Renewable energy auctions

Goal-oriented policy design

Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

CONTENTS

IMPRINT

Text contributions with a given author's name do not necessarily represent the opinion of the company.

Published by
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn und Eschborn

Friedrich-Ebert-Allee 40
53113 Bonn, Germany
Telefon: +49 228 44 60-0
Fax: +49 228 44 60-17 66

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
Telefon: +49 61 96 79-0
Fax: +49 61 96 79-11 15

E-Mail: info@giz.de
Internet: www.giz.de

Team leaders
Torsten Fritsche (GIZ), Fabian Joas (GIZ), Jan-Christoph Kuntze (GIZ)

Authors
Oliver Tietjen, Ana Lucia Amazo Blanco, Tim Pfefferle (GIZ)

Lead reviewers
Michael Pahle (PIK), Karoline Steinbacher (FU Berlin)

Contributors
Klas Heising (GIZ), Frank Seidel (GIZ), Paul Suding (GIZ), Hanne May (ergo), Katherina Grashof (IZES), Hendrik Meller (GIZ), Torsten Schwab (GIZ), Toby D. Couture (E3 Analytics), David Jacobs (IET Consulting)

Editing & Design
ergo Unternehmenskommunikation GmbH & Co. KG, Berlin

Date of publishing
February 2015

Please quote as:
GIZ (2015): Renewable energy auctions. Goal-oriented policy design.

PART 1
INTRODUCTION

Renewable energy deployment in electricity sectors has become a priority around the globe. Renewable energy is seen as a path to a low-carbon future, a cost-efficient addition to the generation mix, a means to reduce energy import dependency and a contribution to domestic value added. To achieve these goals, governments implement various instruments, including quotas, feed-in tariff schemes, investment subsidies or tax incentives.

The use of auctions[1] for advancing renewable energy capacity is not a new concept, although early examples, such as the UK's NFFO[2] scheme in the 1990s achieved mixed results at best (Cozzi, 2012). However, in recent years auctions have grown in popularity, largely led by emerging and developing countries. In Brazil, China, and India, auctions have managed to drive renewable electricity prices down (Elizondo et al., 2014). But experiences in France have shown that tenders can also increase procurement costs compared to, in this case, administratively determined feed-in tariffs (Couture et al., 2015). Another major challenge has been to discourage bidding at prices below actual cost levels, as this has often resulted in the commissioned volume not being built or only with major delays.

Policy-makers should therefore pay close attention to auction design. This guide is intended to provide them with an analytical overview of how policy goals (e.g. support cost efficiency, volume effectiveness, system integration) may be achieved through certain auction design features. It explores suitable auction design options and examines potential trade-offs between goals that result from certain design features.

The policy goals addressed in this guide can be substantially affected by auction design features and are often pursued in practice. However, other goals associated with renewable energy, such as climate protection or lower energy import dependency, are not addressed as they are not directly related to auction design. Although not every policy-maker will necessarily consider the selected goals to be equally relevant, they are given the same weight in this document. Importantly, this guide does not provide specific recommendations for certain design features, but highlights basic links between goals and design features. The best choice and combination of design features are always context-dependent and thus require in-depth analysis for each respective country.

The analysis in Chapters 3 and 4 is based on theoretical considerations and the experiences of several countries. The findings are mainly derived from a literature review and interviews with key informants. The country examples were chosen based on three criteria. First, they represent 'typical' examples of tailoring design features in pursuit of a policy goal. Second, they are often referred to in the literature and third, they reflect a large variety of institutional and geographic conditions in order to give a more complete picture. Thirteen countries matching these criteria were identified: Brazil, California (US), China, Denmark, France, Germany, India, Morocco, The Netherlands, Peru, Portugal, South Africa and the UK. Their experiences are highlighted in reference to design features linked to policy goals, and in more detail in the country boxes.

Renewable energy auctions are procurement systems in which various bidders compete to be (partially) compensated for producing a given volume of electricity (kWh) or capacity (kW). Auction conditions are determined by government policy. Auctions are not a renewable energy support[3] scheme per se. Instead, they are used to allocate power purchase or support contracts, like a feed-in tariff or a feed-in premium, so that the support level is determined on a competitive basis rather than set by the administration.

1 The terms 'auction' and 'tender' are used interchangeably in this guide.
2 Non-fossil fuel obligation (NFFO)
3 The term 'support scheme' does not only refer to subsidies for otherwise commercially unviable renewable energies, since they are a cost-efficient alternative in many countries. For reasons of simplicity the term refers to auctions as support instruments.

PART 2
THE GLOBAL TREND TOWARDS RENEWABLE ENERGY AUCTIONS

Since the mid-2000s the number of countries implementing support schemes for renewable energy has grown rapidly. In the early phase of renewable energy promotion, administratively determined feed-in tariffs were the predominant support instrument, besides renewable portfolio standards. However, in recent years there has been a trend towards auction schemes: While nine countries had implemented tender procedures in 2009, the number had reached 55 by early 2014 (REN21, 2014).

One concern regarding administratively determined feed-in tariffs is the prompt adjustment of tariff levels to technology cost development. In Germany and Spain, cost of photovoltaics decreased rapidly over a certain period, while the support tariffs remained high. This led to an oversupply, vast investor profits and heavy support costs (Elizondo et al., 2014). The avoidance of such a mismatch is one reason for introducing auctions instead of other instruments. Auctions are, in theory, a cost-effective way to promote renewable energies, as they allow for the procurement of a targeted volume at the lowest possible cost due to the competitive allocation of financial support.

Legal issues may also play a role when introducing auction schemes. Administratively determined feed-in tariffs and feed-in premiums are, under certain conditions, sanctioned by the WTO when combined with ***local content requirements***. The feed-in tariff programme of the Canadian province Ontario was found to be inconsistent with WTO law due to the local content requirements attached. However, renewable energy auctions are unlikely to be subject to WTO law if they comply with these requirements (Kuntze & Moerenhout, 2013).

Auctions are also used to work out a reasonable pricing for renewable energies in other support schemes that are established or planned. In China, for example, stakeholders could not agree on a tariff level for onshore (wind) projects. Auctions were then adopted to evaluate competitive prices for administratively determined feed-in tariffs introduced later (Elizondo et al., 2014).

However, auctions also face drawbacks and challenges.[4] Some basic conditions must be met if they are to function properly and successfully (Maurer & Barroso, 2011). Competition among potential project developers is of the utmost importance. For instance, the market power of large local players or an undesirable market environment might deter potential bidders and lead to a low competition level. The involved bidders might then engage in strategic behaviour to increase their profits and in so doing support costs.

Participants need to trust the tender process. It is crucial that the auctioneer and the contractual partner of the auction winners are independent and financially strong (Maurer & Barroso, 2011). Trust is enhanced when administrative capacities enable the timely issuance of required permits or documents, such as proof of grid connection or environmental impact assessments. This means that the requested administrative resources, skills, institutions and procedures ought to be in place to implement auctions effectively, and ensure the procurement process is carried out in a transparent and fair manner. It might be necessary to utilise capacity-building measures or temporary advice from external experts in order to create a more suitable administrative environment.

In fact these challenges are often not resolved sufficiently. Common problems include low participation and thus competition levels, as well as unsatisfactory realisation rates, for example due to over-optimistic auction bids (winner's curse). As auction procedures are relatively complex, this leads to transaction costs for administrations and bidders (del Río & Linares, 2014). The latter face risks since the application is costly and they might not be selected. Participants incorporate these risks (risk premiums) in their bids, implying higher support costs.

4 For a more complete discussion of advantages and disadvantages of auctions as support instrument see for example Maurer & Barroso (2011) and del Río & Linares (2014).

Finally, the question of whether auctions are an appropriate policy tool depends on country-specific conditions. If policy-makers have decided to implement tenders, they can draw on a number of design features (see box), according to the desired policy goals and specific country characteristics.

MAIN DESIGN FEATURES OF RENEWABLE ENERGY AUCTIONS

AUCTION PRODUCT: The product to be procured in the auction can be renewable electricity (in kilowatt hour; kWh) or capacity (in kilowatt; kW). First, the volume must be defined:[5] How much electricity (kWh) or capacity (kW) is tendered? Quantities can be restricted to some regions or sites, instead of being indifferent about the location. Policy-makers can also demand only smaller or larger projects, or implement distinct auctions for both, instead of a single auction for all project sizes. The auction product is often limited to specific renewable energy technologies, for example only PV capacities are demanded. In technology-neutral auctions various technologies compete for the auction award.

PREQUALIFICATION: defines the requirements bidders must fulfil in order to participate. Bidders that do not meet all criteria are either disqualified in a pre-stage or during the auction procedure itself. Requirements can take on different forms, though they are often intended to increase project realisation rates. For instance, project-specific requirements may include proof of technical and commercial viability, a secured site and grid connection, or permits for construction and operation. Others are bidder-specific, such as proof of financial soundness or track record. Prequalification can also refer to local content requirements or environmental standards.

AUCTION FORMAT: determines how winners are selected. The most frequently used types are static ***sealed bid*** auctions. Other formats feature dynamic ***descending clock*** auctions or ***hybrids*** of both. A further element concerns the winner´s remuneration and the way it can be determined ***(auction pricing)***. Winners either receive what they bid (pay-as-bid) or all successful bidders get the same ***(clearing)*** price (uniform pricing). Specific auction formats have a strong impact not only on prices ***(strategic behaviour),*** but also on other outcomes such as realisation rates ***(winner's curse)***.

Bids can be selected based on various criteria. Price (least-cost) is frequently the only criterion ***(pure price-based auction).*** But in numerous auctions bids are ranked by a score which can include pricing, local content share or technology innovations ***(multi-criteria auction).*** Alternatively, bidders can receive a bonus, if they meet these criteria (lower bid price in the selection procedure or higher support as an auction award). Other features are a ***price ceiling*** as a bid limit, minimum or maximum project volumes or ***bidder concentration rules,*** which prevent large volumes from being allocated to few bidders.

AUCTION AWARD: is typically a power purchase agreement. This contract includes the tariff per produced kWh, the duration and time-profile of payments, and/or the maximum amount of electricity supported. Payment schemes can be specified as a (sliding) ***feed-in premium***, which typically implies sales on the market (direct marketing) and a bonus payment on top of the market price. In contrast, ***feed-in tariffs*** as an auction award often include a centralised sales process (e.g. by the contracting party of the power purchase agreement). As an alternative to feed-in payments (per kWh), the auction award can also be an investment subsidy per installed capacity (kW).

PENALTIES/COMPLIANCE RULES: are designed to ensure commissioned projects are realised. Usually financial guarantees are required, to comply with auction rules ***(bond guarantees)***. These can be paid either before the auction by all participants (bid bonds), or only by the winners (completion or construction bonds). If a winning project is cancelled, delayed in terms of the predefined realisation time, or does not operate as stated, penalties can be (partly) executed. Penalties can also include reduced support levels, shorter remuneration periods or contract termination. Penalties are either fixed or adjusted according to the level of non-compliance or delay.

5 The auctioneer may choose not to publish this volume, as has been the case in the Brazilian auctions.

PART 3 GOALS: CONNECTING POLICY GOALS WITH DESIGN FEATURES

Renewable energy development is linked to various policy goals. Accordingly, these goals need to be taken into account when choosing appropriate auction designs. Policy-makers can select from a menu of design features in order to reach a particular goal.

Policy goals can also vary broadly. This analysis focuses on those most common, and largely similar goals are in some cases grouped into one category.

- **SUPPORT COST EFFICIENCY** is understood as the provision of a specific volume of electricity or capacity from renewable sources at the lowest possible support cost. This goal refers only to the minimisation of the support costs of the awarded volume, which is typically paid by ratepayers via a levy or by state budget. A broader definition would also include costs arising from expansion of renewables (e.g. grid reinforcement; see system integration below), administrative costs of the auction scheme and indirect effects (e.g. allocating risks to consumers rather than to generators; see glossary under feed-in premium).

- **VOLUME EFFECTIVENESS** refers to the timely achievement of high implementation rates by projects contracted in the auctions. Ineffectiveness, in turn, can mean that the contracted projects are abandoned or only partly built.

- **SYSTEM INTEGRATION** refers to the interaction of renewable energies within the power system and takes related costs into account. An important factor is the temporal coincidence of production from (fluctuating) renewable energies with demand. Grid connection and bottlenecks should be considered as well as the provision of ***ancillary services*** (e.g. reactive power, frequency response). All of which are necessary to guarantee security of supply, especially with increasing shares of renewable energies.

- Many countries connect **INDUSTRIAL DEVELOPMENT** with auction schemes. Some governments seek to foster the development of local industries, jobs or research and development in new technologies. Others seek to increase tax revenues and create other socio-economic benefits.

- Because most electricity sectors around the globe are or were state-owned, they are often dominated by a small number of large companies. Tenders that are open to independent private investors can lower this market concentration. The underlying reasoning is to increase competition in the electricity sector, and to reduce the market power of dominant players. This can be achieved by a variety of auction participants (and winners) and is known here as **BIDDER DIVERSITY**.

  Moreover, for some countries the involvement of ***smaller actors*** (i.e. 'citizen energy') in renewable energy development is a key component of auction designs. Since auctions typically deter smaller actors from participating due to strong competition, financial risks and transaction costs, policy-makers may introduce specific measures to ensure their access.

- Infrastructure projects globally face growing resistance from affected community members and renewable energy projects are no exception. **SOCIAL ACCEPTANCE** therefore also needs to be addressed. Reservations are based mainly on negative externalities, e.g. noise, visual impact or landscape 'fit'. Extensive capacity expansion in small areas as well as low levels of involvement and participation risk increasing 'not in my backyard' (NIMBY) attitudes.

