
Auctions for Renewable Energy in the European Union

Questions Requiring further Clarification

BACKGROUND

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Energiewende



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IMPRINT

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Questions Requiring further Clarification

STUDY ON BEHALF OF

Agora Energiewende
Rosenstrasse 2 | 10178 Berlin

Project lead:

Daniel Fürstenwerth

daniel.fuerstenwerth@agora-energiewende.de

Christian Redl

christian.redl@agora-energiewende.de

Editor:

Mara Marthe Kleiner

WRITTEN BY

Fraunhofer ISI

Mario Ragwitz, Anne Held, Jenny Winkler
Breslauer Str. 58 | 76139 Karlsruhe | Germany

Consentec GmbH

Christoph Maurer

Grüner Weg 1 | 52070 Aachen | Germany

TU Wien | Energy Economics Group

Gustav Resch, Marijke Welisch, Sebastian Busch
Gusshausstr. 25-29/370-3 | 1040 Wien | Österreich

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Preface

Dear reader,

The new Energy and Environment State Aid Guidelines of the European Commission require as of 2017 that support for renewable energy projects generally be awarded in a competitive bidding process. Exceptions to this rule are allowed only for small-scale projects, if too few bidders would be eligible, if support levels would increase or if project realisation rates would decrease.

In economic theory, calls for tenders, or auctions, are an efficient tool for determining prices. However, the literature draws attention to various prerequisites for a successful tendering process: sufficient competition must be assured, for example, through a sufficient number of bidders as well as by involving small market actors. Since the tendering process brings about additional risks for project developers, the auction design needs to address these risks or else costs may increase significantly. In addition, experience in other countries shows that a significant number of awarded projects may not be realised.

Carefully assessing the available options for auction design is thus a central precondition for the cost-efficient expansion of renewable energy. As an increasing number of European Union Member States are considering the implementation of auctions for renewable energy, Agora Energiewende recently invited a group of academics to examine the key conditions for efficient tendering procedures and to reflect on international experience in this area. This paper is the product of this effort. It highlights the most important auction-design features, and identifies critical issues requiring further assessment. We hope you enjoy reading it.

Yours,

Patrick Graichen

Executive Director of Agora Energiewende

Agora's key takeaways at a glance

1.

Tendering procedures for renewable energy need to be carefully designed. The introduction of competitive bidding for a specific renewable-energy technology in a given country needs to be preceded by a thorough analysis of the conditions for successful tendering, including market structure and competition. Specific project characteristics of the various renewable-energy technologies must be considered appropriately in the auction design.

2.

Pilot tenders should be used to enable maximum learning. Prior to adoption of tendering schemes, multiple design options should be tested in which the prequalification criteria, auction methods, payment options, lot sizes, and locational aspects are varied. Learning and gaining experience is of utmost importance, as poor auction design can increase overall costs or endanger deployment targets.

3.

The most challenging technology for auctions is onshore wind. Experiences made with auctions for certain technologies (e.g. solar PV) cannot be readily applied to other types of renewable energy. Onshore wind is particularly difficult due to the complexity of project development, including extended project time frames (often over two years), the involvement of multiple permitting authorities and the need for local acceptance.

4.

Inclusion of a variety of actors is a precondition for competition and efficient auction outcomes. The auction should be designed to facilitate a sufficiently large number of participating actors, as this will minimise strategic behaviour and ensure a level playing field for all actors, thus enabling healthy competition. As renewable deployment often hinges critically on local acceptance, enabling the participation of smaller, decentralised actors in auctions is important.

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1 Introduction: Motivation and goals for auctions

At the European level, ambitious renewable energy targets for 2020 have been set based on Directive 2009/28/EC, and European policy makers have recently endorsed a renewable energy target of at least 27 percent of the EU's energy consumption by 2030 based on the Commission's proposal as set out in its communication COM(2014)15.¹

The stronger market integration of renewable energy (RE) as well as improved competitive mechanisms to increase incentives for its adoption are clear aims of the European Commission (EC), as expressed in the new guidelines on state aid for environmental protection and energy.² In addition to a switch from fixed feed-in tariffs to feed-in premiums, auctions are a key mechanism being promoted by the EC. From 2015 onward, all existing renewable support schemes are to be progressively replaced by market-based instruments, including **competitive bidding processes**, which are expected to increase cost effectiveness and limit distortions to competition. From January 2017, Member States are to set up **competitive auctions** (also called requests for tender) for granting support **to all new renewable energy installations** (with only limited exceptions). The following exceptions have been set forth:

- (a) "Member States demonstrate that only one or a very limited number of projects or sites could be eligible; or
- (b) Member States demonstrate that a competitive bidding process would lead to higher support levels (for example to avoid strategic bidding); or

- (c) Member States demonstrate that a competitive bidding process would result in low project realisation rates (avoid underbidding)" [sic].³

Furthermore, Member States may deviate from the general principle of technology-neutral auctions and apply technology specific requests for tender under various circumstances – for example, in view of "*the longer-term potential of a given new and innovative technology*", "*the need to achieve diversification*" or "*network constraints and grid stability*".⁴ In addition, exceptions can be made for small projects, i.e. smaller than 1 MW in general, or smaller than 6 MW or 6 generation units in the case of wind energy or demonstration projects.

Furthermore, the EC's guidance on support schemes asks for more coordination and cooperation between European Member States in supporting renewable energy.⁵ Specifically, the EC has called for greater harmonization between RE policy components, as well as the further use of cross-border exchanges for RE generation within the EU. The map in Figure 1 shows the main support schemes used in EU Member States as of the end of 2013. Feed-in tariffs and feed-in premiums are the two dominant instruments. Only in the Netherlands is the tariff level determined based on requests for tender. By contrast, in Belgium, Poland, Romania and Sweden, quota schemes based on tradable green certificates are used. In all Member States, support levels are set administratively. While the shift from fixed tariffs to premiums is already frequently taking place, experience with auctions as main support scheme⁶ is very limited.

1 European Commission, 2014. *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, A policy framework for climate and energy in the period from 2020 to 2030, COM(2014) 15 final, Brussels*. Available at: http://ec.europa.eu/energy/doc/2030/com_2014_15_en.pdf.

2 Guidelines on State aid for environmental protection and energy 2014-2020 (2014/C 200/01).

3 See above.

4 See above.

5 European Commission guidance for the design of renewables support schemes, (SWD(2013) 439 final).

6 Auctions are used as an instrument for individual technologies in some countries, like for offshore wind in Denmark or for PV in France.

Member States have started to implement reforms to national support schemes; implementing auctions has been a main focus in this regard. The German federal government plans on tendering 600 megawatts (MW) in openspace photovoltaic as a pilot request for tender, and to extend the use of auctions to all renewable technologies by 2017. In general, a crucial question is whether administratively determined prices – as is currently foreseen under the German support scheme for renewable electricity – contradict the rules established for a liberalized single European market. Posed differently, the following question looms large: Is market-based price determination necessary over the medium term in order to ensure compatibility between support schemes for renewable energy and the internal market?

In theory, tendering for renewable energy allows the competitive determination of conditions for remuneration, and can thus be used to establish competitive and economically efficient price levels for feed-in tariffs, feed-in premiums, or investment grants. Typically, a given volume of generation from renewable energy is tendered so that the quantity of annual expansion is simultaneously regulated. In view of the increasing importance of managing support costs for renewable energy, tendering is a compelling option for improving total system efficiency. To this end, a prerequisite is that tenders actually improve the efficiency of funding renewable energy in comparison to other support schemes. Accordingly, it is necessary to ensure that the expected market-based efficiency gains from auctions are not outweighed by additional risk premiums or the negative impacts of strategic behaviour by investors. Furthermore, it is important to assure compliance with RE deployment targets, so that plant operators largely abide by their commitments to construct new renewable energy facilities. A suitable tendering process, based on detailed knowledge of the market addressed, as well as its agents, is therefore crucial for successful implementation.

