IRENA
International Renewable Energy Agency

Renewable Energy Auctions in Developing Countries

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 cooperation, 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.

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Acronyms

ANEEL	Agência Nacional de Energia Elétrica (Brazil)
BNEF	Bloomberg New Energy Finance
BNDES	Brazilian National Development Bank
CCEE	Chamber for Commercialisation of Electrical Energy (Brazil)
CSP	Concentrated Solar Power
DOE	Department of Energy (South Africa)
EPC	Engineering, Procurement and Construction
EPE	Energy Research Company (Brazil)
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
IPP	Independent Power Producer
KWh	Kilowatt-hour
MASEN	Moroccan Agency for Solar Energy
MEMEE	Ministry for Mines, Energy, Water and the Environment (Morocco)
MEN	Ministry of Energy and Mines (Peru)
MME	Ministério de Minas e Energia (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
ONE	Office National de l'Electricité (Morocco)
OSINERGMIN	Peruvian government's Energy and Mining Regulator
PERG	Global Rural Electrification Programme
PPA	Power Purchase Agreement
PROINFA	Programme of Incentives for Alternative Electricity Sources (Brazil)
PV	Photovoltaic
RE	Renewable Energy
REFIT	Renewable Energy Feed-in Tariff (South Africa)
REIPPP	Renewable Energy Independent Power Producer Procurement (South Africa)
RET	Renewable Energy Technology
SIE	Energy Investment Company

Executive Summary

The rapid worldwide expansion of renewable energy in recent years has been largely driven by support policies. Typically, these aim to address market failures in an effort to promote the uptake of renewable energy while achieving a number of other objectives, including energy diversification, the development of a local industry and job creation.

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.

Renewable energy auctions, despite some difficulties in implementation in the past, have become a popular policy tool in recent years. The number of countries that adopted renewable energy auctions increased from 9 in 2009 to at least 44 by early 2013, out of which 30 were developing countries. The renewed interest in auction schemes is driven by their potential to achieve deployment in a cost-efficient and regulated manner. Auction schemes have benefited from the rapidly decreasing costs of renewable energy technologies, the increased number of project developers, their international exposure and know-how, and the considerable policy-design experience acquired over the last decade. When well designed, the price competition inherent to the auction scheme increases cost efficiency and allows price discovery of renewable energy-based electricity, avoiding potential windfall profits and underpayments. While auctions have become very attractive, they only benefit the successful bidders and tend to favour large players that are able to afford the associated administrative and transaction costs.

Based on national energy plans as well as the size and maturity of the renewable energy market, the design of auction schemes will reflect each country's priorities in terms of technology, volume and location. Technology-specific auctions allow for the promotion of certain technologies and diversification of the portfolio. In addition to selecting the technology, auctions can be site-specific. The identification of sites with ideal resources and secured grid connection potentially reduces risks to investors. Technology-neutral auctions have also served to promote renewable energy technologies, which have even been able to compete with fossil fuels on certain occasions. The design of auctions allows governments to include other national priorities, the most common one being local content requirements. These different aspects of renewable energy action schemes are described in this report, drawing on experiences from five countries, namely Brazil, China, Morocco, Peru and South Africa.

The most common type of auction is the sealed-bid auction, where project developers simultaneously submit their bids with an undisclosed offer of the price at which the electricity would be sold under a power purchase agreement. An auctioneer ranks and awards projects until the sum of the quantities that they offer covers the volume of energy being auctioned. Another type of auction is the multi-round descending-clock auction, where in an initial round, the auctioneer offers a price, and developers bid with offers of the quantity they would be willing to provide at that price. The auctioneer then progressively lowers the offered price in successive rounds until the quantity in a bid matches the quantity to be procured. Hybrid models are possible, using both the descending clock auction in a first phase and the sealed-bid auction in a second phase.

Instrumental to the design of auctions are stringent bidding requirements (financial, environmental, grid connection, *etc.*) and strong compliance rules (penalties, bid bonds, project completion guarantees, *etc.*) that reduce the risk of underbidding, project delays and project failure.

As with other deployment policies and support mechanisms, the successful implementation of auctions relies on an appropriate regulatory and institutional framework, relevant skills and adequate infrastructure to attract investors.

The findings of this study indicate that in designing and implementing auction schemes, policy makers may want to consider the following:

» **Type of auction:** the sealed-bid auction is simple, easy to implement, fosters competition and avoids collusion. Descending clock auctions are more difficult to implement, but they allow for a fast price discovery as well as greater transparency.

» **Ceiling prices** should not be disclosed to the bidders in order to ensure greater competition.

» **Auction volumes** must be determined in relation to the capacity of the market to deliver, particularly in markets with a limited number of local renewable energy developers and suppliers. Determining the optimal number of rounds and the volumes that would create greater competition is a challenge that requires learning by doing.

» Streamlined **administrative procedures**, with **communication** and **transparency** provided equally to all bidders, are essential to the success of an auction scheme.

» Strong **guarantees and penalties** are essential to the success of auction schemes, preventing potential underbidding and minimising the risk of project delays and completion failure.

Introduction

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

Among the common policies implemented, tariff-based support schemes have proven to be very effective in stimulating growth in RE. Over the recent past, auction schemes have gained popularity given their inherent advantage in minimising support costs and regulating the deployment of RE.

While many studies have been published on feed-in-tariff schemes, literature on auctions is more scarce. In an effort to fill the knowledge gap and take stock of experiences to date, this report analyses the design of RE auctions in selected developing countries. The objective is to identify best practices and provide some insights to policy makers regarding the type and the design of auctions.

Section 1 of the report gives an overview of trends in auctions and illustrates their increasing popularity, especially in developing countries. It also describes auction schemes and the different types that have been implemented in the countries studied in this report. Based on the existing literature, strengths and weaknesses of auctions are briefly discussed.

Section 2 explores the implementation of the auction scheme in five developing countries: Brazil, China, Morocco, Peru and South Africa. The case studies are based on a literature review, interviews, workshops and expert meetings. The evolution of tariff-based support mechanisms for renewable energy-based power generation and the factors leading to the adoption of auctions are described for each country. The specific national objectives to be achieved by the auction and the way it was implemented are analysed, including the type and design. The case studies also explore the evolution of the price of electricity established under the power purchase agreement (PPA).

Section 3 synthesises lessons learnt from the selected case study experiences and draws conclusions regarding the type, design, and related aspects. The objective of this section is to provide insights to policy makers in designing auctions to best fit the country's national priorities and efficiently use available resources.

1. Trends in Renewable Energy Auctions

Policy makers face different barriers in promoting the development and deployment of RE-based electricity generation, depending on the stage of technological and market maturity as well as on country specific conditions. The experience of the last fifteen years has shown that a range of different policies has effectively addressed these barriers and supported renewable energy technologies (RET) at a regional, national or local/municipal level. Today, in countries with a growing RE-based electricity market, policy makers face the challenge of maintaining its growth, while managing the level of support at a reasonable level (neither too high nor too low) and adapting to an evolving market environment. Different policies have been used to mitigate both the non-economic barriers (*e.g.* grid access, authorisation procedures) and the economic barriers (*e.g.* high cost of capital, low electricity market price) to the deployment of RET, namely tariff-based support mechanisms (feed-in tariff (FIT), feed-in premium (FIP) and auction/ public tendering schemes[1]). Tariff-based support mechanisms are the most common examples of price-driven policy instruments, where the price (*i.e.* tariff paid to the RE electricity generator) is set (or partially set in the case of FIP) by the responsible regulatory body and the quantity of RE electricity generated is determined by the market actors. Conversely, in the case of auction schemes, the regulatory body defines quantities (and usually other selection criteria) and the tariff is defined by competitive bidding from the project developers.

While the FIT and FIP are relatively straightforward concepts that carry a clear meaning in the literature and for policy makers, the auction scheme is a less straightforward option that can refer to a range of different competitive public procurement processes. This report focuses on the assessment of one type of tariff-based support mechanism, the auction scheme, analyses its implementation in five developing countries and draws conclusions and lessons learnt.

1.1 OVERVIEW OF TRENDS IN AUCTIONS

The procurement of new and existing electricity capacity was undertaken by electric utilities or governments in line with the vertical unbundling of the power sector beginning in the late 1980s and early 1990s. The first auctions for long-term electricity contracts were carried out in the 1990s between state utilities and independent power producers (IPP). They were initially implemented in monopolistic energy markets and saw a renaissance in countries with liberalised markets in the late 2000s. In the UK, for example, the Non Fossil Fuel Obligation (NFFO) was in place from 1990 to 1998 under which a generator put in a bid to produce a specific amount of electricity from a particular technology at a certain price. With the implementation of a second wave of power sector reforms in 2004, auctions have been organised to ensure an adequate volume of new power generation in a number of developing countries with a rapidly increasing electricity consumption. Brazil, Canada, Chile, China, Ireland, Portugal and the UK were among the first countries to adopt RE auction schemes.

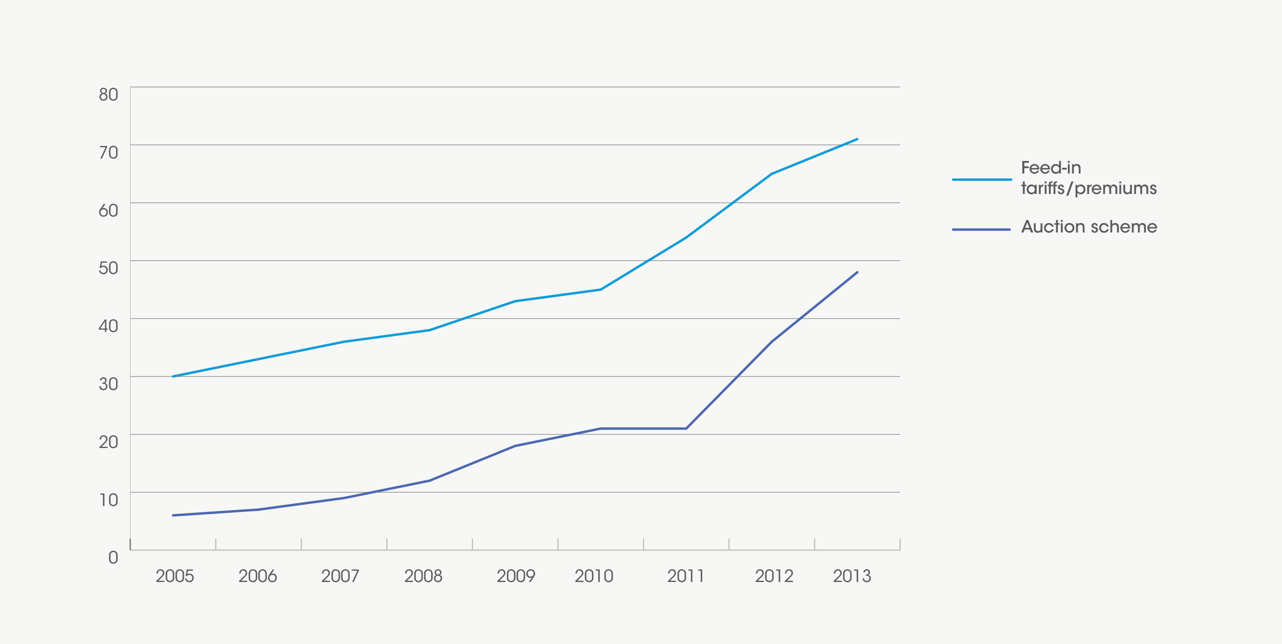
Figure 1 illustrates the global trends in the use of auctions and other tariff-based support schemes (FIT and FIP) from 2005 to 2013. It should be noted, however, that some of the countries included in this graph have announced schemes, but not implemented them. The trend clearly shows that although the FIT and FIP are the most popular support schemes with a steady increase in the number of countries adopting them, auction schemes have been catching up over the last couple of years.

In 2009, at least nine countries implemented auction schemes to promote the deployment of RE. Only one year later this number had already increased to 21[2] (REN21, 2009; REN21, 2010) out of which, 12 are developing countries. In 2011, 7 additional countries implemented auctions, all of which were middle income countries (Bosnia and Herzegovina, El Salvador, Guatemala,

[1] *The terms auction and public tendering are used interchangeably. In this report, we refer to the scheme as auction.*

[2] *Argentina, Brazil, Canada, Chile, China, Denmark, Egypt, France, Hungary, Ireland, Israel, Latvia, Mexico, Mongolia, Peru, the Philippines, Poland, Portugal, Slovenia, South Africa and Uruguay.*

FIGURE 1 TRENDS IN NUMBER OF COUNTRIES ADOPTING AUCTION SCHEMES AND OTHER TARIFF-BASED MECHANISMS (2005 –2013)



Source: REN21, 2005; REN21, 2007; REN21, 2010; REN21, 2011; REN21, 2012; REN21, 2013.
Notes: Figures for the years 2006, 2008 and 2009 are based on estimations.

Honduras, India, Indonesia, Panama) and in 2013, the auction scheme had been used for a variety of RET in at least 44 countries (REN21, 2013)[3] as shown in Figure 2.

There seems to be a clear upward trend in the use of auction schemes over the last couple of years. It is worth mentioning here that some countries (including Peru, Morocco and South Africa) adopted auction schemes as their dominant support scheme for renewables, but auctions are also often used to promote a particular technology type and may coexist with other support schemes such as the FIT (in China for instance).

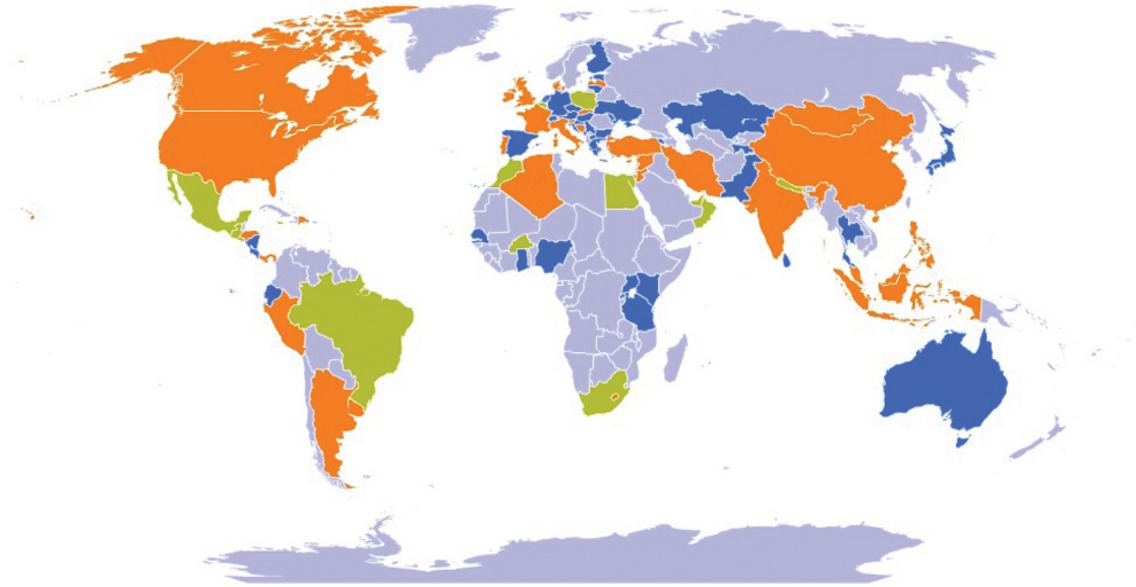
1.2 BACKGROUND ON AUCTIONS

RE auction schemes are also referred to as *demand auctions* or *reverse auctions* or *procurement auctions* (as opposed to supply auctions). They are different from other tariff-based support schemes (FIT or FIP) in that only selected RE-based electricity generators benefit from the support tariff, and the tariff level is based on the prices indicated by the project developers in their bids during the auction process. The main features of auction schemes are:

- The government opens an auction process or issues a call for tenders to install a certain capacity of RE electricity from a given technology (technology-specific auction) or from a group of eligible technologies (alternative energy auction or technology-neutral auction).
- The government imposes defined requirements for the project developers to participate in the bid (e.g. proof of financial capability, secured land, environmental license, *etc.*). Project developers are also normally required to deposit guarantees to ensure the successful completion of projects awarded.
- 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. In some cases there is a phase of pre-qualification of the project developers who will be authorised to participate in the auction.
- The government evaluates the projects on the basis of the price and other criteria, such as the share in local manufacturing, technological specifications and environmental requirements.

[3] *Additional countries include: Algeria, Belgium, Burkina Faso, Cape Verde, Cyprus, Dominican Republic,Iran, Italy, Jamaica, Jordan, Lesotho, Malaysia, Mongolia, Morocco, Nepal, Oman, Palestenian Territories, Peru, South Africa, Singapore Syria, United Arab Emirates and United States.*

Figure 2 RE tariff-based mechanisms in 2013



Source: based on REN21 data, 2013

» A PPA is signed with the preferred bidder (with the lowest price if the evaluation is based on the price only or on the highest score in the case where the evaluation is based on multiple criteria with assigned weights). This contract provides the renewable generators with a fixed price for a certain number of years and a guaranteed purchase for all generation, which can be used as the basis for financing the project.

There are three different types of auctions studied in this report: the sealed-bid auction, the descending clock auction and the hybrid type of auction (used in Brazil) where the first phase operates as a descending clock auction then the second phase operates as a pay-as-bid sealed-bid auction.

