CLEAN ENERGY MINISTERIAL
Accelerating the Transition to Clean Energy Technologies

IRENA
International Renewable Energy Agency

RENEWABLE ENERGY AUCTIONS

A GUIDE TO DESIGN

About IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international co-operation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity. *www.irena.org*

About CEM

The Clean Energy Ministerial (CEM) is a high-level global forum to promote policies and programs that advance clean energy technology, to share lessons learned and best practices, and to encourage the transition to a global clean energy economy. Initiatives are based on areas of common interest among participating governments and other stakeholders.

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This guidebook comprises of six chapters and can be downloaded from *www.irena.org/Publications*.

RENEWABLE ENERGY AUCTIONS

A GUIDE TO DESIGN

CHAPTERS

About the report

In 2013, IRENA carried out its first study on the topic, *Renewable Energy Auctions in Developing Countries*, which highlighted key lessons learned from developing countries that have implemented auctions, namely Brazil, China, Morocco, Peru and South Africa. The report presented an analysis on auction design options, as well as best practices on the implementation of auctions in the form of recommendations for policy makers. Furthermore, IRENA's *Adapting Renewable Energy Policies to Dynamic Market Conditions* report reiterated the importance of auctions in today's electricity markets.

Building on this work, the present guidebook assists policy makers in understanding the implication of different approaches to renewable energy auctions. Structured around four key design elements, it offers a range of choices and makes recommendations to facilitate optimal decision-making in a given context. The analysis focuses on potential challenges that need to be addressed, and the guidebook assesses alternatives that may be considered for each auction design element. Achieving objectives of renewable energy policies, such as cost-effectiveness, security of supply, and contributions to socio-economic development, among others, is thoroughly discussed. The guidebook presents the main trade-offs involved in decisions on auction design (*e.g.* between reduction of barriers to entry and discouragement of underbuilding, or between design simplicity and the ability to reflect exact preferences regarding the technology mix and spatial distribution of the renewable energy capacity to be contracted) and offers guidance on how to find an optimal balance that takes into account the objectives and circumstances of each jurisdiction.

The analysis is supported by specific country experiences, representing different contexts and circumstances, and offers lessons learned and best practices on how governments can design and implement auctions to meet their objectives. Divided into six chapters, this guidebook supports policy-makers in designing renewable energy auctions tailored to their needs.

Chapter 1 (Summary for Policy Makers) synthesises the findings and presents the main conclusions and policy recommendations for the design of auctions.

Chapter 2 (Renewable energy policies and auctions) contextualises auctions within the larger realm of renewable energy support schemes. It provides an overview of recent international trends in renewable energy policies, highlighting the role that auctions have been playing in many electricity markets worldwide. This analysis is complemented by an overview of the key strengths and weaknesses of auctions.

The next four chapters discuss different components that make up a renewable energy auction scheme, presenting analyses of past experiences and lessons learned. The key elements of auction design have been classified into four categories, each of them analysed in a separate chapter.

Chapter 3 (Auction Design: Demand) addresses design alternatives involving the auction demand, which comprises key decisions on what exactly is to be purchased in the auction, and under what conditions.

Chapter 4 (Auction Design: Qualification Requirements) analyses the qualification requirements to determine which suppliers are eligible to participate in an auction, as well as the conditions with which they must comply and the documentation required prior to the bidding stage.

Chapter 5 (Auction Design: Winner Selection) discusses design choices regarding the winner selection, which is at the heart of the auction process and involves handling the bidding and clearing rules, as well as awarding the winners' products.

Chapter 6 (Auction Design: Sellers' Liabilities) addresses the seller's liabilities, primarily associated with the characteristics of the product being auctioned, along with responsibilities and obligations stipulated in the auction documents.

The geographical scope of the work is global, as the recommendations from the guidebook could apply to all countries that are considering adopting auctions schemes. The report is focused on electricity, and mostly on solar and wind auctions.

Glossary

The following definitions reflect the nomenclature used by the International Renewable Energy Agency (IRENA) and are strictly related to the renewable energy industry; definitions used by other organisations and publications may vary.

Auction: Auctions refer to competitive bidding procurement processes for electricity from renewable energy or where renewable energy technologies are eligible. The auctioned product can be either capacity (MW) or energy (MWh).

Auction demand bands: Different categories within the total demand of an auction that require specific qualification requirements for submitting the bid (*e.g.* demand bands dedicated to specific technologies, project sizes, *etc.*).

Auctioned volume: The quantity of installed capacity (*e.g.* MW) or electricity generation (*e.g.* MWh) that the auctioneer is aiming to contract through the auction.

Auctioneer: The entity that is responsible for setting up the auction, receiving and ranking the bids.

Bid: A bidder's offer for the product awarded in the auction – most usually a power purchase agreement for the renewable energy generation or capacity.

Bidder: A physical or juridical entity that submits its offer in the auction process. Also referred as project developer, seller.

Levelised cost of electricity (LCOE): The constant unit cost of electricity per kWh of a payment stream that has the same present value as the total cost of building and operating a power plant over its useful life, including a return on equity.

Power Purchase Agreement (PPA): A legal contract between an electricity generator (the project developer) and a power purchaser (the government, a distribution company, or any other consumer).

Project developer: The physical or juridical entity that handles all the tasks for moving the project towards a successful completion. Also referred as seller and bidder, since the developer is the one who bids in the auction.

Off-taker: The purchaser of a project's electricity generation.

Overcontracting capacity: Contracting more capacity than the auction volume.

Underbidding: Offering a bid price that is not cost-recovering due to high competition and therefore increasing the risk that the projects will not be implemented.

Underbuilding: Not being able to bring the project to completion due to underbidding.

Undercontracting capacity: Contracting less capacity than the auction volume.

Acronyms

ANEEL	Agência Nacional de Energia Elétrica (Brazil)
BNEF	Bloomberg New Energy Finance
BNDES	Brazilian National Development Bank
CCEE	Câmara de Comercialização de Energia Elétrica (Chamber for Commercialisation of Electrical Energy, Brazil)
COD	Commercial Operation Date (or deadline)
CSP	Concentrated Solar Power
DEA	Danish Energy Authority
DEWA	Dubai Energy and Water Authority
DOE	Department of Energy (South Africa)
EIA	Environmental Impact Assessment
EC	European Commission
EPC	Engineering, Procurement and Construction
EPE	Empresa de Pesquisa Energética (Energy Research Company, Brazil)
EU	European Union
FEC	Firm Energy Certificates
FIP	Feed-In Premium
FIT	Feed-In Tariff
GDP	Gross Domestic Product
GNI/CAP	Gross National Income per Capita
IEA	International Energy Agency
IOU	Investor-Owned Utility
IPP	Independent Power Producer
kWh	kilowatt-hour
LCR	Local content requirements

MASEN	Agence Marocaine de l'énergie Solaire (Moroccan Agency for Solar Energy)
MEMEE	Ministry for Energy, Mines, Water and the Environment (Morocco)
MEN	Ministerio de Energía y Minas de Perú (Ministry of Energy And Mines of Peru)
MME	Ministério de Minas e Energia (Ministry of Mines and Energy, Brazil)
NDRC	National Development and Reform Commission (China)
NEA	National Energy Administration (China)
NERSA	National Energy Regulator of South Africa
NFFO	Non Fossil Fuel Obligation (UK)
NREAP	National Renewable Energy Action Plan
NREL	National Renewable Energy Laboratory
NSM	National Solar Mission (India)
PPA	Power Purchase Agreement
PROINFA	Programme of Incentives for Alternative Electricity Sources (Brazil)
PV	Photovoltaic
RAM	Renewable Auction Mechanism
REC	Renewable Energy Certificate
RPO	Renewable Purchase Obligation
RPS	Renewable Purchase Standard
REIPPP	Renewable Energy Independent Power Producer Procurement (South Africa)
TSO	Transmission System Operator
VGF	Viability Gap Funding
WTO	World Trade Organisation

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1

SUMMARY FOR POLICY MAKERS

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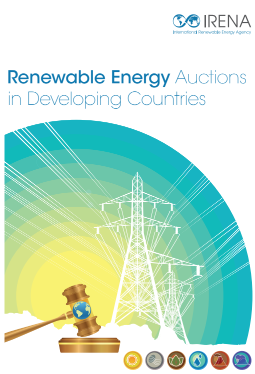
1 Summary for Policy Makers

A global energy transition is underway, with the reality of a sustainable energy system based on renewables beginning to emerge. As of today, 164 countries have set renewable energy targets and have adopted support policies to address market failures in an effort to help reach them[1]. These policies typically aim to promote the deployment of renewable energy while achieving broader development objectives, including socio-economic benefits such as income generation and job creation. Indeed, IRENA estimates that by the end of 2014, there were 7.7 million jobs worldwide in the renewable energy sector, excluding large hydropower[2].

1.1 TRENDS IN RENEWABLE ENERGY POLICY

Despite the extensive experience in policy design acquired over the past decade, the need to craft and implement tailored policies as well as learn from past experiences remains important in addressing prevalent barriers to renewable energy deployment. Recently, factors that influence policy-making have shifted dramatically. These include the rapid decline in the costs of renewable energy technologies, approaching grid parity and the growing share of variable renewable energy.

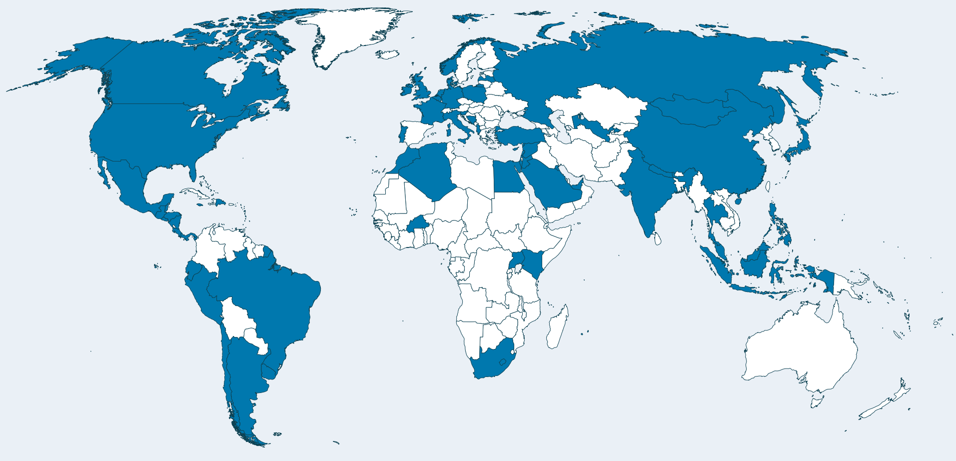
To account for these dynamics, support mechanisms need continual adaptation to maintain a stable and attractive environment for investments in the sector while ensuring the long-term reliability of the energy system in a cost-effective manner (IRENA, 2014a). In this context, auctions have become increasingly popular, often being the preferred policy – alone or in combination with other measures - to provide incentives to renewable energy deployment. The number of countries that have adopted renewable energy auctions increased from 6 in 2005 to at least 60 by early 2015 (Figure 1.1).



IRENA's 2013 report *Renewable Energy Auctions in Developing Countries* demonstrated the effectiveness of auctions in selected markets. Building on this work, IRENA has produced the guidebook, *Renewable Energy Auctions: A Guide to Design,* which analyses the different auction design elements and highlights best practices for policy makers and investors. This *Summary for Policy Makers* highlights the main findings and provides recommendations to guide decision-making on the design and implementation of auctions.

[1] *IRENA (2015), Renewable Energy Targets Setting*
[2] *IRENA (2015), Renewable Energy and Jobs – Annual Review 2015*

Figure 1.1: Countries that have implemented renewable energy auctions by early 2015 (in blue)



Source: Based on data from REN21, 2015

The designations employed and the presentation of material in this map do not imply the expression of any opinion on the part of IRENA concerning the legal status of any region, country, territory, or area, or concerning the delimitation of frontiers or boundaries.

1.2 STRENGTHS AND WEAKNESSES OF AUCTIONS

Renewable energy auctions are also known as "demand auctions" or "procurement auctions", whereby the government issues a call for tenders to procure a certain capacity or generation of renewables-based electricity. Project developers who participate in the auction typically submit a bid with a price per unit of electricity at which they are able to realise the project. The auctioneer evaluates the offers on the basis of the price and other criteria and signs a power purchase agreement with the successful bidder.

The increasing interest in auction schemes is driven by their ability to achieve deployment of renewable electricity in a well-planned, cost-efficient and transparent manner while also achieving a number of other objectives. The strengths of auctions lie in their i) flexibility, ii) potential for real price discovery, iii) ability to ensure greater certainty in price and quantity and iv) capability to guarantee commitments and transparency.

Flexibility. Auctions are flexible in their design, allowing the possibility to combine and tailor different design elements to meet deployment and development objectives. Therefore, one of the mechanism's strengths is its ability to cater to different jurisdictions reflecting their economic situation, the structure of their energy sector, the maturity of their power market and their level of renewable energy deployment.

Real price discovery. A key strength of auctions is their effectiveness as mechanisms of price discovery. A good auction design brings out the real price of the product being auctioned in a structured, transparent and, most importantly, competitive process. This addresses the fundamental problem of information asymmetry between the regulator (or any other entity responsible for determining purchase prices and support levels) and project developers. This is of particular relevance in the context of procurement of and support to renewable energy, given that these technologies are still evolving at a significant pace and also considering the development of local supply chains and the maturity of the market.

Greater certainty regarding prices and quantities. Auctions allow policy makers to control both the price and quantity of renewable energy produced by providing stable revenue guarantees for project developers (similar to the feed-in tariff) while at the same time ensuring that the renewable generation target is met more precisely (similar to quotas and tradable green certificates). Therefore, both investors and policy makers benefit from greater certainty on the future outcome of the policy.

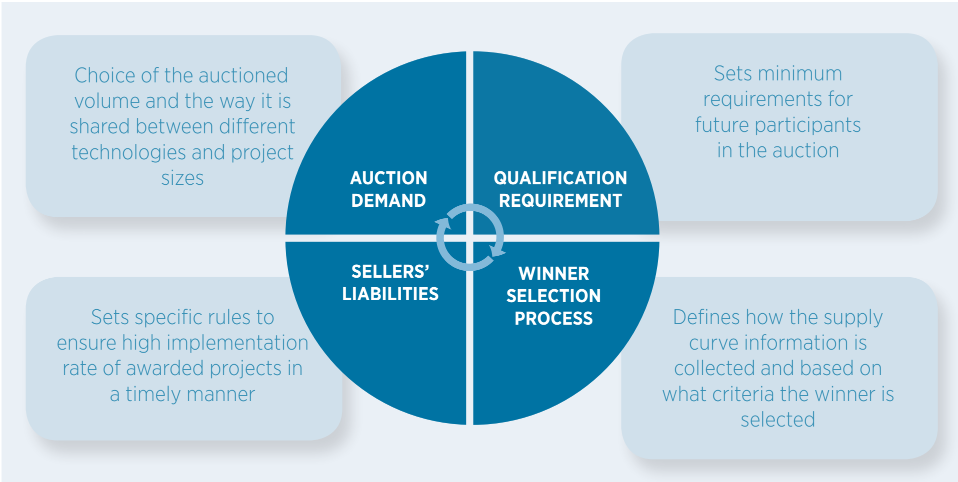
Commitments and transparency. Another feature of auctions is that they result in a contract between two entities that clearly states the commitments and liabilities of each party. This type of structure can offer greater regulatory certainty to investors, minimising the likelihood that their remuneration would be challenged in the future even as the market and policy landscapes change. Furthermore, by ensuring a transparent, fair, open and timely procurement process, an auction minimises the risk of market distortion and the possibility that the consumer would overpay for the product. However, auctions are normally associated with relatively high transaction costs, for both the bidders and the auctioneer, and with a certain risk of underbuilding and delays.

Relatively high transaction costs associated with the administrative procedures necessary to take part in the auction (*e.g.*, qualification arrangements) may constitute potential barriers to the participation in the bid, especially for small and/or new players, thereby reducing competition. Transaction costs incurred by the entity in charge of organising and holding the auction are also occasionally mentioned as a weakness of this scheme.

Risk of underbuilding and delays. Another potential weakness of auctions relates to underbuilding and delays in the construction. Overly aggressive bidding in the competitive environment of the auction can be traced to a variety of factors, from excessive optimism about the evolution of technology costs to the underestimation of financial consequences in case of project delays.

The extent to which each of the above-mentioned strengths and weaknesses will affect the results of any given auction depends largely on design choices (Figure 1.2) and how well adapted they are to the circumstances and specific country context of the auction. To increase deployment in a cost-efficient way and meet development

Figure 1.2: Categories of auction design elements



objectives, the auctioneer can tailor and combine different design elements, which can be categorised as the auction demand, the qualification requirements, the winner selection process and the sellers' liabilities (Box 1.1). Each of these categories and its constituent design elements are discussed in a dedicated chapter of this guidebook.

The potential of an auction to achieve deployment in a cost-efficient way is of particular relevance in the context of procurement of renewable energy, given that the technology is still evolving at a significant pace. For a successful auction, its design should ensure: i) increased competition among participating bidders in order to bring the prices down; and ii) that the participation in the auction is limited to bidders that have the capacity to implement projects at the contracted price in the given timeframe while contributing to the broader development goals.

1.3 INCREASING COMPETITION FOR A COST-EFFICIENT MECHANISM

The level of competition in the auction is determined by the diversity of technologies that can compete, the volume that is auctioned, and the level of participation of bidders in the auction. In addition, the prevention of collusive behaviour among bidders and the manipulation of prices need to be ensured, especially when the competition is limited, in order to maximise the cost-efficiency of the auction.

Diversity of competing technologies

The level of competition in the auction is initially determined by the diversity of technologies that can compete. In technology neutral auctions, different technologies compete among each other, which enables the deployment of the least-cost technologies. For instance, in Brazil, renewable energy technologies were competing

BOX 1.1: CATEGORIES OF AUCTION DESIGN ELEMENTS

The **auction demand** refers to the choice of the volume auctioned and the way it is divided between different technologies and project sizes. There are various arrangements - technology-neutral auctions or technology-specific auctions, and standalone or systematic auctioning schemes - that can define how the penetration of renewables in the generation mix will take place. Other considerations include the allocation of costs and responsibilities among different stakeholders (see Guidebook Chapter 3).

The **qualification requirements** determine which suppliers are eligible to participate in the auction, including the conditions they must comply with and documentation they must provide prior to the bidding stage. This category encompasses requirements related to reputation, equipment, production site selection, securing grid access, and instruments to promote local socio-economic development (see Guidebook Chapter 4).

The **winner selection process** is at the heart of the auction procedure, and it involves the application of the bidding and clearing rules, as well as awarding contracts to the winners. This category covers the bidding procedure, the requirements of minimal competition, the winner selection criteria, the clearing mechanism and marginal bids, and the payment to the auction winner (see Guidebook Chapter 5).

The **sellers' liabilities** are primarily associated with the characteristics of the product being auctioned, along with certain responsibilities and obligations stipulated in the auction documents. This category of design elements involves commitments to contract signing, contract schedule, remuneration profile and financial risks, nature of the quantity liabilities, settlement rules and underperformance penalties, and the delay and underbuilding penalties (see Guidebook Chapter 6).

directly with natural gas in 2011 and the price of wind energy was much lower than expected.

Auctions can also be limited to selected technologies (see Guidebook Section 4.2) to support their development or to reach specific renewable energy deployment. For example, auctions held under India's National Solar Mission focused on concentrated solar power and photovoltaic specifically. As such, India committed to a systematic auctioning scheme that promoted competition within each technology.

Apart from increasing competition, technology-neutral auctions reduce the risk of undercontracting due to the high level of participation of potential project developers in the bid. Technology-specific auctions have the potential to further reduce prices due to the resulting development of the technology, as well as provide additional guidance to developers. Table 1.1 highlights the impact of technology requirements on the outcome of the auction.

Table 1.1: Summary comparison of technology requirements

Criteria / Options	Technology specific auctions	Technology natural auctions
Simplicity	Straightforward division of demand	Rules to compare different bidders competing in the same demand band
Guidance from auctioneer	Strict criteria for each category	Bidders are treated equally, with more relaxed guidance
Promotion of competition	Competition only within a single technology	Seeks the most cost-effective technologies
Avoided under contracting	Any of the sub-auctions might fail to attract bidders	High flexibility in matching bids to demand bands

Characteristics of the relevant attribute: *Poor* *Medium* *Very good*

Separating the auctioned volume in different products by imposing different qualification requirements is referred to as defining the auction demand bands (see Guidebook Section 3.1). In addition to segmenting demand by the type of renewable energy technologies, many other different criteria have been used, such as project sizes, locally manufactured versus internationally manufactured equipment *etc*. In India, for instance, a specific share of the total volume of photovoltaic auctioned is meant to be developed through locally manufactured equipment. Other auctions have defined demand bands on the basis of the generation profiles. In the Californian scheme (Box 1.2), for example, the auction demand is split into three different categories. Even though each category might favour specific technologies, a project can choose to participate in any of the bands defined: i) baseload electricity; ii) peaking electricity; and iii) non-peaking electricity. These auctions have resulted in a major representation of wind power in the non-peaking category and a total dominance of photovoltaic in the peaking group.

BOX 1.2: COMPETITIVE DEMAND BAND AUCTIONS IN CALIFORNIA

- Auction demand bands are defined according to the generation profile:
  i. Baseload electricity (*e.g.* biomass, biogas, geothermal)
  ii. Peaking electricity (*e.g.* solar PV, solar thermal)
  iii. Non-peaking intermittent (*e.g.* wind, smal hydro)
- The bands are competitive, since a generator car bid in any band.

Volume auctioned

Aside from determining the eligible technologies, the level of competition in the auction is also influenced by the volume auctioned. One of the challenges for the auctioneer is deciding on the number of rounds and the volumes to auction in each round. Auctioning a large volume at once allows for rapid capacity addition in economies that experience fast energy demand growth. However, it might result in a lack of competition, especially in markets with a small number of project developers. A case in point is South Africa's 2011 auction, where the first round was not very successful in enhancing competition, given that the volumes auctioned were not defined for the different demand bands. There was no capacity limit attributed to this first phase other than the 3 725 MW target for the entire programme (involving five rounds), which meant that demand far outstripped supply. In the second round, a volume cap was set, leading to strong competition and a reduction in prices.

The volume auctioned does not necessarily need to be fixed. Price-sensitive demand curves can be used to contract more than the minimum quantity required when the auctioned price is low, leading to optimal quantity and price (see Guidebook Section 3.2). This option is favourable when the cost of technology is changing at a fast pace and the government faces the risk of misestimating the price of developing projects (for example solar PV). In this case, the volume contracted can be increased from the initial plan. Price-sensitive demand curves may be defined, for example, by determining a total budget for renewable energy expansion which results in the auction demand being inversely proportional to the equilibrium price, as in the case of Netherlands (Box 1.3).

BOX 1.3: PRICE SENSITIVE VOLUME AUCTIONED IN THE NETHERLANDS

Auctions in the Netherlands are based on a well-defined annual budget since 2011 and they are technology-neutral. For each round, the government sets support levels that increase from one round to the next. In 2013, for example, these were 70 EUR/MWh (92 USD/MWh) for the first round, 80 EUR/MWh (105 USD/MWh) for the second round, 90 EUR/MWh (119 USD/MWh) for the third round*, etc.*

This way, low-cost renewable energy technologies are the first to submit their bids and be granted financial support, as the selection takes place on a "first come, first served" basis. Renewable energy technologies with higher costs can participate in subsequent bidding rounds, which are held until the maximum amount of the available budget has been allocated - EUR 1.5 billion in 2011 (USD 2.085 billion); EUR 1.7 billion in 2012 (USD 2.17 billion); EUR 2.2 billion in 2013 (USD 2.9 billion); and EUR 3.5 billion in 2014 (USD 4.655 billion) distributed over the lifetime of the plants. Therefore, bidders waiting for a higher remuneration level round risk having the auction's budget exhausted before reaching that round.

Level of participation of bidders

Reducing entry barriers for potential bidders and their perception of associated risk contribute to spurring competition by increasing the number of participants in the auction. Encouraging the participation of a large number of bidders also reduces the risk of collusion.

Reducing entry barriers

The auctioneer can increase competition by reducing barriers to entry for potential bidders. This can be done by: introducing qualification requirements and compliance rules that correspond to the conditions of the market; reducing administrative procedures and transaction costs; and providing timely and comprehensive information to bidders.

Imposing qualification requirements and compliance rules for the participation in the auction allows the auctioneer to restrict competition to bidders who have the capability to deliver the quantity of energy promised in the contract in a timely manner. However, if too stringent, these requirements could pose an entry barrier for small and/or new market players. In the case of the 2009 auction in Peru, strict compliance rules limited the participation in the bid to only 27 bidders (Box 1.4).

BOX 1.4: COMPLIANCE RULES AND DELAY PENALTIES IN PERU

In Peru's auction that started in 2009, bidders are required to deposit several guarantees, including a bid bond of USD 20,000/MW of capacity installed which is lost if the bid is won but the bidder fails to sign the contract. At a later stage, a performance bond of USD 100,000/MW of capacity installed is required.

If delays occur in the construction phase for two consecutive quarters, penalties are deducted from the deposited guarantee. In the case of delays to the start of commercial operation of the plant, the performance bond is increased by 20% over the outstanding amount from the date of verification. The project developer may request to postpone the date of the commercial operation provided that it is within a defined deadline and no longer than three months. If the accumulated delay exceeds one year from the date specified in the bid, the government can choose to accept postponing the deadline accompanied by an increase in the performance bond by 50%. If it chooses not to, the contract is fully terminated.

Entry barriers can be reduced with the government's providing the needed resource assessments, feasibility studies and permits to the bidders, that reduce transaction costs. The auctioneer can also streamline administrative procedures by simplifying processes or setting up a one-stop-shop for collecting or submitting documents. For instance, responsibility of securing grid access and siting permits is normally undertaken by the government, such as in the case of France offshore wind auction in 2011. The auctioneer took on the responsibility of selecting the most appropriate site, including grid access and maritime permits, assisted in the logistical arrangements for the delivery of parts and set up a one-stop-shop for administrative procedures. The same approach was taken in the Danish offshore wind auction (Box 1.5).

Finally, the auctioneer must define fair and transparent rules and obligations for all stakeholders and any additional information or adjustments about the bid must be clearly communicated to all the competitors equally. This is crucial to encourage the participation of a higher number of bidders. For example, in South Africa, a conference is organised at the beginning of the auction and a dedicated website is set up that enables the government to communicate any changes to all market agents equally.

BOX 1.5: CENTRALISED PROJECT LICENSING IN DENMARK

Denmark is planning an auction for near-shore wind farm projects in which the government is responsible for selecting a large number of candidate sites, only a few of which will be contracted. Six near-shore sites compete in this first round to host a total of 350 MW (it is expected that three sites will be contracted).

The transmission system operator will carry out environmental impact assessments and conduct preliminary surveys for all six sites. These include geophysical and geotechnical surveys (wind, current, tidal and wave conditions). The surveys are planned in a way that the results are published before the completion of the tendering procedure, informing bidders of the conditions and risks of building at the sites. This considerably facilitates the work of project developers, encourages their participation in the bid and lowers their costs.

Reducing the perception of risk

In addition to addressing entry barriers, reducing investors' risk perception can contribute to increasing the level of participation. This can be done by ensuring that the demand-side responsibilities will be met (*e.g.* the reliability of the contract off-taker), by mitigating the risks related to the financial market (inflation and currency exchange) and increasing certainty and regularity in the way the auction rounds are scheduled.

At the outset, the government needs to ensure that the demand-side responsibilities will be met, by considering the reliability of the contract off-taker, the type of contracting scheme and the allocation of cost (see Guidebook Section 3.4). When the utilities are creditworthy, selecting them as the off-takers offers sufficient guarantees to project developers. Another potential off-taker could be the government itself.

In addition, the type of contracting scheme also affects the confidence of project developers. For example, investors' risk perceptions can be reduced by opting for a contract for engineering, procurement, and construction (EPC) of a power plant without the obligation to operate and maintain it over an extended period of time. Such a scheme was successfully implemented in Morocco for wind and hydro until 2010. Another contracting scheme could be to involve the government in the project's equity –such as in the Dubai solar power auction in 2014, where the Dubai Electricity and Water Authority (DEWA) has a mandated 51% equity share in the project. As for the allocation of costs, the selected design impacts the outcome in different ways. In most instances, the cost of the scheme is passed on to the consumers, and the risk perception usually depends on the credibility of the distribution companies and whether they have stable schemes in place to ensure collection of the consumers' payments. Table 1.2 summarises the benefits of each option.

Table 1.2: Summay comparison of cost allocation and contract off-taker

	Contract off-taker		Allocation of costs	
Options / Criteria	Independent entities: *e.g.* utilities	Government-backed contracts	Passed-through to consumers	Fully subsidised by the state
Investors' confidence	May have issues with credit-worthiness	Usually very credible	As long as tariffs are cost-reflective	As long as state companies are solvent
Simplicity	Experience in collecting tariffs	Greater bureaucracy	Utilities usually collect tariffs	Centralised payments

Characteristics of the relevant attribute: *Poor* *Medium* *Very good*

Investor confidence can also be enhanced through different methods of allocating financial risks related to exchange rate and/or inflation that can impact income throughout the contract period (see Guidebook Section 6.3). There are straightforward escalation clauses that can be used to reduce those risks. For example, in Chile, the auctioned contracts are denominated in US dollars and adjusted periodically according to the United States' Consumer Price Index– which implies that developers are shielded from both interest rate risks and inflation risks. A similar scheme is applied in Brazil, where contracts are nominated in Brazilian Reals but adjusted yearly for domestic price inflation. In contrast, in India, the contracts offered have so far been nominated in Indian rupees with no adjustment for inflation. These methods differ essentially in the risk allocation between consumer and project developer and as a result, in the price.

Finally, the use of systematic auctioning schemes increases investors' confidence by ensuring a commitment to an auctioning schedule with planned rounds. This option allows market agents to better adjust their expectations and plan for longer term. This, however, carries a risk of over commitment, in which case it may be possible to dynamically adjust the auction schedule and quantities according to perceived shifts in the market conditions. Another advantage of splitting demand into several auctions according to a long-term plan is the steep learning curve from the first few rounds, for both the project developers and the auctioneer. Box 1.6 shows the benefits of implementing auctions regularly in South Africa and India.

Preventing collusion and price manipulation

The most effective way of ensuring cost efficiency in an auction implementation is to steer competition. When competition is significant – with a large number of bidders with similar cost structures and risk preferences – opportunities for collusion decrease dramatically. Yet, when there is uncertainty in the number of participants in the auction or when achieving high competition is not possible, explicit measures may be adopted to prevent collusion and price manipulation.

Bidding procedure and payment to the auction winner

A well-chosen design of the bidding process (see Guidebook section 5.1) could make collusion more difficult. In general, policy makers should avoid revealing too much information on the auction demand. Attempts to prevent communication and exchange of information among bidders during the auction can also be made.

» Sealed-bid processes are straightforward and potential suppliers are required to provide their bid information directly to the auctioneer. Typically, offers are kept undisclosed until the day of the auction to prevent players from getting an advantage through privileged information. It makes the exchange of information and the explicit or tacit co-ordination among bidders more difficult. This is also the case in hybrid designs with a sealed-bid auction step.

BOX 1.6: REGULAR AUCTIONING SCHEME IN SOUTH AFRICA AND INDIA

South Africa and India have committed to a particular auction schedule and the experience seems to indicate a success of this strategy, as illustrated in Table 1.3.

In South Africa, the Renewable Energy Independent Power Project Procurement Programme was changed from a standalone tender to a rolling series of bidding rounds. The commitment to multiple rounds has had a significant impact in terms of building confidence among bidders and learning by doing. Between the first and second round, the number of bids received increased by 49%, the percentage of qualifying bids increased from 53% to 64% and the price dropped by 39% for photovoltaic and 23% for wind.

The National Solar Mission in India aimed to support the development of the solar power sector and committed to a systematic auctioning scheme. Between the first and second round, the total capacity offered in the bids increased by 100%, the percentage of projects installed in a timely manner increased from 89% to 100%, and the price dropped by 28%.

Table 1.3: Systematic auctions and the learning curve impact

Country	Renewable energy technology	First iteration	Second iteration	Learning curve impact
South Africa	Various	2011: 53% bids qualified	2012: 64.5% bids qualified	11% increase in bid qualification rate
India	Solar PV	2010: 12.16 INR/kWh	2011: 8.77 INR/kWh	28% decrease in contracted price

» Iterative processes, in contrast, allow bidders to only gradually disclose their bid information during the auctioning rounds. The most common way to implement this type of scheme is via a so-called descending clock auction. In the case of Brazil (see Box 1.7), the auctioneer proposes a new, slightly lower price in each round and the participants make their offers for the decremented price. This iterative process continues until supply and demand match. As such, this type of dynamic revision typically relies on information being disclosed by the auctioneer at every bidding round. If bidders have information on the supply-side quantity at each round, they can bid strategically in an attempt to end the auction prematurely and increase their own remuneration.

BOX 1.7: THE BRAZILIAN HYBRID AUCTIONS

In its auction process, Brazil has combined a descending-clock auction followed by a pay-as-bid round. The auctioneer iteratively decreases prices, collecting investor's quantity bids, until a point when overall supply is greater than demand by a certain factor, unknown to the bidders. After this, a sealed-bid auction takes place.

Table 1.4 summarises the impact of different bidding procedures on the outcome of an auction. By defining how the winner's remuneration is related to the bid price (see Section 5.5), policy makers can prevent participants from strategically bidding.

Table 1.4: Summary comparison of bidding procedures

Options / Criteria	Sealed-bid process	Iterative process	Hybrid process
Simplicity	Straightforward	Requires gathering all the bidders	More difficult to implement and communicate
Transparency and fairness	Possibly opaque mechanism once offers are opened	Open real-time information	Ensured by the iterative phase
Bidders' ability to react	Information must be disclosed beforehand	Gradual disclosure of information, allowing agents to respond	Only during the iterative phase
Prevention of collusion and price manipulation	Undisclosed information makes bid coordination more difficult	Bidders may force the auction to terminate early	Second phase makes collusion more difficult
Matching supply and demand	Supply and demand curves fully known	Requires some assumptions for optimal results	Supply and demand curves fully known in the second phase

Characteristics of the relevant attribute: *Poor* … *Medium* … *Very good*

In pay-as-bid schemes, the bidders do not seek to simply win the auction, but rather to win it while submitting the highest possible bid – implying that estimating other players' bids plays an important role. In marginal pricing schemes, by making project developers' remuneration essentially independent from their bid price, bidders are encouraged to disclose their actual costs.

Ceiling price mechanism

The adoption of ceiling prices is aimed to prevent exceedingly high prices that could result from collusion. Although effective at maintaining the price below a given limit, determining the price ceiling can be challenging, as setting a price that is too low can adversely limit competition to big players (able to bid at prices lower than the ceiling). The auctioneer still needs to decide whether the ceiling price should be disclosed prior to the auction.

Full disclosure tends to involve a slightly greater degree of transparency, but may result in bids that are just below the ceiling price (in the case of limited competition). Maintaining the ceiling price undisclosed however, can result in disqualification of otherwise sound bids that are only slightly higher than the ceiling price. By introducing a ceiling price, there is an upfront acknowledgement of a risk that the auction scheme may not fulfil its intended role of achieving low prices and that, as a result, the auctioned volume will not be fully contracted (see Box 1.8).

BOX 1.8: PRICE CEILINGS IN SOUTH AFRICA AND INDIA

- In South Africa, the disclosure of the ceiling price combined with the lack of a strict volume cap resulted in high prices. The subsequent rounds, with undisclosed ceiling prices and well-defined volume caps, led to significantly lower prices.
- The intense competition in the Indian auction meant that the "anchoring" caused by the disclosed price caps was of little concern.

1.4 ENSURING THAT PARTICIPATION IS LIMITED TO BIDDERS THAT CAN SUCCESSFULLY MEET THE AUCTION'S GOALS

While auctions have been successful in triggering competition and ensuring cost effective renewable capacity additions, experience shows that certain design elements are essential to ensure that: i) participation is limited to bidders that have the capacity to deliver the quantity of energy promised in the contract in a timely manner; ii) the projects are selected in a way that fulfils the country's renewable energy deployment goals; and iii) socio-economic objectives can be reached. Such design elements include qualification requirements to participate in the bid, criteria in selecting the auction winner and rules that project developers must comply with after being selected.

Ensuring the successful development of the renewable energy project

Qualification requirements can be a means to ensuring that the bidders have the financial, technical and legal capability to develop the project. Once the winner is selected, compliance rules are important to ensure a timely development of the renewable energy projects. Imposing qualification requirements and strict compliance rules can help reduce the risk of underbidding. Such requirements have been successful in preventing speculative bidding in many jurisdictions. In the state of California, project viability requirements have been set to prevent speculative bidding and limit the participation to projects that can demonstrate economic viability, using information on developer experience, project location, interconnection studies and development schedule (Box 1.9).

Reputation requirements

Reputation requirements are generally associated with the information that must be provided regarding the bidding company, proving that it is adequately prepared to develop the project. These can include legal requirements, proof of financial health, agreements and partnerships and past experience requirements.

BOX 1.9: STRICT DOCUMENTATION REQUIREMENTS IN CALIFORNIA

The strict documentation requirements introduced in the Californian auction aim to:

- prevent speculative bidding;
- discourage participation of "concept only" projects;
- assess whether the price bid is realistic through the required information about site location, commercialised technology, and developer's experience.

Typically, having more constraining requirements allows the government to provide guidance and ensure a greater level of commitment by the project developer, although this could potentially hinder the participation of small players and/or new market entrants. Table 1.5 summarises the results that can be anticipated from the level of the strictness of the requirements. Box 1.10 discusses the reputation requirements for participation in Morocco's Concentrated Solar Power (CSP) auction in 2012.

Table 1.5: Summary comparison of reputation requirements

Criteria / Options	Strict reputation requirements	Lenient reputation requirements
Level of participation	○ Many potential bidders may be excluded	◕ Lower barriers to entry
Transaction costs	○ Costs for bidders (gathering documentation) and the auctioneer (revising it)	◕ Less bureaucracy
Project completion	● Higher guarantees	◔ Must rely on contractual penalties and liabilities
Guidance from Auctioneer	● Control over companies' shareholding structure and disclosure of information	○ Very little control

Characteristics of the relevant attribute: ○ *Poor* ◔ ◑ *Medium* ◕ ● *Very good*

Compliance rules

Stringent compliance rules are meant to ensure that, once the winners are selected, contracts will be signed, projects will be completed on time and the risk of under (or over) performance is reduced. They include bid bonds (see Guidebook Section 6.1); rules related to project lead times (see Guidebook Section 6.2); penalties for delays and underbuilding (see Guidebook Section 6.6); penalties for underperformance (see Guidebook Section 6.5); and the assignment of liabilities for transmission delays (see Guidebook Section 6.7).

BOX 1.10: REPUTATION REQUIREMENTS IN MOROCCO'S CSP AUCTION IN 2012

In Morocco's CSP auction in 2012, qualification requirements included proof of financial capacity, access to finance and technical experience. The lead of the consortium had to have invested in two infrastructure projects with an aggregate amount of equity and debt of at least USD 800 million within the last ten years and the bidding consortium had to have a net worth of at least USD 200 million.

As for the consortium's technical experience, the lead company had to have developed, operated and managed thermal power plant(s) in the last ten years totalling at least 500 MW, including a minimum capacity of 100 MW in the last seven years. In addition, the lead company of the consortium also had to have successfully developed and operated a minimum capacity of 45 MW thermal solar power plant without being liable for penalties or damages in performance or delay, in excess of 5% of the contract value.

A common concern of auctions is to what extent the project developer's bid is a binding commitment, since most liabilities are enforced by the power purchase agreement, which is not signed until after the auction is complete and the bidders are announced. Most auctions involve either: 1) no specific commitments at the bidding round; or 2) bid bonds, requiring bidders to provide an initial deposit that would be lost in case the selected bidder does not go through with signing the contract, as in the case of Germany (Box 1.11). Bid bond requirements reduce the risks that the winning bidder might not sign the contract, but they do not totally guarantee the bidders' reliability. Under specific circumstances, auction implementations with no bid bonds may be a reasonable choice as they are simpler to implement and more attractive to bidders.

BOX 1.11: BID BONDS IN THE GERMAN SOLAR AUCTION OF 2015-2017

In Germany's 2015-2017 solar auctions, each bidder must provide a bid bond worth EUR 4 (USD 4.47 at 2015 average exchange rate) per kW to be installed in order to be considered in the auction. This deposit is reduced to EUR 2 (USD 2.23) per kW if the bidder already has a building permit, as this eases the after-auction work and decreases the auctioneer's risk of not having a signed contract. Lowering the bid bond can also facilitate the participation of smaller players. The regulatory agency, Bundesnetzagentur, sorts the bids from the lowest to highest price, and projects are selected until the auction volume has been filled. Bids beyond the auction volume do not receive the right to remuneration for their output and get their bid bond back.

The lead time, i.e. the time given to project developers to complete the power plant before the contract begins, is a key attribute of renewable energy auctions. The degree of flexibility given to the auction winner can vary from the point that the tender documents are published to the point of contract signing. It is also possible to let bidders suggest desired lead time, taking this variable into account in the winner selection process (see Guidebook Section 5.3).

Having defined the time limit for project completion, the auction design can include elements to minimise the risk of delays and to ensure that projects are built according to the contractual schedule. Such elements include completion bonds, delay-specific penalties, clauses that determine the obligations during the delay period and contract resolution clauses. Particular attention has been given to such mechanisms due to delays in early and even some recent auctions, many of which reportedly associated with underbidding, as in the case of offshore wind in Denmark (Box 1.12).

BOX 1.12: PENALTIES IN DENMARK'S ANHOLT WIND FARM AUCTION IN 2010

The auction was designed to guarantee an installation of 400 MW of offshore wind within 20 months after the winner was announced. Bidders were incentivised to offer the lowest possible price as this was the only selection criteria. As such, strict penalties and non-compliance rules had to be applied to guarantee compliance with the schedule.

Delay time	Penalty
Up to five months	DKK 10 (USD 1.78) per MWh (around 1% reduction of the remuneration)
Between five and nine months	DKK 20 (USD 3.56) per MWh (around 2% reduction of the remuneration)
Up to one year	DKK 30 (USD 5.34) per MWh (around 3% reduction of the remuneration)
More than one year	DKK 400 million (around USD 71 million)

Note: Average 5.6 DKK/USD in 2010

If the winner chooses not to install the plant at all, the following fees apply:

Time to decide	Penalty
Up to five months from winning the contract	DKK 100 million (around USD 17.75 million)
Between six and twelve months	DKK 200 million (around USD 35.5 million)
More than one year	DKK 400 million (around USD 71 million)

In this specific auction, if the winner opted out within the first six months, the second winner could take over the contract and undertake the project within the same time frame, having an increased risk of running into penalties due to time pressure. This specification (not included in subsequent auctions), combined with high penalties for delays and a very strict time plan, resulted in low interest in the Anholt tender and a low competition level. A key lesson from this experience is that, while penalties can help to ensure project implementation, overly harsh limitations can reduce competition.