Generally, requests for tender in the energy sector are made in order to receive a defined service at a competitive price. Competitors often have to prove their fulfilment of certain prequalification criteria. Sometimes, the tenders are limited

to certain regions or technologies. Such restrictions determine who can participate in the first place, and do not serve as evaluation criteria during the tendering process. After the eligible participants submit their offers, price is usually the sole criterion for a decision, making these requests for tender equivalent to auctions.⁷ Accordingly, auction theory can aid us in designing and evaluating this form of renewable energy support. In the following, the terms auction and tendering procedure are used interchangeably.

This paper discusses the key features of an efficient and at the same time socially and politically acceptable tendering process. It falls short, however, of describing a solution that addresses all questions and challenges. Section 2 presents key criteria and design features that should be considered when formulating requests for tender or auctions. We then discuss the tendered product (Section 3), the selection of the auction procedure (Section 4), prerequisites for the actual realization of successful bids (Section 5), the integration of smaller agents (Section 6) and geographical distribution (Section 7). Each aspect is compared with existing international experiences.⁸ Finally, the knowledge gained is used to draw conclusions concerning the optimal design of potential pilot projects in EU Member States (Section 8).

⁷ To be exact, these requests for tender are reverse auctions, as the buying rather than the selling of a product is concerned.

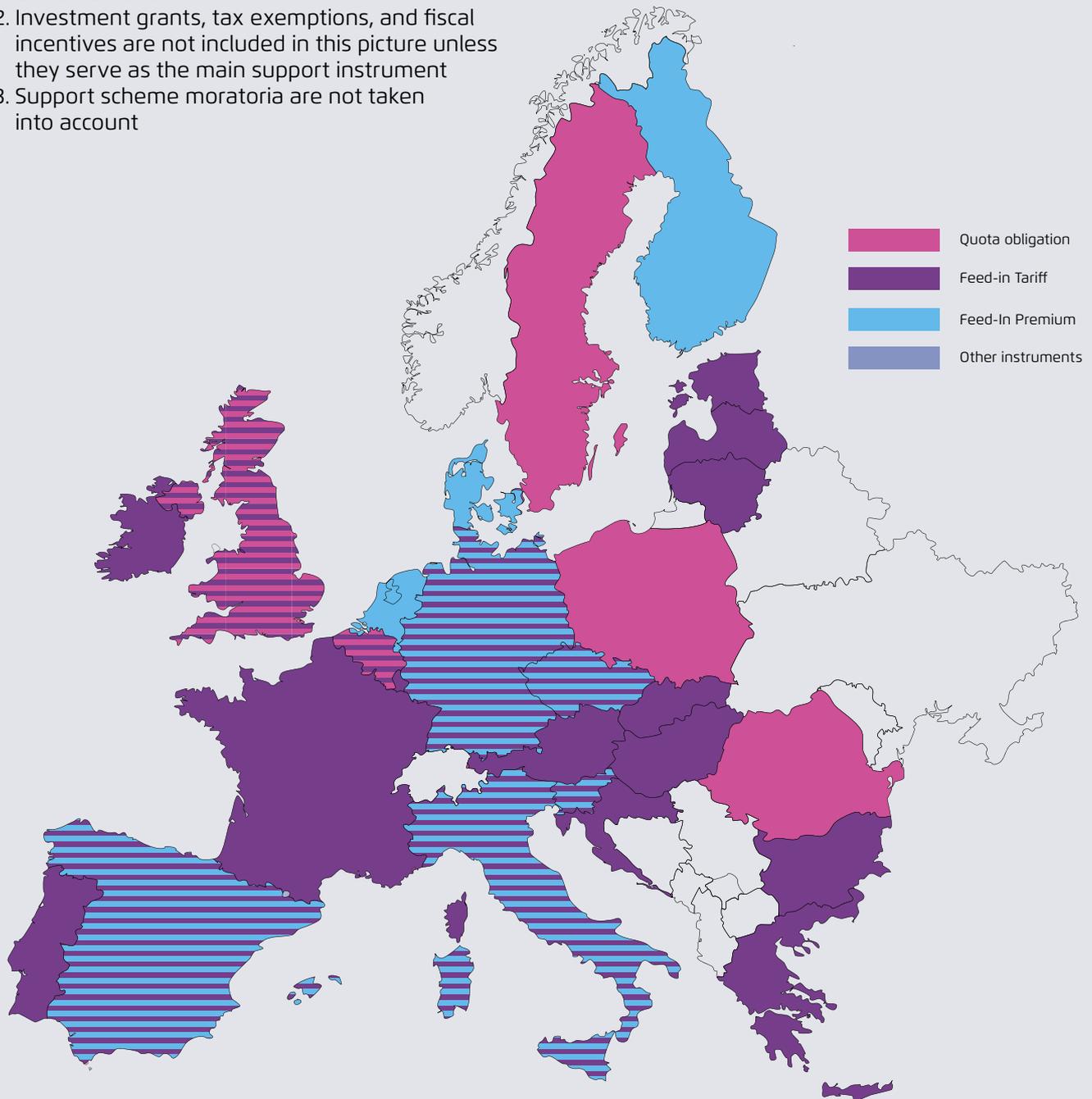
⁸ A tabular summary of the countries analyzed and experiences gained can be found in the appendix.

Main support instruments used in the EU28 Member States at the end of 2013

Figure 1

Notes:

1. The patterned colours represent a combination of instruments
2. Investment grants, tax exemptions, and fiscal incentives are not included in this picture unless they serve as the main support instrument
3. Support scheme moratoria are not taken into account



Held et al, DIA-CORE. A. Held, S. Steinhilber, M. Ragwitz et al: Assessing the performance of renewable energy support policies with quantitative indicators – Update 2014, report in the frame of the EU project DIA-CORE, forthcoming. Note that Malta and Cyprus are not included in this map. Malta applies a combination of Feed-in Tariffs and Feed-in Premiums, whereas Cyprus applies Feed-in Premiums.

2 Prerequisites: How can requests for tender contribute to cost-efficient energy transition?

Policy discussions on support for renewable energy typically cite improving cost efficiency as a key requirement. Efficiency implies reaching a given goal with the smallest possible effort or, alternatively, using given resources to achieve the greatest possible output. "Cost efficiency" is the term commonly used in this connection. Nevertheless, other factors and criteria that influence the total costs to society have to be taken into account when designing support instruments. Some important factors and criteria are listed and discussed briefly below, serving as a point of reference for the following sections.

- **Static efficiency** is assured if the defined target for expansion can be reached with the least possible effort. Static efficiency thus requires the optimal allocation of resources. Applied to the expansion of renewable energy, this means that at a given point in time the most cost-effective technology and/or combination of technologies is used at the best locations.
- The criterion of **dynamic efficiency** reflects the extent to which a support mechanism is – among other things – capable of spurring technical progress and innovation, and thereby achieving the greatest benefit for the economy as a whole. In this regard, technical innovation and the continuous improvement of operational procedures provide room for medium- and long-term cost reduction. At the same time, it has to be considered that static and dynamic efficiency can be at loggerheads. For example, when trying to achieve a short-term expansion for renewable energy, it can be statically efficient to exclusively focus on the technologies that are currently the cheapest. However, subsidizing new and more expensive technologies can prove to be dynamically efficient with a view to attaining technological progress (but does not have to be!).
- From a political point of view, **minimising support costs**, especially those assessed to consumers via levies and surcharges, is an independent and important criterion alongside maximizing system-wide efficiency. While minimizing levies and surcharges is often considered to be more efficient in promoting renewable energy, this viewpoint is not entirely correct.

