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THE BOTTOM LINE

Auctions in various forms are being used to promote the generation of electricity from renewable sources. Properly structured auctions can avoid the disadvantages feed-in tariffs and renewable purchase obligations. Moreover, they offer the best of both of these early mechanisms, providing stable revenue guarantees for investors while also avoiding the risk of overbuilding. They do this by determining both price and quantity in advance.

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Promoting Renewable Energy through Auctions

Why is this issue important?

Experience with the use of auctions to promote renewable energy can guide future efforts

Among the examples of the benefits to be obtained from generating electricity from renewable sources are (i) increasing countries' energy security by reducing their dependency on fossil fuel imports, (ii) reducing greenhouse gas emissions as part of a worldwide effort to mitigate climate change, (iii) promoting electrification while reducing the need for isolated applications such as diesel generators, and (iv) minimizing local pollution.

Eager to take advantage of these positive effects, policy makers in developed and developing countries alike have sought to promote the development of renewable energy at the international level, through initiatives such as the United Nation's "Sustainable Energy for All" (SE4ALL) project, and at the national level. At the beginning of 2013, 127 countries had renewable energy support policies in force (REN21 2013), an indicator of global interest in promoting renewable energy.

On the other hand, an analysis of current policies reveals great diversity in the mechanisms adopted by governments to meet this common goal. In addition, as the renewable energy sector has matured, policy revisions have become increasingly common. Therefore, an in-depth analysis of individual countries' experience can be useful in guiding future regulatory action by providing detailed information on the pros and cons of particular policies. A large body of literature has grown up around the features and performance of various policies to promote renewable energy.

This note singles out auctions as an important mechanism that has been implemented in a growing number of countries in recent decades.

What has been the conventional wisdom?

Feed-in-tariffs and renewable purchase obligations were the first approach taken

Historically, the most common means of promoting renewable energy in the electricity sector have been feed-in tariffs (FITs) and renewable purchase obligations (RPOs, also known as renewable portfolio standards, RPS). While usually supplemented by other official policies, such as government-mandated renewable energy targets or tax reductions, these mechanisms are similar to auction schemes in the sense that they can be adjusted flexibly to regulate incentives and to ensure that some amount of renewable energy capacity will be built. The most important characteristics of both types of policies are presented below.

FITs. A FIT fixes the price that will be paid for renewable energy fed to the grid. Open access to the grid is usually also guaranteed under FIT schemes, thus minimizing barriers to market entry and preventing utilities from using their market power or power of incumbency to limit development of renewable energy. After the pioneering U.S. Public Utility Regulatory Policies Act (PURPA) of 1978, the FIT approach rapidly gained popularity both for its simplicity and for the long-term revenue certainty that it offered to developers and investors.

A challenge of FIT schemes, however, has been determining the tariff level that will stimulate the desired investment. In an

environment of rapidly changing equipment costs and information asymmetry, there is a risk that the FIT may be set above market costs. When the FIT exceeds the levelized costs of energy[1] by too much, investors rush to the market and additions to capacity quickly exceed the official target, with the result that consumers end up paying too much for energy. (Situations like this have occurred in Spain and Germany, for example.) So-called feed-in premium mechanisms have recently been proposed as a way around this problem by making investors sensitive to market price signals—at the cost, however, of diminishing the revenue stability that helps attract investors.

RPOs. RPOSs basically require electricity suppliers to include a minimum amount of renewable energy in their supply. They are often supplemented by a scheme for trading renewable energy certificates. The most important precursor of this sort of mechanism was the Alternative Energy Law adopted in Iowa (United States) in 1983. Because RPOs work by predetermining the amount of renewable capacity to be built (and then allowing the market to determine how that capacity will be remunerated), the possibility of overshooting the desired capacity is not an important risk to consumers, as it is with FITs.

On the other hand, RPO schemes offer less assurance to investors about future cash flows. In essence, the risk of overbuilding is transferred from consumers to investors. In addition, renewable energy certificates presuppose the existence of a competitive market. There is a risk, moreover, that their pricing may be manipulated by an incumbent utility or a small group of large utilities. Another characteristic of this type of scheme is that it tends to favor more mature technologies, since investors will seek the cheapest opportunities for the development of renewable generation. All of these factors limit the magnitude, diversity, and pace of investment under RPO schemes.

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[1] The levelized cost of energy is the price of electricity required for a project to make the net present value of all revenues and costs equal to zero at a discount rate equivalent to the required rate of return. It provides a convenient way of summarizing all relevant costs of energy in a single measure that is easily comparable across different types of technologies.

What is the new evidence?