3.1. Support cost efficiency

Attaining low support costs for renewable energy frequently motivates governments to implement auctions. However, auctions do not lead to low support costs per se, although a variety of design features can help achieve this goal.

Low entry barriers and penalties foster competition and decrease risk premiums

If administrative, financial or technical entrance requirements for bidders are kept low, competition will be fostered. Low penalty levels have the same effect, because the risk of failure after winning a bid is reduced. This also implies incorporating lower risk premiums into the bids (Müsgens & Käso, 2014). New market participants might be especially attracted by low entrance barriers. On this account, the Peruvian scheme has established almost no administrative barriers (i.e. almost no prequalification requirements). Indeed, most of the new renewable volume contracted through auction rounds has been assigned to independent power producers that were not present on the Peruvian market prior to 2008 (Ecofys & GIZ, 2013). Note that it is not recommended to impose low pre-qualification and penalty levels at the same time as this might attract speculative bidding and result in poor realisation rates (see section 3.2 and 4.1).

Long-term fixed feed-in tariffs render lower risk premiums and thus lead to the lower bids

As pricing on the electricity market is volatile, developers, private investors and lenders might be deterred if their revenues (partly) depend on alternating market prices (Hauser et al., 2014). Auction winners can be exempted from selling their electricity individually if the electricity is sold centrally on the market by the contract partner (e.g. distribution companies or grid operators). Renewable producers can thus receive a long-term fixed feed-in tariff for the electricity produced that covers total investment costs (up to 15-25 years, depending on technology). This auction award provides them with revenue stability and eases financing (del Río & Linares, 2014). Besides lower risk premiums and thus lower financing costs, this design feature might attract more potential bidders and thus applies pressure on auction prices due to competition.

Pure price-based and technology-neutral auctions render lower price levels

The use of a pure price-based auction, whereby least-cost bids are the most successful, leads to lower price levels than schemes incorporating other decision criteria (Ausubel & Cramton, 2011). If criteria other than price need to be met, or if these increase the score obtained by a bid, projects that are merely cheap are less likely to be selected.

Similarly, if all renewable energy technologies compete in an auction following the same rules (i.e. technology-neutral auction),[6] the cheapest bids are chosen. In technology-specific auctions, the cheapest technologies are only selected up to defined volumes, with the remaining capacity being reserved for more expensive technologies (Frontier Economics, 2014). However, although technology-neutral auctions favour lowest support costs, they might induce higher total system costs, as they do not necessarily imply the deployment of renewable energies with the highest value for the total system. Where policy-makers seek to optimise total system costs, a technology-specific approach that procures a suitable portfolio of technologies can be the better choice (see section 3.3).

Price ceilings limit cost risk but must be carefully set

When auction rounds face low competition, even high bids can succeed. Such results can be prevented by a price ceiling. However, the price ceiling itself influences the level of competition (Maurer & Barroso, 2011): If the ceiling is set too low, only few bidders enter the auction, leading to less competition. If it is disclosed before the auction and the competition level is weak, bidders can use it as an anchor point and increase their bids close to the ceiling.

It is therefore important to set the maximum price at a reasonable level. In Peru, for example, this price is based on several factors such as technology, capital and operating costs, the annual rate of return, project size and grid connection costs (Ecofys & GIZ, 2013). Access to substantial information on electricity generation cost components and cost development trends is therefore key. Likewise, changes in the auction design can also influence project costs, for example, due to higher risks and related capital costs (risk premiums) (Elizondo et al., 2014). Price ceilings should be adapted to these changes over time.

6 Note that focus is here not on dynamic cost efficiency, which considers whether a policy instrument helps drive down the costs of less mature technologies (Held at al., 2014). Dynamic cost efficiency could imply that technology-specific support is desirable.

South Africa chose the administratively determined tariffs of the former feed-in tariff scheme REFIT[7] as the price ceiling of the first auction round. This, however, implies that it is disclosed, which can lead to problems with strategic behaviour (see also section 4.4). Hybrid designs such as those used in Brazil have used competitive bidding in the first descending clock auction round to determine the price ceiling of the second sealed bid round, which helped to set prices close to the actual generation cost. Competition between the bidders of the second round is fostered by lower auction volumes compared to the first round (Ecofys & GIZ, 2013). Although high competition in Brazil has contributed to low support costs, it might also come with low realisation rates (see Brazil box and section 4.6).

Overall support costs can also be capped by setting a fixed budget as in the Netherlands, where a budget for the auction scheme payments is determined every year, allowing a direct cost control (Held et al., 2014).

IN FOCUS: BRAZIL

Since 2009 Brazil has allowed wind energy within its auction system. The average final price for wind energy during 2009-2013 was USD 69/MWh or about 60% lower than the country's administratively determined feed-in tariff, Proinfa. Cunha et al. (2014) observe that the direct competition of wind power plants with conventional generators seems to have brought a new price paradigm for all other technologies. With the exception of a few mega hydro auctions, auctioned prices were significantly higher before the emergence of wind power as a major player.

A high competition level and the chosen auction award are two important reasons for this trend (i.e. the power purchase agreement). Brazilian authorities decided to offer an attractive contract in terms of risk protection for investors, which appears to have increased the number of potential participants and decreased price bids. Auction winners receive a long-term (20-year) feed-in tariff and the energy contracts are indexed to the local consumer price index, making the seller's contracted amount constant throughout the contract (Maurer & Barroso, 2011; Porrua et al., 2010). In addition, the Brazilian development bank, BNDES, offers favourable financing conditions to project developers. They are offered loans of up to 80% of the total investment, to be paid in (up to) 16 years at a basic spread of 0.85% per year (Gornsztejn, 2012). These favourable conditions are partly due to the fact that the power purchase agreement acts as a state guarantee, independent of delivery. Starting from the delivery date, the government first pays BNDES to cover the agreed loan quota, after which payment is made to project developers.

However, it is unclear at present whether the achieved prices are sustainable or whether project developers have made overoptimistic (winner's curse) or strategically low bids (underbidding), potentially leading to low realisation rates (Elizondo et al., 2014; Held et al., 2014).

7 Renewable Energy Feed In Tariff (REFIT)

3.2. Volume effectiveness

Though auctions are designed for the procurement of a specific amount of electricity or capacity, practical experience shows that non- or delayed realisation of the auctioned volumes is a common phenomenon. However, the following design features are more likely to render higher levels of effectiveness.

Comprehensive prequalification helps to identify reasonably-calculated bids

Prequalification criteria are checked at an early stage of the auction procedure, and can be used to sort out projects with low realisation probability. They can refer to project specifications, such as commercial and technical feasibility, and the provision of necessary permits (Held et al., 2014), particularly site and grid connection permits. These permits can either be required before the auction, or be guaranteed to auction winners. Site-specific auctions are advantageous in securing the site and enable the grid connection to be clarified by the regulator, which should thus be unproblematic (del Río & Linares, 2014).

Prequalification can also refer to the bidding party and require proof of technical and financial capability or track record (Held et al., 2014). In California, bidders need to prove that at least one member of the development team has had experience with the construction of a similar project (SDG&E, 2014). Regarding financial capability, completion and performance (bid) bonds can be required from auction participants or from winning projects to prove their solidity. In Brazil, auction winners need to deposit a project completion guarantee corresponding to 5% of investment cost. The guarantee is released after certain project milestones are completed (Lucas et al., 2013).

As an alternative to prequalification, these project- or bidder-specific requirements can be integrated into the auction selection process, given that winners are selected according to several criteria (Ausubel & Cramton, 2011). In China's offshore and France's solar auction, bidder experience or the feasibility of the project increase the bid score (Held et al., 2014; DFBEE, 2014).

Reasonable penalty levels help prevent delays or defaults

Setting reasonable penalty levels is an important and complex task of auctioning procedures. Though the need for penalties to reduce production deviations, project delays or cancellations is clear, designing them can be less straightforward. As penalties increase the risk for bidders, it is important to sanction them only for delays for which they are responsible and can effectively address, otherwise the high risks could deter investors (Hauser et al., 2014). In Peru, although contract termination was enforced in one case (small hydro, 5 MW plant) due to a delay of over a year, this was not applied to a project that was also delayed because the latter was exposed to a force majeure incident (flooding) during construction (Ecofys & GIZ, 2013).

From an enforcement perspective, it can be useful to have a range of penalties according to the severity or types of delays. Penalties may be required if a selected bid does not translate into a project on time, if the agreed electricity amount has not been delivered or if the whole project is cancelled. They may include lowering support levels, cutting support periods, confiscation of bonds, additional penalty payments or the termination of the contract (Held et al., 2014).

Penalties must be clear and credible to become effective. In the UK's NFFO programme or in the Chinese Wind Concession Program, penalties were not clearly defined, which resulted in low realisation rates (Kopp et al., 2013). On the other hand, prequalification that is too demanding or excessive penalties can ward off investors, particularly small ones, and thus create a lack of bids (see also section 4.1).

Consistent high information levels mitigate the winner's curse

Besides prequalification and penalties, detailed information made available to participants can mitigate the likelihood of selecting financially non-feasible projects (i.e. winner's curse). All requirements and obligations related to the subsequent project contract must be clearly specified and provided before the auction. One frequent problem is that bidders overestimate the production output of their project and thus the project's viability (del Río & Linares, 2014). To prevent such miscalculations, the regulator can publish wind measurement and solar radiation data for specific sites.

The auction format itself also determines how much information will be available. Dynamic auctions with multiple rounds (e.g. descending clock auctions) are advantageous in that bidders benefit from learning effects (Maurer & Barroso, 2011). If the auctioneer publishes pricing and volumes after each round, bidders implicitly share information, as the price discovery process allows them to revisit their earlier offers and thus make more robust bids.

Overall support costs can also be capped by setting a fixed budget as in the Netherlands, where a budget for the auction scheme payments is determined every year, allowing a direct cost control (Held et al., 2014).

IN FOCUS: PERU

Although the Peruvian scheme has not yet fully proven its effectiveness, its realisation rates appear relatively successful (i.e. installed MWs relative to allocated MWs). Out of 27 projects selected in the first Peruvian auction 21 projects are operating on schedule. These Projects were selected in 2010 and scheduled to start operating in December 2012. They amount to 236 MW or 55% of the capacity adjudicated in this auction (Herrera & Maxwell, 2014). In comparison, the realisation rate under the UK's NFFO programme was only 26%, whereas France achieved a mere 20% and Brazil only 30% in its first three auctions (Cunha et al., 2014; del Río & Linares, 2014; Ecofys & GIZ, 2013).

The main reason why the realisation rate is relatively high in Peru is the strict compliance regime, requiring various bond guarantees from project winners, including a bid guarantee of USD 20,000/MW that is released once a contract has been signed, a construction guarantee of USD 100,000/MW and an operational guarantee kept during the whole contract period. In addition, authorities have established penalties for construction delays. They range from 20% plus on the construction guarantee to contract termination or extension combined with 50% plus on guarantee payments for delays of more than one year (Ecofys & GIZ, 2013). However, low levels of prequalification requirements increase the risk of delays and non-execution, which might explain the suboptimal rate of projects starting operations on time. Other realisation hurdles include problems with environmental permits and access to finance (Ecofys & GIZ 2013).

Though Peru's case demonstrates the importance of credible penalty schemes, it also shows the limited impact on realisation rates. Policy-makers should therefore also address issues such as access to financing, bottlenecks in the permitting process and technical qualifications required from bidders.

3.3. System integration

As renewable energy shares grow, it becomes more important to integrate them into the electricity system. Whereas support cost efficiency (see above) involves attaining the lowest support costs (including investment and operation costs of renewable energies), system integration considers the cost attached to the integration of renewable energies into the overall electricity system (so called "integration costs").[8] How to achieve integration strongly depends on several circumstances in the respective country such as its grid infrastructure, its power technology mix and the structure of the electricity sector in general (e.g. market vs. state monopolies).

Deploy renewable energies where they fit best to grid capacities

System operators should analyse the sites at which additional renewable energy capacities induce lowest system costs. Higher production costs at less favourable but well connected sites could for example outweigh lower production costs entailing high grid connection costs at good wind sites (IEA, 2014). In general, renewable energy deployment should be in line with future (local) demand development and grid expansion plans. Likewise, short-term grid bottlenecks due to regional hotspots should be avoided. By implementing regional- or site-specific auctions, renewable energy capacities can be more strategically allocated in terms of grid constraints and thus reduce grid costs (del Río & Linares, 2014). Alternatively 'system-friendly' projects could achieve an additional bonus payment or a higher score in multi-criteria auctions. California adds project-specific transmission costs on top of the bids in the auction selection procedure (SDG&E, 2014).

Production deviations caused by the inherent uncertainty of renewable energy production (forecast errors) or grid stability challenges not directly related to renewable energies, must be overcome for a reliable electricity supply. Costs arising from such short-term adjustments (balancing costs) can be mitigated if renewable energies also assume system responsibilities, such as ancillary services. These services could be prequalification criteria, as illustrated in French PV tenders that require the provision of reactive power or distant control (DFBEE, 2014). System service requirements for renewable projects can also avoid costs for general stabilisation measures. Morocco, for example, has established specific tenders to support end-of-line PV to avoid drops in grid frequency. These measures were considered cheaper than local grid reinforcement (Amara, 2014).

Promote a renewable energy portfolio that produces electricity when needed

Another aspect of system integration refers to how well fluctuating renewable energy supply can match demand. Generation profiles of wind and solar plants are stochastic in that they depend on weather conditions, which change between hours, days and seasons. In order to avoid costly curtailment under good weather conditions or a lack of supply under bad weather conditions, it is important to bring volatile production in line with demand. Which renewable energies are most suitable strongly depends on local weather and demand conditions (IEA, 2014). If solar production largely coincides with high demand, as in Central Europe or any other country with high air condition usage, PV plants create high system value. Hence it can be useful to deploy further PV plants, even if wind power might have cheaper production costs. Technology-specific auctions are therefore a useful design feature to promote renewable energy portfolios in line with demand. Moreover, in cases where PV production is already very high during sunny hours, new PV plants could get a bonus for geographic orientation leading to more production during other hours (e.g. east or west instead of south orientation).