THE SEALED-BID AUCTION

In the sealed-bid auction, bidders simultaneously submit their bids with an offer of price and quantity, and no bidder knows the offered price of the other participants. Bids that meet all of the mandatory requirements outlined in the call for tenders are ranked from the lowest to the highest price if the evaluation is based on the price only. Starting from the lowest price, projects are awarded until the sum of the quantities that they offer covers the volume auctioned. According to the government's priorities, there is a possibility to rank projects not only according to price, but also to include a more comprehensive set of criteria, such as the project's contribution to local industrial development, the project developer's technical expertise, *etc.* In this case, the selected projects may not be the ones with the lowest price, but the ones that offer the best value for money.

The sealed-bid auction can either be a first-price sealed-bid auction or a pay-as-bid auction (Maurer and Barroso, 2011). While the first-price sealed-bid auction aims for the allocation of a single product (project) to one project developer (*e.g.*, the 160 MW concentrated solar power (CSP) for the Ouarzazate I project in Morocco in 2011), the pay-as-bid auction results in the allocation of multiple units of the same product with different prices to more than one project developer (*e.g.*, the 3,725 MW auction in South Africa in 2010). Allocating the volume to be contracted to more than one project developer reduces the risk of not meeting the demand in case the project is not completed on time or at all.

The selection of bids can take place in one or two phases. In the two-phase selection process, projects go through an initial pre-qualification phase to identify bidders who would be allowed to tender and a second evaluation phase. Pre-qualification is used in certain cases (large projects and those requiring technical expertise) and it helps narrow the field to only those who have the ability to comply with the terms of the contract and the financial capability to undertake the work.

THE DESCENDING CLOCK AUCTION

The descending clock uses multi-round bids where the auctioneer announces a price for acquiring the RE electricity generated. Bidders bid for the right to provide the quantity of the product they wish to supply at the going price announced. The auctioneer progressively lowers the price (which results in a lower quantity offered from bidders) until the quantity offered matches the quantity to be procured. This is a more dynamic auction system where participants know each other's bids and adapt their price and quantities accordingly in subsequent rounds. Table 1 presents a summary of the characteristics of the two types of auctions described above.

THE HYBRID AUCTION

In this report, we also present the Brazilian case where a hybrid type of auction is used. This describes an auction where the first phase operates as a descending clock auction then the second phase operates as a pay-as-bid sealed-bid auction. In this case, the use of a hybrid auction aims at taking advantage of the benefits of both auction systems: price discovery in the descending clock auction and avoidance of collusion between small numbers of participants for setting the final price in the sealed-bid auction.

1.3 ANALYSIS OF AUCTIONS

The following section provides an analysis of the strengths and weaknesses of the auction scheme based on the existing literature on its design and implementation. It helps analyse the intrinsic characteristics of the auction scheme and the determining factors in the environment in which it is used.

STRENGTHS

Auctions limit the risks for investors because they offer guaranteed revenue over a period of time.

» With auctions, generators are guaranteed the purchase of their RE-based electricity at a fixed price as well as guaranteed access to the grid as per the signed PPA. Under these circumstances, the project developers are assured a market for the electricity they produce, which reduces the risk of investment.

» The longevity of the PPA (often between 15 and 20 years) constitutes another element of security. This stability of long-term fixed payments involves lower risks for RE project developers and investors and is therefore likely to lower the costs of financing (RREEF Research , 2009). This again can lower the per kilowatt-hour (kWh) cost of RE deployment and increase the efficiency of the support scheme compared to other support policies (Jager and Rathmann, 2008).

Table 1 Sealed-bid auctions and descending clock auctions

SEALED-BID AUCTIONS	DESCENDING CLOCK AUCTIONS
Bidders simultaneously submit bids with disclosed offer of price and quantity. Bids that meet all of the requirements are ranked and the top projects are selected until the volume auctioned is met	The auctioneer offers a high price that is expected to create excess supply. Bidders state the quantities they would supply at this price. While there is still excess supply, the auctioneer decreases the price until supply is met
Possibility to rank projects not only according to price, but including other criteria	No project ranking. The auction results in offered quantities for determined price
Limited volume auctioned, selection of a number of bids to match the volume	Limited volume auctioned, selection of a number of bids to match the volume target
Ceiling price used for the selection process	Price (ceiling) discovery at the end of the process
Average price not necessarily disclosed at the end of the auction round	Average price disclosed at the end of the auction round

Auctions lead to cost efficiency due to price competition.

- Auction schemes establish a competitive bidding situation and put downward pressure on prices. The prices and overall costs of the auction can be controlled by setting a maximum price over which bids will not be selected (ceiling price). A comparative analysis conducted in three different countries showed that auctions can be useful for reducing the price of renewables and establish competitive pricing. In China, for instance, the average price for a concession project was 66% of the average price for a non-concession project (Junfeng, et al., 2006). If conditions are competitive, the winning price can be considered reflective of the actual cost, reducing some of the concerns associated with FIT or FIP overpayments. In some cases, the winning prices resulting from competitive bidding have been used to establish cost-based FIT levels for certain RET.

Auctions are useful for volume and budget control.

- Auctions are useful for controlling capacity installed, because they set a targeted or capped volume as a key element of their design. They are also useful to control the budget, especially when a ceiling price is used.

Well scheduled and enforced auctions can increase the predictability of RE-electricity supply.

- Since auction schemes are built-in ways of controlling deployment volumes, such as setting the levels of capacity or constraining the budget available for capital support, they do not face the volume problems that may occur under FIT and FIP schemes. Auctions can provide a clear schedule for the new power capacity to be procured, provided the problems of underbidding and non-performance are addressed. Since they can be tailored to suit near- to medium-term supply needs, auctions can facilitate future power planning and increase the predictability of future supply trends for policy makers.

Selection of the preferred bidder on criteria other than price allows for the achievement of multiple policy objectives.

- While auctions typically select the winning bids on the basis of price, they are often used to achieve other policy objectives using additional evaluation criteria (*e.g.* local employment, local environment, industrial development, *etc.*). Projects could be scored higher, for example, if they are located in high-load areas or in areas that currently lack electricity access, thereby engendering additional economic benefits to the jurisdiction.

WEAKNESSES

Auctions can lead to discontinuous market development (stop-and-go cycles).

- Unless auction schemes are linked to a fixed schedule of auctions at regular intervals (*e.g.*, more than once per year), they may lead to a stop-and-go pattern of deployment. These conditions prevent investment in local manufacturing facilities and the development of a robust supply chain.

Participating in auctions requires resources that small-scale or new project developers may not have.

- The risk for bidders that their project will not finally receive a contract is relatively high, especially in very competitive auctions. To win the auction, bidders must present feasibility studies and land use permits, adding layers of transaction costs with little assurance that this risk will be rewarded with an actual contract. Therefore, it is often argued that auctions are best suited to larger-scale established developers that can afford these initial efforts and up-front transaction costs.

Competitive bidding can lead to underbidding.

- Under an auction scheme, an incentive is created for bidders to bid as low as possible in order to increase their chances of securing a contract. A serious risk is, however, that developers will bid too low to actually be able to realise the project, that is, underbidding. Returns on investment would then be too low to secure financing for the project. There is also the risk that project developers deliberately bid too low and after being selected pressure governments to retroactively raise prices. Experience suggests that underbidding is widespread and contract failure rates remain high, leading to slower growth (Couture, 2011).

Table 2 presents a summary of the strengths and weaknesses of auctions described above.

Table 2 Strengths and weaknesses analysis of auction schemes

STRENGTHS	WEAKNESSES
» Cost efficiency due to price competition » Useful to establish competitive pricing » High investor security linked to long-term PPAs » Useful for volume and budget control » Well scheduled auctions can increase the predictability of RE-based electricity supply » Other policy objectives can be achieved through auctions	» Discontinuous market development (stop-and-go cycles) » Relatively high risks of not winning the project for high investment costs from bidders » Risk of underbidding

Auctions for RE-based electricity have been used in an increasing number of countries over the past decade. Although FIT and FIP are still the most popular mechanisms, we see that the use of auctions is increasing worldwide as seen in Figure 1.

While literature on feed-in schemes is relatively abundant, the auction schemes are less well documented. Given their increasing use, the next section of this report focuses on their more detailed assessment. The report analyses five different case studies of RE auctions and draws conclusions on the best practices that can be learnt from the implementation of auction schemes in these countries.

2. Renewable Energy Auction Schemes: Case Studies

2.1 SELECTION OF CASE STUDIES

RE auction schemes have been applied in a number of countries across different continents. Each country has its own method of applying RE auctions in its own economic, social and political context. In this report, five developing countries were selected to provide case studies on RE auction schemes: Brazil, China, Morocco, Peru and South Africa.

The rationale for selecting these countries was to provide a contrasting and diverse array of examples where the auction scheme has been used and that will provide comprehensive findings related to best practices in RE auctions. The selection of countries was based on the country context criteria and selected characteristics of the auction schemes.

COUNTRY CONTEXT CRITERIA

The selection of the countries studied was to provide diversity in the following criteria:

Economic conditions for each country were assessed using the World Bank 2011 gross national income per capita (GNI/cap)[4]. Countries were classified as follows: low income, GNI/cap of USD 1,025 or less; lower middle income, GNI/cap of USD 1,026 - USD 4,035; upper middle income, GNI\cap of USD 4,036 - USD 12,475; and high income, GNI/cap of USD 12,476 or more.

Investment conditions were selected based on the World Bank Ease of Doing Business Index 2011[5]. Countries were ranked as follows: easy, rank 1-61; medium, rank 62-122; difficult, rank 123-183. In the case studies, the Ernst and Young's 2012 attractiveness of investment in renewable energy are referred to (Ernst and Young, 2011).

The ***electricity markets conditions*** were categorised as monopolistic or competitive. A country is classified as monopolistic if the majority of its utility operations are controlled by one main vertically integrated supplier. This contrasts to a competitive market where several key players may operate within the same market.

The renewable electricity market for each country was measured by the market share of RE sources in electricity production and consumption. For consistency, all data is taken from the International Energy Agency (IEA) energy statistics for 2012, in some cases complemented with references from national statistics.

The ***policy environment*** for each country is assessed for two indicators: the policy targets in place and the length of time these measures have been in place for. The REN21 Global Status Report was used for this purpose. Policy experience is considered long if it has been implemented for more than 10 years or short if less than 10 years.

AUCTION SCHEME CHARACTERISTICS

Additionally, countries were selected on the basis of experience in implementing auction schemes with applicable technologies. Criteria for selecting countries were based on how long the auction schemes had been in place and what technologies were eligible under the scheme. This gives an indication of each country's experience in undertaking energy auctions.

2.2 BRAZIL

2.2.1 Country context

Brazil is a fast growing economy and it has had an average gross domestic product (GDP) growth rate of 4% between 2007 and 2011[6]. It is classified as upper middle income by the World Bank. Despite having excellent investment opportunities as a growing economy, investment conditions have been rated as difficult in the World Bank's Ease of Doing Business Index 2011.

4 *http://data.worldbank.org*
5 *http://data.worldbank.org*

6 *World Bank Statistics, http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG*

Nevertheless, Brazil was ranked 10th in Ernst and Young's 2012 investment attractiveness for renewable energy, which indicates a highly attractive market (Ernst and Young , 2012a).

The Brazilian energy sector was privatised in the 1990s. One of the major reasons for the power sector reform was the need for expansion to ensure supply requirements were met. Brazil's electricity demand grows at about 5% annually, representing an annual additional capacity of 5 GW (Maurer and Barroso, 2011). Brazil has a liberalised electricity market and an Interconnected National System (SIN) spread across most of the country. Isolated systems serve local demand in the Amazon that is not connected to the SIN due to the geographical characteristics of the area. The transmission system is operated by 64 companies that have obtained permits through public auctions promoted by the Brazilian electricity regulatory agency, Agência Nacional de Energia Elétrica (ANEEL). They are responsible for the construction and operation of transmission facilities. The electricity distribution market consists of 63 companies responsible for distributing energy to more than 61 million consumers. The top 5 companies are responsible for more than 40% of the electricity sold in the country (Ecofys, 2009).

Energy policy in Brazil is the responsibility of the Ministry of Energy and Mines, Ministério de Minas e Energia (MME). ANEEL is the regulating body for the electricity market and is also responsible for publishing and managing energy auctions and operating tariff-based schemes across the country. ANEEL regulates the activities of transmission and distribution, the main issues being tariffs and the quality of the service.

Brazil's RE power capacity including large hydro, is the fourth largest in the world. The country's electricity generation was 516 TWh in 2010, with 78% produced by hydropower (IEA, 2012). Despite this large deployment of hydropower technologies, Brazil finds it attractive to support other RET (wind, solar, small hydro and biomass) for a number of reasons, including:

- Abundant resource potentials;
- Production complementarity between hydro and wind in the Northeast and hydro and biomass in the Southeast and geographic complementarity between wind and biomass resource potential;
- Other RET have shorter construction times than large hydro plants, which helps to hedge the load growth uncertainty;
- Close proximity of locations with RE potential to load centres, which minimises transmission costs;
- Flexibility for balancing seasonal and variable production given the flexibility offered by hydro reservoirs.

The government's 10 year Energy Expansion Plan 2020, *Plano Decenal de Expansão de Energia 2020*, proposes a target of 16% RE-based electricity generation excluding large hydropower (biomass, wind and small scale hydropower). The two main support schemes in Brazil to integrate RE have been a FIT scheme operating between 2002 and 2006 and technology-specific auctions since 2007.

2.2.2 Evolution of tariff-based support mechanisms for RE-based power generation

In 2002, the Brazilian government set up a FIT scheme, the Programme of Incentives for Alternative Electricity Sources (PROINFA) under Law 10,438 to support investments in wind, biomass and small-scale hydro. The initial target was for 3,300 MW capacity by 2009 with equal shares of 1,100 MW for each of these technologies. Due to a relatively slow start and some implementation issues, installed capacity reached 2,888 MW with 132 projects (60 projects, 1,157 MW small-hydro; 51 projects, 1,182 MW wind; and 21 projects, 550 MW for biomass) (Eletrobras, 2012). The gate closure for new projects to be qualified for the PROINFA tariffs was December 2006, but its implementation has been postponed a few times until 2012. Projects are supported for 20 years and the costs of the scheme are recovered through a customer levy on electricity bills[7]. The tariff rates under PROINFA were comparably attractive to investors, with wind at USD 150/MWh, small hydro USD 96/MWh, and biomass USD 70/MWh (Barroso, 2012)[8].

While successful in starting the domestic RE business, PROINFA was not applied in the most efficient

[7] *For additional information, see PROINFA: http://www.mme.gov.br/programas/PROINFA/*

[8] *The following exchange rates are used: in 2008 BRL1.68/USD; in 2009 BRL 1.85/USD; in 2011 BRL 1.63/USD.*

way because of the high tariffs that were initially set. Moreover, the selection criterion of qualified projects was based on the date of the environmental permit (the older the permit the higher the priority of the project in the merit order for contracting). This has led to a black market for environmental licenses. Although there was an established procedure for obtaining environmental licenses at each step of the project, requirements sometimes varied and licenses were frequently difficult to obtain. Therefore, many projects were delayed, faced large cost overruns, or in some cases failed. Additional difficulties included grid connections and construction delays. Other delays specific to wind projects were due to the local content requirements, also known as 'national indices', that 60% of the equipment and 90% of the services needed to be sourced locally in order for the project developer to receive funding from the Brazilian National development Bank (BNDES) – a government-owned funding agency responsible for most of generation financing in the country. This coincided with a time when there was only one wind manufacturer in Brazil, creating major bottlenecks (Azuela and Barroso, 2011).

In 2004, a legal framework to utilise energy auctions as a mechanism to ensure supply adequacy in the country was introduced. The centralised procurement process organised by the government is based on the load forecast by distribution companies; and short, medium and long-term energy contracts are auctioned to generation facilities. Existing and new generation compete in different processes and all contracts should be backed by Firm Energy Certificates (FEC). The legal framework of the auctions allowed the introduction of new policy mechanisms by the government, such as the ability to conduct technology-specific auctions (laws 10,848 and 10,847).

The first technology-specific (biomass and small hydro) auction was held in 2007. The original motivation for auctions was price disclosure and efficiency in the procurement process by reducing the asymmetry of information between the industry and the government. Since 2008, auctions have been launched annually to contract RE projects. Figure 3 provides a summary of relevant RE electricity tariff-based support mechanisms implemented in Brazil since 2002.

2.2.3 Description of the auction scheme

CHARACTERISTICS OF THE AUCTION

The auction process is led by the regulator (ANEEL) under the guidelines of the MME. An auction committee undertakes the main auction tasks which are distributed among different institutions: the MME, ANNEL, the Chamber for Commercialisation of Electrical Energy (CCEE), which is responsible for spot price setting, contract settlement and conducting energy auctions, and the Energy Research Company (EPE) that sits within the MME and provides support in the planning of the energy sector. This committee defines the auction, suggests price caps, prepares the auction documents and coordinates with transmission planning.

Auctions for RE-based power generation in Brazil are held to introduce new capacity to meet the growth in electricity demand in the regulated market (new energy auctions), and/or to add supplementary energy to increase the system's reserve margin (reserve energy auctions), but both follow the same process.

