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DESIGNING RENEWABLE ENERGY AUCTIONS:
A POLICYMAKER'S GUIDE

Scaling Up Renewable Energy Project
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A POLICYMAKER’S GUIDE TO RENEWABLE ENERGY AUCTIONS

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DISCLAIMER
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CONTENTS

This guide is designed for energy ministries, utilities, regulators and others who make decisions on the design of renewable energy auctions. It is a brief foundational document and introduces key auction design concepts. Section 1 summarizes the reasons behind the introduction of renewable energy auctions and recent global auction results. Section 2 presents advantages and disadvantages of auctions versus administratively-set feed-in tariffs and negotiated tenders. Section 3 discusses the elements energy policymakers should consider in preparing and implementing renewable energy auctions. Section 4 outlines the design process and timing of auctions, while Section 5 explores the key design elements and some of the options energy policymakers have to reflect. The guide concludes with an "outlook' on trends in auction design. Future USAID reports will cover these topics in more detail.[1]

[1]Note: USAID would like to acknowledge IRENA's *Renewable Energy Auctions: A Guide to Design* (2015) for its contribution to auction design theory.

SCALING UP RENEWABLE ENERGY THROUGH AUCTIONS

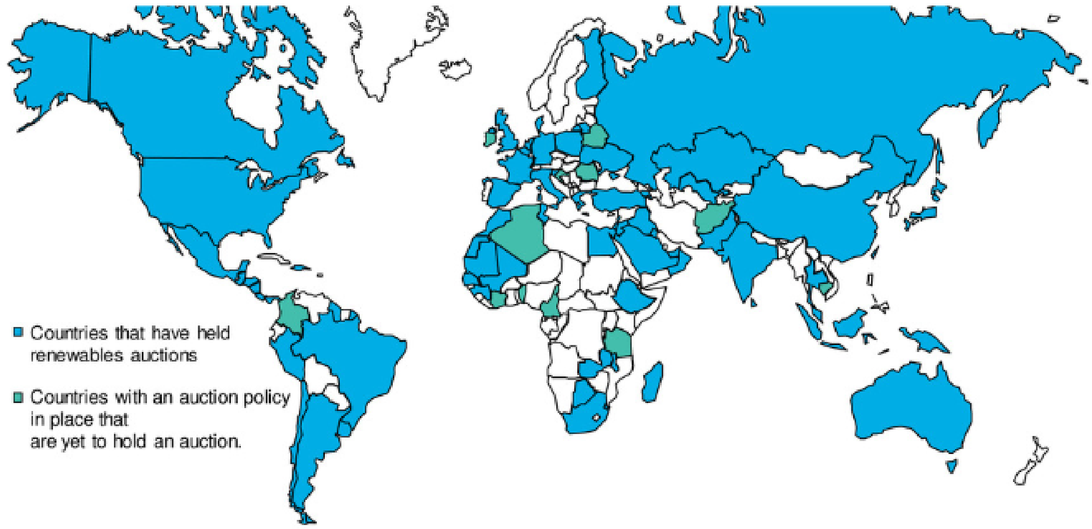
Renewable energy (RE) auctions are transparent and competitive mechanisms that allow policymakers to procure clean energy at prices that reflect those in the market. Unlike negotiated procurements or feed-in tariffs (FITs), auctions have the potential to provide price discovery, reduce windfall profits for power producers, and give cash-strapped utilities and consumers lower prices for electricity[1] by forcing companies to compete against one another on price. Auctions can also increase the ability of governments to steer the build-up of RE capacities more precisely over time and location. They can also help spur private investment by giving investors the confidence that energy projects will be awarded using fair contracting practices.

Auctions are an important tool for achieving energy sector goals. These goals can go beyond adding new power capacity at low cost to include such other objectives as dispatchability, energy diversification, improved and efficient RE grid integration, and matching generation and transmission build-up.

> **DEFINING RENEWABLE ENERGY AUCTIONS.** An auction is a competitive process for procuring electricity generated by renewable energy.[2] It is designed to allocate a supply contract or incentive based solely on the bids submitted by participating bidders according to transparent award rules.[3] The bid evaluation criteria can be solely based on price or add such other award criteria as the creation of a local industry, the environmental impacts of a project, or its local/social acceptability.
>
> The term "tender" are also used to designate this type of competitive procurement process. This paper uses term "auction," as it is the preferred term in the energy industry.

Auctions have helped utilities procuring power to capture substantial price decreases across RE technologies. Auctions were held in at least 48 countries worldwide in 2018, up from 29 countries in 2017[4]. In Figure 1, the countries that have held auctions are shown in blue and those planning to implement RE auctions in 2017 in green. In that same year, there were 60 GW of RE capacity awarded.[5] Record-low prices for solar PV projects to be commissioned in the next five years were reported in Mexico[6] (USAID supported Mexico on its auction's design and implementation) ($1.9 cents/kWh), Chile[7] ($2.1 cents/kWh), Saudi Arabia[8] ($2.3 cents/kWh), and Abu Dhabi/UAE[9] ($2.4 cents/kWh). Similarly, record-low prices for onshore wind were reported in Mexico[10] ($1.8 cents/kWh), Morocco[11] ($2.5 cents/kWh), and Brazil[12] ($3 cents/kWh). Auctions in the Netherlands and Germany[13] awarded offshore wind projects to bidders offering to build their projects using the revenue from the sale of electricity at the wholesale market with no production subsidy.[14]