The regulator could furthermore consider the existing capacity mix and available flexibility options (e.g. storage, demand-side management and flexible backup capacities). For example, old coal plants are typical baseload technologies. They can hardly adjust their operating mode in response to short-term, weather-dependent renewable energy production. If the power sector is dominated by such inflexible plants, it is particularly important to achieve stable generation profiles from renewables or dispatchable renewable energy sources (e.g. biomass plants). Technologies with these characteristics can also be promoted through technology-specific auctions or bonuses in multi-criteria auctions. In turn, electricity sectors with more flexibility options will integrate high shares of volatile renewable energies more easily (IEA, 2014).

Feed-in premium and obligatory direct marketing foster market integration

As an alternative and/or complement to regulatory planned system integration, renewable energies can also be integrated into the electricity market, assumed a well-functioning liberalised wholesale electricity market with competing private plant operators is in place. Essentially, market integration can be fostered by an auction award that does not cover all project costs.

8 Integration costs of renewable energies arise because of certain characteristics, namely the location-specific production potential and the weather-dependency, while the latter implies variable feed-in profiles and uncertainty when exactly they produce. Note that also fossil plants have integration costs (e.g. due to grid connection and unexpected outages) (Hirth, 2013).

By receiving only a fraction of total cost, winning projects must sell their electricity on the market in order to fill the gap between support revenues and the levelised cost of electricity, whereby plant operators receive price signals that incentivise them to produce more in hours with scarce supply and high demand, and less in hours with high supply and low demand. Although weather-dependent technologies (wind and solar) can only reduce and not raise their production in the short-time, market integration has also positive effects on their production profile. Instead of short-term adjustments they can be constructed to produce more when needed (e.g. orientation of PV, see above), incentivized by electricity price signals (Hiroux & Saguan, 2010).

The auction award could be a feed-in premium on top of the electricity price or payments per installed capacity (kW). In both cases renewable energy suppliers are responsible for selling their electricity on the market (obligatory direct marketing).

Moreover, a technology-neutral scheme is better suited than a technology-specific one to foster market integration, if the market is functioning well. If all renewable energies compete for the same support and participate in the electricity market, the cheapest technologies that meet demand will be, at least in theory, deployed, since the optimal technology portfolio is incentivised by electricity price signals (Frontier Economics, 2014; Hiroux & Saguan, 2010). But this model is controversial in the political and scientific debate. Some observers doubt that electricity markets based on marginal costs are able to refinance renewable energies that have zero marginal costs and high capital costs (see e.g. Grashof & Weber, 2014 in the German debate and Couture et al., 2015 for a discussion of this topic). Moreover, grid constraints are typically not, or at least not fully, part of electricity market price signals. Thus, regional or site-specific auctions might be necessary to prevent grid bottlenecks even when renewable energies are integrated into the market.

IN FOCUS: GERMANY

System integration has often played a minor role in early auction design. However, with increasing renewable shares, integration has become more important. The German Renewable Energy Act (EEG) was implemented in 2000 and initially only included administratively determined feed-in tariffs. Since 2012 renewable energy producers have been able to choose between the feed-in tariff or direct marketing in combination with a sliding feed-in premium, the latter being mandatory for all new projects since 2014 (small projects are exempted) (Pahle & Schweizerhof, 2015). The sliding market premium is still fixed by the administration, but from 2017 onwards, with a pilot stage for PV-only starting 2015, it will be determined in auctions (BMWi, 2015).

These reforms are a first step towards market integration, which is considered necessary by many policy-makers since the renewable energy share (mainly wind and PV) significantly rose to 27.8% in 2014. Although the sliding feed-in premium is in fact close to a feed-in tariff, it is designed to not incentivise renewable production at negative electricity prices that outweigh the feed-in premium. The underlying economic rationale assumes negative prices as an indicator for overproduction and renewable energy should not be supported at such times. Moreover, with the obligatory direct marketing, producers should learn to independently sell their electricity on the market, and to get in touch with market risks. Another of direct marketing is that renewable energy production forecasts are improved (see Pahle & Schweizerhof, 2015 for more details). However, it is contested by some observers if these targets can be achieved by the recent policy design (e.g. Purkus et al., 2014).

Other EEG amendments aim for system integration via ancillary services. For example, wind power operators must fulfil technical requirements in respect of voltage and frequency stability, while operators of existing wind mills receive an upgrade bonus. Since 2014 distant control functions have been mandatory for all renewable energy technologies.

Table 1. Policy goals and design features

This table presents design features (top row) that can be used to achieve each of the goals (left column). A given design feature is to be understood in terms of its relationship to a specific goal, and not in how it may interact with other design features or goals (see chapter 4).

POLICY GOALS / DESIGN FEATURES	AUCTION PRODUCT	PREQUALIFICATION	AUCTION FORMAT	AUCTION AWARD	PENALTIES/ COMPLIANCE RULES
SUPPORT COST EFFICIENCY	Technology-neutral, fixed auction budget	Low level	Pure price-based selection, (undisclosed) price ceiling	Long-term feed-in tariff, central marketing	Low level
VOLUME EFFECTIVENESS	Provision of information about sites (e.g. wind data), site-specific or guaranteed sites and grid connections	Project-specific: technological and commercial feasibility, secure land and grid connections, permits company-specific: experience, financial requirements	Dynamic auction (e.g. descending clock), multi-criteria/bonuses: realisation possibility of project		Financial guarantees, penalties for: delays, abandonment of project, poor performance
SYSTEM INTEGRATION	Technology-specific (regulatory), technology-neutral (market), Site-/regional- specific	Provision of ancillary services	Multi-criteria/bonuses: system needs regarding ancillary services, demand fit, grid constraints	Obligatory direct marketing, feed-in premium (market integration)	
INDUSTRIAL DEVELOPMENT	Technology-specific, long-term auction schedule	Local content requirements	Multi-criteria/bonus: local content		
BIDDER DIVERSITY	Long-term auction schedule, provision of information about sites (e.g. wind data), site-specific or guaranteed sites and grid connections, separate auctions for small actors	Low level, easy and transparent procedure	Maximum project size, bidder concentration rule	Long-term feed-in tariff, central marketing	Low level
SOCIAL ACCEPTANCE	Regional-specific	Certain project value reserved for local population, local environ-mental impact assessment	Multi-criteria/bonus: environmental impact or other local needs		

3.4. Industrial development

Many governments also use renewable energy auctions for their potential to create local economic and social value. This can be in terms of job creation, socio-economic development, research and development or foreign direct investment. However, these requirements can lead to the opposite scenario, creating supply bottlenecks, frustrating businesses and driving up costs to a point where further market development is halted. Striking the right balance is therefore crucial.

Local content requirements can create economic opportunities

Local content requirements can imply different goals. Job creation is an underlying ambition, with specifications for a minimum percentage of locally hired workers among the most common clauses used. Governments can require certain components or services to be domestically sourced in order to foster the development of local industries. More complex regulations, such as those in South Africa, include a range of socio-economic aspects with regard to respecting community needs and stipulating management control requirements (Baker & Wlokas, 2014).

Requirements can be made voluntary or mandatory. If voluntary, bidders are given an incentive to demonstrate a higher share of local content in order to score better. Morocco pursued this option for its first CSP project in Ouarzazate (Ecofys & GIZ, 2013). If a certain level of local content is mandatory, bidders can only qualify for the auction by proving the requested proportion. Local content requirements thus become a pre-qualification instrument. The choice of measures ranges from providing incentives to administering penalties and ultimately disqualification from participation in a given auction. In any case, it is often recommended to gradually increase local content requirements in order to facilitate industrial development (Stephenson, 2013).

South Africa's example has demonstrated that even carefully designed local content regimes may prove ineffectual if not tailored to local market conditions (Baker & Wlokas, 2014; see South Africa box). Before implementing these measures, it is therefore essential to perform a detailed market analysis: where and in what way do local content requirements make sense, given a certain level of industrial development?

Where local capacity does not yet exist to a sufficient extent, it is recommended that capacity-building measures be put in place. Because without building up local skills and industry, local content requirements are only likely to push up prices. Similarly, businesses' and other stakeholders' perspectives should be integrated in the design of local content requirements in an early decision-making phase. Some businesses, for example, have reported that they do not necessarily struggle with the required percentage of locally sourced inputs, but rather with regulations stipulating, in great detail, which components and services need to be provided locally.[9]

The type of jobs to be created also depends on local circumstances such as the available workforce, the structure of the industry and particular technologies. While many governments seek to establish a manufacturing industry, this might not always be feasible (IRENA & CEM, 2014). However, in many cases there are significant opportunities with regard to operation and maintenance, and the existing skill base will often be more suited to this sector. Local content requirements should therefore be designed to maximise existing opportunities.

Technology-specific auctions and long-term auction schedules give room for growth and maturation

Auctions aiming to increase local content should be technology-specific. This auction type has the advantage of shielding a certain technology from early competition. An industry can thus develop, since price competition is less fierce and the technology can be deployed at an early phase. Technology development is stimulated through learning-by-doing and catalyses cost reductions in order to achieve competitiveness. Another key component is that the industry can rely on a long-term policy. Thus, a reliable long-term auction schedule facilitates the industry development.

9 Comment by Vestas business representative at Wind Energy and Development Dialogue 2014.

IN FOCUS: SOUTH AFRICA

South Africa operates an auction scheme that not only stipulates a certain percentage of locally sourced material and service provision, but also includes factors such as plant ownership, community involvement, preferential procurement and management control (Eberhard et.al, 2014). When bidders pass the first round, their bids are assessed not only according to the price, but also in terms of local content requirements. Fulfilment of this criterion makes up 30% of the final decision.

South Africa's approach has been both praised and criticised. It allows bidders comparatively high flexibility with regard to how they intend to meet the local content requirements. While stipulations are significantly more detailed in countries like Brazil in terms of which components need to be locally sourced, bidders in South Africa can determine where local sourcing is cheaper for them. However, the record on job creation has been mixed at best (Balmer, 2014). Even though socio-economic development has been an essential component of the scheme, it has run into a number of roadblocks associated with the lack of capacity development. The South African example illustrates that it is difficult to build up the necessary capacity in the absence of concomitant education and technical training measures. Capacity building and local industry development go hand in hand. Local content requirements should be accompanied by other policy measures to facilitate the establishment of an industry and to achieve the economic development goals intended in the first place.

3.5. Bidder diversity

Auctions can help lower market concentration if significant shares of the auction winners are new companies rather than incumbents. Thus, auction design should consider the power of the incumbents and the needs of new entrants, who can be small local as well as large international players.

Transparency and stable regulatory framework are important for investment security

As a transparent and stable regulatory framework is beneficial in general, it gains particular importance if new entrants shall be attracted. Long-term schedules make investments more attractive because market newcomers typically rely on long-term business plans (Lucas et al., 2013). They often have less experience with the local market and regulations, such as administrative processes regarding permissions and grid connections. Thus, all relevant aspects regarding auction participation and the electricity market should be clearly specified, otherwise novices might be deterred by high regulatory risks and transaction costs. Above all, grid connection terms should be settled, since in many countries the incumbents also (partly) own the grid and could thus discriminate against new players. Publishing site-specific data (e.g. solar radiation) can illustrate the attractiveness of local sites and minimise production risks. Site-specific auctions can be attractive for new entrants since requirements (e.g. securing land, grid connection etc.) and local conditions (e.g. site resources) can be more clearly defined (del Río & Linares, 2014).

Low entrance barriers are key, especially to attract smaller actors

New entrants can be encouraged by simple scheme and prequalification procedures. In Peruvian auctions only basic data and a prefeasibility study are required, which attracted many international companies (Ecofys & GIZ, 2013).

Where policy-makers encourage the participation of small actors ('citizen energy'), low barriers are even more important, because auctions favour large players due to strong competition, high risk and transaction costs. Prequalification requirements can be a prohibitive obstacle, as small actors might simply not have the capacity to handle the associated administrative challenges (Hauser et al., 2014). If most requirements have to be met and presented before the bidding process starts, small actors face high entry barriers. As many costs associated with prequalification are identical for all actors, small actors have to incur relatively higher costs (del Río & Linares, 2014). For citizens' initiatives above all, democratic processes may have the effect of further prolonging decision-making processes. Such factors represent sunk costs which cannot be recovered in case of bid failure. The capacity of small actors to repeatedly participate in auction schemes is therefore limited. Consequently, low prequalification levels or easy and transparent procedures are key elements in fostering their involvement.

Fixed long-term feed-in tariffs as auction award provide revenue security

Small actors typically depend on revenue security since they cannot cover the same risk as large companies (Hauser et al., 2014). Where there are important revenue risks, mainly as a result of electricity price uncertainty, small actors might be deterred from entering the auction scheme. It is therefore preferable to opt for fixed long-term feed-in tariffs as auction awards. If these tariffs are the only revenue source, auction winners are sheltered from electricity market risks through higher revenue predictability.

Low financial burdens encourage actor diversity

If the financial burden associated with financial guarantees and penalties is high, small actors may not have the capacity to handle these requirements. Small actors are less likely to possess significant financial resources or to have full access to capital markets as institutional investors and large companies. Moreover, due to a lack of available securities, small actors are likely to pay higher risk premiums. By contrast, large actors are able to integrate specific projects into their existing portfolios, thereby lowering the associated risk premiums. Small actors thus face higher risk levels than large businesses (Jacobs et al., 2014).