Once the project is completed, the commitments assumed by the project developer can be ensured through the inclusion of settlement rules in the design of the auction. When applied, these rules define how deviating from contractual obligations would affect the plant's remuneration. These design elements can address the following attributes: 1) frequency in assessing performance; 2) variation of contract remuneration based on over- or under-performance; and 3) revision of the quantity that was committed at the time the contract was signed.

Settlement rules are an important element of auction design primarily because of concern about perverse incentives, that might reward developers for systematically over- (or under-) estimating their generation expectations. Including settlement rules is a way of ensuring that the project developer's declarations of expected renewable energy generation are realistic and with commensurate remuneration. Brazil has implemented such sophisticated settlement rules described in Box 1.13.

BOX 1.13: BRAZIL UNDERPERFORMANCE PENALTIES AND OVER-PERFORMANCE COMPENSATIONS

In Brazilian auctions, the penalties for over- and underperformance vary depending on the renewable energy technology and the type of auction conducted. For new energy auctions, penalties for underperformance are calculated annually and in a cumulative manner every four years:

- Annual underperformance penalties are applied when the average annual generation is less than 90% of the contracted amount. In this case, the developer must pay either: 1) the product of the average spot price in that respective year and the quantity not delivered; or 2) the product of the contract price and the quantity not delivered, whichever is higher.
- Given the generation variability of some renewable energy technologies, a cumulative four-year performance assessment takes place. In this case, if the average four-year generation falls below the amount contracted, the developer must pay either: 1) the product of the average spot price of the four years and quantity not delivered; or 2) 1.06 times the contract price times the quantity not delivered, whichever is higher. The additional 6% over the contract price is a penalty for not delivering the contracted energy over the four years.

Upper limits are also established, so that any generation that surpasses the upper limit can be sold at the spot price. In the case of wind generation, the upper limit for the first year is set at 130%, for the second at 120%, for the third year at 110% and for the fourth year at 100%, after which the cycle is repeated.

There are different indicators to detect under- (or over-) performance. They can be related to capacity-oriented agreements, energy-oriented agreements or financial agreements, with different levels of associated risks (see Guidebook Section 6.4).

- Capacity-oriented agreements imply a commitment to install, maintain and operate renewable energy capacity only, with no obligation regarding the quantity of electricity generated, implying the allocation of risk to the buyer.
- Energy-oriented agreements represent a commitment to deliver a given amount of renewable energy, and they imply a more balanced risk allocation between project developers and the electricity buyer.
- Financial agreements represent a commitment to a certain generation profile and any deviations between the actual plant generation and the quantity committed in the contract must be settled at the electricity spot price. This implies that the project developer assumes the responsibilities associated with these deviations.

Ensuring that the renewable energy deployment goals are reached

Policy makers can limit participation in the auction to those projects that are aligned with the country's policies in reaching the renewable energy targets. Technological requirements can be imposed when specific renewable energy technologies are intended to be developed, and the project size requirements can be designed according to the deployment goals. Moreover, location constraints can be introduced to control the geographical distribution of renewable energy deployment, and grid access requirements can be enforced to ensure feasibility of integrating renewable generation into the system.

Technological requirements

The auctioneer can also define other technological requirements, in addition to selecting the technologies that can compete, such as specifications on the equipment used.

Imposing equipment specifications can help ensure that the sector will be developed using state-of-the-art technology and appropriate quality of components. In South Africa, for example, wind turbines had to be compliant with the international technical standard IEC 61400-1, while in Brazil, wind turbines had to be new with a minimum nominal capacity of 1.5 MW. The latter did not apply to domestically produced turbines, which could be smaller.

Project size requirements

Imposing constraints on the project size can take a form of an upper and lower bound which defines the range of installed capacity of individual projects.

Maximum and minimum size constraints can be desirable for different reasons. Implementing a minimum size constraint has the potential to increase the benefits of economies of scale and reduce the transaction costs associated with small projects, although potentially deterring the participation of small players. By contrast, a maximum size constraint can encourage the participation of smaller players (as it becomes more difficult for large projects to dominate the auction), increasing participation of bidders. In addition, small-scale renewable energy projects might sometimes be preferred as they tend to result in a better geographical dispersion, greater proximity to loads, and fewer concerns regarding environmental impacts.

In the case of Dubai, the trade-off between project size and economies of scale has been addressed by modifying the size of the project (Box 1.14).

BOX 1.14: TRADE-OFF BETWEEN MAXIMUM PROJECT SIZE AND ECONOMIES OF SCALE

In the 2014 project-specific solar auction in Dubai, the project was awarded at a very competitive price of USD 59.9 per MWh. By increasing the project size from 100 MW to 200 MW during ex-post negotiations, a further price reduction of the winning bid to USD 58.4 per MWh was possible.

Location constraints

Policy makers may add constraints regarding the sites to develop the renewable energy projects. In the absence of such constraints, project developers will select the highest-performing sites, thereby concentrating the development of renewable energy in resource-rich locations.

Imposing location constraints is usually intended to either achieve greater geographic diversity of projects, or to ensure proximity to the grid and/or loads, or to address other considerations. This can be done by introducing: i) location-specific demand bands (see Guidebook Section 3.1); ii) a "project location" component in the winner selection criteria (see Guidebook Section 5.3); or iii) a location requirement for the participating projects. For example, in the German solar PV auctions in April 2015, location requirements were introduced in order to avoid competition in the land usage between energy and food production (Box 1.15).

Grid access requirements

The consideration of grid access requirements as a precondition to participating in the auction is important to ensure the feasibility of integrating renewable generation into the grid. These requirements can take the following forms (ranging from more-lenient to strict): 1) no access permit is required to qualify to bid (auction winners obtain the permits after the auction); 2) an access permit is required before the auction, regardless of whether grid expansion or strengthening is required; and 3) an access permit is required before the auction, and only projects that do not necessitate grid expansion or strengthening are allowed to participate. One reason for including this

BOX 1.15: LOCATION CONSTRAINTS IN GERMAN SOLAR PV AUCTIONS

The large-scale construction of PV systems on arable land has been discouraged in Germany by the Renewable Energy Act since July 2010, and FITs are not offered to projects located in such areas. This resulted in the concentration of large PV systems on specific redeveloped brownfield sites or in the close vicinity of highways and railway lines. The German solar PV auction in 2015 specified that project locations will indeed be restricted to the areas already indicated in the Renewable Energy Act (brownfields). In the 2016 auctions, these restrictions will be made more flexible and the permitted project locations will include unproductive agricultural land.

requirement is that it generally takes less time to implement a renewable energy project than it does to build new transmission facilities. The possible advantages or disadvantages of each option are summarised in Table 1.6.

Ensuring socio-economic development through renewable energy deployment

In line with the country's overall objectives, policy makers can introduce design elements to maximise socio-economic benefits from renewable energy deployment. Usually these goals are reached either by imposing qualification requirements or by introducing a criteria in the winner selection process. For example, South Africa adopted both mechanisms to design its auction in a way that promotes job creation, local enterprise development, and empowerment of marginalised social groups and local communities.

Qualification requirements promoting socio-economic development

Qualification requirements to promote socio-economic development can be aimed at local industry development or local empowerment and employment.

To support the development of a nascent domestic industry, policy makers can include local content requirements that mandate foreign or domestic developers

Table 1.6: Summary comparison of grid access permit requirements

Criteria \ Options	No grid access permit required	Grid access permit required, allowing participation of projects that demand grid expansion/ reinforcement	Grid access permit required, constrained to projects that do not demand grid expansion/ reinforcement
Avoided risk of delays	○ The access permit must be obtained afterwards	◕ Possible delays due to grid expansion	● Safest option as both the grid and the grid access permit available
Simplicity	● Less bureaucracy and transaction costs	○ Additional complexity in selecting auction winners	◔ Complex and costly process to provide permits to all bidders
Level of participation of bidders	● Lower entry costs and transaction costs	◑ Wider variety of projects accepted	○ More restrictive in terms of options

Characteristics of the relevant attribute: ○ *Poor* ◔ ◑ *Medium* ◕ ● *Very good*

to source a certain share of equipment or a portion of overall costs from local manufacturers or producers. Table 1.7 shows the implementation of local content requirements in selected countries. It is important that such requirements are applied with other design elements that support the development of a local industry. For example, certainty and regularity in the way the auction rounds are scheduled gives market agents the right signal for long term investments.

Careful policy consideration is needed with regard to designing and implementing local content requirements. They should be time-bound and accompanied by measures to facilitate the creation of a strong domestic supply chain and a skilled workforce.

In conclusion, having more constraining requirements allows the auctioneer greater opportunities for guidance and ensures a greater level of commitment, but often at the expense of cost efficiency and potentially detering prospective bidders.

Table 1.7: Local content requirements in auctions

Jurisdiction	Year	Description
Brazil	2009	To qualify for subsidised loans by the Brazilian Development Bank (BNDES) under its FINAME programme, wind turbine makers participating in auctions were initially required to get 40% of components from Brazilian suppliers, rising to 60% in 2012. From 2013, manufacturers have to produce or assemble at least three of the four main wind farm elements (*i.e.* towers, blades, nacelles and hubs) in Brazil. This policy has led to the rapid growth of a domestic supply chain.
Quebec (Canada)	2003	In the 1 GW wind auction, a local content requirement was set of 40% (first 200 MW), 50% (next 100 MW), and 60% (remaining 700 MW).
	2005	A second auction of 2 GW required 60% local content requirement.
	2010	60% local content requirement.
China	2003	50% local content requirement and counted for 20% of bid evaluation.
	2005	70% local content requirement and counted for 35% of bid evaluation.
	2006	Wind power equipment manufacturers were required to participate in the bid, individually or part of a consortium.
	2009	The requirements on local content were abolished. By 2012, four out of the top ten manufacturing companies were Chinese and they accounted for 27% of the total market share.
India	2014	PV auction of 375 MW with local content requirement .
South Africa	2011	Wind auction requirement of 25% local content, which the government aims to raise step-by-step to 45% (first bid submission phase), 60% (second phase), and 65% (third phase). For solar PV, the local content requirement rose from 28.5% under the first round to 47.5% in the second.

Multi-criteria selection process

Another mechanism to promote socio-economic development in a renewable energy auction is the introduction of additional criteria in the comparison of bids. This is similar to introducing "soft" qualification requirements, as bidders who meet the desirable qualities regarding the socio-economic impact receive bonuses for the purpose of bid comparison. For instance, it is possible to offer a bonus to projects that use locally manufactured equipment, rather than introducing local content requirements. Such a mechanism has been implemented in South Africa (Box 1.16).

Other jurisdictions have adopted multi-criteria bid evaluation methods in order to create different incentives. The French auction starting in 1996 used a compound winner selection criteria to reach cost efficiency, location and technological diversity and research and development support (Box 1.17).

BOX 1.16: COMPOUND WINNER SELECTION PROCESS IN SOUTH AFRICA

The project selection criteria was based on a 70/30 split between price and economic development considerations in the South African auction.

Socio-economic development factors were used as eliminatory requirements in the qualification phase by setting thresholds for different indicators, such as local content, job creation and ownership. In the selection phase, the bids were "graded" according to their degree of compliance with each of the economic development features, based on a target level for each variable. Ten points were awarded for achievement between threshold and target levels, and an additional ten points for achievements above the target level.

For instance, in the job creation criteria, a fraction of 18% of skilled black employees is the minimum to pass the qualification phase, but the target used in the second phase is 30%. Similarly, the minimum share of employees that must belong to local communities must be 12%, but a share of 20% guarantees the highest grade in the second phase. In parallel, the value of local content spending has a minimum of 25% but a target of 45% guarantees the highest grade, and so forth.

Furthermore, the risk of underbidding decreases by introducing additional criteria in the comparison of bids, thus decreasing the price weight such as the case of China (Box 1.18).

BOX 1.17: COMPOUND WINNER SELECTION CRITERIA IN FRANCE

In the French auction, the price has always been an important criterion in the selection of the winners, but not the only one. The French government emphasised a mix of factors such as the cost efficiency of production, research and development support, local benefits and emergence of new technology. Therefore, the bids were evaluated based on the following criteria: electricity purchasing price per kWh; economic advantages of the project; long-term benefits of the chosen technical solutions; technical and financial reliability; environmental aspects; contribution to research and development; and local stakeholder opinion.

Compound winner selection may result in other priorities being met, but may sacrifice price efficiency. Some evidence of this can be found by comparing the prices resulting from wind auctions held around the same time in France and the UK. The French auction resulted in an average price of 0.052 EUR/kWh compared to 0.047 EUR/kWh in the UK where the electricity price was the only criteria for bid selection. It should also be noted that in the French case it was the first auction round whilst in the UK's case it was the fourth round.

BOX 1.18: AVERAGE-PRICE CRITERION IN CHINA'S PROJECT-SPECIFIC AUCTIONS

In the third wind power auction in 2005 in China, the contribution of price to the final score was reduced to 40% and to 25% in the 2006 auction.

In its fifth wind power auction in 2007, the price criterion, still accounting for 25% of the bid score, was redesigned to benefit the bid closest to the average (highest and lowest bids being excluded). This mechanism was adopted as a protection against adventurer bidders who might not be able to honour the contract and to discourage bidders from offering below-market prices.

Although this scheme was successful in limiting underbidding, it disregarded the most competitive bidders (*e.g.* the ones with higher technology productivity) to the benefit of the those closer to the average price. Consequently, the average price achieved in the 2007 auction was approximately 12% higher than in the previous auction.

1.5 POLICY RECOMMENDATIONS

Renewable energy auctions play an important role in the new generation of policies due to their ability to support deployment while increasing transparency and fostering competition, resulting in lower prices. Auctions are flexible in their design, allowing the possibility to combine and tailor different design elements to meet deployment and development objectives. Therefore, one of the mechanism's strengths is its ability to cater to different jurisdictions reflecting their economic situation, the structure of their energy sector, the maturity of their power market and their level of renewable energy deployment.

Renewable energy auctions have gained popularity as an instrument to support renewable energy deployment and have been adopted by more than 60 countries by early 2015, up from 6 in 2005. They have become increasingly successful and sophisticated in their design and many lessons can be learnt from the vast pool of country experiences in terms of attracting a large number of players, increasing competition and ensuring lower costs. While designing auctions, policy makers may want to consider the following recommendations:

Account for trade-offs between different design elements

When selecting design elements, policy makers should carefully consider the inherent trade-offs between potentially the most cost-effective outcome and other objectives.

In defining the **auction's demand**, ambition for a greater role of renewables in the energy mix must be weighed against cost-effectiveness.

- When the objective is to develop a specific technology, policy makers may want to select a *technology-specific auction* – one of the ways of defining "*exclusive demand bands*". If the goal is minimising costs, a *technology-neutral auction* can be introduced, allowing competition between technologies, therefore favouring the more mature and cost-competitive ones.
- When the objective is to meet urgent capacity needs while retaining flexibility in holding auctions, policy makers may auction the total volume at once through a *standalone auction*. If the objective is to further enhance investors' confidence for a most cost-effective outcome, the total volume auctioned, if considerable, can be divided into different rounds in a *systematic auctioning* scheme, with a cap on the volume auctioned in each round. This facilitates long-term planning by policy makers, bidders, and equipment suppliers, which may be beneficial to the country's renewable energy industry and to the grid planning.

In establishing the **qualification requirements,** there is a trade-off between reducing entry barriers to encourage competition and discouraging underbuilding.

- Allowing the participation of a large number of bidders while ensuring that they can successfully deliver the project requires a careful selection of qualification requirements. While the requirement for an extensive track record in the field, for example, can help ensure timely project completion, it may also limit the participation of new and/or small players.
- Specific renewable energy deployment goals can be reached through qualification requirements, such as technological requirements, project size requirements or location constraints. Although they can lead to desirable outcomes, they may increase the contracted price, as developers need to adapt their projects to these requirements.
- If the objective is to also meet broader development goals, policy makers can include additional selection criteria. Local content requirements, for example, can support the local industry, job creation and other socio-economic benefits. Such requirements are most effective when aligned with other design elements, such as a long-term auction schedule, and applied with other supporting policies.

While a simple **winner selection process** provides greater transparency, some degree of complexity may have to be implemented to ensure that the objectives of the country are achieved by the auction.

- If the objective is to reach the lowest price using a simple and straightforward procedure, policy makers can choose to adopt the classical *minimum-price criteria* for the selection of a winner. However, other objectives can be achieved by incorporating non-monetary criteria, such as socio-economic benefits, location, developer's experience *etc*. This may, however, result in higher prices and a more complex mechanism.

» When the main objective is to ensure cost effectiveness, policy makers can also set a ceiling price above which bids are not considered. However, if the ceiling price is not calibrated properly, there is a risk that a suboptimal amount of renewable energy will be contracted, as it could lead to the outright rejection of certain perfectly reasonable bids. Experience has shown that keeping the price ceiling undisclosed can help increase the cost effectiveness of the scheme but at the risk of disqualifying potentially good projects that are just above the ceiling. Disclosing the ceiling price in auctions where competition is not fierce, might result in equilibrium prices right below the ceiling.

In determining the **sellers' liabilities** in the contract, there are various ways to allocate risks between the project developer, the auctioneer and the contract off-taker, including financial, operational and project implementation risks. The over allocation of risks to developers impacts the level of participation of bidders and ultimately the contracted price.

» In order to limit the risk of delays and underbidding, policy makers can enforce stringent compliance rules, but at the expense of increasing transaction costs, which in turn may limit the participation of bidders and also result in an increase in price.

» Developers might be subject to risk, but they should not be subject to uncertainties. The risk allocated should be clearly communicated, transparent, fully quantifiable, and enforced. Protecting possible bidders against uncertainties is key to gaining their confidence.

» The auctioneer should ensure that the compliance rules and penalties included in the auction are enforced.

Ensure transparency to increase developers' confidence

Attracting bidders is key for the success of an auction. Transparency, simplicity and the developers' perception about the fairness of the process increase investors' confidence.

» The auctioneer must define fair and transparent rules and obligations for all stakeholders. Any information or adjustments about the bid must be clearly communicated to all competitors equally (dedicated website, conference at the start of the auction, *etc*.). Policy makers need to consider evaluating the process at the end of each round as it is important to factor lessons learned into the design of the following rounds.

» Administrative procedures should be simplified, streamlined and facilitated when possible (permits, grid connections, *etc*.). Setting up a one-stop-shop could help minimise transaction costs and efforts of the bidders, preventing delays in project implementation. Also, the time, humanpower and skills needed to evaluate bids have to be carefully estimated.

» Policy makers should minimise the investors' perceived risk through an institutional and regulatory framework that ensures a predictable and stable environment for investments. A good auction design is not enough in a market in which the level of scepticism is high and the credibility of the auctioneer is in question.

Tailor the design of auctions to the specific context

There is no "one-size-fits-all" formula for successful auctions. Different design elements should be selected and combined in a way that is tailored to meet the goals of the auction, according to the country's specific requirements and characteristics. While determining which auction design best fits the specific context, policy makers should take the following types of constraints into account: those arising from the macro-economic conditions (local and global), the characteristics of the power sector, and the inter-dependencies between design elements.

All the design elements, examples and other recommendations are analysed and illustrated in this study on *Renewable Energy Auctions: A Guide to Design*.

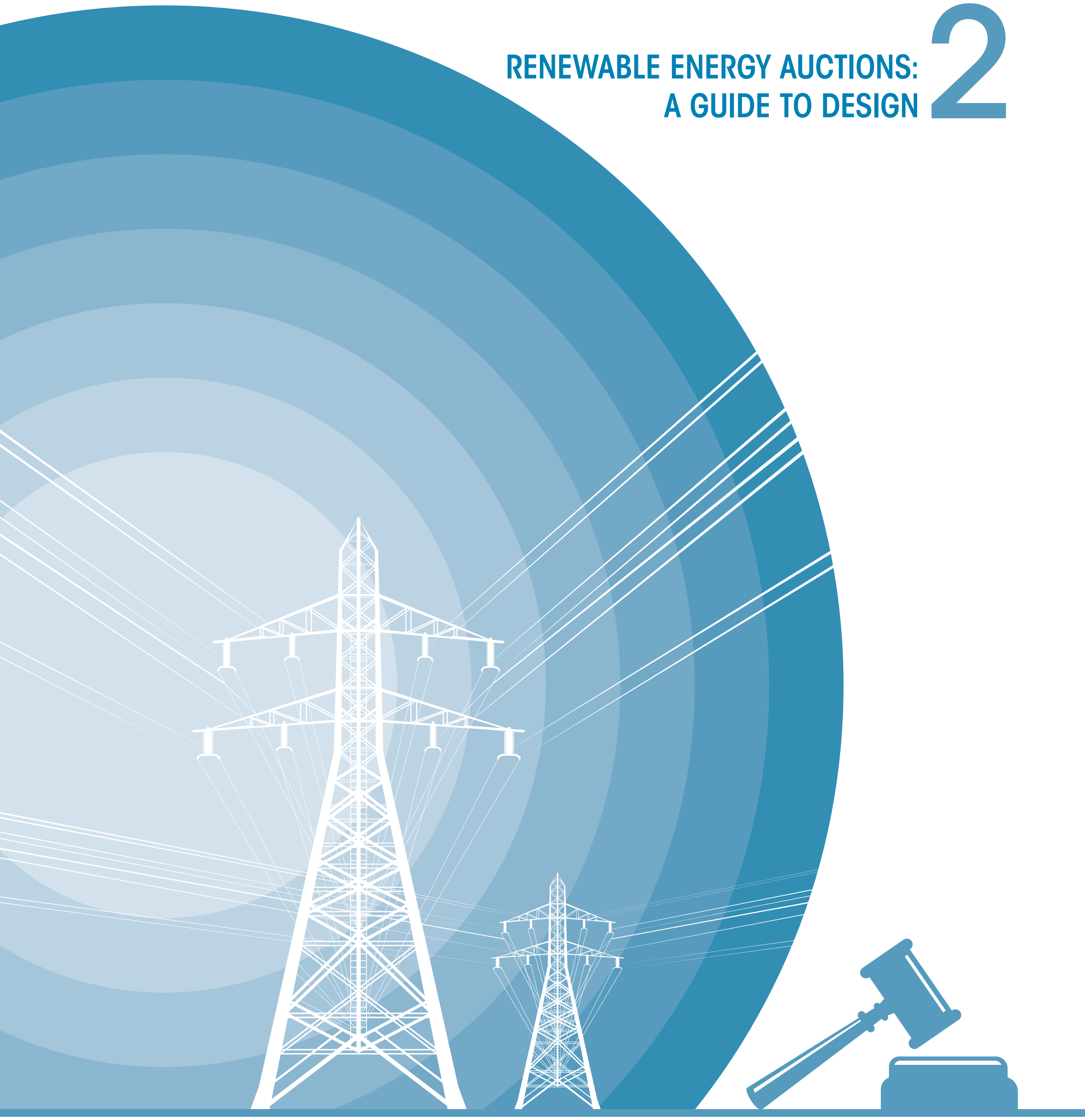
CLEAN ENERGY MINISTERIAL

Accelerating the Transition to Clean Energy Technologies

IRENA

International Renewable Energy Agency

RENEWABLE ENERGY AUCTIONS: A GUIDE TO DESIGN 2



RENEWABLE ENERGY POLICIES AND AUCTIONS

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2.1 INTRODUCTION

Successful policies have been instrumental in encouraging investments in renewable energy and stimulating the development of the sector. Despite the extensive experience in policy design acquired over the past decade, the need to craft and implement innovative policies as well as to learn from past experiences remains important in addressing prevalent barriers to deployment.

Recently, factors that influence renewable energy policy making have shifted dramatically. For instance, the considerable decline in costs of renewable energy technologies has made it challenging to set appropriate levels of support. In addition to the need to control support costs, policy makers can benefit from opportunities to execute policy course-corrections and to plan for complementary infrastructure such as grids, while also setting a plan to maximise socio-economic benefits from deployment.

As for investors, they are mostly driven by the predictability of revenues and transparency of rules for policy support. Today, they are faced with increasingly dynamic investment environments, not only due to the impacts of technological advancement and the emergence of new markets for investments, but also to the expanding range of broader socio-economic strategic goals determining renewable energy policies. These broader goals often result in specific incentives for certain technology mixes and spatial patterns of renewable energy development. In this context, investors can benefit from support mechanisms that allow policy makers to send clear signals to the market and offer adequate levels of guidance to investors.

There is, therefore, a need for innovative support mechanisms that maintain a stable and attractive environment for investments in the sector, but which also allow for cost tracking and avoidance of windfall profits, while offering policy makers the possibility of clearly signalling long-term policy goals to the market. In this context, countries have been increasingly adopting renewable energy auctions to support deployment. The number of countries relying on this type of mechanism has risen from just 9 in 2005 to at least 60 by early 2015 (REN21, 2015).

Renewable energy auctions are also known as “demand auctions” or “procurement auctions”, whereby the government issues a call for tenders to install a certain capacity of renewable energy-based electricity. Project developers who participate in the auction submit a bid with a price per unit of electricity at which they are able to realise the project. The government evaluates the offers on the basis of the price and other criteria and signs a power purchasing agreement with the successful bidder.

In 2013, IRENA carried out its first study on the topic, *Renewable Energy Auctions in Developing Countries* (IRENA, 2013a), which highlighted key lessons learned from developing countries that have implemented auctions, namely Brazil, China, Morocco, Peru and South Africa. The report presented an analysis on auction design options, as well as best practices on their implementation in the form of recommendations for policy makers.

Building on that report and on the study on Adapting Renewable Energy Policies to Dynamic Market Conditions (IRENA, 2014a), the objective of this guidebook is to elaborate on the strengths and weaknesses of renewable energy auctions, structured around four categories of "design elements" that are key for a successful implementation. The guidebook analyses different options to be considered for each design element, focusing on potential challenges that need to be addressed. The extent to which different objectives of renewable energy policies – including cost-effectiveness, security of supply, and contributions to socio-economic development – can be achieved through the design choices made is discussed in detail. Ultimately, the guidebook aims at presenting the fundamental trade-offs involved in these design choices (*e.g.*, between reducing entry barriers and discouraging underbuilding, or between design simplicity and the ability to reflect preferences regarding the technology mix) and offering guidance on how to strike a balance that is adjusted to the policy objectives and circumstances of each jurisdiction.

The analysis is supported by specific country experiences, representing different contexts, and provides lessons learned and best practices on how governments can design and implement auctions in the most cost-efficient way while ensuring that winning projects come online in a timely manner. Divided into six chapters, this guidebook aims to support policy makers in designing successful renewable energy auctions.

Chapter 1 (Summary for Policy Makers) synthesises the findings of the report and presents the main conclusions and recommendations for policy makers on design of auctions.

Chapter 2 (Renewable Energy Policies and Auctions) contextualises auctions within the larger realm of renewable energy support schemes. It presents an outlook of recent international trends in renewable energy policies, highlighting the role that auctions have been playing in many electricity markets worldwide. This analysis is complemented by an overview of the key strengths and weaknesses of auctions.

The next four chapters discuss the key auction design elements that make up a renewable energy auction scheme, presenting analyses of past experiences and lessons learned. These design elements have been classified into four categories, each of them analysed in a separate chapter.

Chapter 3 (Auction Design: Demand) addresses design alternatives involving the auction demand, which comprises key decisions on what exactly is to be purchased in the auction, and under what conditions.

Chapter 4 (Auction Design: Qualification Requirements) analyses the qualification requirements, which determine the suppliers that are eligible to participate in the auction, as well as the conditions they must comply with and the documentation that they must provide prior to the bidding stage.

Chapter 5 (Auction Design: Winner Selection) discusses design choices regarding the winner selection process, which is at the heart of the auction procedure and involves handling the bidding and clearing rules as well as awarding the winners' products.

Chapter 6 (Auction Design: Sellers' Liabilities) addresses the seller's liabilities, chiefly associated with the characteristics of the product being auctioned, along with certain responsibilities and obligations spelled out in the auction documents.

The geographical scope of the work is global, since the recommendations from the guidebook will apply to all countries that are considering or implementing auction scheme. The report is focused on electricity and mainly on solar and wind auctions.

Through this activity, IRENA aims to provide recommendations on how policy makers can best address the challenge of efficiently and effectively designing and implementing auctions while adapting to dynamic market conditions and minimising the cost of public support and policy uncertainty for project developers.

2.2 TRENDS IN RENEWABLE ENERGY POLICIES

Over the last two decades, many countries have introduced a combination of incentives to promote grid-connected and off-grid renewable energy electricity in support of multiple policy objectives. These include, among others, enhancing energy security, reducing greenhouse gas emissions, improving local environmental sustainability and increasing energy access. As of today, 164 countries have set renewable energy targets (IRENA, 2015a) and have adopted policies to address market failures in an effort to help reach them.

Classification of policy instruments

To better describe some of the current trends in renewable energy policies, it is useful to broadly define three main categories of renewable energy support schemes that directly influence the procurement of renewable electricity generation: tariff-based instruments, quantity-based instruments and hybrid instruments (tariff/quantity-based instruments)[1].

Tariff-based instruments provide economic incentives for electricity generation using renewable energy sources, awarded in the form of investment subsidies (generally used in the earliest stages of technology development) or as a payment for the energy generated. Examples include feed-in tariffs (FITs) and feed-in premiums (FIPs).

A FIT institutes an administratively fixed price for the remuneration of renewable energy fed into the grid. Although FITs are effective in offering stable revenue guarantees for potential renewable energy project developers, setting an adequate tariff level can be challenging in an environment of rapidly changing equipment costs and information asymmetry. Moreover, because policy makers control price rather than quantity, the country risks not meeting or exceeding its official target for renewables if the administratively set FIT is not in line with the market realities. One common way to avoid exceeding the targets is by setting caps on the capacity installed.

Another tariff-based mechanism, the FIP, consists of a payment to renewable energy generation on top of the electricity market price. Unlike a FIT, the remuneration is more uncertain, but there are incentives to produce when the power system needs electricity the most (strongly correlated with higher prices) when possible.

Quantity-based instruments provide direct control over the amount of renewable capacity installed or energy produced. A renewable purchase obligation (RPO) is such an instrument, imposing a minimum quota or a share of renewable energy production on electricity suppliers, and is often supplemented by a renewable energy market allowing for the trading of renewable energy certificates (RECs). As a quantity-based mechanism, RPOs offer better guarantees that the target will be met (compared to tariff-based instruments), but they provide less guarantees to project developers with respect to future cash flows – in practice, the risk of over/underbuilding is transferred from government to developers.

[1] To promote a country's renewable energy sector, economic instruments such as the ones listed are generally provided in combination with different types of fiscal and financial incentives, such as tax credits, accelerated depreciation, preferential loans and others. There is a large body of literature reporting on the features and performance of different types of mechanisms; see, for example, Menanteau et al. (2003), Kreycik et al. (2011), Elizondo-Azuela, Barroso (2011) and Wang (2012). Readers interested in policy mechanisms other than those discussed in this report may seek information in any of these references.

Country experience has shown that a key determinant to the success of RPO/REC schemes has been the existence of a strong compliance regime. The REC markets can function only when both the off-takers (purchasers of renewable energy generation) and the developers are adequately incentivised to carry out their intended functions in a market. In the absence of such a regime, REC markets are known to deliver sub-optimum results. Mexico, which currently is undertaking energy market reform, is planning to introduce this form of mechanism to support renewable energy deployment.

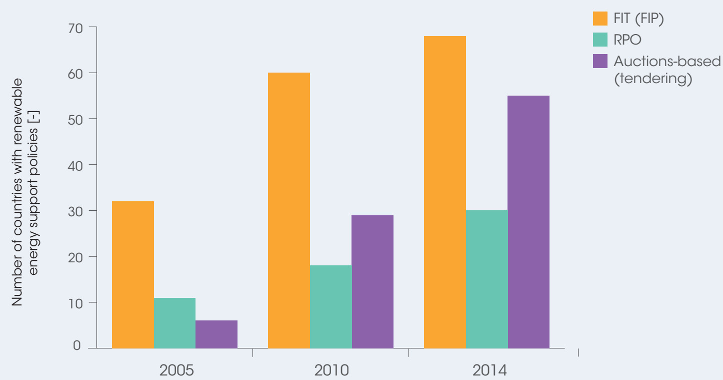
The main objective of this guidebook is to address the topic of *hybrid instruments*, or auction-based policies. Hybrid instruments combine features of tariff- and quantity-based instruments. In auction-based mechanisms, both price and quantity are determined in advance of building the projects through a public bidding process. Because of this characteristic, auctions can be more effective than "pure" tariff or quantity instruments, providing stable revenue guarantees for project developers (similar to the FIT mechanism), while at the same time ensuring that the renewable generation target will be met precisely (similar to an RPO). The bidding process allows for price discovery, and, with sufficient competition, the auction outcome can be cost-effective.

Although auctions have proven to be strong mechanisms for ensuring market efficiency as well as economic efficiency (as they minimise the level of subsidy required), they have been criticised for their higher transaction costs, both for auctioneers and bidders. This could limit the entry of small/new players and result in cases of subpar performance in deployment rates (i.e., delayed or cancelled constructions). Still, auctions have become the most preferred renewable energy support mechanism in an increasing number of countries. This trend is discussed in Box 2.1.

BOX 2.1: GROWTH IN DIFFERENT TYPES OF RENEWABLE ENERGY POLICIES

Figure 2.1 indicates the number of countries adopting policies in the three main categories – tariff-based, quantity-based and hybrid – in 2005, 2010 and 2014.

Figure 2.1: Number of countries with renewable energy policies, by type



Source: (REN21, 2014).

The figure shows that all three classes of mechanisms have experienced growth over the years as more countries have adopted renewable energy policies. Although FITs and FIPs have remained the most common types, the net increments in the adoption of different support mechanisms over time offer a valuable insight on recent trends.

From 2005 to 2010, the policy instrument with the most significant increment was FITs (26 new adopters), with auction-based mechanisms following close behind (21 new adopters). From 2010 to 2014, however, auctions had the highest growth (27 new adopters), with FITs showing only modest growth (7 new adopters).

Several factors explain this shift. Significant decreases in the costs of several renewable energy technologies, and the relative competitiveness, even without support schemes, played an important role. More importantly, a change in the priority of goals of policy design, from effectiveness (increase in the deployment) to efficiency (cost of the policy mechanism and impacts on supply costs) affected the adoptions of auctions. The increasing costs of support in countries that were early adopters of FITs, accompanied by the economic crisis contributed decisively to this change of focus.

Noteworthy is also the fact that developing countries accounted for many of the new adoptions in the period 2010-2014. Budget limitations and the fact that affordability of energy is a key strategic goal in many of these countries contribute to preference for policies that facilitate the containment of support costs, while stimulating deployment.

Source: (Elizondo-Azuela and Barroso, 2011).

In the European Union (EU), for instance, auctions seem to be on a clear upwards trend and are expected to only increase in importance in the future. In 2014, the European Commission (EC) prompted many of its Member States to introduce renewable energy auctions by 2017 (Box 2.2).

BOX 2.2: EU GUIDELINES ON RENEWABLE ENERGY AUCTIONS

Aiming to prevent distortions in the single European market, generated by different renewable energy deployment instruments adopted by each country, the EC listed effective public interventions in a statement released in 2013. Among them, it emphasised auctions as a means of lowering renewable energy prices and fostering the competitiveness of these technologies. The first point defended by the EC is directed to competition among different technologies as a way of minimising support systems and their distortive effects on the electricity market. The only caveat applies to new and promising technologies that still need special support in their first steps of development, for which the EC recommended technology-specific auctions.

Furthermore, because the Commission represents the interests of 28 Member States, ensuring harmony and homogeneity of renewable energy expansion in the region is a crucial and complex issue. Therefore, another central point of the discussion is the avoidance of unilateral intervention by one or few Member States. Such initiatives are likely to lead to imbalance in renewable energy deployment, possibly harming companies and other Member States.

In 2014, the EC released its Guidelines on State Aid for Environmental Protection and Energy for 2014-2020. The document requires Member States, who want to keep their support for renewable energy deployment, to implement a pilot bidding process for part of their renewable energy capacity additions in 2015 and 2016. Starting in 2017, then, aid should be granted based only on a competitive bidding procedure. Nonetheless, exemptions from implementing bidding procedures apply to countries that have features such as insufficient available sites, network constraints/grid stability and/or high system integration costs.

Sources: (European Commission, 2013), (European Commission, 2014), (Reuters, 2015).

Blurriness of traditional policy classification

One important trend in recent renewable energy policy has been the increasing blurriness of the lines seperating the different categories of policy instruments, as policy makers seek to take advantage of the complementary characteristics of the different support mechanisms. Therefore, the idea of introducing "hybrid" renewable energy support mechanisms – not only limited to auction-based schemes – has gained importance in the new generation of policies. Several examples illustrate a new norm involving many hybrid tariff-quantity mechanisms.

» In Australia's Renewable Energy Target programme (a quantity-based mechanism), there is a cap on the price of the tradable Small-Scale Technology Certificate (tariff-based)[2]. This cap has the effect of limiting the escalation of total support costs, among other goals.

» In the Unites States (US), in the state of Massachusetts's Renewable Portfolio Standard (RPS) scheme (quantity-based), a floor for the REC prices was established (tariff-based scheme) in response to the significant volatility of certificate prices, which had introduced difficulties for the bankability of renewable energy projects. The implementation of a price floor within an RPO represents a step away from the conceptual orthodoxy of simply defining quantities and letting the REC revenues of each agent be defined by the market alone.

» Some utilities in the U.S. states of Oregon and Wisconsin have used or are currently use FIT schemes (tariff-based) as the basic mechanism for contracting renewable energy to meet their utility-specific purchase obligations (quantity-based). In this case, the FIT defined by the utility dictates the remuneration to the renewable energy project developer, ensuring revenue stability for projects contracted up to the amount corresponding to the obligation of the utility.

Auction-based mechanisms also have been used in conjunction with other support schemes. One such example is the adoption of auctions together with a RPS. Under this type of mechanism, the RPS serves as the main driver of demanded quantities, providing market agents with an indication of a long-term potential demand that can drive decision making and facilitate the development of local supply chains. Such a mechanism has been implemented in New York, as described in Box 2.3.

BOX 2.3: THE ROLE OF AUCTIONS IN THE RPS PROGRAMME OF THE STATE OF NEW YORK

In the U.S. state of New York, funds gathered through a surcharge on each kilowatt-hour sold by the state's investor-owned utilities are managed by the New York State Energy Research and Development Authority (NYSERDA), which acts as a central administrator for the process of procuring renewable energy to meet the RPS target (originally defined in 2005 as 25% of the state electricity consumption by 2013, but extended in 2010 to 30% by 2015).

NYSERDA holds competitive auctions to award long-term agreements entitling projects to receive production incentives, in the form of credits for each megawatt-hour (MWh) of renewable energy delivered to the State of New York. In these auctions, the winner selection is based not only on price bids, but also on expected economic benefits to the state of New York declared by the bidder and duly evaluated by NYSERDA (see chapter 5 for further discussions).

Source: (NYSERDA, 2014).

Auctions also have been used in interaction with FIT-based policies. In China (see Box 2.4), where auctions have been used to reveal the appropriate level of a tariff-based incentive, to reduce the effect of information asymmetry when determining FITs.

[2] The cap on the Small-Scale Technology Certificate prices is set to a value below that of the unitary short-fall charge for entities that fail to meet their quantity obligations.

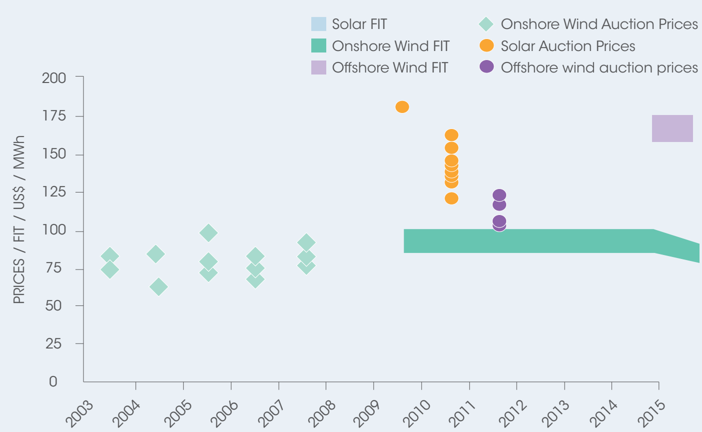
BOX 2.4: DETERMINING FIT LEVELS THROUGH AUCTIONS IN CHINA

The first auctions to award wind power concessions in China were organised in 2003. Before that date, a few isolated wind power initiatives had been undertaken at prices set directly by local governments, on a case-by-case basis, resulting in a wide dispersion of final prices (from USD 75 to USD 197 per MWh among different Chinese regions), with a relatively high average.

In this context, a bidding scheme was devised as a way to provide a credible, market-based mechanism to determine the price level and reduce the amount of deliberation involved in the process of price determination. Auctions were thus implemented starting in 2003 for larger-scale projects (100 MW or more), while tariffs for smaller projects continued to be defined on a case-by-case basis. After several competitive bidding rounds, the nationwide FIT levels for wind power were set using the results of the auctions that had been carried out up to that date with tariffs varying according to the regions. Figure 2.2 illustrates the onshore wind FIT levels (the band) together with the price results of the previously held auctions (the triangles).

Given the effectiveness of auctions in revealing costs and establishing benchmarks for setting economically efficient FITs, the development of both solar PV and offshore wind in China followed a similar path, evolving from tenders (2009-2010 for solar, 2011 for offshore wind) to FITs (starting in 2011 for solar and 2014 for offshore wind) (see Figure 2.2).

Figure 2.2: Auction prices and FIT levels in China[3]



Sources: (IRENA, 2013a), (IRENA, 2014b), (Elizondo-Azuela, Barroso et al., 2014).

Furthermore, auctions have been used to control the quantity of capacity installed under the FIT scheme, thus avoiding overbuilding. Such a case is exemplified in Italy, as described in Box 2.5.

[3] *This case was analysed in the 2013 IRENA report Renewable Energy Auctions in Developing Countries.*

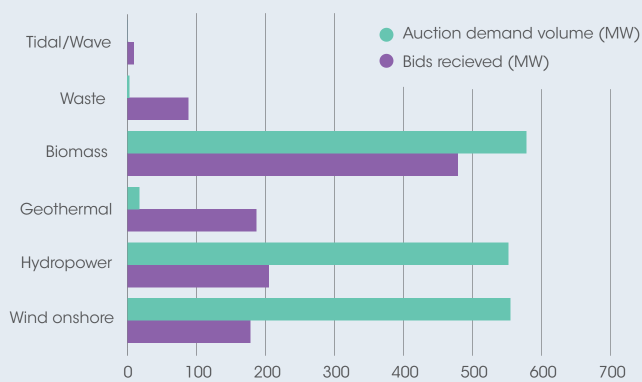
BOX 2.5: AUCTIONS FOR FIT SUPPORT IN ITALY

In July 2012, the Italian Regulatory Authority for Electricity Gas and Water (Autorita per l'Energia Elettrica e il Gas (AEEG)) introduced a new incentive regime for renewable energy plants starting operations from January 2013 onwards. With the aim of limiting the expenses brought by the FIT scheme, a total cap on national spending for all renewable energy technologies was set, with the exception of solar PV, for which separate cost limits are applicable.