Auctions have been implemented in countries with electricity sectors with different degrees of liberalization and maturity. In Zambia and Senegal, solar PV project sites were awarded at $6 cents/kWh in 2016 and $4.7 cents/kWh in 2017.[15] Malaysia's second round under the Large-Scale Solar auction program saw prices drop to $8 cents/kWh.[16] In Kazakhstan, auctions assisted by USAID in 2018 resulted in unweighted average wind prices of $5.3 cents/kWh. In Afghanistan, 10 MW of solar PV capacity were awarded at $7.3 cents/kWh[17] in a 2016 auction assisted by USAID with a significant capital subsidy. Although they are not the focus of this document, auctions have long been implemented for the competitive procurement of thermal energy resources in several countries, including Brazil, Colombia, Vietnam, the Philippines, Thailand, and the UK, and for the procurement of demand and supply resources in various US states.[18]



Source: Bloomberg NEF. Note: In the U.S., we classify as auction the offshore wind tenders organised at a state level.

Figure 1. Countries implementing or planning to implement RE auctions as of 2018.

AUCTIONS AND PRICE CHANGES

Globally, the average levelized cost of electricity (LCOE) for utility-scale solar PV installations fell from $36 cents/kWh to $10 cents/kWh between 2010 and 2017, a 73% reduction.[19] Auctions can result in prices that more closely reflect rapid and drastic changes in technology, financing, and other costs. The increasing experience of project developers and manufacturers, and competition between them, combined with a greater familiarity with RE technologies by insurers and multilateral and commercial lenders, is another driver of RE cost reductions.

Auction prices generally fluctuate with the broader macroeconomic context of a country. For example, Brazil saw its wind auctions' prices increase in 2015 as a result of the economic recession that began in 2014.[20] Here, auction prices increased due to a higher cost of capital for projects, resulting from a reduced availability of concessional loans from the domestic development bank BNDES, and higher prices for imported equipment due to the devaluation of the Brazilian *real*. In India, several auctions have been annulled because prices offered were deemed too high by authorities[21]. Such actions create uncertainty for investors, who might choose not to participate in future rounds, and thus should be avoided. A ceiling price above which bids are disqualified gives energy policymakers certainty about expenditures, and investors certainty that the auction rules will not change. before the process concludes.

RENEWABLE ENERGY GRID AND SYSTEM INTEGRATION

Developing countries have ambitious generation capacity addition plans to address strong electricity demand growth, but RE grid integration capabilities often lag. Instruments that consider RE system and grid integration costs within the auction include time-of-day or time-of-year payment factors (as in Mexico and the UAE), project location bonus/malus (Germany), and capacity quotas (Kazakhstan). Instruments outside the auction should consider the regulatory frameworks needed for allocating balancing and forecasting responsibilities[22] for RE producers, demand-side management, and storage integration.

RENEWABLE ENERGY PROCUREMENT METHODS

There are several price-setting mechanisms to procure electricity from RE. This section shows the advantages and disadvantages of the three most prevalent methods: administratively-set tariffs, negotiated tenders and auctions. Hybrid mechanisms are also possible.

ADMINISTRATIVELY-SET TARIFFS (FEED-IN TARIFF, FIT)

The price paid to RE producers is set by the government (step 1 in Figure 2). RE producers willing to accept this price level determine the volume of RE capacity/electricity built (step 2 in Figure 2). Projects offered at a price higher than the one defined by the government are rejected and therefore not realized.

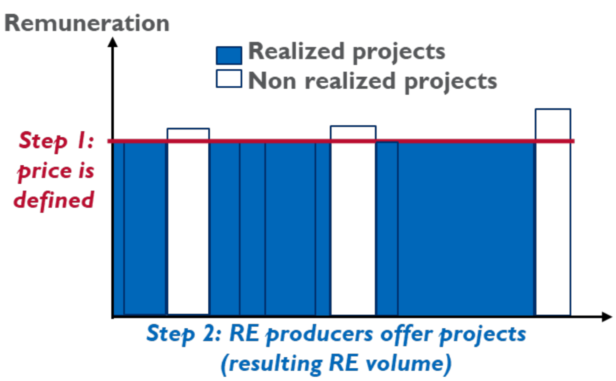


Figure 2. Price Formation in an Administratively-Set FIT

Advantages

- Does not require intense competition for the mechanism to function properly. Especially suitable for markets or segments with little competition like small markets.
- Low risk for RE producers: access to the tariff is not restricted to the group of successful bidders. Especially suitable for less mature RE technologies.

Disadvantages

- Low volume control unless FIT has budget/capacity cap.[23]
- Slow in reacting to market price changes.

Source: Navigant Energy 2019

NEGOTIATED TENDERS

The government sets the auction volume,[24] for example a 100 MW project (step 1 in Figure 3), and bidders (A, B, and C) offer a price. Once qualified bids are ranked, the auctioneer engages in negotiations with the preferred bidder (bidder A, step 2). Negotiations enable changes in project size and price (step 3).