However, as in many (developing) countries investors face high regulatory and market uncertainties, such investment risks could also deter big players. In order to achieve a high participation, risk mitigation for investors might be useful as exemplified by private public partnerships in Morocco (see box).

Create separate schemes for smaller actors and restrict project sizes

Though it is difficult to imagine how small rooftop PV projects can be viably included in an auction scheme, India used this instrument for small-scale PV installations. The award has been a capital subsidy for part of the plant's investment cost (Khana & Barroso, 2014). France, on the other hand, has kept administratively determined feed-in tariffs for smaller projects below 100 kW (see box).

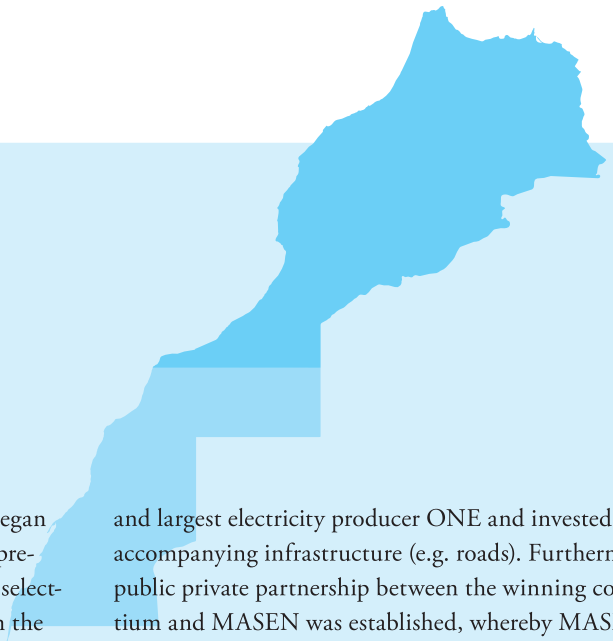
Alternatively, small projects could benefit from separate auctions where they do not face competition from larger players operating at scale. Capping the project size or the total awarded volumes allocated to individual bidders (bidder concentration rule) can be another way of facilitating the development of a more diverse actor landscape with increased involvement of smaller players. In India and California the maximum project size is capped and any single bidder can only be awarded for projects up to a certain amount[10] (del Río & Linares, 2014; Headway Solar, 2014).

IN FOCUS: FRANCE

France has various support schemes for PV in place. Projects smaller than 100 kW receive an administratively determined feed-in tariff, whereas projects between 100 kW and 250 kW can participate in the PV online tender, and larger projects have separate auction schemes. One aim of the standardised online procedure is easy access (low transaction costs) for small bidders. It is a simple sealed bid auction and the auction award is a feed-in tariff (pay-as-bid) for 20 years. Winners do not have to pay guarantees and there are no strict penalties except a lower support tariff in case of delays (Held et al., 2014).

This auction design has attracted many small actors, but there are also drawbacks. Only about 60% of the bids were eligible due to unclear prequalification requirements, for example, regarding the stipulated CO_2 assessment. In fact, only a low number of bidders were selected in the auctions, since it was possible for individual companies to make several bids (Held et al., 2014). The French example shows that low access barriers and low risks alone may be insufficient. Small actors in particular need a clear and transparent auction procedure whereby a diverse mix of winners might only be achieved by introducing maximum bid volumes per participant.

10 California's and India's schemes are not designed for small actors. Both have minimum project sizes and the maximum project sizes are high, with 20 MW (California) and 5 MW to 50 MW (India).

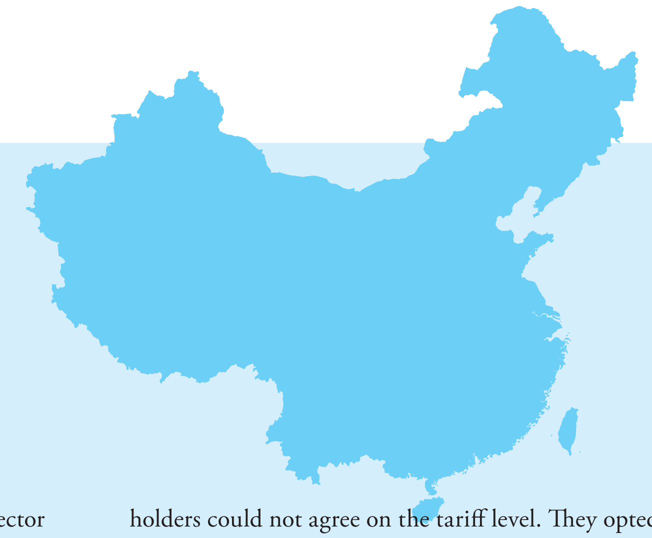


IN FOCUS: MOROCCO

The large scale tenders for the Moroccan Solar Plan began in 2010 and targeted international players, given the prequalification requirements. Project consortiums were selected in a prequalification stage, among other factors, on the basis of company experience (e.g. they had to operate solar thermal plant capacities of at least 45 MW) and financial soundness (Ecofys & GIZ, 2013). Although the prequalification requirements are demanding and the tender process is intricate, a sufficient number of investors were attracted.

The tenders were managed by the Moroccan Agency for Solar Energy (MASEN), which is also involved in project development. MASEN commissioned several studies for the sites, negotiated connections with the grid operator and largest electricity producer ONE and invested in the accompanying infrastructure (e.g. roads). Furthermore, a public private partnership between the winning consortium and MASEN was established, whereby MASEN provides the debt which is sponsored at low interest rates from international partners such as the World Bank. A significant part of the investment risk is thus shifted away from the investors, increasing investment attractiveness (Ecofys & GIZ, 2013).

One downside is that due to the public private partnership, MASEN and ONE hold project shares and ONE can keep its predominant position in the electricity sector (Ecofys & GIZ, 2013).



IN FOCUS: CHINA

Though the unbundling of the Chinese electricity sector started in the late 1980s, it is still rather concentrated and dominated by state-owned companies (Lucas et al., 2013). One goal of China's renewable energy policy, in particular the Wind Farm Concession Program from 2003-2009, was the attraction of private investors. However, only a low number participated or won slots in the wind auctions. One reason was that foreign companies had to disclose proprietary information, which was not acceptable for many and they abstained from participating. Moreover, state-owned incumbents cross-subsidised their wind projects to push down auction prices (underbidding) (Cozzi, 2012). This example shows that a fair and transparent auction process is a precondition for the attraction of private investors, and that the behaviour of local incumbents can hamper new entrants if no additional design features are in place.

The Chinese experience further shows that auction results (namely the price) can be used as benchmarks. The Renewable Energy Law, established in 2005, initially put the focus on administratively determined feed-in tariffs. However, stakeholders could not agree on the tariff level. They opted to use the results of wind onshore auctions to determine tariffs. In fact, in 2009 the Chinese government introduced four geographically differentiated feed-in tariffs based on the five auctions rounds of the Wind Farm Concession Program. PV auctions prices of 2009 and 2010 served in a similar way as a benchmark for the PV tariffs introduced in 2011 (Elizondo et al., 2014).

The Chinese example indicates that auction results can be used to discover reasonable support tariffs for other support instruments and avoid excessive or slow renewable deployment. However, the whole process takes many years, from the introduction of auctions to administratively determined feed-in tariffs, and the regulatory effort is quite demanding. It is also likely that the discovered technology costs are decreasing in the meantime due to technological progress. Moreover, only well-designed auctions serve as a good price discovery process. If strategic behaviour such as underbidding is a major problem, as observed in China, auction prices will serve only as a rough indication.

3.6. Social acceptance

Public resistance can be a major obstacle to the expansion of renewable energies. Depending on the catalyst for such opposition – lack of information or participation, local concentration or environmental concerns – auctions can be designed to mitigate these problems and improve social acceptance.

Involve local citizens and make them benefit from renewable projects

Public acceptance tends to grow along with the level of information and public involvement (Olsen, 2010). Local citizens need to feel informed in order to make decisions about whether a given project suits the local environment. Moreover, they need to be involved in decision-making processes in order to attain a degree of transparency. Local residents can become weary of processes that feel 'strange' or disruptive, especially in terms of the developers' motives. Auctions could therefore facilitate engagement between citizens and developers.

This is best achieved by eliminating the distinction. Where citizens become developers and operators, much of the tension can be resolved. Local residents can also be engaged by making them investors in local renewable energy projects. When in a position of having to make financial decisions, residents are encouraged to engage in detail with project proposals and are more likely to participate in a dialogue process with the developer. Ideally, this can help to bridge differences. Social acceptance thus goes hand in hand with provisions for encouraging small actor participation in auctions.

Strong compensation laws can mitigate concerns

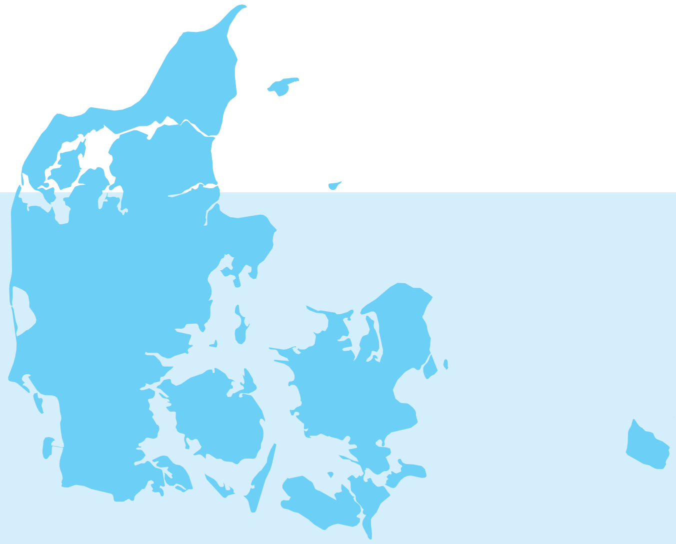
A further option is instituting strong financial compensation laws. Many residents fear negative effects on their property value, caused by renewable energy deployment. In order to increase social acceptance, a corresponding regime could be set up, governing which potential damages resulting from the construction of a plant are to be compensated (Olson, 2010). On the other hand, such measures could lead to higher project costs and a higher share of large investors becoming auction winners, since they possess sufficient financial resources to pay out compensation packages. In turn, this may lead to more local resistance. Hence, this instrument should be approached with care.

Local development funds link benefits to renewable projects

In addition to the previous options bidders may be obliged to contribute to a fund set up to finance local development. Such a fund can also entail efforts to offset some of the actual or perceived negative consequences of renewable energy projects. By using this scheme, local residents can derive direct benefits from renewable energy projects in their neighbourhood. In Denmark, a green fund has been set up to facilitate these developments (Olson, 2010).

Avoid local concentration and environmental impacts

Strong auction competition can induce the deployment of certain technology in particular regions, due to good resources or site availability, for example. Such movements can create anxiety even before projects are realised as it did in Great Britain in the 1990s because of the planned wind projects of the NFFO scheme (Mitchell & Connor, 2004). To pre-empt such local resistance, regional (and technology) specific auctions can distribute renewable capacities over a larger number of regions (del Río & Linares, 2014). Regional environmental concerns can also be addressed through strict prequalification requirements. Environmental impact assessments can show the projects' effects on the local environment and according to this include or exclude them from the auctions. Alternatively, environmental impacts or other measures to decrease local resistance can be considered in a multi-criteria auction.



IN FOCUS: DENMARK

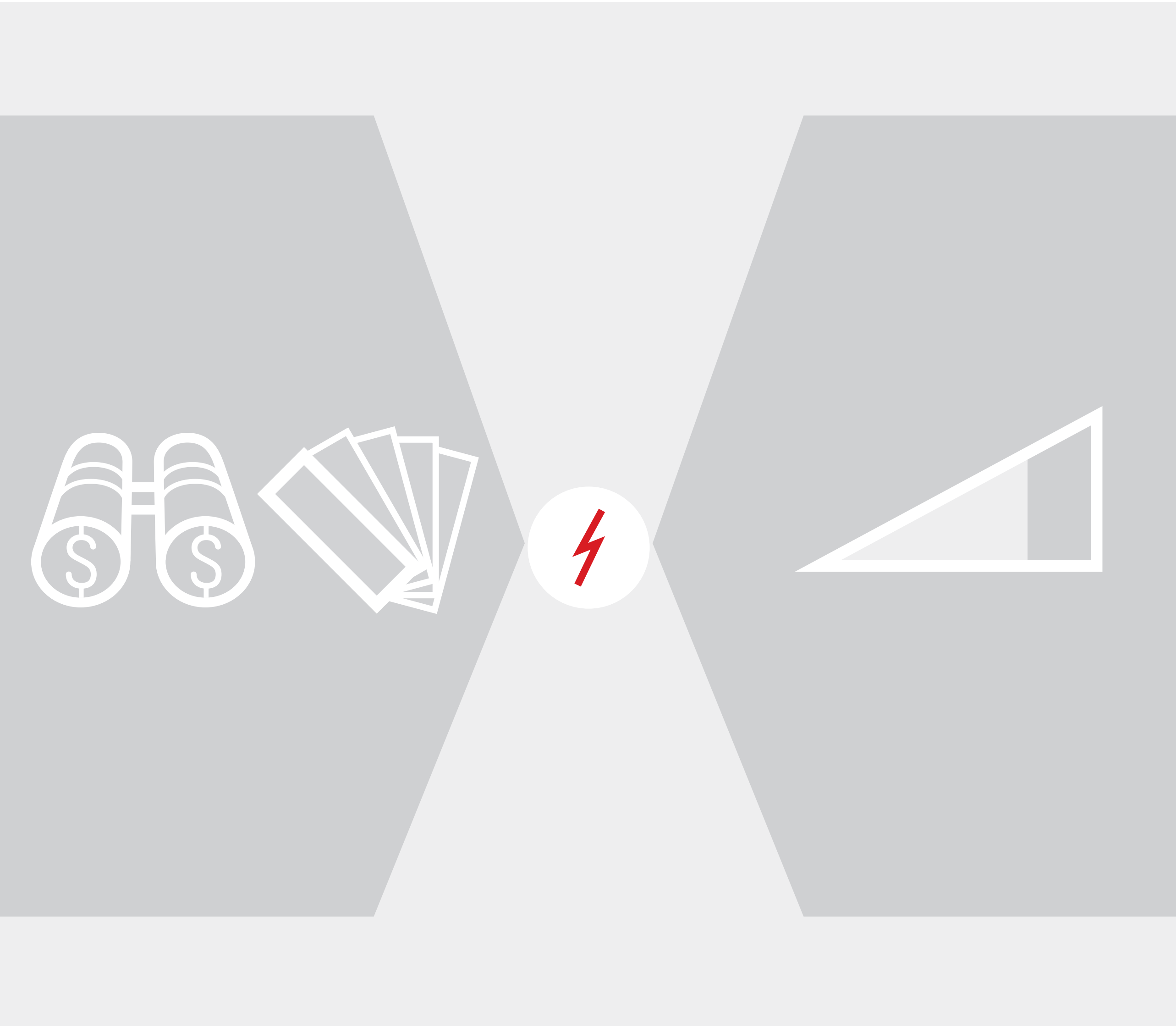
Denmark's auction scheme makes provisions for increasing social acceptance. It has set up a fund of DKK 10 million (around EUR 1,350,000) to help small actors conduct economic or technical feasibility studies for wind energy projects. The fund is aimed at local cooperatives which are eligible to receive up to DKK 500,000 (around EUR 70,000) in credit guarantees. If a project is not realised, the loan does not have to be repaid up to this amount (Jacobs et al., 2014).