Auction mechanisms tested in several countries have been performing remarkably well

The schemes described in the previous section show an interesting symmetry. FITs control the price paid for renewable energy, leading to uncertainties with respect to the quantity of renewable capacity; whereas RPOs control the quantity of renewable energy, resulting in price uncertainties that must be managed by investors. Faced with this conundrum, policy makers began to see in auction mechanisms an alternative that might yield the best of both worlds, providing stable revenue guarantees for investors while avoiding the risk of overbuilding. Auction schemes do this by determining both price and quantity in advance, using a public bidding process.

Simply defined, an auction is a selection process designed to procure (or allocate) goods and services competitively, wherein the allocation is determined based on financial offers from prequalified bidders. Where competition is feasible and desirable, auctions have proven very effective in attracting new players to the market and in efficiently matching supply and demand. Auctions also increase the competiveness and transparency of the procurement process, making the resulting obligations less likely to be challenged when the political or institutional landscape changes (Maurer and Barroso 2011).

Auction-based schemes to foster generation from renewable sources were first explored under the United Kingdom's Non–Fossil Fuel Obligation (NFFO) scheme, introduced in 1989. The results of this first implementation were not very promising. The NFFO was seen as much more complex than alternative FIT schemes, and there were major concerns with underbuilding. In fact, of a total of 2,659 MW of wind capacity rights awarded through auction, only 391 MW were effectively built. As a consequence, the United Kingdom switched to an RPO mechanism in 2002 (Pollitt 2010).

Despite this early setback, auction-type mechanisms surged in popularity over the ensuing decade (del Río Gonzalez and Linares 2014). Between 2005 and 2013, while the number of countries implementing FIT or RPO schemes roughly doubled in size, the number implementing auction schemes increased sixfold (table 1). Much of

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Table 1. Countries with active renewable energy policies of various types

Mechanism	Number of countries with active policies	
	2005	2013
Feed-in tariff/feed-in premium payment (FIT)	34	71
Electric utility quota obligation (RPO/RPS)	11	23
Public competitive bidding/tendering (auctions)	7	45
All renewable promotion policies (includes the support mechanisms listed above, plus others)	48	127

Source: REN21 Renewable Energy Policy Network 2005; REN21 2013.

Note: FIT = feed-in tariff; RPO = renewable purchase obligations; RPS = renewable portfolio standard. RPO and RPS are alternative names for the same basic instrument.

the renewed interest in auction mechanisms was led by developing countries (Lucas, Ferroukhi, and Hawila 2013). By contrast, RPO schemes were concentrated in high-income countries (figure 1).

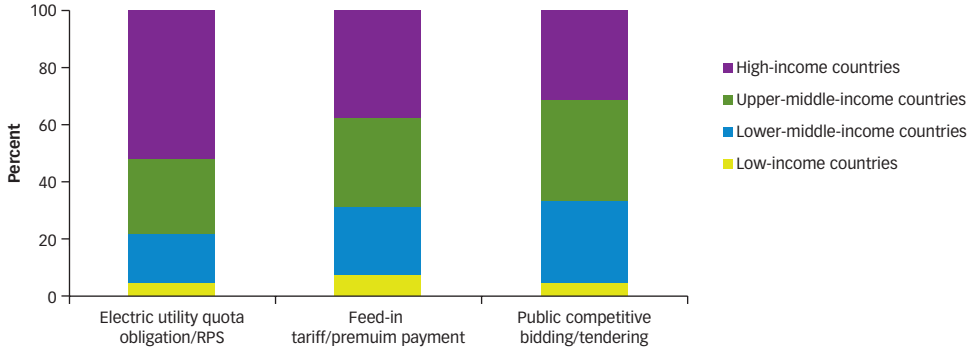
Auction mechanisms can differ greatly from one implementation to the next, as features are adjusted to suit a particular country's needs. While this characteristic can be a plus (auctions are very adaptable instruments), it also makes it harder to draw cross-country comparisons and distill policy recommendations. However, some of the most important elements at the core of auction schemes are the following:

Specification of supply and demand. This part of the auction process determines who can participate in the auction and how much product—in this case, contracts for the supply of electricity produced from renewable sources—will be contracted. Typically the recipients of the auctioned product are power distribution companies or a government-controlled entity that can offer reasonable financial guarantees to bidders. The auction demand (expressed in terms of units of energy, capacity, or some other specific ancillary service) must be determined. Sophisticated mechanisms in which the demand is allowed to vary with the auctioned price are also possible. On the supply side, the auction mechanism may restrict bids to particular types of technologies or sites, and this restriction may be applied at several levels (technology-neutral, technology-specific, location-specific, or even project-specific).