The criteria that are emphasized in this section pertain to system-wide costs. Other relevant aspects that are connected with the decision to introduce renewable energy tendering (namely, distributional effects, administrative costs, acceptance, technology-neutrality, location-based compensation and supply differences) will partly be addressed in the following sections.

To what extent can requests for tender and auction-based support systems contribute to reaching efficiency targets? To answer this question, one has to take into account that requests for tender are inherently market-based allocation mechanisms. As such, they have been successfully deployed in different branches of the economy – for example, in the allocation of UMTS frequencies. Furthermore, requests for tender are suitable economic mechanisms for distributing scarce resources. Indeed, scarcity is a prerequisite for the successful use of requests for tender or auction-based support systems.

Therefore, the more options are able to compete, the easier it is to achieve scarcity (in this case defined as bids for a project volume that exceeds the demanded volume). For this reason, requests for tender are often proposed in connection with technology-neutral support systems for

renewable energy.⁹ Efficiently designing a technology neutral auction is nevertheless a complex task, not least because of the diverse generation characteristics of different technologies. When seeking to promote dynamic efficiency, it is important to note that competitive price determination across the spectrum of RE technologies can have different impacts: On the one hand, a positive impact can be achieved if price distortion is avoided. On the other hand, dynamic efficiency can be hampered if investors only focus on the cheapest technological options. Accordingly, technological-neutrality has been widely criticized as undermining dynamic efficiency.

In view of the above, and especially considering the political objective of avoiding excessive support costs for consumers, renewable energy subsidies are currently aimed at promoting specific technologies. In the area of wind power, support efforts even extend to the promotion of generation facilities in certain geographic areas. The role of tender systems in minimizing these support costs is a controversial issue:

→ A largely unchallenged yet problematic aspect of administrative price determination is the non-transparency of the actual costs for the expansion of renewable energy when support levels are determined. This encourages lobbyism. Furthermore, the decision process is lethargic, and unable to respond quickly and appropriately to changes in the costs of production factors. Overcoming these weaknesses and enabling the competitive determination of support levels is seen as the main benefit of a tendering system – even if significant elements of the existing system are maintained, such as feed-in tariffs, premium

payments for the direct sale of green energy, and compensation rates based on technology and location.

→ On the other hand, it is sometimes argued that Member States' overall RE targets for 2020 – and, specifically, the targets set in their National Renewable Energy Action Plans (NREAPs) – are frequently so ambitious that it is necessary to almost fully exploit the potential for expansion that exists in each country. This is partially the case because annual expansion rates for a given technology are restricted by many non-economic barriers, including administrative and grid-related constraints, as well as limitations related to spatial planning. If these constraints are the key limitations to the addition of new capacity, and if expansion targets need to realize the full deployment potential that is available, then potential scarcity will not occur. This argument is crucial, because using an allocation instrument would appear unnecessary if all or nearly all of the expansion potential must be realized. In such a situation, determining the amount of support for renewables is not a decision on allocation but rather on the distribution of excess returns.

→ Finally, it has to be taken into account that – depending on the design options for a tendering procedure (which will be discussed in the following) – the awarded product cannot be directly compared to the support levels applicable under today's feed-in systems in Europe. While the latter is a support that is oriented towards all facilities that are put into service during a certain period of time, auction products usually contain liabilities for the successful bidder (especially in regard to the timely realization of the project). These liabilities are typically priced into the demanded support during the tender bidding process. This is not necessarily inefficient but does lead to a rise in support costs. It is unclear whether these additional costs are outweighed by the cost reductions achieved through the competitive determination of the support level.

Thus, it remains unclear if, how and in which particular cases a tendering procedure can contribute to the cost efficient promotion of renewable energy and, by extension,

9 For a technology-neutral support system, expansion targets would only be announced across technologies. In this connection, an unforeseen delay in the expansion of certain technology (e.g. wind power) could be made up for with another technology (e.g. PV). The overall supply would therefore most probably be above the expansion amount demanded in the technology specific requests for tender. In this type of tendering, unforeseen developments with a technology can quickly induce demanded expansion to exceed supply. A technology neutral auction could be used as a competitive allocation instrument to choose the statically efficient expansion projects across all available technology options.

to a cost-efficient energy transition. The efficiency of a measure is determined by the valuation standard used. Apart from this, a crucial role is played by the specific design features of the tendering procedure as well as the overall regulatory environment for the promotion of renewable energy. Both of these factors will be discussed in the following. In general, requests for tender can be a useful support instrument for particular technologies while being less suitable for others. In any case, before implementing a tendering procedure to promote a certain renewable energy technology, a case-specific audit should take place to assess whether a given market fulfils the prerequisites for a successful tendering process.

International experience with regard to a potential increase in cost efficiency through tendering procedures

Box 1

In various countries that have made use of requests for tender to promote renewable energy, we find comparably low offers or demand prices for the amount of electricity to be generated. A remarkable example is the low compensation rate currently demanded by potential operators of wind power plants in Brazil: the electricity that is fed in is priced at €31 to €52 per megawatt-hour (MWh).^{*} Similar to fixed feed-in tariffs, the support level is fixed for 20 years and adjusted for inflation. In the past, lower offer prices were often linked to a lower implementation rate. Underbidding (to gain market share) was a ubiquitous problem with renewable energy tenders in countries like China (wind and solar energy) and in the United Kingdom. Relatively high offer prices from an international or European point of view have been witnessed in France and Italy in recently conducted tendering for wind energy (Italy) and photovoltaic (small-scale plants in France). For example, wind power plants that were awarded a contract in the first two tender rounds in Italy in 2013 will be compensated with €100 to €117 per MWh. In the national context, this can nevertheless be seen as a success, as the former system of quotas resulted in even higher compensation rates.

^{*}This information stems from successful offers from the tendering rounds between 2009 and 2012.

3 The product: What should be tendered?

The goal when introducing tendering is to add market-based competition to allocation decisions for the expansion of renewable energy. The tendered product and the criterion for awarding contracts are decisive for ensuring that this mechanism leads to the efficient expansion of renewable energy.

Under the current support system, no immediate allocation decision is made. Nevertheless, the administratively defined support level in feed-in tariff systems such as the German EEG leads to an indirectly higher return for projects characterized by especially low generation costs. Presumably, this increases the probability that these projects will be realized. The support level could thus be viewed as a score function in the broadest sense of the term. Undoubtedly, support costs do not fully reflect the economic consequences (costs and benefits) associated with the expansion of renewable energy. Other important factors, such as system integration costs (grid management, grid expansion, etc.) are nevertheless externalities from the investor's point of view, and are thus not considered in investment decisions.¹⁰

That being said, a further option proposed by several sides is to change the selection criteria contained in the tendering process such that not only the demanded support but also the system costs and benefits of the different bids are considered in a comprehensive manner. Proposals from this point of view call for a favourable assessment of offers that, for example, will install generating facilities that are beneficial for grid management, or that will regionally distribute the expansion of renewable energy, which has grid benefits. From our perspective, however, it seems nearly impossible to objectively and unambiguously assess the costs or benefits of an expansion project for the power

system as a whole. Yet in the absence of an objective valuation standard, one can hardly imagine a successful and efficient competitive tendering procedure. For this reason, nearly all tendering models proposed for the reform of the administrative price setting of feed-in tariffs focus on the demanded support level as a selection and award criterion. In practice, the use of this criterion allows the direct and clear comparison of offers, and the implementation of the tendering procedure as an auction.