Denmark is also pursuing an alternative path to promoting social acceptance. Project developers of nearshore wind plants are obliged to offer at least 20% of the project's shares to the local population (Danish Government, 2009). Permanent residents within a perimeter of 4.5 kilometres of the wind power plant are given pre-emptive rights to a maximum of 50 shares. A share is defined as the annual price of 1,000 kWh. If residents do not exhaust the 20% quota, shares are made available to all permanent residents of the relevant community. The quota does not refer to investment costs, but rather to the calculated revenues derived from power generation over 20 years. Additionally, Denmark is planning to offer a bonus of DKK 0.01/kWh to plants which display local share-ownership of at least 30%.

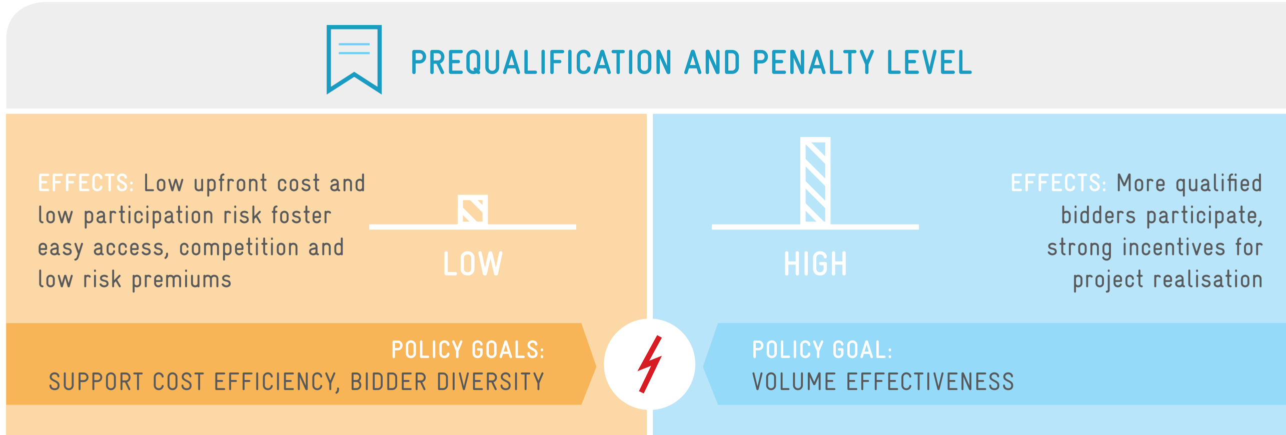
PART 4
TRADE-OFFS: CONFLICTING POLICY GOALS

Renewable energy auctions are often adopted to achieve a range of policy goals. But seeking to maximise one goal typically reduces the likelihood of meeting others. The possible outcomes of such conflicts are analysed here on the basis of theoretical considerations and country experiences. The featured list is not exhaustive. In some cases, basic trade-offs are not even considered as administrative efforts or auction schedules.

Some countries might hire qualified staff and strive for an easy and fast participation procedure, whereas others may not, since this incurs high administrative costs. The same applies to long-term auction schedules. Although they are recommended for achieving high investment security, many countries do otherwise as they deem political flexibility to be more important.



4.1. Prequalification and penalty level



The first trade-offs arise when prequalification and penalty levels are specified. Although these constitute two different design features, they entail similar effects. If only a few prequalifications are demanded, the upfront project costs, and thus the risk of not recovering them, are lower. Alongside this, fewer penalties reduce the risk related to construction delays or a lower performance. Low levels for both criteria thus make it easier and less risky to participate in the auctions. This could stimulate higher number of bids and might apply downward pressure on auction prices. It could imply lower risk premiums, which would then affect support costs (Müsgens & Käso, 2014). Small actors might benefit especially, as they are frequently unable to bear the high risks and transaction costs resulting from penalties and prequalifications (Hauser et al., 2014).

Many prequalifications, in turn, favour the participation of more qualified bidders. Less qualified bidders can then be excluded at an early stage. This is important to avoid winner's curse and achieve high realisation rates (volume effectiveness). Participation of only reliable bidders can also be fostered by a high penalty level since the cost risk related to deviations is excessive (Held et al., 2014).

The relevance of both criteria can be observed in Portugal and Denmark. Phase C auctions in Portugal in 2008 were designed to encourage the participation of small companies. However, the non-existence of prequalifications was a major reason for very low realisation rates of about 3%. The chosen penalties proved to be ineffective (10% of the investment costs as deposit), since there was no time limit for the realisation (Kopp et al., 2013; Müsgens & Käso, 2014). Although the prequalification procedure for the Danish offshore auctions is simplified in terms of a one-stop-shop for permits, entry barriers are high (Held et al., 2014). Potential investors have been deterred by short realisation times and high penalties, if the project is cancelled (financial guarantees are executed) or delayed (support tariff is reduced, additional financial penalty for longer delays). For the third tender only one bid was submitted and the price (14 ct/kWh) was approximately double that of previous tenders. However, the advantage of such strict compliance rules is a high realisation rate (Frontier Economics, 2014; Müsgens & Käso, 2014).

PREQUALIFICATION LEVEL[11]

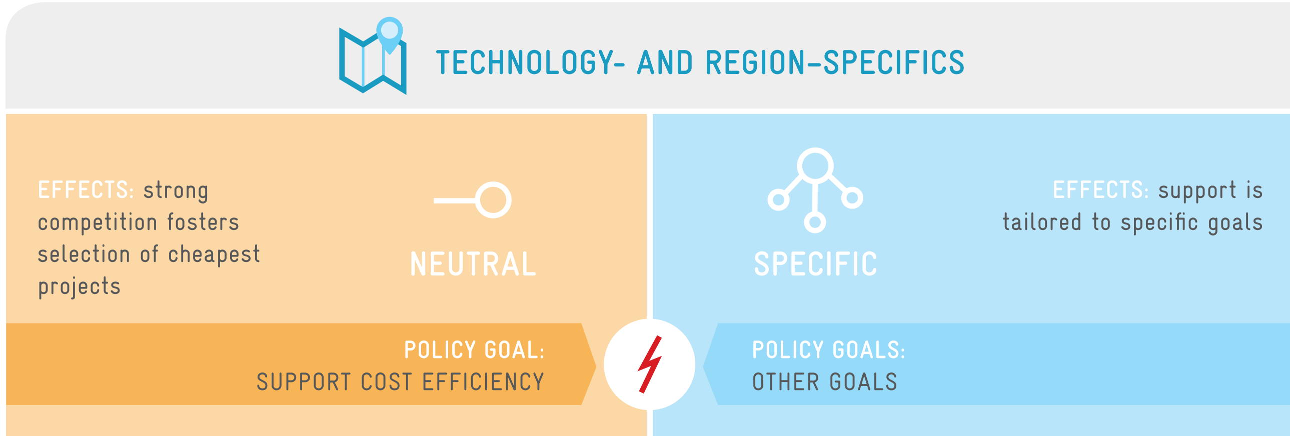
LOW	MEDIUM	HIGH
Germany: basic data and land-use resolution; optional: additional permits instead of higher financial guarantees Peru: basic data, prefeasibility study Portugal: only basic data	China: financial and company experience requirements, feasibility studies site-specific, thus securing land, grid connection etc. unproblematic Netherlands: environmental and other permits, prove of viability of the project UK: prove of technical, legal and commercial feasibility, but not necessary to have all permissions before auction	Brazil: site assessment, grid access approval, environmental permits etc. California: company experience, securing land, grid connection study etc. Denmark: environmental impact assessment, various permits, short realisation time etc., one-stop shop for permits site-specific, thus securing land, grid connection (socialised, not nearshore) etc. unproblematic France: CO_2 assessment, financial requirements, permits, grid connection paid by firm etc. India: financial and technical requirements, company is responsible for grid connection Morocco: company experience, financial and technical requirements etc. South Africa: securing land, prove of viability of the project, technical, financial and environmental requirements, etc.

11 The information contained in the tables of Chapter 4 is taken from the following sources: Agora Energiewende (2014), Baker & Wlokas (2014), BMWi (2015), Cozzi (2012), Cunha et al. (2014), del Río & Linares (2014), DFBEE (2014), Ecofys & GIZ (2013), Elizondo et al. (2014), Frontier Economics (2014), Hauser et al. (2014), Headway Solar (2014), Held et al. (2014), Khana & Barroso (2014), Kopp et al. (2013), Lucas et al. (2013), Müsgens & Käso (2014), SDG&E (2014), Shukla & Sawyer (2012).

PENALTY LEVEL

LOW	MEDIUM	HIGH
China: operation must begin within three years, but no clear penalties UK: operation must begin within four to five years, but no penalties	Brazil: Auction participants provide guarantees (1% of project costs in first and 5% in second round). If delay of project realisation is > one year, guarantees can be executed, but in practice not applied. In case of too strong deviations from contracted production the support level is reduced. France: Operation must begin within 20 months. Duration of support is reduced by the delay multiplied by two. If project not commissioned, no penalties. Germany: Project must be commissioned within 24 months. Bid and construction guarantees that are executed in case of delay or project termination. Guarantees are halved if bidders have additional land-use/construction permits before auction. Netherlands: Penalties for non-realisation within four years: guarantees executed (only large projects), loss of support and same project cannot participate in auction in the next five years Portugal: Companies must provide deposit (10% of investment cost) no construction deadline. South Africa: Bid guarantee. Contract is cancelled if commitment under power purchase agreement failed to meet.	California: Auction winners must provide deposit. Project must be commissioned within 18 months. Fixed penalties for delays. Penalties for too low production. Denmark: Winners pay guarantees that are (partly) executed if project is cancelled. If project is delayed, support tariff is reduced and additional penalty, if delay exceeds one year. India: Project must be commissioned within 13 (PV) and 28 months (CSP). Penalties modulated by the delay. If project is cancelled, bank guarantees executed. Morocco: Winners pay construction and performance bonds. Penalties modulated according to delay. Peru: High bid and construction guarantees while the latter increases with delay and is executed if project is cancelled. Operational guarantee continues throughout duration of contract.

4.2. Technology- and region-specifics



A basic conflict of renewable support schemes is whether all technologies are to the same extent eligible (technology-neutral), some might receive higher support or only some are eligible at all (technology-specific). A technology-neutral auction helps to promote strong competition due to a potentially higher number of participants, compared to auctions with separate slots for different technologies or only one. Competition between technologies has the further impact that projects with lowest costs are selected, which decreases support cost. Moreover, in countries with liberalised wholesale markets a technology-neutral scheme is also a step towards market integration (see section 3.3) (Frontier Economics, 2014).

By contrast, technology-differentiated support or separate auctions for specific technologies are useful if other goals are pursued (Maurer & Barroso, 2011). If local manufacturing industries are to be built, auctions are typically restricted to one or two technologies. Technology and regional bands can also help to spread capacities over the whole country and thus avoid problems with social acceptance due to local concentration (del Río & Linares, 2014). Separate auctions for different project sizes are beneficial if small actors are desired.

Auctions can also be tailored to electricity system requirements. Grid bottlenecks can be addressed by regional differentiation and the provision of ancillary services can be rewarded by premiums. Moreover, technology-specific support can be very important in matching demand profiles with fluctuating renewable energies, particular in countries lacking a liberalised wholesale markets (see section 3.3).