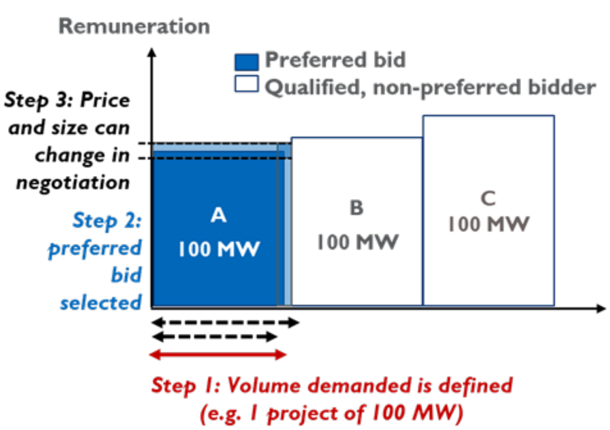


Figure 3. Price Formation in Negotiated Tender

Advantages

- Volume control and greater flexibility to tailor projects to need than auction.
- Some competition in pricing but lower than in auction.

Disadvantages

- Difficult to scale if many bidders are present.
- Bidders face risk of not being awarded and must absorb sunk cost of project pre-development.
- Risk of delayed project execution due to negotiation stage.
- Limited transparency in selection process.

Source: Navigant Energy 2019

AUCTIONS

The government sets the auction volume demanded (step 1 in Figure 4), bidders offer price, auctioneer ranks bids. The resulting price level is defined either at the level at which the auction volume is met by the ranked bids (uniform pricing) or by each individual bid (pay-as-bid) (step 2).

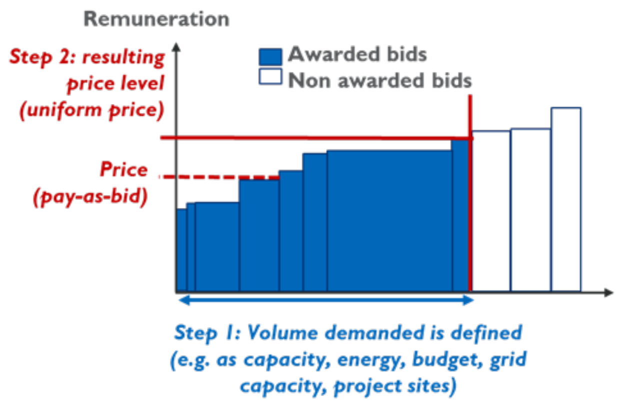


Figure 4. Price Formation in Auctions

Advantages

- Volume control.
- Competitive pricing.
- Faster project execution after award than in negotiated tender. [25]
- Easier to scale up for multiple projects and rounds.

Disadvantages

- Requires competition.
- Requires stronger institutional capabilities.
- Bidders face risk of not being awarded and sunk cost of project predevelopment.
- Risk of underbidding and project non-completion.

Source: Navigant Energy 2019

PREPARING AND IMPLEMENTING AUCTIONS

Defining policy objectives to be achieved with the auction, as well as knowing the market, project development cycles and available institutional capacities support the design of auctions that fit the local framework conditions. This diagnosis also helps identify areas within the policy framework that need to be adapted to adequately distribute risk between RE producers and the public. This section helps policy makers understand the main actions needed from the planning to the implementation of auctions.

CLARIFY POLICY OBJECTIVES EARLY IN THE PROCESS

Two of the most common policy goals of RE auctions are allocating available funding efficiently and achieving RE generation targets through the timely implementation of projects. Other policy goals include grid and system integration of awarded projects and local value creation. The former aims at coordinating the deployment of projects with current and planned grid capacities to avoid impasses or to minimize expansion costs. Local value creation entails the contracting of projects with a positive (local) socioeconomic impact, such as the local sourcing of components used, a share of local workforce hired, or sharing ownership of the project with the community.

Recognizing the trade-offs between policy objectives is part of the auction design process. For example, requiring a bid or completion bond from bidders helps ensure that selected bidders are serious and aim to commission projects without delay. On the other hand, this could increase financing costs and lead to higher bid prices. It is important to map trade-offs and agree on the prioritization of policy objectives and then ensure they are reflected in the auction's design.

TAILOR THE AUCTION TO THE LEVEL OF MARKET READINESS

The success of an auction strongly depends on how it fits local market conditions. Thus, when designing an auction, it is important to assess the level of market readiness. For example, South Africa over-estimated the size of its RE market size and project bid readiness in its first round of auctions, which led to the award of projects at prices close to the ceiling price. This, in turn, prompted the introduction of capacity caps per technology in later rounds.

MARKET SIZE

A market readiness assessment should consider the project pipeline, the level of development of the local renewable energy sector, the project development and operation phases, the impacts of existing regulation and incentives on the project development process, and other factors such as the structure of the power market. Assessing the project pipeline helps to determine the level of competition expected in the auction. A project pipeline might exist due to historical FITs or projects developed based on a bilaterally-negotiated memorandum of understanding between the power producer and the government. The expected level of competition should inform the volume auctioned.

> **AUCTIONS IN NASCENT RE MARKETS.** In countries introducing auctions, especially in nascent RE markets, starting with smaller auction volumes through pilot projects helps policymakers build interest from the private sector. The lessons learned from the pilots can be useful in when expanding the auction scheme to larger volumes or more technologies. If the grid allows it, the volume (or at least future volumes through multiple rounds) should be sufficient to attract broad competition, including from international bidders. Policymakers should thus consider the transaction costs faced by bidders wishing to enter the market, as low volumes might lead some actors to decide not to enter a market.