As capacity caps are in place for each technology, project developers must participate in a descending auction to gain access to the existing FIT. The bids that offer the highest tariff reduction from the pre-established FIT win the right to access them. The scheme is addressed at power plants with a minimum capacity of 5 MW, with the exception of hydro (minimum 10 MW) and geothermal (minimum 20 MW). Smaller power plants can obtain access permits either directly or via registries.

The awarded capacity in three auctioning rounds in the 2013-2015 period totalled 1 383 MW, with a high competition for onshore wind, biomass and hydropower. The government's target volumes for geothermal, waste and tidal/wave technologies were not met, because of the lack of sufficient bids. The cumulative results by source are summarised in Figure 2.3.

Figure 2.3: Summary of the cumulative results of Italy auctions, 2013-2014



Data Source: (Gestore Servizi Energetici, 2014)

In the case of onshore wind, the received bid capacity increased from 88.4% of the auction capacity in the first round to 354% in the third round. The increasing competition led to increasing tariff bid reductions:

- from 2.5% to 24.4% for the 1st round
- from 9.5% to 19.0% for the 2nd round
- from 26.4% to 30.0% for the 3rd round

Sources: (Gestore Servizi Energetici, 2014), (Del Río, Linares, 2014)

A common method of selecting the appropriate policy is based on the size of the project. Because the policies that can best accommodate the needs of small-scale and large-scale projects can be very different, and because both classes of projects can be very desirable (a topic that is addressed further in chapter 4), this type of differential treatment is not uncommon – as described in Box 2.6.

BOX 2.6: INTERACTION BETWEEN AUCTIONS AND FITS IN FRANCE

Small-scale renewable energy projects are often seen as highly desirable by policy makers, as they tend to result in a better geographical dispersion of projects, greater proximity to loads and fewer concerns regarding environmental impacts. However, this category of projects tend to be naturally disadvantaged in auctions, since many of the associated *transaction costs* are independent of the project size, and smaller projects cannot dilute these costs in a larger contract. As such, some countries have implemented auctions for medium- and large-scale projects and a tariff-based scheme for small-scale projects.

In France, the support mechanism for promoting solar PV involves an auctioning scheme for projects greater than 100 kW (projects between 100 kW and 250 kW face a simple and streamlined process, and those above 250 kW follow a more complicated auction), whereas small-scale projects (less than 100 kW) receive a FIT. The special provision for small-scale projects is the likely responsible for the fact that more than half of France's 4 GW solar power capacity by 2012 consisted of projects smaller than 250 kW.

Even though this type of special treatment to promote smaller-scale projects can be justifiable in several ways, it often is difficult to determine what constitutes a project that is "too small" to participate in an auction. Many jurisdictions adopt a minimum project size for an auction that is often much higher than France's 100-250 kW threshold. For example, the minimum project size in Uganda, California and India is 1 MW, 3 MW and 5 MW respectively (see Section 4.2).

While conventional wisdom suggests that auctions would be a poor fit for small-scale projects, there have been some positive experiences. Since 2012 the Solar Energy Corporation of India has been carrying out rooftop solar auctions (up to 1 MW) in various cities. In conclusion, auctions have proven to be an adequate mechanism even for small-scale projects, when transaction costs are manageable. Many jurisdictions have opted to adopt the same scheme for projects of all sizes although sometimes segmenting the auction demand into different bands based on project size (see Section 3.1).

In addition, there are examples of auctions whose design seem to explicitly contradict the recommendations delineated above, suggesting a unique set of country circumstances and/or policy goals. In the case of Uruguay's solar policy, for example, competitive tenders are used to allocate small-scale projects (a total of 1 MW to be contracted from projects with capacity between 500 kW and 1 MW and a total of 5 MW to be contracted from projects with capacity between 1 MW and 5 MW). Meanwhile, large-scale projects (between 5 MW and 50 MW) receive a pre-determined FIT (up to a limit of 200 MW).

Sources: (Elizondo-Azuela, Barroso, et al., 2014), (Wentz, 2014), (Del Río, Linares, 2014), (MNRE, 2015).

In summary, either as standalone mechanisms or as supports for other renewable energy instruments, auction-based schemes have been gaining momentum and countries have accumulated a large body of valuable experience. They have proven to be an interesting tool to stimulate competition between renewable energy project developers, to provide price disclosure while managing a fixed amount of investment and to reduce risks associated with long-term contracting. Section 2.3 further discusses the strengths of auctions as well as their weaknesses.

2.3 KEY STRENGTHS AND WEAKNESSES OF RENEWABLE ENERGY AUCTIONS

The recent surge in the popularity of the auction scheme suggests that an in-depth evaluation of this instrument is highly desirable to guide future implementation. In this guidebook, an auction is an objective mechanism used to promote the competitive procurement of products offered by renewable energy generators and thus to promote the development of renewable generation.

Much like other renewable energy support mechanisms, the auction scheme has become increasingly sophisticated over the years, as policy makers have sought to reinforce its strengths and mitigate its weaknesses through its design – and this will be the main focus of this guidebook.

Key strengths

The increasing interest in auction schemes is driven by their ability to achieve deployment of renewable electricity in a well-planned, cost-efficient and transparent manner while also achieving a number of other objectives. The strengths of auctions lie in their i) flexibility, ii) potential for real price discovery, iii) ability to ensure greater certainty in price and quantity and iv) capability to guarantee commitments and transparency.

Flexibility. Auctions are flexible in their design, allowing the possibility to combine and tailor different design elements to meet deployment and development objectives. Therefore, one of the mechanism's strengths is its ability to cater to different jurisdictions reflecting their economic situation, the structure of their energy sector, the maturity of their power market and their level of renewable energy deployment.

Real price discovery. A key strength of auctions relates to them being particularly effective mechanisms of price discovery. A good auction design brings out the real price of the product being auctioned by means of a structured, transparent and most importantly, competitive process. This is a way of dealing with the fundamental problem of information asymmetry between the regulator (or any other entity responsible for determining purchase prices and support levels) and renewable project developers. This is of particular relevance in the context of procurement of, and support to, renewable energy (given that these technologies are still advancing at a significant pace) and also considering the development of local supply chains and maturity of the market. The first renewable energy auction held in Germany reveals a solar PV project development cost higher than the FIT levels in place, as detailed in Box 2.7.

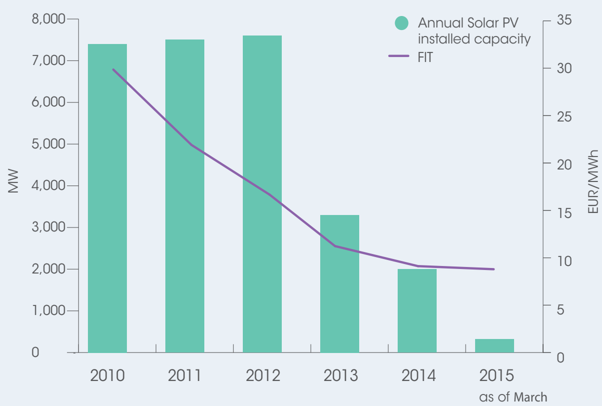
BOX 2.7: PRICE DISCOVERY IN THE FIRST RENEWABLE ENERGY AUCTION IN GERMANY

Germany is taking the first step to introduce auctions. Every year, three rounds of auctions are scheduled. The first round was held in April 2015 for solar PV, with bids related to a minimum installed capacity of 10 kW and a maximum capacity of 10 MW.

The auction contracted a total capacity of 156.97 MW of solar PV at an average price of 91.7 EUR/MWh (102.5 USD/MWh). This is lower than the ceiling price of 112.9 EUR/MWh (126.2 USD/MWh) set in the auction, yet higher than the current FIT level of 90.2 EUR/MWh (100.82 USD/MWh) for solar installations up to 10 MW, although the competition was intense (the auction was four times oversubscribed).

The auction prices seem to better reflect the actual costs faced by the project developers. FIT levels in Germany were generally considered too low, which could explain the sharp decline in solar PV installed capacity since 2013, compared to the previous years. Figure 2.4 illustrates the evolution of the FIT for ground-mounted solar systems since 2010, in relation to the annual installed capacity. With the digression of FIT, aligned with the stagnation in the development costs in the European market, FIT prices reached a point at which eligible projects were hardly economically feasible, as states by the regulator.

Figure 2.4: Annual solar PV installed capacity and solar FIT evolution in Germany, 2010-2015



Sources: (Bundesnetzagentur, 2015), (German Solar Industry Association, 2014), (Solar Energy Industries Association, 2014), (Lang, 2015), (Norton Rose Fulbright, 2015), (Colthorpe, 2015), (Tsanova, 2015) and (German Energy Blog, 2015).

Greater certainty regarding prices and quantities. In the case of auctions, the prices and quantities are determined before the construction of new projects begins. Therefore, both investors and policy makers benefit from greater certainty[4] on the future outcome of the policy. In contrast, pure tariff-based schemes typically allow quantities to fluctuate, which means that a jurisdiction can exceed or not meet its policy target. Meanwhile, pure quantity-based schemes allow tariffs to fluctuate, which typically means allocating more risk to investors (potentially discouraging them from participating in the market). Although auctions are not the only alternative for hybrid price/quantity setting[5], they offer a solution for simultaneously determining both variables under a market-based scheme.

Commitments and transparency. Another feature of the auction is that it typically results in the signing of a bilateral contract between two institutions, in which each party's commitments and liabilities are clearly stated. This type of structure can offer greater regulatory certainty to investors, minimising the likelihood that its remuneration will be challenged in the future even as the market and policy landscapes change. Furthermore, by ensuring a transparent, fair, open and timely procurement process, an auction can minimise the risk of market manipulations and the possibility for the consumer to overpay for the product.

Potential weaknesses

Despite the strengths of auctions, specific concerns that policy makers should keep in mind and seek to mitigate during their design have emerged. These include:

Transaction costs for bidders may constitute a *barrier to the participation of small players*. These costs are associated with the execution of administrative procedures necessary to take part in the auction (*e.g.*, those necessary for qualification arrangements). Whenever the transaction costs are high in comparison to the total anticipated profits (the likelihood of which is higher for players with smaller-sized projects), participants may be discouraged from participating in auctions. In addition to *social acceptance* and *structural concentration* issues that may result from these barriers, the reduction in competition resulting from any dissuasion of players from participating due to specific design choices reduces competition and may result in opportunities for the *exercise of market power*.

[4] Some mechanisms, such as FITs, offer higher certainty on the outcomes of the policy to the investor. Due to the fixed price at which all the production achieved is sold, auctions have the feature of offering higher certainty both to the investor and the policy maker.

[5] Examples of other classes of hybrid price/quantity policies are provided in Section 2.2.

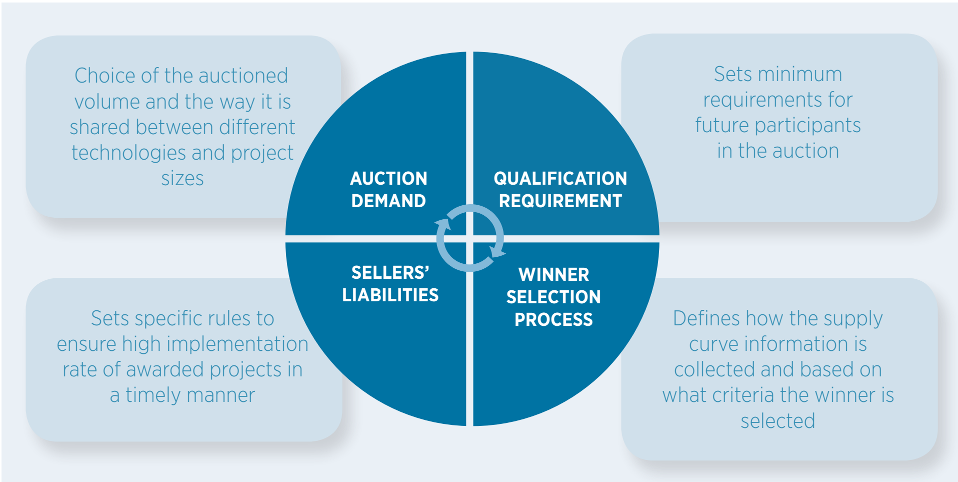
Transaction costs incurred by the auctioneer (the entity in charge of organising and holding the competitive process) generally are associated with the mechanism's greater complexity compared to the implementation of a purely tariff-based or purely quantity-based scheme. However, it has been noted that these transaction costs are, in most cases, only a fraction of the potential benefits from competition within the auction. In fact, much of the initial costs will be diluted in subsequent auctions, since most of the processes and systems will already be in place for subsequent tenders, even if fine-tuning will be necessary.

Risk of underbidding and delays in the construction of new capacity traditionally have received the most attention, due to poor experiences with early implementations of auctions. Overly aggressive bidding could be traced to factors that range from excessive optimism about the evolution of technology costs to the lack of penalties in cases of project delays. Although bidders have an incentive to engage in "adventurous" bidding if the liabilities imposed by the auction design are not sufficiently strict, instances of excessive optimism have been identified even when the project developer is held liable for any delays or underperformance ("winner's curse").

2.4 OVERVIEW OF AUCTION DESIGN ELEMENTS

The extent to which each of the above-mentioned strengths and weaknesses affect the results of any given auction depends largely on design choices and how well adapted they are to the local circumstances and specific country context. To increase deployment in a cost-efficient way and meet development objectives, the auctioneer can tailor and combine different design elements, which can be categorised as: 1) *auction demand*, which refers to the choice of the volume auctioned and the way it is shared between different technologies and project sizes; 2) *qualification requirements,* which determine which suppliers are eligible to participate in the auction, as well as the conditions with which they must comply and the documentation that they must provide prior to the bidding stage; 3) the *winner selection process*, which is at the heart of the auction procedure itself and involves the bidding and clearing rules as well as the process of awarding contracts to the winners; and 4) *sellers' liabilities*, which are chiefly associated with the characteristics of the product being auctioned, along with certain responsibilities and obligations spelled out in the auction documents (see Figure 2.5). Each category is analysed in detail in the following chapters.

Figure 2.5: Categories of auction design elements



This classification has been chosen for its flexibility, which makes it possible to describe a wide array of auction implementations involving different fundamental choices made by policy makers in designing auctions.

Box 2.8 provides an example of another approach used to classify design elements in an auction *i.e.* a multi-stage renewable energy auction. A common auction design is the two-phase process, in which there is an initial pre-qualification phase where the short-listing of candidates takes place and a second evaluation (competitive) phase. Examples of this type of structure are the South African and the Moroccan auctions. In terms of the classification of design elements proposed in this guidebook, it is possible to understand the first stage as imposing *qualification requirements*; whereas the second stage applies the *winner selection process*.

Another common classification of renewable energy auctions involves the choice of technology focus, involving a distinction between the technology-neutral, technology-specific, multi-technology and project-specific auctions.

Despite the different approaches used to classify the design elements of auctions, the one adopted in this guidebook allows for a clearer understanding of how the different design elements can be combined to benefit the outcome of the auction

BOX 2.8: MULTI-STAGE RENEWABLE ENERGY AUCTION DESIGN

A common two-phase auction design includes an initial pre-qualification phase where the short-listing of candidates takes place and a second evaluation (competitive) phase. The two-phase auction model can be attractive to narrow the field of candidates to only those who have the ability to comply with the terms of the contract and the adequate financial and technical capability. Clearly identifying these phases can be especially helpful when substantial work must be undertaken by the auctioneer to review and analyse the bid documentation– a condition that is typically associated with auctions that have stringent requirements. The exact requirements can vary from one implementation to the next, although proof of technical, commercial and financial strength, previously completed projects and detailed engineering documentation for the project site, are common examples of documentation that could be assessed in a preliminary auction stage.

Although having very thorough documentation requirements has some downsides (as discussed in Chapter 4), if policy makers choose this route, they could consider the possibility of using a two-phase auction structure to better streamline the evaluation process.

Even though many variations can be done in this regard, auctions with more than two stages are very rare. However, Uganda's small-scale solar PV auctions are an example of a three-stage bidding process. In this case, the qualification phase has been split into two stages: a pre-qualification stage in which the developers are screened for their technical and financial capabilities, and a second qualification stage in which a more detailed assessment is done (based on technical, financial, social and environmental parameters). Only the developers who have passed these two stages are allowed to compete in a third stage with the project's financial proposal.

Sources: (Tenenbaum, 2015), (Maurer and Barroso, 2011).

process. As such, this classification provides policy makers a more accessible framework that guides the design of auctions.

It is possible to hold auctions that are technology-neutral, allowing the various renewable energy generation technologies to compete amongst themselves. However, technology-focused auctions are a more common implementation, and can be represented either in a technology-specific auction or in a multi-technology auction with separate demand bands (Box 2.9).

BOX 2.9: TECHNOLOGY-NEUTRAL, TECHNOLOGY-SPECIFIC, MULTI-TECHNOLOGY AND PROJECT-SPECIFIC AUCTIONS

Technology-specific auctions can be interpreted as imposing *qualification requirements* to the bidders regarding the renewable energy source to be tapped – and, in some cases, the generation technology itself (see Section 4.2). In many cases, technology-specific auctions are used as a first "push" favouring a given generation source, to be adjusted as the technology matures and depending on the success of the auction. In China, for example, wind-specific and solar-specific auctions have been used to promote these two technologies prior to the government setting FITs. In Brazil, the renewable energy auctions in 2008 and 2009 were biomass-specific and wind-specific, respectively, followed by auctions mostly allowed for multiple technologies to compete amongst themselves.

Multi-technology auctions can be interpreted as a series of technology-specific auctions held in parallel. This configuration is interpreted in this guidebook as auctions with *exclusive demand bands* (or products), in which each demand band is dedicated to a specific technology (see Section 4.2). Auctions structured in this manner can induce economies of scale and reduce transaction costs – since, by having similar guiding principles and similar requirements for all technologies, the developers' costs to bid on multiple projects would be reduced, and the auctioneers' costs associated with qualifying potential suppliers and organising the procedures could also be substantially lower. Peru and South Africa are examples of countries that have used this type of scheme to their benefit: in both countries, each renewable energy technology participated in essentially independent (but simultaneous) "sub-auctions".

Project-specific auctions involve competitive bidding for a particular project selected by the government. China, Denmark, Dubai and Morocco are examples of jurisdictions where this type of auction has been implemented. Project-specific auctions can be interpreted as a particular category of exclusive demand band auctions, in which the demand band can be met by only one project (see Section 3.1). Alternatively, they can be regarded as an auction with particularly constraining qualification requirements, in which only a few pre-approved sites are eligible for participation (see Section 4.3). An important distinction, however, is that they tend to require much less effort from the bidders' standpoint, as the government takes great responsibility regarding site selection, grid connection and procurement of site-specific documentation.

2.5 GENERAL CONCLUSIONS

Renewable energy auctions play an important role in the new generation of policies due to their ability to support deployment while increasing transparency and fostering competition, resulting in lower prices. Auctions are flexible in their design, allowing the possibility to combine and tailor different design elements to meet deployment and development objectives. Therefore, one of the mechanism's strengths is its ability to cater to different jurisdictions reflecting their economic situation, the structure of their energy sector, the maturity of their power market and their level of renewable energy deployment.

Renewable energy auctions have gained popularity as an instrument to support renewable energy deployment and have been adopted by more than 60 countries by early 2015, up from 6 in 2005. They have become increasingly successful and sophisticated in their design and many lessons can be learnt from the vast pool of country experiences in terms of attracting a large number of players, increasing competition and ensuring lower costs. While designing auctions, policy makers may want to consider the following recommendations:

Account for trade-offs between different design elements

When selecting design elements, policy makers should carefully consider the inherent trade-offs between potentially the most cost effective outcome and other objectives.

In defining the **auction's demand**, ambition for a greater role of renewables in the energy mix must be weighed against cost-effectiveness.

» When the objective is to develop a specific technology, policy makers may want to select a *technology-specific auction* – one of the ways of defining "exclusive demand bands". If the goal is minimising costs, a *technology-neutral auction* can be introduced, allowing competition between technologies, therefore favouring the more mature and cost-competitive technologies.

» When the objective is to meet urgent capacity needs while retaining flexibility in holding auctions, policy makers may auction the total volume at once through a *standalone auction*. If the objective is to further enhance investors' confidence for a most cost-effective outcome, the total volume auctioned, if considerable, can be divided into different rounds in a *systematic auctioning* scheme, with a set cap on the volume auctioned in each round. This facilitates long-term planning by policy makers, bidders, and renewable energy equipment suppliers, which may be beneficial to the country's renewable energy industry and to the grid extension planning.

In establishing the **qualification requirements**, there is a trade-off between reducing entry barriers to encourage competition and discouraging underbuilding.

» Allowing the participation of a large number of bidders while ensuring that they can successfully deliver the project requires a careful selection of qualification requirements. While the requirement for an extensive track record in the field, for example, can help ensure timely project completion, it may also limit the participation of new and/or small players.

» Specific renewable energy deployment goals can be reached through qualification requirements, such as technological requirements, project size requirements or location constraints. Although they can lead to desirable outcomes, they may increase the contracted price, as developers need to adapt their projects to these requirements.

» If the objective is to also meet broader development goals, policy makers can include additional selection criteria. Local content requirements, for example, can support the local industry, job creation and other socio-economic benefits. Such requirements are most effective when aligned with other design elements, such as a long-term auction schedule, and applied with other supporting policies.

While a simple **winner selection process** provides greater transparency, some degree of complexity may have to be implemented to ensure that the objectives of the country are achieved by the auction.

» If the objective is to reach the lowest price using a simple and straightforward procedure, policy makers can choose to adopt the classical *minimum-price criteria* for the selection of a winner. However, other objectives can be achieved by incorporating non-monetary criteria in the process, such as socio-economic benefits, location, developer's experience *etc*. This may, however, result in higher prices and a more complex mechanism.

» When the main objective is to ensure cost effectiveness, policy makers can also set a ceiling price above which bids are not considered. However, if the ceiling price is not calibrated properly, there is a risk that a suboptimal amount of renewable energy will be contracted, as it could lead to the outright rejection of certain perfectly reasonable bids. Experience has shown that keeping the price ceiling undisclosed can help increase the cost effectiveness of the scheme but at the risk of disqualifying potentially good projects that are just above the ceiling. Disclosing the ceiling price in auctions where competition is not fierce, might result in equilibrium prices right below the ceiling.

In determining the **sellers' liabilities** in the contract, there are various ways to allocate risks between the project developer, the auctioneer and the contract off-taker including financial, operational and project implementation risks. The over allocation of risks to developers impacts the level of participation of bidders and ultimately the contracted price.

» In order to limit the risk of delays and underbidding, policy makers can enforce stringent compliance rules, but at the expense of increasing transaction costs, which in turn may limit the participation of bidders and also result in an increase in price.

» Developers might be subject to risk, but they should not be subject to uncertainties. The risk allocated should be clearly communicated, transparent, fully quantifiable, and enforced. Protecting possible bidders against uncertainties is key to gaining their confidence.

» The auctioneer should ensure that the compliance rules and penalties included in the auction are enforced.

Ensure transparency to increase developers' confidence

Attracting bidders is key for the success of an auction. Transparency, simplicity and the developers' perception about the fairness of the process increase investors' confidence.

» The auctioneer must define fair and transparent rules and obligations for all stakeholders. Any information or adjustments about the bid must be clearly communicated to all competitors equally (dedicated website, conference at the start of the auction, *etc.*). Policy makers need to consider evaluating the process at the end of each round, as it is important to factor lessons learned into the design of the following rounds.

» Administrative procedures should be simplified, streamlined and facilitated when possible (permits, grid connections, *etc.*). Setting up a one-stop-shop could help minimise transaction costs and efforts of the bidders, preventing delays in projects implementation. Also, the time, humanpower and skills needed to evaluate bids have to be carefully estimated.

» Policy makers should minimise the investors' perceived risk through an institutional and regulatory framework that ensures a predictable and stable environment for investments. A good auction design is not enough in a market in which the level of scepticism is high and the credibility of the auctioneer is in question.

Tailor the design of auctions to the specific context

There is no "one-size-fits-all" formula for successful auctions. Different design elements should be selected and combined in a way that is tailored to meet the goals of the auction, according to the country's specific requirements and characteristics. While determining which auction design fits best the specific context, policy makers should take two main types of constraints into account: those arising from the local (current) macro-economic characteristics and the stance of the electricity industry; and those related to inter-dependencies among design elements.

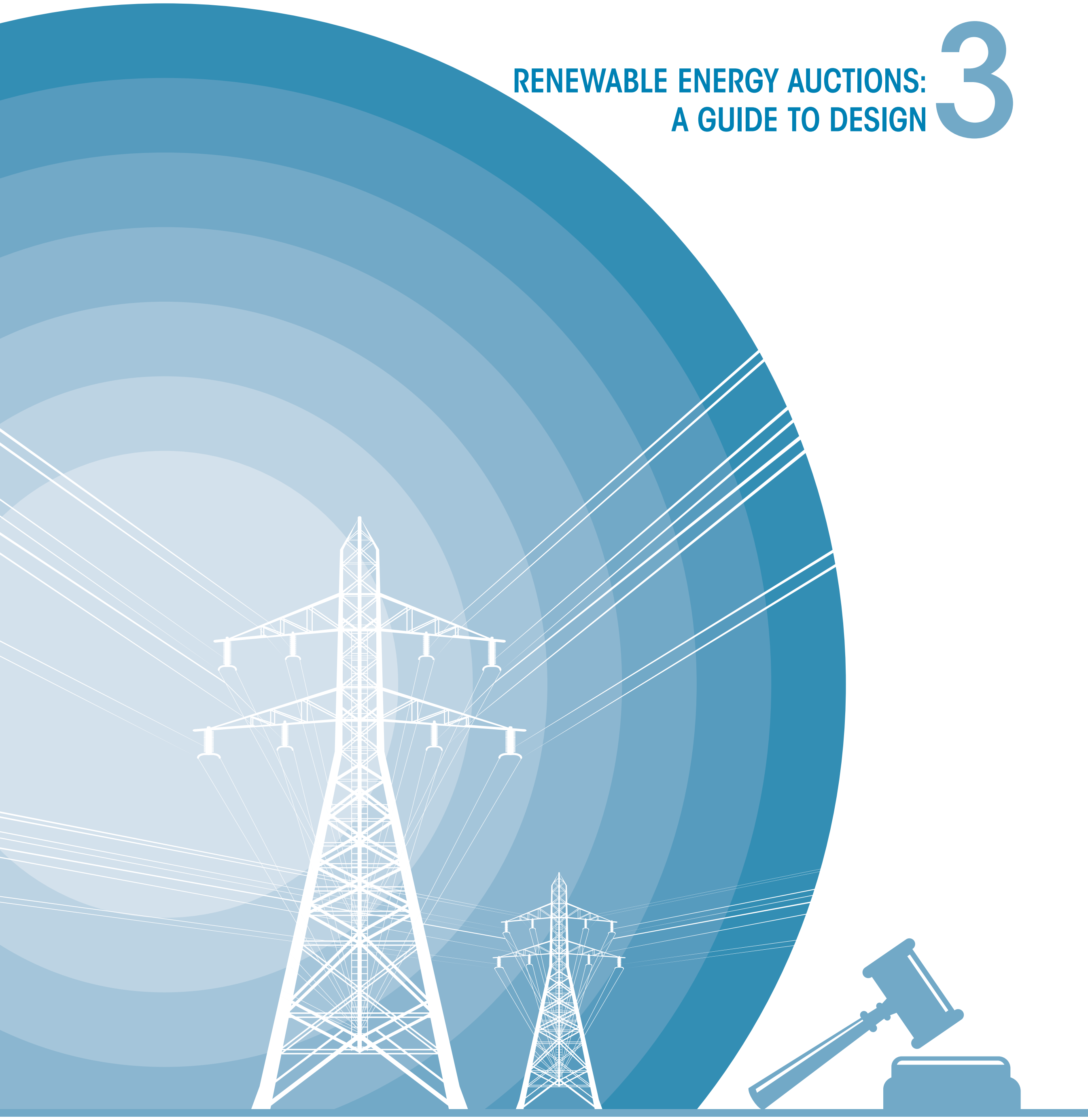
All the design elements, examples and other recommendations are analysed and illustrated in this study on *Renewable Energy Auctions: A Guide to Design*.

CLEAN ENERGY MINISTERIAL

Accelerating the Transition to Clean Energy Technologies

IRENA

International Renewable Energy Agency



RENEWABLE ENERGY AUCTIONS: A GUIDE TO DESIGN 3

AUCTION DESIGN: DEMAND

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3 Auction design: Demand

The auction demand involves key decisions on what exactly is to be procured in the auction and under which conditions. It thus comprises demand-side considerations and topics that fall in this category include: 1) the *specific demand bands*, which define whether and how the total demand is shared among different "products"; 2) the *volume of products* to be auctioned; 3) the *periodicity and long-term commitments*, which determines whether a pre-set auction schedule is adopted, and 4) the *demand-side responsibilities* that ensure the creditworthiness of the auctioneer. Figure 3.1 summarises these design elements, that are further discussed in the chapter.

3.1 SPECIFIC DEMAND BANDS

Demand bands are associated with how the total energy demand is structured and allocated to products with different characteristics. A product can be defined by the particular attributes of the Power Purchase Agreement (PPA) signed after the auction (see Chapter 6) or by the different qualification requirements requested in order for the developer to be eligible to participate in the auction (see Chapter 4).

Perhaps the most typical example of separating auctioned volumes into demand bands is according to different renewable energy technologies (see Section 4.2). However, in practice, it is possible to partition the demand in many other ways: some renewable energy auctions have split their demand based on locally manufactured versus internationally manufactured equipment, project size and geographical location, among others.

Figure 3.1: Overview of demand-side considerations

Specific demand bands

Related to the partitioning of renewable energy demand based on different criteria (technology, size, location, *etc.*):

» Exclusive demand bands
» Competitive demand bands
» Partially competitive demand bands

Volume auctioned

Key input in the auction process, consistent with the renewable energy policies and electricity system's technical capabilities:

» Fixed auctioned volume
» Price-sensitive demand
» Multi-criteria volume setting

Periodicity and commitments

» Standalone auctions – used to achieve economies of scale, mainly in smaller countries with less mature technologies
» Systematic auctions – may attract a larger number of bidders, leading to gradual renewable energy penetration

Demand-side responsibilities

» Allocation of costs
» Contract off-taker
» Contracting schemes

Consumers → Contract off-taker → Generator

Regardless of the criterion used to distinguish the demand bands, multi-product renewable energy auctions can be classified as being 1) *exclusive*, when separate capacity targets are allocated to two or more renewable energy products in such a way that the demanded quantities do not intermingle (*i.e.*, the products do not compete with each other); 2) *competitive*, when different products compete for the same total demand on relatively equal terms, for example, when the auctioneer establishes a capacity target to be installed for which more than one renewable energy technology compete; or 3) *partially competitive*, which represents a middle point between the first two options.

Exclusive demand bands

In auctions that involve multiple products, setting pre-determined demand bands is in principle no different from organising multiple independent auctions for the different products – although organising a single auction may reduce the burden on the auctioneer. Since the earliest auctions, exclusive demand bands have been implemented to foster the development of specific technologies. The first renewable energy auctions, which were organised in the United Kingdom (UK) in the 1990s, awarded contracts as a result of a competitive bidding process within exclusive technology bands, which allowed each technology to progress at an appropriate pace rather than competing with other technologies (discussed later in Box 3.11).

Multiple criteria besides the renewable generation technology can be used to define exclusive demand bands – such as the project size as in the case of India (see Box 3.1) and France. India has also had some experience with splitting the auction's demand into projects that fulfill a given level of local content requirement (LCR) and projects that did not (see Section 4.5).

One of the main benefits of adopting exclusive demand bands is that it offers better guidance to potential project developers. Furthermore, reserving demand bands to less mature technologies encourages the development and deployment of those technologies and the diversification of the energy mix. A similar argument can be made for promoting smaller-scale projects and domestically manufactured equipment. However, one disadvantage is that the fragmentation of demand could result in less competition among suppliers, which in turn may result in higher prices for the renewable energy purchased. In addition, there is a higher chance that at least one of the bands may fail to attract enough bidders, leading to an increased risk of undercontracting.

In order to mitigate this risk, some countries have allowed a transfer of demand between sub-auctions when one of them is undersupplied. For example, in 2011, in the Indian state of Karnataka, the auction originally foresaw contracting 50 MW of solar PV and 30 MW of solar thermal generation, but this split was revised to 60/20 when only one 20 MW bid was received for the second technology.

BOX 3.1: EXCLUSIVE DEMAND BAND BASED ON PROJECT SIZE IN PUNJAB, INDIA

A common downside of exclusive demand band auction schemes is that they could limit the participation of small and/or new players, a topic that is discussed in Section 2.2 and Box 2.8. One possible way to address this risk is by introducing them for small-sized projects. In the Indian state of Punjab's 2013 solar power auction, for example, a portion of the demand (50 MW in total) was reserved to relatively small-scale projects (1-4 MW), and only newly established companies were able to participate. The remaining 250 MW was reserved for well-established companies with project sizes of 5-30 MW.

In December 2014, the state of Punjab organised a new auction for the installation of 250 MW of solar PV projects. This time, the auction demand was divided into three categories: 50 MW was allocated to small-scale projects (1-4 MW), 100 MW to medium-sized projects (5-24 MW) and 100 MW to large installations (25-100 MW). However, the undersubscription of eligible bids in the first category and the predominance of maximum-sized bids in the second category (24 MW) showed an overall preference for larger projects among the project developers, indicating that further incentives may be needed to overcome the transactions costs.

Source: (Elizondo-Azuela, *et al.*, 2014), (Pillai and Banerjee, 2009).

Similarly, in the 2010 auction in Peru, the bids received for the biomass generation product amounted to only 143 GWh per year, whereas the available capacity on auction for that product was 813 GWh per year. As a consequence, some of this unmet demand was transferred to the wind power demand band, which resulted in 571 GWh per year of wind being contracted, 178% higher than the original demanded quantity (320 GWh per year). This type of decision is usually made after bids are received and surpluses and deficits in different products are identified. There are more complex *ex ante* transferring schemes that can also be considered, approaching the situation of *partially competitive* schemes described later.

Competitive demand bands

Another way of auctioning multiple products is through competitive auctions that involve a single pool representing the entire auction demand, to be allocated by means of the winner selection process only (see Chapter 5), with no products being entitled to a minimum awarded quantity. In its purest version, fully competitive auctions involve only a single product, and once suppliers satisfy the criteria to participate in the auction (see Chapter 4), they are all treated equally. A competitive auction could be, for example, one in which various renewable generation technologies compete for a single quantity target, with the most extreme case being a technology-neutral auction. For example, the 2011 auctions that were held in Brazil were technology-neutral, and renewable energy technologies were competing with natural gas.

Because competitive auctions seek to maximise competition in order to achieve the most cost-effective results, they tend to favour the most attractive technologies and sites available, at the expense of other potentially promising- but ultimately costlier projects. While this is a feature that allows competitive auctions to drive prices down, it tends to favour mature technologies.

By definition, in a competitive auction, all bids must be compared according to the same selection criterion; however, this does not mean that competitive auctions are necessarily completely neutral. It is possible, for example, to propose a contract with specified demand bands that are better suited to certain renewable energy generation profiles (such as a contract that involves energy delivery obligations concentrated in the daytime, catered to solar power), allowing other technologies to compete for this product if they are willing to accept the higher price/quantity risks. California's Renewable Auction Mechanism is an interesting case study of this type of implementation (see Box 3.2), and Chile has adopted a similar strategy in its recent conventional electricity auctions.

In summary, in an auction involving exclusive demand bands, each bid is pre-allocated to a particular band depending on its characteristics (technology, size, etc.). In contrast, an auction involving competitive demand bands may allow the project developer to choose the product with the most suitable risk preferences and generation profile, with the option to even bid for more than one product. By promoting product differentiation without an explicit separation between the bids, this type of implementation tends to highlight the competitive nature of the auction mechanism.

Partially competitive demand bands

Partially competitive auctions, in turn, seek to find a balance between the two alternatives described above, with the aim of achieving the best of both worlds by combining the improved guidance of exclusive auction schemes with the greater cost-effectiveness of competitive schemes. As is often the case with hybrid implementations, this typically comes at the cost of higher complexity, since there is a larger number of variables that need to be determined to achieve the desired result.

One reasonably straightforward way to implement an auction involving partial competition is to assign minimum exclusive volumes to each demand band, while leaving the remainder of the auction demand after these minima to be allocated in a competitive fashion to the best offer. Guatemala's 2012 auctioning scheme, which involved auctioning both renewable and non-renewable energy sources for new and existing suppliers, used this type of scheme. It allocated minimum demanded

BOX 3.2: AUCTION DEMAND BANDS IN CALIFORNIA

The U.S. state of California introduced its Renewable Auction Mechanism (RAM) in 2011, aimed specifically at promoting geographically distributed, small-scale generation projects of various renewable energy sources. Originally intended as a one-time programme involving four auctions organised in a period of two years for procuring a total of 1 000 MW, the programme has since been extended.

A very specific characteristic of the RAM is the way in which the auctioned volume has been shared among demand bands. Although the bands are technology-neutral, they are designed to implicitly favour one or another technology through the product definition and commitment profiles. In the Californian scheme, the auction demand is split into three different categories: 1) baseload electricity (suited for biomass, biogas, landfill gas and geothermal), 2) peaking electricity (suited for solar PV and solar thermal) and 3) non-peaking electricity (suited for wind and small hydro).

This categorisation favours competition among similar technologies, and results seem to indicate a major representation of wind power in the non-peaking category and a total dominance of solar PV in the peaking group. However, this is not a hard rule: it is the generators' responsibility to define the type of product that they can most properly deliver. Unlike the classic technology-specific bands, in which a specific project can bid in only one of the categories, in the competitive demand bands, a project has the possibility to bid in more than one category.

For instance, different hydropower projects have been accepted both in the baseload and in the non-peaking electricity categories. Ultimately, this type of auction structure leads to greater competition, with the aim of achieving the lowest price regardless of the technology.

Results from the first four auctions suggest that the RAM is an economically efficient mechanism for the procurement of wholesale distributed generation. However, one important concern is that the winning projects may not represent a diverse array of renewable energy sources, as might have been intended: in the first auctions, for example, solar PV accounted for 95% of all bids, with 13 out of 15 winning bids. This is because solar PV technology is relatively well developed and less expensive compared to other distributed generation options.

Since RAM 1, the number of baseload and non-peaking bids has increased steadily (at the expense of peaking electricity products), and the procurement of these resources has grown, although at modest rates.

Sources: (California Public Utilities Commission, 2013), (California Public Utilities Commission, 2015), (Wentz, 2014).

quantities to the most desirable products and maximum quantities to less-desirable ones (see Box 3.3).

BOX 3.3: PARTIAL COMPETITION SCHEME WITH MINIMUM BAND ALLOCATIONS IN GUATEMALA

Guatemala has organised three iterations of a competitive auctioning scheme in which a wide array of types of projects can participate – including renewable and non-renewable energy sources, new and existing generators, and international players.

These schemes have been carried out in a partially competitive fashion, such that specific technologies are allocated a minimum capacity to be contracted. Volume caps are also set on other technologies, to ensure some competition among the technologies for the demanded quantity above the technology-specific minimum.

The main parameters set in 2012 Guatemala's auction were as follows:

- A total auctioned volume from all technologies of 600 MW, out of which a minimum capacity of 300 MW is to be contracted from renewable energy sources, out of which a minimum capacity of 200 MW is from hydropower, and a minimum capacity of 30 MW is from biomass and wind. Therefore, a capacity of 70 MW represents a competitive demand band for all the renewable energy technologies;
- As such, a maximum capacity from non-renewable energy sources of 300 MW was set, out of which a cap of 80 MW is set on coal and a cap of 200 MW is set on natural gas;
- The auction required also a minimum capacity of 300 MW to be contracted from new suppliers, as a way to encourage new players in the market and a maximum capacity of 300 MW to be contracted from international players, in order to limit the foreign participation and to encourage the domestic one.

To comply with all of these criteria while minimising the cost of the electricity purchased, Guatemala uses a linear optimisation model to select the auction winners. Despite the benefits of this design, it comes with a high level of complexity, increased costs for the auctioneer and reduced transparency from the bidders' point of view (given that they do not explicitly know how the winner selection process took place).

Source: (Comisión Nacional de Energía Eléctrica, 2012)

Main findings

Even though single-product auctions can in principle be more focused on fulfilling objectives, auctioning multiple products simultaneously has also been a common strategy – enabling the reduction of transaction costs, and allowing policy makers to provide better guidance. There is a wide array of implementation options for distributing the auctioned demand into bands, as both exclusive and competitive auctions have been implemented worldwide. The experience with partially competitive schemes is limited, but, where applied, this type of mechanism has proven to be successful as well. There is little consensus on which design alternatives are the most desirable, indicating that this is a very context-dependent choice.

The main advantages and disadvantages of the different demand band alternatives presented in this section are summarised in Table 3.1.

Table 3.1: Summary comparison of demand band options

Criteria / Options	Exclusive demand bands	Competitive demand bands	Partially competitive demand bands
Simplicity	● Straightforward division of demand	◐ Rules to compare different bids competing in the same demand band	○ More complex set of rulings
Guidance from the auctioneer	● Strict criteria for each category	◐ Bidders are treated equally, with more moderate guidance	◕ A mix of moderate and strict criteria
Competition	◔ Segmentation of demand may lead to less competition	● Allows competition among all the bidders	◕ Allows limited competition among classes of bidders
Avoided under-contracting	◔ Any of the sub-auctions might fail to attract bidders	● High flexibility in matching bids to demand bands	◕ Moderate flexibility in matching bids to demand bands

Characteristics of the relevant attributes: ○ *Poor* ◔ ◐ *Medium* ◕ ● *Very good*

3.2 DETERMINING THE AUCTIONED VOLUME

A key input to the auction is the desired amount of renewable energy to be contracted – a target that must be consistent both with government policies for renewable energy development and with the existing system's technical capabilities to absorb the renewable energy (see Section 4.4). There are essentially three ways to determine the auctioned volume: 1) under a *fixed volume method*, the government simply determines the desired demand level in a unilateral fashion; 2) in a *price-sensitive demand curve* mechanism, demanded quantities are affected by the auction's equilibrium prices according to a rule that is determined ahead of time; and 3) in a *multi-criteria volume setting* method, other parameters and more complex guiding principles may be used to determine the demand level. In all three options, there is an additional decision to be made regarding whether or not the determined volume will be disclosed to potential bidders.