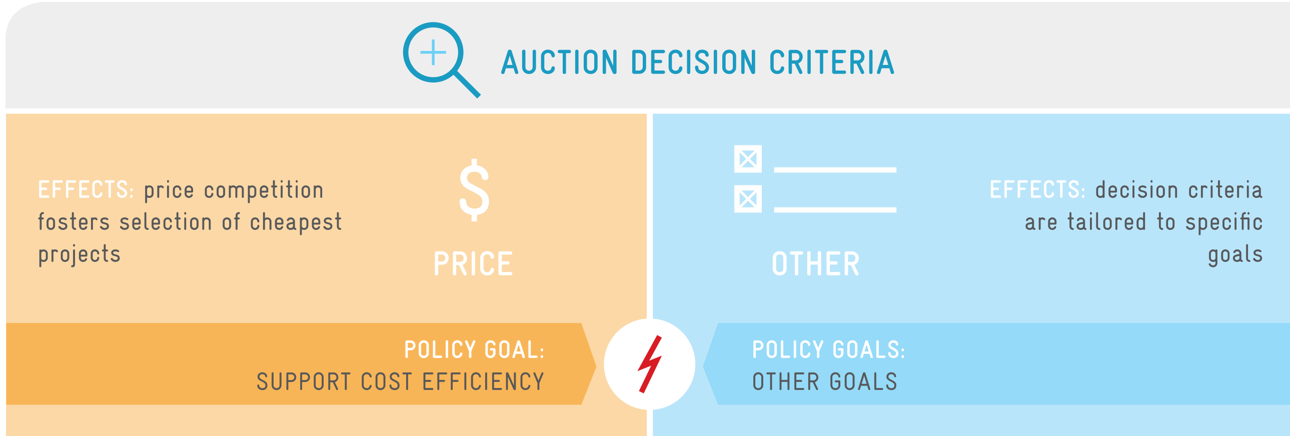
Nearly all countries have implemented a technology- (and regional-) specific auction scheme due to various goals: building up local industries (China, Brazil, France, India, Morocco, Portugal, South Africa), system integration (California, France), participation of small actors or social acceptance (Denmark, France, South Africa). The Netherlands, on the contrary, established a technology-neutral scheme[12] with strong focus on support cost efficiency (Held et al., 2014).

12 In the Netherlands, there are predefined tariff and technology categories, but all technologies can participate in a free category. Thus, the scheme is a mixture of a technology-specific and technology-neutral auction. However, if the annual fixed auction budget is fully spent in the earlier technology-neutral (or free) category, there is no money left for the technology-specific auction rounds (Kopp et al., 2013).

TECHNOLOGY- AND REGION-SPECIFICS

NEUTRAL	REGION-SPECIFIC	TECHNOLOGY-SPECIFIC
Brazil: only the "regular new energy auctions"	California: total capacity is partitioned among three grid companies	Brazil: the "reserve energy auctions" are either restricted to one technology (mostly wind onshore) or there is competition between wind onshore, biomass and/or small hydro
Netherlands: predefined tariff (and technology) categories, but all technologies can participate in free category	China, Denmark, Morocco, Portugal: site-specific	California: product type-specific: baseload (e.g. biomass), peaking (e.g. PV), non-peaking (e.g. wind)
	France: max. supported solar hours per year: 1,580h/a in mainland, 1,800h/a in Corsica and overseas	China: separate auctions for wind onshore and offshore, PV, CSP
	India: central and state-level auctions	Denmark: separate auctions for wind offshore and near shore
		France: separate auctions for wind onshore and offshore, small and large PV, Biomass. In the large solar auctions further differentiation (e.g. solar with trackers)
		Germany: only ground mounted PV (from 2017 onwards also for other technologies)
		India: separate auctions for PV and CSP
		Morocco: separate auctions for wind onshore, PV, CSP
		Peru: quotas within auctions for wind onshore, solar, biomass, small hydro
		Portugal: only wind onshore
		South Africa: quotas within auction for wind onshore, PV, CSP, biomass (and –gas), small hydro and separate auctions for small and large projects
		UK: quotas within auction for several technologies (e.g. wind, biomass) depending on auction round

4.3. Auction decision criteria



A similar trade-off between support cost efficiency and various other goals can arise from auction decision criteria (Maurer & Barroso, 2011).[13] A purely price-based selection process implies lower support costs, whereas other goals involve restrictions that might lead to higher costs. In principle, the regulator can choose any decision criterion in addition to pricing to pursue specific goals. One potential pitfall of multiple criteria is low transparency regarding the assessment process (Ausubel & Cramton, 2011). Thus, clearly defined criteria are important.

Country examples show that winners are typically not solely selected by pricing. Industrial development is often required, or increases the score in the bid ranking (France, China, India, Morocco, Portugal, and South Africa). In Denmark the winners of the nearshore wind auction are obliged to offer at least 20% to local residents, and receive a bonus for their support if they reach more than 30%. This also generates local content, since the local population benefits from the projects, but is primarily implemented to increase social acceptance (Held et al., 2014). Other criteria involve the assessment of technical and financial aspects of the project (China, France, Morocco, Portugal) or to increase the realisation rate. Security of supply and transmissions costs can also be used as evaluation criteria, as in California, where price bids are adjusted by a deliverability and transmission adder (SDG&E, 2014).

13 Note that support cost efficiency refers here to a certain amount of renewable capacity or production that is reached with minimum support costs. Decision criteria that induce the integration of renewables into the system can increase support costs, but lower overall system costs (see also section 3.3).

AUCTION DECISION CRITERIA

PRICE

Brazil: local content is precondition only for financing, not within the auction procedure itself

Germany, Peru: price only

Netherlands: regulatory determined increasing price in each round within each round: first come, first served

MULTI-CRITERIA

California: price, resource adequacy, transmission costs

China: price (in 2007: bid closest to the average bid), local content, technical experience

Denmark: primary price, negotiated procedure local content bonus for near shore

France: price, CO_2 assessment (since 2013), innovation (only solar > 250 kW)

India: price, local content (separate auction)

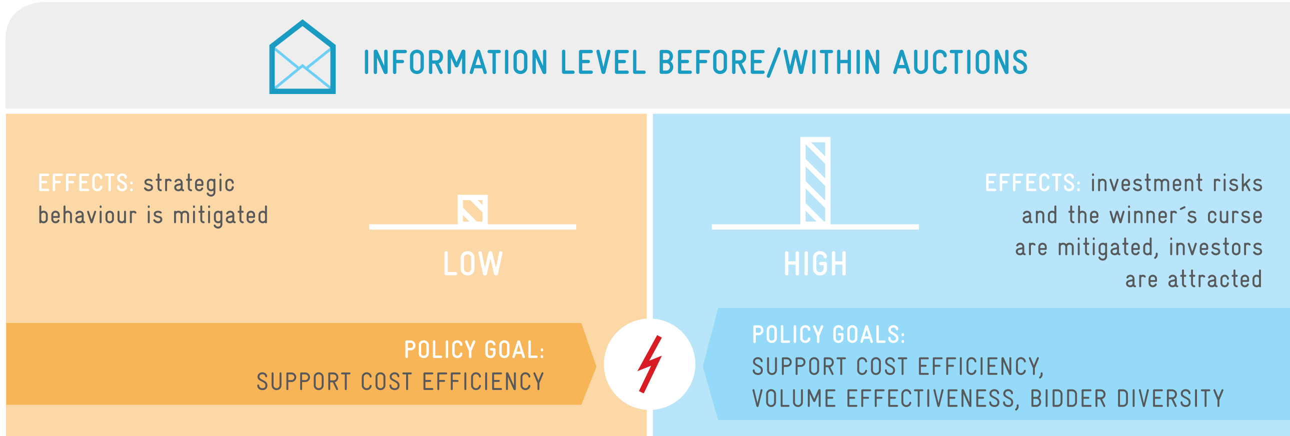
Morocco: price, technical and financial aspects, local content

Portugal: price, local content, technical aspects (e.g. voltage control), innovation

South Africa: price, local content

UK: non-transparent selection process (mainly price)

4.4. Information level before and within auctions



There is a basic conflict between low and high information levels given by the regulator. Low information levels (e.g. where the regulator does not publish previous auction results and the price ceiling) curb strategic behaviour. Bidders can use less information to adjust their offers in order to receive higher profits, which is positive for support cost efficiency (Müsgens & Käso, 2014).

Given strong competition, a high information level reduces participation risk. If the price ceiling is disclosed, bidders do not have to be afraid that their bids are excluded. Moreover, bid quality can be improved by high information levels. If previous auction results are published, bidders can use them to improve their own cost estimates. This increases the probability that the actually cheapest bids are selected instead of the perceived ones. Support cost efficiency as well as volume effectiveness will benefit, because winner's curse will be less likely to occur (Müsgens & Käso, 2014).

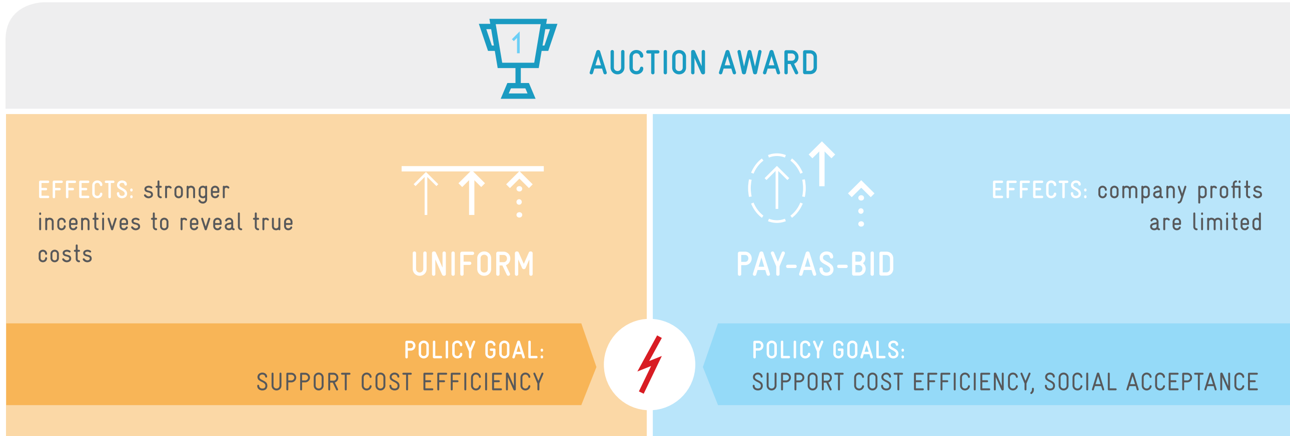
The auction format and information level are interdependent. A static sealed bid auction, with only one bidding round, offers little information to participants. They cannot see or react to other bids. In a dynamic descending-clock auction, by contrast, prices and volumes are published after each round. Participants can thus adapt their bids (Held et al., 2014). A high level of information might also be useful if new investors and small actors are to be attracted, as they might face higher uncertainty as local incumbents. However, a caveat with dynamic auctions is that they also tend to induce higher transaction costs, which could deter small actors (Frontier Economics, 2014).

Assessing whether the overall information level in a specific country is low or high is not a straightforward task and is certainly not covered in detail here. Most of the analysed countries use typical static sealed bid auctions, except Brazil (hybrid), Denmark (sealed bid with subsequent negotiations) and the Netherlands (iterative sealed bid). An interesting example regarding the disclosure of the price ceiling is South Africa. In the first auction, the price ceiling was known by bidders, which in combination with weak competition, led to prices close to the price ceiling. In the following rounds the price ceiling was undisclosed, which was one reason why price reductions could be achieved (Ecofys & GIZ, 2013; Frontier Economics, 2014).

INFORMATION LEVEL BEFORE/WITHIN AUCTIONS

LOW	MEDIUM	HIGH
California, Germany, India: sealed bid, one auction round	Brazil: descending clock in first round that determines price ceiling in second round (sealed bid)	Denmark: sealed bid with subsequent negotiated procedure, site-specific, high level of transparency and information offered
Peru: sealed bid, one auction round, undisclosed price ceiling	volume reduction in second round (height unknown for bidders)	
South Africa: sealed bid, one auction round, undisclosed price ceiling	China, Morocco: sealed bid, one auction round, site-specific	
UK: sealed bid, one auction round, non-transparent selection process	France: sealed bid, one auction round, easy access online auction	
	Netherlands: sequential sealed bid rounds with increasing prices	
	Portugal: sealed bid, one auction round, site-specific	

4.5. Auction award



There are different ways in which auction awards can be specified. The two most often used are the uniform market clearing price, or a support equivalent to what the price winners have bid. The latter – pay-as-bid pricing – seems an attractive option. Winners receive only what they need for cost recovery, which induces low support costs. Furthermore, ratepayers pay no more than necessary, which is beneficial for social acceptance (Müsgens & Käso, 2014; Klessmann et al., 2014). But this scheme has one drawback (Kahn et al., 2001; Müsgens & Käso, 2014): auction participants are stimulated to bid above actual cost levels. In fact, bidders try to maximise their profits by bidding a price that is as high as possible but could still be selected. Every bidder has its own 'optimal' guess and therefore puts a different mark-up on actual cost level. This can result in the reordering of the best bids in such a way that not only the cheapest projects are selected, but the ones with better estimates. Hence, the total costs for society can be higher than necessary. Under uniform pricing, optimal bids do not have to be estimated. If competition is sufficient, all bidders have incentives to bid at true cost levels because they will only gain the market clearing price.