PROJECT DEVELOPMENT AND OPERATION PHASES

Project development and operation cycles also inform the auction design. Knowing the project development duration and risk of project failure allows policymakers to decide which permits should be required before the auction takes place. Unclear permitting processes, overlapping roles, and limited capacity within the permitting authorities can delay the project development process. Time to needed by developers to secure land rights and procure a grid connection permit also need to be considered.

> **TAILORING AUCTION DESIGN TO LOCAL FRAMEWORK CONDITIONS IN KAZAKHSTAN.** The first two auctions in Kazakhstan are an example of auctions tailored to the objectives and features of a country's power sector. Given that its power system has surplus generation capacity, designers kept the capacity limits low. Since there was no previous experience with auctions and bid prices were unpredictable, officials set ceiling prices at the level of the administrative FIT. The auction also set capacity limits at multiple nodes of the system to minimize new transmission costs, and ensure the system could absorb the electricity generation resulting from the auction. Finally, the organizers performed site-specific auctions since resource potential studies had been conducted for those sites.

SUPPORTING MARKET READINESS FOR RE AUCTIONS

To support market readiness for RE auctions, a clear legal framework that defines the rights of independent power producers (IPPs) vis-à-vis state-owned utilities or grid operators is important. In countries with less liberalized electricity sectors, a state-owned utility can procure new RE capacity through the auctioning of Engineering, Procurement and Construction contracts, and retain the ownership and operation of installations. Alternatively, a country can opt to auction contracts for IPPs to channel private investment into the power sector, especially if public resources are insufficient. If RE auctions are to attract private investment, a clear IPP framework and level-playing field with incumbent actors are important.

The use of syndicated loans between development and commercial finance institutions, guarantees, and private-public partnerships can also make RE projects more attractive. The latter supposes an examination of the type of financing available to RE projects in terms of sources, whether domestic or international, the split between debt and equity, and public and private funds. The risk perception and lenders' familiarity with RE projects also needs to be examined.

ENSURE INSTITUTIONAL CAPABILITIES MEET AUCTION REQUIREMENTS

The institutional capabilities required depend on the type of auction, its implementation timeline, and desire for auction scalability. Engaging with key stakeholders such as the ministry of energy, energy regulator, grid operator, and permitting authorities at the local/national levels in the early stages of the auction facilitates cooperation from project approval authorities. A point of -contact for the auction's implementation helps coordinate inter-agency work and communications with bidders. Selecting an auctioning authority with some independence from other state actors increases private sector trust in the process.

Countries have chosen different entities as auctioneers, including the energy regulator (BNetzA in Germany), the electricity market operator (CENACE in Mexico, XM in Colombia, CCEE in Brazil) or dedicated agencies (MASEN in Morocco). South Africa decided that its auction program would be run by a dedicated agency (the Department of Energy Independent Power Producers Office) staffed by employees of the ministries of energy and finance who are experienced in working with private sector and public-private partnerships, rather than Eskom (the public utility), which was historically responsible for IPP procurement.[26] If the electricity sector is not liberalized, it is important to define the role of state utility, particularly regarding IPP rights and compensation in the case of curtailment.

The auction design, bidding documents and PPA documents can benefit from best-practice templates, but tailoring them to the individual auction is important. Capacity building on auction design and bidder perspectives helps authorities implement a successful auction.

> **BIDDING DOCUMENTS FROM MEXICO'S AUCTIONS.** USAID has translated several documents from Mexico's power generation auctions from Spanish to English as examples of global best practices following assistance to the country's generation and transmission auctions. They include Mexico's auction bid announcement, a list of bidding rules, bid manual, and social action plan; they are available on https://www.usaid.gov/energy/scaling-renewables/resources#2.

The responsibility for the selection and pre-development of a site is an important choice in the auction design. Although site selection and pre-development by the government can make an auction more attractive, particularly in a nascent market, governments have limited financial and human resources. Hybrid solutions, whereby the government defines a grid area for the auction and bidders select and develop a site, can be an alternative (South Africa REDZ). Countries might require bidders to certify the technical characteristics of their projects to help the auctioneer ensure these will be developed using state-of-the-art equipment and processes. In Brazil, projects need to certify their solar/wind metric data and annual energy production through an independent company. In South Africa, wind turbines were required to be compliant with the international technical standard IEC 61400-1.[27]

Auctions are not always the best fit for a country. An administratively-set FIT can be more suitable for less mature technologies or small-scale generators that have difficulties managing risk or the transaction costs from participating in an auction. As the local market matures, countries could gradually introduce auctions as opposed to discretionary, direct procurement. Even in a small market with low competition, introducing a competitive procurement framework has two key advantages over direct procurement. First, formulating and publishing formal participation and award criteria reduces the room for discretionary judgment calls in the process. And second, experience shows challenges in and to the process of direct procurement, whereby parties negotiate the terms of a project and PPA, which can lead to delays in the process.

