D2.1-DE, December 2019

Auctions for the support of renewable energy in Germany

Main results and lessons learnt

AURES II has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817619

D2.1-DE, December 2019, Auctions for the support of renewable energy in Germany

Authors: Thobias Sach, Bastian Lotz, Felix von Blücher (Navigant)
Reviewed by: Jasper Geipel (TU Wien), László Szabó, Mária Bartek-Lesi, Bettina Dézsi (REKK), Corinna Klessmann (Navigant)
Submission date: M14
Project start date: 01 November 2018
Work Package: WP2
Work Package leader: REKK

Dissemination level: PU (Public)

Contents

1 Introduction

Renewable energy auctions have become the new standard for determining subsidy levels for renewable energy sources (RES) worldwide. Over the past years, many countries have implemented and further developed auctions for the deployment of RES. This allows to identify good practices as well as pitfalls and lessons to learn from the individual cases.

Against this background, this report provides an overview of the current status of renewable auctions in Germany. The focus is on auctions for onshore wind and solar PV, which are at the core of the German renewable support scheme. Being the first comprehensive AURES study on renewable auctions in Germany, the report also provides some background information on key design elements of the German support scheme and the auction formats that are implemented.

The first renewable auction in Germany was held in April 2015 as part of the pilot auction scheme for ground-mounted solar PV. The broad shift from administratively-set support levels to renewable auctions followed in 2017. Since then, several auctions rounds – mostly technology-specific – have taken place with a high frequency. By December 2019, a total of 17.25 GW of renewable energy capacity has been auctioned in 40 auction rounds. However, significant undersubscription in the recent onshore wind auctions threatens the foreseen RES expansion path.

The large number of auction formats, rounds and volume provide for an interesting study case. Specific design elements reflect the characteristics of the German power system. One example is the maximum quota for the yearly capacity addition of onshore wind in the so-called grid expansion area (*Netzausbaugebiet*) that is applied in the auction to account for regional capacity limitations of the transmission grid.

The remainder of the report is structured as follows:

- Chapter 2 provides a brief overview of the German electricity sector
- Chapter 3 outlines key design elements and characteristics of the German renewable support scheme, the Renewable Energy Sources Act (EEG)
- Chapter 4 provides an evaluation of the auction results and recent developments within the sector
- Chapter 5 concludes the report.

2 Overview of the German electricity sector

Germany's electricity system is undergoing a substantial transformation. In the last two decades, the *Energiewende* ("energy transition") led to a strong development of renewable energy sources, especially of wind and solar power (Figure 1). The rapid expansion is likely to continue, as Germany aims to reach a renewable share of 65% of electricity consumption by 2030 and foresees yearly technology-specific RES capacity additions until then.

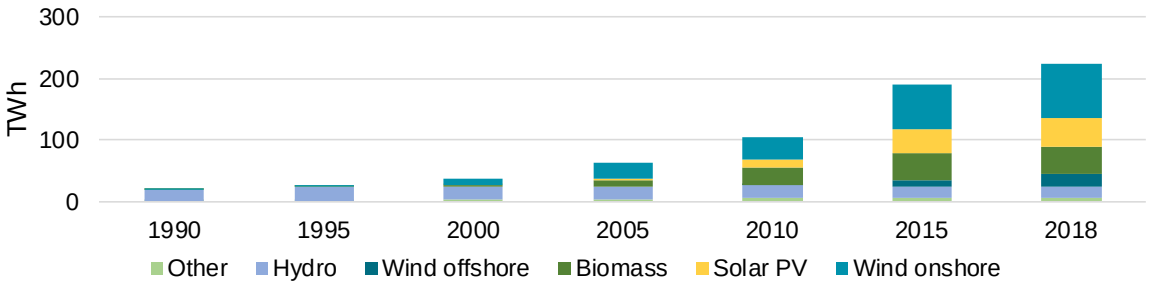

Figure 1: Installed renewable capacities in Germany. Source: Navigant based on (BMWi, 2019).

At the same time, conventional capacities and their generation are in decline. Increasing prices for EU emission allowances, decommissioning of power plants and other factors led to decreased conventional generation in recent years. As a result, renewables make up the largest share of electricity generation in Germany since 2014. The renewable share of electricity generation currently stands at 35% (Figure 2). However, the carbon intensity of Germany's electricity generation today is still among the highest in Europe due to the large share of coal-fired power plants (Agora Energiewende and Sandbag, 2019).

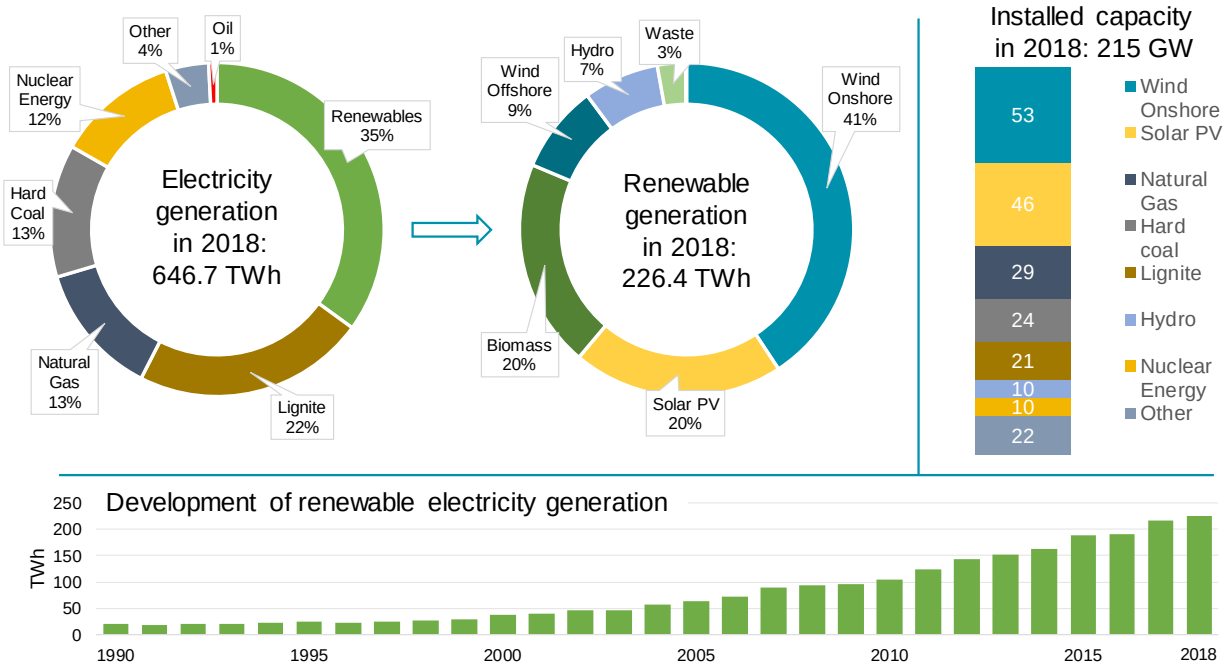

Figure 2: Electricity generation and installed capacities in Germany. Source: Navigant based on (BMWi, 2019).