Fixed auctioned volume

Fixed volume schemes, in which the auction demand (in energy or capacity terms) is determined by the auctioneer and assumed to be fixed, are the most common and straightforward to implement. This approach has the benefit of offering guidance to the bidders, and is also regarded as simple and transparent. In order to increase transparency, the demanded quantity is most often fully disclosed.

One consideration regarding full disclosure, however, is that letting the market have full knowledge of the auction demand can be undesirable if bidders can use this information to influence the outcomes. For example, in a descending clock auction (see Section 5.1), if bidders have information on the supply-side quantity at each round, they can bid strategically in an attempt to end the auction prematurely and increase their own remuneration. When a bidder knows that s/he is a pivotal player to meet the demand, s/he can choose to leave the auction, which forces the auction to terminate at a higher equilibrium price, unless the auctioneer accepts some undercontracting. For this reason, in Brazil's renewable energy auctions and Colombia's conventional energy auctions – both involving descending clock rounds – an effort is made to keep the demanded quantity undisclosed until after the auction.

Price-sensitive demand curves

In the case where the volume is set using a price-sensitive demand curve, if the auction's equilibrium price is lower than the government's original estimates, the demanded quantity could rise in response, and vice versa. This representation of the volume as a function of equilibrium price could result in more desirable outcomes, especially if the bids received depart substantially from the government's original expectations. For example, if the auctioneer had estimated a much higher price for developing solar PV projects, the volume contracted can be increased from the initial plan if investors offer much lower prices due to the falling costs of technology.

Despite the increased flexibility, following a price-sensitive demand curve adds a slightly higher level of complexity to the mechanism and makes it more difficult to clearly communicate the auction's demanded quantity to the market.

Price-sensitive demand curves may be defined, for example, by determining a total budget for renewable energy expansion, which results in the auction demand being inversely proportional to the equilibrium price, as in the case of the Netherlands (see Box 3.4). If the price resulting from the auction is lower than the equilibrium price, the volume can be adjusted upwards, and vice versa. This type of representation is often practical from the auctioneer's standpoint, in the sense that policies to support renewable energy deployment are generally limited by the maximum amount of resources that can be allocated to the initiative.

BOX 3.4: PRICE-SENSITIVE DEMAND ON MULTIPLE BANDS BASED ON A TOTAL BUDGET IN THE NETHERLANDS

Since 2011, the Netherlands' renewable energy programme SDE+ (Stimulering Duurzame Energieproductie/Encouraging Sustainable Energy Production) has combined auctions with feed-in premiums (FIP) in a unique way. Contracts are awarded by means of technology-neutral auctions, while compensation takes place based on a FIP that results from the auction. The FIP is calculated as the difference between the price offered during the bidding process and the monthly average electricity price, and it is paid for 15 years.

The support scheme is based on a well-defined annual budget and is meant to achieve least-cost promotion of renewable energy. Since 2012, both renewable electricity and heating technologies have been included under the same scheme. The SDE+ is operated in the form of sequential bidding rounds with increasing prices. For each bidding round, the government sets the support levels that increase from one round to the next. In 2013, for example, these were 70 EUR/MWh (92 USD/MWh) for the first round, 80 EUR/MWh (105 USD/MWh) for the second round, 90 EUR/MWh (119 USD/MWh) for the third round, *etc.*

In this way, low-cost renewable energy technologies are the first to submit their bids and be granted financial support, as the selection takes place on a "first come, first served" basis. Renewable energy technologies with higher costs can participate in subsequent bidding rounds, which will be held until the maximum amount of the available budget has been allocated (EUR 1.5 billion in 2011, roughly USD 2.08 billion, EUR 1.7 billion in 2012, roughly USD 2.17 billion, EUR 2.2 billion in 2013, roughly USD 2.9 billion, and EUR 3.5 billion in 2014, roughly USD 4.65 billion, distributed over the lifetime of the plants). Therefore, bidders waiting for a higher remuneration level round may risk having the auction's budget exhausted before reaching that round. In 2012, for example, the available budget was already exhausted during the first bidding round, resulting in project bids of 70 EUR/MWh (92 USD/MWh), most of which was allocated to heating and to combined heat and power.

There is also a free category in each bidding round, in which project developers have the opportunity to request a lower level of compensation than the one of the respective bidding round.

Due to the fact that the SDE+ scheme allows the deployment of only the most cost-effective technologies, the overall budget is usually exhausted before reaching higher-compensation bidding rounds. As such, the Dutch government is planning to organise separate tenders for offshore wind energy in 2015.

Sources: (IRENA, 2014a), (Ecofys, 2014), (Agora, 2014), (Del Río, Linares, 2014).

Multi-criteria volume setting

Multi-criteria volume setting methods are more complex than the price-sensitive demand curves described previously, as the volume set is not simply a function of the price. This approach can be the best way to represent certain more sophisticated demand allocation procedures which involve multiple demand bands (see Section 3.1), although in general, it is more difficult to communicate these criteria to the public. One example of this type of multi-criteria implementation can be found in Brazilian auctions, in which the auctioned demand depends on the number and capacity of potential suppliers (see Box 3.5).

Main findings

Fixed auction volume schemes have been the most common option implemented worldwide, and they seem to be reasonably functional. Indeed, adjusting demanded quantities may not be an option for many jurisdictions, given the strict policy commitments that various countries have engaged in, such as the 2020 targets set in the European Union. Under a fixed auction volume scheme, governments can accomodate to a limited budget for the support of renewables by implementing a price cap mechanism (see Section 5.2); and if the prices resulting from the auction are lower than expected, policy makers can consider the possibility of holding another auction.

Introducing price-sensitive demand curves and/or multi-criteria volume setting methods allows policy makers to automatically incorporate some flexibility to the contracted quantity, to the extent permitted by budgetary allocations and the government's policy objectives. Although these alternatives tend to imply a higher mechanism complexity, the benefits of having a more refined demand curve can outweigh the potential downsides.

The main advantages and disadvantages of the different auction volume options presented in this section are summarised in Table 3.2.

Table 3.2: Summary comparison of auction volume options

Options / Criteria	Fixed auctioned volume	Price-sensitive demand	Multicriteria volume setting
Simplicity	Simple to implement and communicate	Slightly more complex (for some implemen-tations)	Potentially more complex; cannot be described as a function of price
Guidance from the auctioneer	Policy mak-ers' goals are unidimentional (quantity only)	More flexibility in setting goals (price and quantity)	Greater flex-ibility: multi-dimensional goals
Matching supply and demand	Cannot respond to prices	Capable of reaching optimal demand and price	Depends on the criteria selected

Characteristics of the relevant attributes: *Poor* *Medium* *Very good*

BOX 3.5: COMPETITION AS A CRITERION TO SET THE AUCTION VOLUME IN BRAZIL

Brazil's renewable energy auctions have two distinct features regarding their volume setting method: 1) a feature for adjusting the auction's total volume as a function of supply, and 2) a feature for allocating this volume to the various renewable energy products according to the total supply registered to each product.

The first feature aims to promote competition and prevent the price from being too close to the cap. Prior to the auction, two parameters are defined and kept undisclosed: the "total demand", which represents the maximum amount of energy that will be contracted from all products, provided that there is sufficient supply; and the "demand parameter", which is used to force a minimum level of competition.

For example, if the demand parameter is equal to 1.5, this means that the auction's supply must be at least 50% higher than the total volume. If supply is insufficient, then the volume will be automatically adjusted downwards: Volume auctioned = Min {Total Demand; Total Supply/Demand Parameter} (the demand parameter is always greater than one).

The second feature is used to allocate the total volume to the various renewable energy products according to the number of bidders in each product. Brazilian auctions have so far designated a total volume to be allocated to various products representing different technologies. The 2013 auction allowed the participation of wind, solar and biomass.

For example, if the volume auctioned is 500 GWh, and the bids received in the first round correspond to 1 600 GWh of wind power, 800 GWh of solar power and 100 GWh of biomass, then the auction demand would be distributed proportionally: 320 GWh for wind, 160 GWh for solar and 20 GWh for biomass.

In addition, the government also sets a "reference factor" for solar and biomass, representing the maximum share of the auction demand that can be allocated to these two products. For example, in the case above, 32% of the volume is allocated to solar; however, if the government had set a reference factor of 25% for that technology, then the demand for solar would be revised to 125 GWh rather than 160 GWh. Because wind has the lowest reference price of the three products offered in that auction, it is treated as the "default" technology. Therefore, demand for wind would be increased so that the total auction demand is still equal to 500 GWh.

Even though the procedure for determining the volume is described in the Brazilian auction documents, all relevant parameters are kept undisclosed.

Sources: (Elizondo-Azuela, Barroso *et al.*, 2014), (Maurer, Barroso, 2011), (Porrua, Bezerra, Barroso, | Lino, Ralston, Pereira, 2010)

3.3 PERIODICITY AND LONG-TERM COMMITMENTS

The periodicity of auctions are associated with a country's energy policy and long-term commitment to renewable energy deployment. A country that seeks to introduce an auction scheme has two options: 1) a *standalone auctioning scheme*, in which each auction is organised individually, without the commitment to further bidding rounds in the future; and 2) a *systematic auctioning scheme*, which involves longer-term planning and pre-commitment to an auction schedule to be carried out over an extended period, typically along with a total quantity to be awarded in the course of those future auctions.

Standalone auctions

Concentrating the entire demanded quantity into a single standalone auction may be desirable if the policy target is small. This approach may also help promote economies of scale (although this can have some drawbacks, as discussed in Section 4.2). Several Indian states as well as Dubai, Peru and Uruguay have chosen the route of standalone auctions. In addition, the government may be hesitant to commit to a long-term schedule for newly introduced renewable energy technologies, as it can be difficult to predict the auction's success in attracting bidders and developing projects, especially in the case in which country's experience with auctions is limited.

The main benefit of standalone auctions is that the government retains its liberty and flexibility to adjust the auctioning schedule in response to any shifts in market conditions. If the government overcommits and eventually finds itself in a situation where it must revise its prior commitment, this could have a negative impact on the investors' confidence in the system.

The main downside of adopting a standalone auction, however, is that it tends to magnify the "stop-and-go" characteristic of the auction scheme, as developers and manufacturers find it more difficult to plan for the development of a renewable energy supply chain in the country. Brazil is one example of a country that has chosen this route: even though renewable energy auctions have been organised almost every year since 2008, the decision of how much to contract and from which technologies is made on a year-by-year basis.

Systematic auctioning scheme

Systematic auctioning schemes involve a commitment to a longer-term auctioning schedule. This alternative allows market agents to better adjust their expectations and to plan for the longer term. Additionally, introducing a steady stream of new projects rather than a substantial, aperiodic influx (as it is typically the case with standalone auctions) helps the government promote the development of a local industry. In addition, having a long-term auction schedule provides better guidance for planning the grid infrastructure, so that the stream of new projects are smoothly integrated. Choosing this option, however, may result in a risk of overcommitment, forcing the government to dynamically adjust the auction schedule and quantities according to perceived shifts in market conditions.

The upside of splitting the demand into several auctions according to a long-term plan seems to be significant, as the success of earlier auctioning rounds seems to result in more success in later rounds. Generally, there is a steep learning curve for the first few rounds of an auctioning scheme, as the auctioneer goes through a learning by doing process and the project developers, as well as other market agents such as financiers, gain confidence in the programme. In India the National Solar Mission has shown the advantages of a systematic auctioning scheme (see Box 3.6).

BOX 3.6: SYSTEMATIC AUCTIONS IN INDIA

When launching its National Solar Mission (NSM), India aimed to support the development of the solar power sector and committed early on to a systematic auctioning scheme in three phases announced ahead of time. Phase I was planned to take place between 2010 and 2013, Phase II between 2013 and 2017, and Phase III from 2017 to 2022. Periodic evaluations of progress were scheduled regularly, during which the capacity targets for subsequent phases could be revisited based on observed cost and technological trends, (domestic and global). The idea was to protect the government from exposure in case expected cost reduction did not materialise or was more rapid than expected.

Therefore, the first phase involved relatively modest capacity additions in grid-connected systems. In the second phase, taking into account the experience of the initial years, capacity increased significantly.

Sources: (Eberhard, 2013), (Elizondo-Azuela, Barroso *et al.*, 2014), (Wentz, 2014), (Bloomberg, 2015).

In a number of jurisdictions, the move towards multiple round auctions (see Box 3.7) has had positive learning curve impacts (see Table 3.3).

Table 3.3: Systematic auctions and the learning curve impact

Country	Renewable energy technology	First iteration	Second iteration	Learning curve impact
South Africa	Various	2011: 53% bids qualified	2012: 64.5% bids qualified	+11% increase in bid qualification rate
India	Solar PV	2010: 12.16 INR/kWh	2011: 8.77 INR/kWh	28% decrease in contracted price
California (USA)	Various	2011: 92 bids received	2012: 142 bids received	+54% of bids received

BOX 3.7: SYSTEMATIC AUCTIONS IN CALIFORNIA AND GERMANY

California

Four auctions were planned from the get-go, to be carried out in the timespan of two years, with predetermined demand levels (although those quantities were later revised upwards). See Box 3.2 for more detailed info on the auctions in California.

Germany

One of the main features of the newly designed auction in Germany is the longer-term planning and a pre-commitment to a schedule. Nine auctions are planned over the course of 2015-2017, and all of them will take place every year in April, August and December and will be announced by the German regulatory agency, Bundesnetzagentur, six to nine weeks before the auction. The reason for having a systematic auctioning scheme is to ensure a continuous renewable energy project pipeline, while at the same time to test different design elements in different auction rounds.

Sources: (Eberhard, 2013), (Elizondo-Azuela, Barroso *et al.*, 2014), (Wentz, 2014), (Bloomberg, 2015).

In South Africa, for example, the commitment to multiple rounds has had a positive impact in terms of building investors' confidence in the programme (see Box 3.8).

BOX 3.8: SYSTEMATIC AUCTIONS IN SOUTH AFRICA

In 2011, the South African Renewable Energy Independent Power Project Procurement Program (REIPPPP) was changed from a standalone tender to a series of bidding rounds. The first three rounds took place in 2011, 2012 and 2013, and two more rounds are planned until 2016. Overall, the number of bidders increased by 49% from the first round to the second, and by 18% in the third round (see Table 3.4).

To stimulate competition, rules for allocating volumes for each round were developed, and the multiple-round auction allowed both bidders and auctioneers to learn by doing. Table 3.4 illustrates the increase in competition throughout the rounds, both in the number of bidders and in the difference between the total bid capacity and awarded capacity (see Box 5.5 for further discussion on the auction results).

Table 3.4: Results of multiple auction rounds in South Africa

	Round 1	Round 2	Round 3
Number of bidders	53	79	93
Qualified bidders (and % increase)	28 (53%)	51 (64.5%)	74 (79.6%)
Projects awarded	28	19	17
Bids capacity (MW)	2 128	3 255	6 023
Capacity auctioned (MW)	3 725	1 275	1 473
Capacity awarded (MW)	1 415.5	1 044	1 456

Main findings

Organising an extended renewable energy programme that involves multiple auction rounds facilitates long-term planning for bidders and other market agents such as equipment suppliers, which have several well-documented benefits. As such, systematic auction schemes may attract a larger number of bidders and be beneficial to the country's renewable energy industry and to the grid planning.

However, standalone auctions have also been used often, and may be particularly appropriate when dealing with less-mature technologies or when the total quantity to be auctioned is small. Standalone auctions also allow the government to retain maximum liberty and flexibility to adjust the auctioning schedule in response to shifts in market conditions. The main advantages and disadvantages of the two periodicity options for auctions presented in this section are summarised in Table 3.5.

Table 3.5: Summary comparison of the auction frequency options

Options / Criteria	Standalone auctions	Systematic auctions
Policy makers' ability to react to changing market conditions	Full flexibility, no long-term commitments	Limited, although caveats can be introduced ex ante
Investors' confidence	Unpredictability may detract some investors (costs of entering a new market)	Enables long-term planning; learning curve during the first auctioning rounds
Development of a local industry	"Stop and go" dynamics	Gradual renewable energy integration

Characteristics of the relevant attributes: *Poor* *Medium* *Very good*

3.4 DEMAND-SIDE RESPONSIBILITIES

Another consideration with regard to auction demand is that, typically, the auctioned product will involve some payment stream to the project developer once the renewable energy plant comes online, and the bidders need to be assured that the auctioneer will keep his/her side of the contract. In this regard, there are decisions to be made relating to: 1) the selection of the *contract off-taker*; 2) the *allocation of costs* to consumers; and 3) defining *contracting schemes* in a way that offers certainty to project developers.

Contract off-taker

The contract off-taker is the entity that signs the contract with the auction winner and becomes responsible for the contract payments – often functioning as a mediator between electricity consumers (or government entities responsible for carrying out the payments) and the project developer. In many cases, a state-owned company plays the role of the contract off-taker. The utilities that service the regional load are also good candidates, since they typically already collect a regulated tariff from electricity consumers in exchange for providing connection services. This would facilitate the task of passing through the costs of the auctioned contract.

The most important attribute for the contract off-taker is its creditworthiness; otherwise, concerns about counterparty risks may drive away potential bidders. If a jurisdiction's state-owned companies and utilities are not financially stable, it is sometimes desirable to seek alternative entities to play this role.

Peru is an example of a country that revised its contracting arrangements, changing the contract's off-taker. In hydropower-exclusive auctions carried out in 2009 and 2011, distribution companies had been used as off-takers. However, in the country's renewable energy-exclusive auctions in 2010 and 2011, the Peruvian government itself was the contract's off-taker (represented by the Ministry of Mines and Energy), likely in order to eliminate any doubts about counterparty creditworthiness. The issues faced by Indian states represent another interesting case study (see Box 3.9).

Allocation of costs

The allocation of costs can follow multiple methods of implementation. Even by only taking into account the "standard" implementation, in which the costs of renewable energy contracting mechanisms are simply passed on to consumers, it is possible to adjust the cost allocations to different consumer classes. In certain implementations, industrial consumers pay the lion's share of the costs of renewable energy contracting, whereas in other mechanisms, more cost is allocated to residential consumers.

In addition, sometimes the burden of this cost on electricity tariffs is reduced (or even entirely eliminated) by the introduction of some kind of subsidy structure. In this case, the remuneration for renewable energy initiatives comes (partly or entirely) from government budgets, state-owned companies, or in some cases development banks or international aid entities. More often than not, taxpayers are ultimately responsible for funding this type of scheme.

As for the allocation of costs, the design selected impacts the outcome in different ways. In most instances, the cost of the scheme is passed on to the consumers and the risk perception usually depends on the credibility of the distribution companies and if they have stable schemes in place to ensure collection of the consumers' payments.

BOX 3.9: THE IMPORTANCE OF THE CONTRACT OFF-TAKER IN INDIAN STATE-LEVEL AUCTIONS

Inspired by the National Solar Mission programme, multiple state authorities in India have sought to promote similar state-level policies, most of which have involved auctions. However, one major challenge faced by the states that was not as prominent in federal-level auctions was the absence of creditworthy off-takers for the auctioned contracts. The financial situation of government-owned utilities varies heavily from state to state, and this is a factor that has influenced investors' participation and bidding.

Table 3.6 llustrates the total amount of capacity that subscribed to participate in the renewable energy auctions of Tamil Nadu and Andhra Pradesh (these two experiences are comparable because they have similar dates of realisation and target quantities). Andhra Pradesh attracted a substantially higher number of bidders than Tamil Nadu. While it is impossible to properly address all factors that influenced this result, the very different bankability of the two states' utilities has been cited as an important factor behind the significant difference in the two auction' ability to attract investors.

Table 3.6: Evidence of the effect of the contract off-taker's creditworthiness on the level of participation

Indian State	Auction date	Utility's bankability	Demanded quantity (MW)	Bid quantity (MW)	Difference in bid quantity
Tamil Nadu	Jan 2013	Poor	1 000	499	+168%
Andhra Pradesh	Feb 2013	Good	1 000	1 339	

The importance of the creditworthiness of the contract off-taker is also illustrated in the auctions carried out in the Indian state of Rajasthan. In 2011, a 200 MW solar auction was called, in which the contract off-takers were the three distribution companies active in the state. In mid-2012, the auction was postponed and upon its redesign later that year, the off-taker was shifted to the state's nodal agency, the Rajasthan Renewable Energy Corporation Limited (RRECL), which is in better financial health. The increased competition in Rajasthan's auction was likely due to this shift.

Source: (Elizondo-Azuela, Barroso *et al.*, 2014).

In Brazil, for example, the allocation of costs differs between the types of auctions and their scope. In the regular auctions, which are addressed to cover the distribution companies' demand, the costs are allocated to them, while in the reserve auctions, meant to ensure a security of supply margin, the costs are allocated to all consumers, as detailed in the Box 3.10.

BOX 3.10: COST ALLOCATION OF RENEWABLE ENERGY AUCTIONS IN BRAZIL

In Brazil, there are two main classes of auctions organised by the government that can be used as a renewable energy support scheme:

In regular auctions, the demand is determined by the distribution companies, which declare how much electricity they wish to contract to ensure that their load remains fully backed by long-term contracts. Usually these auctions involve conventional electricity, although in 2007 and 2010 there was a decision that they would be renewable energy-exclusive. Distribution companies pass on the costs of these contracts to regulated consumers.

Reserve auctions are summoned at the government's discretion – the main objective bring to enhance security of supply, although in practice they have been used as a renewable energy support mechanism (exclusive to wind, solar, biomass and/or small hydro). This type of contract is signed with the wholesale electricity market operator, the Chamber for Commercialisation of Electrical Energy (CCEE) (rather than with individual distribution companies), and costs are socialised among all consumers via a specific charge (including free consumers that are not served by a distribution company).

Figure 3.2 illustrates the different contract structures and payment flows in these two types of schemes. It is relevant to point out that the two arrangements differ not only in terms of cost allocation (which is specific to each distribution company and shared only among regulated consumers in the case of regular auctions, but socialised among all customers in the case of reserve auctions), but also in terms of the contract off-taker. In the case of the regular auctions, the contracts signed between the auction winners and the distribution companies are settled in a fully bilateral fashion. Although the contracts have special provisions to ensure projects' bankability and offer financial guarantees, the government does not partake in these arrangements.

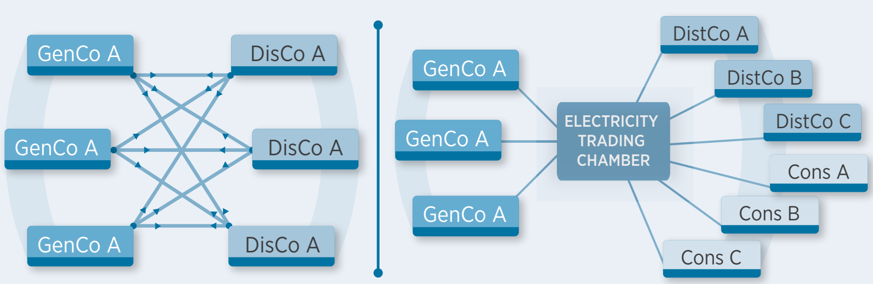
Figure 3.2: Contracting schemes in Brazilian regular and reserve auctions

Regular auctions

» Demand decided by distribution companies (discos).
» Winning projects sign contracts with each participating disco.
» Energy costs are passed on to regulated consumers in tariffs.

Reserve auctions

» Government decides the demand.
» Winners sign contracts with the electricity trading chamber (central institution).
» Contract costs are passed to regulated and free consumers via a reserve energy charge.



Sources: (Barroso, Bezerra, Rosenblatt, Guimarães, Pereira, 2006), (Maurer, Barroso, 2011), (Elizondo-Azuela, Barroso et al., 2014).

In the United Kingdom (UK), the subsidies paid for renewable energy in the contracts awarded came from a tax on electricity paid by all the consumers, as explained in Box 3.11. The main advantages and disadvantages of the different options regarding the contract off-taker and the allocation of costs are summarised in Table 3.7.

Table 3.7: Summary comparison of the off-taker and cost allocation options

	Contract off-taker		Allocation of costs	
Options / Criteria	**Furthest from government**	**Closest to government**	**Least centralised**	**Most centralised**
Brief description	Independent entities: *e.g.* utilities	Government-backed contracts	Passed-through to consumers	Fully funded by the state
Investors' confidence	May have issues with credit-worthiness	Usually very credible	As long as tariffs are cost-reflective	As long as state companies are solvent
Simplicity	Experience in collecting tariffs	More bureaucracy	Utilities usually collect tariffs	Centralised payments

Characteristics of the relevant attributes: *Poor* *Medium* *Very good*

Contracting schemes

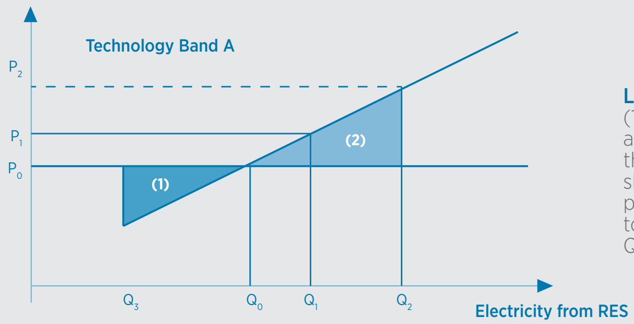
Contracting schemes may be altered in an attempt to offer developers better security to address any investment uncertainty. An example of such an implementation is to organise an auction for the engineering, procurement and construction (EPC) rights of a given power plant – rather than an auction for a long-term contract that includes the obligation to operate and maintain the plant over an extended period of time. In Morocco, this type of EPC auction has been carried out before the implementation of auctions that result in a PPA. Even though this type of arrangement differs from "traditional" auction-based renewable energy policies in several important ways, past experiences in this regard may be valuable to evaluate certain design elements.

Another way to alter the contracting scheme is to involve the government in the project's equity. This solution can be implemented when the jurisdiction may have difficulties to offer credible contract guarantees. One example of this type of arrangement was observed in the Dubai solar power auction in 2014, where the Dubai Electricity and Water Authority (DEWA) has a mandated 51% equity share in the project. It should be noted, however, that having the government as active involved may result in undesirable side-effects – such as greater bureaucracy, limited management flexibility, and possibly giving a perception that the government will shield the developers from risks.

BOX 3.11: SUBSIDISATION OF PRICES IN THE UK'S NFFO AUCTIONS

The economic rationale of the Non-Fossil Fuel Obligation (NFFO) auctions organised in the UK in the 1990s is shown in Figure 3.3. The price in the pool market (P_0) was used to determine the subsidy granted to the renewable energy generated. The projects that are price competitive with conventional electricity, ($q < Q_0$), would not receive any subsidy (as they will be carried out anyway), whereas a project with a higher cost (P_1) would receive a subsidy equal to its generation cost minus the pool price (P_1-P_0). A ceiling price for different technology bands was fixed (P_2 for technology A).

Figure 3.3: Economic rationale of the NFFO

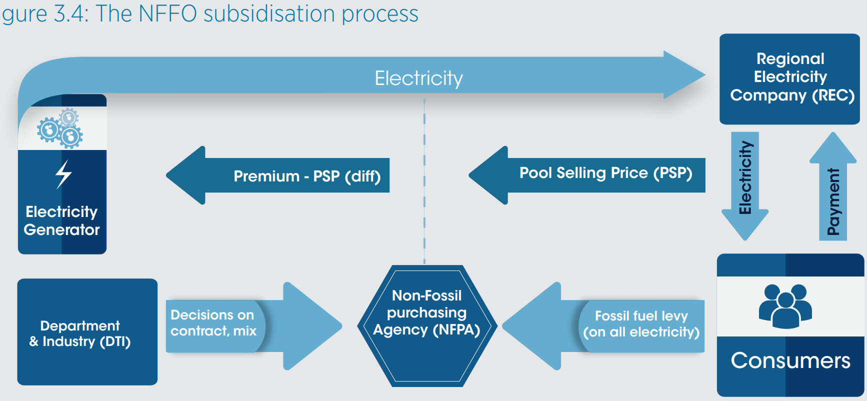


Legend: The shaded area (1) is the producer's surplus arising from the production of the electricity flow Q_3-Q_0. The shaded area (2) is the subsidy paid by an ideal NFFO in order to generate the electricity flow Q_2-Q_0

Source: (Agnolucci, 2005)

The policy instrument aimed to give each project the subsidy needed to make the generation cost per kWh equal to the pool price. A diagram of the subsidisation process can be seen in Figure 3.4. The Regional Electricity Companies (RECs) purchases electricity at the market price -the Pool Selling Price(PSP). The Non-Fossil Purchasing Agency (NFPA) reimburses the REC the difference between the premium price – established in the contract awarded as a result of the auction – and the PSP. The subsidy is paid out of the funds that come from the Fossil Fuel Levy (FFL), a tax on all electricity (not only on electricity from fossil sources). This amount was originally set at 10%, but by the end of the NFFO it had dropped to 1%. This led to a restriction in technology bands in later rounds of the NFFO, such that technologies like biomass or offshore wind were not allowed in NFFO because of their high cost.

Figure 3.4: The NFFO subsidisation process



Source: (Cozzi, 2012)

Another potential solution is to get multilateral development banks to assume part of the senior debt, thereby obtaining the assured reliability of international financial institutions. However, this is not always an easy task, despite the fact that more and more renewable energy development loans and funds are made available. Export credit agencies also could insure the political risk of the government defaulting, thereby reducing the risk exposure of the project developer. The main advantages and disadvantages of the different contract schemes are summarised in Table 3.8.

Table 3.8: Summary comparison of contract scheme options

	Contract schemes	
Options / Criteria	**Least government involvement**	**Government**
Brief description	Classical PPA arrangement	Government retains asset ownership
Investors' confidence	Developers maintain full responsibility	Government becomes co-responsible
Simplicity	Straightforward	More bureaucratic
Cost effectiveness	Straightforward price signals for performance	Assignment of responsibility may be muddled

Characteristics of the relevant attribute: *Poor* *Medium* *Very good*

Main findings

Demand-side responsibilities can be structured in multiple different ways. However, a common trend among the various topics described in this section is that there is often a "sliding scale" between the multiple options in which the government may play a greater or lesser role. In most mature electricity markets, it is generally desirable to minimise government involvement in these design choices: which would imply using utilities as contract off-takers, allocating contract costs to consumers (without additional subsidies), and adopting a straightforward PPA as a contracting scheme. However, if a jurisdiction cannot reasonably offer credible guarantees to project developers, a "second best" solution may be needed.

CLEAN ENERGY MINISTERIAL
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RENEWABLE ENERGY AUCTIONS: A GUIDE TO DESIGN 4

AUCTION DESIGN: QUALIFICATION REQUIREMENTS

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4 Auction design: Qualification Requirements

Qualification requirements determine which suppliers are eligible to participate in the auction, including the conditions they must comply with and the documentation that they must provide prior to the bidding stage. This category encompasses requirements related to: 1) *reputation*, which relates to the capability of the bidding company to develop the project; 2) *technology*; 3) *production site selection;* 4) *securing grid access*; and 5) *instruments to promote local socio-economic development.*

In general, having stricter requirements allows the government greater opportunities for guidance and ensures a greater level of commitment by the project developer. In the U.S. state of California, qualification requirements have mainly been used to prevent speculative bidding, as detailed in Box 4.1.

Qualification requirements are very useful in mitigating the risk that the companies will engage in "adventurous" bidding without necessarily having the capability to deliver the project, a known challenge in auction implementation. However, this comes at the cost of magnifying another common challenge: high transaction costs and a tendency to alienate (and ultimately exclude) smaller players that may be unable to comply with the stringent conditions. This has the undesired side effect of reducing competition at the auction. Even if smaller players could theoretically comply with the stricter requirements, the resulting transaction costs can be an issue not only to bidders (who must procure the necessary documentation), but also to the auctioneer (who must validate and catalogue this information). Ultimately, these conflicting interests must be balanced when selecting harsher or milder qualification requirements. Figure 4.1 summarises the different types of qualification requirements for renewable energy auctions, which are further developed in the chapter.

4.1 REPUTATION REQUIREMENTS

Reputation requirements relate to the documentation that must be provided about the bidding company itself, proving that it has the adequate capacity to develop the project. Although reputation requirements can vary considerably, they typically can be categorised as: 1) *legal requirements*, which are more administrative in nature; 2) *proof of financial health*, which serves to indicate that the company is able to take the project to completion; 3) *agreements and partnerships*, which involves documenting third-party involvement in the project; and 4) *past experience requirements*.

BOX 4.1: STRICT QUALIFICATION REQUIREMENTS IN CALIFORNIA'S AUCTION

In California, the three large investor-owned utilities (IOUs) have set project viability requirements to prevent speculative bidding in the state's Renewable Auction Mechanism (RAM). The set requirements aim to discourage the participation of "concept-only" projects "that have not been sufficiently vetted for economic viability, permitting risks, interconnection costs, and development schedule." For example, 100% site control is required (through either direct ownership or lease), and previous experience with project development is relevant. The IOUs also are responsible for evaluating whether the bids are suitable for each particular project, using information provided by the bidders on project location, commercialised technology, developer experience, interconnection studies and the development schedule.

A large number of projects are screened during each bidding round, and many are considered unsuitable for participating in the auction. In the first round, half of the projects were rejected for failing to demonstrate the ability to meet the required commercial operation deadline (COD) of 18 months, based on the IOUs' assessment of the interconnection studies and schedules of milestones submitted with the offer. For this reason, the COD was revised to 24 months. As a result, the percentage of projects disqualified for this reason dropped significantly in subsequent bidding rounds (see Table 4.1). Another reason for rejecting projects was the failure to provide conforming documentation to support the offer. Table 4.1 shows the number of projects allocated to one of the three California IOUs that have not passed the qualification stage in the four RAM rounds. Although it is difficult to evaluate whether the RAM qualification requirements are overly stringent based on these results alone, the fact that the percentage of projects screened out for COD decreased after the first round demonstrates a learning by doing process.

Table 4.1: Number of offers passing the auction qualification stage for a Californian IOU

	RAM 1	RAM 2	RAM 3	RAM 4
Number of offers	92	142	130	126
Offers screened out for COD	45	22	16	30
Offers screened out for other reasons	1	7	21	16
Total projects screened out	46	29	37	46
Percentage of projects screened out	50%	20%	28%	37%

Figure 4.1: Overview of the different types of qualification requirements

Reputation requirements	Technological requirements
Usually based on the following information regarding the bidding company itself: » Legal requirements » Proof of financial health » Agreements and partnerships » Past experience requirements	Supply-side constraints: » Renewable energy generation source » Equipment specifications » Project size constraints
Socio-economic development instrument	**Production site selection**
Maximising the socio-economic benefit through: » Empowerment and employment requirements mainly focused on the local community » Local content requirements - aimed to promote the local industry	The following aspects must be defined » Site selection responsibility » Location constraints » Site documentation requirements
	Securing grid access
	Defines how the physical access to the electric grid will be ensured

Legal requirements

Legal requirements are never fully absent from auction procedures, since a minimum amount of documentation that uniquely identifies the bidder and proves its compliance with local laws will always be necessary. Additional requirements specific to each auctioning procedure may involve, for example, instructions on how bidding consortia must be registered, and, potentially, constraints to participation depending on the company's ownership and shareholding structure. In Chilean auctions, for example, a specific-purpose company must be formed in order to participate in the bidding process.

Proof of financial health

Proof of financial health involves documentation on the company's financial situation, proving that it is capable of completing the project, and that it is at least able to shoulder the liabilities rather than simply declaring bankruptcy in case it is unable to deliver (see Section 6.6). A requirement of minimum net worth is typically used to this end, although different countries have used different metrics. In Chile, for example, the bidder's credit rating (published by a reputable company) must meet minimal requirements, while in Morocco, developers need to prove their financial capacity. Also loosely related to the company's financial health are the up front deposits typically required prior to the bidding stage, which are meant to ensure the bidder's commitment: the bid bond (usually refunded once the contracts are signed; see Section 6.1) and the completion bond (see Section 6.6).

Agreements and partnerships

Agreements and partnerships refer to the requirement that the bidders disclose not only partner companies participating in the bidding consortium, but also service providers and other contractors for the project. Most commonly, this involves revealing the identity of the manufacturer of renewable energy equipment so that the auctioneer can verify its reputation. In South Africa, for example, bidders have been required to prove the reliability of their suppliers, and in China's 2006 wind power auction, the equipment manufacturer was required to have a stake in the bidding consortium as a way to develop a local manufacturing industry (see Section 4.5). Another possible arrangement would be to require information, for example, on the lending companies financing the project, which would effectively require the developer to secure financing upfront, before it obtains its power purchase agreement (PPA).

Past experience requirements

Past experience requirements imply that the bidding company or consortium must prove its competence by indicating that it has successfully completed similar projects. These can range from lenient to constraining and specific. Box 4.2 illustrates the case of Morocco, where strict requirements regarding past experiences are implemented.

BOX 4.2: PAST EXPERIENCE REQUIREMENTS IN AUCTIONS: THE CASE OF MOROCCO

The first stage of tendering for solar power in Morocco is a pre-qualification stage, in which participants must comply with strict requirements in order to participate in the tender itself (the second stage). For example, in the solar auction organised in 2011 by the Moroccan Agency for Solar Energy (MASEN), qualification was based on assessment of the following criteria relating to past experience:

- Past experience in developing tendered solar projects: the bidding company must have developed and operated solar thermal power plants with a minimum capacity of 45 MW, which must have been won in a past bidding process. Furthermore, this project must not have been liable for penalties or damages for delays or underperformance in excess of 5% of its contract value.
- Past experience with thermal power projects: the bidding company must have developed, operated and managed thermal power plants in the last ten years totalling at least 500 MW, including a minimum capacity of 100 MW in the last seven years.

These strict qualification requirements represented a strong barrier to entry for many project developers, as only large and experienced companies with resources to participate in the auction were able to qualify. Ultimately, MASEN received only 12 bids for its first auction. Furthermore, the demanding conditions resulted in two-thirds of the received bids being disqualified in the pre-qualification round. Only 4 out of the 12 applications went on to the second stage, which may have limited competition.

In contrast, in Brazil the emphasis is on technical documentation with less strict past experience requirements (see Box 4.3).

BOX 4.3: PAST EXPERIENCE REQUIREMENTS IN AUCTIONS: THE CASE OF BRAZIL

For project developers to participate in auctions in Brazil, they have to fulfill a number of technical requirements, such as obtaining a prior environmental licence, a preliminary grid access authorisation, in addition to financial qualifications. However, there are no past experience requirements. The qualification requirement stage is highly standardised and fully automated (web-based), being tailored for each technology. For example, the steps to register for a solar PV and wind A-5 auction organised in 2014 were as follows:

- Project registration at the regulator (ANEEL)
- All technical data concerning the project must be entered on the Empresa de Pesquisa Energetica (EPE) website
- Environmental licence
- Studies and reports on environmental impact
- Grid access authorisation
- For solar PV auctions, PV modules and inverters must be new and their electrical behavior must be in accordance with the grid procedures
- Certification of solar/wind metric data and annual energy production
- The certifying company must not be a shareholder, directly or indirectly, and must not be responsible for the development of the project
- Official documents proving the right to use the land
- Participants' net worth must be at least 10% of the project's estimated investment cost

As illustrated by the list above, qualification requirements in the Brazilian auctions relate mostly to grid access authorisation (see Section 4.4), site documentation (see Section 4.3) and technology-specific requirements (see Section 4.2). The relatively loose reputation requirements mean that the Brazilian auctions are more inclusive, and have likely allowed a higher rate of projects to pass the qualification stage (as illustrated in Table 4.2). Furthermore, because qualification requirements almost never change from one auction to the next, a project that has been qualified once is likely to succeed in qualifying for subsequent auctions if it does not win.

Table 4.2: Results in the qualification stage of the Brazilian New Energy Auction in 2014

	Bidders interested in participating in the auction		**Bidders qualified to participate in the auction**	
Renewable energy source	Number of projects	Volume (MW)	Number of projects	Volume (MW)
Wind	763	18 760	557	14 155
Solar PV	224	6 068	179	4 872
Small hydro plants (<30 MW)	30	526	25	412

Sources: (Elizondo-Azuela, Barroso et al., 2014), (Maurer, Barroso, 2011).

Main findings

More recent auctions usually implement minimum requirements to ensure that a bidding company is financially, technically and legally capable of developing the project. However, there is less consensus about how strict these requirements should be. Brazil, for example, requires little reputation-related documentation beyond standard legal compliance and a minimum net worth, whereas Morocco and California have adopted more stringent requirements in their auctioning schemes.

The trade-offs involved in adopting stricter or more lenient requirements tend to be very similar for each of the reputation requirements discussed in this section. For this reason, the main strengths and weaknesses of reputation requirements can be described using a single category of possible implementations, as summarised in Table 4.3.

Table 4.3: Summary comparison of reputation requirements

Criteria / Options	Strict requirements	Lenient requirements
Level of participation	Many potential bidders may be excluded	Lower barriers to entry
Reduced transaction costs	Costs for bidders (gathering documentation) and the auctioneer (reviewing documents)	Less administrative burden
Ensured project completion	Higher guarantees	Must rely on contractual penalties and liabilities
Guidance from the auctioneer	Control over companies' disclosure of information	Very little control

Characteristics of the relevant attribute: *Poor* *Medium* *Very good*

4.2 TECHNOLOGICAL REQUIREMENTS

Technological requirements that must be met by the project developer include: 1) the choice of *renewable energy generation source*; 2) *equipment specifications*, which impose certain constraints on the equipment to be used; and 3) *project size constraints*, which indicate the minimum and maximum scale to which projects must conform.

Renewable energy generation source

The choice of renewable energy generation source is generally driven by government-mandated targets. It is typically an essential part of the auction, as some degree of specification is needed to distinguish the auction's renewable energy focus from conventional electricity generation. In practice, the easiest way to implement this is by listing each of the generation sources that may participate in the auction individually. In multi-technology auctions, separate demand bands are often introduced for the different renewable energy generation sources (as described in Section 3.1), although some auctions allow for direct competition among the various technologies.

Sometimes, the renewable source is further broken down into sub-categories, such as technologies that have different technical and economic characteristics. It is common, for example, to distinguish between onshore and offshore wind, as well as between solar thermal and solar PV. In India's 2010 solar auction, a distinction was even made between thin film and crystalline silicon solar PV panels; although these two classes competed against each other in the auction, thin film panels were made exempt from the local content requirement (see Section 4.5). Similarly, bioelectricity is often classified according to fuel, such as biogas, biomass from urban and rural residue. In general, all of these specifications are viable options – although stricter technology requirements may limit the number of potential bidders, reducing competition.

Equipment specifications

Equipment specifications aim to ensure that the country's renewable resources will be developed using state-of-the-art and quality equipment – *e.g.*, requiring certification and compliance to international standards. Adopting equipment specifications is a relatively mild (and less invasive) alternative to having the auctioneer verify the equipment supplier's reputation during the qualification process (see Section 4.1 on Agreements and partnerships), as it requires only the seller's commitment to ensure compliance of the equipment. In South Africa, for example, wind turbines were required to be compliant with the international technical standard IEC 61400-1, while in Brazil, wind equipment was required to be new and to have a minimum nominal capacity of 1.5 MW (except domestically produced generators, which could be smaller).