> **PREPARING THE INSTITUTIONAL FRAMEWORK FOR AUCTIONS IN MEXICO.** As part of its 2013 constitutional reform, Mexico implemented a major restructuring of its power sector, which resulted in some of the world's most competitive renewable energy prices. Three long-term electricity auctions in 2016 awarded 8 GW, representing an estimated US $9 billion in new investments, with average prices of $4.8, $3.4, and $2.1 cents/kWh, respectively. USAID provided critical assistance in the design and development of Mexico's auctions through an Auctions Working Group that included the energy ministry (SENER), regulator (CRE), market and system operator (CENACE), and major utility (CFE). USAID supported the development of the first auction's bidding rules, the development and operation of an auction IT system in the first two auctions, and provided prequalification verification services and support to the design of clean energy certificates as well as the country's first transmission auction. By 2020, Mexico anticipates having four times the solar and wind infrastructure it had in 2012 and will be well in its way to meet its 35% clean energy target by 2024. However, the fourth auction has been indefinitely postponed due to changes in government.

THE DESIGN PROCESS AND TIMING OF THE AUCTION

During the auction design process, government stakeholders (e.g., policymakers, utility, regulator, market operator) determine priorities, adapt them to the local market, define the regulatory framework and institutional capabilities, decide on the optimal auction design, implement an auction under clear rules that attract competition, and evaluate (and if necessary adjust) the auction design based on lessons learned.

Performing auctions without adequate planning will not achieve low prices. The time required for the design of the auction is country-specific, although best practice is to plan and announce auctions in advance to create investor interest, and allow investors time to obtain the documentation they need to participate. An auction calendar with a description of the upcoming auctions could be published a couple of years in advance to create bidder interest.[28] In South Africa, the auction design was prepared in the nine months preceding the publication of the request for proposals (RfP),[29] and the lead time between the publication of the RfP and bid submission was three months. The time needed depends on whether the government is responsible for site selection and pre-development, and the human and financial resources available to the auction agency to prepare the tender documentation, consult with the private sector, and process their feedback.

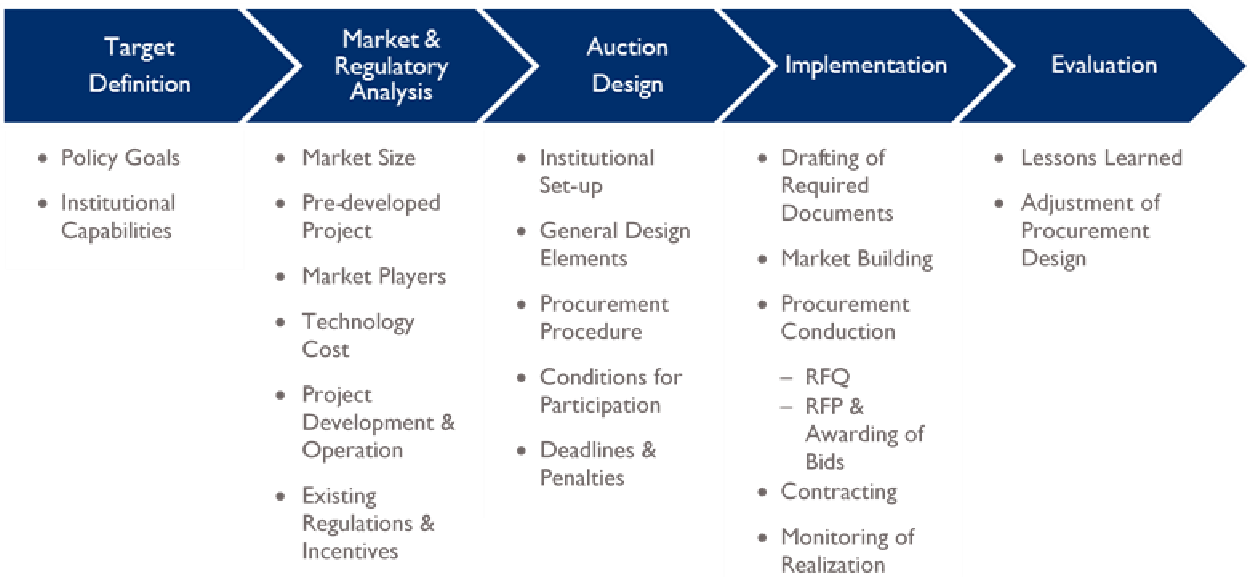


Figure 5. Overview of the Auction Process

PREPARING INSTITUTIONS via trainings and learning from the feedback collected at workshops in the auction design and implementation stages prepares institutional actors for the auction, creates ownership of the process, and can reduce the risk of delays when the auction is implemented. In 2017, USAID brought a delegation from Tanzania to Brazil for a ten-day study tour that included an auction simulation and visits to the principal stakeholders, government entities, and private sector companies involved in Brazil's auctions. Securing enough funding for institutions to prepare the auction, engage transaction advisors and advertise the auction helps them prepare. In Denmark's offshore wind auction preparation costs worth €1.6 million were funded by the government for the 2012-2015 period.[30] In South Africa, preferred bidders pay a development fee equal to 1% of their total project cost to recover some government costs.[31]

THE AUCTION IMPLEMENTATION STAGE involves more than collecting and ranking bids. Once there is agreement on design elements, an active participation strategy with the private sector can help to further refine the design, increase participation, and reduce the risk of delays in the auction. "**Market building"** measures help bidders prepare for the auction, and often include an announcement of the auction in advance, a timetable with auction process activities and dates, an auction manual, offering training and auction simulations to bidders and financial institutions, and holding a pre-bidding conference. Ensuring the same information and clarifications are accessible to all bidders increases the transparency and fairness of the auction process.