Germany's liberalised electricity market showed significant over-capacities in the past decade (BNetzA, 2019a). In the coming years, this is likely to change. The ongoing phase-out of nuclear energy will be concluded by 2022 and a gradual phase-out of coal power plants is foreseen until 2038. Additionally, the development of onshore wind is currently stagnating due to acceptance issues, delays in the land-use planning, emerging minimum distance rules on state level and a series of lawsuits against wind projects. Bidder surveys show, that currently more than 1 GW of wind projects are being sued (FA Wind, 2019a). Furthermore, the announcement of the transition from fixed support levels to auctions led to strong capacity additions still within the administrative system, potentially lowering the availability of developed wind projects in the first years of the auction scheme.

Regarding the national electricity grid, Germany is affected by a great North-South disparity in electricity balance: demand centres are located in the South while the majority of generation capacities and RES potential lie in the North. This specific situation regularly leads to partial grid congestion and the need for redispatch measures. Part of the solution to ease the stress on the national grid is a strong exchange with neighbouring countries.

Located at the heart of central Europe, Germany naturally has a vivid electricity exchange with its neighbouring countries. From a more or less equal balance of electricity imports and exports until 2002, Germany has developed into a strong electricity exporter. The strong development of renewable energies sources in combination with continued generation of conventional power plants led to a significant electricity surplus in recent years. From 2015 to 2018, Germany had a net electricity export of over 50 TWh per year (BMWi, 2019).

While the electricity wholesale market prices in Germany are lower compared to most of its European neighbouring states[1], end consumer prices for electricity are among the highest in Europe due to high taxes and levies[2]. This includes the EEG levy, which finances the renewable support scheme and makes up 20% of the electricity prices for households.

21 years after the liberalisation of the power market, four large utilities - E.ON, RWE, EnBW, and Vattenfall - continue to dominate the German electricity market. They are still responsible for the bulk of electricity generation, distribution and retail supply. However, their market shares are decreasing.

[1] Germany's and Denmark's average day-ahead market prices in 2018 were at 45 €/MWh and the price in Czech Republic was at 46 €/MWh, while prices in Austria, Belgium, France, the Netherlands, Poland, Switzerland, etc. were at or above 50 €/MWh (Agora Energiewende and Sandbag, 2019).

[2] In 2018, electricity prices for households in Germany were at 33.32 ct/kWh, only the prices in Denmark were slightly higher (33.79 ct/kWh), while the average price level within EU 28 was at 23.56 ct/kWh (BMWi, 2019).

3 Characteristics and design elements of the German Renewable Energy Sources Act (EEG)

The Renewable Energy Sources Act (EEG, *Erneuerbare-Energien-Gesetz*) forms the legal basis for the support for renewable energy sources (RES) in Germany. Its main aim is to increase the RES share of electricity generation. The EEG first came into force in April 2000 as a follow-up regulation to the Electricity Feed-in Act (*Stromeinspeisungsgesetz*) of 1991, which was the starting point of RES support in Germany. Since 2000, the EEG has been amended several times. Its current version is the EEG 2017. The next amendments are foreseen for 2020.

This chapter is organized as follows. We first describe the main characteristics of the EEG 2017 applicable to all auctions held under this law. We then continue by outlining key design elements for the technology-specific onshore wind and solar PV auctions as well as the joint auctions for solar PV and onshore wind. Finally, we briefly describe key characteristics of other auctions under the EEG, i.e. for biomass, offshore wind and the planned innovation auctions.

3.1 Main characteristics of the EEG 2017

The revision of the EEG in 2017 has induced a paradigm shift for the support of renewable electricity generation in Germany. In principle, support for electricity from RES is no longer allocated on the basis of administratively-set feed-in tariffs. Instead, sliding feed-in premiums are competitively determined in auctions for installed generation capacity (i.e. kW). The premium is paid per generated electricity unit (in ct/kWh) and financed by the electricity consumers via a surcharge on their electricity bills. The successful participation in an auction is thus a pre-condition to receive support payments. Administratively-set support payments remain possible in exceptional cases only, e.g. installations below de-minimis thresholds or pilot installations. At the same time, RES projects may opt to sell electricity to third parties without receiving support payments as provided for in § 21a EEG 2017.

The main objective of the EEG reform in 2017 has been to manage the capacity expansion of RE in line with national renewable targets (i.e. volume control) and to reduce support costs as a result of the induced competitive pressures between bidders (i.e. cost-efficiency). The focus of the EEG is on electricity generation from renewables. Its main objective is to increase the share of RE in gross final electricity consumption to 40-45% by 2025, 55-60% by 2035, and at least 80% by 2050.[3] Besides, auctions should be designed in a way that allows a variety of market players to participate and that guarantees an effective synchronization between RE and grid expansion.

The EEG 2017 also introduced a major change with respect to the steering of RE expansion, more generally by defining a transparent RE expansion pathway via maximum annual capacity additions per technology from 2017 onwards. The climate protection program 2030 (*Klimaschutzprogramm 2030)* adopted in October 2019 revised some of these capacity addition targets (see also Figure 3):

- Wind onshore: 2.8 GW of gross annual newly-built installations between 2017 and 2019 and 2.9 GW of annual gross newly-built installations from 2020. According to the climate protection program, total installed onshore wind capacity is planned to reach between 67 and 71 GW by 2030.
- Solar PV: 2.5 GW of gross annual newly-built installations. The initially planned cap on overall installed solar PV capacity of 52 GW by 2030 as set out in the EEG 2017 is supposed to be removed and overall capacity is now expected to be increased to 98 GW in line with the climate protection program 2030.
- Biomass: 150 MW of gross annual newly-built installations between 2017 and 2019, 200 MW of gross annual newly-built installations from 2020.
- Wind offshore: an increase in installed capacity to 6.5 GW in 2020 and to 15 GW in 2030. The climate protection program 2030 updated the expansion target for 2030. Installed offshore wind capacity is now planned to reach 20 GW.

