field.

The issue of contract design raises an important issue to also consider. The contract itself may be a form of information that can augment or detract from efficient outcomes. Although a PPA template was issued in each RFO, in each case we reviewed, the California utilities allowed for some level of contract negotiation on a bidder-by-bidder basis. While certain terms may be fixed, bidders were allowed to submit redlined contracts along with their proposals. Because in each case there is no standard contract that all bidders must adhere to, there is no level playing field. Since many of the terms of the contract have financial implications, bidders would therefore need to consider their negotiating abilities in developing their bids. Contract negotiation policies should therefore also be viewed as part of the information policy paradigm for RFOs. We are not suggesting that there should be zero tolerance for contract changes. Rather, parameters must be drawn about the acceptability of certain contract changes and those parameters should be announced prior to final bid submission. This ensures that the same criteria will be applied to all bidders in evaluating whether they can equally and realistically perform under the contract.

4 Recommendations and Conclusions

Information theory has made extensive contributions to the design and implementation of auctions in numerous markets. By applying it to the competitive solicitation process currently used by utility companies, our aim has been to demonstrate how public dissemination of information can lead to more efficient procurement outcomes and, by extension, electricity prices that more accurately represent the competitive cost of power. Based on our research, we have observed that some utility procurement processes are being done on the basis of very limited information exchange. Utilities, as the solicitors in these procurements, have an opportunity to better the results of their procurements by actively managing what information is provided to potential bidders in order to displace private information on future market value and encourage more bidders to participate, and more aggressive bidding by suppliers with reduced risk premiums. We do not intend to suggest that utilities release their actual reference levels for future electricity prices. Rather, we argue that it is important that they release their assumptions about underlying drivers, like fuel price outlooks, and supply and demand forecasts. In doing so, they would allow bidders to develop views congruent with the soliciting utilities' expectations, or at the minimum direct bidders to credible public sources for this information. Bidders need to get information simultaneously and sufficiently ahead of any financial bid submission, so that they can absorb it and reflect it in their proposal. The release of such information could also have longer term positive effects, in that it may serve as

a launch-pad for attracting new players to future competitive solicitations. Furthermore, a more concrete and documented bid evaluation process, released for public consumption, would also be helpful in encouraging new participants and potentially lower risk premiums in future RFPs.

Unfortunately, a flood of information during the RFP alone will not necessarily level the asymmetry of sophistication between bidders in that RFP, as that process takes time. The release of information should therefore be considered within the overall RFP design (including in the RFP marketing plans and in design of the bid evaluation mechanics, the specification of the contract template, as well as in providing after-the-fact reporting of RFP results). In fact, the bidder "education" process for an RFP may involve targeted information release way in advance of an RFP, for example, as part of or alongside an overall (annual) resource assessment. Acknowledgement of concrete future resource needs will serve as a signal to potential parties of upcoming RFPs and therefore allow new participants to adequately prepare, thereby encouraging greater competition.

Lastly, it is important to keep in mind that information release should be targeted to improve competition. The common counterargument to information release, as discussed at the outset of this paper, is that there is in fact "insufficient" competition. If there is in fact insufficient competition, one should probably reconsider the overall purpose of a competitive solicitation – "hiding" information will not improve outcomes. Some will argue that the problem is that there is concern of potential collusion. There are a number of factors that may present the market with opportunities for collusion; some of these factors may be negated with careful RFP design.

Nevertheless, we do need to recognize that there is always a risk of giving away too much (strategic) information, and this concern should be evaluated critically with each individual piece of information being proposed for release, along with the timing of that release.

The question of strategic information has two factors. First, one must be mindful that in reality there may be distinctions between workable competition and theoretical paradigm of perfect competition. In reality, there is no practical equivalent to perfect competition. Therefore, the objective for electricity auctions should be represented as "workable competition," where resulting prices are reflective of the underlying fundamentals and well-accepted commercial arrangements. Moreover, within the broader RFP design, it is almost always possible to implement competition safeguards through other means. For example, the timing of the RFP could lessen concerns of competition and allow for promotion and release of more information. Anticipating energy needs further out in time could allow for RFPs that permit new suppliers (even those who have not yet constructed their power plants)and therefore participation in the RFP will not be limited to existing suppliers. Auction format and other design mechanisms may be available to ameliorate other anti-competitive concerns as well. The second issue regarding "strategic" information revolves around how information will be absorbed by bidders within the context of the RFP. For example, if information released by the utility does not supplant private conjectures by some bidders or worse yet, reinforces those private

conjectures, and that is known by all bidders, then competition may be further weakened. RFP design elements can, once again, reduce this problem. For instance, the format of the bid could be adjusted to minimize the importance of private conjectures. As an example, if certain policy or regulatory changes (and the economic impact of those changes) are a considerable factor involving private "conjectures", the utility can offer to mitigate the value of this "private" information by formatting the bids so that bidders submit project proposal assuming no such regulatory change (and therefore proposals will not reflect differing risk premia for this uncertain regulatory element). In summary, in order to adequately address these types of practical issues of information release, information policies must be considered well in advance of RFP issuance and coordinate with overall RFP design.

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