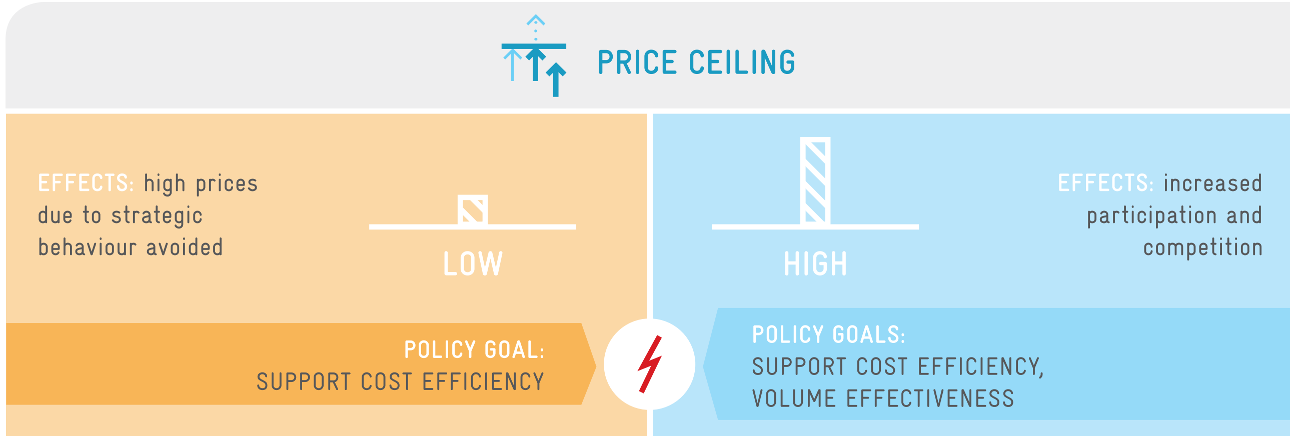
The basic conflict can be described as follows: either the overall costs for society are more likely reduced (at higher profits for companies and higher costs for ratepayers – uniform pricing), or support costs are more likely minimised at the expense of a (slightly) distorted selection of projects (pay-as-bid). Some observers also consider uniform pricing more suitable for small firms (Müsgens & Käso, 2014): In general, they have access to less information than large firms and are therefore less able to guess the optimal price as they are under pay-as-bid. Others, however, claim that pay-as-bid is more intuitive, because auction winners get what they bid, and thus is rather more accepted by auction participants (Klessmann et al., 2014).

In practice, most countries have implemented pay-as-bid pricing. One reason might be lower political costs, because they are or at least seem to be cheaper for ratepayers. The theoretical advantage of uniform pricing described above is in contrast not as intuitive and hard to measure. Moreover, in many countries the competition levels were expected to be low or at least highly uncertain before the auction. If bidders are allowed to participate with several projects and the competition level is low, strategic bidding is also a major problem with uniform pricing (Klessmann et al., 2014).

AUCTION AWARD

UNIFORM	PAY-AS-BID	OTHER
Germany: second and third auction round	Brazil: second round	Denmark: price of first sealed bid round can be renegotiated
UK: first and second round	Germany: all except second and third auction round	
Netherlands: uniform for each price category (regulatory determined)	UK: third to fifth round	
	California, China, France, India, Morocco, Peru, Portugal, South Africa	

4.6. Price ceiling



A low price ceiling can restrict the impact of strategic behaviour and thus limit support costs. But specifying a reasonable level is demanding, since the regulator needs information about the true cost of technologies (see section 3.1). If the price ceiling is too low, potential bidders could be deterred and undersupply, resulting in lack of competition. The remaining bidders could set their bids close to the ceiling (if it is disclosed) since they know that almost all bids will be accepted. In turn, a high (or none) price ceiling would encourage more bidders, but potentially at the cost of higher prices due to strategic behaviour (Elizondo et al., 2014; Maurer & Barroso, 2011).

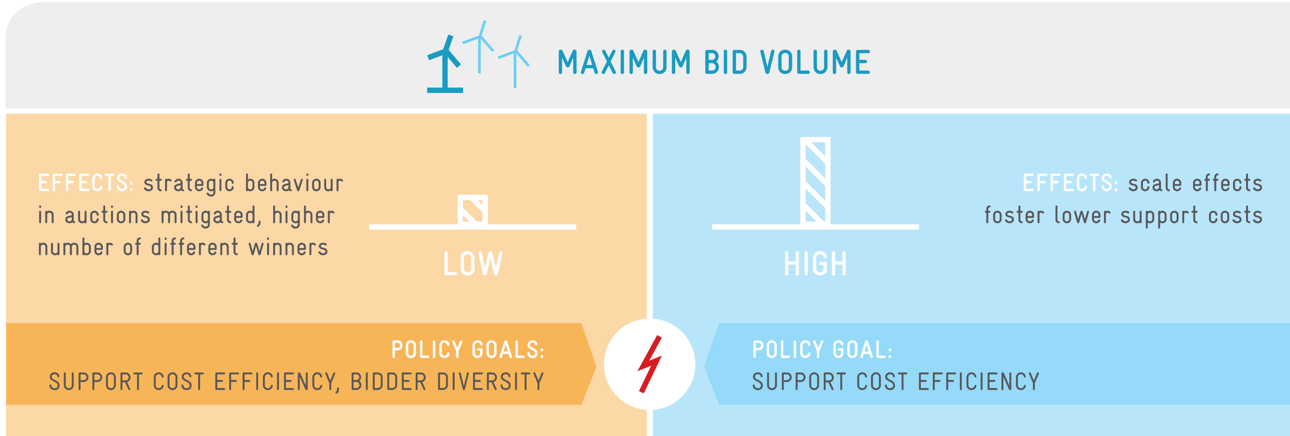
Most countries have introduced price ceilings. In Brazil, the price ceiling[14] of wind energy auctions has been repeatedly lowered since 2009, from roughly USD 110 /MWh to below USD 60 /MWh at the end of 2013. Average wind auction prices, however, remained relatively stable in 2011 and 2012 and even increased in 2013. One concern is that prices have fallen below sustainable levels in recent years, and cannot recover due to the tight ceiling. Besides increased component costs, auction prices might have risen because the government had reduced some benefits for wind energy projects in later auctions. If such changes in installation cost and auction design are not reflected in the price ceiling, a lack of supply can become an issue. This has not been the case so far, as more than 9,000 MW of wind power plants have registered for each of the last four Brazilian auctions, outnumbering capacity demand by far. However, having an auction price so close to the ceiling indicates that recent auctions have lacked competition, with many suppliers dropping out and others simply offering the price ceiling. This may also increase the risk of construction delays or defaults by winners who placed unrealistic low bids (Elizondo et al., 2014).

14 This price ceiling refers to the maximum price of the first descending clock auction round. The price ceiling of the second sealed bid round is determined by the first round.

PRICE CEILING

YES	NO (OR NOT IDENTIFIED)
Brazil: price ceiling for the second sealed bid auction round is determined in first descending clock round, price ceiling for the first round is administratively determined	China, Denmark, France, Morocco
California, France, Germany: administratively determined	
India: maximum support per MW in latter auctions	
Netherlands, Peru, Portugal: administratively determined	
South Africa: in first round former technology-specific feed-in tariff, undisclosed in latter auctions	
UK: determined within selection process	

4.7. Maximum bid volume



If policy-makers seek to reduce electricity market concentration or support participation of small actors, they can apply maximum project size rules or define the maximum capacity allocated to one bidder. Particularly small companies could be deterred without such rules because the (perceived) chance to win against large entities might be low (Hauser et al., 2014). Thus, bid restrictions could also increase competition and support cost efficiency.

High (or none) maximum bid volumes do attract potentially more large companies, which can increase the overall bid volume, foster competition and lower support costs. Whether a bounded bid volume decreases or increases competition levels depends on local conditions. Moreover, the higher the maximum bid volume, the more scale affects are possible due to larger projects implying lower support costs (Ausubel & Cramton, 2011; Müsgens & Käso, 2014).

Restricted project sizes (California, Germany, India) or separate auctions for small and large projects (France, South Africa) have occurred in some countries. One goal of the French PV online tender is an easy access for small actors to increase the level of competition. But since one company can submit several bids, only a low number of firms were selected (Held et al., 2014). Explicit seller concentration rules can prevent such undesired results. The winner of Portuguese tenders (2005-2008) were excluded from the next bidding round, while in California one company cannot win more than 50% of total allocated capacity. India has similar restrictions in place (del Río & Linares, 2014).

MAXIMUM BID VOLUME

YES

California: > 3 MW, < 20 MW, multiple projects per company possible, but seller concentration rule: Amount of capacity allocated to one company cannot be > 50% of total capacity or revenue cap.

France: separate solar auctions for > 100 kW, < 250 kW and > 250 kW, multiple projects per company possible

Germany: > 100 kW, < 10 MW, multiple projects per company possible

India: Allowed project size range depends on round. Multiple projects per company possible, but seller concentration rule: amount of capacity allocated to one company is limited (depends on round).

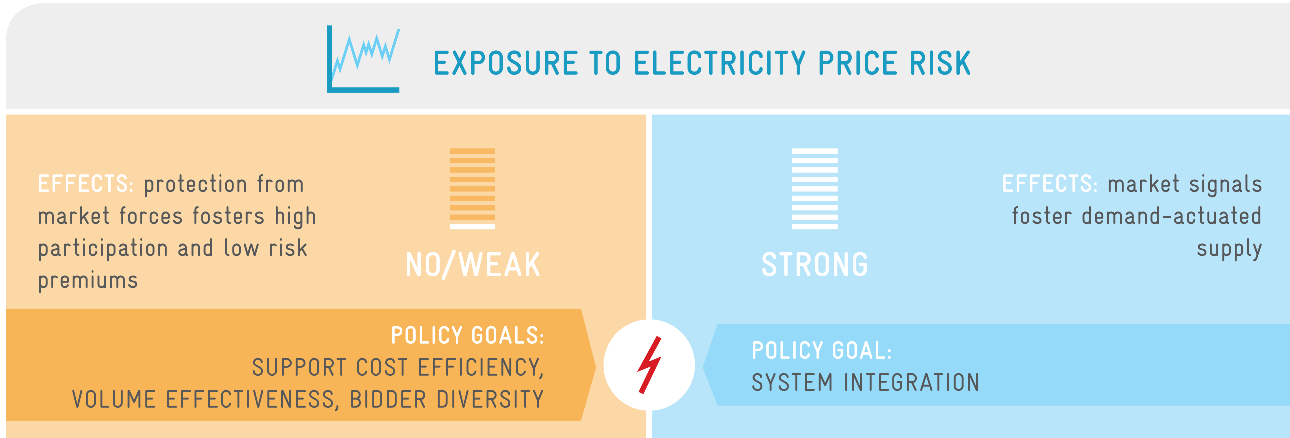
South Africa: separate auctions for smaller (between 1 MW and 5 MW) and large projects (> 5 MW)

NO (OR NOT IDENTIFIED)

Brazil, China, Denmark, Morocco, Netherlands, Peru, UK

Portugal: seller concentration rule: successful bidders of first round could not participate in second round

4.8. Electricity price risk



Market integration in this case depends on a well-functioning wholesale electricity market with competing private plant operators. In such a market environment renewable energy producers will see electricity prices in their revenue stream (see section 3.3), and are thus exposed to market risks. An auction award is the most relevant design feature for addressing these risks. If auction winners receive a remuneration that covers total cost (feed-in tariff), they are not exposed to electricity price risks. Such a low risk level is beneficial for the support costs due to lower risk premiums incorporated into the auction bids. An overall higher participation level can also be expected, which fosters auction competition and volume effectiveness. In particular small companies will benefit, as they are less able to manage high risks (Hiroux & Saguan, 2010; Kopp et al., 2013).

If policy-makers aim for market integration, auction winners can be required to sell the electricity on the market, with the auction award being a sliding or, with higher risks, fixed premium (feed-in premium). One result is that renewable supply will more demand-driven and this can improve the cost efficiency of the overall electricity sector. Since this is inevitably connected to higher investment risks for the auction winners, the support cost efficiency of the auction alone might be negatively affected (risk premiums) (Hiroux & Saguan, 2010; Kopp et al., 2013).

As many countries have not yet achieved liberalised wholesale markets, most of the countries considered show no electricity price risk. Moreover, low shares of renewables imply low pressure to integrate renewables into the market, given that fossil-fuel plants or other capacities are able to meet volatile demand (IEA, 2014). Under these conditions, policy-makers often care more about the good functioning of tendering, high participation rates and low support costs (due to low risks). Most countries do not expose renewable energies to electricity price risks via their auction scheme, except Denmark, Germany and the Netherlands. Auction winners in these countries receive a sliding feed-in premium and are obliged to sell their electricity on the market. However, with increasing renewable shares and evolving electricity markets, this topic is likely to become more important (cp. Couture et al., 2015).

ELECTRICITY PRICE RISK

NONE OR NEGLIGIBLE

Brazil: feed-in tariff, duration depends on technology

California: feed-in tariff for 10, 15 or 20 years

China: feed-in tariff for 30,000 full load hours (10-15 years), after that average local feed-in tariff

France: feed-in tariff for 20 years (1580h/a in mainland, 1,800h/a in Corsica and overseas, more hours: 5ct/kWh)

India: feed-in tariff for 25 years (first two rounds), investment subsidy (per MW) to close viability gap for regulatory determined production tariff

Morocco: feed-in tariff for 20 (wind) or 25 (solar) years

Peru: feed-in tariff for offered volume (kWh) per year for 20 years (more produced electricity is sold at market price)

Portugal: feed-in tariff

South Africa: feed-in tariff for 20 years

UK: feed-in tariff for 8 to 15 years (depends on auction round)

LOW

Denmark: sliding feed-in premium for 50,000 full load hours (12-14 years), direct marketing

Germany: sliding feed-in premium for 20 years, direct marketing

Netherlands: sliding feed-in premium, direct marketing, support duration depends on technology

PART 5 GLOSSARY

A

Ancillary services
Refers to a range of functions that help guarantee system security. These include black start capability (the ability to restart a grid following a blackout); frequency response (to maintain system frequency with automatic and very fast responses); fast reserve (which can provide additional energy when needed) and the provision of reactive power, among others.

Auction pricing
Auction winners either receive the same uniform price (mostly the clearing price) or they receive individually what they bid in the auction, called pay-as-bid. There are also other auction remunerations (based e.g. on Vickrey pricing) that are not part of this guide.

B

Bidder concentration rule
To avoid the selection only of a low number of auction participants that placed several bids, bidder concentration rules can be implemented. Typically, the amount of electricity or number of capacities allocated to one company is restricted.