[3] In 2018, the share of renewable energy in gross final electricity consumption was 35 percent.

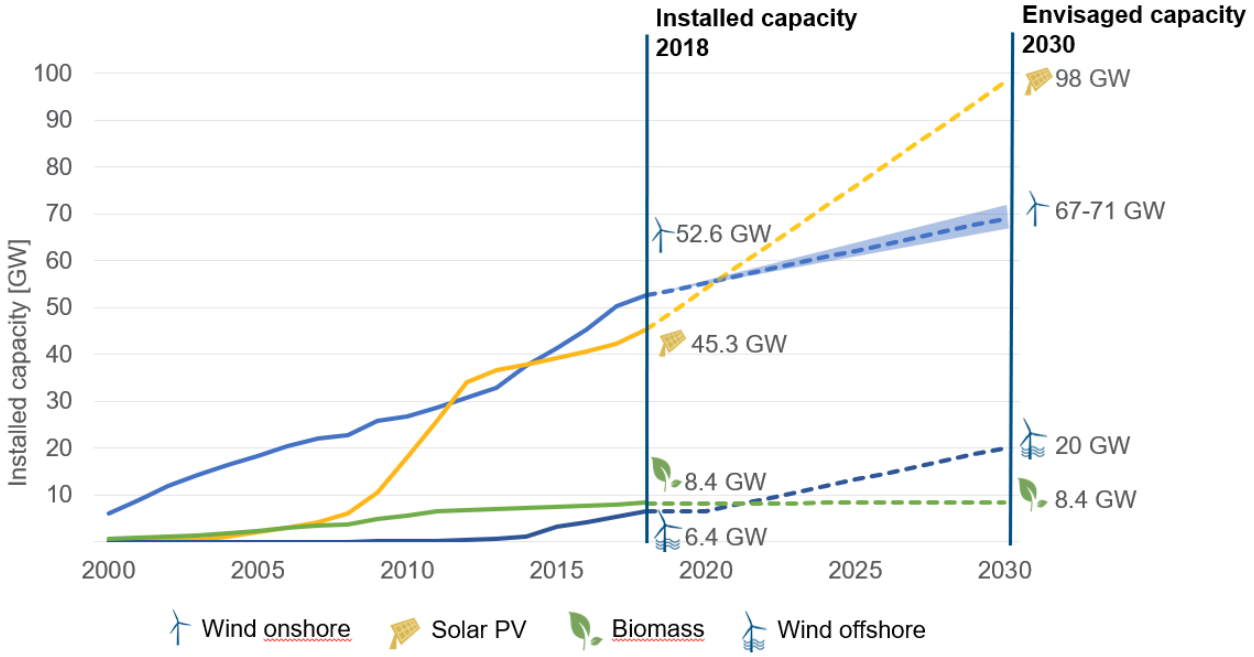

Figure 3: Development of installed RES capacities and capacity expansion pathways as envisaged by the climate protection program 2030. Source: Navigant.

To reach these capacity additions, the EEG 2017 introduced auctions for specific technologies and plant sizes: solar PV (>750 kW), onshore wind (>750 kW), offshore wind (as further specified in the Offshore Wind Energy Act, WindSeeG) and biomass (>150 kW). The solar PV auction were preceded by pilot auctions since 2015 as part of the ground-mounted PV Auction Ordinance (FFAV, *PV-Freiflächenverordnung*) as foreseen by the EEG 2014. For each technology, the EEG 2017 determines a regular auction schedule by laying out specific auction dates and tender volumes from 2017 onwards. In December 2018, the Omnibus Energy Act (EnSaG, *Energiesammelgesetz*) amended the EEG to specify additional auction volumes and rounds (*Sonderausschreibungen*) for solar PV and onshore wind between 2019 and 2021. Accordingly, until 2021, 4 GW of capacity for each solar PV and onshore wind will be tendered in addition to the auction volumes defined in the EEG 2017 (i.e. 1 GW in 2019, 1.4 GW in 2020 and 1.6 GW in 2021).

For each technology, multiple auction rounds take place every year following the pre-determined auction schedule as provided for in the EEG 2017 and the amendments of the EnSaG:

- Wind onshore auctions: In 2019, six auctions rounds have been held and seven rounds are planned in 2020 and 2021 respectively. Three rounds per year are envisioned from 2022 onwards. Tender volumes per auction round amount to between 500 and 1000 MW.
- Solar PV auctions: In 2019, five auctions rounds have been held and seven rounds are scheduled for 2020 and 2021 respectively. Three rounds per year are envisioned from 2022 onwards. Tender volumes per auction round amount to between 175 and 500 MW.
- Biomass auctions: In 2017 and 2018, one auction round per year was held. Two rounds per year are planned from 2019 onwards. Tender volumes per round amount to between 122 MW and 226 MW.
- Wind offshore auctions: One auction round was held in 2017 and 2018 respectively with tender volumes of 1550 MW each. Tender volumes between 700 and 900 MW are envisaged per year from 2021 onwards.

In addition, cross-border auctions with Denmark were piloted under the Cross-border Renewable Energy Ordinance (GEEV, *Grenzüberschreitenden-Erneuerbare-Energien-Verordnung*) as foreseen by the EEG 2014. Moreover, multi-technology auctions open to solar PV and onshore wind are organized twice a year (200 MW auction volume each) in line the EEG 2017 and the Ordinance on Multi-technology Auctions for Onshore Wind and Solar PV (GemAV, *Verordnung zu den gemeinsamen Ausschreibungen für Windenergieanlagen an Land und Solaranlagen*). The EEG 2017 also provides for so-called innovation auctions. The recently adopted

Innovation Auction Ordinance (*Verordnung zu den Innovationsausschreibungen und zur Änderung weiterer energiewirtschaftlicher Verordnungen*) foresees the introduction of one technology-neutral auction round per year between 2019 and 2021. Their aim is to test new price mechanisms and auction procedures, such as the allocation of fixed market premiums and endogenous adjustments of auction volumes. So far, no auction round has been held.

The auctioned good of any tender organized under the EEG is defined in terms of installed capacity (i.e. MW). To participate in auctions and receive support payments, bidders need to specify the size of their projects (i.e. kW) and the level of the strike price of the sliding market premium[4] (in € cents/kWh), i.e. the constant sum of the average market price plus the sliding premium, which they would aim to receive for a specific project for 20 years.[5] In order to qualify, bids need to specify the project location and include proof of certain project planning stages (e.g. a building permit). Bids are evaluated based on price only. The cheapest bids are awarded until the tender volume is depleted. In case they are awarded, RE projects sell the electricity they produce at market prices and only receive the difference between the strike price determined for each project in the auction and the average market price as a support payment, i.e. the sliding market premium.