New energy auctions are used to contract new capacity needed to meet the growth in electricity demand

Figure 3 Evolution of RE electricity tariff-based support mechanisms in Brazil

(technology neutral or specific). All projects contracted in an auction are required to start delivery after three or five years (referred to as A-3 or A-5 auction respectively)[9]. A-3 auctions are typically used for wind, solar and small-hydro. A-5 auctions are used for large-scale hydro and conventional power sources where five years planning for PPAs are needed, but more recently they have also been used for RET. On average, one A-3 and one A-5 auction are held every year. PPAs are typically secured for 30 years for hydro and 20 years for wind and biomass. The distribution utilities first declare their power requirements[10], a centralised procurement process is carried out and the successful generation companies enter into bilateral contracts with each distribution company in proportion to their demand forecast, with no provision of guarantees by the government. Energy contracts are long-term, indexed to consumer price index and are auctioned in the regulated market where 100% of the energy is bought in competitive bids with guaranteed revenue for generators. FECs are awarded for each 100 MW, and the total FECs must add up to the total capacity contracted. The regulator issues FECs to each generator in the system. This type of auction is usually for large-scale RE-based power generation and conventional power. Free market contracts can also be agreed between consumers and IPPs. They are usually short- to medium-term bilateral contracts.

Reserve energy auctions are organised at the discretion of the MME and used to contract supplementary energy to increase the system's reserve margin. Using reserve energy auctions, the government can contract a given quantity of energy even if it was not considered in the demand forecasts prepared by the distribution companies and contracts do not need to be covered by FECs. This type of auction is also used to contract RE-based power generation and MME determines the technologies and the volumes to be auctioned. In this case, auctions can be specific to one technology (biomass in 2008, wind only in 2009), or to several (small hydro, biomass and wind in 2010) (Maurer and Barroso, 2011).

The RE-based power generation auctions in 2010 and 2011 were a combination of new energy auctions and reserve auctions. The latter are usually more suited for contracting RE-based power generation since the contracts under reserve auctions do not provide firm energy to the grid and the requirements can therefore be less stringent and the associated costs lower (Cunha, et al., 2012).

Pre-requisites to register a candidate project for the auction include a prior environmental license, a grid access approval issued by the system operator and resource assessment measurements undertaken by an independent authority (Cozzi, 2012). Moreover, a 60% local content requirement is imposed on wind equipment to be purchased from national manufacturers (Kuntze and Moerenhout, 2012). As for type of auction, Brazil uses a hybrid mechanisms whereby:

- The first stage operates as a descending price clock auction with competitive bidding from lowest bidders and it aims to discover the price ceiling (Couture, et al., 2010). The auction is initiated with a high price that is expected to create excess supply and bidders state the quantity they would supply at this price. While there is still excess supply, the auctioneer decreases the price until supply is met, in addition to a certain margin. This margin would be used in the next stage to keep competition among the bidders who pass the first stage.
- The second stage is a final pay-as-bid sealed-bid auction. Winners of the first stage bid a final sealed price, which cannot be higher than the price disclosed in the first stage (Kreycik, Couture and Cory, 2011). The second stage is held to meet the actual demand and assure that there is no collusion between small numbers of participants for setting the final price.

Regarding compliance, bidders are required to deposit a bid bond equal to 1% of the project estimated 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. Auction winners also need to deposit a project completion guarantee equal to 5% of the investment cost that is released after certain project milestones are completed. Several penalties are applicable in case of delays. During the period in which the plant is delayed the contract price is reduced, and the regulator has the right to ask for contract termination for any

[9] *In addition to the new energy auctions, auctions are also held for renewal of existing contracts. These are referred to as A-0 or A-1 auctions. Apart for the delivery duration, their design is similar to the new energy auctions.*

[10] *The cumulative demand forecast is not divulged to the bidders.*

delay of more than one year in the project milestones (Cunha, et al., 2012). As for penalties, in the case where the annual production is below 90% of the quantity of electricity contracted, the investor is penalised for the shortage by 115% of the contract price in addition to making up the deficit in the following year. In the case where the annual production exceeds 130% of the quantity contracted, the excess electricity generated receives a fixed tariff of 70% of the contract price and the surplus 30% is accumulated for accounting in the following year. Finally, any deviation between 90% and 130% is accumulated for four years and can be used in the accounting process of any of the years in that four-year period (Porrua, et al., 2010), (Cozzi, 2012). Table 3 summarises the main characteristics of the auctions in Brazil.

IMPLEMENTATION OF AUCTIONS IN BRAZIL

Brazil has had a successful experience with the implementation of energy auctions. Since 2005, a total of 62 GW have been contracted through 25 auctions for new capacity including 9 RE-based power generation auctions. There have been 443 new generation projects for all technologies including conventional power with 60% renewables (40% large scale hydro and 20% other RE). These auctions were organised though a combination of new energy auctions and reserve energy auctions and are illustrated in Table 4.

In 2007, the first alternative energy auction was launched to attract small hydropower and biomass projects. Following the announcement of the auction, 143 companies registered for pre-qualification (total project volume of 4,570 MW). ANEEL qualified 87 companies to take part in the auction process (project volume amounting to 2,803 MW). The remaining projects did not meet some of the technical requirements such as environmental permits or ensured grid access and were therefore disqualified. The auction resulted in 541 MW for biomass contracts (average of USD 82.6/MWh) and 97 MW for small hydro (average of USD 81.7/MWh). Those volumes were awarded to only 17 companies, which was a relatively small number, partly as a consequence of the PROINFA offering higher tariff rates.

Table 3 Summary of the major characteristics of auctions in Brazil

CHARACTERISTICS OF THE AUCTIONS IN BRAZIL	
Legal basis	Laws 10,847 and10,848 adopted in 2004
Authorities in charge	Government: Ministry of Energy and Mines (MME) Executive body: Electricity Regulatory Agency (ANEEL)
Eligible technologies	Auctions can be technology-specific (e.g. biomass only auction in 2008 and wind only auction in 2009 and 2010), alternative energy auctions (wind, small hydro and biomass in 2007 and in 2010) and technology-neutral auctions (carried out regularly since 2005, where all RETs have been participating since 2011). ANEEL determines which RET are eligible in auctions and they can compete with conventional power (as in the case of 2011 auction)
Selection process	Pre-requisite to bid for projects: prior environmental license; grid access approval; technology specific documents (such as fuel contracts for biomass and certified production for wind) Selection in 2 stages: Stage 1 descending price clock auction; Stage 2: final pay-as-bid auction
Agenda of auctions	New energy auctions annually based on forecast energy capacity needs. These auctions are technology neutral but the government can determine the eligible technologies, thus allowing exclusive participation of RE. Reserve auctions are held at the discretion of the MME. Typically one reserve energy auction is held for RE-based power generation every year but this is not the rule.
Duration of tariff	Typically 20 years for wind; 20 years for biomass; 30 years hydro
Compliance	Long list of technical documents to participate. Bidders have to deposit several guarantees, including a bid bond of 1% of project's estimated investment cost and a project completion bond of 5% of project's estimated investment cost. Penalties for delays and under production. Contract termination for delays greater than one year.

Table 4 Summary of volumes and prices of the winning bids in Brazil

NAME OF AUCTION	AUCTION TYPE	TECHNOLOGY	TOTAL CAPACITY (MW)	AVERAGE PRICE (USD PER MWh)
1st Alternative Energy Auction 18-Jun-07	Alternative Energy	Small Hydro	97	71.04
		Biomass	541	73.07
1st Capacity Auction (Biomass) 14-Aug-08	Technology Specific	Biomass	1284	36.50
2nd Capacity Auction (Wind) 14-Dec-09	Technology Specific	Wind	1806	84.79
3rd Capacity Auction 26-Aug-10	Technology Specific	Small Hydro	30	74.70
		Biomass	648	76.84
		Wind	528	70.10
2nd Alternative Energy Auction 27-Aug-10	Alternative Energy	Small Hydro	101	83.69
		Wind	1520	78.81
		Biomass	65	76.83
12th Energy Auction 17-Aug-11	Technology Specific	Wind	1068	62.84
		Biomass	198	64.65
4th Capacity Auction 18-Aug-11	Alternative Energy	Wind	921	62.27
		Biomass	297	62.32
13th Energy Auction 20-Dec-11	Technology Neutral	Wind	977	56.9
		Biomass	100	53.76
		Large Hydro	135	49.47
14th Energy Auction	Cancelled			
15th Energy Auction 14-Dec-12	Technology Neutral	Wind	289	42.09
		Large Hydro	294	42.42

The first biomass only auction was held in 2008. It resulted in 2,379 MW across 31 plants (bagasse from sugar cane and elephant grass). The winning bid was settled at the average price of USD 36.50/MWh.

The first wind only auction took place in 2009. Following the government's announcement, 441 projects were registered, out of which 339 fulfilled all government requirements (total project volume reached 11,100 MW). There were 71 projects selected (amounting to 1,806 MW) and the final average price reached USD 84/MWh, 26% below the ceiling price. The projects, established for 20 years, are planned to be operational by 2014. Apart from increasing the share of wind power in the energy mix, one of the reasons behind the wind only auction in 2009 was to determine its market price. Spurred by the international financial crisis, this auction benefited from the decreased equipment cost of wind technology and created a strong competition between investors. Its classification as a reserve energy auction further supported the competitive process since project developers were not required to guarantee power generation with FECs. Nevertheless, the compliance rules and penalties for non-compliance described above were applied.

In 2010, a new energy auction and a reserve energy auction took place for wind, biomass and small-hydro power. Nearly 80% of energy contracted was awarded to wind projects at an average price of USD 72/MWh, about 20% below the ceiling price (70 wind projects totalling 2,048 MW). In addition, 12 biomass projects were awarded (amounting to 713 MW) for an average price of USD 78.42/MWh, about 17.5% below the ceiling price and 7 projects for small hydro power (total of 132 MW) at an average price of USD 83.57/MWh, 5% below the ceiling price. Biomass and wind contracts were provided for 20 years while those for small-hydro power plants were given 30 years. All projects were to be operational by 2013.

In August 2011, a new energy auction and a reserve energy auction took place. The new energy auction allowed natural gas-fired thermal plants to compete with renewable sources (wind, biomass and small hydro). It resulted in 1,265 MW of contracted RE capacity (1,068 MW wind, 198 MW biomass and 1,029 MW of natural gas), whereas the reserve energy auction led to 1,218 MW of contracted RE capacity (921 MW wind and 297 MW biomass). In this auction, wind projects (average price USD 63/MWh) successfully outbid natural gas projects (average price USD 65/MWh).

In December 2011, another technology neutral new energy auction was held in order to meet the projected demand of utilities for the year 2016. Wind was awarded 81% of the total power contracted (39 projects totalling 977 MW) at an average price of USD 53/MWh. In addition, two biomass projects of 100 MW were awarded at an average price of USD 54/MWh. Although the December 2011 auction was not limited to RE, none of the aspiring natural gas-based projects could qualify to compete. Moreover, small-hydro project developers participated in all three auctions in 2011 but could not secure any PPAs, suggesting that they could not compete with the other technologies.

It should be noted that the auctioning process slowed down in 2012 as the 14^{th} new energy auction was cancelled by the government due to low demand projections from the distributors. The 15th new energy auction, also launched in 2012, resulted in a total contracted capacity of 289 MW for wind (10 projects) and 294 MW for large hydro (2 projects); with average prices of USD 42.1/MWh and USD 42.4/MWh respectively.

2.2.4 Conclusions

The auctions in Brazil have been successful in contracting significant capacity of RE-based electricity. RET have gone through substantial cost reductions, especially wind, which has emerged as the fastest growing technology and is now reaching a mature domestic industry. Compliance rules have been incorporated but the Brazilian Association of Wind Power (Abeeolica) has expressed concerns that lower return margins could mean that projects remain vulnerable to complications that could arise during construction because of underbidding (Ernst and Young, 2012b). Some of the key lessons from this Brazil's auctions are summarised below.

GREATER RE CAPACITY AND LOWER PRICES FOLLOWING THE INTRODUCTION OF THE AUCTION SCHEME

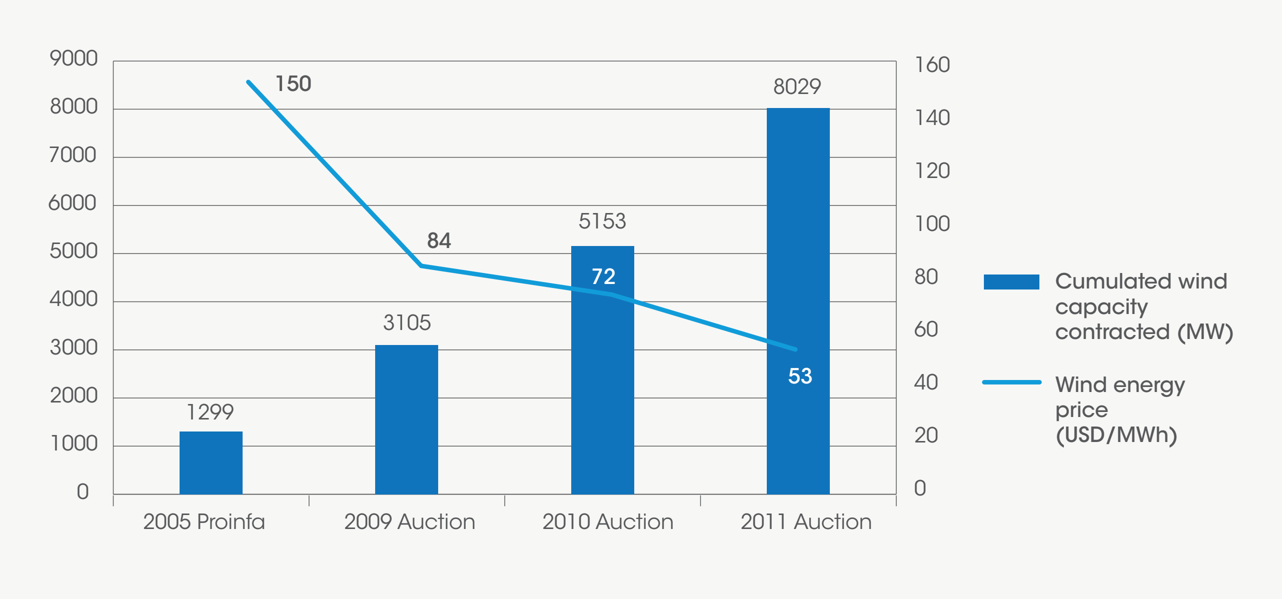
Auctions between 2008 and 2011 (small-hydro, wind and biomass) resulted in a total RE-based power capacity of over 10 GW in parallel to the PROINFA scheme that enabled an installed capacity of 2,889 MW between 2002 and 2011 (mostly wind). Figure 4 details the accumulated wind capacity since 2002 which marks the start of the PROINFA scheme, reaching 8 GW by 2011. It also illustrates the gradual drop in the price of wind power, with the average price for contracts decreasing by one third compared to those signed under Brazil's PROINFA programme in 2002.

The auction scheme and PROINFA have been effective at spurring growth and deployment of RE in Brazil. However, their successful implementation has been subject to challenges, some of which have led to delays in project implementation including: the rules on environmental permits; PROINFA's requirement of achieving an even split between the three technologies (small-hydro, biomass and wind) at the expense of cost efficiency; and the difficulty in meeting the 60% local content requirement on equipment in a nascent wind industry in order to receive financing from BNDES.

LOCAL CONTENT REQUIREMENT HAS PROMOTED THE DOMESTIC WIND INDUSTRY

Delays in the first wind auction were caused by the requirement to have 60% of the cost of equipment spent locally, as only one manufacturer was operating at the time. Out of the 71 wind projects allocated in

Figure 4 Wind capacity and energy auction price history



Source: (Barroso, 2012)

2009, 51 have had delays due to difficulty in financing, problems getting environmental permits approved, or delays in installing the turbines within the three-year timeframe. However, the success in attracting foreign investment with the entrance of General Electric, Alston, Vestas, Siemens, Suzlon and Gamesa to the Brazilian market (Cozzi, 2012) testifies to the fact that auctions have contributed to the growth of the domestic wind industry.

TECHNOLOGY-SPECIFIC AUCTIONS HAVE SUPPORTED THE DEVELOPMENT OF RE

Before 2010, all the auctions involving RE in Brazil were technology-specific auctions (*e.g.* the wind only auction in 2009, the biomass only auction in 2008 or the alternative energy only auctions in 2007 and 2010). These led to the market development and price competitiveness of all RETs and ultimately even allowed them to compete directly with natural gas in the technology neutral auction in 2011, where both wind and biomass were more competitive (on average) than natural gas power plants. It should be noted however that wind and gas cannot compete for contracts on the same grounds as they deliver products with different reliability levels.

Wind energy has been a strong winner in the recent alternative energy auctions and there are concerns that wind may be crowding out biomass and small-hydro while deterring the entrance of relatively new technologies such as photovoltaic (PV) and CSP. With the present market conditions solar, for example, cannot compete with wind. As a result, other support schemes have been introduced for small scale solar. For instance, in August 2012, ANEEL announced two new pieces of regulation to support the solar industry: a net metering scheme for generation between 1 kW and 1 MW and a tax break of 80% for PV system installations up to 30 MW. In order to support large scale deployment of solar energy, the government could resort to technology-specific auctions for PV and CSP as it did in the past, potentially for very small capacities in order to test the market and stimulate price discovery.