In general, explicit equipment specifications are most useful when generators are partially or fully shielded from risks (see Section 6.4), since project developers may not always have optimal incentives to adopt state-of-the-art technologies. If equipment specifications are too stringent, however, this could lead to an undesirable increase in transaction costs and limit competition among equipment suppliers. For example, requirements on renewable energy generation equipment may translate into documentation requirements for the equipment supplier (see Section 4.1) and/or specific requirements regarding domestic manufacturing (see Section 4.5).

Project size constraints

Project size constraints refer to how the total installed capacity for individual projects must remain within an upper and lower bound defined in the auction. In California, for example, projects were required to be between 3 MW and 20 MW (the lower bound was raised from the originally proposed 1 MW), whereas in India's 2011 solar auction, projects were between 5 MW and 20 MW (the upper bound was increased to 50 MW in the 2014 auction). Project size constraints are strongly related to the number of projects that are approved by the auction – and therefore, they have implications for the level of competition in the auction procedure (see Section 5.2).

Both maximum and minimum size constraints can be desirable for different reasons (see Box 2.8 on the relationship between project size and renewable energy support policies). A minimum size constraint can be justified as a way to limit the associated administrative work (*e.g.,* separate contracts must be signed for individual, small projects). In addition, small projects can reduce the benefits of economies of scale. On the other hand, implementing a maximum size constraint can encourage the participation of smaller players, as it becomes more difficult for large companies to dominate the auction, and it can also mitigate environmental concerns (as in the case of the pilot PV auctions in Germany). Another side benefit of having multiple winning projects when the maximum project size is small is that the country could benefit from a "portfolio effect" – reducing the risks of projects not coming online on time or at all.

A potential impact of imposing maximum and minimum project sizes is that project developers may have to choose sub-optimal configurations to exploit a given renewable resource. This is most noticeable in the trade-off between maximum project size and economies of scale. In the 2014 solar auction in Dubai, for example, the entirety of the auction demand was awarded to a single bidder at extremely competitive costs, and by increasing the contracted amount from 100 MW to 200 MW, it was possible to reduce the winning bid even further (from 59.90 USD/MWh to 58.40 USD/MWh). The benefits of economies of scale also were visible in the 2010 wind auction in Uruguay, where even though the project size requirement was set between 30 and 50 MW, all three winning projects had a capacity equal to the upper limit.

Main findings

Renewable energy auctions normally specify which renewable energy generation sources are allowed to participate; some auctions are exclusive to a single technology while others allow for the participation of multiple technologies (sometimes involving separate technology bands, as described in Section 3.1). A summary comparison of the requirements related to the renewable energy generation sources is provided in Table 4.4.

Equipment specifications tend to have smaller impact on the outcomes of the auction overall, as long as specifications are not too strict. Finally, imposing minimum and

Table 4.4: Summary comparison generation source requirements

Criteria \ Options	Choice of renewable energy generation source	
	Technology-specific auctions	**Technology-neutral auctions**
Guidance from the auctioneer	◕ Supports the development of selected technologies	○ Tends to favor more mature technologies
Cost-effectiveness	◑ Competition only within a single technology	● Seeks the most cost-effective technologies
Simplicity	● Straightforward quantity goals	◑ Criteria is defined to compare technologies

Characteristics of the relevant attribute: ○ *Poor* ◔ ◑ *Medium* ◕ ● *Very good*

maximum size constraints are another common requirement that can lead to desirable outcomes – although they may also limit the price reductions achievable from the auctions, as developers may need to adapt their projects to these requirements. A summary comparison of the different technological requirements related to equipment specification and project size constraints is provided in Table 4.5.

Table 4.5: Summary comparison of equipment specifications and project size requirements

Criteria \ Options	Equipment specifications		Project size constraints	
	Strict requirements	**Lenient requirements**	**Strict requirements**	**Lenient requirements**
Guidance from the auctioneer	● Can ensure usage of top-of-the-line equipment	◑ Bidder will select most cost-effective options	● Can control minimum and maximum size	◔ Tends to favor large-sized projects
Level of participation	◑ Might exclude some participants	● Lower barriers to participation	◔ Might exclude some participants	● Lower barriers to participation
Cost-effectiveness	◔ More limited options for manufacturers	● Bidder will select most cost-effective options	◑ May force suboptimal configurations	● Bidder will select most cost-effective options

Characteristics of the relevant attribute: ○ *Poor* ◔ ◑ *Medium* ◕ ● *Very good*

4.3 PRODUCTION SITE SELECTION AND DOCUMENTATION

Another category of important requirements relates to production site documentation. From a design standpoint, the most important elements to consider are: 1) who is responsible for the task of *site selection* (usually either the government or the project developer); 2) *location constraints*, which are conditions related to the geographical distribution of the renewable energy projects; and 3) *site-specific documentation requirements*, which the project developers must comply with prior to the auction.

Responsibility for site selection

The default choice in the design of renewable energy auctions is to assign the project developer the responsibility of evaluating candidate sites and selecting the most suitable one. However, there are several instances in which the auctioneer (usually, the government) assumes this responsibility instead. One important upside of this is that it can drastically reduce the costs for bidders, as they do not need to invest in collecting the relevant documentation, carrying out resource assessments and studying grid connection options for each candidate production site. This may also facilitate the licensing procedure itself, which can be critical in bringing the projects online in time. In the early renewable energy auctions in the United Kingdom this was a major problem that kept projects from being finalised.

A potential weakness of making the auctioneer responsible for site evaluation, however, is that government-selected projects can be less attractive than the portfolio that would be formed by several competing companies. In addition, companies can be more agile than the state in selecting and evaluating new sites. This is especially valuable when there is a constant need for a steady stream of new renewable energy projects.

Schemes in which the auctioneer assumes responsibility for site selection are often associated with project-specific auctions *(i.e.,* auctions in which each production site is allocated its own demand band; see Section 3.1). Even though this type of auction is exclusive in principle, it usually facilitates the participation of a larger number of bidders because the government takes more responsibility for site selection and documentation, reducing the time and resources that each bidder needs to commit. Egypt has adopted such a scheme in its wind auction in 2014 that resulted in record low bid prices. However, there are also schemes in which multiple government-selected sites compete for a limited demand, such that only a fraction of the production sites identified by the government would be contracted in the auction procedure. Examples of this alternative can be found in Brazil and Denmark (see Box 4.4).

It is also relevant to note that, if a long-term auctioning schedule is in place (see Section 3.3), a company that fails to win a particular auction may use the documentation already gathered to participate in future rounds. As a consequence, the costs incurred by potential bidders in preparation for the auction are not necessarily irrecoverable.

BOX 4.4: CENTRALISED PROJECT LICENSING IN BRAZIL AND DENMARK

Brazil

Since the inception of its electricity auctions in 2005, Brazil has adopted a special scheme for selecting large hydropower projects. Although for most generation technologies, production site selection is carried out by the project developers, in the case of large hydro plants, the government assumes this responsibility. This is largely due to the higher complexity of the necessary technical and environmental studies, which involve negotiations with different levels of government (multiple uses of water are regulated by various agencies and often involve municipal and state governments as well as the federal government).

The auction scheme was designed under the notion that the government would provide a steady stream of new hydro projects to be auctioned, such that the overall supply of project sites would be systematically greater than the total demand for projects. This would result in competition between project sites, and only the most promising locations would be selected. Sites not selected would remain available for subsequent auctions. However, due to the lack of sufficient human resources and a complex (multi-institution) licensing process, the government has not been able to provide enough projects to be auctioned, becoming a limiting factor to large hydropower expansion in the country.

The Brazilian experience illustrates that, although allocating the responsibility for site selection to the government might ease the project developers' work and decrease costs, it may not lead to the best results if all responsible entities are not properly equipped to meet this challenge. At the same time, there does not seem to be an easy solution to this conundrum, as project developers too would have difficulties in carrying out the complex procedures for environmental licensing of large hydro plants.

Denmark

Similar to the Brazilian model, Denmark is planning an auction for near-shore wind farm projects in which the government is responsible for selecting candidate sites, only a few of which will be contracted. The first such tender is planned for 2015, with operation starting by 2020. A broad majority in the Parliament made the decision that six near-shore sites (all of which located a minimum of 4 kilometres from the shore, and each with a capacity of up to 200 MW) will compete in this first auction round to host a total of 350 MW; thus, it is not expected that more than three sites will be contracted in this round.

The transmission system operator will carry out environmental impact assessments (EIAs) and conduct preliminary surveys for all six sites. These include geophysical and geotechnical surveys, EIAs and MetOcean surveys (wind, current, tidal and wave conditions). The preliminary surveys have been planned so that the results are published before completion of the tendering procedure, informing bidders of the conditions and risks of building at the sites. As with Brazil's large hydropower auctions, the Danish government has a strong role in the organisation of the auctions, considerably facilitating the work of project developers and lowering their costs.

Sources: (Maurer, Barroso, 2011); (Danish Energy Agency, 2013).

Location constraints

In auction designs where the project developers are responsible for site selection, "location constraints" refer to the extent to which the developers are free to choose their production sites. Renewable energy auctions can be either location-agnostic or location-specific (with project-specific auctions representing a particular type of location-specific schemes).

Under location-agnostic schemes, the project developer is responsible for finding a suitable production site. Because there is no guidance in the selection of a potential location, project developers are incentivised to find the highest-performing sites. Although attractive in principle, this type of mechanism tends to concentrate the development of projects in resource-rich locations, which can have unintended consequences. For example, the grid infrastructure might not be able to integrate such large capacity into the system, or residents in regions with a high concentration of new installations may develop "not in my back yard" (NIMBY) sentiments. Finally, this would result in uneven distribution of economic activity, and less-viable regions may have less opportunity to reap the economic benefits from renewable energy deployment. Therefore, policy makers have good reasons to try to minimise the concentration of new renewable energy development to specific areas.

One way of tackling this issue is by introducing location constraints on renewable energy project, usually aiming either to achieve greater geographic dispersion of projects, or to ensure proximity to the grid and/or loads. Location constraints can be introduced in the form of location-specific demand bands (see Section 3.1), or alternatively, by incorporating a "project location" component in the winner selection criteria (see Section 5.3). Wind auctions in Uruguay have chosen the latter option (see Box 4.5).

Location constraints can also be introduced in order to avoid competition in the land usage between the energy production and food production (IRENA, 2015b). Large solar ground mounted systems, for instance, are usually restricted to unusable land. In the case of Germany, the large-scale construction of PV systems on arable land has been discouraged by the Renewable Energy Act since July 2010, and FITs are not offered to projects located in such areas. This resulted in the concentration of large PV systems on specific redeveloped brownfield sites or in the close vicinity of highways and railway lines. The German solar PV auction in 2015 also specified that project locations will indeed be restricted to the areas already indicated in the Renewable Energy Act (brownfields). In the 2016 auctions, these restrictions will be made more flexible and the permitted project locations will include unproductive agricultural land.

When considering the issue of location constraints in auction design in a given jurisdiction, a possible issue of interest is whether projects that are physically located in another country are eligible for participation (*i.e.,* representing a cross-border

BOX 4.5: LOCATION-DEPENDENT ELEMENTS IN URUGUAY'S WIND AUCTIONS

Although the location constraint was not explicitly stated in the wind farm auction organised in Uruguay in 2013, the auction design highlighted the potential trade-off between the wind regime and the cost of connection to the national grid – two of the most important location dependent attributes.

- For the resource potential, one of the technological requirements in the auction referred to the plant utilisation factor, which had to be at least 30%. If this requirement is not met, a penalty is applied for the underproduction, as defined in the contract. Therefore, even though site selection is the responsibility of the project developer, it is essentially restricted to areas with a favourable wind regime. In practice, however, economic incentives likely played a much greater role in directing site selection. At a price of around 85 USD/MWh, a utilisation factor of 40% doubles the internal rate of return of the project, compared to a 30% utilisation factor (for a given investment cost). Project developers detected some areas with capacity factors of over 35%.
- The cost of connecting the plant to the national grid was incorporated in the evaluated bid price, serving as a secondary locational price signal. This is especially relevant in cases when several plants share a connection, as the costs for its construction can be split. In practice, however, the connection costs of the winning bids did not exceed 2% of the total price offered.

Source: (Mercados Energeticos Consultores, PSR, 2013).

supply resource). There have been recent discussions about whether cross-border resources are eligible to participate in capacity adequacy mechanisms in Europe (Henriot, 2014). Although these discussions are ongoing and no clear guidelines have been established so far, the topic of cross-border resource participation in renewable energy auctions is increasingly relevant, and policy makers should be aware of several important issues (see Box 4.6).

Site-specific documentation requirements

Site-specific documentations are required mainly in the situation in which the selection of the site falls in the project developer's responsibility and they can have a significant impact on the bidder's transaction costs. Although most auction mechanisms require some degree of site-specific documentation, the strictness of this requirement varies substantially among implementations. Some of the most common documentation requirements include proof of land-use rights, building permits, detailed construction plans, environmental and water licences, and renewable resource measurement records.

On the one hand, strict requirements imply a greater degree of commitment by the project developer and thus tend to reduce the likelihood that the project will be delayed or fail to come online. Because more information is known beforehand,

BOX 4.6: PARTICIPATION OF CROSS-BORDER RENEWABLE GENERATION RESOURCES: THE CASE OF EUROPE

A key issue with cross-border participation in auctions is compatibility with the strategic goals of a local renewable energy policy. For instance, if the priority is to develop a local industry, then allowing cross-border participation may not be desirable, since the resources to develop projects will be directed to other countries. On the other hand, such participation is not necessarily in conflict with goals, such as emission reduction, as the imported electricity would still displace local conventional generation.

Once the desirability of cross-border participation is evaluated, its feasibility should be assessed. An important requisite to ensure commercial feasibility is that the participation of cross-border resources does not result in double counting (which is relevant from the perspective of meeting renewable energy goals) or double remuneration (*i.e.,* preventing payments for generation – particularly those targeted specifically at renewable plants – from two jurisdictions simultaneously). Double remuneration would make projects appear more competitive, leading to inefficiencies in selecting auction winners.

Measuring the amount of renewable energy delivered to the jurisdiction where the auction is held is also important. Alternatively, the measured energy (considered for the purposes of clearing the contract awarded) could correspond to the energy delivered at the terminal of an interconnector. For example, the product contracted in the auction could be considered as energy imports backed up by renewable generation in the country in which the generator is located. It may be necessary to verify to what extent the energy delivered in the buying country is effectively backed up by the production of the contracted renewable energy. Exchange of information between the system/market operators may be required to enable this verification. Creating channels for information exchange and designing auction rules to prevent perverse incentives may result in additional costs for the buying country and in additional complexity of auction design. Difficulties may arise if the trading and measurement intervals used in the two countries do not coincide.

Assessing physical feasibility is also important while considering the participation of cross-border resources in auctions. One means to guarantee that enough cross-border transmission capacity will be available is to require selling generators to acquire the necessary transmission rights for the interconnection between the two countries. One challenge that may arise, however, is a mismatch between the duration of the transmission rights[1] and that of the contract awarded through the auction. Constraints to trading may also arise when scarcity conditions prevail in the country in which the generator is located. If local demand has priority over exports, when scarcity occurs this can result in discrimination between local and cross-border contracts[2]. This may be particular important if renewable energy development is seen as being critical to ensuring security of supply.

[1]Depending on the nature of the seller's obligations and on the policy objectives of the buying country, either physical or financial transmission rights may be required. The differentiation of these instruments is beyond the scope of this guidebook and are discussed in detail in Batlle, Mastropietro and Gómez-Elvira (2014).

[2]In the EU, Directive 2005/89/EC introduces provisions to prevent such discrimination, by establishing that "[..] Member States shall not discriminate between cross-border contracts and national contracts" (EU, 2006). The extent to which this provision is effective is discussed in Batlle, Mastropietro and Gómez-Elvira (2014), where it is argued that scarcity events may be eventually categorised as force majeure.

speculative bidding is minimised. Furthermore, when the project developer is responsible for selecting production sites, providing the government with more information on the project's future generation profile can be helpful for system planning purposes.

On the other hand, less-stringent requirements can play an important role in reducing auctions' transaction costs, both for the auctioneer and for the bidder (see Box 4.7). This is mostly relevant for unsuccessful bidders who otherwise would end up committing substantial resources in vain. This issue may be mitigated when there is a long-term auction schedule (see Section 3.3), as unsuccessful bidders may participate in subsequent auctions using the same documentation. Less-stringent site-specific requirements can also be more attractive to bidders who do not wish to disclose certain information (such as resource measurement records).

Main findings

Most renewable energy auction schemes in which the responsibility of selecting production sites falls on the government represent project-specific schemes – including China, Denmark, Dubai and Morocco, among others. The guidance provided by the auctioneer has the potential to substantially reduce bidders' transaction costs. However, the most common design choice seems to involve project developers selecting their own production sites (as seen in Brazil, India, South Africa), requiring a fair amount of site-specific documentation. Although including such requirements can deter the participation of bidders, they have many advantages as shown in Table 4.6.

Table 4.6: Summary comparison of site-specific requirements

Options / Criteria	Site-specific documentation requirements	
	Strict	**Lenient**
Reduced transaction costs	Costs for bidders (gathering documentation) and the auctioneer (reviewing it)	Less administrative burden
Avoided delays	Documentation already prepared	Documents may need to be procured after the auction
Level of participation	Potential bidders may be excluded	Lower barriers to entry

Characteristics of the relevant attribute: *Poor* *Medium* *Very good*

BOX 4.7: LESS-STRINGENT DOCUMENTATION REQUIREMENTS IN PROJECT-SPECIFIC AUCTIONS IN DENMARK

Increasing the share of wind-based electricity production is a high priority for the Danish government. Denmark commissioned its first offshore wind farm back in 1991, prior to most other countries, and this early start has allowed the country ample time to refine and adapt its support scheme for offshore wind. Because the government plays a strong role in the project-specific auction, this transfers much of the risk from the project developer to the authorities, limiting the developer's risks to those related to project implementation (delays, technology price changes, *etc*). Moreover, the documentation requirements in the qualification phase are rather lenient, since the government is responsible for pre-evaluating and selecting candidate sites. In the qualification phase, participants only need to prove their financial and technical capability to finance the wind farm's construction and operation.

When the concession is awarded to the successful bidder, the Danish Energy Agency (DEA), which is the national authority for renewable energy as well as the competent authority for offshore wind projects, provides the following:

- Licence to carry out preliminary investigations
- Licence to establish offshore wind turbines
- Licence to exploit wind power for 25 years, with the possibility of this being prolonged
- Approval for electricity production in compliance with electricity legislation.

The grid connection to the shore is also guaranteed (see Section 4.4), including the offshore platform which is designed, built and operated by the Danish system operator Energinet, with all costs covered. Energinet also has a proactive role in providing information on the site. In addition, the DEA is responsible for undertaking the environmental impact assessment (EIA) (this responsibility was assumed by the winner of the auction in earlier rounds). However, the DEA reserves its right to cancel the auction in case the EIA cannot be obtained or if the auctions prices are deemed too high.

As a result, both the risk premium and the cost of capital were greatly reduced in the latest auction held in early 2015. In addition, the time between the auction and the actual contracting was also reduced, resulting in more accurate price estimations on main components and services. The benefits have contributed to the winning price level for the 400 MW Horns Reef III being as low as DKK 0.77 per kWh (0.117 USD/MWh[i]) for 50 000 full load hours, representing the lowest price level in Europe for offshore wind.

In the Danish auction, the system is designed in a way that ensures that the best locations are utilised first. This is considered to be especially suitable for expensive offshore wind and is seen as a good tool for a small country like Denmark, which has limited opportunities to increase offshore capacity. However, this approach requires specific expertise from the DEA.

[i] *At an exchange rate of 6.6 DKK/USD, compatible with the exchange rate in early 2015 approximately.*

Sources: (Winkel et al., 2011), (Del Río, Linares, 2014), (Danish Energy Agency, 2009), (Danish Energy Agency, 2013), (IEA Wind, 2014).

Many different types of location constraints have also emerged, reflecting a wide array of different concerns – including network congestion and expansion costs (as in Uruguay) and land use considerations (as in Germany). In particular, several jurisdictions have also expressed an increasing concern with the high geographic concentration of renewable energy projects at the most suitable sites, which may pave the way for stricter location guidelines in the future.

A summary comparison of the different location constraints alternatives presented in this section is provided in Table 4.7.

Table 4.7: Summary comparison of location requirements

	Responsibility for site selection		Location constraints	
Options / Criteria	**Government**	**Project developer**	**Location-agnostic auction**	**Location-specific auction**
Guidance from the auctioneer	● May promote more uniform dispersion	○ Projects tend to be concentrated in selected sites	○ Projects tend to be concentrated in selected sites	◕ Control over which locations are acceptable
Investors' confidence	● Bidders do not spend resources on site searching	◔ Costs of seeking suitable sites	◔ Costs of seeking suitable sites	◑ Slightly more focused search
Effectiveness of site selection	◔ Site evaluation may be slow/ bureaucratic	● Evaluation carried out by many developers	● A wide range of candidate sites compete	◕ Evaluation restricted to a specified area

Characteristics of the relevant attribute: ○ *Poor* ◔ ◑ *Medium* ◕ ● *Very good*

4.4 SECURING GRID ACCESS

Physical access to the electric grid is an essential requirement to ensure the feasibility of integrating renewable generation into the network and allowing energy transactions to succeed. Conditions for grid access relate to several other topics addressed in this guidebook, such as the determination of the auction demand at each location and at each possible point of connection of candidate projects to the grid (see Section 3.1), the choice of contractual lead times, especially in cases where expansion of the grid may be required to access renewable energy resources (see Section 6.2), and the establishment of specific liabilities of the seller (see Section 6.7). This section focuses on access to transmission and distribution networks (the grid) as a qualification requirement for renewable energy auctions, briefly discussing how different design alternatives for this requirement may influence the topics listed above[3].

An access permit is an official document that entitles a project to connect to the electricity grid and to feed energy into it, starting at a date defined in the document and eventually conditioned to items such as grid strengthening or expansion. Due to the highly technical profile of grid operation activities and the need to evaluate the systemic impacts of integrating new generation, the issuing of an access permit by an administrative body that has competence over grid operation (*e.g.*, the transmission or distribution network operator) is required before the start of a project's commercial operations – but not necessarily before an auction. This permit may specify that the generator's access to the grid can occur only after certain activities are undertaken to expand the grid capacity (or strengthen existing grids) to levels required to accommodate the power output of the project. If such grid intervention is required, the entity liable for implementing these activities must be clearly defined.

Considering the above, the qualification requirements regarding grid access can take the following forms, ranging from more-lenient to strict: 1) *no access permit is required for qualification*, which enables auction winners to obtain the permits only after the auction; 2) *an access permit is required before the auction, but projects that necessitate grid expansion or grid enforcements are allowed to participate*; and 3) *an access permit is required before the auction, and only projects that do not necessitate grid expansion or strengthening are allowed to participate*.

No grid access permit required

The option of not requiring access permits for qualification, and thus allowing auction winners to obtain the permits only after the auction, is a design choice that decreases the workload of the administrative bodies responsible for issuing the access permits. This is because only auction winners will have to engage in the administrative process required to obtain the permit.

Grid access permit required, qualifying projects that necessitate grid expansion

Requiring that a grid access permit be obtained before the auction, and as a qualification requisite for participation, is a common design choice for renewable

[3] *There are other relevant aspects of the access to and use of the transmission and distribution grids, besides securing access to the public service networks, that will not be addressed here. For instance: the responsibility for the implementation of connection facilities (from the generation site to the public network); and the commercial treatment of any curtailment of the output of projects due to network constraints. These items are more generally related to the coordination of generation and transmission expansion and not solely to auctions in particular.*

energy auctions. This is largely because it generally takes less time to implement a renewable energy project than it does to build new transmission facilities – which can be relevant when the renewable energy potential to be developed is located far from the existing grid. Moreover, evaluating the technical feasibility of connecting a project to the grid before the auction takes place can provide developers with important information about any required grid expansion or strengthening before they prepare their offers and commit to delivery within the auction process. Because the access permits are typically administrative in nature, they serve as risk mitigation instruments for project developers when acquired prior to bidding.

Whenever project delivery lead times are compatible with the time required to execute grid expansion activities, allowing generators whose grid access is conditioned to grid expansion to participate in the auctions may result in opportunities for more-efficient contracting. In this case, generators whose access to the grid will be feasible only after the construction of new grid facilities (which can be pursued up to the time of product delivery) receive access permits and qualify for the auction.

However, allowing these generators to participate may result in additional complexities in the winner selection process. For example, in the case where two projects have almost identical technical and economic characteristics, except that the first requires costly network reinforcements to allow it access to the grid, and the second does not, selecting the second project may be preferred. One option would be to somehow specify the allocation of transmission infrastructure costs in order to create economic signals for the co-ordination of generation and transmission expansion within the winner selection process.

To co-ordinate the expansion of generation and transmission, it is possible to: (1) use a procedure for the allocation of network infrastructure costs that assigns to each project a portion of the costs of grid reinforcements required for power evacuation; and (2) ensure that these costs allocated to the project, through transmission access charges, are internalised by the investor in the bids. If the costs are properly internalised into bids, the winner selection process will result in the choice of the projects that result in the most efficient expansion of both the generation and the transmission systems. While defining the procedures for the calculation and application of grid access charges, it is recommended to define the conditions for their updating in a way that reduces the exposure of the project developers to fluctuations of the charges to the extent possible. These charges ultimately aim at guiding project siting decisions and changing them frequently after projects are built and already sited may significantly increase the risk perceived by project developers while bringing little benefits in most situations.

The above-mentioned recommendations should be evaluated, however, in light of other auction design goals that may have priority in a given jurisdiction. For instance, a certain pattern of spatial distribution of projects may be desired for social or political reasons and would require that projects imposing higher costs to grid expansion are built.

Another notable issue is that, under this design choice, the entity responsible for grid expansion (the transmission system operator, the central planning agency or other agents) can determine the auction demand and its segmentation among different substations of the grid. Introducing the right incentives for this entity to plan and implement grid expansion in an efficient and pro-active manner, based on prospective information on renewable energy potentials, is a demanding task for the regulator and for policy makers (see Section 6.7).

Grid access permit required, limited to projects that do not necessitate grid expansion

A safer design choice is to constrain the set of qualified projects to those that do not require any expansion of the electricity grid. Implementing this choice may appear conceptually simple at first: if the entity responsible for issuing the grid access permit determines that the network capacity[4] is insufficient, then the project does not receive the permit and does not qualify for the auction.

Yet greater complexity arises in cases where there is some available capacity at a given connection point to the grid, but the number of candidate generators seeking connection at that point exceeds this capacity. For example, if three projects, each with a capacity of 50 MW, seek connection at a substation that can accommodate only 100 MW. In this case, the three projects would individually receive the grid access permit, but the winner selection process would have to ensure that, at most, two projects are contracted.

Moreover, operationalising this design can be a complex task, in part because the loading of the grid depends on the interaction of the power output of all generators that win the auction in a given area. Therefore, evaluating several different scenarios of auction winners – either before the auction or during the winner selection process – may be necessary to determine the actual limit of contracting at each point of connection to the grid. An example of a situation in which projects exceeded the grid capacity at a specific connection point occurred in Turkey, which is now organising auctions to allocate connection rights (see Box 4.8).

[4] Including the capacity of already existing facilities and that of facilities that are already planned and whose commercial operation will occur before the target date.

BOX 4.8: AUCTIONS FOR GRID CONNECTION PERMITS FOR WIND AND SOLAR PROJECTS IN TURKEY

In recent years, Turkey's renewable energy development policy has focused mainly on wind power. In response to the large number of applications for wind power connections since 2007, the regulatory framework had to be adapted. To manage connection capacity, a unique queue management system was created by the transmission system operator and the regulator, which consists of an auctioning process for wind and solar installations to control the high uptake rate of renewables in the country.

In contrast to most countries, where grid connection is guaranteed to all renewable energy projects and the allocation strategies for connection are usually based on first-come-first-served or pro-rata schemes, in 2011 Turkey adopted an innovative way to manage the queue of grid connection requests for renewable energy technologies after experiencing a three-year delay in wind and solar applications. The objective of this strategy is to efficiently allocate connection permits while at the same time control the high volume of applications for grid connection driven by other incentives such as the feed-in tariff. The queue management process consists of the following steps:

1) The transmission system operator publishes the connection conditions and available capacity for each substation for connecting wind or solar, taking into account the stability of the current infrastructure.

2) Wind and solar power project proposals are sent to the regulator (EMRA) and the transmission system operator (TEIAS) to study connection opportunities.

3) EMRA provides licences to the projects in cases where the available grid capacity can accommodate them. Otherwise, TEIAS initiates an auction to determine the allocation of connection rights.

4) In the auction, all the applicants for the same substation send in their bids, representing a fee per MW of installed capacity — the "contribution margin" — that the project developer is willing to pay if the licence is obtained. The applicant with the highest bid wins the auction and the right to connect to the grid. The contribution margin is paid by the winner of the auction to TEIAS in addition to standard connection and grid usage fees.

This tendering tool allows the transmission system operator to receive information regarding both the applicants' willingness to pay to be connected and the regions where the grid needs reinforcements, in order to be capable of introducing more renewable energy.

With the success of the first grid connection auction for wind power, in June 2013 the first solar auction was organised, capped to 600 MW of grid capacity. A total of 9 GW of applications was received, only 7% of which was accommodated by the grid.

Sources: (Cetinkaya, 2013), (REKK, 2013), (Energy Market Regulatory Authority, 2015).

This design choice has the advantage of eliminating the risk of underdelivery due to delays in grid reinforcement, and it may be the only feasible choice when, for whatever reason, the lead time between the auction and the date of product delivery is smaller than the time required to expand the grid. The disadvantages are, besides the complexity introduced in the qualification stage and the winner selection process, the potential reduction of competition in the auction, since the limitation of the demand at each point of grid connection to the existing or already planned capacity results in a fragmentation of the auction demand.

Main findings

The decisions about whether or not to require a grid access permit as a qualification requirement for an auction, and whether or not to constrain qualification or winner selection to projects that do not require grid expansion, depends heavily on the characteristics of each jurisdiction. If the existing grid has enough spare transmission capacity that can be accessed easily or if the grid expansion can be executed within a suitable time frame, a decision not to require an access permit before the auction is feasible. If this is not the case, requiring an access permit before the auction can be a sensible solution. It will then be necessary to decide whether or not to constrain qualification or winner selection to projects that do not require grid expansions. The possible advantages or disadvantages of each option are summarised in Table 4.8.

Table 4.8: Summary comparison of grid access permit requirements

Criteria / Options	No grid access permit required	Grid access permit required, allowing participation of projects that demand grid expansion	Grid access permit required, constrained to projects that do not demand grid expansion
Avoided delays	The access permit must be obtained afterwards	Possible delays due to grid expansion	Safest option as both the grid and the grid access permit available
Simplicity	Less bureaucracy and transaction costs	Additional complexity in selecting auction winners	Complex and costly process to provide permits to all bidders
Level of participation	Lower entry costs and transaction costs	Wider variety of projects accepted	More restrictive in terms of options

Characteristics of the relevant attribute: *Poor* *Medium* *Very good*

4.5 INSTRUMENTS TO PROMOTE SOCIO-ECONOMIC DEVELOPMENT

At times, countries implementing renewable energy support schemes may wish to maximise the socio-economic benefits of this support on a higher level. As a consequence, many policy makers have been exploring the possibility of explicitly requiring auction winners to play an active role in regional development. Most commonly, mechanisms introduced in this regard relate to 1) *empowerment and employment*, which refers to economic activity at the local and regional levels; or 2) *local content requirements*, which are explicitly associated with the prospect of promoting the local renewable energy industry.

Empowerment and employment

Empowerment and employment requirements mostly seek to ensure that the local services economy will receive benefits from the renewable energy project – a phenomenon that can happen naturally even if no constraints are in place. South Africa adopted this type of requirement in its auction procedure (see Box 4.9), and China also made efforts to measure indirect economic benefits in some of its wind power auctions.

Local content requirements

Local content requirements (LCR) impose a minimum contribution from local suppliers for the development of the renewable power project. This has been a common approach in several countries seeking to support the development of a nascent national renewable energy industry, but the design and the way that the LCR are determined can vary significantly. Saudi Arabia, for example, proposes to require that a minimum of 20% of a project's components be produced locally, Morocco has an LCR for 30% of the project's capital cost, China required 50% local production of wind power equipment until 2006 and 70% until 2009, and South Africa requires 25% of total project spending to be local. Brazil did not impose LCR requirements on the auction scheme itself, although a minimum level of local content was necessary to apply for attractive state bank loans (IRENA, 2014c).

BOX 4.9: FOCUS ON SOCIO-ECONOMIC GOALS IN SOUTH AFRICAN RENEWABLE ENERGY AUCTIONS

The South African Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) is a competitive bidding mechanism with long-term PPAs for developers. Socio-economic benefits from renewable energy deployment represent one of the requirements in the qualification stage and are maximised through the use of weighted development criteria during bid evaluation (see Box 5.9).

Six types of factors are taken into account in the qualification requirements: environment (environmental authorization), land (land right, notarial lease registration, proof of land use application: see Section 4.3), commercial/legal (acceptance of the PPA, project structure), financial (full and partial price indexation, financial proposal), technical (energy resource, technical proneness: see Section 4.2) and economic development. The latter is most relevant to this particular design aspect. One of the requirements is that no more than 60% of project capital investment may consist of foreign currency. Other elements addressed by the “economic development” requirements are job creation, local content, ownership, management control, preferential procurement, enterprise development and socio-economic development.

For wind projects, for example, at least 12% of the shares of the project developer’s company must be held by black South Africans and another 3% by local communities. In addition, at least 1% of project revenues must go to socio-economic contributions, and the minimum threshold for local content is set at 25%.

These economic development requirements are designed to incentivise bidders to promote job growth, domestic industrialisation, community development and black economic empowerment. However, the requirements have been controversial for several reasons: many international bidders felt that they were too demanding and played too substantial a role, whereas domestic participants, backed by South African trade unions, felt that they were not demanding enough. Government officials see these requirements as being excellent for achieving positive socio-economic outcomes. They see a potential to boost local manufacturing in a sector that is completely underdeveloped in the country. More detailed results regarding the impact of the auctions on the economic development are illustrated in Box 5.9.

The fourth round of the REIPPP Programme was held in August 2014 and the 13 winning bids, consisting in 6 solar PV projects, 5 onshore wind, one small hydro and one biomass project, represent a total investment of around USD 2 billion, with only 28% coming from foreign funding.

Sources: (IRENA, 2013a), (IRENA, 2014b), (Eberhard, Kolker, Leigland, 2014), (Department of Energy – Republic of South Africa, 2015).

However, to ensure that such an investment will eventually pay off, an LCR scheme should be coupled with a gradual phase-out plan – beyond which the national industry ought to be able to compete directly with international prices. China, for example, adopted LCR clauses in its early mechanisms for fostering renewable energy, but as the country's wind equipment industry flourished, these constraints were deemed no longer necessary.

Specific socio-economic benefits in line with national priorities can be targeted through the design of LCRs (Box 4.10). Generally, it is essential to consider existing areas of expertise in the design of such requirements and link them closely to a learning-by-doing process. To ensure the full-fledged development of an infant industry, LCR should be time-bound and accompanied by measures that facilitate financing of the industry, the creation of a strong domestic supply chain and a skilled workforce. This subject is addressed in greater depth in IRENA's 2014 report *Rethinking Energy*.

Another concern regarding LCR is a legal one. This type of practice has been questioned under World Trade Organization (WTO) rulings regarding competition, and international manufacturers that feel undermined by such policies can resort to international forums for complaints. For example, the United States filed a formal dispute at the WTO against India, questioning the use of LCR in India's National Solar Mission auctions. To some extent, it is possible to reduce the risk of this type of reaction by choosing "softer" LCR – for example, by introducing LCR as a weighted parameter in the winner selection process (see Section 5.3) rather than as a hard constraint, or by splitting the auction demand into "LCR" and "non-LCR" bands (see Section 3.1), as India did in its 2014 auction (see Box 4.10). However, there is a large grey area surrounding what types of LCR implementations are "acceptable" or not.

Main findings

Mandatory clauses aiming to promote economic development (either in the form of empowerment and employment clauses or in the form of LCR) have been relatively popular in renewable energy auction implementations, particularly among developing economies, despite some controversy surrounding the issue. In general, this type of design alternative may be desirable in a context of a larger policy, and as long as the economic sectors that benefit from these provisions can be expected to stand on their own later on.

BOX 4.10: LCR IN BRAZIL, INDIA AND SAUDI ARABIA

Brazil

In Brazil, the LCR is a requirement not from the auctioneer but from the Brazilian National Bank of Development (BNDES), in order for project developers to qualify for the highly attractive (subsidised) loans. The BNDES local content policy aims to develop the industrial manufacturing chain for the wind and solar sector. The first version of the programme required a minimum of 60% local content in order to apply for a loan for wind projects; however, the guidelines changed in 2013, establishing that project developers must meet at least three of the following four criteria for wind farms:

1) Wind towers manufactured in Brazil, with at least 70% of the steel (by weight) or reinforced concrete produced in Brazil;
2) Wind blades produced in Brazil;
3) Nacelle (the main part of the turbine) assembled in a local facility in Brazil;
4) Hub (the part that involves the nacelle) assembled in Brazil, using national cast iron.

As a result of this policy, international wind equipment manufacturers – including Alstom, GE Wind, Vestas, Suzlon and Gamesa – have set up local assembly plants in the country.

India

In the 2014 National Solar Mission auction, projects that used nationally manufactured equipment were auctioned separately. The difference between the "LCR" price and the "non-LCR" price reflected a difference in investment costs of around INR 10.6 million per MW ($171 per kW[i]), which suggests that the levelised cost of electricity generated by a plant complying with LCR was around 15% higher.

Saudi Arabia

An even stricter and more detailed LCR is proposed on bidders in renewable energy auctions in Saudi Arabia. The proposed auction design strongly favours local involvement in the production and construction of projects, as the levels of local content and local labour proposed by bidders are expected to play an important role in the winner selection process (see section 5.3).

For wind, maximum points would be awarded in the first round to bids with 50% of the project components produced locally, and 60% in the second round. There will be a minimum requirement of 20% local content, although no points awarded for this level.

Within the overall local content scores, different scores will be awarded to different components, with a view to encouraging the production of certain components in Saudi Arabia. For example, blades and towers will be awarded a score of 50%, while gearboxes are given a 100% rating and nacelle assembly 25%. These scores, along with the scores of all other components, will then be averaged out to derive the overall local content level.

[i] *At an exchange rate of 62 INR/USD.*

Source: (IRENA, 2014c), (Ministry of New and Renewable Energy, 2012), (Elizondo-Azuela, Barroso et al., 2014), (Cunha, Barroso, Porrua, Bezerra, 2012), (World Nuclear Association, 2015), (Del Río, Linares, 2014), (K.A.CARE, 2013).

Even though different alternatives to promote economic development can vary substantially in goals and scope, in general terms it is possible to define a broad spectrum between a very strict implementation and another imposing no provisions for economic development at all. A summary comparison of these alternatives is presented in Table 4.9.

Table 4.9: Summary comparison of the strictness of the different options to promote socio-economic development

Criteria / Options	Instruments to promote socio-economic development	
	Strict requirements	**Lenient requirements**
Guidance from the auctioneer	Formally guarantees that local industry/ communities will benefit	Relies on economic principles for enriching the region
Development of a local industry	Often seen as a "long-term investment", expecting local markets to flourish	No particular advantage (but some local development is likely to happen regardless)
Cost-effectiveness	It is often costly for developers to comply with the requirements	More competition among manufacturers and service providers
Transparency and fairness	Possible perception that local companies are favored. May lead to legal issues	Might favor international, well-established companies

Characteristics of the relevant attribute: Poor Medium Very good

CLEAN ENERGY MINISTERIAL
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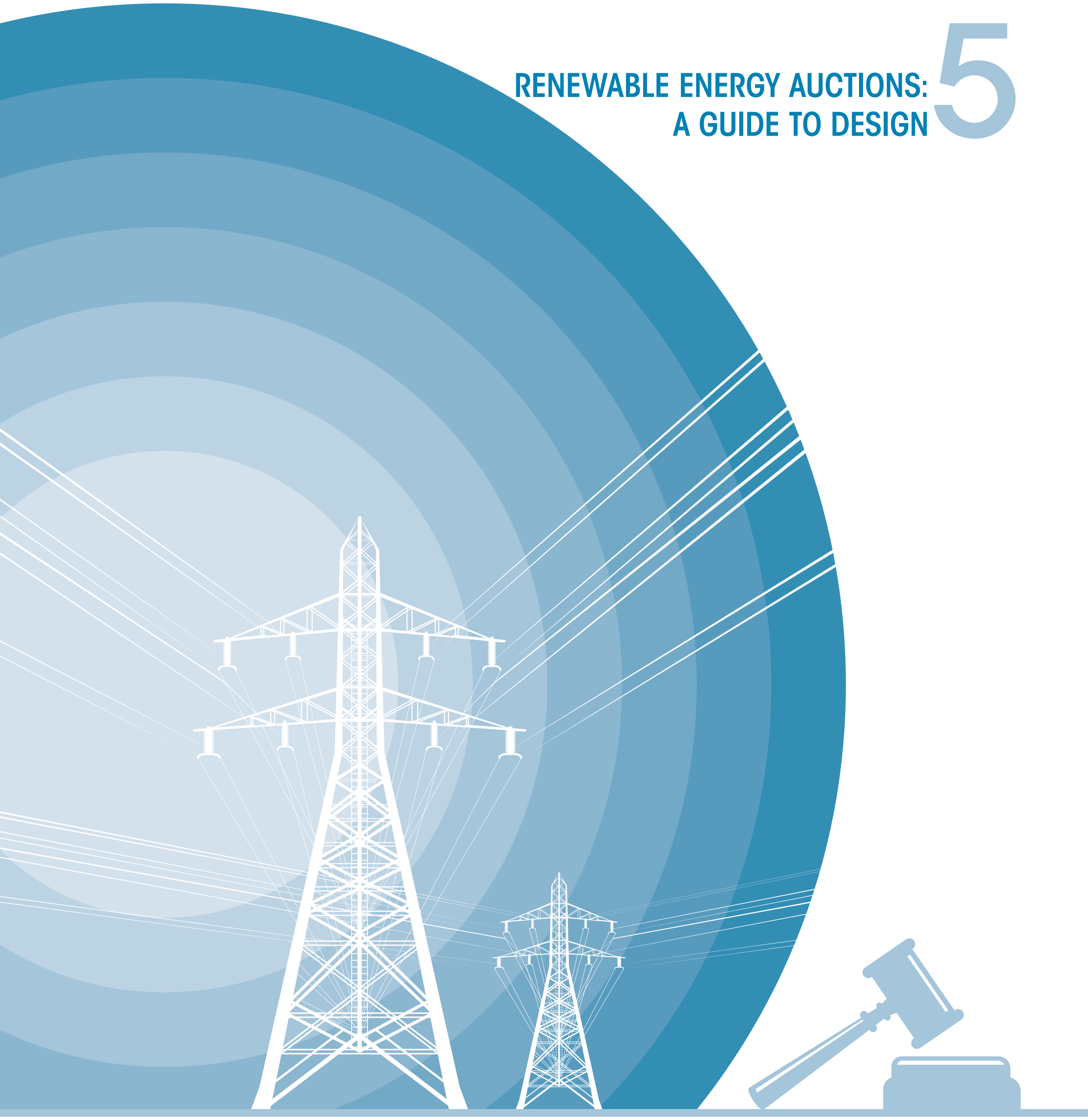
A GUIDE TO DESIGN 5



AUCTION DESIGN:
WINNER SELECTION PROCESS

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5 Auction design: winner selection process

The winner selection process is at the heart of the auction procedure and involves the application of the bidding and clearing rules as well as awarding contracts to the winners. Within this category, the following design elements are addressed: 1) the *bidding procedure*, defining how the supply-side information is collected for the competitive process; 2) *requirements of minimal competition*, which include special provisions to promote a minimum degree of competition in the bidding procedure; 3) the w*inner selection criteria*, dictating how to rank the bids and select the winners; 4) the *clearing mechanism and marginal bids*, defining the rules for allocating contracts in case the supply does not exactly meet the demand; and 5) *payment to the auction winner*, establishing how the project developer will be remunerated after winning the contract. Figure 5.1 summarises these design elements, which are further developed in this chapter.