Table 1 provides an overview of main characteristics of auctions and framework conditions in Germany.

Table 1: Main characteristics of auctions and framework conditions in Germany

Characteristics	Description
Country characteristic (RE expansion pathway)	Germany aims for a share of 40-45% of electricity consumption from renewables by 2025, 55%-60% by 2035, and at least 80% by 2050, compared to 35% in 2018. The EEG 2017 defines annual capacity additions per technology from 2017 onwards: • Wind onshore: 2.8 GW of gross annual newly-built installations between 2017 and 2019; 2.9 GW of annual gross newly-built installations from 2020. • Solar PV: 2.5 GW of gross annual newly-built installations. • Biomass: 150 MW of gross annual newly-built installations between 2017 and 2019, 200 MW of gross annual newly-built installations from 2020. Wind offshore: an increase in installed capacity to 6.5 GW in 2020 and 15 GW in 2030. In addition, the current government has the ambition to increase the share of RES-E to 65% of gross electricity consumption. To reach this goal, additional auctions (so-called *Sonderausschreibungen*) beyond the auction schedule initially foreseen in the EEG 2017 were introduced in 2018 (see below).
Legal basis / name of auction scheme	Renewable Energy Sources Act (EEG 2017), in particular §§ 28 to 36i for onshore wind auctions, §§ 28 to 35a and 37 to 38b for solar PV auctions, §§ 28 to 35a and §§ 39 to 39h for biomass auctions. Multi-technology auctions open to solar PV and onshore wind are

[4] Note that sliding market premiums are sometimes also referred to as asymmetric or one-sided contracts for difference.
[5] To level site-specific differences in the availability of wind resource between projects, bid levels are adjusted to a reference wind site (100%) before they are ranked (so-called reference yield model or *Referenzertragsmodell* as specified in § 36h EEG 2017.

	organized in line with §§ 28 to 35 EEG and § 39j and the Ordinance on Multi-technology Auctions for Onshore Wind and Solar PV (GemAV, Verordnung zu den gemeinsamen Ausschreibungen für Windenergieanlagen an Land und Solaranlagen). Auctions for offshore wind are organized in line with the Offshore Wind Energy Act (WindSeeG, Windenergie-auf-See-Gesetz). Cross-border auctions are conducted under the Cross-border Renewable Energy Ordinance (GEEV, Grenzüberschreitenden-Erneuerbare-Energien-Verordnung) as foreseen by the EEG 2017. Technology-neutral innovation auctions are planned in line with § 39j EEG and the Innovation Auction Ordinance (InnAusV, Verordnung zu den Innovationsausschreibungen und zur Änderung weiterer energiewirtschaftlicher Verordnungen).
Objective	The main goal of auctions under the EEG is the competitive determination of market premiums for electricity from renewable energy sources as well as the precise steering of volumes in line with the set capacity addition targets set for individual RES technologies. In addition, auctions are to establish more competition within the overall support scheme. This is to ensure a steady and cost-efficient expansion of renewable energy and enhance acceptance for the energy transition. In this context, the auction design also includes specific elements to promote actor diversity. Small and medium-sized actors should have a fair chance of participating in auctions, in order to increase competition and innovation and reduce market concentration. The effective synchronization between renewables and grid expansion is an additional goal.
Auctioneer and contractual counterparty	The Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway (Bundesnetzagentur, BNetzA) conducts the auctions (§ 22 para. 1 EEG). The BNetzA also administers the installation registry (the so-called Marktstammdatenregister), which all authorizations and the commissioning of renewable installations need to be reported to. Grid operators act as the contractual counterparty for successful bidders, i.e. sign contracts with RE projects and pay out support payments.
Technology focus and differentiation (eligible technologies)	• Technology-specific auctions for onshore wind, solar PV and biomass • Multi-technology auctions (i.e. joint auctions) for solar PV and onshore wind • Offshore wind auctions • Cross-border auctions for solar PV or onshore wind • Technology-neutral innovation auctions

Volume and frequency of the tenders	The EEG 2017 determines a regular auction schedule by laying out specific auction dates and tender volumes from 2017 onwards. In December 2018, the Energy Omnibus Act (EnSaG, *Energiesammelgesetz*) amended the EEG to specify additional auction volumes and rounds (*Sonderausschreibungen*) for solar PV and onshore wind between 2019 and 2021: • Wind onshore auctions: Initially 3-4 rounds per year (2017-18), increased to 6-7 rounds per year 2019-2021), 3 rounds per year from 2020 onwards. Tender volumes per auction round amount to between 500 and 1000 MW since 2017. • Solar PV auctions: Initially, 3 rounds per year (2015-18, including FFAV auctions), increased to 5 auctions (2019), 7 rounds per year planned for 2020 and 2021, 3 rounds per year planned from 2022 onwards. Tender volumes per auction round amount to between 175 and 500 MW since 2017. • Biomass auctions: In 2017 and 2018, one auction round per year was held, two rounds per year from 2019 onwards. Tender volumes per round amount to between 122 MW and 226 MW since 2017. • Wind offshore auctions: One auction round was held in 2017 and 2018 respectively with tender volumes of 1550 MW each. Tender volumes between 700 and 900 MW per year from 2021 are envisaged. • Multi-technology auctions: 2 rounds per year since 2018 (200 MW each) • Cross-border auction: One auction open to Danish solar PV installation was held in November 2016. The auction volume was 50 MW. Further cross-border auctions may be implemented in the coming years. • Innovation auction: One round per year between 2019/2020 and 2021 is planned. Planned auction volumes increase from 250 MW in 2019 to 400 MW in 2020 and 500 MW in 2021.
Main features of auction procedure[6]	Bidders submit a sealed bid to the BNetzA. Bidders need to specify the size of their projects and the level of the strike price (in €/kWh), i.e. the constant sum of the average market price + sliding premium, which they aim to receive for a specific project for 20 years. In order to qualify, bids need to specify the location of the project and include proof of certain project planning stages. Bids are evaluated based on price only.
Type of support	Support is generally paid in the form of a sliding market premium for a period of 20 years. Technology-specific average day-ahead market prices are determined on a monthly basis for the calculation of the applicable market premium paid out to awarded projects. For successful bidders in the planned innovation auction, support will

[6] This auction procedure applies to the main auction types in Germany, i.e. the technology-specific and multi-technology auctions.

	be paid in the form of a fixed market premium. Administratively-set support payments remain possible in exceptional cases only (e.g. de-minimis thresholds or pilot installations).
Support period	20 years (Existing biomass installations may receive subsequent support for a period of 10 years)
What is auctioned?	Installed capacity (MW)
Lead time before auction	Details on each auction round are published 6 to 8 weeks in advance on the website of BNetzA.
Budgetary expenditures per auction and per year	There is no overall budget limit. Support for renewables is financed by the end user via a levy on the electricity consumption. The costs for the support for renewables (not specific to the auction scheme) are substantial and amount to 24 billion Euro per year. This sum translates into an EEG levy of 6.756 ct/kWh.
Grid connection/access related costs	Charging is generally based on actual costs. In general, RES-E developers pay for their own connection line and substation. General reinforcements of the grid are socialized via tariffs. For offshore wind, sites are pre-developed by the state and grid connection capacity is provided.
Balancing and profile costs	The RES-E operators have balancing responsibility within their balancing group.