DRAFT VERSIONS OF PARTICIPATION DOCUMENTS such as a draft request for qualifications (RfQ), RfP, power purchase agreement (PPA) and implementation agreement should be published early. Consulting the private sector, banks, and investors for feedback on a draft PPA before publishing a final, non-negotiable contract, helps create a bankable PPA and reassures bidders that all auction winners are signing the same terms with the off-taker, except for the price offered. Publishing the draft and final versions of the PPA can help ensure transparency.

The RfQ process shortlists bidders meeting the technical and financial requirements, and so reduces the bids to be evaluated to the most promising ones. Shortlisted bidders are invited to respond to an RfP; bids are then evaluated based solely on price or on additional criteria such as local value creation or added value toward system integration.

Modifications to the final versions of the RfQ, RfP, and PPA in the negotiation stage should be avoided. Once the auction results have been announced, policymakers should ensure the PPA is signed as soon as possible. A late signing can delay project realization and may lead to prices that are no longer reflective of current market conditions. Penalties in case project milestones are not met, including the timely signing of the PPA at the bidder's fault, minimize the risk of delays.

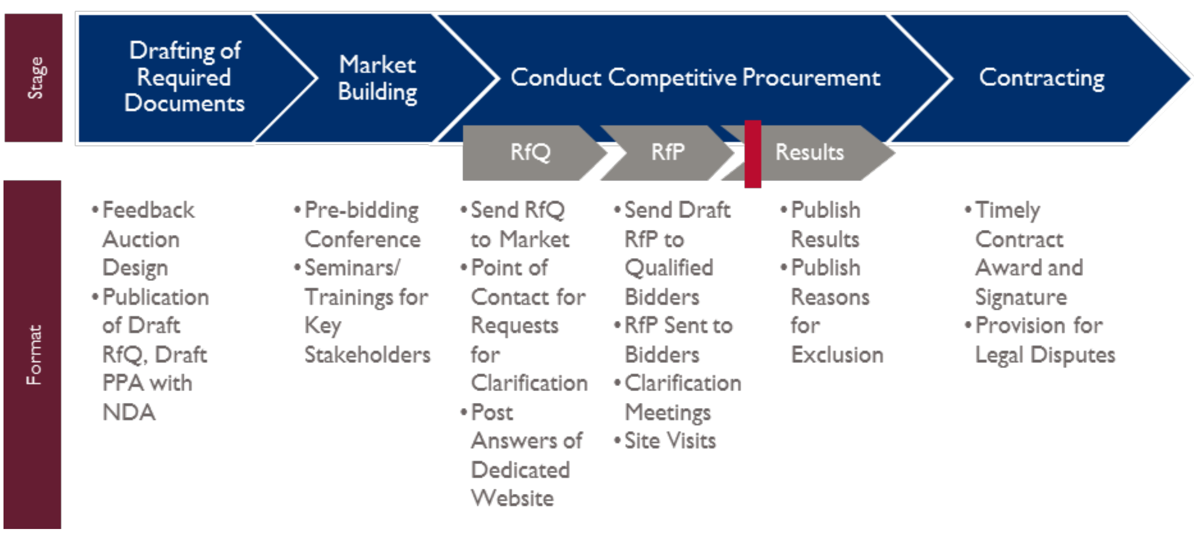


Figure 6 - Example overview of the auction implementation process

DESIGNING SIMPLE AUCTIONS

The introduction of an auction creates a market for RE remuneration. The rules by which this remuneration is determined and allocated are known as design elements. They need to be transparent and well-understood by both by auctioning authorities and bidders.

For countries with limited market maturity and institutional capabilities, it is important to create a simple auction design. More complex auctions can, however, better react to different policy preferences and market conditions. Key design elements can be grouped into four categories:[32] general design, auction procedure, conditions for participation, and deadlines and penalties.

Initial design includes the auctioned item (kWh, kW, budget), auction volume, site-specific vs. site agnostic auctions, the technology type, and technology size. The *auctioned item* is the good to be procured in the auction, and can be defined as electricity capacity, electricity generation or a financial budget. If defined as capacity, a total quantity in MW is auctioned. If defined as generation, bids are awarded per kWh and there is a total target amount of kWh. If defined as a budget, there is an overall amount of RE tariff volume to be provided. The *auction volume* refers to the amount of RE electricity or capacity demanded by the auctioneer. The volume auctioned should be in line with RE targets, the capacity the market can deliver, and grid constraints.

In **site-agnostic auctions**, the government defines a target volume for the auction round and bidders compete with their projects, which they have pre-developed at their chosen site. In *site-specific auctions*, the project site is selected and pre-developed, either partially or fully by the government. Bidders then compete for the right to construct their projects at the specific site. This type of auction allows for better coordination between project construction and the required grid expansion.

Figure 5 presents various levels of locational steering that could be implemented in an auction: from no locational signals in site-agnostic auctions, to "hard" locational signals in site-specific auctions. Site-specific auctions reduce the risks and costs associated with the project development process for bidders. Faulty pre-development work, however, would reduce this benefit. In Zambia's first auction round, site selection issues on the project sites led to additional development work after project award.