Figure 5.1: Overview of the design elements in the winner selection process

Bidding procedure

Collecting supply side information:

» Sealed bid process - all bid info is directly provided to the auctioneer

» Iterative process including descending clock auction - bid info is disclosed gradually during the auction

» Hybrid process

Requirements of minimal competition

» Maximum awarded capacity constraint-prevents a single player from becoming dominant in the auction

» Ceiling price mechanisms - "anti-monopoly" mechanism, preventing dominant players from bidding high

» Other mechamisms

Winner selection criteria

» Minimum-price auctions

» Adjusted minimum-price auctions - using a "correction factor"

» Multi-criteria auctions

Clearing mechanisms and marginal bids

Clearing the auction's supply and demand through flexible demand schemes, price-quantity bidding or ex-post adjustments

Payment to the winner

» Pay-as-bid pricing - most common implementation, despite the dependence of one's bid on its remuneration

» Marginal pricing schemes - encourage disclosure of real project development costs

» Nonstandard pricing schemes

5.1 BIDDING PROCEDURE

The bidding procedure is the first step of the auction procedure and involves collecting information on the price levels at which bidders would be willing to develop new renewable energy generation capacity. Bidding can be carried out via three main approaches: 1) *sealed-bid processes*, in which all bid information is provided to the auctioneer beforehand; 2) *iterative processes*, in which information is provided gradually during the auction; and 3) *hybrid processes*, in which an iterative phase is followed by a sealed bid phase.

Sealed-bid process

Sealed-bid auctions are straightforward processes in which bidders are required to provide their bid information directly to the auctioneer. Typically, offers are kept sealed until the day of the auction to prevent players from getting an advantage through privileged information. The main advantage of this type of scheme is its simplicity. However, depending on how the bidding procedure is structured, sealed-bid schemes may be associated with a lack of transparency, especially if the winner selection process is complex (see Section 5.3). In addition, there can be a large time gap between the opening of the sealed bids and the disclosure of the winners which may deter bidders. Moreover, given that bidders are required to disclose the minimum price they are willing to receive for the auctioned product, this issue could drive away potential participants.

Despite these concerns, sealed-bid schemes are among the most commonly implemented auctions worldwide. Project developers tend to be reasonably comfortable with its design, and the relative familiarity of sealed-bid processes from the bidders' standpoint can be a positive aspect of this alternative. China, Dubai, India, Morocco, Peru and South Africa are all examples of jurisdictions that have opted for this type of mechanism.

Iterative process

Iterative processes, in contrast, allow bidders to only gradually disclose their bid information during the auctioning rounds. The most common way to implement this type of scheme is via a so-called *descending clock auction*[1] (or Dutch auction), in which at each round the auctioneer proposes a new, slightly lower price than in the previous round, and the participants make their offers, in terms of quantity they are willing to provide and this price. This iterative procedure continues until the supplied and demanded quantities match.

The main benefits of a descending clock auction are associated with its transparency and the revealing of information by bidders. One example of iterative bidding is found in the Italian renewable energy auctions organised for plants larger than 5 MW in order to gain access to the tariff-based incentive (see Box 2.5). In this particular implementation, the auctioneer gradually increases the discount percentage from the original feed-in tariff (FIT) offered to the participants, which could accept the

[1] *Ascending clock auctions are also an example of iterative process, but typically they are not used in the context of renewable energy procurement*

deduction or refuse it (leaving the auction). This iterative procedure continues until the target capacity is reached.

In theory, a descending clock auction could lead to better price discovery, since bidders are able to revise their bids dynamically as the auction evolves. However, evidence seems to suggest that potential suppliers rarely revise their bids over the course of the auction. Another potential downside is that this type of dynamic revision usually relies on information being disclosed by the auctioneer at every bidding round. In general, policy makers tend to avoid revealing too much information in order to prevent collusion and/or strategic bidding.

Another limitation of the descending clock auction is that the bidders that were dismissed at previous auctioning rounds are usually excluded from the auction. Moreover, there is an implicit assumption that the optimal allocation will not involve a higher-priced bid, which is not always the case when there are indivisible bids (see Section 5.4). Furthermore, the descending clock auction is unidimensional, since the offers at each round must be synthetised into a single number (the price). This means that, in order to introduce compound winner selection criteria (see Section 5.3) in a descending clock auction, it is necessary to acquire non-price information from bidders beforehand, and to aggregate this information into a bonus (or penalty) to be accounted for in the price bid during the descending clock rounds. Brazil has adopted this mechanism in its auction schemes (see Box 5.1).

Hybrid process

Hybrid processes attempt to combine characteristics of both sealed-bid and iterative processes. They typically involve an initial descending clock phase followed by a sealed-bid phase, although other mechanisms also could be adopted. Because all the bidders that remain in the auction until the end must disclose the minimum price they are willing to receive, hybrid processes do not protect bidders' secrecy as well as the purely iterative auction mechanisms.

However, hybrid auctions allow for some price discovery: the moment in which the descending-clock phase is interrupted and the sealed-bid phase begins represents a key point at which participants may revise their bids. Having a sealed-bid auction as a second phase in a hybrid process allows a pay-as-bid criterion to be used to determine the payment to the auction's winner (see Section 5.5). Following the descending clock auction, the auctioneer does not have any information on the minimum price that bidders would be willing to bid; this is why pure iterative auctions tend to be strongly associated with marginal pricing. The desire to implement a pay-as-bid criterion may be a motivation for countries to adopt hybrid schemes rather than the simpler descending clock alternative. Brazil is one example of a country that has adopted this hybrid scheme in its electricity auctions since 2005 (see Box 5.1).

BOX 5.1: EXPERIENCE WITH HYBRID AUCTIONS IN BRAZIL

Brazil represents a classic example of hybrid design of the bidding process in electricity auctions. The mechanism is a combination of a descending clock auction followed by a pay-as-bid round. Brazilian auctions are carried out fully via an online platform, and involve three well-defined steps:

- The initial step, phase zero, involves bidders confirming the quantity of electricity (in GWh per year) that they are willing to commit at the auction's ceiling price (disclosed in advance). This quantity cannot be revised in later rounds, even as the offered price decreases.
- Phase one of the auction involves multiple rounds, in which the auctioneer informs the new price level (decrementing a constant value in USD/MWh from the previous round's price), and bidders confirm whether they wish to continue in the auction (using the full quantity offered in phase zero) or not. Phase one is terminated when the overall supply matches the auction's demand plus a certain adjustment factor unknown by the bidders. Those that remain in the auction proceed to phase two.
- Phase two functions as a sealed-bid auction for the bidders that remain. However, bidders are not allowed to revise the quantities offered during phase zero, and they cannot offer a price higher than the ceiling price at which phase one was terminated.

Therefore, phase one of the Brazilian mechanism has some of the benefits of the iterative process – such as the price discovery and possibility of adaptation throughout the process – but bidders proceed to phase two with incomplete information due to the undisclosed "adjustment factor" on the demand. Bidders do not know how close they are to meeting the demand, although they know that there is some surplus in supply, which incentivises them to lower their bids further in the sealed-bid phase. Table 5.1 summarises the price difference between the two phases in Brazilian auctions held between 2006 and 2011 (see Box 5.2).

Table 5.1: Prices in the first and second phase of Brazilian auctions

Auction [1, 2]	LER 2009	LFA 2010	LER 2010	A-3 2011	LER 2011	LER 2014
Renewable energy source	Wind	Wind, biomass[3]	Wind	Wind, biomass	Wind, biomass	Solar
Total volume contracted (MW)	753	666	255.1	468	460	202
Final price in the first phase (descending clock) – USD/MWh	77.6	69.8	63.6	52.5	51.5	110.5
Maximum winning price in the auction (after second phase) – USD/MWh	76.5	69.0	63.1	52.4	51.0	110.4
Minimum winning price in the auction (after second phase) – USD/MWh	65.5	65.3	60.5	48.2	47.5	100.4

[1] Brazilian auctions are named A-5 and A-3, meaning that the lead time is five and three years, respectively, for the winning projects. LER and LFA are the Portuguese abbreviations for Reserve Energy Auction and Alternative Sources Auction (renewable energy sources), respectively.
[2] Prices in Brazilian reais were converted to US dollars using a fixed exchange rate of 2 BRL/USD for all values in this table. However, the market exchange rate was approximately 1.7 BRL/USD during 2009-2011 and 2.2 BRL/USD during 2014.
[3] In LFA 2010, A-3 2011 and LER 2011 wind and biomass competed with each other and the prices represent the results of the whole auction, they are not per technology.

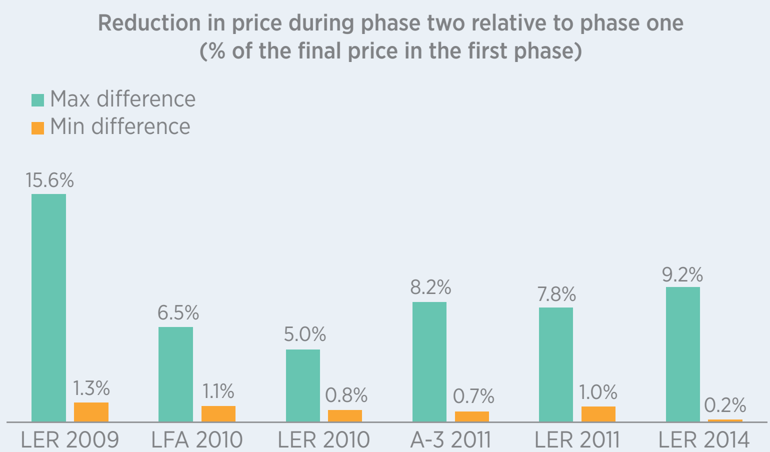
The hybrid process has contributed to further decreasing the price resulting from the Brazilian auctions (see Box 5.2) through the second phase which is the sealed-bid auction with vaying percentages of reduction (see Figure 5.2).

BOX 5.2: PRICE REDUCTION THROUGH HYBRID AUCTIONS IN BRAZIL

The second phase of the hybrid process in Brazil succeeded in further reducing the price established during the descending clock phase. Figure 5.2 shows the maximum and minimum difference in price achieved following the implementation of the second phase. One criticism of this mechanism, however, is that it still includes the main drawback of the pay-as-bid auction (see Section 5.5) and could lead participants to engage in the "winner's curse" phenomenon, meaning that they underbid in order to win the auction, and ultimately undergo economic losses as a result.

Another drawback of the Brazilian auction scheme (or of any descending clock auction in general) is that the process could last too long. The 2014 auction for solar power plants, for example, lasted eight hours, as the closing price proved to be much lower than the opening price (while the price decrement and duration of each round were fixed).

Figure 5.2: Price differences between the Brazilian auction phases



Souces: (ANEEL, 2015), (Elizondo-Azuela, Barroso et al., 2014), (Maurer, Barroso, 2011).

Another advantage of adopting a hybrid process is that it helps reduce the risk of collusive or strategic behavior – more prominent when a few participants account for a considerable share of supply – through the second phase of the sealed-bid auction (see Box 5.3). When competition is significant – with a large number of bidders with similar cost structures and risk preferences, and little concentration – opportunities for collusion decrease dramatically. In these cases, 1) a minor subgroup of participants behaving strategically is likely to be outbid by suppliers bidding competitively, and 2)

BOX 5.3: PREVENTION OF COLLUSIVE BEHAVIOR

Efforts to increase the number of bidders in an auction can help in preventing opportunities for collusion. These efforts are related, for instance, to reducing entry barriers, as discussed in Chapter 4. It is the competition within each demand segment that is relevant for opportunities for collusion. Therefore, explicit (*e.g.,* per technology) or implicit segmentation (*e.g.*, spatial limitation of demand due to transmission constraints) should be considered carefully. Segmentation results in auctions being multi-product in their nature, which may offer opportunities for collusion (for instance, co-ordination among bidders to allow the predominance of different bidders within different segments). Yet achieving high competition within the auction may not always be possible. In this case, explicit measures may be adopted to prevent collusion from affecting auction results.

The first category of such measures relates to design choices that make collusion more difficult. For instance, the adoption of a sealed-bid auction (or hybrid designs) hinders collusive behavior, since it makes the exchange of information and the explicit or tacit co-ordination among bidders more difficult. The auctioneer may opt not to reveal, before the auction, some information that is crucial for the design of strategies by colluding bidders – such as information on the auction demand. Attempts to prevent communication and exchange of information among bidders during the auction also can be made. The effectiveness of such measurements should be evaluated with care, since co-ordination and information exchange before the auction are still possible, and agents may attempt to use intricate signaling techniques[1] when direct communication is not possible.

A second category involves design choices that prevent abnormally high prices resulting from collusion, such as the adoption of ceiling prices.

Finally, the monitoring of bids and auction results by regulators – eventually aided by competition-monitoring authorities – enables the identification of collusion. Specific bidding phenomena to be addressed includes signaling (*e.g.*, conveying relevant information with the goal of co-ordinating bids) and punishment (*e.g.*, bids that aim at punishing an agent for failing to comply with specific behavior patterns).

Legally challenging any identified collusive behavior is often difficult, and it may require imposing formal rules that severely constrain bidding flexibility. Yet the monitoring and identification of collusive behavior offers opportunities to improve subsequent auction designs. This is particularly relevant when a series of auctions is held (systematic auction schemes). When such repeated auctions are held, bidders have opportunities to learn how to co-operate and may develop inter-auction strategies for signaling and punishment. Naturally, these repeated auctions offer regulators and policy makers opportunities to gradually improve the auction design in response to attempts of collusion.

[1] An example of such elaborate signaling techniques refers to code bidding in the spectrum auctions held by the US Federal Communications Commission: it has been suggested that some bidders used the last digits of their dollar-nominated bids – when these last digits did not have a material impact on the total amount of the bid (e.g., the sequence '378' in a bid such as 313,378, as reported in Cramton and Schwartz (2002) – to convey information to others.

Source: (Cramton, Schwartz, 2002), (Klemperer, 2002).

it is unlikely that any agreement involving a sufficient number of bidders will be stable, since co-ordination costs and the likelihood of some bidders failing to act according to the agreed strategy to maximise their profits, increases significantly.

Main findings

From evaluating several international auction implementations, it seems that policymakers most often tend to adopt the more straightforward sealed-bid mechanism. Descending clock auctions and hybrid auction mechanisms remain as alternatives, if the price discovery process is found to be important for bidders to adjust their bids during the auction. A potential impact of different options on the outcome of the auction is summarised in Table 5.2.

Table 5.2: Summary comparison of the bidding process options

Options / Criteria	Sealed-bid process	Iterative process	Hybrid process
Simplicity	● Straightforward	◑ Requires gathering all the bidders	○ More difficult to implement and communicate
Transparency and fairness	◑ Possibly opaque mechanism once offers are opened	● Open real-time information	◕ Ensured by the iterative phase
Bidders' ability to react	○ Information must be disclosed beforehand	● Gradual disclosure of information, allowing agents to respond	◑ Only during the iterative phase
Preventing collusion and price manipulation	◕ Undisclosed information makes bid coordination more difficult	◔ Bidders may force the auction to terminate early	◑ Second phase makes collusion more difficult
Matching supply and demand	● Supply and demand curves fully known	◔ Requires some assumptions for optimal results	◕ Supply and demand curves fully known in the second phase

Characteristics of the relevant attribute: ○ *Poor* ◔ ◑ *Medium* ◕ ● *Very good*

5.2 REQUIREMENTS OF MINIMAL COMPETITION

Auction schemes can include special provisions to ensure a minimum degree of competition in the bidding procedure, as measured by a few criteria assessed by the auctioneer. This type of mechanism may take several forms, such as 1) *maximum awarded capacity constraints* to a single bidder; 2) *ceiling price mechanisms,* beyond which no bids may be accepted; and 3) *other constraints* to the awarding of auctioned products.

Maximum awarded capacity constraints

Maximum awarded capacity constraints typically seek to prevent a single player from becoming too dominant in the auction. In a sense, this type of constraint can be similar to maximum project size constraints (see Section 4.2), although it is broader because it ensures that a company cannot dominate the auction even if it submits bids for multiple separate projects. Similar to imposing a maximum project size, maximum awarded capacity constraints may help the participation of smaller players in the auction. This would result in a beneficial portfolio effect by diversifying risks for the successful implementation of the awarded capacity.

On the other hand, caps to the maximum awarded capacity may reduce opportunities for economies of scale (as described in Section 4.2). Examples of jurisdictions that have implemented measures to limit the capacity awarded to a single player include California (in which a bidder could not bid for more than 50% of the auctioned demand on aggregate) and Portugal (where successful bidders in one round of the auction were not allowed to participate in the subsequent round).

Ceiling price mechanisms

Ceiling price mechanisms imply that bids beyond a certain price cap will be rejected automatically, even if there are no other bids and the auction will fail to meet its demand target as a consequence. Typically, this maximum price level is calculated as a "reasonable" price that is compatible with the expected costs of building and operating the power plant, preventing a player from offering a much higher bid and receiving windfall profits for the contract's duration. Because dominant players could have an incentive to bid high, using their market power to drive prices upwards, ceiling prices often are interpreted as "anti-monopoly" mechanisms. This scheme also can be considered a particular case of a price-sensitive demand curve (see Section 5.2.), in which the demanded quantity abruptly falls to zero at a certain threshold.

By introducing a ceiling price, the government acknowledges upfront that there is a risk that the auction scheme may not fulfil its intended role (achieve low prices) and that, in this case, the government will not fulfil all of its goals, such as contracting all the auctioned volume. However, a downside is that if the ceiling price cap is not set properly, there is a risk that a suboptimal amount of renewable energy will be contracted, as it could lead to the outright rejection of certain perfectly reasonable bids (representative of developers' actual costs of building and operating some viable, but not extremely cost-effective, plants).

Another decision that needs to be made is whether or not the price ceiling should be disclosed prior to the auction. Full disclosure tends to involve slightly greater transparency. However, one potentially negative aspect of disclosing a ceiling price is that it may anchor bidders' perceptions of what is a "fair" price and affect their bidding behavior. Yet one potentially negative aspect of keeping the ceiling price undisclosed is that there is an increased chance that a "reasonable" bid will be rejected when it is only slightly higher than the ceiling price, resulting in a suboptimal contracted quantity. In practice, the choice between disclosed and undisclosed ceiling prices tends to matter only in situations in which competition is relatively low. When competition is able to drive prices downwards substantially, bids that are close to the ceiling price should have little bearing on the auction's results.

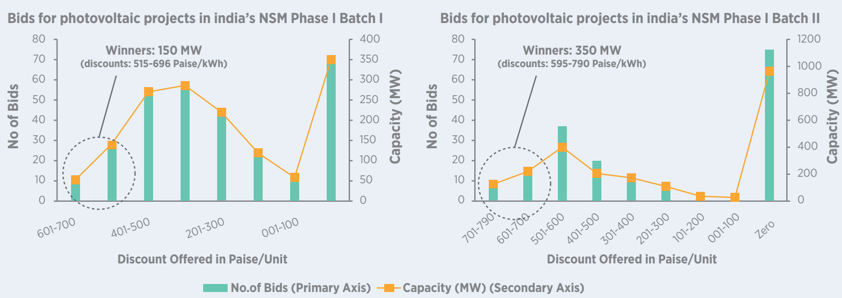
Fully disclosed ceiling prices are an intrinsic feature of certain auction design alternatives, such as mechanisms in which bids are in the form of a "discount" over a reference remuneration level, as in Italy, the Netherlands, and India (in the 2010-2011 national-level auctions) (see Box 5.4). Likewise, the auction's opening price in descending clock schemes (see Section 5.1) represents a natural price cap, as implemented in Brazil. In turn, undisclosed ceiling prices have been implemented in Peru, South Africa and other countries (see Box 5.5).

In Peru's sealed-bid auctions, the regulator sets a volume cap and an undisclosed ceiling price for each technology, above which no offer can be accepted. The ceiling price is determined by the regulator based on typical capital and operating costs, project size and connection costs (for a rate of return of 12% per year over 20 years). The ceiling price is only disclosed after the auction if 1) the auction's demand is not entirely met by the bids received in that round and 2) at least one bid was rejected for being higher than the price cap. In such an event, the ceiling price is incremented

BOX 5.4: EXPERIENCE WITH DISCLOSURE OF CEILING PRICES IN INDIA

India's National Solar Mission auctions in 2010 and 2011 involved a fully disclosed ceiling price. Contrary to the South African experience, there were major price discounts relative to the disclosed ceiling price. As illustrated in Figure 5.3, a large fraction of the bidders did offer the maximum allowed price (rightmost column in the figures, representing a discount of zero from the price ceiling), which suggests that full disclosure of the price cap does result in an anchoring effect. However, because the amount of bids received vastly outnumbered the desired capacity additions (by ten to one in the 2010 auction, and nearly nine to one in 2011), these bids did not truly matter for the auction's results – as only the bids in the leftmost columns, representing the lowest price offers, were ultimately contracted. Therefore, largely due to the stronger level of competition, India was able to procure solar power at extremely competitive prices.

Figure 5.3: Bids for PV projects in India[1]



[1] OBS: a discount of 100 Paisa per kWh (as shown in the horizontal axis of the figure) corresponds to approximately 16 US$/MWh at an exchange rate of 62 INR/USD. The ceiling price (corresponding to an offered discount of zero) was approximately equal to 298 USD/MWh in the Batch I auction (figure on the left), and to 256 USD/MWh in the Batch II auction (figure on the right).

Sources: (IRENA, 2013a), (Rycroft, 2013), (Eberhard, Kolker, Leigland, 2014), (Elizondo-Azuela, Barroso et al., 2014), (Ministry of New and Renewable Energy, 2012).

by an undisclosed factor, and a new auction is called. There are concerns that this arrangement could allow bidders to behave strategically, as they can intentionally bid too high in the first iteration in order to have the ceiling price revealed and increased for the re-called auction – as project developers may simply re-submit a bid that had exceeded the ceiling. In some cases, the previous FIT is used as a ceiling price, when a jurisdiction moves from FIT to an auction with the aim of reducing the cost of support, as occurred in South Africa (see Box 5.5).

Country experience with ceiling price was also analysed in the 2013 IRENA report *Renewable Energy Auctions in Developing Countries*.

BOX 5.5: EXPERIENCE WITH DISCLOSURE OF CEILING PRICES IN SOUTH AFRICA

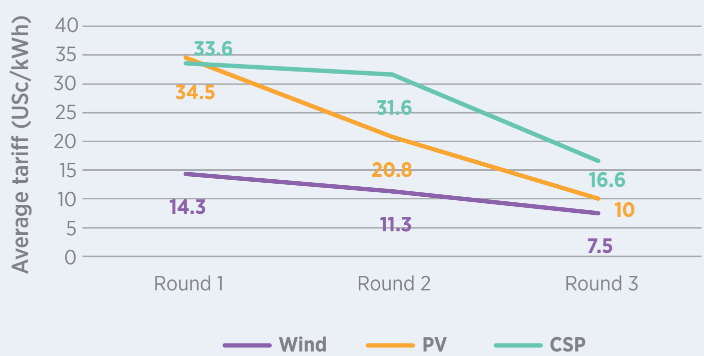
In 2011, South Africa launched the Renewable Energy Independent Power Producer Procurement (REIPPP) programme, with the aim of promoting renewable energy development through auctions. Five auction rounds were planned, with a total target of 3 725 MW.

The first round of the programme took place in August 2011. Although the auction was successful in contracting 28 new renewable energy plants (representing all bids that passed the qualification phase), the contract price obtained in the first round was relatively high, suggesting that the auction was unable to substantially drive prices downwards. Two features of the auction design influenced the result: 1) the ceiling prices were fully disclosed to the public, as they were based on the preceding programme's FIT levels – thus providing a benchmark that anchored project developer's expectations; and 2) there was no capacity limit set other than the 3 725 MW target for the entire programme (involving five auctions), which meant that demand far outstripped supply. As a consequence, all projects that satisfied the qualification requirements were selected, and the lack of competition failed to create pressure on bidders to reduce their offered prices. The average price of this first phase was very close to the ceiling price.

For subsequent rounds, the ceiling prices for each technology were set at slightly lower levels (and were kept undisclosed), and the allocation of capacity in each round was limited for each technology (the volume cap was set at 1 275 MW in the second round and 1 473 MW in the third round). Therefore, prices received for the second and third rounds were very competitive and lower than expected.

Although the success of the South African experience can be attributed to some extent to the non-disclosure of the ceiling prices in the second and third auction rounds, the higher competition in these later rounds deserves much of the merit. The introduction of a volume cap meant that bidders were effectively competing and only the lowest offers would be contracted. The decrease in the average contracted price through the first three bidding rounds can be seen in Figure 5.4.

Figure 5.4: Evolution of the prices in the REIPPP rounds



Note: Exchange rates used were equal to 8 ZAR/USD, 7.94 ZAR/USD and 9.86 ZAR/USD respectively, according to the date of each round.

Other mechanisms to promote competition

Countries can adopt other means to minimise market concentration and promote competition. These approaches are similar to price cap mechanisms in the sense that they offer conditions (fully or partially disclosed) to declare an auction void, representing an "insurance" against the auction not functioning properly. There are several ways to implement this type of scheme, although it tends to be less common than the two alternatives described above.

In Brazil, for example, an auction's demand is revised downwards automatically to be always slightly lower than the available supply, ensuring that the participants would always need to compete for the lowest price to some extent (see Box 3.5). Although this mechanism helps in promoting competition, it also implies that a certain percentage of the total potential supply always will be rejected – which may lead to suboptimal contracted quantities in situations in which the supply-demand balance is tight. The Brazilian auctions also do not disclose the auction's demand to avoid collusive behavior.

Another example is the auction in California, where the IOUs (California's three large investor-owned utilities) may reject bids at their own discretion whenever there is evidence of market manipulation or when prices are not competitive with other procurement options (see Box 5.6).

BOX 5.6: CALIFORNIA'S RAM PROGRAMME

Under California's renewable auction mechanism (RAM), after the qualification phase, the state's three large investor-owned utilities may reject the bids at their own discretion whenever there is evidence of market manipulation or when prices are not competitive with other procurement options, with the goal of protecting ratepayers against unwarranted increases in electricity prices. If the IOU wants to utilise this discretion, it must submit a letter to the California Public Utilities Commission (CPUC) explaining its decision to reject a bid before the capacity cap was exhausted.

As a result, a majority of projects that passed the qualification phase were rejected in the selection process on the grounds that they were not cost-competitive. Therefore, the RAM succeeded in achieving lower prices than any other procurement methods in California, and the programme did not meet its capacity targets in full in any of the auctioning rounds. An important concern is that the programme might be too competitive, because of the high number of rejected bids. Table 5.3 illustrates the low percentage of winning projects, for one of the IOUs during the four RAM rounds. A similar situation was seen for the other two IOUs.

Table 5.3: Winning projects versus qualified projects in results of California's RAM programme

	RAM 1	RAM 2	RAM 3	RAM 4
Number of qualified projects	46	113	93	65
Number of winning projects	9	10	22	10
Percentage of projects selected from the qualified projects	20%	9%	24%	15%

Because the specific bid prices are confidential, it is difficult to assess the competitiveness of the bids that were rejected, and the threshold for what constitutes a competitive project may have been modified throughout the auctions. However, given that procurement targets have not been met in past auctioning rounds despite more than sufficient eligible bids, it would seem that the IOUs are using this mechanism liberally.

Because of the many qualified projects rejected in the selection process, it is possible that the RAM created a "development bubble", with many developers investing time and money in analysing and documenting projects that will never be financed through the RAM. Therefore, it might be worth evaluating whether too much of a burden is placed on the project developers in an early stage. The programme's ongoing viability may be harmed if developers lose faith in it after wasting considerable resources in unsuccessful projects.

Sources: (California Public Utilities Commission, 2015), (Wentz, 2014).

Main findings

The most effective way of maximising the success of an auction is by attracting a greater number of bidders – which in general results in a more cost-effective allocation of contracts and results in reduced prices. In this context, adopting requirements of minimal competition most often function as a "stopgap" mechanism when the auction has not fulfilled its main role of promoting competition between project developers. This does not mean that provisions to prevent market concentration are undesirable – indeed, the auction mechanism will be more robust if it properly anticipates certain "worst-case" outcomes and introduces provisions to deal with them. However, policy makers should be aware that these requirements are not a substitute to actual competition between multiple bidders.

A summary comparison of different options for ensuring a minimum degree of competition is presented in Table 5.4.

Table 5.4: Summary comparison of options to ensure competition

Options / Criteria	No requirements of minimal competition	Maximum awarded capacity constraints	Ceiling price mechanisms
Level of participation of bidders	Risk that larger players will dominate the auction	May incentivise small players to participate	May exclude some players if ceiling price is too low
Risk of Undercontracting	Lowest risk of undercontracting	Some risk if the number of bidders is small	Substantial risk if price cap is not calibrated properly
Cost-effectiveness	Neutral	May reduce opportunities for economies of scale	May have an effect in reducing equilibrium prices
Prevented collusion and price manipulation	No specific provisions	Impose some limits to individual companies	"Anti-monopoly" mechanism

Characteristics of the relevant attribute: *Poor* *Medium* *Very good*

5.3 WINNER SELECTION CRITERIA

The winner selection criteria, which dictate how to rank the bids and select the winners, is another topic that is at the core of an auction. Although it is possible to consider multiple criteria, translating these attributes into a one-dimensional "index" allows for the direct comparison of bids in order to ensure consistency in the selection mechanism. According to their winner selection criteria, auctions can be roughly classified as: 1) *minimum-price auctions*, which represent the most straightforward way of comparing bids; 2) *adjusted minimum-price auctions*, which maintain the cost-centric criterion but introduce a few adjustment factors; and 3) *multi-criteria auctions,* which tend to depart more strongly from minimum-price auctions by assigning a considerable weight to non-price parameters.

Minimum-price auctions

Minimum-price auctions represent "classical" implementation, in which the key objective is to contract the desired product at the lowest cost. While there may be several reasons for taking other criteria into account when selecting the most desirable bids, an important benefit of standard minimum-price auctions is their simplicity and objectiveness. Standard minimum-price criteria have been the norm in India and Peru, among other countries.

Among other criteria, the price was included in China's wind auction winner selection, the bid closest to the average would benefit the most, with the highest and lowest bids being excluded (see Box 5.11).

Adjusted minimum-price auctions

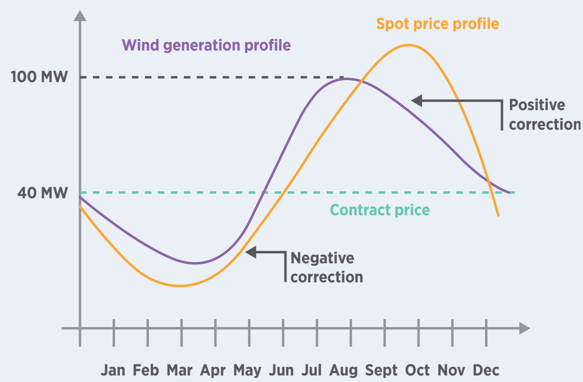
Adjusted minimum-price criteria are necessary when different products are involved in the auction, requiring a "correction factor" that makes it possible to compare the different bids on the same basis (see Box 5.7). In most implementations, project developers may bid for the different products, or demand bands, knowing how this choice will be reflected in either a bonus or a penalty on their bid for comparison purposes. This design element can be used in competitive auctions (see Section 3.1) that may involve products with very different characteristics. Brazil, for example, has allowed for the direct competition between biomass and wind power in certain auctions (see Box 5.7).

BOX 5.7: FACTORING IN RENEWABLE PRODUCTION COMPLEMENTARITY IN THE AUCTION PRICE IN BRAZIL

Brazil adopts a adjusted minimum-price criteria in its auctions, introducing a "correction factor" which correlates the average spot price profile and the power plant's production profile. The regulation authority estimates the future spot price profile and the project developer indicates the generation profile of the plant. Therefore, different generation bids, such as for wind and biomass, can be compared on the same basis, considering the economic value of their generation accordingly.

Figure 5.5 provides a theoretical example of how the scheme works. The wind bid is adjusted according to the plant's generation profile compared to the system's spot price profile: when the plant generates mostly at times when the spot price is high, the adjustment will turn into a bonus, whereas when the plant generates mostly at times when the spot price is low, the adjustment will turn into a penalty. The average of all the bonuses and the penalties, using the generator's declared production profile and a set of long-term price expectations produced by the government, will result in the "correction factor" (positive or negative) to be added to the bid price. For the purpose of the winner selection process, the auctioneer will take into consideration the adjusted bids of each project developer; however, once a project is selected, its remuneration will be based on its original price bid – as the correction factor essentially represents an externality.

Figure 5.5: Example of the wind generation profile, the spot price and the contract price



In Brazil's A-5 auction in 2014, the correction factor for all of the winning wind projects was negative, as wind production for typical plants in the country's northeast tends to be concentrated in the dry season, when spot prices tend to be higher (see Table 5.5).

Table 5.5: Coorrection factors in A-5 Auction in 2014 in Brazil

Project name	Installed capacity (MW)	Auction bid (USD/MWh)	Correction factor (USD/MWh)	Price for evaluation (USD/MWh)
Aura Lagoa do Barro 01	27	69.8	-2.1	67.8
Laranjeiras III	26	71.1	-2.8	68.3
Ventos da Santa Dulce	28	70.0	-2.4	67.6
Boa Esperança I	28	69.3	-1.5	67.7
Canoas	30	70.7	-2.6	68.1

The exchange rate used to convert values from Brazilian reais to US dollars was approximately 2.2 BRL/USD during 2014.

Sources: (ANEEL, 2015), (Elizondo-Azuela, Barroso et al., 2014), (Bezerra, Cunha, Ávila, Barroso, Carvalho, Pereira, 2013).

In mechanisms where the bidder is allowed to select the most suitable alternative, characteristics of the auctioned product could include the lead time for the project's commercial operation date (see Section 6.2) and the indexation and escalation clauses involved in the contract (see Section 6.3). Because projects with different lead times and/or indexation cannot be directly compared, an adjustment factor must be calculated in order to maintain a cost-centric winner selection criterion.

Another example of an adjusted minimum-price mechanism was Uruguay's 2013 wind auction, where the price used to determine the priority order was adjusted through a coefficient that reflects the local content of the project, as described in Box 5.8.

BOX 5.8: COMPARATIVE PRICE IN URUGUAY'S AUCTIONS

During the winner selection process in Uruguay's 2013 wind auction, the bid price for a project was modified upwards according to the local content share, using a coefficient to determine "the comparative" price. The local component of the projects ranged between the minimum 20% required and a maximum of 49%. Figure 5.6 illustrates the impact of the local component on the comparative price, indicating that a 1% increase in it reduced the comparative price by 0.2%.

Figure 5.6: The impact of national component participation on the comparative price (%)

However, the price stipulated in the PPA is not the comparative price, but a price that reflects the sum of the generation bid price and the unitary connection cost. Table 5.6 summarises the results.

Table 5.6: Comparison of the winning projects in Uruguay

Winning project	Bid price (USD/MWh)	Awarded price (USD/MWh)	Comparative price (USD/MWh)	Local component (%)
Venti Consortium	84	84.93	81.16	42.9
Fingano	NA	84.53	84.53	20
Palmatir	85	86.6	86.26	22

Sources: (Mercados Energeticos Consultores, PSR, 2013), (Proyecto Energía Eólica, 2015).

Multi-criteria auctions

Multi-criteria auctions involve introducing additional criteria in the comparison of bids. Unlike adjusted minimum-price schemes, however, they do not necessarily seek to represent proxies for actual costs. Instead, multi-criteria auctions tend to involve "virtual" costs that typically represent a preference but not a requirement for certain aspects of the bid. In this sense, multi criteria auctions are like introducing "soft" qualification requirements, as bidders that meet certain desirable qualities receive bonuses for the purpose of bid comparison. It is possible, for instance, to attribute a "grade" to the bidder's reputation and past experience rather than imposing a strict requirement (see Chapter 4), or to offer a bonus to plants that use locally manufactured equipment, rather than necessarily introducing hard domestic content constraints (see Section 4.5).

To ensure fairness and transparency of the auction process, it is desirable that the procedures to translate relevant attributes into comparable bids are known beforehand, so that suppliers may select the most attractive combination of attributes for their bid. However, this greatly increases the complexity of the mechanism, since the auctioneer must prepare a full set of grading criteria to be disclosed to the bidders. Nonetheless, there are multiple examples of successful multi-criteria auctions in China, France, South Africa and elsewhere.

In South Africa, socio-economic development factors were used as eliminatory requirements in the qualification phase, by setting thresholds for different indicators, such as local content, job creation and ownership (see Box 5.9). In addition, socio-economic benefits were important elements in the compound winner selection in the second phase of the auction.

BOX 5.9: COMPOUND WINNER SELECTION PROCESS IN SOUTH AFRICA

Three key objectives of renewable energy auctions in South Africa have been 1) increased generation capacity, 2) diversification of the energy mix towards less carbon-intensive technologies at low prices and 3) the creation of economic development opportunities. As such, the project selection criterion was based on a 70/30 split between price and economic development considerations (see Box 4.9).

In the selection phase, the bids were "graded" according to their degree of compliance with each of the economic development features, based on a target level for each variable (which is higher than the minimum level required for participation). Ten points were awarded for achievement between threshold and target levels, and an additional ten points for achievements above the target level. The resulting grade for economic development compliance receives a 30% weight in the compound winner selection criterion.

For instance, in the job creation criteria, a fraction of 18% of skilled black employees is the minimum to pass the qualification phase, but the target used in the second phase is 30%. Similarly, the minimum share of employees that must belong to local communities must be 12%, but a share of 20% guarantees the highest grade in the second phase. In parallel, the value of local content spending has a minimum of 25% but a target of 45%, and so forth.

Yet the tender's economic development requirements have been controversial, as they are often confusing as well as expensive for bidders to comply with. However, these requirements have helped to generate political support for the programme from politicians and the general public. By increasing the role of these factors to 30% of bid value, the programme helped increase the visibility of economic development considerations and underscore their importance.

Table 5.7 illustrates the results of solar PV and wind winning projects along the four bidding rounds, in terms of local content and local job creation. As observed in the case of wind projects, the local content spending barely exceeded the threshold of 25% in the first round, increasing until almost reaching the target of 45% in the fourth round.

Table 5.7: Socio-economic benefits criteria in South African auctions

	Round 1		Round 2		Round 3		Round 4	
Technology	Solar PV	Wind	Solar PV	Wind	Solar PV	Wind	Solar PV	Wind
MW contracted	632	634	417	563	435	787	415	676
Local content %	38.4	27.4	53.4	48.1	53.8	46.9	64.7	44.6
Job Creation: construction (citizens)	2381	1810	2270	1787	2119	2612	3825	2831
Job Creation: Operations (citizens)	6117	2461	3809	2238	7513	8506	9273	8161

Sources: (IRENA, 2013c), (Eberhard, Kolker, Leigland, 2014), (Department of Energy – Republic of South Africa, 2015).

The French experience, discussed in Box 5.10, resembles that in South Africa and uses a compound winner selection criteria aimed at cost efficiency, location, technological diversity, and support for research and development (R&D).

BOX 5.10: THE COUMPOUND WINNER SELECTION CRITERIA IN FRANCE

In France's renewable energy auctions, the price is an important criteria in the winner selection – but it is not the only one. In designing the auctions, the French government emphasised a mix of factors such as the cost efficiency of production, support for research and development (R&D), local aspects and emergence of new technology.

France's first auction was held in 1996, aiming to install between 250 and 500 MW of wind power by 2005. The main goals were to diversify the French energy mix, to incentivise geographic diversity (while taking into consideration public opinion and acceptance of the sites) and to encourage technological diversity, motivating R&D of different turbines and products. The government also aimed to develop a local wind industry, and the programme was a big incentive for the development of local wind turbine producers.

The country's pay-as-bid auction assessed the bids based on the following criteria:

- Price per kWh
- Economic benefits of the project
- Long-term benefits of the chosen technical solutions
- Technical and financial reliability
- Environmental aspects
- Local stakeholder opinion.

The compound winner selection criteria results in several priorities being met, although it likely sacrifices price efficiency in the process. Possible evidence of this can be found by comparing the prices resulting from wind auctions held in parallel in France and the UK: the first round of the French auction resulted in a higher average price (approximately 68 USD per MWh[1]) than the UK NFFO, whose only criteria for bid selection was the electricity price. Prices achieved in the UK NFFO in rounds 4 and 5 were respectively equal to 65 USD/MWh[1] and 51 USD/MWh[1].

Another example illustrating that price was not the main criteria in the French renewable energy auctions is the PPI (Programmation Pluriannuelle des Investissement / Multi-Year Invesment Programme) tender round for biomass in 2006. The projects were ranked according to a pre-defined point scale, in which the maximum amount of points was 30, based on the following criteria:

- Price (10 points)
- Plan for supply of biomass resources (12 points)
- Energy efficiency of the installation (7 points, elimination if lower than 50%)
- Technical and financial capabilities (1 point or zero, the latter meaning elimination).

This division of criteria is certainly not typical compared to most other renewable energy auctions, as price is not the main criteria, but accounts for a modest one-third of the selection process.