3.2 Key design elements of the renewable auctions

The following section provides a detailed description of auction design elements of the two most prominent EEG auctions in terms of auctioned capacity and organized auction rounds, i.e. onshore wind auctions (section 3.2.1) and solar PV auctions (section 3.2.2). In addition, we outline key auction design elements for the remaining auctions held under the EEG 2017, including the multi-technology auctions for solar PV and onshore wind, biomass auctions, offshore wind auctions as well as the planned innovation auctions (section 0).

3.2.1 Onshore wind auctions

The participation in auctions is mandatory for onshore wind installations with a capacity of more than 750 kW (§ 22 Abs. 2 EEG 2017). Between May 2017 and December 2019, 13 technology-specific auction rounds for onshore wind with a total auction volume of 9.2 GW have taken place. In the following, we briefly outline both the auction design and the preferential rules for community actors in the auction design as currently applicable. Table 2 provides an overview of the key design elements applicable for the Germany onshore wind auctions.

Auctions take place at a late stage of the project planning cycle. Installations are eligible if they have obtained permits in line with the Federal Immission Control Act (BImSchG, *Bundes-Immissionsschutzgesetz*). The

latter must have been granted three weeks before the auction date and registered in the installation registry administered by BNetzA (the so-called *Marktstammdatenregister*).[7] Moreover, bidders have to submit a financial guarantee/bid bond amounting to 30 € per kW for their bid size. The bid bond can be provided in the form of a bank guarantee or as a payment to a BNetzA suspense account. This is to secure potential claims of the transmission system operators in case of penalties.

The award price equals the bid price (i.e. pay-as-bid pricing rule). Germany aims for a balanced geographic distribution of onshore wind installations. To balance out varying site qualities in terms of wind resources in the ranking of projects, the bid price is adapted to reflect a 100% site for the calculation of the market premium as part of the so-called reference yield model (REM, *Refererenzertragsmodell)*. In addition, awards can be limited in areas, in which transmission grids are significantly (over-)stressed (so-called grid expansion areas or *Netzausbaugebiete*), via regional capacity addition limits (§ 36c EEG 2017). Currently, such a maximum quota is effective for the grid expansion area that covers parts of the Northern German states Lower Saxony, Bremen, Schleswig-Holstein, Hamburg and Mecklenburg-Vorpommern, where annual capacity additions are capped at 902 MW.

Moreover, a ceiling price for submitted bids applies. The ceiling price is calculated as the average bid price of the last awarded bid in the last three auction rounds increased by 8 %. Initially, the ceiling price amounted to 7 cents/kWh, but was decreased to 6.3 cents/kWh in 2018 and to 6.2 cents/kWh in 2019.

Upon public announcement of the award decision, successful bidders have 30 months for the project realization before the award expires and is withdrawn. However, penalties are phased in already 24 months after the announcement of the award. For the auction rounds in February, May and August 2019 the realization time limit had been reduced to 24 months, in order to incentivize faster deployment.

The EEG 2017 envisages special conditions for community energy projects (BEG, *Bürgerenergiegesellschaften*) (§36g EEG 2017). In this context, eligible BEGs are defined as wind cooperatives with at least ten private individuals. The majority of voting rights needs to be held by local individuals and one individual can own a maximum share of 10%. Project size is limited to 6 turbines with a total capacity of up to 18 MW. Local municipalities must be offered a buy-in. In auction rounds held in 2017 the following preferential rules for BEG within the auction design applied:

- Lower material pre-qualification requirement: BEG did not have to submit a BImSchG permit at the time of bidding and could thus participate in the auction at earlier stages of project planning.
- A reduced penalty in case of non-realization (15 instead of 30 € per kW of installed capacity)
- A realization period increased by 24 months compared to other projects (54 months in total)
- BEG are awarded with the highest awarded bid instead of their own bid price (uniform pricing rule)

These special rules had been made use of heavily during the auctions rounds in 2017, which led to unintended consequences. For example, the preferential rules provided significant incentives to be categorized as BEG. As a result, many professional multi-project developers set up local project companies that would fall under the BEG definition. This led to a significant misuse of the rule which potentially crowded out community energy actors that were initially targeted by the preferential rules. In addition, the initially implemented preferential rules led to growing uncertainty over whether such projects would be realized due to the lower applicable pre-qualification requirements. Since the beginning of 2018, the preferential rules for BEG have been partially suspended. The only remaining rule allows BEG to be awarded on the basis of uniform pricing (see § 104 Abs. 8 EEG 2017).

[7] Installations which had received a permit by 31 December 2016 were eligible to receive an administratively-set market premium until the end of 2018.