In the following sections, we take as a starting point the implementation of tendering via an auction procedure as well as bid selection based on the requested support level. Working from this basis, there are several specific design options; for example: What marketing rules are to apply? How are subsidies to be structured and paid? That being said, the design options and their trade-offs do not differ considerably between an auction procedure and administrative price determination.

One fundamental question is who will be in charge of marketing the electricity generated by the RE plants. On the one hand, it is possible to have the RE plants managed by a central authority, e.g. by a transmission grid operator. Under this scenario, the plant operators would only collect payments via the RE support instrument. The amount of this payment would have to be economically viable for the plant operators. Support based on a fixed feed-in tariff is a particularly suitable mechanism in this regard. By contrast, another option is for the plant operator to directly market the energy it produces. In this case, the plant operator enjoys freedom of action to optimize its activities, depending on the rules in place (especially regarding permitted marketing channels). The freedom of action granted may pertain to the selection of marketing strategies or to the possibility of attaining additional benefits by creating a plant portfolio (which may contain non-RE plants). Under this model, the plant operator receives income from the marketing of its generation plant, in addition to support payments. This has to be considered when choosing

¹⁰ In Germany, the 95 percent limit as hardship provision in grid management or the reference yield model for onshore wind energy can be seen as single/individual attempts to internalize system integration costs – even though they have not necessarily been introduced for this reason.

and designing the support instrument. Initially, policymakers must decide whether the support instrument should be designed as a feed-in premium (in € per MWh) or rather as a capacity payment (in € per MW and year). The latter is similar to an investment grant that is disbursed over the operating lifetime. The two approaches differ in the incentives they create for the plant operator.

Regardless of whether a capacity payment or feed-in premium is chosen, policymakers must also determine the markets in which plant operators may sell energy. In the interest of static efficiency, it seems desirable to allow RE plant operators to participate in all markets. However, from a short term perspective this may lead to an undesired negative effect for non-subsidized conventional plants (or flexible consumers and storage) that are forced to compete with subsidized RE plants. In the long run, it nevertheless seems inevitable to open all marketing channels to RE plants – especially in a system with a high RE share. This is the only way to guarantee that the best – i.e. the most efficient – solutions fulfil the needs that arise in the electricity supply system.

Above all, a feed-in premium that is paid depending on the actual quantity of energy produced at a particular plant to supplement proceeds received from market sales sets incentives for high plant availability as well as for the production of electricity from renewables. At the same time, a feed-in premium can set incentives for electricity production in situations in which no feed-in would be more efficient from a system perspective. (More efficient strategies would be to provide balancing energy or activate production curtailment when negative prices prevail.) However, in comparison to a green-certificate system, one can argue that negative prices up to the negative value of the premium or certificate can be reasonable if the system boundaries include RE targets. In this case, the premium level is an indication of the value society attaches to the achievement of RE targets.

Capacity payments – or similar models that limit the quantity of electricity eligible for support – do not initially create such an explicit production incentive. This enables

plants that are subsidized by capacity payments to participate in all marketing channels without distortion to competition. At the same time, this lowers the incentive for availability due to the low relevance of their production and marketing for the day-ahead spot market.

Auctions of energy as well as capacity-related premiums seem generally feasible for tendering procedures. Accordingly, proposals containing both design options have been presented in the past. However, problems in arriving at a clear definition of a plant's renewables-based generation capacity are often cited as a challenge in designing capacity-related premiums. For example, generator output currently determines the installed capacity of a wind power plant. But this can lead to false incentives – namely, the oversizing of generator output in relation to rotor diameter, the latter of which is much more relevant to a plant's total costs.

An additional issue that arises when designing an energy-related premium is determining if it should be designed as a fixed markup on the income from market revenues or as a sliding premium, as is currently implemented in Germany, Italy, the Netherlands and the UK. In principle, both arrangements are compatible with tendering procedures.¹¹

¹¹ In terms of the practical implementation of sliding premiums, offers are based on the sum of the feed-in premium and the sales revenue from the relevant power exchange. Here, the concrete premium is calculated ex-post, analogous to the market premium currently used in several Member States, such as Germany and the Netherlands.

Choice of the tender product in an international comparison**Box 2**

In regard to the choice between capacity- or energy-related compensation, an international comparison shows a clear preference towards the latter. An exception can be found in the tendering of small photovoltaic facilities in Austria, where investment grants are awarded in a simplified manner. A further trend that can be seen in the majority of the analysed countries is that energy-related compensation is usually based on the total amount of electricity produced. The plant operator is thus not charged with the marketing of its product. An exception to this standard is the support practiced in the Netherlands, which can be classified as a hybrid model. In the Netherlands, contracts are awarded by tendering procedure, while compensation takes place based on a predefined sliding feed-in premium. Denmark represents another exception. Requests for tender for offshore wind parks have been conducted there for several years using sliding premiums. Another feature of this procedure that is of topical interest is that the offshore location is predefined and the plant operator does not bear any grid access costs, as they are completely socialized.

4 Auction procedure: How to award the contract?

In addition to the auction product, the precise auction procedure used and the price determination mechanism are two areas in which there is freedom to customize tendering for renewable energy. The following options can be identified:

→ A widespread form of tendering is an auction that uses a closed order book (**sealed bid auction**). In this form of auction, bidders submit an offer containing an offer amount (i.e. the capacity to be installed or energy to be produced) as well as the premium¹² demanded. Bids are then accepted according to ascending bid prices (i.e. the demanded premiums), until the predetermined targeted tender volume (i.e. defined in capacity, energy or monetary terms) is reached or no more offers (in total or below a potential ceiling price) exist. The sealed bid auction is a static auction, meaning that the bidders cannot react to their competitors' moves. Payment then follows either according to the bids (**pay-as-bid**), amounting to the highest accepted bid (**pay-as-cleared**) or amounting to the lowest not accepted bid (**Vickrey auction**). A problem with static auctions is the so called "winners' curse" – the winner of the auction will sense that the offer it submitted was too cheap, as its competitors will have estimated the demanded good at a higher value. A main advantage of the sealed bid auction is its simplicity, which usually leads to low costs for market participants. The biggest disadvantage of this auction design is its static structure, which does not allow participants to translate pricing information into their bidding strategies. This is especially difficult when uncertainties concerning price formation arise – an issue that is quite relevant in subsidies for renewable energy.

→ Another commonly used form of tendering is the **descending clock auction**. The auctioneer first announces

a high premium. The participants of the auction then disclose the expansion volume they aim to realize given this premium. Subsequently, the price (and thus implicitly the offered volume) is reduced by the auctioneer until the offered volume equals the desired one. The desired volume for the tender does not necessarily have to be disclosed beforehand, neither to the bidders nor to the auctioneer. De facto, the *descending clock auction* can be organized such that the auctioneer fixes the volume during the auction, based on the offers presented to him. The *descending clock auction* is a dynamic auction, allowing the participants to take competitors' behaviour into account. This behaviour can be revealed to the participants in various ways – for instance, if the auctioneer announces the total volume offered in relation to the last price invoked. This lowers the possibility of miscalculating the value of the product being auctioned. In a *descending clock auction*, a uniform price is always paid that equals the lowest published premium (corresponding to the marginal bidder's price or cost). The biggest advantage of the *descending clock auction* is that bidders can adapt their behaviour according to the information that they receive during the auction. This increases the auction's efficiency and the "winners' curse" problem is reduced. However, the particular design of the auction – for example, concerning the amount of information that is disclosed at the beginning of the auction (e.g. the maximum price or the demanded quantity) – considerably influences participants' behaviour, and thus the auction's outcome. The parameterization risks of a dynamic auction are thus potentially higher than in a static auction.