THE DESIGN OF THE AUCTION SCHEME HAS LED TO FIERCE COMPETITION WITH RELATIVELY LOW RETURNS IN RECENT YEARS

The auction scheme has enabled competitive bidding and has led to successfully bringing down the price of generation. However, the low prices in the 2010 and 2011 auctions have raised concerns regarding the realisation of allocated capacity. A study by Bloomberg New Energy Finance (BNEF) estimates that at least 40% of the wind capacity contracted in 2010 would yield returns below 10%[11] and at least 25%-40% of total tendered wind capacity in 2010 and 2011 is expected to at least experience considerable delays[12].

[11] *The assumption that a return below 10% is low is a subjective one.*
[12] *www.bnef.com/Insight/2612*

PENALTIES FOR NON-COMPLIANCE

Brazil has implemented a rather flexible set of compliance rules to reduce the risk on investors. In addition to the annual remuneration/ penalty on the yearly production deviations above/ below the agreed upon volume of electricity generated, a four year rule offers investors some degree of flexibility by allowing the producers to accumulate and carry over productions within some limits to make up for under production risks in future years.

REVERSE CLOCK AUCTION

The hybrid type of auction that has been used in Brazil entails a descending clock auction stage that has proven to be effective in determining the ceiling price for bids, followed by a sealed-bid auction that has ensured competition between bidders. The descending clock auction stage creates a dynamic system where participants know each other's bids and adapt their price and quantities accordingly. In the case of Brazil, the use of a hybrid auction has benefited from both auction systems: price discovery in the descending clock auction and no collusion between small numbers of participants for setting the final price in the sealed-bid auction. The hybrid auction mechanism allows better and quicker price discovery as compared to other auction designs.

2.3 CHINA

2.3.1 Country context

China has consistently experienced a high GDP growth rate, reaching over 9% in 2011. It has been classified as a lower middle income country by the World Bank[13]. The investment conditions in China are ranked as medium by the World Bank's Ease of Doing Business Index. The main reason is that private investments are heavily restricted and regulated, especially in the energy sector. However in recent years, the Chinese Government's regulations have encouraged and guided private investments in RE (Wang and Tao, 2011).

The transition of China's electricity sector from a centralised to a competitive market is in progress. The unbundling started in the late 1980s, when the generation sector was opened to new actors from both the public and the private sector. The most considerable changes were made in 2002, when the State Power Cooperation, which until then held 46% of generation and 90% of transmission capacity, was split into eleven smaller companies, separating the generation from the transmission and distribution. The majority of electricity is sold under long-term contracts in a single buyer model at a fixed generation price set by the Pricing Bureau of the National Development and Reform Commission (NDRC). The electricity market is regulated by NDRC, which is responsible for setting tariffs and the level of RE-based electricity support and approving the construction of new power plants, amongst others. As for generation, the so-called Big Five state-owned electricity production utilities (China Huaneng, China Guodian, China Datang, China Huadian, and China Power Investment) produce 49% of the country's electricity and the other half comes from local government corporations, semi-private and private companies. The unbundling of transmission and distribution has not taken place and the country's six regional grids remain controlled mainly by two state-owned grid companies.

Having one of the fastest growing economies in the world, China's electricity consumption has been increasing rapidly. In 2010, electricity generation reached 3,938 TWh, primarily from coal power plants, with 18.3% from RE sources, predominantly large hydropower (IEA, 2012). The country's electricity demand is projected to rise significantly in the upcoming years, establishing a strong need for additional generation capacity. The country's concerns over energy security and environmental protection resulting from its reliance on imported fossil fuels, have driven the country to tap into its abundant RE resources. Currently, the share of wind and solar energy is growing in the energy mix. China had the highest new wind capacity of 17.6 GW in 2011, reaching a total of 62.4 GW. Its solar PV capacity reached 3.1 GW, the sixth largest in the world. Furthermore, China's solar cell production ranked number one worldwide for the fourth consecutive year in 2011 (REN21, 2012). In order to further increase the adoption of renewables, China's 12th Five-Year Plan sets a target for RE sources to reach 9.5% of total energy consumption, and 20% of annual electricity production by 2015 (Yuanyuan, 2012). In 2012, the targets were further defined as follows: 100 GW of wind capacity (including 5 GW offshore wind), 35 GW of solar energy[14] and 290 GW of hydro power by 2015.

[13] *World Bank Statistics, http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG*

[14] *www.businessweek.com/news/2013-01-30/china-to-boost-solar-power-goal-67-percent-as-smog-envelops-beijing*

2.3.2 Evolution of tariff-based support mechanisms for RE-based electricity

The Renewable Energy Law came into effect in January 2006 and was amended in 2010. It provided a legislative framework for developing RE-based electricity, including a guaranteed purchase requirement. The law states that the purchase price for RE-based electricity is determined by the NDRC. It does not give details on the design of auctions or FIT, but provides the legal basis for RE-based electricity support at the national level, the regulations for its implementation, as well as the administrative practices that determine the RE-based electricity pricing system. The first set of implementation rules states that the government determines the tariff for RE-based electricity according to prices determined by the auction scheme[15].

China has considerable experience in operating tariff-based support schemes to promote RE given its implementation as early as 2003. These mechanisms are technology specific, as illustrated in Figure 5, and each one has evolved independently on the basis of respective administrative measures, laws and regulations[16].

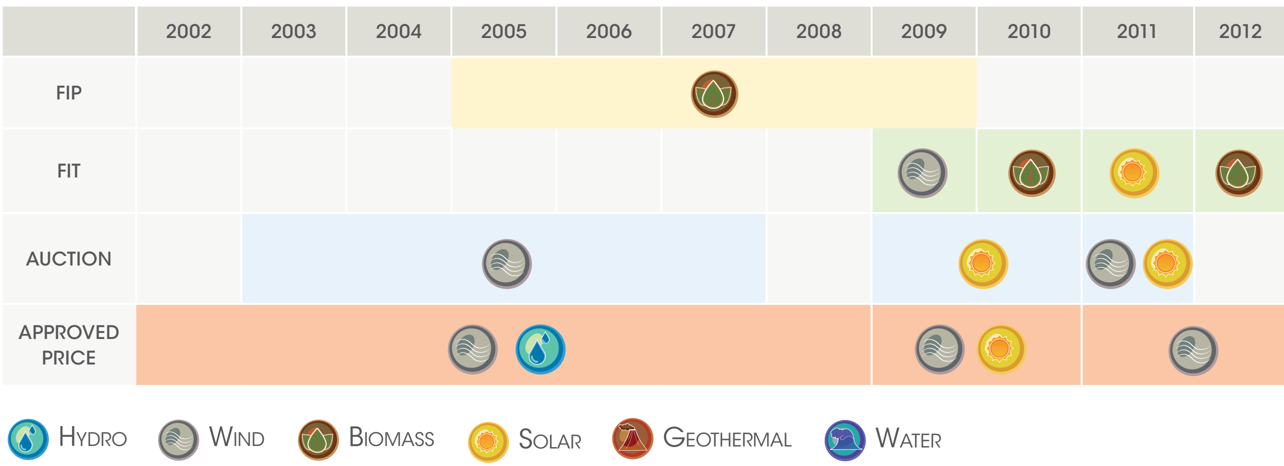
RE auctions were introduced in 2003 for onshore wind, but were soon after implemented for solar PV, offshore wind and CSP and they have been used to discover the real price of RE-based electricity, and subsequently set the level for the FIT. For onshore wind, a fixed tariff was introduced in 2009 following the auction scheme and it led to the setting of four different tariff levels[17] according to the resource availability of the site. As for grid-connected solar PV, a unified FIT was announced in 2011 after two rounds of auctions in 2009 and 2010[18]. Starting 2005, electricity from biomass received a FIP of USD 0.03/kWh on top of the electricity price with payment duration of 15 years. In 2010, the FIP was replaced by a unified FIT of USD 0.11/kWh for biomass power generation from agriculture and forestry. In 2012, a FIT of USD 0.1/kWh was adopted for eligible waste power generation. Finally, hydropower plants (large and small) have been receiving government regulated prices mainly on a project-by-project basis by central and local governments (see Figure 5).

The cost of supporting RE-based electricity is covered by a consumer surcharge that was initially RMB 0.001/kWh (USD 0.0001/kWh) and that gradually increased to the current RMB 0.008/kWh (USD 0.001/kWh). The surcharge is collected by the grid operators and held in a RE fund managed by the Ministry of Finance.

2.3.3 Description of the auction scheme

The Renewable Energy Law and its implementing regulations provide the legal foundation for the pricing system of renewables. In general, auctions are run at irregular intervals, based on decisions made by national authorities with no long-term agenda. The NDRC is in charge of onshore wind auctions while the

Figure 5 Evolution of RE electricity tariff-based support mechanisms in China



[15] *Implementing rule "Temporary Implementation Rules for Establishing a Feed-in Tariff for Renewable Energy Power and the Sharing of Expenses in Purchasing Electricity from Renewable Energy", NDRC Price [2006] No. 7.*

[16] *China's energy policy strongly focuses on administrative measures that are enforced strictly.*

[17] *Ranging between RMB 0.51/kWh and RMB 0.61/kWh (USD 0.07/kWh and USD 0.09/kWh), Exchange rate; 2005: 0.1219 RMB/USD; 2006: 0.1253 RMB/USD; 2009: 0.1462 RMB/USD; 2010: 0.14643 RMB/USD; 2012: 0.1581 RMB/USD.*

[18] *For solar PV, besides national auctions, there were other coexisting pricing methods, including national government approved price (eight projects 2008-2010), local government fixed (e.g. in Jiangsu and Shandong) or approved price, before the national FIT was introduced in 2011.*

National Energy Administration (NEA) is in charge of the recent solar and offshore wind auctions. Practical management of the bids is done by bidding agencies like Zhongshe International Bidding Co. Ltd. and the China Hydro Power Project Consulting Group. The NDRC and the NEA publish the auctions with detailed instructions. The evaluation committee is made up of members from the NDRC, NEA, state-owned grid companies, provincial development and reform commissions, provincial power companies, bidding agencies and technical experts. The evaluation procedure normally includes pre-qualification, detailed evaluation, ranking of candidates and negotiation.

The RE auctions are technology-specific and are intended to set the standard FIT for onshore wind and solar PV projects. The volumes auctioned depend on the technology but usually range between 100 MW and 300 MW. China uses a first-price sealed bid type of auction. Table 5 summarises the main characteristics of these auctions.

SOLAR TECHNOLOGY

Solar PV. The solar PV auctions were held in 2009 and 2010 (10 MW and 280 MW respectively) and projects were selected using the 'lowest price win' methodology. The auctions were organised for pre-identified projects or sites.

CSP. China announced the tendering for its first 50 MW CSP plant in October 2010 in North China's Inner Mongolia autonomous region. The tenders were opened in January 2011 and the China Machinery and Equipment International Tendering Co, Ltd was entrusted by the NEA to oversee the bidding process. Only three bids were received, all from state-owned companies. The low interest of private companies might be explained by the perception that CSP is not yet a mature technology and faces high risks. Datang Renewable Energy won the project with USD 0.1136/kWh[19]. In 2012, the second CSP tender for a 92 MW project in Yulin City was awarded[20].

WIND TECHNOLOGY

Onshore wind. The selection criteria for wind power (for projects over 50 MW) evolved significantly over its implementation period to incorporate the lessons learnt. In the first round of the Wind Concession Program in 2003, the NDRC invited investors to submit their bids, aiming for price discovery of wind power. It is a site-specific auction whereby companies bid to develop projects in predetermined areas. The

Table 5 Summary of the major characteristics of auctions in China

CHARACTERISTICS OF THE AUCTIONS IN CHINA	
Legal basis	Renewable Energy Law, Temporary Implementation Rules for Establishing Price for Renewable Power and Sharing of Expenses in Purchasing Electricity from Renewable Energy, adopted in 2006 and amended in 2010
Authorities in charge	Government: National Development and Reform Commission (NDRC), National Energy Administration (NEA). Executive agency: Zhongshe International Bidding Co. Ltd and the China Hydro Power Project Consulting Group.
Eligible technologies	Auctions are technology-specific for the following: wind onshore (minimum 50 MW), wind offshore, solar PV, CSP.
Selection process	Selection in one stage, based on price, following the 'lowest price wins' criterion, or weighted score from price and local content. For onshore wind: 'lowest price wins' for the first two rounds, 40% weight for price in third round (2005),decreasing to 25% by the fourth round (2006).Other evaluation criteriaincluded technical expertise and local economic benefits. Auctions for solar and offshore wind are mainly 'lowest price win' auctions.
Agenda of auctions	Between 2003 and 2007, onshore wind auctions were organised annually. Currently auctions are organised on an ad-hoc basis for wind and solar.
Duration of tariff	25 years for onshore wind with two stages: support tariff (resulting from auction) is paid for 30,000 full load hours; after that the average electricity tariff in the market is paid. 30 years for offshore wind (including 4 years construction period).
Compliance rules	No clear rules. No clear penalty for non-compliance.

[19] *Conversion rate 0.1485 USD/RMB*

[20] *www.renewablesinternational.net/esolars-chinese-partner-makes-a-successful-bid-for-solar-thermal-project-in-fuxin-city/150/510/30493/*

government was responsible for securing land and environmental permits, but the costs would be borne by the bidders (Cozzi, 2012). At the beginning of the program, the lowest bidder was selected to supply electricity to the grid at the price established in the auction for the first 30,000 full load hours of the wind farm. Then, the tariff would comply with the average price in the local electricity market (Wang, 2010). In addition to providing a price quote, bidders were required to declare the share of the equipment to be produced domestically, with a minimum requirement of 50% local content imposed (Liu and Kokko, 2010). Winning bidders were expected to start operating within three years of signing the contract and the period for the concession was 25 years. This selection system favoured companies that bid the lowest, creating a risk of underbidding.

In 2005, the NDRC issued the Notice of Requirements for the Administration of Wind Power Construction that increased the local content requirement to 70% to encourage the local development of wind power industry (Campbell, 2010). The evaluation criterion was modified to include local economic benefits and company background (technical expertise and project management experience) with 40% of the weight allocated to price. In 2006, the weight for price was further adjusted to 25% to reduce the risk of underbidding and to support local economic development. Another additional requirement implemented was that wind power equipment manufacturers were required to participate in the bidding directly. They could either bid individually or with an investment consortium as a supplier. In both cases, they were required to submit a complete plan for equipment manufacturing localisation.

Finally in 2007, a new methodology for scoring the price criteria was adopted that favoured the average price (excluding lowest and highest bid), to address underbidding. Bids closest to the average score the highest. Other principles of the wind concession included (Wang and Tao, 2011):

» A PPA must be signed between the winning bidders and the provincial grid company that must purchase all the power generated by the winning projects;

» The developer is responsible for the construction, operation and maintenance of the project; the government is responsible for land rental and environmental permits, but the costs are borne by the bidder;

» The investment in the construction of transmission lines and the connection to the network should be carried out by the grid company. The local government undertakes the construction of roads to wind farms in addition to some preparatory work; and

» The actual project capacity can be modified (usually increased) during the contracting phase after negotiation with the government.

There are no clear compliance rules or clear penalty for non-performance.

In 2009, the auction was replaced with a FIT and the requirement on local content was abolished when the US-China Joint Commission on Commerce and Trade met and China agreed to remove its local content requirement on wind turbines[21].

Offshore wind. Offshore wind auctions started in 2011 and are still on-going; pre-qualification requirements include (Tao, 2012):

» The bidder must be an independent legal entity whose net assets are larger than the capital value of the project, and with an existing wind farm capacity no smaller than the project's capacity. The project can be financed partially with foreign capital.

» The project developer must sign a supply contract with a wind turbine manufacturer. The manufacturer must have installed more than 100 large wind turbines (larger than 1 MW).

» To ensure reliable offshore wind power, wind turbines must undergo a performance test.

In the evaluation phase, the price accounts for 55% of the score, while the technical design, the experience of the bidder and the project financial data account for 25%, 15% and 5% respectively. Moreover, the methodology used for scoring the price criteria is based on the discounted average price (excluding lowest and highest bid and discounting the calculated average

[21] *www.irena.org/DocumentDownloads/events/CopenhagenApril2012/5_Liming_Qiao.pdf*

by 10%). Bids closest to the discounted average score the highest[22]. The weight on the price is relatively high, compared to 25% for onshore wind, indicating that the scheme favours lower bids. Moreover, the low weight assigned to the bidder's experience decreases the advantage for experienced foreign suppliers.

The concession period is 30 years (including four year construction period), and the entity that is granted concession is responsible for the design, investment, construction, operation, maintenance and decommissioning of the project. When the concession period expires, the entity can sign another concession contract, or decommission the wind farm.

Challenges facing the implementation of offshore wind auctions include insufficient preparatory work from bidders and a lack of clear compliance rules. Some projects had insufficient wind measurement data, or lacked technical feasibility studies. This resulted in poor estimates and uncertainty in installed capacity, power output and cost, leading to the cancellation of projects in some cases. The selection criteria (*i.e.*, focusing on the lowest bidding price) has led to frequent underbidding due to the high level of competition, causing many projects to be postponed or cancelled. Underbidding also resulted in public companies becoming the main, if not the only winners, leaving private and foreign investors out of the market. This situation contradicts the original objectives of attracting multiple sources of investment and avoiding the concentration of market power. The compliance with PPAs and the verification of the completion of projects has also been unclear and not enforced in many cases, resulting in projects with various performance levels. Moreover, offshore wind auctions face ineffective coordination among government bodies.