Process for selecting winners. Typically, the winner of the auction is determined by the lowest bid. However, other decision criteria are not uncommon, such as a compound index that ranks the candidates. The process for selecting winners also defines whether the auction will include a price cap (which may be disclosed or undisclosed) and how the ultimate remuneration of bidders will be determined (first price, second price, and pay-as-bid are some common implementations) (Maurer and Barroso 2011).

Another important component of the auction scheme is the so-called price-discovery mechanism. The choice between sealed-bid auctions and descending-clock auctions, in which bidders respond iteratively to earlier bids, often hinges on whether the more effective price discovery of the descending-clock auction offsets the increased risk of strategic or collusive behavior among participants. Some countries (Brazil, in particular) have implemented

Figure 1. Countries with policies to foster renewable energy in 2013, by income category



Source: REN21 2013.

"The choice between sealed-bid auctions and descending-clock auctions often hinges on whether the more effective price discovery of the descending-clock auction offsets the increased risk of strategic or collusive behavior among participants."

hybrid systems in an attempt to combine the best features of the two price-discovery processes. The greater complexity of the hybrid mechanism is its chief disadvantage.

Product characteristics. Typically, the product offered to the winners is a long-term power purchase agreement. Among the important components of such agreements are duration, escalation and indexation clauses, and the liabilities of the contracting parties. Depending on how the generator's obligations are defined, an accounting or settlement mechanism to deal with the intermittency of production must usually be defined as well. An attractive product—that is, an agreement that protects investors from multiple sources of risk (inflation risk, exchange rate, and resource availability)—will tend to increase the number of participants in the auction at the cost, of course, of transferring those risks to consumers.

Requirements and penalties. These terms are designed to ensure that the winners of the auction will fulfill their obligations. Some standard practices include bid bonds (to be executed if bidders do not meet their obligations), completion bonds (to be executed if project milestones are not met), and the possibility of contract termination after a predetermined period of delay. Sometimes, in order to prevent "adventurous" bidding, participants are asked to provide guarantees of their financial health before they are allowed to bid.

Strategy and coordination. Staging an auction implies prior work to coordinate the renewable capacity to be acquired through the auction with the expansion of the transmission grid and of the generation system as a whole. At an even higher level, it may also make sense to coordinate the expansion of renewable generation capacity with the manufacturing of required equipment for which the country has a relative comparative advantage. To further this goal, domestic content requirements have been added to the terms of power purchase agreement in several cases. Even more subtle measures, such as a long-term strategy involving periodic auctions, can implicitly promote coordination by allowing industries to plan for the longer term.

National experience with renewable energy auctions has been quite diverse, reflecting the flexibility inherent in auction design. The World Bank has analyzed the current state of auction-based mechanisms for the development of renewable energy in Brazil, China, and India. Those case studies are part of the Live Wire series, as noted at the end of this brief.

Some highlights of the three countries' auction design are presented in table 2.

How does this affect our thinking?

The right auction scheme for a given country depends on close analysis

Choosing the best instrument to promote the development of renewable energy in a particular country hinges on multiple factors, but auction-based schemes are an alternative that policy makers should consider. Auctions appear as an effective way to stimulate competition among investors, provide price disclosure while eliciting the right amount of investment, and offer revenue stability via long-term contracting. It is important, however, that policy makers have a clear understanding of the strengths and weaknesses of various auction schemes.

Auctions offer stable guarantees to both investors and consumers. Auction winners are assured a stable, long-term revenue stream. Consumers have the security of knowing that the right amount of renewable energy capacity will be built. This two-sided benefit of the auction process is especially valuable when there is reason to believe that the environment may be technologically, economically, politically, or institutionally unstable.

Well-designed auction schemes can kick-start a country's renewable energy program. Because organized auction processes tend to attract attention from international players, they can be an interesting alternative for countries in which the energy market lacks a mature renewable energy segment. In fact, this may be one reason why auctions have been popular in emerging economies, where the risk of a few firms exerting too much market power has been a barrier to RPO schemes. The three countries surveyed by the World Bank have exploited the opportunity to develop their domestic capacity to produce renewable energy equipment as well as other supporting industries and services. Although domestic content requirements have been challenged in international trade forums,

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Table 2. Features of auctions designed to promote the generation of electricity from renewable sources in Brazil, China, and India