Bond guarantees
Payments required from the bidding participants and/or from auction winners to prove their serious intent to put the project into practice. Bid bonds are executed in case bidders' obligations are not met, whereas completion or construction bonds are executed if project milestones of the auction winners are not met.

C

Clearing price
The auctioneer sorts the bids in ascending order. The most expansive bid that is needed to meet demand determines the clearing price. Thus, the clearing price is the price where aggregated supply meets demand.

D

Descending clock auction
The auctioneer begins by setting a high price and asking bidders to state the quantities they wish to sell at that price. If the quantity offered exceeds the target to be procured, the auctioneer states a lower price, and again asks bidders which quantities they want to offer at the new price. This process continues until the quantity offered matches the quantity to be procured or until excess supply is negligible. Due to the iterative auction rounds (dynamic auction), there is an interaction between the participants.

F

Feed-in premium
A subsidy (here: auction award) that is paid per produced electricity (kWh) on top of the wholesale market price. It is typically combined with an obligatory direct marketing, i.e. producers are responsible for selling their electricity on the market. It can either be fixed or 'sliding', i.e. it is adjusted according to the electricity market development to fill the gap between the market price and the support tariff. Since a fixed premium implies that producers bear the risk of electricity price development, it exposes them to higher electricity market risks compared to a sliding premium.

In fact, a sliding feed-in premium is close to a feed-in tariff in terms of risk allocation and market integration. The main difference is that producers under a sliding premium are typically responsible for selling the electricity, which incentivises them not to produce at negative prices that outweigh the premium and forces them to take an interest in the selling process. However, in both cases they receive the same revenue per kWh, because the sliding premium is adjusted according to the electricity price development. Under a fixed premium in contrast, producers additionally care about the long-term electricity price development since the premium is not adjusted (for more detail see Pahle & Schweizerhof, 2015).

Note that a higher market risk for producers implies a lower risk for consumers. With a sliding premium, consumers (who pay the tariff) guarantee producers a fixed price: If the electricity price is lower than expected, consumers pay a higher premium to the producers and vice versa. Thus, they bear the electricity price risk instead of the producers. The choice of the tariff – feed-in tariff, sliding or fixed feed-in premium – therefore always implies a risk allocation between producers and consumers.

Feed-in tariff
A subsidy (here: auction award) that is paid per electricity produced (kWh) to cover the total cost of a renewable project. Typically, producers do not have to sell the electricity on their own on the market. This is assumed by the contracting party of the power purchase agreement instead.

H

Hybrid auction
combines different auction types. One approach is to have a descending clock stage followed by a (sealed) pay-as-bid stage, which has been the model implemented in Brazil: The first-stage descending clock auction (see above) is used as a preselection and to determine the price ceiling for the second stage. In the second stage, winners submit a schedule of prices and quantities as typical in sealed bid auctions (see below).

L

Local content requirements
Policy measures that require investors to source a certain percentage or amount of (value of) intermediate goods from local manufacturers or producers. These local producers can be either domestic companies or localised foreign-owned enterprises.

M

Multi-criteria auction
A type of auction where the winners are determined by various criteria besides the price bids, such as local content, technological innovations, environmental concerns. Typically, the criteria are weighted and incorporated into a single score, which serves to rank the bids.

P

Pure price-based auction
A type of auction where the winners are determined solely by the least-cost bids.

Price ceiling
A limit set by the regulator on how high the price of a product in an auction (and for a particular technology) can be. The regulator can either choose to disclose the price ceiling before the auction or to leave it unpublished.

S

Strategic behaviour
Refers in this context to any bid setting that is intentionally higher or lower than is necessary to cover project costs (plus competitive project return). If the competition level in the auctions is too low and bidders are aware of this, they can bid a price that is higher than necessary in order to increase their profits. By contrast, participants can also bid a lower price than necessary for strategic reasons (underbidding), for instance to avoid the entrance of other participants and thus gain higher market share (market power).

Sealed bid auction
Firstly, bidders submit a schedule of prices and quantities. The auctioneer then gathers all the bids, creates an aggregate supply curve, and matches it with the quantity to be procured. The clearing price is determined when supply equals demand, and the winners are all those projects whose bids, or sections of their bids, offer lower prices than the clearing price. Since the bids are submitted at the same time (one auction round) and there is no interaction between the bidders, the sealed bid auction is static. Winners receive different prices based on their financial offers (pay-as-bid) or the same clearing price (uniform pricing).

W

Winner's curse
Results when project developers realise, after winning a bid, that their project is not commercially viable because their bid was too low. It can result in the termination of the project if the cost of the penalties is lower than the costs of the project realisation. In contrast to underbidding, excessively low bids are not intended.

PART 6
REFERENCES

Agora Energiewende (2014): Ausschreibungen für Erneuerbare Energien: Welche Fragen sind zu prüfen? Berlin, Germany: Agora Energiewende.

Amara, A. (2014): Speech given by the Minister of Energy, Mines, Water and Environment of Morocco. Inauguration of the first edition of the International Photovoltaic Exhibition & Conference, 4th November 2014. Casablanca, Morocco.

Ausubel, L. M., & Cramton, P. (2011): Auction design for wind rights. Report to Bureau of Ocean Energy Management, Regulation and Enforcement. Maryland, USA: University of Maryland.

Baker, L. & Wlokas, H. L. (2014): South Africa's Renewable Energy Procurement: A New Frontier. Tyndall Working Paper 159, Norwich, UK: Tyndall Centre.

Balmer, M. (2014): Effects of auction systems on companies and job creation in South Africa: Lessons from the renewable energy procurement program. Presentation for the 9th Wind Energy and Development Dialogue (WEED 2014), 9th October 2014, Berlin, Germany.

BMWi (2015): Verordnung zur Einführung von Ausschreibungen der finanziellen Förderung für Freiflächenanlagen sowie zur Änderung weiterer Verordnungen zur Förderung der erneuerbaren Energien. Berlin, Germany: Federal Ministry for Economic Affairs and Energy.

Couture, T., Jacobs, D., Rickerson, W. & Healey, V. (2015): The next generation of renewable electricity policy. How rapid change is breaking down conventional policy categories. Denver, USA: National Renewable Energy Laboratory.

Cozzi, P. (2012): Assessing Reverse Auctions as a Policy Tool for Renewable Energy Deployment. Energy, Climate, and Innovation Program, Center for International Environment and Resource Policy. Medford, USA: Tufts University.

Cunha, G., Barroso, L., & Bezerra, B. (2014): Lessons learned from the auction-based approach to integrate wind generation in the Brazilian electricity market. Paris, France: CIGRE.

Danish Government (2009): Promotion of Renewable Energy Act. Copenhagen, Denmark.

del Río, P., & Linares, P. (2014): Back to the future? Rethinking auctions for renewable electricity support. Renewable and Sustainable Energy Reviews 35: 42-56.

DFBEE (2014): Das Ausschreibungsmodell für erneuerbare Energien: Deutsch-französisches Büro für erneuerbare Energien (DFBEE). Berlin, Germany: DFBEE.

Eberhard, A., Kolker, J. & Leigland, J. (2014): South Africa's Renewable Energy IPP Procurement Programme: Success Factors and Lessons. Washington, USA: PPIAF.

Ecofys & GIZ (2013): Lessons for the tendering system for renewable electricity in South Africa from international experience in Brazil, Morocco and Peru. Berlin, Germany: Ecofys.

Elizondo Azuela, G., Barroso, L., Khanna, A., Wang, X., Wu, Y., & Cunha, G. (2014): Performance of renewable energy auctions: experience in Brazil, China and India. Policy Research Working Paper 7062. Washington, USA: World Bank Group.

Frontier Economics (2014): Technologieoffene Ausschreibungen für Erneuerbare Energien. Report for EFET Germany. London, UK: Frontier Economics.

Gornsztejn, J. (2012): Financing Wind Power Development in Brazil. Presentation for the Multi-stakeholder workshop on Wind Energy, 13th to 14th April 2012, Copenhagen, Denmark.

Grashof, K. & Weber, A. (2014): Herausforderungen durch die Direktvermarktung von Strom aus Wind Onshore und Photovoltaik. Report for Greenpeace. Saarbrücken, Germany: IZES.

Hauser, E., Weber, A., Zipp, A., & Leprich, U. (2014): Bewertung von Ausschreibungsverfahren als Finanzierungsmodell für Anlagen erneuerbarer Energienutzung. Report for Bundesverband Erneuerbare Energien. Saarbrücken, Germany: IZES.

Headway Solar (2014): Project Allocations Under the Phase I Batch II of National Solar Mission: An Overview. New Delhi, India: Headway Solar.

Held, A., Ragwitz, M., Gephart, M., de Visser, E., & Klessmann, C. (2014): Design features of support schemes for renewable electricity. Report for the European Commission. Utrecht, The Netherlands: Ecofys.

Herrera, C., & Maxwell, A. (2014). Acting Now on Climate: How is Peru addressing climate change and moving toward a low-carbon future? NRDC Issue Brief. Natural Resources Defense Council.

Hiroux, C., & Saguan, M. (2010): Large-scale wind power in European electricity markets: Time for revisiting support schemes and market designs? Energy Policy 38: 3135–3145.

Hirth, L. (2013): The Market Value of Variable Renewables. Energy Economics 38: 218-236.

IEA (2014): The power of transformation: Wind, sun and the economics of flexible power systems. Paris, France: OECD/IEA.

IRENA & CEM (2014): The socio-economic benefits of large-scale solar and wind: an econValue report. Abu Dhabi, United Arab Emirates: IRENA.

Jacobs, D., Peinl, H., Gotchev, B., Schäuble, D., Matschoss, P., Bayer, B., Kahl, H., Kahles, M., Müller, T. & Goldammer, K. (2014): Ausschreibungen für erneuerbare Energien in Deutschland – Ausgestaltungsoptionen für den Erhalt der Akteursvielfalt. IASS working paper. Potsdam, Germany: IASS.

Kahn, A.E., Cramton, P., Porter, R. H., & Tabors, R. D. (2001): Pricing in the California Power Exchange Electricity Market: Should California switch from uniform pricing to pay-as-bid pricing? Blue Ribbon Panel Report, USA: California Power Exchange.

Khana, A., & Barroso, L. (2014): Promoting renewable energy through auctions: the case of India. Live wire knowledge note series 2014/15. Washington, USA: World Bank Group.

Klessmann, C., Wigand, F., Gephart, M., Blücher, F. v., Kelm, T., Jachmann, H., Ehrhart, K.-M., Haufe, M.-C., Kohls, M. & Meitz, C. (2014): Ausgestaltung des Pilotausschreibungssystems für Photovoltaik-Freiflächenanlagen. Report for the German Federal Ministry for Economic Affairs and Energy. Berlin, Germany: Ecofys.

Kopp, O., Bode S., Ehrhart, K.-M., Engelhorn, T., Gebhart, M., Grave, K., Groscurth, H.-M., Klessmann, C., Nabe, C., Onischka, M., Pietrzyk, S. (2013): Wege in ein wettbewerbliches Strommarktdesign für erneuerbare Energien. Mannheim, Germany: MVV Energie.

Kuntze, J.-C., & Moerenhout, T. (2013): Local Content Requirements and the Renewable Energy Industry - A Good Match? Geneva, Switzerland: ICTSD.

Lucas, H., Ferroukhi, R., & Hawila, D. (2013): Renewable Energy Auctions in Developing Countries. Abu Dhabi, United Arab Emirates: IRENA.

Maurer, L., & Barroso, L. (2011): Electricity Auctions: an overview of efficient practices. A World Bank study. Washington, USA: The World Bank.

Mitchell, C., & Connor, P. (2004): Renewable energy policy in the UK 1990–2003. Energy Policy 32: 1935-1947.

Müsgens, F. & Käso, M. (2014): Auktionsdesign für Photovoltaikanlagen auf Freiflächen. Report for BDEW. Cologne and Cottbus, Germany: r2b Energy Consulting, Brandenburg University of Technology.

Olsen, B. E. (2010): Wind energy and local acceptance: How to get beyond the nimby effect. European Energy and Environmental Law Review 19: 239–251.

Pahle, M. & Schweizerhof, H. (2015): A risk perspective on market integration and the reform of support of renewables in Germany. Discussion Paper. Potsdam, Germany: PIK.

Porrua, Fl., Bezerra, B., Barroso, L.A., Lino, P., Ralston, F., Pereira, M. (2010): Wind power insertion through energy auctions in Brazil. Power and Energy Socitey General Meeting 25th-29th July 2010. Minneapolis, USA: IEEE.

Purkus, A., Gawel, E., Deissenroth, M., Nienhaus, K. & Wassermann, S. (2014): Beitrag der Marktprämie zur Marktintegration Erneuerbarer - Erfahrungen aus dem EEG 2012 und Perspektiven der verpflichtenden Direktvermarktung. Energiewirtschaftliche Tagesfragen 64: 8-15.

REN21 (2014): Renewables 2014. Global Status Report. Paris, France: REN21 Secretariat.

SDG&E (2014): June 2014 Request for Offers. Renewable Auction Mechanism V (RAM). Presentation for the Bidder's Conference of RAM V, 6th June 2014.

Stephenson, S. (2013): Addressing Local Content Requirements in a Sustainable Energy Trade Agreement. Geneva, Switzerland: ICTSD.

Shukla, S. & Sawyer, S. (2012): 30 Years of Policies for Wind Energy: Lessons from 12 Wind Energy Markets. Abu Dhabi, United Arab Emirates: IRENA together with GWEC.

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Sitz der Gesellschaft
Bonn und Eschborn

Friedrich-Ebert-Allee 40
53113 Bonn
Telefon: +49 228 44 60-0
Telefax: +49 228 44 60-17 66

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn
Telefon: +49 61 96 79-0
Telefax: +49 61 96 79-11 15

E-Mail: info@giz.de
Internet: www.giz.de