It has been more than two years since the first offshore wind auction was launched (September 2010), but project development has yet to commence. The NEA issued the auction and selected four winners, whilst the State Oceanic Administration was charged with managing the sea area. Out of the four projects selected, one was moved 15 km further offshore, the area of a further two projects had to be reduced and the fourth is still going through the necessary approval processes for its relocation, as the original area was found to have conflicts with other uses.

As shown in Table 6, the price of onshore wind did not drop following the implementation of the auction, in part due to changes in the design of the scheme that were meant to reduce underbidding and support the development of the local industry. The lack of non-compliance rules and the focus of the evaluation

Table 6 Summary of volumes and prices of the winning bids in China

YEAR	AUCTION TYPE	TECHNOLOGY	VOLUMES AUCTIONED (MW)	VOLUMES CONTRACTED (MW)	AVERAGE CONTRACT PRICE (YUAN/ kWh)	AVERAGE CONTRACT PRICE (USD/ MWh)
2003[23]	Technology-specific	Onshore wind	200	7,300*	0.4365, 0.513**	52.7, 61.9
2004			300		0.382, 0.519, 0.509	46.1, 62.7, 61.5
2005			450		0.4877, 0.4616, 0.6	59.4, 56.3, 73.1
2006			700		0.4656, 0.5006, 0.42	58.3, 62.7, 52.6
2007			4,750		0.4680, 0.5216, 0.5206, 0.551	59.1, 65.8, 65.6, 69.5
2009		Solar PV	10	10	1.0928	159.8
2010			280	280	0.73-0.91	106.9, 133.2
2011		CSP	50	50	0.9399	139.6
2011		Offshore wind	1,000	1,000	0.7779, 0.7070, 0.6881, 0.6882	115.5, 105, 102.2, 102.2

Source: (Junfeng, et al., 2007)

*Notes: * The reason that the total volume contracted is bigger than the sum of the volume auctioned is because during the auctioning process the understanding of the wind capacity on site improved in some cases and then the contracted capacity was modified accordingly (in most cases, they increase the capacity e.g. from 300 MW to 600 MW for a project auctioned in 2007).*

*** The reason why there are different prices is that auctioning is project/site-specific.The same applies to offshore wind.*

[22] *www.bnef.com/Insight/2118*

process on the price criterion led to high competition and underbidding in the early rounds resulting in prices that were lower than reasonable to make the project effective. In the second round, the same companies bid higher for projects with the same wind resources and similar conditions; for example, the bidding price by the Huarui company for the Rudong wind farm was 40% higher in 2004 than it was in 2003 (0.56Yuan/kWh in 2004 versus 0.3979Yuan/kWh in 2003). The considerably low prices were a result of over-estimating the wind resource and hence the expected electricity generation or underestimating the cost of the wind turbines and maintenance (Junfeng, et al., 2007).

In order to limit underbidding in 2005, the criteria for ranking bidders were expanded to cover their comprehensive strength, including technical plans and economic benefits; their weight increased in subsequent years from 60% in 2005 to 75% in 2006. In 2007, the selection criterion was based on the average bid price (excluding the highest and the lowest) thus explaining the price increase.

For solar PV, prices went down by 17% and 33% depending on the location, mainly due to the decreasing cost of the technology, but it also shows an increasing level of competition and the development of the solar PV industry in China.

2.3.4 Conclusions

Auctions and FIT, along with an enabling framework, have helped reduce market barriers and encourage large-scale deployment of RE-based electricity in China. They have played a significant role in promoting the development of large-scale RE projects and local RE industries.

The RE auctions were instrumental in this development: for instance, during the lifetime of wind auctions, 7.3 GW of wind capacity was contracted. The auctions also served to discover the real price of RE resulting in the replacement of auctions by FIT in 2009.

PREVENTION OF UNDERBIDDING

The absence of stringent compliance rules leads to the risk of underbidding. Projects for certain technologies (*e.g.* solar PV, CSP) are still selected based on the 'lowest price wins' criterion and therefore these auctions are susceptible to underbidding. To reduce this risk in the case of wind, other criteria were added to the project evaluation stage including technical experience and the local economic benefits. In addition, the change of the method for calculating contract prices from the lowest bid to the average bidding price helped reduce the risk of underbidding.

SITE SELECTION

Auctions in China are site specific, where the government auctions projects in pre-determined locations. As such, it frees the investors from the liability of securing land, obtaining environmental permits, carrying out resource assessments and securing access to the grid. However, in the case of offshore wind, the lack of proper coordination among different government entities in resolving the complications came about, such as delays due to the lack of consultation with the State Oceanic Administration regarding the demarcation of the suitable sea area for project implementation. Other key lessons for offshore wind included the need for more thorough feasibility studies, clear compliance rules, as well as effective coordination within government entities at different levels that includes all stakeholders.

LOCAL CONTENT

The local content requirement on onshore wind that was set at 50% in 2003 and that was raised to 70% in 2005, played a significant role in the development of the domestic wind industry. In 2012, four out of the top ten manufacturing companies were Chinese and they accounted for 27% of the total global market share (REN21, 2012). By 2010, the three Chinese companies Sinovel, Goldwind and Dongfang were among the top ten wind power technology manufacturers globally. Moreover, leading global wind technology manufacturers such as Vestas, Suzlon, Gamesa and GE have set up production facilities in China (Wang, Qin and Lewis, 2012). In 2009, the requirement on local content was abolished. It is interesting to note that after 2005, no foreign company won any of the wind auctions as local equipment being cheaper in initial cost was often chosen for projects (Howell, et al., 2010).

As for offshore wind in 2011, there was no explicit requirement on local content, but the design of the auction was not favourable to foreign suppliers since the weight on experience in turbine manufacturing, which is normally the biggest advantage of foreign suppliers, was as low as 9%. Moreover, the expectation of a low rate of return made it difficult for international developers to compete with state owned enterprises; resulting in low participation by international developers, as only two out of the 26 bidders were foreign. There are concerns that the state-owned enterprises were able to submit low bids because they benefited from financial support from their parent companies through fossil fuel profits. Although this cross-subsidisation resulted in the deployment of wind energy, it hindered discovery of true cost of wind energy, undermined competition and deterred foreign investment (Cozzi, 2012).

2.4 MOROCCO

2.4.1 Country context

Morocco has been classified as a lower middle income country by the World Bank[23] and its GDP growth rate exceeded 4.5% in 2011. The investment conditions are ranked as medium in the World Bank's Ease of Doing Business Index. In the 2012 Ernst and Young renewable investment attractiveness indices, Morocco is ranked 25 out of 40 reflecting its investment potential (Ernst and Young, 2012b). The main drivers for RE deployment in Morocco include the increasing demand for additional generation capacity, the high dependence on imported fossil resources and the abundance of RE resources (wind, solar and hydro). The establishment of dedicated entities such as the public utility Office National de l'Electricité (ONE) responsible for the wind sector and the public-private Moroccan Agency for Solar Energy (MASEN) in the solar sector have helped increase the RE investment attractiveness of Morocco. MASEN is owned in equal parts by the government of Morocco, ONE, the Energy Investment Company (SIE) and the Hassan II Fund for Economic and Social Development.

ONE is a public owned company and currently holds a monopoly on the electricity market despite efforts to liberalise it over the past two decades. It operates as a single buyer owning most of the transmission and the distribution grid. Morocco started to liberalise its electricity market in 1994 when it introduced Decree No. 2-94-503 stating that power plants with capacities up to 10 MW can be built and operated by private enterprises. Projects above 50 MW should be auctioned openly and all power produced is sold to the ONE. In 2008, Law No. 16-08 raised the 10 MW upper limit to 50 MW. However, IPPs still have to negotiate PPAs with the ONE on a case by case basis. As of 2009, the IPP-owned share of total installed capacity was 34% (26% from coal, 7% from natural gas and 1% from wind power). In a further effort to liberalise the Moroccan electricity market, the new Renewable Energy Law 13-09 allowed private entities to produce and sell electricity from renewable sources.

Morocco is the only North African country without significant oil resources and it is the largest energy importer in the region, with 95% of energy needs being sourced externally. In 2010, Morocco generated 25 TWh of electricity (primarily from coal) with a share of 18.4% from RE, the majority from hydro (IEA, 2012). In order to diversify its energy mix, Morocco seeks to expand its wind and solar capacity by conducting auctions. In 2010, the Government announced its targets of 2,000 MW of solar and 2,000 MW of wind by 2020. There are also plans for additional 550 MW of hydro by 2016. The aim is to reach a renewable electricity installed capacity share of 42% by 2020 (14% each for solar, wind and hydro)[24].

ONE has been developing hydro projects since the 1960s and wind projects since 1998, and had accumulated about 280 MW of wind and 1,306 MW of hydro by 2010[25]. In the same year, Morocco announced the new Integrated Wind Energy Project that aims to increase installed wind capacity from 280 MW to 2000 MW by 2020 at an estimated investment of USD 3.7 billion. Additionally, MASEN was created by the Ministry for Mines, Energy, Water and the Environment (MEMEE) to manage auctions for CSP (and possibly PV).

2.4.2 Evolution of tariff-based support mechanisms for RE-based electricity

Prior to the launch of the Integrated Wind Energy Project, ONE used to auction the engineering, procurement and construction (EPC) of wind and hydro projects and was responsible for financing, operating and maintaining these projects. By 2010, all existing hydro and two wind projects were developed (60 MW

23 *World Bank Statistics, http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG*

24 *Ministère de l'Energie, des Mines, de l'Eau et de l'Environnement ; Stratégie Energétique Nationale 2011*

25 *Ministère de l'Energie, des Mines, de l'Eau et de l'Environnement ; Stratégie Energétique Nationale 2011*

in 2007 and 140 MW in 2010) by auctioning the EPC. As such, there is no PPA and ONE owns the projects.

In 2006, the EnergiPro programme was established and it granted a tariff for self-generation of installed capacity up to 50 MW in order to incentivise large industries to invest in RE and to promote independent production of electricity to ease pressure on the ONE. Entities with high electricity consumption were allowed to construct power plants (up to 50 MW) and connect them to the national grid to transmit the electricity to the consumption site. There are no technology restrictions in EnergiPro; however, companies that have taken part in the programme have mostly installed wind power so far (Norton Rose, 2010). The surplus of the generation can be sold to ONE at a fixed tariff. The scheme had two main components:

» ONE ensures grid access to all RE-based electricity, therefore, the project does not have to be located at the consumer site. The IPP has to pay minor charges to finance the strengthening of the grid.

» Any surplus electricity produced is guaranteed to be purchased by ONE at 60% of wholesale electricity price (purchase at full price may encourage over-sizing). The PPA is fixed for 20 years.

Moreover, ONE operates a subsidised programme for solar PV installations in rural areas called the Global Rural Electrification Programme, *Programme d'Electrification Rural Globale* (PERG).

In 2011, Morocco introduced the auction scheme for wind and later for solar in 2012. ONE is still responsible for managing auctions for wind and hydro projects, whereas solar auctions are undertaken by MASEN. Figure 6 provides an overview of the RE-based electricity support mechanisms to date.

2.4.3 Description of the auction schemes

The MEMEE has the overall responsibility for achieving RE targets and implementing the auctions. The auctions run in two phases: the pre-qualification phase and the evaluation phase. Auctions are technology and site-specific and the type of auction used is the first-price sealed-bid auction.

Table 7 illustrates the main characteristics of Morocco's current auction schemes.

WIND AUCTIONS

In 2010, the previously adopted EPC model was replaced by auctions in which the project developers are responsible for the financing, constructing and operating the project. The electricity is sold to ONE according to the PPA. This takes place under a public private partnership between ONE and the winning project developer in order to share the risk and facilitate access to finance. Wind auctions are announced through ONE's website on an ad-hoc basis. Under the Integrated Wind Energy Project, there are plans for six wind farms: one 150 MW wind farm was auctioned in Taza in 2011 and five more (a total of 850 MW) were auctioned in 2012. The auctions run in two phases: the pre-qualification phase and the evaluation phase.

Pre-qualification phase: an expression of interest is published by ONE and the requirements for the prequalification include the project developers' financial capacity, access to finance and technical experience. For instance, the bidder must have completed a minimum of 10 wind projects and at least two of them must be over 10 MW. An inter-ministerial committee assists the ONE in the selection of qualifying projects. Preference is given to regional or national companies and selected projects are invited to participate in the auction.

Figure 6 Evolution of RE electricity tariff-based support mechanisms in Morocco

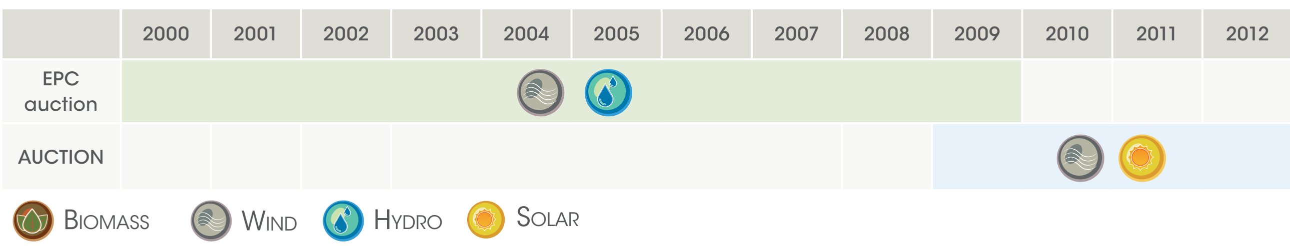


Table 7 Summary of the major characteristics of auctions in Morocco

CHARACTERISTICS OF THE AUCTIONS IN MOROCCO	
Legal basis	Renewable Energy Law 13-09 and MASEN Law 57-09 adopted in 2010
Authorities in charge	Government: MEMEE; Executive body:MASEN in charge of solar auctions; ONE in charge of wind and hydroauctions
Eligible technologies	ONE organises technology specific auctions for wind onshore and hydro in designated locations and for maximum capacity installed MASEN organises technology specific auctions for solar CSP (combined with some solar PV) in designated locations and for maximum capacity installed
Selection process	1. Pre-qualification phase: experience, financial and technical capacity 2. Evaluation phase: technical specifications, financial (debt/equity ratio, PPA percentage), industrial integration (e.g. 30% local content for solar auctions)
Agenda of auctions	160 MW solar Ouarzazate I: March-December 2010 1st phase, January-Oct 2011 2nd phase, financial close September 2012 150 MW wind onshore in Taza: October-December 2010 1st phase, May 2011-March 2012 2nd phase, financial close end 2012 850 MW onshore wind in 5 locations: January-end 2012 2nd phase on-going
Duration of tariff	20 years for wind and 25 years for solar
Compliance rules	Penalties for delay and underperformance determined in PPA. Guarantee paid at signature of PPA. Termination of PPA as last resort.

Evaluation phase: ONE sets the criteria that the bidders must include in their offers, such as the technical specifications, the debt/equity ratio, the percentage of public participation in the capital and the requirement on local content. Projects are also evaluated based on the price.

The following wind auctions have taken place:

» In 2011, a 150 MW wind project consisting of 50 wind turbines (3 MW each) in Taza, with a 20 year public private partnership, was awarded to a consortium led by France's EDF Energies Nouvelles (EDF EN). The project management consists of a local subsidiary company (EDF EN Maroc), along with other members of the consortium, including Japan's Mitsui and turbine manufacturer Alstom. For this auction, the size of the project was too small to aim for full industrial integration, so the local content requirement was limited to the purchasing a percentage of the material from local industry.

» Pre-qualification for 850 MW was undertaken in January 2012. There were 16 consortia who submitted bids and the pre-qualified bidders have been announced [26]. The selected bidder will enter a public private partnership with MASEN. Financing will be provided by the African Development Bank, the European Investment Bank and German Development Bank. The conditions of the industrial integration criteria are still to be designed for this auction.

Regarding compliance rules, penalties are determined in the PPA for delay in the construction and/or for lack of operational performance of projects. A financial guarantee is required at the time of financial closure. Bidders are responsible for meeting financial close under the PPA and failure to do that by a fixed date may result in the termination of the PPA (Norton Rose, 2010). So far, delays have been handled without the need to apply any penalties.

SOLAR AUCTIONS

MASEN is responsible for managing the solar auction scheme to install 2000 MW across five sites in Morocco by 2020. In 2012, the first solar auction was announced for 500 MW at Ouarzazate, which will be the largest CSP project in the world (combined with some PV), and will be implemented in four phases. The auctioning of phase one for 160 MW (Ouarzazate I) was concluded in 2012 and the second phase (Ouarzazate II) is scheduled to be auctioned in 2013. MASEN operates a two phase auction process like ONE. A pre-qualification phase and an evaluation phase.

In the pre-qualification phase, bidders were selected if they satisfied pre-defined requirements including

[26] *See ONE website for details on the wind auctions: www.one.org.ma/*

financial capacity, access to finance and technical experience. The lead of the consortium must 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 must have a net worth of at least USD 200 million. As for the consortium bid's technical experience, the lead company must have developed, operated and managed a thermal power plant 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 must also have successfully developed and operated a minimum capacity of 45 MW thermal solar power plant (Norton, 2010)[27].