Table 2: Design Elements for onshore wind auctions

Design elements	Description
Auction format	Static sealed bid & multiple item auction
Eligible technologies and participation technologies?	Technology-specific. Onshore wind installations above 750 kW which have not been awarded in a previous auction are eligible. There is no maximum bid size for regular bids, but a maximum bid size for community energy projects (BEG) of up to six onshore wind energy installations with a total capacity of not more than 18 MW.
Auction procedure	Bidders submit a sealed bid to the BNetzA. The BNetzA checks compliance with the prequalification criteria and excludes offers that exceed the price ceiling or that did not provide the required pre-qualification requirements, i.e. a financial security (bid bond) and/or proof of the required permit (BImSchG). The BNetzA ranks eligible bids according to the offered price. Based on this ranking, the BNetzA determines the bids that are needed to fill up the auctioned volume. For bids in the grid expansion area, bids are awarded until the annual capacity quota is reached. Once this cap is reached, bids for the grid expansion area are no longer considered, even if their bid prices are cheaper than bids outside this area. For unsuccessful bidders, the bid bond is paid back. Once successful bidders are notified, they are required to realize the awarded project within 30 months. Otherwise the award expires. In case of non-realization after 24 months, staggered penalties apply. Once projects have been successfully realized the bid bond is reimbursed.
Pre-qualification requirements	Participants need to provide a permit in line with the BImSchG as well as a financial guarantee (bid bond) of 30 € per kW for their full bid size either in the form of a bank guarantee or as deposit into a BNetzA suspense account.
Auction volume	Installed capacity (i.e. MW)
Pricing rule	Pay as bid pricing rule with the exception of community energy projects (BEG) for which uniform pricing applies.
Award procedure	Price-only. In case of equal bid prices, bids with smaller bid sizes (i.e. offered capacity) are awarded first. In case those bids have an equal bid size and bid price, the final award decision will be taken by lots.
Price limits	Disclosed ceiling prices are in place (currently at 6.20 cents/kWh).
Favourable treatment of specific actors	In 2017, the following preferential rules for community energy projects (BEG) applied: Lower material pre-qualification requirement (no BimSchG permit required); reduced penalty in case of non-realization (15 instead of 30 € per kW of installed capacity); longer realization period of 54 months; uniform pricing rule instead of pay-as-bid. Since 2018, BEGs only benefit from uniform pricing (§ 104 Abs. 8 EEG). The reference yield model (REM) partly offsets site-specific differences in the availability of wind resources, thus promoting a regional dispersion of onshore wind deployment. The REM works as a bonus for

	projects in sites with lower wind resources and as a malus for projects in sites with better wind resources. The grid expansion area (NAG) limits annual capacity additions in certain pre-defined areas with strain on the transmission grid and acts as a quota on awarded bids for projects located in these areas. Currently, this area covers parts of the North-German states of Lower Saxony, Bremen, Schleswig-Holstein, Hamburg and Mecklenburg-Vorpommern with a capacity limit set at 902 MW.
Realisation time limit	Penalty-free realization period: 24 months (from the publication of the award decision) Realization period, after which penalties are phased in: 24 – 29 months Realization period after which the award decision and support payment is suspended, and the full penalty amount applies: 30 months (except for auction rounds in February, May and August 2019, where this realization period was reduced to 24 months).
Penalties	In case an awarded project has not entered into operation within a period of 24 months after the public announcement of the award decision, the bidder needs to pay a penalty to the transmission grid operator, which corresponds to the confiscation of the submitted bid bond. The following penalties from the date of the award publication are applicable: • 10 € per kW of overall bid size (months 24 to 26) • 20 € per kW of overall bid size (months 27 to 28) • 30 € per kW of overall bid size (after month 28) The maximum penalty is limited to 30 € per kW, the penalties do not add up.
Way of monitoring progress of realisation	There are no intermediary milestones to monitor project realization of awarded projects. Once awarded projects have become operational, this is confirmed by the responsible TSO in the installation registry (*Markstammdatenregister*).
Transferability of support right	Awarded contracts are project- and thus location-specific, given that the award decision is tied to a valid BImSchG permit. This means that the role of post-award transferability to another project at a different site is not possible. The possibility to sell an entire project remains valid.
Other	In principle, electricity produced in onshore wind installations awarded in auctions may not be used for self-consumption throughout the whole support period of 20 years and will lead to the suspension of support payments. The strict exceptions to this rule are defined in § 27a EEG. In addition, support rights awarded in an auction under the EEG will be suspended if an installation sells guarantees of origin (in line with § 80 EEG 2017, so-called *Doppelvermarktungsverbot*).

3.2.2 Solar PV auctions

The participation in auctions is mandatory for solar PV installations with a capacity of more than 750 kW (§ 22 Abs. 3 EEG 2017). Between February 2017 and October 2019, ten technology-specific auction rounds for solar PV have taken place under the EEG 2017. In addition, six pilot auctions for ground-mounted solar PV were held under the FFAV between April 2015 and December 2016. The EEG 2017 which entered into force on 1 January 2017 replaced auctions organized under the FFAV. Since the introduction of auctions for Solar PV in 2015, a total volume of 3.6 GW has been auctioned.

The main auction design elements under the FFAV have remained in place for auctions organized under the EEG 2017, however. In addition to ground-mounted installations, roof-top installations as well as installations on other constructions (*sonstige bauliche Anlage)* have been incorporated in the EEG auction system. Moreover, arable land and grassland in disadvantaged areas may be used for solar PV installations if authorized by the respective Federal State (*Bundesland*), which had previously been exempted. Finally, all solar project above 750 kW need to participate in auctions. Table 3 provides an overview of the key design elements applicable for solar PV auctions in Germany.

When submitting their bids, auction participants for ground-mounted solar PV installations are obliged to demonstrate proof about the project status, e.g. by providing an adopted zoning plan. The type of proof varies depending on the site on which the installation is to be erected. Other installations (e.g. rooftop installations) are not obliged but may provide relevant accompanying documents in this respect (e.g. to reduce the second financial guarantee, see below). In addition, all bidders need to provide a first financial guarantee/bid bond amounting to 5 € per kW when entering the auction. The bid bond may be in the form of a bank guarantee or as a payment into a BNetzA account.

Ceiling prices apply. In 2019, the ceiling price was set at 8.91 cents/kWh for the first two auction rounds and reduced to 7.50 cents/kWh for the last two auction rounds in June and October. Once bids are submitted, the BNetzA checks compliance with the prequalification criteria and excludes offers that exceed the price ceiling or did not hand in the first bid bond. The BNetzA ranks eligible bids according to the offered price until the auction volume is reached. The award price equals the bid price (i.e. pay-as-bid pricing rule). Note in this context the second and third auction rounds under the FFAV in August and December 2015 implemented the uniform pricing rule.

Within ten days after the public announcement of the award decision, successful bidders need to submit a second financial guarantee/completion bond amounting to 45 € per kW for the whole bid size which is reduced to 20 € per kW in case the project is in more advanced planning stages, e.g. proof of an adopted land-use plan for the site in question can be provided.

After the public announcement of the award decision, bidders need to realize their projects within 24 months. Otherwise, the award decision and corresponding support payments are withdrawn. If the project is realized within 18 months of the announcement of the award decision, support is paid according to the award value with no support payment deductions. Project completion after this period leads to deductions from the award value of 0.3 cents per kWh. In the case of non-realization, penalties apply (see Table 3). Self-consumption from solar PV installations receiving support under the EEG is not possible, i.e. the produced electricity needs to be fully fed into the grid.