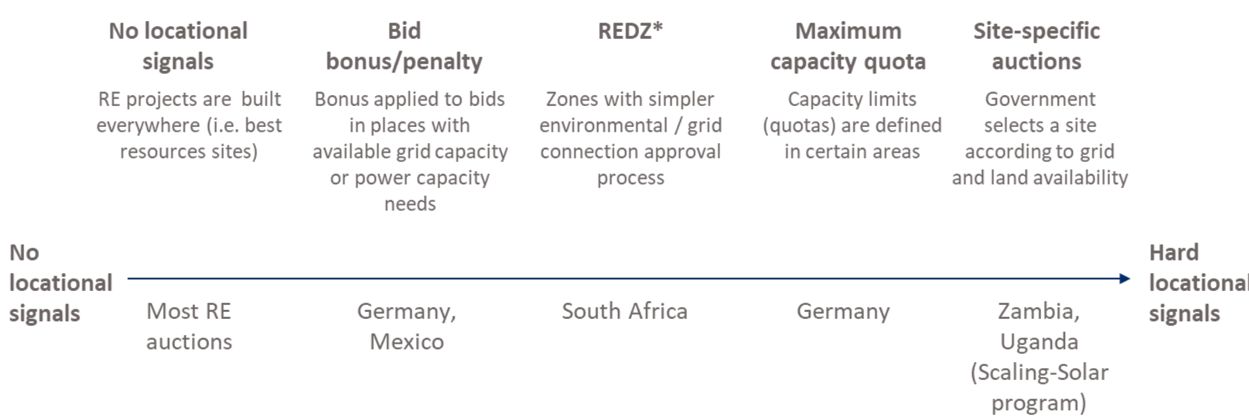


Figure 7. Auctions and range of locational signals

Auction procedure refers to the way bids are submitted and selected during the bidding process, and includes decisions on static vs. dynamic auctions, bid selection criteria, pricing rules, and number of rounds. Auctions can be performed as a *static, dynamic* or as a *hybrid* of these two formats.

In a static auction, participants submit their bids simultaneously, and are unaware of competing bids (a **"sealed-bid auction"**). Most countries have implemented this type of auction. Static auctions are often easier to adopt from the government and bidders' perspective than a dynamic auction.

In a dynamic auction, bidding takes place over several rounds. Bidders can observe the development of the auction price and competing bids, and adapt their bidding strategies and bids during the auction process. Both auctions can work well, but the choice depends on the market; there is also a likelihood of implicit collusion between bidders, which might be the case with few, well-connected bidders.

Although a paper-based RfP format can help bidders become familiar with the process, a country may consider more automated processes such as a web-based RfP or a web-based dynamic auction platform. Web-based solutions help the auctioneer gather and evaluate a large number of bids, announce results, and make the answers to bidder questions available to all auction participants. Electronic bidding platforms are used in Mexico and in some auctions in India to make bidding smoother and more transparent. A platform can also house a data room and document management platform to share all information with bidders, and give some access to the public.

Conditions for participating in the auction encompass the requirements bidders or projects need to meet to participate in the auction, including technical requirements, financial guarantees, and the ceiling price. **Technical requirements** involve standardized evidence of project progress, for example, a grid connection agreement, an environmental permit, or an approved zoning/development plan. They help ensure a high probability of realization, since the projects participating in the auction have already overcome some of the risks related to project planning, including securing a location or key permits.

> **MITIGATING ENVIRONMENTAL AND SOCIAL IMPACT RISK.** In Mexico, the development of RE projects and associated transmission infrastructure has put pressure on local communities, largely indigenous. In many instances, this has slowed down, and sometimes prevented, the development of RE projects near vulnerable populations. This was the case for some of the 1 GW of RE projects awarded in the first round of the auctions in early 2016 in the Yucatan region. Post auction, USAID began supporting the Mexican government's Ministry of Energy (SENER) and a number of agencies to address legal and governance gaps in the effective management of social issues that arise during the development, construction and operation of energy projects. Several pilot projects are ongoing.

Financial guarantees help prove the seriousness of bidders, and typically back up the penalties incurred in the event of a delay or failure to realize a project. A financial guarantee can be divided into two steps: commitment (bid bond) and completion (completion bond). International experience shows there are many ways to define financial guarantees depending on the country's needs and on other investments the developer has already provided before bidding. In Ethiopia's government-sited auction of a 100-MW solar PV park, bidders were required to submit a bid bond of $3/kW, and a completion bond of $15/kW. In Brazil's bidder-sited auctions,[33] a bid bond worth 1% of investment costs and a completion bond of 5% of investment costs are required. In Peru's and Argentina's bidder-sited auctions,[34] bidders must submit a bid bond of $50,000/MW ($50/kW) and completion bond of $250,000/MW ($250/kW).

A **ceiling price** is a maximum price above which bids will be disqualified. A ceiling price acts to avoid excessive producer revenue when there is little or limited competition in the auction. Disclosing the ceiling price to bidders in advance prevents otherwise qualifying projects from being rejected simply because bidders did not know the ceiling price. The disclosure of the ceiling price also gives bidders more planning security. However, disclosing ceiling prices can weaken the competitive price discovery of the auction if bidders orient their bids toward the ceiling price.

Setting the ceiling price at an appropriate level is not a trivial exercise. Ceiling prices are often set based on an assessment of generation costs (LCOE) plus a producer rent. The LCOE-based ceiling price should be calculated from the perspective of a typical investor, taking the regulatory framework and transaction costs into account, including taxes and tax exemptions, market risk premiums, and financing conditions. Administrative calculations should be validated with market parties. In the Netherlands there is a consultation process and a revision of the ceiling price setting process by an external reviewer.