	Brazil	India	China
Case study	*Wind:* 11.7 GW awarded in 10 auctions, 2009–13	*Solar:* 4.4 GW awarded in 15 auctions, 2011–13 (but only around 2.7 GW expected to materialize)	*Wind:* 3.5 GW awarded in 5 auctions, 2003–07 *Solar:* 0.3 GW awarded in 2 auctions, 2009–10 *Offshore wind:* 1.0 GW awarded in 1 auction in 2011
Country renewable policy	*Target:* No official target for renewable energy Main fostering mechanism: sporadic technology-specific auctions; fiscal and financial benefits	*Target:* 20 GW of solar by 2022 (National Solar Mission) Main fostering mechanism: RPO-based in the long term, supported by auctions and FITs	*Target:* 200 GW of wind, 50 GW of solar by 2020 (five-year plans) Main fostering mechanism: policy based on FIT scheme
Auction types	Regular auctions and reserve auctions, both centrally organized but differing in allocation of responsibilities	National-level auctions (large-scale and rooftop) and state-level auctions; decentralized implementation	Centralized tenders only, differing by technology type
Main goals of auctions	To exploit synergies between wind and hydro, to correctly assess wind power's contribution to the system	To procure solar capacity at low cost in the scale-up phase of solar power development	Price-discovery mechanism to determine benchmarks for setting FITs
Basic auction design	Technology-neutral or technology-specific auctions Hybrid price discovery Inflation-indexed PPA Clear obligations and penalties	Technology-specific auction Sealed bids PPA without escalation Clear obligations and penalties	Project-specific tender for concession sites Sealed bids PPA without escalation Unclear obligations and penalties
Unique design innovations	Yearly and 4-year settlements to protect investors from wind generation uncertainty Attempts at generation-transmission coordination	Pricing based on the lowest bid received (in some state-level auctions) Capital subsidy schemes (in some national-level auctions)	Multi-criterion winner selection "Average-price" criterion substituting the lowest-price criterion
Domestic content	"Indirect" DCR, required to apply for attractive loans from state bank (BNDES)	DCR not implemented in many state auctions; mixed signaling to manufacturers	DCR of 50–70 percent was enforced up to 2009. Domestic industry is currently competitive

Source: Authors.

DCR = domestic content requirement; FIT = feed-in tariff; PPA = power purchase agreement; RPO = renewable purchase obligation.

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Live Wire 2014/13. "Promoting Renewable Energy through Auctions: The Case of Brazil," by Gabriela Elizondo-Azuela, Luiz Barroso, and Gabriel Cunha.

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Live Wire 2014/15. "Promoting Renewable Energy through Auctions: The Case of India," by Ashish Khana, Luiz Barroso, and Gabriela Elizondo-Azuela.

a well-designed auction scheme can take advantage of existing competitive and comparative advantages in the manufacturing of renewable energy equipment and in the provision of services in both domestic and international markets.

Auction mechanisms should be fully integrated with other regulatory, planning, and economic strategies. Auctions do not operate in a vacuum. The interdependence between an auction scheme and a country's regulatory structures and practices can be an asset or a liability to the auction's success. Despite the guarantees that auction mechanisms offer to investors, their success is likely to be limited if they are not supported by an environment of regulatory stability, transparency, and fairness. On the other hand, auction mechanisms that are deeply integrated with a country's energy planning can be very effective in expanding the generation and transmission systems in a coordinated way, for the simple reason that auctions signal what projects are to be built well in advance.

Auction mechanisms can be very effective in reducing prices. In Brazil, China, and India, auction mechanisms have been successful in bringing energy prices down, compared to levelized cost benchmarks calculated on the basis of "reasonable" assumptions (which are generally used to determine an auction's cap price and price levels for FIT programs). In part, the price reductions can be attributed to the development of industries and services that support renewable energy generation, as described above. And, of course, lower energy costs represent gains for consumers. Attracting additional bidders tends to be a more effective strategy for driving prices down than choosing a lower price cap.

Auctions are complex, and transaction costs can be significant. A criticism of auction schemes is that they are significantly more complex and more costly than either FIT or RPO mechanisms. Besides requiring more public resources to design, analyze, and carry out the selection procedure, this complexity (which is the downside of their flexibility) also makes it more difficult for smaller players to participate because it is more difficult for them to dilute transaction costs in their portfolios. The cost of complexity must be kept in mind when considering sophisticated auctions. Brazil's auctions are an example of a high-complexity mechanism that had unforeseen consequences.

Discouraging overoptimistic behavior has been a major challenge of past implementations. Common problems, such as delays in construction and underperformance, have been identified in systems using multiple auctions to foster renewable energy. Although these problems can be dealt with to a degree by stiffening penalties for failing to meet the original objectives, it does seem that the winning bid too often represents a best-case scenario rather than a reasonable expectation. Policy makers should be aware of this risk and seek to build a mechanism that can accommodate deviations in a robust way. Incentives to provide early warning of potential problems should be built in, so that mitigation measures can be taken at the earliest possible stage.

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