For Ouarzazate I, the expression of interest was released by MASEN in March 2010 and bids from 200 consortia were received, four of which were pre-qualified.

In the evaluation phase, the selection was based on the price. MASEN also set a condition on local requirement: 30% of the plant's capital cost (local equipment manufacturing, operation and maintenance, R&D) must come from the local industry. MASEN is responsible for promoting the development of R&D, education and training to support this local requirement as a means of improving economic conditions and creating jobs in country. In order to limit the cost per kWh, MASEN also:

- Took an active role in conducting an initial environmental impact assessment for each project site and in commissioning a pre-feasibility study for determining the type and size of the auctioned CSP projects.
- Secured concessional low-interest loans from international finance institutions[28] in order to fund the public private partnership between MASEN (25%) and the project consortium (75%), the aim being to reduce the support costs for Morocco.

The winning bid is awarded a 25 year PPA with MASEN and the project is to be commissioned by 2015. A financial guarantee is required at the time of financial closure and bidders are responsible for meeting financial close under the PPA, failure to comply by a fixed deadline may result in the termination of the PPA (Norton Rose, 2010).

For Ouarzazate 1, the ACWA consortium[29] won the bid with an average price of MAD 1.6/kWh (USD 0.19/kWh) compared to MAD 2.06/kWh (USD 0.24/kWh) offered by the Enel-led consortium and by the Abengoa-led consortium. The winning price was 22% lower than the next competing bidder. This suggests that ACWA's consortium has a significantly lower rate of return as compared to its rivals (estimated at around 5% as opposed to 10% for the competing consortia) and therefore, it was able to outperform its more experienced rival (Abengoa and ACS own 410 MW and 300 MW of commissioned CSP as compared to ACWA and TSK's 5 MW of recently awarded bid in South Africa)[30]. Prices and volumes and winning bids are presented in Table 8.

In designing the solar auction, MASEN followed the procurement criteria used by World Bank and the other international financing institutions (as far as these were consistent to each other). The penalties for project delay are defined in the PPA and depend on the severity of non-compliance.

Table 8 Summary of volumes and prices of the winning bids in Morocco

YEAR	AUCTION TYPE	TECHNOLOGY	VOLUMES AUCTIONED (MW)	VOLUMES CONTRACTED (MW)	AVERAGE CONTRACT PRICE (USD/kWh)
2011	Technology-specific	Wind	150 MW	150 MW	NA
2012			850 MW	In process	NA
2012		Solar	160 MW	160 MW	0.189

27 *without being liable for penalties or damages in performance or delay, in excess of 5% of the contract value*

28 *The Ouarzazate project is financed by the African Development Bank USD 236 million, European Investment Bank USD 156 million, International Bank for Reconstruction and Development USD 200 million, KfW USD 136 million, French Agency for Development USD 136 million and Clean Technology Fund USD 100 million. The equity stake is USD 474 million.*

29 *Arabian Company for Water and Power Development (ACWA Power) (Saudi Arabia), Aries Ingeniería y Sistemas (Spain) and TSK Electronica y Electricidad (Spain)*

30 *https://www.bnef.com/Insight/5976*

2.4.4 Conclusions

It is still too early to draw conclusive lessons learnt from the new solar auction scheme in Morocco, as the first project has only recently been awarded. But some initial lessons can still be learnt from the auction process so far.

THE TWO-PHASE SELECTION PROCESS

ONE and MASEN both use a two-phase selection process with a pre-qualification phase and an evaluation phase based on mostly the price. Both the international financing institutions and MASEN had no experience in CSP auctions of this scale so discussions with individual consortia were undertaken to examine the technical specifications of each bidder. The objective was to select only the bidders with relevant experience and financial capacity to reduce the risks that might impede the successful implementation of the projects and to eventually achieve Morocco's ambitious targets.

INSTITUTIONAL AND REGULATORY FRAMEWORK

Morocco's stable political and regulatory environment and its experience with IPPs have been essential in attracting investors; the establishment of the specific governing agency for solar energy, MASEN, was instrumental in the successful management of the CSP solar auction. Moreover, Morocco's adoption of the public private partnership model was crucial in de-risking the large scale projects, thus securing their financing, especially for CSP, which was the largest initiative in the region of its kind.

CONCESSIONAL FINANCING

The provision of concessional finance through international financing institutions and the financial backing provided to the bidders by MASEN led to a favourable result for the auction, *i.e.* low prices in the solar bids submitted.

One key reason why ACWA's consortium was able to bid this low was that the project was being financed using concessional debt (lower interest rates of approximately 3% with the inclusion of a grace period, during which only the interest and not the principal has to be paid). These rates would not have been offered by commercial lenders as this is the first standalone utility-scale CSP project in the country. This project benefited from this high level of support because it was perceived as a strategic demonstration project designed to spur replication and improve the technology and create jobs (it has been estimated that Ouarzazate 1 will generate 2080 man years for the construction and 112 full time jobs for the operation phase), develop the local clean industry and contribute to the socioeconomic development of certain regions of Morocco[31].

2.5 PERU

2.5.1 Country context

Peru is a fast growing economy with a high GDP growth rate of 6.9% in 2011[32] and investment in the country has been classed as easy in the World Bank's Ease of Doing Business Index. The power sector in Peru was reformed and restructured between 1991 and 1993, followed by a privatisation and concession process. The restructuring process, articulated in the Electricity Concessions Law of 1992, unbundled the vertically integrated state monopoly into generation, transmission, and distribution, thereby paving the way for the introduction of private operators, competition in generation and commercialisation, in addition to adopting the auction scheme. The law established the methodology for tariff setting, granting of concessions, customer service guidelines and operators accountability. It also changed the role of the State from owner and operator to policy maker and regulator (ESMAP, 2011).

In 2011, Peru's total electricity generation was 35 TWh, 57.8% of which came from RE (55% large hydro and 2.8% other RE) (IEA, 2012). Peru's energy resources are abundant and diverse; however, the availability of cheap natural gas[33] has slowed down the deployment of RETs in the country (Cherni, 2012). As of 2011, only 6% of the biomass potential was exploited, 5% of the hydro potential and 1% of the wind potential (Mitma Ramirez, 2012). The country had a target for 5% RE-based electricity generation by 2013 excluding large hydro and has introduced policy measures since 2008 to support this. Peru started its first auction in the second half of 2009, so its experience is fairly short.

[31] *https://www.bnef.com/Insight/5976*

[32] *World Bank Statistics, http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG*

[33] *The sixth largest natural gas reserves in the region are based in Peru. Electricity generation from natural gas is being subsidised by the government, resulting in low prices and the distortion of energy market and hindering the development of RE. International Finance Corporation (IFC, 2011).*

2.5.2 Evolution of tariff-based support mechanisms for RE-based electricity

The Ministry of Energy and Mines (MEN) has established a series of legal decrees and regulations that promote RE-based electricity, creating a legal framework that aims to provide investment security for the sector. In particular, the legislative decree No. 1002[34] designates MEN as the responsible entity for designing the national RE policy and defining the share of RE-electricity (excluding hydro) that must be procured by the Peruvian system operator at a fixed price. The extra cost of supporting RE-based electricity is shared among all consumers in the electricity bill. For the first five years (until 2013), this quota was set at 5% of the total national electricity consumption. Renewable energy sources include biomass, wind, solar, geothermal, tidal and small-hydro (below 20 MW). The decree also states that the RE-based electricity is given priority in the daily dispatch. Producers sell the RE-based electricity in the market and receive a fixed tariff by the Peruvian government's Energy and Mining Regulator (OSINERGMIN) determined in auctions carried out by OSINERGMIN. Figure 7 illustrates renewable energy auctions that have been held so far.

2.5.3 Description of the auction scheme

Peru operates technology-specific pay-as-bid sealed-bid auctions. The basics of the auction are developed and approved by the MEN and the rules and regulations are very clear and simple compared to other countries, facilitating the participation of bidders[35]. Table 9 provides an overview of the key features of Peru's RE auction scheme.

OSINERGMIN determines a cap on the generation and a price ceiling for each auction and technology, above which no offer would be accepted. The price ceiling is determined according to the project's estimated capital and operating costs with an expectation to yield a rate of return of 12% per year over a contract period of 20 years, taking other factors into consideration such

Figure 7 Evolution of RE electricity tariff-based support mechanisms in Peru

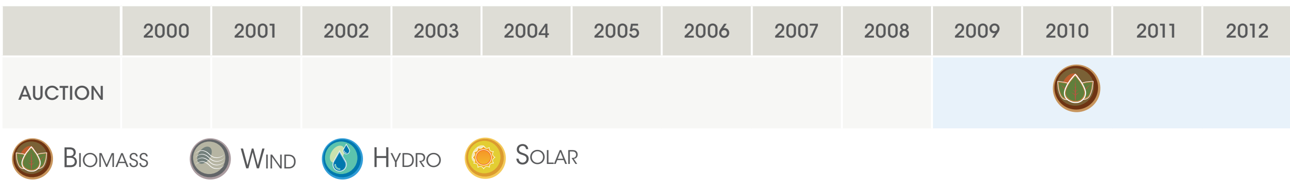


Table 9 Summary of the major characteristics of auctions in Peru

CHARACTERISTICS OF THE AUCTIONS IN PERU	
Legal basis	Supreme Decree No. 1002 adopted in 2008, amended by Supreme Decree No. 012-2011-EM in 2011
Authorities in charge	Ministry of Energy and Mines (MEN) Energy and Mines Regulator (OSINERGMIN)
Eligible technologies	Technology-specific auctions targeting solar, biomass and waste, wind, small hydro and geothermal
Selection process	Selection in one round without a prequalification phase based on price and quota of energy; Ceiling price defined by OSINERGMIN (undisclosed) and quota defined by MEN. The bidder must submit proof of a range of technical requirements, provide resource assessments for a period not less than one year, submit a pre-feasibility study for each project
Agenda of auctions	First auction: 2009-2010; Second auction: 2011; Third auction envisaged for 2013
Duration of tariff	20 years PPA
Compliance	Use of performance bonds deposited by the project developers in order to secure completion of projects. Compliance with volume of energy generation contracted is ensured by penalising shortages. In the case of delays, extension can be granted and/or performance bond value is increased. Contract is terminated if failure to complete.

[34] *EL PRESIDENTE DE LA REPÚBLICA, Decreto Legislativo de promoción de la inversión para la generación de electricidad con el uso de energías renovables DECRETO LEGISLATIVO Nº 1002, 2008 www.osinerg.gob.pe/EnergiasRenovables/contenido/Normas/DL_No_1002.pdf*

[35] *Telephone interview with Riquel Mitma Ramírez, Technical Coordinator, OSINERGMIN (27 August 2012)*

as the size of the project and the estimated connection costs[36]. The ceiling price is only revealed if it is exceeded by at least one bid received in the case where the total volume auctioned is not contracted in a complete auction round. In such an event, there is no restriction on the bids that exceeded the ceiling to re-submit a bid for the same project (Maurer and Barroso, 2011).

Bidders are required to deposit several guarantees, including a bid bond for USD 20,000/MW of capacity installed (that is lost if the bid is won but the bidder fails to sign the contract), and at a later stage, a performance bond of USD 100,000/MW of capacity installed. If delays occur in the construction phase for two consecutive quarters with regard to the declared timeline, 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 MEN 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.

The winning projects are granted priority dispatch and access to transmission and distribution networks. PPAs are set for a period of 20 years but for a limited amount of energy produced annually (GWh/year). Electricity produced above that cap is sold at market price, and projects that produce less than the amount specified in the bid are penalised by a reduction in the tariff.

In the first auction round in 2009, a total of 33 bids were received out of which 26 projects were contracted. The volumes auctioned were not met, particularly for biomass and small hydro. For these technologies, the average prices offered in the bids were considerably lower than the ceiling price (see Table 10). Since the ceiling price of biomass was higher than that of wind, the volumes auctioned but not covered were contracted to wind projects that were not selected but still below the ceiling price. Wind and solar auctions also resulted in prices 27% and 18% lower than the ceiling respectively (Battle and Barroso, 2011). This could be due to the high level of competition among bidders, in addition to the fact that the ceiling price was kept undisclosed. The success rate of each round is shown in Table 10 and it is defined as the percentage of volume awarded compared to volume auctioned. Table 10 below provides a summary of the winning bids in Peru.

A second call for bids was announced in 2010 to meet the capacity requirements not covered in the first round. It attracted 19 companies with 27 projects, but only one small hydro project of 18 MW capacity was awarded. Other participants were disqualified because the prices offered were higher than the ceiling price.

Table 10 Summary of volumes and prices of the winning bids in Peru

TECHNOLOGY	YEAR	VOLUMES AUCTIONED (GWh/YEAR)	VOLUMES CONTRACTED (GWh/YEAR)	SUCCESS RATE	AVERAGE CONTRACT PRICE (USD/MWh)	CEILING PRICE (USD/MWh)
Small hydro	2009/2010 first call	500	160	32%	60.2	74
	2009/2010 second call		18 MW	5%	64	-
	2011	681	681	Almost 100%	53.2 (-11%)	-
Solar PV	2009/2010	181	173	96%	221.1[40]	269
	2011	43	43	100%	119.9 (-46%)	-
Wind	2009/2010	320	571	178%	80.4	110
	2011	429	473	100%	69.0 (-14%)	-
Biomass and waste	2009/2010	813	143	17.6%	63.5	120
	2011	828	14	2%	99	-

36 *OSINERGMIN 2011, RESULTADOS PRIMERA SUBASTA. Available at: www2.osinerg.gob.pe/EnergiasRenovables/contenido/Resultado1raSubasta.html*

It is believed that bidders raised their offered prices around the ceiling of the first round that was disclosed after its failure to cover all the volume auctioned. That ceiling was however reduced in the second round, and this is why many bidders were disqualified. Details of both calls can be found in Table 10.

In the second auction in 2011, OSINERGMIN aimed to award contracts of 1,300 GWh/year from wind, solar, biomass and waste and up to 681 GWh/year from small hydro, reducing the volume auctioned by almost 78% from the first round in order to increase competition and reduce prices[37]. Out of the 37 bidding offers 10 projects were awarded, meeting almost all of the demand. The next auction is expected to take place in 2013.

In January 2012, 10 RE projects were connected to the national grid, including hydro, biomass and biogas plants. In October 2012, 4 solar projects became operational. The remaining projects are scheduled to start commercial operation in 2013. Only one project has missed its deadline so far and was granted an extension by the government[38].

The Peruvian auctions were successful in bringing the prices down. Between the first auction in 2009/2010 and the second one in 2011 prices decreased by 11% for small hydro, 14% for wind and 46% for solar PV (which could also be partly attributed to the decreasing cost of the technology). However, the targeted volumes were not always met (specifically biomass and small hydro), and this could be due to the price ceiling being set too low, disqualifying bidders that offered higher prices.

2.5.4 Conclusions

Peru's auctions have been instrumental in attracting RE project developers and they helped secure a minimum of USD 420 million investments[39]. By 2011, MEN had contracted a total 639 MW of RE across 36 projects: four wind (142 MW), five solar (80 MW), one biomass (23 MW), two biogas (4 MW) and 24 small hydro (180 MW). That was achieved with relatively minimal additional institutional costs (Mitma Ramirez, 2012).

CLEAR AND SIMPLE PROCESS ATTRACTING FOREIGN INVESTMENTS

The auctioning process is straightforward and the rules are simple, clear and easy for bidders to follow. In addition, the auctions were successful in attracting foreign companies (from Spain and other countries in South America) in the absence of any requirements on local content. This is an advantage for transfer of knowledge and expertise. Nevertheless, the auctions have not met the pre-determined volumes for all technologies, mainly due to the low ceiling prices that were set.

STRINGENT COMPLIANCE RULES

Compliance has been good so far and only one project was delayed and did not enter into commercial operation as scheduled. This is mainly due to the stringent application of the compliance rules, including the financial guarantees for bidding and for commissioning, and the strict penalties applied in case of delays or failure to deliver. However, these rules might have limited the number of participants in the auction.

There is no mechanism for reallocation of energy that has not been awarded and both the auctions in 2010 and 2011 failed to meet their quotas. Moreover, the auction model promotes the creation of large-scale generation versus small projects, thereby limiting the participation of small to medium enterprises. In any case, the auctions have helped Peru meet its short term objective for 2013.

2.6 SOUTH AFRICA

2.6.1 Country Context

South Africa is classified as upper middle income country with a GDP growth rate of 3.1% in 2011[40]. It was ranked 35 out of 180 according to the World Bank's Ease of Doing Business Index 2011, indicating that it has a regulatory environment that is relatively conducive to starting and operating businesses. South Africa was ranked 17 in Ernst and Young's renewable energy country attractiveness indices 2012 for all renewable technologies making it a target country for private investment (Ernst and Young, 2012b).