Table 3 Design Elements for solar PV auctions

Design elements	Description
Auction format	Static sealed bid & multiple item auction
Eligible technologies and participation technologies?	Technology-specific. Solar PV installations above 750 kW which have not been awarded in an auction are eligible. Ground-mounted installations may not be larger than 10 MW. For solar installations installed on, at or in a building or on other constructions, no maximum bid size applies.

Auction procedure	Bidders submit a sealed bid to the BNetzA. The BNetzA checks compliance with the prequalification criteria and excludes offers that exceed the price ceiling or did not hand in a first financial security (first bid bond). The BNetzA ranks eligible bids according to the offered price. Based on this ranking, the BNetzA determines the bids that are needed to fill up the auctioned volume. Once successful bidders are notified, they have to hand in a second, higher financial security for the penalty (second bid bond). For unsuccesful bidders, the first financial guarantee is reimbursed. Projects need to be realized within 24 months after the public announcement of the award decision. Otherwise, the support right is withdrawn.
Pre-qualification requirements	Bids have to specify the location at which the project is planned and whether the bid is for ground-mounted installations or for installations on, at or in a building or on other constructions. The bids for ground-mounted installations must in addition be supplemented by a declaration by the bidder that he is the owner of the site on which the solar installation is to be erected or is submitting the bid with the approval of the owner of that site. Bids for ground-mounted installations must also be accompanied by a proof of the project development status (e.g. an adopted land use plan, see § 37 subsection 2 EEG 2017 for more details). Installations on, at or in buildings or on another construction are not obliged but may provide related proof of the project status (e.g. to reduce the second financial guarantee). For ground-mounted solar PV installations, bidders need to provide proof of an eligible site to be able to participate in an auction (see § 37 subsection 1 EEG 2017). Eligible sites include sites already sealed, sites used as a conversion area used for commercial, transport, housing or military purposes, sites located within an area covered by a zoning plan allowing for the erection of solar installations or on sites used as farmlands or grasslands in disadvantaged areas (if authorized by Federal States). A first financial guarantee/bid bond of 5 €/kW of the awarded bid size needs to be provided at the time of bidding as a payment to a BNetzA suspense account or as a bank guarantee. A second financial guarantee/completion bond of 45 €/kW of awarded bid size needs to be provided by successful bidders within 10 days after the announcement of the award decision. The completion bond is reduced to 20 €/kW in case project completion is already more advanced (e.g. proof of an adopted land-use plan pursuant to the Federal Building Code can be provided). The completion bond may be in the form of a bank guarantee or as a payment into a BNetzA account. In case a bidder does not provide a second financial guarantee, the support right is withdrawn, and the bid bond is retained.
Auction volume	Installed capacity (i.e. MW)

Pricing rule	Pay-as-bid pricing rule (In 2nd and 3rd round of auctions in August and December 2015, a uniform pricing rule was implemented)
Award procedure	Price-only. In case of equal bid prices, bids with smaller bid sizes (i.e. offered capacity) are awarded first.
Price limits	Disclosed ceiling prices are in place (currently at 7.50 cents/kWh).
Favourable treatment of specific actors	None
Realisation time limit	Realization period without penalties: 18 months (from the publication of the award decision) Realization period until support right is withdrawn: 24 months
Penalties	After the public announcement of the award decision, bidders need to realize their projects within 24 months. Otherwise, the award decision and corresponding support payments are withdrawn. Project realization within 18 months of the announcement of the award decision incurs no support payment deductions. Project completion after this period leads to deductions from the award value of 0.3 cents per kWh. In the case of non-realization after 24 months, a penalty of 50 €/kW applies. For bidders having submitted a reduced second financial guarantee, the penalty amounts to 25 €/kW.
Way of monitoring progress of realisation	There are no intermediary milestones to monitor project realization of awarded projects.
Transferability of support right	Awarded contracts are bidder-specific, which means that a successful bidder may transfer the support rights from the winning project to another site at the expense of a small support payment deduction of 0.3 cents/kWh. The possibility to sell an entire project remains valid.
Other	Electricity produced in solar PV installations awarded in auctions may not be used for self-consumption throughout the whole support period. In addition, support rights awarded in an auction under the EEG will be suspended if an installation sells guarantees of origin (in line with § 80 EEG 2017, so-called *Doppelvermarktungsverbot*).

3.2.3 Other auctions

The following section provides brief overviews of key auction design elements in the remaining regularly held or planned auction types in Germany, i.e.:

- Biomass auctions (section 3.2.3.1)
- Multi-technology auctions for solar PV and onshore wind (section 3.2.3.2)
- Wind offshore auctions (section 3.2.3.3)
- Innovations auctions (section 3.2.3.4)

3.2.3.1 Biomass auctions

In 2017 and 2018, two technology-specific biomass auctions took place. Since 2019, two auction rounds are held per year with an annual tendered volume of 150 MW. In contrast to other auction types organized in Germany, new installations as well as existing installations intending to receive subsequent funding for 10 years beyond the initial support period granted under the old FiT system may participate in the biomass auctions. This is to account for the fact that biomass installations, unlike non-dispatchable RES such as solar and wind, depend on feedstock and thus incur high operating costs over the lifetime of the plant. New installations need to be larger than 150 kW, while existing installations may also be smaller than 150 kW. For both installation types, the maximum bid size amounts to 20 MW.

To be eligible for participation in the auctions, installations need to comply with a number of pre-qualification requirements. New installations may not have entered into operation yet and have to submit a BimSchG or building permit to the installation registry (*Marktstammdatenregister)* three weeks before the auction date. If their current EEG support right is still valid for a maximum of 8 years, existing installations may participate in the auction to competitively determine the FiP for a subsequent support period of 10 years after the end of initial FiT support payments. In addition to these material pre-qualification requirements, bidders need to provide a financial guarantee/bid bond amounting to 60 € per kW for the overall bid quantity in the form of a deposit into a BNetzA account or as a bank guarantee.

In the 2017 auction round, a ceiling price of 14.88 cents/kWh applied for new installations and a price limit of 16.90 cents/kWh was set for existing installations. Both ceiling prices are subject to an annual degression of 1 % for subsequent years. In principle, awarded bids receive their bid price (i.e. pay-as-bid pricing rule). Awarded existing installations below 150 kW receive the last awarded bid price of the respective auction round (i.e. uniform pricing rule).

After the announcement of the award decision, biomass installations have to be realized within 18 months without incurring penalties. In case the installation is not realized after 24 months from the award decision, the support right is withdrawn. After 18 months from the award decision penalties are phased-in via the (partial) confiscation of the submitted bid bond, i.e. 20 €/kW (18-19 months), 40 €/kW (20-21 months) and 60 €/kW (after 22 months).