→ **Periodical tenders with increasing premiums** represent a further option. In this auction, the premium awarded to a successful bidder within each tender round is administratively fixed. The tenders take place periodically, e.g. from every two weeks to every three months. The premium offered rises with each tender. For instance, a premium of €60 per MWh might be offered in Janu-

¹² In the following, we imply a premium as the auction product for reasons of simplification. Similar options arise for other auction products.

ary, followed by gradual increases in subsequent tendering rounds. In the final tender rounds of a previously determined period of time (e.g. a year), a maximum funding rate is offered. To motivate plant operators to participate in tender rounds with low funding rates, it is necessary to introduce a cap on expenses or quantities over the predefined period of time (e.g. a year). After this cap has been reached, no further tenders take place during this time period. Participants have to weigh the risk of reaching the quantity cap against the chance of higher rates in the following period. Accordingly, it is difficult for bidders to develop an ideal bidding strategy, which can lead to inefficiencies, or the "winners' curse". Moreover, uncertainty concerning whether additional tender rounds will take place can induce windfall profits or stop-and-go cycles of funding, which would lead to higher risk premiums. By contrast, the advantage of this procedure is that when successfully executed, producer surplus can be minimized. At the same time, it can be used – if required for target compliance – to enable the funding of expensive technologies or poor locations, without using explicit mechanisms such as the reference yield model.

→ Another option is to auction off **certificates entitling the winner to funding** via existing support instruments. In Germany, the auctioning of EEG certificates was proposed in this context. Under this plan, plant operators would have to buy certificates in an auction procedure to continue receiving the administratively determined feed-in premium. This approach reduces support costs by the auction's revenue. Ideally, the difference between the administratively determined premium and the successful bidders' willingness to pay would lead to an efficient overall level of support (with results identical to a single-stage auction).

In addition to the foregoing models, some tendering procedures for the support of renewable energy also use hybrid models.

A common problem with auctions is that strategic or collusive behaviour can occur when competition is limited.

Through collusive behaviour bidders seek to raise the offered price or premium. Usually the best way to avoid this problem is to ensure a high degree of competition. For this reason, when auctions for renewable energy are held, one should refrain from strongly segmenting the market in advance. Furthermore, the design of the auction can be adapted depending on how much competition is expected. In situations with a low level of competition, for example, *sealed bid auctions* are better at limiting the risk of strategic behaviour than dynamic auction procedures like the *descending clock auction* or periodical tenders with increasing premiums. However, sealed bid auctions can lead to inefficient price formation, which in turn increases risk and lowers the realization rate of accepted bids. Thus, when tailoring an auction for a low level of competition, one has to weigh the benefits of improved price determination against the risk of collusive behaviour.

Auction procedures in an international comparison

Box 3

Internationally, there is a broad range of auction procedures for awarding renewable energy contracts. While the *sealed bid auction* is widely used, there are considerable differences in the price determination mechanism: *pay-as-bid* is used in France, Italy, California, Brazil (in the second stage of the procedure) and China (within the first rounds of tenders*), whereas Brazil uses the *descending clock auction* in the first phase of the two-stage procedure.

In Denmark, where tendering is used to support offshore wind power, a two-stage procedure is applied: In the first phase, offers are collected in a manner equivalent to a *sealed bid auction*. Several offers are then preselected primarily based on their price. Finally, a dialogue is launched, enabling bidders to improve their offers.

The Dutch model is also notable for several features: its support for renewable energy is based on a well-defined annual budget. To exhaust this budget, multiple auctions are held with predefined feed-in premiums tied to the level of technology. Auctions take place sequentially – the lowest price category is tendered at the beginning, when offers regarding the quantity of energy to be produced are collected (volume tender). The next tender round is held for the next price category, and this is repeated until the predefined budget is exhausted. The compensation rates are determined in advance based on the technology level. However, potential plant operators have the opportunity to submit their project within a “free category” and can thus request a lower level of compensation than that scheduled.**

*As a further consequence, China switched to compensation based on the average bid price. This was the reaction during the initial use of tendering, and sought to prevent underbidding (and, as a consequence, under-subsidy).**This enables participation by projects that originally belonged to a higher predefined price category and faced a higher risk of being excluded from the market. These project receive a lower compensation rate, but one that is nevertheless still viewed as adequate from the project developer’s point of view.

5 Project realisation: How to reach expansion goals?

Energy policy typically defines expansion targets for renewable energy. Based on these targets, auctions are a mechanism for awarding support to bidders and their projects. However, after an auction is held, uncertainty remains as to whether a project will actually be realized – and, by extension, if broader expansion goals will be achieved. This uncertainty is a systematic challenge associated with tendering procedures for renewable energy. Usually, a time span of several years is necessary to evaluate if a gap has arisen between the contracts awarded and expansion attained. Accordingly, it is difficult to undertake corrections if targets are not reached.

International experience with tendering to support renewable energy has shown that underbidding often occurs. In order to win a contract, many market participants will submit low offers that are contingent upon optimistic assumptions about the smooth realization of their RE projects. After the contract is awarded, many plants are never finished because of delays or other problems. When problems arise, the compensation provided under the contract may no longer be sufficient. However, the renegotiation or adjustment of compensation terms is not possible when it comes to auctions. Nevertheless, it should be noted that many auctions were prone to underbidding in the past because support confirmations were awarded without requiring serious commitments from the bidder to realize its planned facility. From the bidder's perspective, there is an option value to having a bid accepted, even if the bidder may ultimately decide not to realize the project. The bidding strategy is therefore not exclusively determined by the expected costs of project realization.

There are clear solutions for avoiding unsatisfactory realization rates. Yet which auction design features are best suited for promoting project realization? This is a key question. In the following, we outline relevant solutions proposed in the literature:

- Overall, aiming for the realization of all accepted bids in an auction seems neither feasible nor efficient. Accordingly, there will always be a certain non-realization rate. To assure the realization of the predefined expansion goal, a quantity higher than the actually targeted quantity for expanding renewable energy should be tendered. This could nevertheless pose problems in practice. On the one hand, it is difficult to politically communicate a seeming inconsistency between the expansion goal and the tendered quantity. On the other hand, from a practical point of view, it is difficult to determine beforehand the “**excess quantity**” that should be tendered. Particularly when subsidy auctions are first implemented, there is bound to be considerable uncertainty when estimating this quantity. Presumably it would be necessary to gather experience over several auction periods in order to make relatively accurate forecasts about the excess quantity that should be tendered.
- Introducing robust **project-related prequalification criteria** as an entry requirement to the auction is probably an effective instrument for achieving high realization rates. One criterion for participation could be, for example, a sound basis for project realization, such as permits to install a plant at a given location, plans for the plant or specific concessions. Once a project has progressed beyond the very initial planning phase bidders are also typically better armed to estimate actual realization costs. This lowers the risks of underbidding. Furthermore, as the bidders have already borne significant costs (and thus have “skin in the game”), they have a greater incentive to actually realize the project. One main disadvantage of strict prequalification is its limiting effect on competition. In addition to the prequalification criteria, which reduce the pool of possible bidders, the necessary costs to fulfil the criteria are an additional hurdle for the potential bidder. Ultimately, these costs represent an advance payment by the bidder, without any guarantee of being awarded the contract. As these costs are sunk at the time of the auction there is an inherent risk

that they cannot be recovered. An advantage of strict prequalification would appear to be the short time span between the auction and the completion of the project, due to its advanced stage. Information on the success of a tendering procedure in producing projects that are actually realized should thus be more promptly available, especially in comparison to the following approach.