[1] *Average exchange rates used were of ca. 1.3 USD/EUR and 1.45 EUR/GBP (1.9 USD/GBP).*

Sources: (Green Stream, 2010), (IRENA, 2013a).

In order to reduce the risk of underbidding, China implemented an alternative multi-criterion scheme to select auction winners, with mixed results. In the country's last wind auction, in 2007, an average-price criterion was included as one of the selection criteria, together with benefits to the local economy and other indicators associated with bidders' technical and managerial experience (see Box 5.11).

BOX 5.11: CHINA'S MULTI-CRITERIA AUCTIONS WITH AN "AVERAGE-PRICE" CRITERION

In China's project-specific auctions for wind power, the selection criteria included not only the price, but also benefits to the local economy and indicators associated with the bidders' technical and managerial experience. The contribution of price to the final score was reduced to 40% in the third wind power auction in 2005, and to 25% in the fourth wind power auction in 2006.

In its fifth wind power auction, in 2007, the price criterion, still accounting for 25% of the bid score, was completely redesigned to benefit the bid closest to the average (with the highest and lowest bids being excluded). Notably, this scheme can be justifiable only in a project-specific auction; otherwise, the most promising projects with higher capacity factors would be excluded. One reason for adopting this mechanism is its ability to protect against "adventurous" bidders who might not be able to honour the contract. It also discourages bidders from offering below-market prices: in previous auctions in China, state-owned companies were able to bid artificially low by benefiting from a cross-subsidy. This situation led to the discouragement of foreign and small developers.

Nevertheless, this scheme presents two main drawbacks. First, it forces contenders to bid based mostly on their competition instead of their costs (with the aggravating factor that it is not below the competition). Second, it still tends to harm the most competitive bidders (*e.g.*, the ones with higher technological productivity, etc.) to the detriment of those which can hit closer to the average price. And in the case that the most competitive bidder strategically bids the average price, he will provide more-expensive energy than he could otherwise. Consequently, the average price achieved in the 2007 auction was approximately 12% higher than in the previous auction.

Sources: (Elizondo-Azuela, Barroso et al., 2014), (Wang, 2010).

Finally, the GET FiT programme in Uganda organises auctions for small power producers to gain premium payments in addition to the FITS. In the case of biomass, hydro and bagasse power plants, the developers compete based on a scoring system that uses a mix of non-price factors (see Box 5.12).

BOX 5.12: NON-PRICE COMPETITION IN UGANDA'S SMALL POWER PRODUCER AUCTIONS

In auctions for biomass, hydro and bagasse power plants in Uganda, developers compete based on a scoring system that uses a mix of non-price factors: financial and economic performance (35 points), environmental and social performance (30 points) and technical and organisational performance (35 points). Participants that receive an overall score of less than 70 points out of the total 100, or that score less than half of the points in any of the three categories, are eliminated. Since the premium payments are already established by the programme, based on the levelised cost of electricity (LCOE) for each of the technologies, there is no price competition.

For solar PV projects, price is included in the auction's winner selection criteria, with a weight of 70%, and the same non-price factors as for the other technologies compounding the other 30%. The government in Uganda made this decision because the solar PV market is changing so rapidly, making the LCOE more difficult to calculate. Given the major decline in the cost of PV panels over the last several years, the price of solar PV electricity has decreased as well, putting project developers in a better position to decide the current cost of production. The winning bids from Uganda's competitive bidding for small-scale plants connected to the main grid were publicly announced in December 2014.

Uganda's GET FiT provides a "top-up" payment in addition to the FIT, as summarised in Table 5.8.

Table 5.8: GET FiT premiums in Uganda

Technology	Current FIT ($/kWh)	GET FIT premium ($/kWh)
Solar PV	0.11	0.054
Biomass	0.103	0.01
Bagasse	0.095	0.005
Hydro	0.085	0.014
Job Creation: Operations (citizens)	6117	2238

Sources: (Multiconsult and Norplan, 2015), (Tenenbaum, 2015).

Main findings

Auction schemes have historically been strongly associated with the "classical" minimum-price criterion and this type of winner selection criterion remains a popular design choice, in large part due its simplicity. More recently, however, this approach has been challenged in many jurisdictions, as other criteria have been incorporated in the winner selection process. Introducing a small number of correction factors with transparent and market-oriented criteria to compare different bids can actually increase the perceived fairness of the process. However, certain difficulties may emerge if the winner selection process becomes dominated by non-monetary criteria, application of which tends to result in higher equilibrium prices. It may also lead to a perception of unfairness if the bidding criteria seem to favour a certain category of bidders.

A summary comparison of different options for determining the winner selection criteria is presented in Table 5.9.

Table 5.9: Summary comparison of winner selection criteria options

Options / Criteria	Minimum price	Adjusted minimum price	Multi-criteria auctions
Simplicity	Straightforward	Slightly more complex	High complexity
Cost-effectiveness	The main objective of this implementation	If implemented well, corrects biases in the pure price criterion	Price is not the main objective
Transparency and fairness	Straightforward comparison	Allows the comparison of different products on the same basis	Criteria may be perceived as unfair or arbitrary
Guidance from the auctioneer	Comparison based only on price, no other criteria	Some flexibility in selecting which adjustments to apply	One of the main objectives of this implementation
Development of a local industry	Does not offer specific advantages	In principle, does not offer specific advantages	May represent these objectives in the winner selection criteria

Characteristics of the relevant attribute: *Poor* *Medium* *Very good*

5.4 CLEARING MECHANISM AND MARGINAL BIDS

Another relevant aspect of the winner selection process relates to clearing the auction's supply and demand once all bids are properly ranked. Clearing is important where individual projects are large in size and non-divisible ("bulky" bids), which implies that strict equality between supply and demand is not always attainable. In such situations, the selection process requires either: 1) *demand-side flexibility*, meaning that the auctioned quantity accommodates inflexible price-quantity bids; or 2) *supply-side felixibility*, meaning that the bidder announces how the contracted quantity may be revised prior to the auction. Alternatively, if no *ex-ante* settlements have been done, 3) *ex-post* adjustments are a way to equalise demand and supply, involving some flexibility in demand allocation after the bids are made public.

In general terms, clearing mechanisms do not directly impact the auction outcomes and therefore they need to be as simple as possible. This is especially true in the case of renewable energy auctions, as renewable generation projects tend to be much more modular than conventional generation projects, and having "bulkier" bids is less of a concern. In addition, clearing is typically a non-issue in project-specific auctions, since the demanded quantity is generally equal to the total capacity of all candidate projects.

Demand-side flexibility

Flexible demand schemes are associated with fully indivisible price-quantity bids, which implies that the total contracted quantity will not always be equal to the predetermined volume auctioned (see Section 3.2). In some cases, such as in the electricity auction carried out in Guatemala (see Box 3.3), an optimisation problem is explicitly solved to determine which of the qualifying bids to contract so that the demand is met in the most optimal way. However, this type of allocation scheme introduces a substantial degree of complexity in the winner selection process, which may not be justifiable or transparent.

Instead, it may be preferable to adopt a simpler heuristic way to determine how the auction demand should be adjusted. In Brazilian auctions, for example, the auction demand can be adjusted upwards, but never downwards, and the next-lowest price bid is always fully accepted. Even though the Brazilian approach may result in a slight risk of overcontracting, it also leads to a simpler scheme overall.

In general, the flexible demand scheme is the most attractive alternative from the bidder's standpoint, since the complexity costs (in a mechanism such as Guatemala's) and the risks of an undesirable outcome (in a mechanism such as Brazil's) are borne by the auctioneer.

Supply-side flexibility

Supply-side flexibility implies that the bidders must adjust their offers in order to properly accommodate a fixed quantity demand. In most cases, this type of implementation involves price-quantity bidding, meaning that the bids submitted must contain information that allows the auctioneer to adjust the contracted quantity (and potentially the contracted price) in order to ensure that the auction's demand is met exactly. In theory, this type of mechanism allows for a more detailed representation of the supply and demand curves, implying that the equilibrium could be identified with greater accuracy. In practice, however, it is not always clear whether these gains offset the additional complexity involved. One way to reduce the underlying complexity of this mechanism (albeit at some cost to flexibility) is to impose constraints on the bids' format. In India, for example, generators may only bid for quantities of solar power capacity in multiples of 5 MW: thus, bidders give up some of their flexibility to determine the optimal quantity to be offered.

When the flexibility is placed on the suppliers' side, the bidders are slightly more constrained when submitting their offer as often the bid needs to respect a certain format, which implies more information to be revealed about their supply curve. In turn, supply-side flexibility schemes reduce the amount of concessions that must be made on the demand side, since the bids will be adjusted to meet the exact quantity auctioned.

Ex-post adjustments

Ex-post adjustments imply that the auction process terminates with a "tentative" allocation of winning projects, subject to confirmation among the interested parties. This type of adjustment can take many forms, from a binary "go/no go" decision (such as in the Chilean conventional energy auctions) to a demand-side decision to adjust the demanded quantity in order to achieve lower prices (such as in Dubai, see Box 5.13). In general, *ex-post* adjustments tend to increase the complexity of the auction mechanism, since the precise conditions for revisiting the relevant quantities after the auction should be completely clear before it takes place. Otherwise, the legitimacy of the process could be questioned, leading to a loss in project developers' confidence. If the conditions for awarding the auctioned product are open to interpretation, negotiation rounds would need to be carried out with the auctioneer, which defeats the key purpose of the auction procedure.

BOX 5.13: EX-POST ADJUSTMENTS ON DEMANDED QUANTITY IN THE PROJECT-SPECIFIC AUCTION IN DUBAI

In November 2014, Dubai's solar auction set a record low price for solar power with a winning bid of 5.98 USc/kWh from Acwa Power (well below the previous lowest price of 8 USc/kWh in Brazil's PV market).

The initial capacity target of the auction was set at 100 MW, but instead of submitting a price for the required capacity, the bidder opted for a price-quantity scheme and put additional alternative proposals to guarantee even lower prices if awarded with greater capacity (200, 800 or even 1 000 MW, with 5.4 USc/kWh for the 1 000 MW option). In this case, the flexible bid offers were initiated by the bidder in an attempt to provide alternatives for the project's capacity at lower prices, not to facilitate the clearing mechanism.

Consequently, *ex-post* adjustments have been made by the Dubai Electricity and Water Authority (DEWA), who accepted an alternative proposal with a higher capacity. Therefore, the expanded 200 MW phase will lower the price to 5.84 USc/kWh over a 25-year period contract. The *ex-post* adjustment in Dubai allowed DEWA to provide economies of scale to the generator, enabling the addition of 100 MW in the procured capacity and achieving simultaneously larger volume and lower prices.

Sources: (Apricum, 2014), (ACWA Power, 2015).

Main findings

Even though some jurisdictions have implemented sophisticated clearing mechanisms for matching supply and demand, as it is the case of Guatemala and Dubai, these tend to be the exception rather than the rule. Most renewable energy auction schemes tend to prefer simpler mechanisms, such as the ones adopted in Brazil (involving demand-side flexibility) and India (involving supply-side flexibility). It is relevant to point out that a clearing mechanism tends to be most important for the auction design when generators' bids are bulky and indivisible. However, the relatively modular nature of many renewable technologies (wind turbines, solar panels, etc.) makes it much easier to adjust the project size than it would be for conventional generators (*e.g.* a coal or gas plant). Ultimately, there are many viable implementations for the clearing mechanism, and the most important conditions are that it is clearly understood and adopted consistently.

A summary comparison of the different alternatives for clearing mechanisms is presented in Table 5.10.

Table 5.10: Summary comparison of clearing mechanism options

Options / Criteria	Demand-side flexibility	Supply-side flexibility	Ex-post adjustments
Simplicity	Auctioneer must determine rules to adjust demand	More complex bids and comparison processes	Depends on interest of both parties
Investors' confidence	Demand accommodates indivisible bids	Investors accept some uncertainty in contracted quantity	Subject to ex-post negotiations
Risk of (over) undercontracting	Overcontracting tends to be common	Bids are adjusted to meet the demand	Risk of parties not reaching an agreement
Matching supply and demand	Typically results in (over) undercontracting	Matches a more refined supply curve	Good, provided that parties reach an agreement

Characteristics of the relevant attribute: *Poor* *Medium* *Very good*

5.5 PAYMENT TO THE AUCTION WINNER

Another issue is how the winners' remuneration for the auctioned product is to be determined based on the results of the bidding procedure. In essence, the following approaches are possible: 1) *pay-as-bid pricing*, in which the project developer's remuneration is dictated by the developer's own bid; 2) *marginal pricing schemes*, in which other project developers' bids are used as a basis for remuneration; and 3) *nonstandard pricing schemes*, which refer to any unique options that do not fall into these typical categories.

Pay-as-bid pricing

Pay-as-bid pricing mechanisms are the most common approach in renewable energy auctions. In this type of scheme, the optimal bidding strategy is more complicated, as the bidders do not seek simply to win the auction, but rather to win while submitting the highest possible bid. Thus, estimating other players' bids plays an important role. In addition, in an attempt to bid lower than the other participants, the auction's winners might fall victim to the "winner's curse", whereby the players tend to underbid and eventually may not be able to fulfill the contract.

Pay-as-bid implementations are typically seen as a means to minimise costs, offering bidders no more than their bid, which is supposed to be the minimum required for developing the renewable energy project. This gives these schemes much wider appeal from a social and political standpoint. The cost-effectiveness of the auction mechanism tends to be an important driver behind the widespread adoption of pay-as-bid pricing.

Marginal pricing schemes

According to the classic economic theory of auctions, marginal pricing schemes tend to be preferred over pay-as-bid mechanisms. This is because, by making project developers' remuneration independent from their price bid, bidders are encouraged to disclose their actual costs. In auctions that seek to satisfy a certain demand for renewable energy on aggregate, the standard implementation involves uniform pricing, in which each of the many auction winners is remunerated based on the same price, given by the most expensive of the accepted bids (or alternatively, by the least expensive of the rejected bids).

One downside of marginal pricing schemes is a possibility of losing social and political support, due to the perception that the auction mechanism imposes a needless burden on consumers (when remuneration is based on the most expensive of the accepted bids). This design alternative typically results in winning projects being remunerated at a value that is higher than their asking price, which may lead to criticism – particularly if the original bids are known to be substantially lower than the equilibrium price. The use of a descending clock bidding mechanism (see Section 5.1) can be one way of mitigating this effect, since a bidder's minimum disposition to receive can be kept undisclosed.

Nonstandard pricing schemes

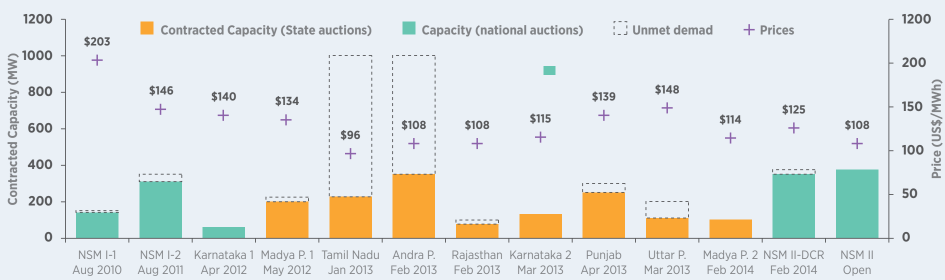
Nonstandard pricing schemes represent a catchall category for any means of pricing the winning contracts that cannot be described as either marginal pricing or pay-as-bid. Most often, these mechanisms involve some kind of *ex-post* negotiation between the auctioneer and the auction winner. However, even though these negotiations may help the auctioneer to negotiate a better deal in the short term, in the longer term, this model can lead to a perception that the auction mechanism is not as fair or transparent as it claims to be. The "L1" pricing scheme adopted in certain Indian states is one example of a nonstandard pricing implementation (see Box 5.14).

BOX 5.14: LOWEST BID CONTRACT PRICING SCHEME IN INDIA

The Indian states of Rajasthan, Tamil Nadu, Andhra Pradesh and Odisha adopted a remarkable and controversial pricing scheme known as L1. In this mechanism, the final contract price is given by the lowest bid offered in the auction. Therefore, the bidders who are able to accept this price will be awarded the PPA. The economic benefit of the scheme is questionable. Although it could be successful in decreasing prices, it mostly resulted in a large number of competitive bidders refusing the PPA.

The L1 bidding scheme did have an immediate effect in reducing prices, but at a cost of a large unmet demand. Figure 5.7 shows that the states where L1 pricing has been implemented (Tamil Nadu, Andhra Pradesh and Rajasthan in January-February 2013; Odisha not pictured) tend to present the lowest prices, but also the highest amount of unmet demand.

Figure 5.7: Overview of the results from recent auctions in India



Note: "Due to the very different nature of the auctioned products (such as the shorter 10-year PPA in Uttar Pradesh and the very different schedule of payments implied by the VGF mechanism from the NSM Phase II), several assumptions needed to be made in order to obtain reasonably comparable values for this Figure. For this reason, the auctioned prices listed here should be interpreted only as rough estimates rather than exact values." The currency conversion used an exchange rate of 60 INR/USD

Source: (Elizondo-Azuela, Barroso et al., 2014), (Bridge to India, 2011-2014)

Main findings

The preferred alternative in most renewable energy auctions seems to involve pay-as-bid payments to the auction winners with fewer jurisdictions adopting marginal pricing schemes and other nonstandard pricing schemes. The greatest disadvantage of marginal pricing implementations is that they may lead to a perception of unfairness, especially if the auctioned price is substantially higher than the cheapest bids (which will result in a large surplus remuneration to those low bids). For this reason, marginal pricing is most often applied in the context of iterative auctions (see Section 5.1), in which bidders' supply curve is not fully disclosed. Pay-as-bid schemes, in contrast, are more straightforward to implement from the auctioneer's standpoint and can be more easily defended politically.

A summary comparison of the different winner remuneration options is presented in Table 5.11.

Table 5.11: Summary comparison of winner remuneration options

Options / Criteria	Pay-as-bid pricing	Marginal pricing	Nonstandard pricing
Price signals for performance	Efficient generators capable of bidding low receive less than less-efficient ones	Cheaper suppliers receive surplus remuneration	Depends on the scheme's design
Better appearance of low price achievement ("political" benefit)	No generator receives more than their requested price	Possible perception that consumers are overpaying for renewables	Possible impression of opacity or unfairness in the long run
Collusion and price manipulation	Bidders have an incentive to submit similar offers	The marginal bid has the power to define all winners' remuneration	Depends on the scheme's design
Transaction costs	Optimal bid strategy depends on competitors' bids	Optimal bid strategy involves revealing actual costs	Nonstandard design requires building a new bid strategy

Characteristics of the relevant attribute: *Poor* *Medium* *Very good*

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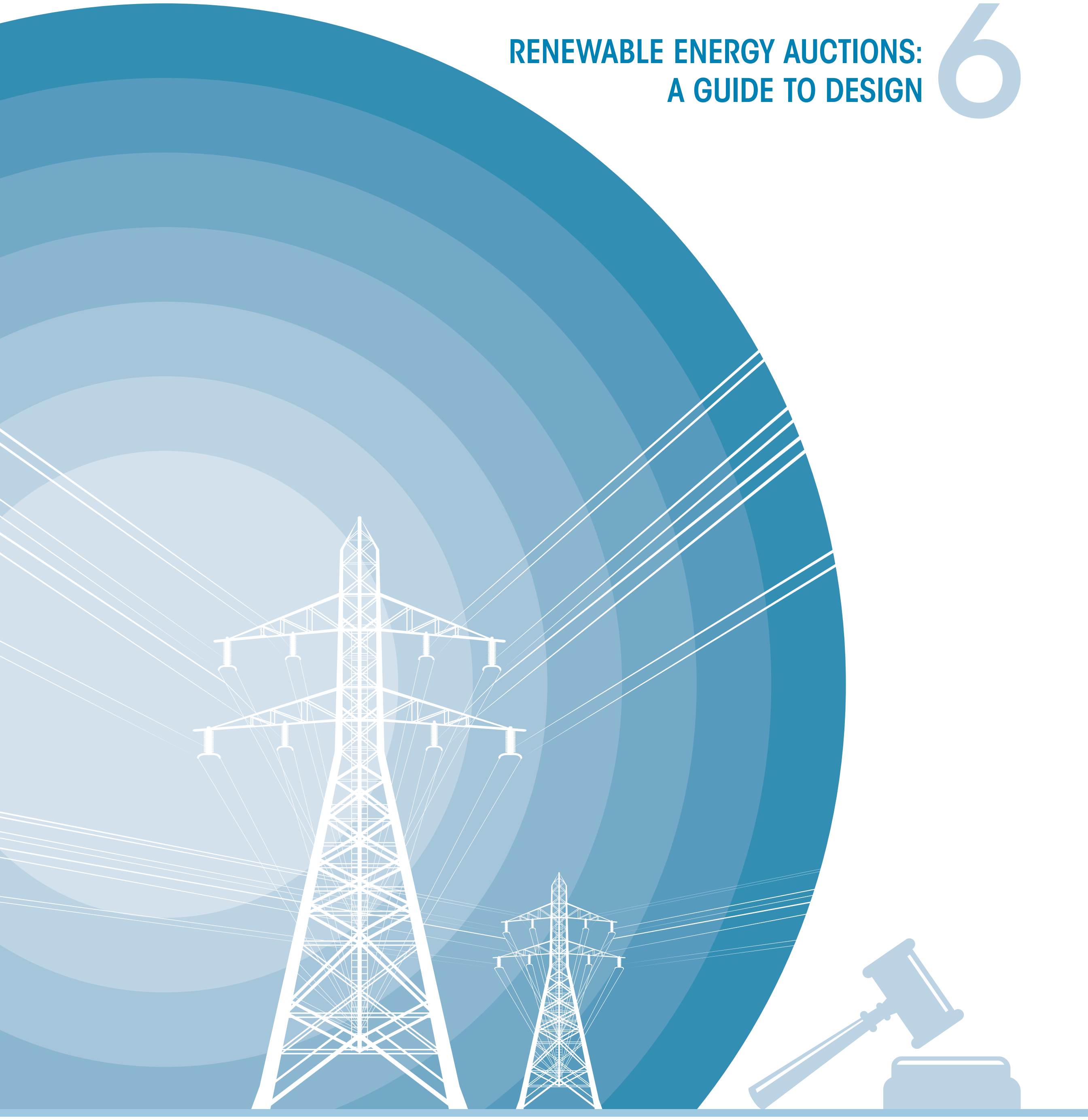

AUCTION DESIGN: SELLERS' LIABILITIES

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6 Auction design: Sellers' liabilities

The sellers' liabilities are chiefly associated with the characteristics of the product being auctioned, and they encompass responsibilities and obligations spelled out in the auction documents. This class of design elements involves: 1) the *commitment to contract signing*; 2) the *contract schedule*; 3) the *remuneration profile and financial risks*; 4) the *nature of the quantity liabilities*; 5) the *settlement rules and underperformance penalties*; and 6) the *penalties for delay and underbuilding*. Figure 6.1 summarises these design elements, which are further developed in the chapter.

Figure 6.1: Overview of the considerations related to sellers' liabilities

Commitment contract signing	**Settlement rules and underperformance penalties**
The choice of requiring bid bonds or not	Critical obligations with an effect on the plant's remuneration, addressed as:
Contract schedule	
» Lead time - lag for plant construction » Contract duration - commitment length » Post - contract provisions - plant's ownership at the contract's end	» Temporal aggregation clauses » Over-and underperformance penalties » Revisions of contracted quantity
Remuneration and financial risks	**Delay and underbulding penalties**
Aims to avoid financial risks (usually inflation) that might affect the remuneration: » Straightforward escalation » Hybrid contract indexation » Variable remuneration profile	Critical rules for a high implimentation rate of the awarded projects: » Completion bon » Delay specific penalties » Contract resolution clauses
Nature of quantity liabilities	**Liabilities for transmission delays**
Defines the nature of commitment assumed by the project developer, which is directly related to the allocation if risk: capacity-, energy- or financial oriented agreements	The liabilities can be assigned to the project developer or to another agent (TSO, the central planning agency, *etc.*)

6.1 COMMITMENT TO CONTRACT SIGNING

A common concern of auctioning processes is to what extent the project developer's bid is a binding commitment, since most liabilities are enforced by the power purchase agreement, signed only after the auction is complete and the winners are announced. Renewable energy auctions involve either 1) *no specific commitments* at the bidding round or 2) *bid bonds*, requiring bidders to provide an initial deposit that would be lost in case the selected bidder withdraws the offer.

No specific commitments

Adopting no specific commitments typically relies on developers not withdrawing their offers in the period between the auction and the contract signing. Although this could be the case if this waiting period is short, there are records of bidders backing down on their offers despite these conditions, as has occurred in California (see Box 6.1).

BOX 6.1: BID BOND REQUIREMENTS: THE CASE OF CALIFORNIA

The Renewable Auction Mechanism (RAM) in California contains several provisions to ensure that only competitively priced products will be procured and that the winning projects will be developed. These include strict qualification requirements as well as requirements for development and performance deposits after signing the contract. However, no bid bonds are required for participating in the auction (see Box 4.1).

The large number of projects that passed the first auction stage based on documentation requirements suggests that the majority of bids are based on realistic projections and reasonably well-developed projects. However, the fact that many developers have withdrawn their offers after winning the auction raises questions about whether those bids were speculative. For example, in one of the investor-owned utilities (IOUs), out of the 51 awarded projects during all four bidding rounds, only 35 contracts have been executed, with 16 bidders withdrawing their bid. In another IOU, 4 bids have been withdrawn out of the 17 winning projects.

This suggests that additional features could be incorporated into the RAM to deter this behavior in future auctions. Since there are no bid bonds and the development deposits are required only after signing the contract, developers might revoke their offers after being selected but before signing the contract. The rules could be modified to require developers to post bid bonds, which would be refunded for the rejected bids, as in the case of Germany, Brazil, and Peru (see Box 6.2). Alternatively, a penalty could be imposed directly on developers who withdraw projects after a winning bid.

Source: (Wentz, 2014).

Bid bonds requirement

Requiring bid bonds typically implies a greater certainty that the contracts will be signed. Since the bidders would not get their bond amount back unless they comply with the offer submitted in the auction, they will have an incentive to avoid "adventurous" bidding, a common concern of auction mechanisms.

One potential downside, however, is that issuing bid bonds requires the auctioneer to manage a large number of deposits, especially if the auction attracts a large number of bidders – and it can be argued that the benefits of this approach do not justify the added transaction cost on the auctioneer's side, in a system that can already be complex. Bid bonds also impose some burden on potential bidders, especially on small and/or new players, although this is almost negligible compared to the costs of developing the renewable energy project, and bidders often must fulfil much more constraining requirements to participate in the auction (see Chapter4). Germany implements a mechanism with different bid bond levels, in which a lower bid bond is accepted in case the bidder has already secured the building permit. This arrangement decreases the burdens, facilitating the participation of smaller players. This case is illustrated by Germany as presented in Box 6.2, along with the bid bond requirements in Brazil and Peru.

BOX 6.2: BID BOND REQUIREMENTS: THE CASE OF BRAZIL, GERMANY, AND PERU

Brazil

Bidders are required to deposit a bid bond equal to 1% of the estimated project cost, which must be declared by the investor and approved by the regulator beforehand. This guarantee is returned after the contract is signed if the investor wins the auction; otherwise, it is returned after the auction.

Germany

In Germany's 2015-2017 solar auctions, each bidder must provide a bid bond worth per 4.5 USD/kW (4 EUR/kW[1]) to be installed in order to be considered in the auction. This deposit is reduced to 2.27 USD/kW (2 EUR/kW) if the bidder already has a building permit, as this eases the after-auction work and decreases the auctioneer's risk of not having a signed contract. Lowering the bid bond also can facilitate the participation of smaller players. The regulatory agency, Bundesnetzagentur, sorts the bids starting from the lowest to highest price, and projects are selected until the auction volume has been filled. Bids beyond the auction volume do not receive the right to remuneration for their output and get their bid bond back.

[1] *An exchange rate of 1.13 USD/EUR was used, compatible with the exchange rate in end 2014-early 2015*

Peru

In the 2013 auction, bidders were required to deposit a bid bond for 50 000 USD/MW of capacity installed which is lost if the bid is won and the bidder fails to sign the contract.

Sources: (Bloomberg New Energy Finance, 2015), (IRENA, 2013a), (Ecofys, 2013), (Del Río, Linares, 2014), (Ministry of Energy and Mines, 2013)

Main Findings

Even though there are some auction implementations that do not apply bid bonds, it is likely that most future implementations will converge to introducing this type of commitment. Introducing a bid bond requirement typically involves a small cost (both in terms of mechanism complexity and in terms of the burden imposed on the bidders), and it has the benefit of greatly reducing the likelihood that contracts will fail to be signed after the auction. Bid bonds are particularly useful when bureaucratic procedures may result in a long waiting period between the awarding of contracts via the auction and the signing of those contracts.

A summary comparison of the different commitments related to contract signing is presented in Table 6.1.

Table 6.1: Summary comparison of contract signing options

Criteria / Options	No specific commitments	Bid bonds requirements
Avoided undercontracting	Riskier	Much safer, although it does not totally guarantee the bidders' project completion
Simplicity	Very simple	Slightly higher transaction costs
Participation of bidders	No constraints	Very slight additional burden imposed on bidders

Characteristics of the relevant attribute: Poor — Medium — Very good

6.2 CONTRACT SCHEDULE

It is important that the auctioned product clearly determines a schedule for the project developer as well as associated liabilities. The most important elements to consider are: 1) the *lead time*, which involves the time granted for the construction of the project; 2) the *contract duration*, reflecting the length of the commitment implied by the auctioned product; and 3) *post-contract provisions*, which typically are associated with plant ownership after the contract's end date. In general, the contract schedule can vary significantly, and various different combinations can result in a successful auction implementation.

Lead time

The lead time is a key attribute of renewable energy auctions that ensures project developers will have enough time to complete the power plants before the contract begins. However, excessively generous lead times might attract some speculative bidders – for example, those who plan to delay the beginning of construction in anticipation of reductions in development costs. Even though construction times are relatively well-known for each type of renewable energy power plant, substantial administrative requirements that must be met after the auction might take significantly more time (see Section 4.3 for site-specific documentation and Section 6.1 for bureaucracy involving signing the contract). Therefore, it may be prudent to devise a schedule that adequately considers these requirements.

Several auction design alternatives seek to offer more flexibility to the auction winner with respect to lead time. For example, the lead time may begin at the point of contract signing, rather than at the point that the auction is held (see Section 6.2). This can be an attractive provision when there is a risk that the contract signing process will be lengthy and will compromise the construction schedule. It is also possible to let bidders suggest their desired lead time, taking this variable into account in the winner selection process (see Section 5.3). Yet another possibility is to include provisions to anticipate the contract's starting date in case the plant is completed earlier than anticipated. Many of these possibilities offer incentives for generators to start operations as soon as possible, and they can be effective additions to the auction design.

Contract duration

Contract duration varies greatly among renewable energy auctions, although a common strategy is to calibrate the duration so it is close to the plant's likely useful life. In this case, the project developer can avoid the burden of estimating the plant's residual value once the contract terminates – which would otherwise be an important component of the developer's remuneration – and considerations on post-contract provisions (see below) become less important.

In addition, to ensure the new projects' bankability, the contract duration should be compatible with the duration of the typical financing maturity given by banks. Latin American countries, such as Brazil and Peru, follow this rule when setting the contract duration. In Uruguay, the contract length is proposed by bidders and included in the bidding documents, and should be between 10 and 20 years. To minimise the risks and to increase the projects' bankability, all submitted proposals asked for a 20-year PPA.

Moreover, the contract duration can be selected in a way that reduces risks associated with inflation. For example, in Brazil, the contracts are indexed to inflation to ease financing and reduce risks for developers (see Box 5.5), while the Indian state of Uttar Pradesh attempted to shorten the contract's length in order to mitigate inflation risks to investors (see Box 6.3).

BOX 6.3: MITIGATING INFLATION RISKS THROUGH CONTRACT DURATIONS: THE CASE OF INDIA

In its decentralised auction, the Indian state of Uttar Pradesh adopted an interesting design to raise project developers' interest in a contract that was not indexed to price inflation. The state lowered the contract duration from the default 25 years to 10 years, after which project developers would be able to sell the electricity at market prices.

Project developers could find this policy very attractive if electricity market prices are expected to escalate approximately according to inflation over the years – offering the possibility of raising long-term revenues. After a decade, the contract remuneration would have lost a major portion of its value, and this trend would have continued until the end of the 25-year contract. Thus, terminating the agreement early could be beneficial for the investor.

At the same time, the bankability of the project can still be ensured as long as the PPA covers the period of loan repayment – even if a 10-year contract does not offer the same income security as a 25-year contract – as it is most critical to lenders and investors that the project has a stable revenue stream. Seeing that most financing agreements tend to have a duration of only around 10 years, this condition would be met by the Uttar Pradesh auction design.

In practice, however, Uttar Pradesh's 10-year PPA was perceived mostly negatively by bidders, as the increased uncertainty in remuneration after the PPA ends was seen as a major downside. This perception, coupled with the difficult financial situation of the state's distribution company, resulted in an insufficient number of bids to cover the auction demand entirely. The lower competition led to higher prices compared to other Indian states which were organising renewable energy auctions in the same period (see Box 5.13).

Sources: (Elizondo-Azuela, Barroso et al., 2014), (Pillai, Banerjee, 2009).

Post-contract provisions

Post-contract provisions are associated with the way project developers may account in their financial models for any residual revenues from their investment after the contract's termination. This element is especially important if contract durations are short, since a considerable share of the developer's revenue will be associated with electricity market price sales after the contract's end date. In these cases, project developers often maintain ownership of the generation assets after that date. Alternatively, certain auctions involve build-operate-transfer instruments, according to which the assets are fully transferred to the government after the contract's termination – in which case it is important to clearly communicate this aspect from the beginning.

Main Findings

The specific provisions that define the contract schedule can vary substantially from one auction implementation to another, although there tends to be more or less a consensus on the rationale used to determine those parameters. A contract's lead time, for example, is typically defined based on reasonable expectations for (technology-specific) construction time and administrative procedures. If the lead time is shorter than needed, the project developer will have very little room for error, resulting in a higher risk of delays that may be penalised. However, excessively long lead times may lead to some degree of speculation, as the project developer delay purchasing the equipment for several months hoping the cost of technology will fall. A summary comparison of different options for the contract lead time are presented in Table 6.2.

Table 6.2: Summary comparison of contract lead time options

	Lead time	
Criteria \ Options	**Shorter**	**Longer**
Reducing uncertainties to investors	High risk of penalties in case of delays	Comfortably accom-modates construction time
Avoiding risks of delays	Greater risk	More comfortable schedule
Ensuring that projects will be brought to completion	Risk of contract termination in case of exessive delays	Might encourage speculation with equipment prices

Characteristics of the relevant attribute: Poor, Medium, Very good

In addition, provisions that determine the contract's duration and asset ownership once the contract terminates chiefly affect the project developer's cashflow projections – and, by consequence, the bid price during the auction. In general, it is desirable to offer a contract duration that is at least compatible with the maturity of typical financing contracts, seeing that this greatly increases the project's ability to secure bank loans. A summary comparison of different alternatives for the contract schedule are presented in Table 6.3.

Table 6.3: Summary of contract schedule options

Options / Criteria	Contract duration		Post-contract provisions	
	Shorter	Longer	Project developer maintains ownership	Assets transferred to the government
Investors confidence	More volatile revenues after contract ends	Predictable cashflows for the entire useful life of the plant	Requires estimating residual value	Zero value after contract ends if rules are clear
Level of participation	May be an obstacle to financing if too short	Comfortably accommodates maturity period for financing	Standard approach in liberalized markets	No major obstacles if rules are well-defined
Liabilities to the demand side	Short period	Long period	Terminated with the contract	Retained along with plant ownership

Characteristics of the relevant attribute: *Poor* *Medium* *Very good*

6.3 REMUNERATION PROFILE AND FINANCIAL RISKS

In principle, the type of auctioned product (installed capacity or energy produced) plays an important role in stabilising the project developer's remuneration throughout the contract's duration. However, even if a winning project is developed and produces electricity exactly as declared in the bid (performance-related liabilities are addressed in Sections 6.4 and 6.5), its contract remuneration might vary over time, and it may be subject to certain financial risks. There are two main types of financial risks that a project developer faces throughout the contract duration: risks associated with currency exchange rate and those associated with inflation. Both of these risks' implications and the ways to mitigate them are discussed in this section. In this sense, auctioned contracts can be categorised as follows: 1) *straightforward escalation*, which is the simplest alternative, as it typically only involves one reference index; 2) *hybrid contract indexation*, which involves more-complex escalation provisions with additional modifiers and conditions; and 3) a *variable remuneration profile*, which refers to contracts in which the project developer's remuneration profile shifts during the contract duration.

Straightforward escalation

Straightforward escalation clauses are used to minimise the contract's complexity, but they still allow for a wide range of implementations for reducing the financial risk of project developers. For example, in Chile, the auctioned contracts are denominated in US dollars and adjusted periodically according to the US Consumer Price Index (CPI), which implies that developers are shielded from both interest rate risks and inflation risks. A similar scheme is being considered in India (see Box 6.5), where so far the contracts offered have been nominated in Indian rupees, with no adjustment for inflation. An intermediate example is Brazil, where contracts are nominated in Brazilian reals but adjusted yearly for domestic price inflation. These three examples of straightforward escalation methods differ in the risk allocation between the consumer and the project developer (see Box 6.4). Other alternatives, such as promoting escalation of the contract price at a flat annual rate, are also possible. No escalation, as in the case of India, represents straightforward escalation at a flat annual rate equal to zero.

Although all of the above alternatives are viable, it generally is preferable to shield project developers from financial risks if they are likely to price those risks very highly. For example, nominating a price in foreign currency could be a suitable option if the national currency is not very strong. Furthermore, different escalation clauses may favour foreign investors over domestic ones or vice versa – another topic that should be assessed by policy makers.

To protect developers from the currency exchange risk, the Indian government is considering offering dollar-nominated contracts. However, the lower, but still existing dollar inflation risk will not be hedged against. The plan aims to take advantage of hedging over the long-term dollar-rupee exchange rate outlook, as explained in Box 6.5.

BOX 6.4: MITIGATING INFLATION RISKS THROUGH INDEXATION: THE CASE OF BRAZIL AND INDIA

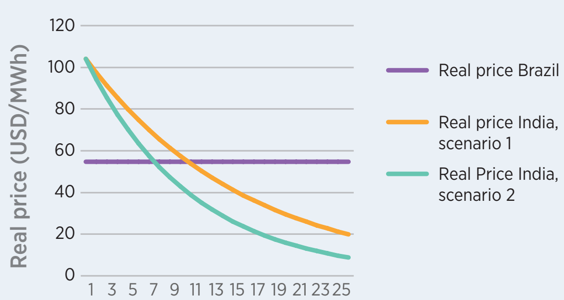
A key component in designing a contract's remuneration profile is the risk allocation between consumers and producers. One important aspect is inflation, which is even more critical in emerging and developing economies as it can run at high rates. In the absence of long-term hedging markets, project developers' revenues could become insufficient to cover investment costs.

To shield developers from such a risk, contracts are often indexed to inflation, meaning that the contract remuneration will escalate in nominal terms. Brazil, Peru and South Africa are examples of countries where such indexing occurs. In contrast, when contracts are not escalated, developers must price this risk when submitting a bid to the auction, being aware that the contract will likely lose value over time in real terms. In India, where most contracts offered in national and state auctions are not indexed to inflation, several mechanisms have been devised to mitigate the impact of the high hedging costs, such as shortening the duration of the auctioned contracts (see Box 6.3) and offering a large portion of the remuneration upfront (see Box 6.6).

Figure 6.2 shows the difference between the remuneration profiles of solar PPAs in India and Brazil, two developing countries with relatively high inflation. The International Monetary Fund's (IMF's) forecasts from October 2014 suggest an average consumer price inflation of 5.1% annually for Brazil and 6.5% annually for India during 2014-2019. Using the prices of recent auctions in both countries[1] (54.7 USD/MWh in Brazil and 104.0 USD/MWh in India[2]), the evolution of the real price over 25 years (contract length) is analysed. Since Brazilian tariffs are indexed to inflation, they will have the same real value during the length of the contract, while the Indian tariffs will lose value over time, subject to inflation.

Two scenarios of inflation have been analysed in India, to show how investors' risk-aversion and hedging against the most extreme downside scenarios may affect perceptions of the value of the contract. Scenario 1 reflects a constant inflation of 6.5% per year (as per the IMF's forecasts), whereas Scenario 2 reflects a scenario in which inflation was 9.5% per year (average of the past five years).

Figure 6.2: Inflation-indexed contracts: The case of Brazil and India[3]



[1] The auctions surveyed were Brazil's solar auction of September 2014 and the auctions in the Indian states of Andhra Pradesh and Rajasthan in February 2013.

[2] Brazilian price: BRL 142.3/MWh, exchange rate: BRL 2.6/USD. Indian price: INR 6.45/kWh, exchange rate: INR 62/USD.

[3] Matters such as the different dates of the auctions were not taken into account for simplification. The figure is an attempt to illustrate the impact of indexation rather than to provide precise quantitative results.

Source: (Elizondo-Azuela, Barroso et al., 2014).

BOX 6.5: MITIGATING CURRENCY EXCHANGE RISKS: THE CASE OF INDIA

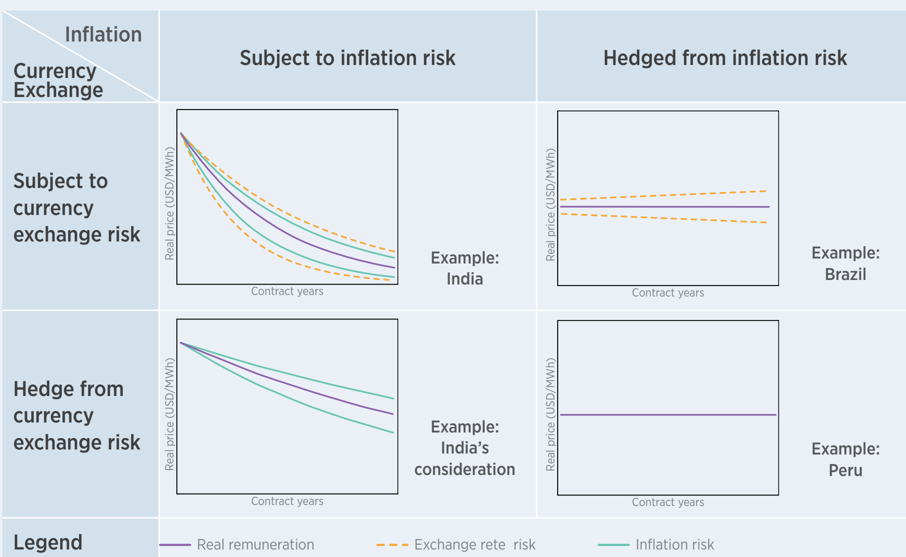
Currently, the renewable energy contracts offered in India's solar auctions are denominated in Indian rupees and are not indexed to inflation, resulting in a high hedging cost of around 6.5%. To reduce these costs and to help developers access international capital, the government is considering offering PPAs denominated in US dollar terms. Under this arrangement, developers would quote their bids in dollars while tying up solar power for 25-year contracts, but consumers are charged in rupees. A hedging cost of 1.5 US cents would then be added to the tariff, which would be pooled in an account used to cover depreciation in the value of the rupee – effectively transferring risks from the investor to the consumer.