37 *Telephone interview with Riquel Mitma Ramírez, Technical Coordinator, OSINERGMIN (27 August 2012)*

38 *Telephone interview with Riquel Mitma Ramírez, Technical Coordinator, OSINERGMIN (27 August 2012)*

39 *FONDO MULTILATERAL DE INVERSIONES (FOMIN)/BLOOMBERG NEW ENERGY FINANCE (BNEF) (2012), CLIMA SCOPIO 2012 Cambio climático y clima de inversión en América Latina y el Caribe. Available at: www5.iadb.org/mif/Climatescope/2012/img/content/pdfs/esp/Climascopio2012-reporte.pdf*

40 *World Bank Statistics: http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG/countries*

In terms of liberalisation of the electricity sector, only the distribution has been fully unbundled. South Africa has a semi-decentralised power distribution sector, with about 180 distribution companies. Unbundling of generation and transmission has not yet taken place, since both activities are dominated by the public utility Eskom, which currently holds the monopoly in the market. Eskom generates more than 95% of all electricity and operates the entire national transmission grid. In 2008, the Renewable Energy Feed-in Tariff (REFIT) programme was introduced to encourage the participation of the private sector in the electricity generation. The REFIT was later replaced by the Renewable Energy Independent Power Producer Procurement (REIPPP) programme in 2011 and the government introduced a bill to create a new entity called Independent System and Market Operator (ISMO). Once the bill is approved, this entity will be responsible for the procurement of electricity from IPPs and the operation of the transmission grid. ISMO reports to the Ministry of Energy which makes key decisions on energy planning. Currently Eskom's Single Buyer Office, established in 2007, is implementing the REIPPP.

Due to its fast growing economy, South Africa's electricity consumption has risen rapidly, outstripping capacity and, leading to a power supply crisis in 2007 and 2008. The demand for electricity is projected to increase significantly in the upcoming years, requiring substantial additional generation capacity within a short time period, which makes RE an attractive solution. Traditionally, RE has not played an important role in South Africa's electricity mix, primarily because of the strong use of coal. In 2010, the total electricity consumption was 240 TWh with 93% generated from coal power plants and only 1% generated from RE, of which more than 90% is from large hydropower plants (IEA, 2012). According to the country's power sector planning policy (the Integrated Resource Plan for Electricity 2010-2030), RE-based generation capacity should rise to 9% by 2030, requiring an estimated additional capacity of 17.8 GW. In order to meet this target, auctions for RE projects were undertaken in 2011 and 2012 with further rounds planned.

2.6.2 Evolution of tariff-based support mechanisms for RE-based electricity

As shown in Figure 8, South Africa started RE auctions in August 2011 to replace the REFIT programme that was initially adopted in 2009 before it came into effect. According to a study for the World Future Council, thee Heinrich Boll Foundation and Friends of the Earth, possible explanations for this change of policy may include potential challenges to grid stability caused by fluctuating energy production from an expected large number of wind power plants; fears of growing expenses on the treasury due to the REFIT's guarantee to buy all renewable electricity; and possible administrative delays caused by an overwhelming number of applications to understaffed authorities (Renewable Energy Ventures (K) Ltd. and Meister Consutants Group Inc.), 2012). RE auctions were considered to be a better scheme for securing competition and lowering prices. The key drivers to the REIPPP include 1) the increase in generation capacity through quickly deployable technologies; 2) the diversification of the energy mix towards less carbon intensive technologies; and 3) the creation of development opportunities through the establishment of a "green economy".

The REIPPP programme is the leading support scheme for RE and the only tariff-based support scheme that South Africa has currently in place. It is mainly used to auction installations with capacity above 5 MW. However, a capacity of 100 MW is reserved to auction small-scale projects with capacities below 5 MW. These projects are auctioned under the umbrella of the Small Projects Renewable Energy IPP Programme and are planned to be auctioned before 2016.

FIGURE 8 EVOLUTION OF RE ELECTRICITY TARIFF-BASED SUPPORT MECHANISMS IN SOUTH AFRICA

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
AUCTION													

WIND HYDRO SOLAR

[41] www.ipprenewables.co.za/#site/index

2.6.3 Description of the auction scheme

CHARACTERISTICS OF THE AUCTION

The REIPPP programme was launched in August 2011 and is scheduled to stay in place until 2014 when PPAs for the last auction are due to be signed. The auction is designed as a pay-as-bid sealed-bid auction. The legal framework for the auction scheme is the Electricity Regulation Act of 2006, and Electricity Regulations on New Generation Capacity (Regulation 7 of GN R. 721 GG No. 32378 dated 5 August 2009).

Auction rounds were announced on a special website of the Department of Energy (DOE), the state-utility Eskom, and the National Energy Regulator of South Africa (NERSA). Successful bidders entered PPAs for 20 years with the transmission operator Eskom and an implementation agreement with the government. Table 11 below provides a summary of the characteristics of the auctions in South Africa.

At the start of the auction, the DOE holds a conference for bidders to understand the auction criteria and the different elements needed for each technology. The auction process operates in two stages:

- *In the first pre-qualification stage*, bidders must demonstrate that the planned project site has been secured and that all necessary approvals have been received. Moreover, bidders need to prove the commercial viability of the project (*i.e.* reliability of suppliers and ability to meet dead-lines). Bids that pass the first stage are admitted to the second stage of the auction.

Table 11 Summary of the major characteristics of auctions in South Africa

CHARACTERISTICS OF THE AUCTIONS IN SOUTH AFRICA	
Legal basis	Electricity Regulation Act of 2006 Electricity Regulations on New Generation Capacity (Regulation 7 of GN R. 721 GG No. 32378 of 5 August 2009) Integrated Resource Plan (20 year country energy plan), 2010 Renewable Energy IPP Procurement Programme, 2011
Authorities in charge	Government: Department of Energy (DOE) Executive body: National Energy Regulator of South Africa (NERSA) Eskom Single Buyer Office: PPA contracts
Eligible Technologies	Technology specific volume targeted across 5 auctions: wind 1850 MW, CSP 200 MW, solar PV 1450 MW, biomass 12.5 MW, biogas 12.5 MW, landfill gas 25 MW, small hydro 75 MW and small projects(<5 MW)100 MW
Selection process	2 stages selection process: 1st: bidders have to meet minimum criteria related to legal, financial, technical and environmental requirements. 2nd: price 70%, economic development including local content 30%
Agenda of auctions	By 2016, maximum of 5 auction rounds planned for total of 3,725 MW across all technologies 1st round: submission date 4th November 2011, preferred bidder announced 7th December 2011, PPAs signed November 2012 2nd round: submission date 5th March 2012, preferred bidder announced 21st May 2012, PPAs signed in February 2013 3rd round: submission date 3rd October 2012 (delayed to 7th May 2013), preferred bidder announced to be confirmed
Volumes auctioned	2011 auction: No volume cap 2012 auction: 1,044 MW volume cap 2013 auction: 1,165 MW volume cap
Volume contracted	In 2011 auction: 1,416 MW; In 2012 auction: 1,044 MW; a total of 1,048 MW Solar PV; 200 MW CSP; 1,196 MW wind; and 14.3 MW Small Hydro
Average contract price	2011 (wind USD 0.17/KWh; solar PV USD 0.41/KWh; CSP USD 0.40/KWh); 2012 (wind USD 0.13/KWh; solar PV USD 0.25/KWh; CSP USD 0.38/KWh)
Duration of tariff	20 years
Compliance	Contracts will be terminated for bidders who fail to meet their commitment under the PPA.

» *In the second evaluation stage* of the auction, bidders are assessed based on the following: 70% of the weight is allocated to the price offered and 30% is allocated to the project's level of contribution to economic development (black economic empowerment, job creation and local content). Whilst a 35% local content requirement was set before the first round as part of the Green Economy Accord, the government plans to raise the requirement to 75% over time (Kuntze and Moerenhout, 2012). In the accord, the wind and solar industries have committed to creating 50,000 jobs by 2020 (South African Renewables Initiative, 2010) for South African nationals by attracting manufacturers to the country, and help alleviate the current high unemployment rate of over 25%[42].

Contracts are terminated for the bidders who fail to meet their commitment under the PPA.

IMPLEMENTATION OF AUCTIONS IN SOUTH AFRICA

Five auction rounds were planned with a total target of 3,725 MW, with specific volumes for each technology (onshore wind 1850 MW, CSP 200 MW, solar PV 1450 MW, biomass 12.5 MW, biogas 12.5 MW, landfill gas 25 MW, small hydro 75 MW and 100 MW for small projects <5 MW). Within each auction round capacity limits are set for each technology, so there is no competition between different technologies. If the target capacity for a certain technology is not achieved within a given round, the needed capacity is added to the subsequent round to ensure that the total capacity target is achieved in the end.

Between the start of the programme in August 2011 and July 2012, South Africa held three RE auction rounds, two of which have closed. The third was scheduled to accept bids (start of second stage) until October 2012, but it was extended to May 2013, due to the realisation that the prequalification process is both lengthy and time consuming after accounting for the experience from the first two auction rounds.

As of August 2012, South Africa's DOE had awarded projects with a total volume of 2,456 MW: 1,416 MW in the first round and 1,040 MW in the second (a total of 1,048 MW solar PV, 200 MW CSP, 1,196 MW wind and 14.3 MW small hydro). PPAs for these projects were delayed as deadlines in the initial bid were too tight and did not account for lengthy administrative procedures and delays caused by complications faced in securing approvals (*e.g.* land zoning). Financial close for the first auction round took place in November 2012 when all PPAs were signed. There have been no significant issues to date with moving towards implementation. A summary of the auction rounds are included below:

In the first round, the ceiling prices were based on the FIT levels set under the preceding REFIT scheme and they were disclosed to the public. From the 53 bids submitted in November 2011, 28 preferred bidders were announced one month later. The offered prices were close to the ceiling price because the only capacity limit that was set was the overall 3,725 MW target, which was to be met across five separate rounds of auctions and broken down into individual total targets for each technology. All projects that satisfied the requirements were selected and the total volume contracted was 1,416 MW; wind and solar PV were the main contracted technologies with roughly 630 MW for each and 150 MW awarded for CSP. The average prices of the bids (shown in Table 12) were relatively high (USD 0.143/kWh for wind, USD 0.345/KWh for solar PV and USD 0.38/KWh for CSP). The lack of competition owning to uncapped allocation failed to create pressure on the bidders to reduce their offered price.

In the second round, 79 bids were received in March 2012, 51 of which were qualified. The percentage of qualifying projects rose to 64% (from 53% in in the first round) but only 19 bidders were selected due to the cap imposed of 1,044 MW. The ceiling prices for each technology were undisclosed. The average prices of the winning bids (shown in Table 12) were considerably lower than the first round (USD 0.112/kWh for wind and USD 0.206/kWh for solar PV). This was due to 1) the slightly decreased price ceilings for each technology in the second round, and 2) the allocation of a capacity limit for each technology. Therefore prices received for the second auction round were very competitive and even lower than expected. This raised concerns for the Eskom Single Buyer Office that winning bidders may not be economically viable. In this case, defaulting bidders would lose the right to the PPA and the allocated capacity would be added to the next auction round.

[42] *Bloomberg, South African Retail Sales Growth Eases as Economy Stalls, available at www.bloomberg.com/news/2012-12-11/south-african-retail-sales-growth-eases-as-economy-stalls.htmlhttp://www.bloomberg.com/news/2012-12-11/south-african-retail-sales-growth-eases-as-economy-stalls.html*

As shown in Table 12, prices dropped considerably between the first round and the second round of auctions for wind and solar, although they were only a few months apart. This was predominantly the influence of the increased level of competition created in the second round by setting a limit on the capacity of technologies auctioned. Another reason was that the price ceilings were kept undisclosed in the second round, resulting in much lower bids. In fact, the ceiling price disclosure in the first round (using the tariffs set for the REFIT programme) had led to high prices close to that ceiling. There were no successful bids for biomass, biogas, and landfill gas technologies, which may possibly be attributed to the low price ceilings for these technologies.

Both auctions saw a good participation of bidders and the second round resulted in a higher percentage of qualifying projects, indicating a better understanding of the pre-qualification process among bidders and/or improved dissemination, as well as increased clarity on the requirements, from the government. Moreover, the scheme managed to attract a good number of international investors, which could be promising for the development of the domestic RE industry. The second round of projects awarded was projected to result in the creation

Table 12 Summary of volumes and prices of the winning bids in South Africa

AUCTION	AUCTION TYPE	TECHNOLOGY	VOLUMES AUCTIONED (MW)	VOLUMES CONTRACTED (MW)	DISCLOSED CEILING PRICE (USD/ kWh)	AVERAGE CONTRACT PRICE (USD/ kWh)
1st round in 2011	Technology-specific	Onshore wind	1,850	634	0.1416	0.143
		CSP	200	150	0.3509	0.40
		Solar PV	1,450	632	0.3509	0.345
		Biomass Biogas Landfill gas	12.5 12.5 25	0	0.1318 0.0985 0.1034	- - -
		Small hydro	75	0	0.1268	-
		Small projects <5 MW	100	0	-	-
2nd round in 2012	Technology-specific	Onshore wind	1,044	563	Undisclosed	0.112
		CSP		50		0.38
		Solar PV		417		0.206
		Biomass Biogas Landfill gas		0 0 0		- - -
		Small hydro		14.3		
		Small projects <5 MW		0		-
3rd round in 2013	Technology-specific	Onshore wind	1,165	-	Undisclosed	-
		CSP				
		Solar PV				
		Biomass Biogas Landfill gas				
		Small hydro				
		Small projects <5 MW				

Source: (Renewable Energy Ventures (K) Ltd. and Meister Consutants Group Inc., 2012) of nearly 7,400 jobs; of which about SAR 12 billion of the total SAR 28 billion (approximately USD 3.34 billion) in renewable energy project value is to use local content[43].

In general, the South Africa auction scheme has successfully attracted project developers. However, future complications may arise when the time comes to update the policy in response to the challenges emanating from dynamic market conditions, as there was little provision for local capacity building and knowledge transfer during the design phase of the scheme, in part due to the foreign consultants assisting the design process.

2.6.4 Conclusions

South Africa decided to meet part of its fast growing electricity demand through a substantial increase in RE capacity. Not having delivered the aimed target, the REFIT was replaced with the auction scheme in an effort to competitively support RE deployment. The auction aimed to reach an ambitious additional RE capacity of 3,725 MW, while developing and supporting local industry, and creating jobs.

INCREASED COMPETITION AND REDUCED PRICES

The first auction round was not very successful in enhancing competition given that the volumes auctioned were not limited for each technology. Also prices offered were high due to the disclosure of the ceiling price. Therefore, in the second round, a cap was set on the volume auctioned and the price ceilings were kept undisclosed, leading to a fierce competition and a reduction in prices.

In both rounds, no projects were awarded to biogas, biomass and landfill gas that could indicate that their price ceiling may have been set too low. This clearly illustrates the important role of the ceiling price, which must be set carefully, and that of caps on volumes auctioned, which should ensure competition.

DELAYS CAUSED BY ADMINISTRATIVE PROCEDURES

In the first round, the deadlines for bid submission did not account for potential delays caused by administrative hurdles. In addition, the timescales set for assessing the bids received were too short, pushing the bid's financial close and the signature of the PPAs several months behind schedule. Timelines should be well adjusted according to expected volumes of bids to be received. This timeframe should also be reflected in the overall planning of the energy sector, given that rapid addition of generation capacity is one of the main drivers for the auction scheme in South Africa.

COMMUNICATION WITH THE BIDDERS AND THE INDUSTRY

The auction process has been a steep learning curve for both the bidders and the auctioneer. This was clearly illustrated by the increasing number of qualifying bidders from the first round to the second who benefited from a clearly communicated transparent process through the DOE's dedicated website. Moreover, adjustments were made in the second and third rounds taking into account lessons learnt from the previous round. Evaluations are still undertaken after each round in order to ensure a continuous improvement in the process. At the same time, communication with the industry is also encouraged in order to set the most appropriate ceiling prices according to market conditions and obtain a better understanding of the capacity of the domestic RE industry before setting requirements on the local content of the projects.

[43] *http://cleantechnica.com/2012/05/23/south-africa-2nd-round-renewable-energy-auction-19-awards-totaling-1044-gw/*

3. Renewable Energy Auction Schemes: Best Practices and Recommendations for Policymakers

When well designed, the price competition inherent to the auction scheme increases the cost efficiency and allows price discovery of RE based electricity, avoiding windfall profits or underpayments. In addition, auctions can be designed to fulfil other national goals such as the development of a local RE industry and the creation of jobs by including local content requirements. This section highlights the main characteristics of auctions and the appropriate conditions under which they can be best implemented. Examples from the case studies are presented to illustrate the types of auctions, ways to ensure competition and compliance as well as other considerations to maximise the benefits of this scheme.

3.1 TYPES OF AUCTIONS

There are several types of auctions, three of them are described in this report: the sealed-bid auction, the descending clock auction and the hybrid auction. Each one has its own characteristics, implementation method, pros and cons.

3.1.1 Sealed-bid auctions

In the sealed-bid auction, bidders simultaneously submit their bids with an undisclosed offer of price and quantity and the bids that meet all of the mandatory requirements are ranked and projects are awarded until the sum of the quantities that they offer covers the volume auctioned. The sealed-bid auction can either be a first-price sealed-bid auction that aims for the allocation of a single project to one project developer (*e.g.* the 160 MW of CSP for the Ouarzazate I project in Morocco in 2011) or a pay-as-bid auction which results in the allocation of multiple units of the same product with different prices to more than one project developer (*e.g.* the 3,725 MW auction of South Africa in 2010). The allocation of the volume to be contracted to more than one project developer reduces the risk of not meeting the demand in case the project is not completed on time or at all.

The selection of bids can take place in one or two phases. In the two-phase selection process, projects go through an initial pre-qualification phase to identify bidders who would be qualified to tender and a second evaluation phase. Pre-qualification is used in certain cases (large projects and those requiring technical expertise) and it helps narrow the field to only those who have the ability to comply with the terms of the contract and the financial capability to undertake the work.