→ A crucial alternative to prequalification is **penalization in the case of default**. Aside from the reliability and solvency of the bidder, no prequalification criteria are required for this approach. However, when bidders are awarded a contract and receive a pledge for support, they also place themselves under the obligation to deliver the offered product. If they fail to deliver, a contractual penalty becomes due. This approach does not oblige the bidder, at least not necessarily, to commit to the realization of a certain project. A bidder could, for example, make an abstract commitment to construct 15 megawatts of wind power during the next five years. If the contractual penalty is sufficiently dimensioned, a substantial incentive is set to comply with the project realization. At the same time, the successful bidder is not tied down to a certain project and is able to change course – for instance, if the original project turns out to be unfeasible. This flexibility makes this auction design more efficient overall. Nevertheless, longer time spans have to be accepted between the auction and the completion of the project. The penalization approach also means that risks, including potential penalties, are likely to be priced into the submitted offers. Therefore, the magnitude of the contractual penalty has to be carefully designed. A trade-off between reaching a certain realization rate and the accepted support costs has to be taken into account. If applicable, some design elements, e.g. a creeping due date for the contractual penalty (to distinguish between actual default and project delays), can lessen the risk surcharge. In any event, a penalization system should require that bidders prove their ability to pay potential penalties when they place their offer, e.g. with a security deposit or guarantee.

→ With a view to penalties, another instrument for achieving high realization rates in combination with low risk surcharges has been discussed: the **ability to transfer obligations** to a “secondary market”. The idea is to enable the auction participant who has been awarded the contract to transfer the support pledge and project obligation to a third party. If this secondary market is established in an efficient way, this would help to reduce the risk associated with the obligation to realize a project – and, by extension, the risk premium priced into the bidder’s offer. The priced-in realization risk is then no longer the bidder’s individual risk, but rather that of a substantially larger group, ideally consisting of all market participants. At the same time, however, secondary trade would increase the complexity of the auction, and could increase the possibility of strategic behaviour and/or collusion between participants.

In conclusion, assuring a satisfactory realization rate in tendering procedures for renewable energy is a complex problem, and remains unresolved. The problem involves minimizing the additional support costs associated with measures to ensure project realization. Different solutions are available, and could potentially be combined. Due to various negative experience in other countries, optimal tendering procedure design with a view to maximizing realization rates cannot be determined ex-ante.

An international comparison of measures to increase realization rates**Box 4**

All observed countries currently make use of pre-qualification in their tendering procedures. The exact requirements differ between countries, however. In Brazil, for instance, potential bidders need to present extensive documentation.* Building-integrated photovoltaics in France can only be contracted by the owner of the building, who has to perform a CO₂ assessment (using a given form). This is the only documentation needed, but it enters into the selection procedure.

In several countries, bidders have to present additional financial guarantees. In Italy, Brazil and Denmark, for instance, bidders have to contribute financing bonds by depositing part of the project volume as a security.

The introduction of penalties – i.e. a payment by the supplier in the case of default, often in a pre-defined period of time – is also pervasive. Usually the penalty serves to complement the measures listed above. Nowadays, penalties are used in Brazil, the Netherlands, Denmark and China. In France, penalties are not foreseen for small-scale photovoltaic facilities; construction delays can nevertheless induce a shortened support period.

*Including, for example, verification of environmental compatibility, a permit to access the grid and, in the case of wind power projects, a location-specific wind report from an independent agency.

6 Enabling a variety of actors and civic participation

The dynamic growth in renewable energy witnessed in recent years in Europe is often largely attributed to the broad variety of agents involved, from institutional investors and plant operators to private citizens at the communal level. Yet beyond their direct involvement in RE projects, civic actors play a crucial role in ensuring public support for the broader effort to transition to renewables. Thus, questions naturally arise as to whether the tendering system should be specifically designed to build upon this public support, or could even be tailored to incentivize it.

When administering auctions, a diverse range of actors in sufficient numbers are required to ensure adequate competition in the bidding procedure. Essentially, actors can be classified as investors, developers, plant operators or sales agents. In this paper, the discussion focuses on investors and the owners of renewable energy plants, as these actors receive the support granted in the tendering procedure.¹³ Yet ensuring a broad diversity of actors could be beneficial, for different investor types address different parts of the overall potential of a technology. Thus, for example, utilities might focus on large wind farms, whereas local communities might invest in individual wind turbines. Accordingly, a variety of actors might be needed to fully exploit the potential for RE expansion. As a result, the issue of who will participate in auctions should be carefully considered when regulators analyse expected market liquidity and competitiveness prior to implementing any kind of RE technology auction.

While we will not particularly discuss the question of whether the participation of local actors or small and medium enterprises (SMEs) should be a specific goal in supporting renewable energy, or whether efficiency and ef-

fectiveness should be the sole aims, the issue of who will be involved should nevertheless be part of political consensus-building.

Assuming that a political consensus in favour of a high variety of actors is reached, we must ask if and under which circumstances a diverse range of actors can be achieved in tendering procedures.

One common method used to ensure high realization rates is to pass on risk to RE plant investors. These risks may lead to higher equity requirements or the need for a bank guarantee. This is likely to pose a much larger obstacle for individuals and small businesses than for large investors (such as an investment fund). Accordingly, addressing this asymmetry in the ability of investors to accept risk as well as how to incentivize a broader range of actors are key issues that need to be considered.

In this regard, explicit as well as implicit measures are imaginable. One explicit measure would be to require the participation of a certain share of specific actors (e.g. SMEs, local cooperatives, private citizens) in a tendering procedure (see box 5). However, if participation is restricted to local actors, one would have to assess whether the free movement of goods is violated by such a requirement. Implicit measures, by contrast, focus on reducing the investment risks and equity requirements (for example, by balancing prequalification vs. penalties). Another possible implicit measure is to limit the complexity of the support mechanism in order to ease and enable broader participation. Implicit measures are consistent with the current policy approach taken in many nations (e.g. Germany) to support a diversity of actors.

¹³ The RE market share of different investor types in Germany can be seen at trend:research (2011): Marktakteure Erneuerbare-Energien-Anlagen In der Stromerzeugung. A report conducted as part of the project "Genossenschaftliche Unterstützungsstrukturen für eine sozialräumliche Energiewirtschaft." trend:research, August 2011 (in German).

**Measures used in Denmark
to increase actor diversity**

Box 5

Among the countries we assessed, only Denmark makes use of explicit measures to increase actor diversity. Specifically, in “nearshore” wind power projects, the bidder must grant at least a 20 per cent ownership stake in the project to affected municipalities. According to current plans, exceeding this share requirement is rewarded with additional financial benefits. It remains to be seen whether these measures are in accordance with European regulations concerning the free movement of goods. With the exception of auctions for small-scale PV, implicit measures were not identified in the analysed countries.

7 Considering geographical aspects: How to achieve a balanced expansion?

Rules governing site selection in the support of renewable energy can be designed in line with a variety of goals. In particular, one must distinguish between the objectives of explicit geographical site selection, and, on the other, the objective of limiting producer surplus at very profitable locations. Rules governing geographical siting may be motivated by a variety of factors, including environmental or grid restrictions or the goal of bolstering public acceptance for RE expansion by achieving greater geographical balance in the distribution of RE plants. By contrast, rules to limit production surpluses primarily aim at increasing efficiency with a view to policy costs.

The geographical siting of RE plants is normally not addressed directly by the support instrument, but rather by spatial planning. For this reason, instruments governing geographical siting are rather exceptional, and are typically limited to excluding certain land areas from RE plant construction.

In rules governing geographical siting, those aimed at limiting production surpluses dominate. This strategy is being used in connection with onshore wind power by lowering feed-in tariffs at high yield locations while at the same time allowing expansion at less ideal locations (see, for example, the reference yield model being used in Germany). Furthermore, sliding tariffs for offshore wind power can be designed to take into account the distance to the coast and the depth of the water.