The underlying idea is that pooling the hedging costs and putting the government's weight behind it will greatly reduce the cost of currency hedging on the market. This would reduce the cost of capital and thereby the cost of solar power, making it more attractive. The ministry expects to generate a "hedge fund" of approximately USD 1 billion, which would be enough to cover 3% depreciation in the value of the rupee over the 25-year contract. However, this is not a completely costless endeavor – if the rupee devalues by 5% against the dollar (for example), the pool would be sufficient for 15 years only.

Because expectations for the US dollar inflation are much smaller than the Indian rupee inflation, this mechanism could reduce the nominal solar tariffs approved in the auction by as much as 40%, mainly due to the mechanism described in Box 6.4. Furthermore, it is also likely that the cost of allocating currency risks to the consumer, estimated at INR 0.90/KWh (1.5 USD cents/KWh), may be lower than the hedging costs as perceived by individual project developers.

Figure 6.3 illustrates how different financial risks influence the project's remuneration. As observed, the current contract arrangement in India exposes the developer most, being subject to both inflation and currency exchange risk. In Brazil, the contracts are indexed to inflation, the remaining financial risk being the currency exchange uncertainties (market with the blue lines). Peru presents the most favorable environment for the project developers, as the contracts are both denominated in dollar and indexed to inflation.

Figure 6.3: Evolution of real remuneration subject to different financial risks



Source: (Elizondo-Azuela, Barroso et al., 2014).

Hybrid contract indexation

Hybrid contract indexation schemes are modified versions of the straightforward escalation schemes, with typically more than one index taken into account. One way to implement hybrid indexation is to "split" the auctioned price into two portions for subsequent years: the first portion would be escalated according to one index, and the second period according to another index. This type of scheme has been adopted in certain French renewable energy contracts, where total remuneration is split into three proportional parts, with the first portion being escalated according to the producer price index (a proxy for operational costs), the second portion according to the cost of labour (a proxy for expenses with personnel), and the remainder not escalated and remaining constant in nominal terms (a proxy for capital remunerations).

An alternative version of hybrid indexation schemes involves a cap on the adjustment according to indexation. In Brazil, a solar power auction in the state of Pernambuco offered a contract with this type of provision: the project developer's remuneration would be escalated according to the consumer price index, unless the adjustment of the electricity tariff for industrial consumers is lower than this limit. Provisions that cap yearly adjustments to a certain fixed value (such as 5%) are also not uncommon.

Variable remuneration profile

Due to the flexibility in designing auctions, long-term contracts do not necessarily involve a stable level for the yearly payments. Variable remuneration profiles are associated with predictable, sharp changes in the project developer's remuneration profile at some time during the contract. This type of arrangement is often used as a mechanism to offer greater revenues to the project developers during the first years, which are most important for financing (this is the case in China, as explained in Box 6.6) – although it typically implies additional complexity that must be factored in by potential suppliers. There might be other circumstances in which variable remuneration profiles can be a defensible strategy: in some cases, for example, a disbursement schedule concentrated in the first few years of the contract may be beneficial to the demand side as well. This has been the case of India's Viability Gap Funding mechanism (see Box 6.6) – in which there was a desire to reduce the long-term effect on tariffs by using a government fund.

Main Findings

IIn theory, as long as there is an efficient financial market that allows project developers and consumers to hedge against risks and smoothen their remuneration profile over time according to their needs, the remuneration profile featured in the contract should not be crucial for the auction outcome. In practice, however, it can be costly for the project developer to procure these financial products – which

BOX 6.6: VARIABLE REMUNERATION PROFILES: THE CASE OF CHINA AND INDIA

China and India have adopted variable remuneration for PPAs, with China's remuneration based on the energy delivered and India's on upfront subsidy payment which reduces the contract's fixed price.

China

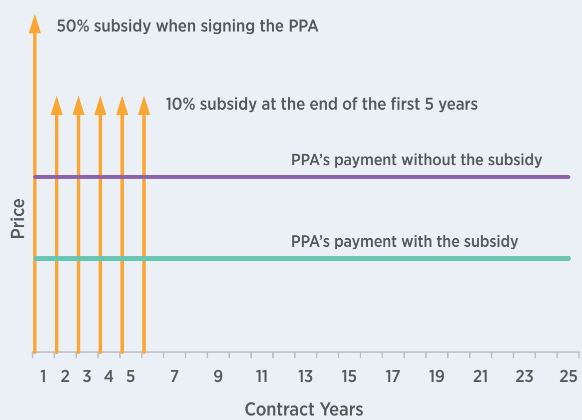
China, meanwhile, implemented a variable remuneration profile based on the energy delivered. The PPAs are signed for a period of 25 years, during which the project developers receive the tariff resulting from the auction only for the first 30 000 full load hours. For the remainder of the contract, the remuneration decreases, converging to the average market price.

This payment scheme aims to avoid over-compensation and to provide a greater safety net to investors during the period of loan repayment. It guarantees a higher income in the first years (usually 30 000 full hour loads are covered in around 10 years), which matches the approximate period of loan repayment, ensuring the project's bankability and easing financing.

India

Phase II of India's National Solar Mission (NSM) auctions introduced a very specific variable remuneration profile called Viability Gap Funding (VGF). In this scheme, the remuneration of the winning bid involves a subsidy that reduces the upfront capital cost, with 50% of the funding received when signing the PPA and the other 50% split equally over the first five years of the PPA (10% at the end of each year) (Figure 6.4). The long-term revenue for plants participating in these auctions would be ensured by a 25-year PPA, but with a considerably lower price than in a case where no subsidy is given.

Figure 6.4: Comparison of the remuneration under VGF mechanism and regular PPA



Sources: (Elizondo-Azuela, Barroso et al., 2014).

often leads to allocating most of the risk to the consumer. Shielding investors from risks related to inflation and exchange rate by means of a straightforward escalation implementation can reduce the cost of financing the project and decrease the price resulting from the auction. However, these arrangements also imply increased risk for the consumers. There are examples of successful auctioning schemes in which the developers assume some financial risks partially or fully.

Regardless of whether risk is mostly allocated to developers or to consumers, straightforward escalation clauses remain the most common choice of implementation for renewable energy auctions. Nonetheless, innovative variations to the contract profile have emerged in several jurisdictions which seek to offer a contract that is better tailored to the investors' needs at minimal cost to the consumer. In the case of hybrid indexation alternatives, for example, more specific price indices are used, rather than general inflation indices, to estimate generators' cost structure. Similarly, a variable remuneration profile can cater to the fact that investors' cashflow is most strained in the debt repayment period.

A summary comparison of the different alternatives for remuneration and addressing financial risk is presented in Table 6.4

Table 6.4: Summary comparison of remuneration and financial risk mitigation options

Options / Criteria	Straightforward escalation: generator absorbs most risks	Straightforward escalation: consumer absorbs most risks	Hybrid contract indexation	Variable remuneration profile
Simplicity	Straight-forward	Requires escala-tion clauses	High com-plexity indexa-tion	Requires rulings to adjust profile
Reduced uncertainties to investors	Investors must seek hedging products	Hedge against infla-tion and currency risk	If well designed, cost-fol-lowing	Possibly better guaran-tees to financiers
Liabilities to the demand side	Little risk left to consum-ers	Con-sumer can dilute risks in its portfolio	Con-sumer can dilute risks in its portfolio	Liabilities reduced after first few years

Characteristics of the relevant attribute: *Poor* *Medium* *Very good*

6.4 NATURE OF THE QUANTITY LIABILITIES

Another important aspect of auction design is deciding how the seller's obligation to deliver renewable energy is determined in the auctioned product. This involves selecting one category of indicators to represent whether project developers have fulfilled their commitment. There are essentially three alternatives regarding the nature of the liabilities imposed on the supplier, which are directly related to the risk allocation on the demand side: 1) *capacity-oriented agreements*, which imply a commitment to maintain and operate renewable energy capacity (and no more); 2) *energy-oriented agreements*, which represent a physical commitment to deliver a given amount of renewable energy in an FIT-like arrangement; and 3) *financial agreements*, which impose greater responsibility on the developer, since the generator may be exposed to fluctuations in the electricity spot price.

Capacity-oriented agreements

Capacity-oriented agreements represent the least amount of commitment on the project developer's side, since they are completely independent from the plant's actual output. To introduce some degree of price signaling in this type of scheme, suppliers may be required to ensure that generation facilities meet minimum availability standards (*i.e.*, number of operational hours per year, excluding failures and maintenance stops), and penalised in case these thresholds are not met.

Under this type of mechanism, project developers are perfectly hedged from energy-oriented risks, so this can be a way of reducing the price of the auctioned contract. In addition, this approach may attract a larger number of bidders, especially small and/or new players who otherwise would not be able to easily absorb the underlying risks.

Capacity-oriented agreements are adopted mostly when the resource availability is unpredictable. This type of contract does not offer incentives for the bidder to choose high-performing sites, and therefore it tends to be most suitable when the government is responsible for selecting possible locations (see Section 4.3). In this case, however, and even in project-specific auctions, a different liabilities scheme can be adopted, mostly to shield the consumers from potential downsides in case the government's initial site assessments were somehow miscalibrated – because, in these types of arrangements, the consumer takes on the production risk.

Still, the main disadvantage of capacity-oriented arrangements remains the risk that the project developer abandons the project after the contractual agreements are met, namely the capacity is installed, therefore not delivering the energy. The early experience in California with wind projects is a good reference. Starting in early 1980s, wind energy investment grew substantially, leading to a total installed capacity of about 1 880 MW by 1990, as a result of tax incentives and capacity-oriented contracts. Shortly after 1990, the development slowed greatly and many projects ceased operation, resulting in the need to introduce production incentives (energy-oriented agreements) for new and existing projects.

Energy-oriented agreements

Energy-oriented agreements imply a higher level of responsibility on the part of suppliers, as they commit to providing a certain quantity of electricity generation throughout the contract's duration. This type of agreements encompasses typically the main characteristics of renewable energy support schemes. In energy-oriented agreements, any positive or negative deviations from the agreed quantity are always settled within the scope of the contract itself, and in this sense, the agreements often resemble FIT mechanisms. Remuneration is proportional to the total electricity generated, regardless of the time of delivery. In Brazil, for instance, the performance assessment is carried out for the yearly average generation and for the cumulative four-year generation (see Box 6.8).

In an energy-oriented agreement, the consumer implicitly assumes all risks associated with the "value" of electricity at the time when the renewable power is delivered (which is measured by the electricity spot price): for the purpose of verifying the generator's compliance with its contractual commitment, energy delivered during the night is as valuable as energy delivered during peak hours. On the other hand, the generator still assumes some responsibility, seeing that if the plant systematically underperforms or overperforms on average the project developer's remuneration will be affected. In addition, energy-oriented agreements have the benefit of familiarity, as they closely relate to FIT agreements. For those reasons, energy-based quantity liabilities tend to be among the most common implementations in renewable energy auctions and have been adopted, for example, in China, India, Italy and the Netherlands.

Financial agreements

Whereas in capacity-oriented agreements the project developers commit just to installing the renewable energy capacity, and in energy-oriented contracts they commit to delivering a certain amount of electricity during the contract's duration, financial agreements more closely resemble "standard" forward contracts, committing to a certain generation profile. In this type of agreement, any deviations between actual plant generation and the quantity committed in the contract must be settled at the electricity spot price in real time. Therefore, the contract profile, which defines the generation profile of the plant during the contract period, is an important element, as the commitment to deliver electricity is verified at each point in time.

In liberalised electricity markets, the electricity spot price is used to settle any deviations between the electricity generated and contractual commitments. This implies that, in capacity- or energy-oriented agreements, the consumer implicitly assumes the underlying price-quantity risks on the generator's behalf.

With financial agreements, in contrast, the generator assumes the responsibilities associated with the quantity committed in the auction. Whenever the generator delivers more than the contracted quantity, it will receive a surplus remuneration based on the spot price; and similarly whenever it generates less than the contracted quantity it must pay the spot price for this difference. One argument for allocating risk in this manner is that the generator might have some influence on the plant's ability to provide electricity (for example, by concentrating maintenance hours in low-priced periods, or by slightly adjusting technical specifications to prioritise generation during peak hours), whereas the consumer has no influence on the matter. Even though the increased risk allocated to the supplier is likely to translate into a slight price increase in the auctioned product, there are circumstances in which this implementation may be preferable – especially if there is a robust financial market for energy derivatives in which the renewable energy developer may adjust its contract position according to its own risk preferences.

Main Findings

The choice of quantity liabilities are associated with the desired risk allocation between generators and consumers. On the one hand, allocating most of the risk to the generator (as it is the case with liabilities based on financial agreements) may lead to cost increases, as the project developer must procure financial products to hedge against price-quantity risks associated with the inherently stochastic availability of the renewable energy resource. On the other hand, allocating too much risk to the consumer (as it is the case with capacity-oriented agreements) may lead to perverse incentives, particularly during the site selection and project design phase – when project developers' choices can directly affect the plant's future performance. One compromise between these two extremes adopted in several renewable energy auctions is the energy-oriented quantity liability, in which both generators and consumers assume some degree of risk. Financial agreements may also be an alternative in certain mature and liberalised electricity markets. Capacity-oriented implementations tend to be much rarer, as the risk of perverse incentives means that the applicability of these schemes is very limited.

A summary comparison of the different options for assigning quantity liabilities is presented in Table 6.5.

[1] One example is the possibility of adjusting the azimuth angle of solar panels, in order to prioritise generation during late afternoon hours (system peak), which could be attractive for the developer, depending on the spot price signals.

Table 6.5: Summary comparison of quantity liability options

Criteria / Alternatives	Capacity-oriented agreements	Energy-oriented agreements	Financial agreements
Reducing uncertainties to investors	After installing the agreed capacity, no other risks	Both generators and consumers assume some risk	Involves real-time settlements in the electricity spot market
Liabilities to the demand side	Consumers are burdened with all production risks	Downside risk if the plant generates mostly in off-peak hours	Production risks are transferred to the generator
Price signals for performance	Limited to penalties for unavailability	Incentives to maximise delivered quantity	Incorporates the implicit "value" of electricity

Characteristics of the relevant attribute: *Poor* *Medium* *Very good*

6.5 SETTLEMENT RULES AND UNDERPERFORMANCE PENALTIES

As discussed in Section 6.4, the nature of the commitment assumed by the project developer can take many different forms. In general, deviating from the contractual obligations will have an effect on the plant's remuneration, representing a departure from the "baseline" remuneration profile discussed in Section 6.3. Regarding these settlement rules, the following attributes can be addressed: 1) *temporal aggregation* clauses to assess over- or underperformance; 2) *over and underperformance provisions*, representing how the contract remuneration varies when the power plant delivers more or less than originally declared; and 3) *revising the contracted quantity*, referring to specific provisions that allow for the reduction of the commitment at the time of the auction.

Settlement rules are an important element of auction design primarily due to concerns about perverse incentives, which may lead developers to be rewarded for systematically over or underestimating their generation expectations. For example, in case of financial agreements, a project developer with a trading mindset may consider buying the electricity on the spot market instead of producing it, if the contract price is higher than the spot prices. In a sense, implementing more-sophisticated settlement rules is a way of adjusting price signals, attempting to ensure that the project developer's declarations of expected renewable energy generation are realistic and that the remuneration is in line with it.

Temporal aggregation

Temporal aggregation relates to how often the power plant's performance is assessed in order to determine whether its remuneration must be revised. Because renewable generation, especially wind and solar, is stochastic in nature, there is always a chance that the generator may be "unfairly" classified as over or underperforming, simply due to random fluctuations. Longer aggregation periods imply that this type of event is less likely. However, they may increase the difficulty in identifying projects whose performance is indeed misestimated.

Yearly aggregations are the shortest possible time frame that allows seasonal aspects to be eliminated, and they are often used for temporal aggregation schemes. In certain implementations, however, one year is not considered long enough to accurately assess the long-term behavior of a plant, leaving the generator vulnerable to exceptional events (see Box 6.7). For example, in the first few months of the plant's operation, substantial variations in the plant's performance can occur. This may justify longer periods for temporal aggregation, such as the four-year settlements carried out in Brazil for wind power plants.

Over and underperformance provisions

Over and underperformance provisions aim to reduce deviations in the quantity of energy delivered from the amount specified in the contract and they represent an incentive for accurate estimation of this quantity. As such, these provisions need to ensure that the suppliers' remuneration per energy unit is highest when the generation is in line with expectations. To that end, remuneration must fall more than proportionally when generation falls, and rise less than proportionally when generation rises. This type of mechanism is straightforward in the case of energy-oriented contracting (see Section 6.4). In capacity-oriented and financial agreements, underperformance provisions are usually implemented based on a revision of the contracted quantity instead (see below). California and Brazil are examples of jurisdictions that implemented specific provisions to address generators' performance (see Box 6.7).

Revising the contracted quantity

Revising the contracted quantity is a way to adjust the project developer's remuneration according to the actual performance of the power plant. In its most straightforward form, this involves adjusting future expectations (along with remuneration) at the end of each "cycle" (representing the reference period for the temporal aggregation). However, it also is possible to institute "tolerance bands", so that a revision of the contracted quantity is triggered when the deviation between actual and expected generation surpasses a given threshold. In capacity-oriented agreements (in which reducing the "contracted quantity" translates into a direct reduction in remuneration) and financial agreements (in which the project developer could adopt the trading strategy described earlier), generators typically are penalised from having their contracted quantity reduced.

BOX 6.7: PERFORMANCE PENALTIES: THE CASE OF BRAZIL AND CALIFORNIA

Brazil: Underperformance penalties and over-performance compensations

In Brazil, the penalties for over- and underproduction vary depending on the renewable energy technology and the type of auction. For new energy auctions, penalties for underproduction are calculated annually and in a cumulative manner every four years:

- Annual underperformance penalties are applied when the average annual generation is less than 90% of the contracted amount. In this case, the developer must pay either: 1) the product of the average spot price in that respective year and the quantity not delivered; or 2) the product of the contract price and the quantity not delivered, whichever is higher.
- Given the variability of some technologies, a cumulative four-year performance assessment takes place. If the average four-year generation falls below the amount contracted, the developer must pay either: 1) the product of the average spot price of the four years and quantity not delivered; or 2) 1.06 times the contract price times the quantity not delivered, whichever is higher. The additional 6% over the contract price is a penalty for not delivering the contracted energy over the four years.

Upper limits are also established, so that any excess generation can be sold at the spot price. In the case of wind generation, the limit for the first, second, third and fourth year is set at 130%, 120%, 110% and 100% respectively, after which the cycle is repeated.

For reserve energy[1], the same bands for energy to be delivered are established, but the penalties for under-delivery and compensations for over-performance are not related to the spot price. In the case of the 2014 solar reserve auctions, the band was set between 90% and 115% of the contracted generation. If the tolerance upper bound is surpassed, surplus energy is purchased at a 30% discount on the contract price and the surplus is accumulated for accounting in the following year. If annual production is below 90% of the quantity contracted, the project developer is penalised, having to buy the difference at a 6% premium over the contract price, in addition to making up the deficit in the following year. The underlying logic is to take advantage of the large storage capacity of hydropower. By allowing a cumulative verification of the production obligations over a four-year period, the hydro reservoirs are being used to leverage the penetration of renewables.

California: Performance deposits

In the RAM auction programme in California, developers must commit a performance deposit after the completion of the project, which is held by the utility through the lifetime of the contract. Through this deposit, utilities require projects to: 1) ensure consistency with the generation profile described in the contract; 2) hold liability insurance against utility losses; and 3) deliver a minimum level of renewable electricity in any given two-year period. For projects 5 MW or less, the performance deposit is equal to the development deposit, and the funds are simply rolled over. Larger projects require 5% of the expected total project revenue as a performance deposit. In general, the requirements for development and performance deposits are designed to reduce risk to utilities, and hence consumers, from uncertainty surrounding distributed projects.

[1] Unlike regular auctions, which cover the distribution companies' demand, the reserve auctions are meant to ensure a security of supply margin in the system. However, in practice, they have been used as a renewable energy support mechanism.

Sources: (Cunha, Barroso, Bezerra, 2014), (Wentz, 2014).

In energy-based agreements, revising the contracted quantity aims to benefit suppliers rather than penalise them. In the classic version of this agreement, the developers' remuneration is proportional to the delivered electricity (implying that there is no need for a contracted quantity), and in the presence of harsh over- and underperformance provisions, it is to the project developer's advantage to adjust the contracted quantity so that it is as accurate as possible. Using this characteristic, it is possible to introduce voluntary mechanisms for revising the contracted quantity (rather than automatic revisions), in which the developer may periodically re-declare generation expectations. This can be an interesting provision to collect up-to-date information on renewable energy output expectations from the project developers.

Main Findings

Once the nature of the auction's quantity liability is defined (Section 6.4), another important decision is how to handle deviations between the generators' effective delivery and the commitments signed at the time of the auction. Multiple RE auction implementations introduce specific provisions to penalize project developers for underperformance and reward them for overperformance – and these mechanisms generally imply stronger incentives for correctly estimating a RE plant's long-term expected production. Even though the details of particular settlement rules can differ significantly between jurisdictions, there is a spectrum between very strict implementations (in which the generator tends to be penalized whenever it underperforms) and more forgiving ones (which give the generator the benefit of the doubt).

A summary comparison of the two extremes of this spectrum involving settlement rules and underperformance penalties is presented in Table 6.6.

Table 6.6: Summary comparison of settlement rule options

Alternatives / Criteria	Settlement rules and underperformance provisions in general	
	Strict requirements / penalties	**Loose requirements / penalties**
Reduced uncertainties to investors	○ Generators may be penalised for random, uncontrollable events	◕ Much smaller chance of generators being unfairly penalised
Liabilities to the demand side	● Generators assume a larger share of the risks	◔ Demand must accommodate the flexibility granted to the project developer
Avoided undercontracting	◕ More likely to quickly correct any errors in the plant's expected production	○ May induce generators to overestimate their plant contributions on purpose

Characteristics of the relevant attribute: ○ *Poor* ◔ ◑ *Medium* ◕ ● *Very good*

6.6 DELAY AND UNDERBUILDING PENALTIES

Ensuring that renewable energy plants are built according to the contractual schedule is a legitimate concern of policy makers. The occurrence of delays in implementing the capacity contracted in early (and even more recent) auctions – many of them reportedly associated with underbidding – has resulted in particular attention being given to mechanisms aimed at avoiding implementation delays. These mechanisms include: 1) *completion bonds*, 2) *delay-specific penalties*, and 4) *contract resolution clauses*.

Completion bonds

A completion bond is a security required from the winner of an auction in case there are delays in project implementation. These bonds can range from security deposits to actual bonds issued by a guarantor (bank, insurance company). When actual bonds are employed, a good practice is to require that the underlying (bond) contract reproduces the clauses of the contract awarded as a result of the auction, in order to avoid lengthy interactions with the guarantor that may result in significant time lags for receiving the payment. Constraints on which banks or insurance companies are accepted as guarantors also may be adopted.

Completion bonds are commonly used because of their straightforwardness. The monetary amount of the bond (defined as a bulk sum, a percentage of the contract remuneration, *etc.*) is generally calibrated to provide sufficient disincentives for delays, while avoiding excessively high levels that might represent barriers to entry for some players. For instance, they help to avoid situations where the premium charged by the guarantor company deters the participation of prudent bidders, as in the case of Germany (see Box 6.8).

BOX 6.8: COMPLETION BOND REQUIREMENTS: THE CASE OF GERMANY

In Germany's auctions during 2015-2017, the projects awarded have to pay a completion bond to the regulatory agency, Bundesnetzagentur, within 10 working days after having won in the auction. The bond is worth 57 USD/kW[1], or 28 USD/kW if the building permit is in place. Moreover, the bidders need to complete and commission the project within two years or they will lose their right to remuneration for the electricity produced.

[3] An exchange rate of 1.13 USD/EUR was used, compatible with the exchange rate in end 2014-early 2015

Source: (Bloomberg New Energy Finance, 2015).

Another alternative would be to introduce surety bonds, which involve a third party that protects the electricity buyer against losses resulting from the project developer's failure to meet the obligation. In this case, the auctioning process awards along with the PPA (which hedges risks to the project developer) a surety bond that hedges risks to the electricity buyer, using a financial entity ("guarantor") as intermediary. In this case, the auctioneer has to differentiate the bids of project developers according to independent evaluations by the guarantor. This evaluation can be seen as roughly equivalent to one more step in the screening and qualification process, since guarantors will require different premiums from project developers with different reputations, according to the likelihood of them defaulting on their obligations.

A common practice is to partially execute the completion bond in case of delays related to specified intermediary milestones in the plant's implementation schedule. This makes it possible to closely monitor the evolution of construction and to provide early financial incentives to the auction winner. If surety bonds are employed, it is typical for the guarantor to automatically require reimbursement from the project developer in case of any partial execution of the bond. This procedure of restoring the obligation in case of partial execution can also be used in cases where other types of completion bonds are used, for instance by obliging the developer to restore security deposits. Upon completion of the project, the restored amount is then returned to the project developer – but the financial losses due to its execution will already have happened.

Delay-specific penalties

The choice of how the project developer's contractual obligations are treated (see Section 6.4) during the period of a plant's delay may result in incentives for more-timely implementation. Delay-specific penalties generally involve imposing fines and other monetary penalties applied just in case of delays. They can take different forms, acting as an adaptive mechanism, with increasing penalties as delays are longer, to milder treatments, with the contract end date postponed to preserve the total contract duration, for instance. Delay penalties can also take the form of an underperformance penalty, considering that the plant delivered 100% less energy than stipulated in the contract, as is the case of Brazil (see Box 6.9).

Besides monetary penalties, they also may involve disincentives of a non-monetary nature, such as preclusion from participating in subsequent auctions in the same jurisdiction.

Penalties for delays are normally listed in the contract awarded from the auction, or are clearly registered in regulatory instruments to which the contract makes explicit reference. Aspects related to the amount of the penalties and their application in case of delays with respect to intermediary milestones in the implementation schedule are similar to those presented for completion bonds.

One lesson learned from early auction implementations has been the challenge associated with having unclear provisions with regard to the contract schedule, not having defined delay penalties, and not requesting completion bonds (see Box 6.9 on experiences in the UK and France).

BOX 6.9: DELAY PENALTIES: THE CASE OF FRANCE AND THE UK

France

Due to the lack of strict requirements for auction participation and to the lack of penalties for underbuilding, the rate of projects constructed following the EOLE 2005 auctions was very low (five years after the auctions, only 10% of the generation contracted was actually produced). Therefore, the main difference between the EOLE 2005 and later auctioning programmes in France lies in the introduction of specific and strict requirements for participation as well as sanctions for delays in constructing the plant. The penalties took the form of either a shortening in the length of the contractual period, a suspension of the licence to operate for a period of time or a financial fee.

UK

Because the UK government did not set penalties for non-performance in the NFFO auctions that took place in the 1990s, project developers were not held responsible for not implementing their plans. In addition, because price was the only selection criteria, developers were incentivised to submit very low bids given the high level of competition of the auction, thus decreasing their chances of making a profit. This, combined with the loose qualification requirements for auction participation, resulted in a fairly low share of the contracted capacity being built after the NFFO rounds. Many of the winning projects had great difficulties in getting planning permissions from the local government and were therefore never built.

Sources: (Del Río, Linares, 2014), (Cozzi, 2012), (Wiser, 2002).

More-recent auctions have defined specific penalties against project underbuilding, as was the case in Brazil where bidders have to deposit several guarantees, including bid and completion bonds. Penalties for delays and underbuilding also apply. However, delay penalties (and completion bonds) have not always been effective in reducing delays in project implementation, especially when external factors interfere in the construction process, as shown by the experience in Brazil (see Box 6.10) and Peru (see Box 6.11).

BOX 6.10: DELAY PENALTIES: THE CASE OF BRAZIL

After signing the PPA, project developers in Brazil are required to deposit a completion bond of 5% of the estimated investment cost of the awarded project. Penalties for delays take the form of underperformance penalties, with 100% less delivered energy (see Box 6.8). If the delays exceed one year, ANEEL has the right to terminate the contract and to keep the financial guarantee.

However, no penalty enforcement has been applied so far, as delays have not been the fault of the project developer but were related to delays in obtaining environmental licences or grid expansion. Table 6.7 summarises the situation of delays with wind projects selected in both renewable energy and new energy auctions in 2009 and 2010

Table 6.7: Overview of wind project delays: The case of Brazil (as of September 2014)

Wind auctions	Reserve Energy Auction 2009	Reserve Energy Auction 2010 and Renewable Energy Auction 2010	Reserve Energy Auction 2011 and A-3 2011
Operation start date as stated in the contract	July 2012	September 2013 & January 2013	July 2014 & March 2014
Number of projects	71	70	78
Number of projects in operation	64	13	6
Number of delayed projects	7	57	72
Percentage of delayed projects (of the total)	10%	81%	92%
Number of delayed projects because of the transmission connection (capacity)	0	20 (257 MW)	23 (263 MW)
Percentage of delayed projects because of the transmission connection	0%	35%	32%

Sources: (Danish Energy Agency, 2009), (Ecofys, 2013), (Elizondo-Azuela, Barroso et al., 2014), (Maurer, Barroso, 2011).

Contract resolution clauses

Finally, contract resolution clauses specify that the contract awarded will be terminated in case of delays above a certain threshold. Contract termination is generally a last-resort measure, since it usually results in the project not being built at all – either due to the loss of the financial asset (the contract) upon which the bidder based the financial feasibility of the project, or even due to the loss of the

BOX 6.11: DELAY PENALTIES: THE CASE OF PERU

Peru has used strict delay penalties. After signing the contract, project developers are required to commit to a completion bond of $100 000 per MW of capacity installed, and they must submit a progress report on the project's evolution every three months. If delays in the contracted timeline for construction occur for two consecutive quarters, penalties are deducted from the deposited guarantee.

If there are delays with the start of commercial operation of the plant, the bond is increased by 20% over the outstanding amount from the date of verification. The project developer may request to postpone the date of commercial operation provided that it is within a defined deadline and no longer than three months. If the accumulated delay exceeds one year from the date specified in the bid, the postponing might be accepted, and an increase in the performance bond by 50% takes place. Peru has implemented these stringent delay penalties in response to the urgency of operating projects to meet the country's rapidly growing energy demand and economic development needs.

Yet despite these stringent compliance rules, Peru has had mixed success in getting projects to start operation on time. Out of the 27 projects awarded in the first auction (selected in 2010 and scheduled to start operation in December 2012), only 19 are operating. Of the remaining eight projects, one was cancelled following payment of the completion bond, one suffered a force majeure incident (flood) and the other six have been delayed for different reasons, such as environmental permitting delays and problems in reaching agreements with local communities.

concession or permit to develop the project, in case this is inexorably associated with the contract.

The early identification of situations in which contract resolution is ultimately required is usually desirable. This can enable swift initiation of any arrangements – such as replacement auctions – needed to substitute the renewable energy capacity that corresponds to the terminated contracts and to meet any policy goals that otherwise may not be fulfilled. Conditioning contract termination to severe delays in meeting intermediary milestones in the contractual schedule is a possible mechanism for this early identification. Typically, resolution of the contract does not relieve the parties of any obligations or costs incurred until the date of the early termination (see Box 6.12).

Main findings

Reducing the likelihood of delays depends on the interaction of various design elements (ranging from the definition of contractual lead times to the definition of qualification requirements) as well as of mechanisms that do not necessarily have to

BOX 6.12: DELAY PENALTIES: THE CASE OF DENMARK

The auction was designed to guarantee the installation of 400 MW within 20 months after the winner was announced. Bidders were incentivised to offer the lowest possible price as this was the only selection criteria. As such, strict penalties and non-compliance rules had to be applied to guarantee compliance with the schedule.

Delay time	Penalty
Up to five months	DKK 10 (USD 1.78) per MWh (around 1% reduction of the remuneration)
Between five and nine months	DKK 20 (USD 3.56) per MWh (around 2% reduction of the remuneration)
Up to one year	DKK 30 (USD 5.34) per MWh (around 3% reduction of the remuneration)
More than one year	DKK 400 million (around USD 71 million)

Note: At an exchange rate of 5.6 DKK/USD.

If the winner chooses not to install the plant at all, the following fees apply:

Time to decide	Penalty
Up to five months from winning the contract	DKK 100 million (around USD 17.75 million)
Between six and twelve months	DKK 200 million (around USD 35.5 million)
More than one year	DKK 400 million (around USD 71 million)
More than one year	DKK 400 million (around USD 71 million)

If the winner of the bid opts out within the first six months, the second winner has to take over the contract and undertake the project within the same time frame, having an increased risk of running into penalties due to time pressure.

This risk, combined with the high penalties for delays and a very strict time plan, resulted in low interest in the Anholt tender and a low competition level. A key lesson from this experience is that while penalties can help to ensure project implementation, overly harsh limitations (steep penalties and strict time plans) can hamper competition.

be treated as auction design elements, such as the design of administrative procedures for licensing and permitting. As a consequence, explicit provisions introducing delays and underbuilding penalties are only one additional element that may influence the auction's outcomes – and the different implementations in various RE auctions can be classified as involving more or less severe penalties.

A summary comparison of the strictness of the options for delay and underbuilding penalties are presented in Table 6.8.

Table 6.8: Summary comparison of delay or underbuilding penalty options

Options / Criteria	Delay and underbuilding penalties	
	More stringent penalties	**More lenient penalties**
Reduced uncertainties to investors	Generators may be penalized for random, uncontrollable events	Much smaller chance of generators being unfairly penalized
Avoided undercontracting	Contracts may be cancelled more often	May be slower in identifying "hopeless" projects and procuring substitutes
Projects completion	Generators will do their best to comply with their commitment	May induce generators to be more careful before assuming the commitment

Characteristics of the relevant attribute: *Poor* *Medium* *Very good*

6.7 ASSIGNED LIABILITIES FOR TRANSMISSION DELAYS

Delays in the delivery of the product contracted in the auction can be caused either by delays in power plant construction or by delays in transmission grid expansion, as in the case of Brazil. The possible outcomes of allowing generators whose grid access is conditioned to grid expansion to participate in auctions (see Section 4.4) depend on yet another design choice: the allocation of the liabilities for not delivering energy or capacity when the required grid expansion is not completed on time. The alternatives available for policy makers are to: 1) *assign the liabilities to the project developer* or 2) *assign the liabilities to another agent*, usually an entity responsible for expanding the grid (the transmission system operator, the central planning agency or other agents, depending on the regulatory framework of the jurisdiction).

Liabilities assigned to the project developer

If the generator is made liable for failure to meet contractual obligations due to delays in implementing the required grid expansions, the resulting perception of risks can greatly impact the bids in the auction. This is not necessarily an inefficient outcome, since projects with a higher risk of not delivering the contracted products on time due to transmission constraints would require a higher risk premium and may be displaced by competitors.

There are many ways in which generators can participate in the implementation of transmission projects, after which the operation of new transmission facilities is transferred to local network operators under regulated payments. In this case, the risk of high financial losses serves as a strong incentive for timely expansion of the grid. However, the extent to which generators are able to influence the implementation of network facilities is limited in many jurisdictions, and placing the liability entirely on them may result in significant risk premiums in auctions or even in low participation.

Liabilities assigned to another agent

If the liability is placed entirely on an agent other than the project developer, the risk of delays in implementing grid expansion is not internalised in the bids. Although this has the potential of reducing the risk premium required by participants, and thus reducing prices, the extent to which it produces desired outcomes depends on which agent assumes the liabilities

An obvious choice is to allocate the risk to the agent responsible for implementing the transmission and distribution network expansion, since this would result in incentives for the timely completion of construction. This can be the preferred choice in jurisdictions where the total revenues of this agent are significant in comparison to the possible monetary volumes of liquidated damages due to non-delivery of energy of renewable generators unable to feed in their generation – for instance, in European counties where a single, sizeable transmission company has a monopoly over transmission in large territorial areas.

However, in cases where transmission companies are comparatively smaller – *e.g.,* in jurisdictions where their scope is limited to concessions involving a small set of facilities awarded as a result of competitive auctions, the possible monetary volume of the liquidated damages can even exceed the total revenues of the transmission agent. This would lead to a high perception of risk by the transmission agent responsible for implementing the transmission facilities and would raise the costs of this activity to unreasonable levels. In this latter case, the risk may end up being transferred to some extent to electricity consumers, who have limited possibilities of influencing the process of implementing network reinforcements.

A possible way of avoiding this undesired allocation of risks is to use other mechanisms to avoid or greatly reduce the possibility of delays in grid expansion. This may require the combination of a proper choice of auction design elements and the adjustment of the electricity regulatory framework that may not relate exclusively to auctions. For instance, if auctions are implemented without sufficiently large lead times for the delivery of products, the probability of delays due to network expansion increases (see Box 6.13). Alternatively, the approach of only contracting projects whose output can be transmitted without expansion of the electricity grid can be adopted, but with incentives for planning authorities to pre-develop the grid in order to avoid unreasonable constraints to the capacity that can be contracted in each substation. The latter approach naturally leads to other key questions, such as how to allocate and recover the costs of the pre-developed network infrastructure.

BOX 6.13: TRANSMISSION RELATED DELAYS: THE CASE OF BRAZIL

The auctions for renewable energy projects in Brazil are held three or five years before the date of delivery of the auctioned product. In practice, however, the lead times have been shorter than this, with many auctions held after the middle of a year, and delivery being required for January of the target delivery year. This box focuses on auctions held three years before the delivery date.

In Brazil, market competition in generation auctions co-exists with centralised, determinative transmission planning. Centralised transmission planning for integrating generation projects that win auctions was traditionally carried out in a reactive fashion. After the auction winners were revealed and their location and nature was defined, three years before the contractual delivery date, transmission was planned, auctioned and built. For some time, this three-year interval was reasonably sufficient to implement the transmission facilities, and this arrangement worked fairly well.

This temporal co-ordination has been failing more recently. In practice, the auctions have been held two years and a couple of months before the delivery date. Environmental constraints have been a frequent cause of delays in the implementation schedule of transmission facilities, and some delays have been thought to relate to underbidding in transmission auctions (after central planning, concessions for the exploration of transmission concessions, including implementation activities). As a result, there have been many cases in which generation facilities are ready to operate by the time their contractual delivery date is achieved, but the output of renewable generators cannot reach the market because transmission capacity reinforcements are not ready in time.

In some of Brazil's early auctions, including those with the participation of renewable generators, the risk of such constraints to the provision of generation was allocated almost entirely to energy buyers. The long-term contract awarded as a result of the auction contained a waiver for the obligations of the project developer in case it could not fulfil these obligations due to delays in the commissioning of transmission. Generators were paid as if their contractual obligations were being met, and buyers had to arrange alternative procurement options. Penalties due to commissioning delays were applied to transmission companies, but these were not nearly commensurable with the losses incurred by the buyer. Due to the scale of the transmission concessionaires in Brazil, as a consequence of the model with competition for transmission concessions, penalties commensurable with the losses incurred by the buyer are not feasible in practice.

Box 6.14 describes the evolution of grid access policies in renewable energy auctions in Brazil, illustrating the interdependencies of defining the qualification requirements related to grid access permits and the sellers' liabilities.

BOX 6.14: EVOLUTION OF GRID ACCESS POLICIES IN BRAZIL

Brazil experimented with some alternatives for dealing with this problem. One involved an auction in which the maximum generation capacity to be contracted at any given transmission substation was limited by the capacity that could actually be drained by the transmission network (*i.e.*, without the need for any further transmission expansion). This limiting draining capacity was calculated by the Independent System Operator (ISO), and the information was made public before the auction. Although there was no evidence of abuse of market power due to this situation, determining the draining capacity at each substation proved to be a technically complex task, subject to some discretionary power by the ISO. This was because the evaluation required an integrated analysis of the network, and some data required for this analysis were difficult to acquire, as the winning projects of other nearby substations were not known.

Another attempt to deal with this problem involved fully allocating the risks of the unavailability of transmission capacity to the seller, without any changes to planning procedures by the Energy Planning Agency. The previous waiver for the generators, in case they could not fulfil the contractual obligations due to transmission delays, was removed. The generators were left with the task of estimating what would be the actual capacity by the time of their delivery date achieved, and made their bids in the auction at their own risk.

Having perceived this situation as undesirable, the Energy Planning Agency is in the process of implementing a novel pro-active planning procedure. Instead of planning transmission only after the auction winners are known, the agency seeks to plan in advance of auctions, based on technical information on the availability of wind resources – hence, predicting attractive areas. This enables the tendering of these transmission facilities before generation auctions. Generators still bear the risks of complying with contractual obligations if transmission is delayed, yet they have comparatively more certainty about the reinforcements to the transmission network that will be online at the contractual date of delivery.

As can be seen, the process results in some interference of the central Energy Planning Agency with competitive generation expansion, as the risks of projects in some areas, and not others, are reduced. The results of this novel approach are yet to be seen.

Source: (Rudnick, Barroso, Llarens, Watts, Ferreira, 2012).

Although the grid access dimension of an auction design was discussed (see Section 4.4), there are relevant interdependencies with the sellers' liabilities.

Main Findings

The issue of coordinating the expansion of the transmission grid with the contracting of new generation projects cannot always be ignored in RE auctions. Section 4.4 has addressed how grid connection ought to be taken into account as a qualification requirement for the auction, showing that in certain circumstances it is possible to sidestep the issue of liabilities in grid connection entirely. However, in certain RE auctions the winning projects rely on additional construction works to evacuate their generation – which requires a specific provision for the allocation of responsibilities. The main argument against allocating this responsibility to the project developer of the RE generation plant is that the agent becomes co-responsible for the actions of a completely separate entity (responsible for building the necessary transmission reinforcements). This forces the project developer to include a risk premium in its valuation, while at the same time sending an ineffective price signal to prevent delays.

A summary comparison of the alternatives for assigning liabilities for transmission delays is presented in Table 6.9.

Table 6.9: Summary comparison of transmission delay liability options

Options / Criteria	Liabilities assigned to the project developer	Liabilities assigned to another agent
Guidance from the auctioneer (on most suitable projects sites)	Developers prioritise the development of projects in sites with no risk in access to the network	Developers do not have incentives to select projects with best siting
Level of Participation	Some bidders may not be willing to bear this risk	No risk for project developers
Reduced uncertainties to investors	Bidders include this liability as a risk premium in their bids	No associated risk premium
Avoided risks of delays	Less potential since the project developer is not responsible for the expansion	Great potential if the liable agents are the ones responsible for implementing network expansion

Reducing uncertainties to investors *Poor* *Medium* *Very good*

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