Deadlines and penalties define the timeframe to build projects, as well as the consequences for bidders for the non-and/or delayed realization of awarded projects. *Penalties* help to counteract delays and/or the non-realization of projects. They are also intended to prevent bidders with no intention of building projects from "hoarding" contracts, since this behavior compromises RE target achievement.

Excessive penalties would lead to substantial risks for bidding participants and high bid prices; bidders would anticipate the risks of penalties in case of delays or non-realization, and price them in the submitted offers.

Examples of penalties include: the execution of financial guarantees if the project is delayed/cancelled or the signing of the PPA is delayed, the cancellation of the PPA, exclusion of the bidder and/or project from future rounds, and a reduction in the remuneration period or level. In Mexico, RE producers that fail to achieve commercial operation in time must increase the performance bond, pay liquidated damages, and cover their contracted supply obligations through spot market purchases.[35] In Peru, the under-production of electricity is disincentivized by reducing the contract price by the same percentage. Electricity that is over-produced is sold at the electricity spot market price, which is typically lower than the agreed-to PPA price.[36]

AVOIDING COLLUSION. Collusion, or the unwanted strategic bid coordination by bidders, can lead to higher prices and drive bidders out of the market. Collusion is more likely to occur if there is limited competition, high market concentration with dominant actors, or a small market with high bidder visibility. In 2018, the auctioneer in Greece cancelled a solar PV auction after prequalified projects appeared to be owned by a few companies that seemed to coordinate their bids in the dynamic auction to drive up prices.

Static sealed-bid auctions[37] are less vulnerable to collusion and bidder coordination than dynamic auction formats. In addition, quantitative, price-only award criteria give influential, well-connected bidders fewer opportunities to influence auctioning authorities in the bid evaluation phase than qualitative multi-criteria auctions since the award criteria leave less room for interpretation. In case of multi-criteria auctions, as in South Africa, a clearly communicated methodology for evaluation and transparent scoring has proved important. Last, clear and transparent auction rules that foster as much participation in the auction as possible help limit unwanted strategic bidding behavior.

INDUSTRY TRENDS IN AUCTIONS

Countries can consider implementing **more complex auction designs** as they gain experience with the mechanism and the local market matures. Table 1 summarizes how different power system goals can be addressed in more complex auction design.

TABLE 1. POWER SYSTEM GOALS AND AUCTION DESIGN

POWER SYSTEM GOAL	AUCTION DESIGN ELEMENT
Bringing in new generation capacity. Taking advantage of declining prices. Encouraging private investment.	Multiple rounds of competitive auctions
Enabling both thermal and RE to compete against one another.	Multi-technology and technology-neutral auctions
Making power available at specific times.	Time-based incentives (e.g., time-of-day blocks, seasonal blocks)
Least-cost generation and transmission.	Zonal developments
Addressing grid constraints. Matching electricity output with nearby load centers.	Location-based incentives/signals
Addressing grid integration concerns. Increasing dispatchability.	Ancillary services, storage
Creating jobs locally and/or nationally.	Qualification requirements, multi-criteria auctions

Two auction design elements deserve greater attention: time- and location-based incentives, and multi-technology and technology-neutral auctions.

TIME- AND LOCATION-BASED INCENTIVES

Time-based incentives aim at matching generation as closely as possible with electricity demand. These measures help improve the efficiency of the overall system since generation is incentivized at the time when demand is highest. Policymakers should consider that generation from variable RE can be steered to match demand only to a certain extent.

Locational incentives aim at steering the construction of projects to specific areas to avoid the concentration of projects in resource-rich but potentially difficult-to-connect areas. Site-agnostic schemes tend to concentrate the development of projects to resource-rich locations, which can overload the grid infrastructure and create competition for land use. Locational incentives might include a bonus/penalty to bids located in areas with available/insufficient grid capacities, RE development zones, and maximum capacity quotas in certain areas.

MULTI-TECHNOLOGY AND TECHNOLOGY-NEUTRAL AUCTIONS

In general, a **technology-neutral** or **multi-technology auction** leads to a higher static efficiency ("lower costs") than a technology-specific auction. Several countries have tested the suitability of multi-technology and technology-neutral auctions. In 2017, Chile introduced technology-neutral auctions that included both conventional and RE plants. Bidders bid into hourly and seasonal time blocks, reflecting different power system needs. This design enabled RE projects to win 100% of the offered capacity.

Policymakers should consider the challenges associated with the design and outcomes of technology-neutral auctions. This type of auction leads to the procurement of the technology with the lowest generation costs but also removes the incentive to reduce windfall profits and offer more competitive bids within the less expensive technology. Potentials for cost reductions in other RE technology segments may go unused along the value chain due to the lower dynamic efficiency and market disruption. In such settings technology-specific ceiling prices can introduce additional competition. If technology-neutral auctions are implemented, time-based incentives such as seasonal supply blocks in Chile can account for different generation profiles.

From a system perspective, technology-neutral auctions offer energy policy planners less control over the power mix, especially to procure electricity with a higher system value from their location or daily/seasonal feed-in profile. Moreover, technology-neutral auctions do not fully account for system integration costs, including those stemming from grid expansion, congestion management, and the need for back-up generation, which are different for different RE technologies.

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