When introducing tendering systems, we would assume that issues that previously fell under the domain of spatial planning would continue to do so. Yet an important question is whether a reference yield model (like that used for onshore wind power and for determining the location for offshore wind power) can be successfully implemented in a tendering procedure. The two following options are available in this context:

→ First, stepped feed-in tariffs as well as reference yield models are compatible with tendering procedures (for instance, through the granting of support for a specific reference yield). A tendering procedure can be used to competitively determine the volume of support at a given reference location. Consequently, the reference yield curve is scaled in order to reflect the relation between standard compensation at the 100-percent location and the bid's outcome at the 100-percent location. The actual support provided at a given location would be based on present feed-in tariff regulations. In most countries (including France, Germany, and the Netherlands) tariff levels are implemented ex-post. This means that after the plant's yield over a fixed number of years is known, the remuneration level for the remaining duration of the support payments is determined. As a variation on the ex-post method with a reference yield model, an ex-ante method is also possible, with location-specific compensation being determined based on a wind map.

→ Second, tendering can take place at a regional level. In this case, separate tendering procedures for areas with different location qualities can be carried out in order to achieve different compensation levels. The advantage of such a procedure is that the reference yield model's individual parameters can be determined competitively. The disadvantage is the emergence of fragmented markets, making the optimal tendered volumes for achieving scarcity even more difficult to determine than for the whole market. The lower liquidity in such fragmented markets would also facilitate strategic behaviour among market actors.

8 Conclusions regarding next steps for implementing auctions

Since there is only limited experience with the use of auctions in EU Member States, the implementation of pilot projects seems to be a very important next step. Clearly, it will be necessary to gain practical experience as well as a better understanding of the different design elements discussed in the foregoing. Therefore, an explorative process of "learning by doing" will be needed in Europe in order to develop tendering procedures that are not only goal-oriented but also feasible in actual practice. Pilot projects should be undertaken to experiment with a range of different conditions. The "Guidelines on State aid for environmental protection and energy 2014-2020" address the issue of pilot projects indirectly by requesting *"In a transitional phase covering the years 2015 and 2016, aid for at least 5 percent [sic] of the planned new electricity capacity from renewable energy sources should be granted in a competitive bidding process on the basis of clear, transparent and non-discriminatory criteria"*.¹⁴ Accordingly, Member States should use this transition period to gain experience with auctions that are conducted for a limited part of the overall renewable energy market.

One example of "learning-by-doing" in action is the tender procedure for 600 MW of open-space photovoltaic capacity that has been called for by German renewable energy law. Photovoltaic seems particularly suitable for testing tendering models, as this technology is characterized by comparatively short planning periods and low investments during the planning process. Experience can thus be gained quickly, and the successful implementation of the tendering procedure is more likely than with other technologies. In testing the suitability of options for RE tendering, special attention should be devoted to product design, auction procedures and measures to stabilize target achievement, as discussed in sections 3 to 5.

While a key aim in pilot projects is to achieve generalizable insights that can be applied to other tendering procedures, the specific characteristics of the photovoltaic segment place limitations on the applicability of insights to other technologies. Accordingly, pilot tender procedures will be needed for other technologies, especially for technologies that are to contribute large shares to meeting the EU's renewable targets, including onshore wind power, offshore wind and biomass. In addition to the aforementioned questions concerning product definition, penalties, and the terms for prequalification, unresolved questions need to be addressed concerning the design of pilot projects. The following questions need to be discussed for pilot tendering procedures with a view to a technology's market segments:

- Is it possible to achieve scarcity and thus competition for the segment addressed?
- Which number and technological specifications for possible sub-segments lead to the desired result?
- How can strategic behaviour in the segment be avoided?
- What are the effects on strategic behaviour of various market and bidder structures for different technologies? Is tendering the capacity rather than the quantity of energy a suitable alternative for some segments?
- Which deadlines between the tendering and commissioning of the power plant are convenient and needed for a quick policy learning process?
- How should significantly longer realization periods be dealt with, e.g. in case of onshore wind and off-shore wind compared to, say, photovoltaic power plants?

In addition to a pilot project's technical and administrative aspects, the question of EU-wide cooperation and the

¹⁴ See footnote 2.

partial opening of projects from other EU Member States to international bidding should be discussed, as this is a clear long-term vision of the European Commission in order to limit distortions between national support schemes.¹⁵ Some of these additional elements concern the general aspect of national instruments and targets versus international cooperation for supporting RE in the EU; others concern specific technical implications for tender design. Among others, the following questions need clarification:

- How can a physical transfer to the electricity system of the country conducting the auction for the pilot project be achieved, if this is required?
- How can the EU Directive (2009/28/EG) for renewable energy's cooperation mechanism be used such that the energy produced can be included into the national target achievement of the Member State conducting the auction for the pilot project?
- What kind of detailed documentation must be provided by the foreign supplier?
- Can prequalification criteria formulated in the context of a tendering procedure be applied abroad? If so, how?

¹⁵ Compare section 3.1.1 of the Guidelines on State aid for environmental protection and energy 2014-2020.

Appendix

Overview: International experience with auctions to support renewable energy (Part 1 of 3)

Table 1

Country	Italy	France	Denmark
Description	<ul style="list-style-type: none"> • Annual auctions of 500 MW for onshore wind power since 2013 (until 2015) • Successful bidders receive remuneration for the electricity fed into the grid (feed-in tariff), guaranteed for 20 years • Grid connection and financing is the project developers' responsibility • Free choice of location • 20 months deadline to construct and commission (after proclaiming the winner of the auction) 	<ul style="list-style-type: none"> • Online auctions for building integrated photovoltaics (100 to 250 kW) since 2011 • Auctions take place periodically (e.g. 5 rounds in 2012), but the first auctions in 2013 were suspended (to improve requirements/criteria) • Target audience: private/small actors • Remuneration (in the form of feed-in tariffs) guaranteed for 20 years, limitation on the base of full load hours (1580 h/a mainland, 1800 h/a Corsica and overseas) • 18 months deadline to construct and commission (after proclaiming the winner of the auction) 	<ul style="list-style-type: none"> • Long-term experiences (since 2004), learning from earlier mistakes and problems (penalties and requirements too strict, lack of coordination with similar procedures in other countries, etc.), participatory approach and transparent provision of information as well as clear political and social acceptance as a guarantee for success • Extensive provision of information for bidders (wind measurements, exploration of the seabed, assessment of environmental compatibility from the DK Energy Agency takes place in advance) • Costs of grid connection are socialized (for offshore wind power, not for nearshore wind power) • Remuneration (in form of sliding feed-in premiums) is limited to certain full load hours (50,000 h/a) • Involvement of local actors in nearshore wind power is required (ownership stakes of at least 20% must be granted to local actors) • Penalties (in some cases high) for noncompliance or delay
Auction procedure	<ul style="list-style-type: none"> • Strict prequalification criteria: financing bonds (5% of the project cost) have to be deposited by the bidder • A complete authorization in public project register is necessary • Pay-as-bid for price determination • Determination of floor price (89 €/MWh) and ceiling price (124 €/MWh) by the tendering authority 	<ul style="list-style-type: none"> • Pay-as-bid for price determination • CO₂ assessment as prequalification requirement (form for life-cycle CO₂ balancing of the planned photovoltaic plant) and as criterion in the evaluation process (33%) • No financial securities necessary • Bidder has to be the owner of the building 	<ul style="list-style-type: none"> • Two-stage selection procedure: pre-selection based primarily on the price, amendment possible in a dialogue with prequalified bidders
Results to date	<ul style="list-style-type: none"> • Average feed-in remuneration: 117 €/MWh (round 1), 100 to 113 €/MWh (round 2) • Participants: mainly large electricity companies, limited number of small and medium-sized enterprises beginning with round 2 • Less offers (allowed) compared to the tendered volume in round 1 	<ul style="list-style-type: none"> • Feed-in remuneration in the first rounds of 2012: 194 to 231 €/MWh • Several offers were submitted but less than half of them accepted 	<ul style="list-style-type: none"> • Feed-in remuneration rate of the last wind park constructed: around 136 €/MWh (Anholt, tendered 2009, running since 2013) • Participants of the auctions so far: mostly large electricity companies, partially supported by institutional investors