MOROCCO'S TWO-PHASE SELECTION

ONE and MASEN both used a two-phase selection process with a pre-qualification phase and an evaluation phase based on the price. Especially in the case of CSP, the limited experience in auctioning this technology and at this scale required discussions with individual consortia to carefully investigate the technical specifications of each bidder. The objective was to select only the bidders with relevant experience and financial capacity to reduce the risks that might impede the successful implementation of the projects.

The sealed-bid auction is the most common auction design, as it is perceived as straightforward for auctioneers and clear for bidders, lowering the cost of participation. It is simple, easy to implement and good at handling weak competition, as it keeps competitors from revealing any information during the bidding process, such as coordinating their biddings and keeping the prices at a higher level (Maurer and Barroso, 2011).

3.1.2 Descending clock auctions

The descending clock auction differs from the sealed-bid auction in that it uses multi-round bids where the auctioneer starts with a high price and progressively lowers the price until the quantity offered matches the quantity to be procured. This is a more dynamic auction system where participants know each other's bids and adapt their price and quantities accordingly in subsequent rounds which allows for a strong and fast price discovery, making it very efficient. The descending clock auction is also less vulnerable to corruption since the process used to determine winners is open. Additionally, winning bidders do not have to disclose the lowest price they would offer, so it encourages participation (Maurer and Barroso, 2011).

3.1.3 Hybrid auctions

Some countries have implemented a hybrid auction (*e.g.* Brazil) where the first phase is a descending clock auction that results in the supply being met within a certain margin, which allows the discovery of the price ceiling and the second stage is a sealed-bid auction that is held to meet the actual demand with the lowest price.

HYBRID AUCTION OF BRAZIL

Brazil has implemented a hybrid auction where the first phase is a descending clock auction that results in the supply being met within a certain margin and the second stage is a sealed-bid auction that is held to meet actual demand with the lowest price. In the case of Brazil, the use of a hybrid auction aims at taking advantage of the benefits of both auction systems: price discovery in descending clock auction as it has proven to be effective in determining the ceiling price for bids and no collusion between small numbers of participants for setting the final price in sealed-bid auction.

3.2 DESIGN OF AUCTIONS

3.2.1. Technology-specific versus technology-neutral auctions

Apart from the type of auction selected, the volume auctioned could be open to any technology (technology-neutral), to selected RE technologies (alternative energy auction), or specific to one technology.

TECHNOLOGY-SPECIFIC AUCTIONS

One of the main attributes of technology-specific auctions is that they enable the introduction of new technologies; this enables the diversification of the energy mix and reduces technology risks. Technology-specific auctions also allow industry development and economic value creation. Some countries have adopted alternative energy auctions where selected RETs are auctioned. This could be used to introduce selected RETs to the energy mix and to identify the most cost competitive RET in a country.

TECHNOLOGY-SPECIFIC AUCTION LEADING TO WIND INDUSTRY DEVELOPMENT IN BRAZIL

In Brazil, the biomass only auction in 2008 and the wind only auction in 2009 (with 60% local content requirement) led to market development and price competitiveness of these RETs. In addition, the emergence of local wind manufacturing companies testifies to the fact that these auctions have been successful in promoting the growth of the domestic wind industry.

In addition to auctions being technology-specific, some countries have resorted to site-specific auctions (which is always the case for offshore wind), as in China and Morocco. Site-specific auctions require additional government resources, but they present advantages that include reduced risk of non-compliance by freeing the investors from the liability of securing land, obtaining environmental permits, carrying out resource assessments and securing access to the grid.

TECHNOLOGY-NEUTRAL AUCTIONS

Technology-neutral auctions help identify the cheapest technology in the country, and also contribute to the diversification of the energy mix in the case where projects are awarded to more than one technology.

TECHNOLOGY-NEUTRAL AUCTION OF BRAZIL

Before 2010, all the auctions involving RE in Brazil were technology-specific auctions, *e.g.* the wind only auction (2009) or biomass only auction (2008), or alternative energy only auctions (2007 and 2010). These led to market development and price competitiveness of RETs. Ultimately, RETs were competing directly with natural gas in the technology-neutral auction in 2011 and both wind and biomass were more competitive (on average) than natural gas power plants.

3.2.2 Price and volume caps

Auctions can be used to promote the deployment of RE while keeping the cost of support within a certain budget, by setting caps on the unit price of the electricity (price ceiling) and on the quantity of electricity purchased under the scheme (volume caps). The cost of support is also minimised through the creation of competition among bidders, which reduces the price of electricity while keeping the investment attractive to project developers. This allows for the discovery of the most competitive price of RE-based electricity in the absence of a properly functioning market place (when the technologies are still in the development stage, when projects are very sensitive to project-specific circumstances or when governments do not have insight in the market data) and prevents underpayments or windfall profits.

Other tariff-based mechanisms such as the FIT and the FIP often present a difficulty in setting a price that stimulates the market without generating windfall profits. As such, auctions can be used to discover the real price of electricity and provide a reference price for setting the most appropriate level of tariffs under the FIT like the Chinese auction of 2009.

PRICE CEILING

In order to limit the cost of support, the auctioneer can set a ceiling price for each technology, above which projects are not considered. This ceiling should not be disclosed to the bidders to avoid the risk of all participants bidding close to it and keeping the price at a high level, as described in the case of the South African auction in 2011. The objective in keeping the ceiling price unknown is to avoid giving price signals to the bidders in early rounds when asymmetry of information between the government and the industry means that realistic market prices are still unknown.

Different mechanisms are used to determine the ceiling price: one option is by utilising the tariffs set by previous policies, *e.g.* the first round of the South African auction in 2011 that set ceiling prices based on the FIT levels of the preceding REFIT scheme. Another option is applicable in the case of a hybrid auction, *e.g.* the Brazilian case, by running a descending price clock auction in the initial stage that results in a price that is used as the ceiling in the second phase which is a sealed-bid auction. The last option studied in this report entails conducting a market research, as shown in the case of Peru. One essential aspect is that the ceiling price should be set appropriately following consultation from the industry and the bidders. If set too low, it limits the number of projects that qualify for the bid, and hence poses a risk of not meeting the volume auctioned and adds to the need for subsequent auction rounds to meet the set targets.

PRICE CEILING IN SOUTH AFRICA

The first round of the South African auction in 2011 was not very successful in obtaining reduced prices. One of the reasons being that prices offered were high due to the disclosure of the ceiling price. Therefore, in the second round, ceilings were kept undisclosed, leading to reduction in prices.

In both rounds, no projects were awarded to biogas, biomass and landfill gas which could indicate that their price ceiling may have been set too low. This clearly illustrates the importance of role of the ceiling price, which must be set carefully.

PRICE CEILING DISCLOSURE IN PERU

OSINERGMIN determines a price ceiling for each auction and technology, above which no offer would be accepted. The price ceiling is determined according to the project's estimated capital and operating costs with an expectation to yield a rate of return of 12% per year over a contract period of 20 years, taking other factors into consideration such as the size of the project and the estimated connection costs. The ceiling price is only revealed if it is exceeded by at least one bid received in the case where the total volume auctioned was not contracted in a complete auction round. In this case, there is no restriction on the bids that exceeded the ceiling to re-submit a bid for the same project (Maurer and Barroso, 2011).

The Peruvian auctions were successful in bringing the prices down. Between the first auction in 2009/2010 and the second one in 2011 prices decreased by 11% for small hydro, 14% for wind and 46% for solar PV (which could also be partly attributed to the decreasing cost of the technology). However, the targeted volumes were not always met (specifically biomass and small hydro), and this could be due to the price ceiling being set too low, disqualifying bidders that offered prices that were higher.

VOLUMES AUCTIONED AND NUMBER OF ROUNDS

The total volumes to be auctioned are generally determined as a result of the country's energy plan and the size and maturity of the RE market. One of the remaining challenges for the auctioneer is deciding on the number of rounds and the volumes to auction in each round. Even though auctioning a large volume would enable the introduction of large capacities at once in fast growing economies that experience quick demand growth, it might result in lack of competition, especially in a market with a small number of RE project developers. A good example is the case of South Africa in 2011, where the first round was not very successful in enhancing competition given that the volumes auctioned were not limited for each technology. In the second round, a cap was set on the volume auctioned, leading to strong competition and a reduction in prices. Determining the optimal number of rounds and the volumes to auction in each round is a learning by doing exercise that is specific to each country.

3.3 REQUIREMENTS AND COMPLIANCE RULES

In general, auctions face a risk of underbidding that becomes more considerable with increased competition that reduces prices beyond the breakeven point for competitors. This could be prevented by imposing qualification requirements for bidders and stringent noncompliance rules such as guarantees and penalties for projects not coming to completion on time or at all, or for projects that produce less electricity than agreed upon in the PPA.

3.3.1 Requirements for bidding

Typically, bidders have to fulfil certain administrative, technical and financial requirements in order to qualify to bid, such as provide financial guarantees, obtain environmental licenses, secure land for the projects and ensure connection to the grid, among others. These requirements are meant to ensure that the projects are completed successfully without any negative impacts on the environment or community. Among the countries studied in this report, there is no clear relationship between the country context (income, investment conditions and electricity market conditions) and the selection requirements used in the auction scheme. We draw the conclusion that requirements are country and project-specific and mainly depend on the national goals set by the country. The local content requirements are the most commonly imposed among the countries studied in this report.

LOCAL CONTENT REQUIREMENTS

Local industry development, job creation and consequent domestic economic development are among the desirable results of RE deployment. Policy makers can facilitate their achievement by including a local content condition in an RE auction that requires the project developers to use domestic equipment and services. Coupled with a stable policy framework that ensures a sizable local demand for equipment and services, local content requirements can attract significant investments into the RE manufacturing sector.

The contribution of local content in a project is usually specified as the percentage of the total project cost sourced locally through both equipment and services (civil engineering work, consultancy fees, *etc.*). This may provide a loophole for the developers when the percentage of local content requirement is low, allowing them to fulfil their quota of local procurement from services without purchasing locally manufactured equipment, which could hinder the development of a local industry. With this approach, most of the jobs are generated in the project development, installation and operation and maintenance sectors with little or no job creation in the manufacturing and R&D sector. Countries which aim to develop a renewable energy manufacturing industry can set more targeted local content rules. For example, in the 2005 onshore wind auctions in China, the developers had to source 50% of the equipment from local manufacturers.

Before incorporating local content requirements within an auction, policy makers should take various factors into consideration. For instance, an assessment of the size of the market should be carried out to determine whether the domestic industry is ready to deliver the needed equipment or services in order to avoid creating bottlenecks and delaying projects. Another aspect that should be considered is the context of world markets. For instance, with the expected overcapacity in PV and wind for the coming years (IRENA, 2012), the decision to locally produce equipment in these technologies might not be the most cost effective.

Finally, local content requirements might lead to the establishment of manufacturing plants in locations where they are not cost competitive on the global scale. Once the local demand for equipment is reduced, these plants may not be able to compete at the international scale. Therefore, in order to ensure the creation of a sustainable local industry, local content requirements need to be corroborated by a long term policy framework that ensures stable and predictable local demand.

3.3.2 Compliance rules

Compliance rules are required in project tendering to ensure that projects will be successfully completed.

TECHNOLOGY-SPECIFIC AUCTION LEADING TO WIND INDUSTRY DEVELOPMENT IN CHINA

In China, the local content requirement for onshore wind that was set at 50% in 2003 and that was raised to 70% in 2005 played a significant role in the development of the domestic wind industry. In 2012, four out of the top ten manufacturing companies were Chinese and they accounted for 27% of the total market share (REN21, 2012). By 2010, the three Chinese companies Sinovel, Goldwind and Dongfang were among the top ten wind power technology manufacturers globally. Moreover, leading global wind technology manufacturers such as Vestas, Suzlon, Gamesa and GE have set up production facilities in China (Wang, Qin and Lewis, 2012). In 2009, the requirement on local content was abolished. After 2005, no foreign company won any of the wind auctions as local equipment being cheaper in initial cost was often chosen for projects (Howell, et al.,. 2010). As for the offshore wind auction in 2011, there was no explicit requirement on local content, but the design of the auction was not conducive to foreign suppliers since the weight on experience in turbine manufacturing was as low as 9%. Moreover, the expectation of low rate of return made it difficult for international developers to compete with state owned enterprises, resulting in low participation by international developers, as only two out of the 26 bidders were foreign. (Cozzi, 2012).

Moreover, in the case where projects are selected based on the 'lowest price wins' criterion, auctions are susceptible to underbidding which occurs when competitors submit bids that are excessively low, threatening the viability of the project and hence its implementation. Potential risks include delays in project implementation, failure to sign the PPA at the agreed terms, failure to complete the project and failure to deliver the planned quantity of electricity. This is why, stringent compliance rules are essential to ensure timely implementation of projects and delivery of the committed amount of electricity in the bid and to minimise the risk of underbidding, which is common in highly competitive markets. Rules include:

- Requiring a bid bond (potentially as a percentage of total project cost) to avoid the risk of the winning bidders not signing the PPA under the terms at which they bid;

- Requiring a project completion bond (potentially as a percentage of total project cost) to avoid the risk of projects not coming to completion;

- Penalising developers for electricity shortfall or paying an agreed tariff for over-production to avoid the risk of projects not delivering the planned quantity of electricity;

- Imposing penalties for delays, to avoid the risk of facing setbacks at various stages

> Morocco's stable political and regulatory environment and its experience with IPPs have been essential in attracting investors; the establishment of the specific governing agency for solar energy, MASEN, was instrumental in the successful management of the CSP solar auction. Moreover, Morocco's adoption of the public private partnership model was crucial in de-risking the large scale projects, thus securing their financing, especially for CSP, which was the largest initiative in the region of its kind.

3.4 OTHER CONSIDERATIONS

In addition to the design elements provided above, there are administrative, regulatory and infrastructural aspects to consider while designing an auction:

3.4.1 Regulatory and administrative considerations

For the auction to successfully attract investors, the country should have an adequate regulatory framework that offers security to investors. The auctioneer must define fair and transparent rules and obligations for all the different stakeholders and any additional information or adjustments about the bid must be clearly communicated to all the competitors equally. Rules that should be regulated include setting the conditions for granting access to the grid and sharing the costs of connection, grid expansion and grid reinforcement. Rules and obligations for transmission system operators must also be clearly defined and implemented.

In order to enable the development of a RE industry and fulfil the goals of socio-economic value creation, decision makers should avoid stop-and-go cycles by establishing a transparent and adequate long-term agenda for the planned auctions and auctioning rounds. Setting a plan for the auctions would also give project developers the chance to plan ahead and to provide all the data requirements.

In addition, the government should facilitate the administrative procedures on investors, by creating adequate, streamlined and slim permitting procedures (requirements for environmental impact assessment, requirements for local stakeholder engagement, *etc.*). Otherwise, project implementation would be delayed and targets could face the risk of not being met on time. Administrative procedures can be simplified and reduced by creating a one stop shop or an automated system.

Finally, the time, manpower and skills needed to evaluate bids should be carefully estimated to reduce the risk of experiencing delays in the evaluation stage. For example, offers received as a response to the South African request for tenders took much more time to process than anticipated. Given limited resources, the auctioneer could also reduce the number of bids to be evaluated by increasing the bidding requirements. In Peru, the number of bidders was limited by requiring high participation fees and imposing stringent compliance rules such that only large companies with the required financial capabilities could participate.

3.4.2 Infrastructure considerations

In some cases, project developers face logistical difficulties in different phases of the bidding process (conducting feasibility studies, resource assessment, site selection, obtaining permits, securing capacity for grid access, *etc.*) or in implementing the projects. This is why the auctioneer should facilitate the process by (partially) providing initial environmental, economic, and/or technical impact assessment for the selected sites to be auctioned and by ensuring the appropriate infrastructure (adequate road, port, *etc.*) to transport equipment and reach locations with good potential. In some cases, the choice of a site-specific auction could help reduce these risks. Otherwise, the government could help by providing publicly available initial resource assessment to facilitate site selection, and could invest in the necessary infrastructure (*e.g.* roads, electricity grid) in areas where RE potentials are high and projects are likely to be developed.

3.4.3 Financial considerations

In order to minimise the cost of capital, the auctioneer should seek to reduce the investment risks taken by the project developers through the provision of a strong legal basis for auctions, thereby increasing credibility for investors. Another way to reduce investment risks is by providing financial guarantees or by partnering with international financial institutions to partially fund the project, like in the case of the Moroccan Solar Plan.

PROVISION OF CONCESSIONAL FINANCING CAN BE CRUCIAL IN LOWERING PRICES

The provision of concessional finance through international financing institutions and the financial backing provided to the bidders by MASEN led to a favourable financial result of the auction, *i.e.* low prices in the solar bids submitted.

One key reason why ACWA's consortium was able to bid low was that the project was being financed using concessional debt (lower interest rates of approximately 3% with the inclusion of a grace period during which only the interest, and not the principal, has to be paid). These rates would not have been offered by commercial lenders to the first standalone utility-scale CSP project in the country. The project benefited from this high level of support because it was perceived as a strategic demonstration project designed to spur replication and improve the technology and create jobs, develop the local clean industry and contribute to the socioeconomic development of certain regions in Morocco.

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