The information contained in the above table is based mainly on the following sources: Held, A.; Ragwitz, M.; Gephart, M.; de Visser, E.; Klessmann, C. (2014): *Design features of support schemes for renewable electricity*. A report created by a research consortium headed by Ecofys and within a study on behalf of the European Commission, DG Energy on the topic of *Cooperation between EU MS under the Renewable Energy Directive and interaction with support schemes*. Utrecht/Karlsruhe/Wien, 2014.

Appendix

Overview: International experience with auctions to support renewable energy (Part 2 of 3)

Table 1

Country	Italy	France	Denmark
Temporary Conclusion	<ul style="list-style-type: none"> + A competitive element was introduced + Country-wide competition for the best locations + Regulated expansion - Strong prequalification criteria hinder market access for small and medium-sized enterprises - Prequalification requirements (bonds, approvals) increase the risk premiums <p>→ Competition, but still comparatively high remuneration levels</p>	<ul style="list-style-type: none"> + Online processing proved to be useful + Clear cap on expansion - High number of bidders that have not fulfilled the prequalification requirements (because of partly ambiguous requirements/prerequisites) <p>→ Comparatively high compensation rates due to limited competition</p> <p>→ Improving the prequalification requirements seemed appropriate and necessary (important: simple design that does not impose an obstacle for small agents)</p>	<ul style="list-style-type: none"> + Limited pre-financing necessary + High realization rates (due to clear/high penalties) + Low risk premiums due to extensive information provided and low financing costs - Limited competition in the previous rounds <p>→ Penalties (for noncompliance) have to be determined with caution</p> <p>→ Participatory approach seems to be beneficial to avoid potential mistakes – but it is prone to lobbying/influence</p>
Country	Netherlands	Brazil	China
Description	<ul style="list-style-type: none"> • In use since 2011, now applied to electricity, heat and biogas (direct feed-in) • Main goal is static cost-efficiency for the limited RE support budget • System can be classified as technology-neutral (even though compensation rates are defined based on technology level – however, these rates indicative and do not have to come into effect) • Sliding premiums are awarded; the selection takes place based on auctions on a “first come, first served” basis • Penalties were introduced in 2012 (for non-compliance after a period of 4 years) 	<ul style="list-style-type: none"> • Used for renewables since 2008 • Successful bidders receive a remuneration for the electricity fed into the grid (feed-in tariff), guaranteed for 20 years for wind power, and 15 for biomass • Online procedure after successful prequalification of potential bidders (certificate for grid access, assessment of environmental compatibility, bonds, etc.) • Positive certificates are often traded (secondary market for investors) • Penalties for noncompliance/delays 	<ul style="list-style-type: none"> • Initially used for onshore wind power, later for photovoltaic to assist in identifying the necessary support levels being offered in subsequently introduced feed-in tariff systems • Now also applied for offshore wind power and CSP
Auction procedure	<ul style="list-style-type: none"> • Auctions take place sequentially – the lowest price category is tendered first and offers are obtained concerning the amount of energy produced (volume tender); the following auction round is for the next highest price category, and so on, until the budget is exhausted 	<ul style="list-style-type: none"> • Two-step procedure: Descending clock in round 1 for pre-selection and determination of a price-cap; round 2 is based on the pay-as-bid principle (while reducing the amount of energy being tendered) 	
Results to date		<ul style="list-style-type: none"> • Wind power dominates • Very low compensation rates: 31 to 52 €/MWh between 2009 and 2012 	

The information contained in the above table is based mainly on the following sources: Held, A.; Ragwitz, M.; Gephart, M.; de Visser, E.; Klessmann, C. (2014): *Design features of support schemes for renewable electricity*. A report created by a research consortium headed by Ecofys and within a study on behalf of the European Commission, DG Energy on the topic of *Cooperation between EU MS under the Renewable Energy Directive and interaction with support schemes*. Utrecht/Karlsruhe/Wien, 2014.

Appendix

Overview: International experience with auctions to support renewable energy (Part 3 of 3)

Table 1

Country	Netherlands	Brazil	China
Temporary Conclusion	<ul style="list-style-type: none"> + Efficient use of means could be achieved (cheapest options prevail) - Risk of over-subsidizing (since, for example, renewable heating and electricity are in the same system) - Stricter control of the feasibility of particular projects seem appropriate during auctioning stage <p>→ In view of the Netherlands' 2020 RE targets, the system is far from offering sufficient incentives for more costly RE options, which appear necessary to achieve RE targets through domestic action</p>	<ul style="list-style-type: none"> + From the cost perspective, a competitive element was successfully introduced + Nationwide competition for the best locations (sufficiently available at many places) - Insufficient IRR induces a low re-realization rate, which can also be expected in the future - Grid expansion is delayed – the actual ability to feed electricity into the grid is uncertain for future projects - Introduction of penalties seems unbalanced, as project developers often have little influence on resulting delays (e.g. in grid connection) <p>→ The tendered volume of energy has to be coordinated with the actual realization</p>	<ul style="list-style-type: none"> + Auctions can be used to determine necessary support levels in the subsequently implemented feed-in systems - Underbidding is a prevalent problem - As a consequence of above, low realization rates occur - Little interest from private actors; stateowned corporations dominate

The information contained in the above table is based mainly on the following sources: Held, A.; Ragwitz, M.; Gephart, M.; de Visser, E.; Klessmann, C. (2014): *Design features of support schemes for renewable electricity*. A report created by a research consortium headed by Ecofys and within a study on behalf of the European Commission, DG Energy on the topic of *Cooperation between EU MS under the Renewable Energy Directive and interaction with support schemes*. Utrecht/Karlsruhe/Wien, 2014.

Appendix

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Positive Effekte von Energieeffizienz auf den deutschen Stromsektor

Endbericht einer Studie von der Prognos AG und dem Institut für Elektrische Anlagen und Energiewirtschaft (IAEW)

Power-to-Heat zur Integration von ansonsten abgeregeltem Strom aus Erneuerbaren Energien

Handlungsvorschläge basierend auf einer Analyse von Potenzialen und energiewirtschaftlichen Effekten

Stromverteilnetze für die Energiewende

Empfehlungen des Stakeholder-Dialogs Verteilnetze für die Bundesrepublik – Schlussbericht

Vergütung von Windenergieanlagen an Land über das Referenzertragsmodell

Vorschlag für eine Weiterentwicklung des Referenzertragsmodells und eine Anpassung der Vergütungshöhe

How do we accomplish the Energiewende? Which legislation, initiatives, and measures do we need to make it a success? Agora Energiewende helps to prepare the ground to ensure that Germany sets the course towards a fully decarbonised power sector. As a think-&-do-tank, we work with key stakeholders to enhance the knowledge basis and facilitate convergence of views.



Agora Energiewende

Rosenstrasse 2 | 10178 Berlin | Germany

T +49 (0)30 284 49 01-00

F +49 (0)30 284 49 01-29

www.agora-energiewende.de

info@agora-energiewende.de