3.2.3.2 Multi-technology auctions for solar PV and onshore wind

Besides the technology-specific auctions outlined above, joint, i.e. multi-technology, auctions, have been held in Germany since 2018, in which both solar PV and onshore wind installations can participate. So far, three auction rounds with a volume of 200 MW per round have been held.

In principle, the same design elements applicable under the technology-specific auctions for solar PV and onshore wind are used. For solar PV ground-mounted installations, the maximum bid size generally amounts to 10 MW as in the technology-specific auctions. However, in certain districts (*Landkreise*) with larger significant available land potential (as defined in Annex 2 of the GemAV), the maximum bid size is increased to 20 MW.

In contrast to the technology-specific onshore wind auctions, the instrument to promote a geographically dispersed deployment of onshore wind by balancing differences in the wind resources in the bid, the

reference yield model (REM), is not used for the calculation of bid prices in the joint auctions.[8] Instead, the so-called Distribution Network Component (VNK, *Verteilernetzkomponente*) has been introduced for both onshore wind and solar PV. The VNK intends to limit capacity additions in districts in which installed renewable energy capacities exceed peak load. These districts are defined as Distribution Network Expansion Areas (VAG, *Verteilernetzausbaugebiete*). The VNK acts as a malus for projects with sites in VAGs and as a bonus for projects outside of VAGs and thus affects the ranking of bids. Figure 4 provides an overview of the VAGs and the corresponding VNKs for onshore wind and solar PV.

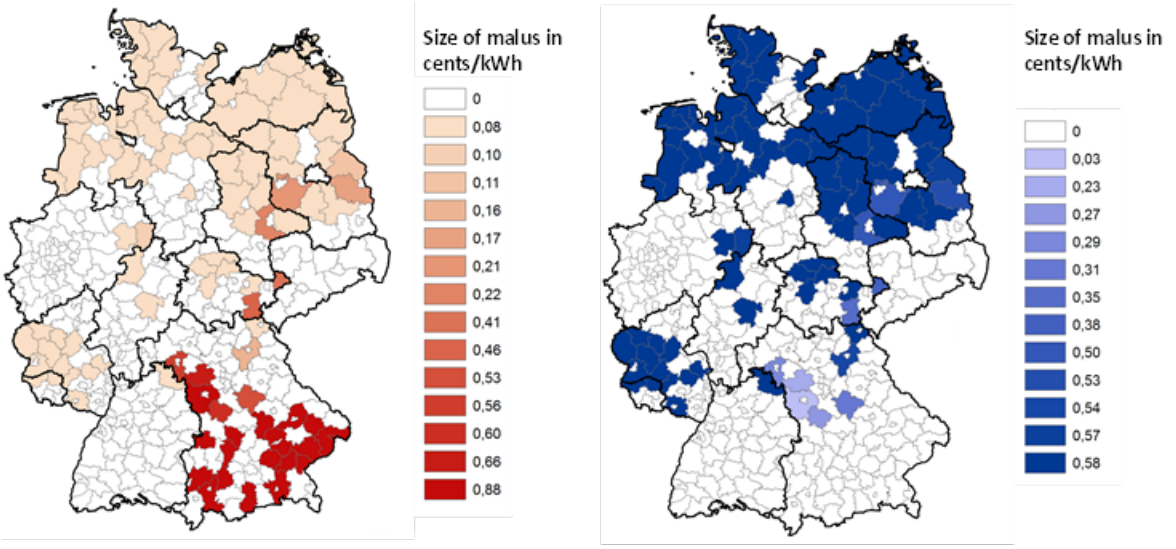

Figure 4 Distribution Network Expansion Areas (VAG; areas on the maps) and Distribution Network Component (VNK; size of malus in the legend) for solar PV (left) and onshore wind (right). Source: (BNetzA, 2019b).

Solar PV projects are bound by the ceiling price applicable in the technology-specific auctions. For onshore wind, ceiling prices in the auction rounds 2019 to 2022 vary depending on the ceiling price area, in which the bidding project is located. Regionally differentiated ceiling prices are currently defined for three ceiling price areas (*Höchstwertgebiete*) as defined in Annex 3 of the GemAV. which have been established on the basis of objective wind data and cost analyses. Their goal is to limit windfall profits in project sites with stronger wind resources. Table 4 outlines the applicable ceiling price areas and their respective ceiling prices, which are calculated based on the ceiling prices applicable in the technology-specific onshore wind auctions. Note that the grid expansion areas (NAGs) implementing capacity addition quotas of currently 902 MW per year remain applicable under the joint auctions.

Table 4 Ceiling price areas (as defined in Annex 3 of the GemAV) and applicable ceiling prices

Ceiling price area	Ceiling price
Area 1	Corresponds to technology-specific onshore wind auctions
Area 2	116% of ceiling price in technology-specific onshore wind auctions
Area 3	129% of ceiling price in technology-specific onshore wind auctions

[8] In addition, preferential rules for community energy projects (BEG) are not applicable.

3.2.3.3 Wind offshore auctions

Since the introduction of the WindSeeG in 2017, support for all offshore wind installations entering into operation by 2021 is competitively determined through auctions. After a transition period (for installations to be commissioned between 2021 and 2025), auctions will be held under the so-called "central model" (for installations commencing operation from 2026 onwards).

So far, two auction rounds in April 2017 and 2018 with an overall auction volume of 3.1 GW have been held as part of the transition period. The goal of these auctions was to allocate grid connection capacity and support payments to pre-developed projects, so-called "existing projects", thereby accounting for the fact that several projects had already obtained permits for the construction of offshore wind parks at certain sites. This model created competition between sites. Under the new central model, 700 to 900 MW are to be allocated annually as of 2021. Under this new scheme, the regulator BNetzA in cooperation with the Federal Maritime and Hydrographic Agency (BSH, *Bundesamt für Seeschiffahrt und Hydrographie*) will determine sites to be auctioned as part of the land development plan in advance and will conduct site-specific tenders to ensure better coordination with grid expansion. This model creates competition between different bidders submitting bids for one site.

Under both systems, sliding feed-in premiums for a support period of 20 years are determined on the basis of pay-as-bid auctions in which developers compete for grid access and the right to build and operate their project. The ceiling price for the auction rounds in the transition period is set at 10 cents /kWh. For the subsequent rounds, the ceiling price will be determined by the lowest bid value afterwards. Successful bidders are fully exempted from grid connection costs, which are financed by end users through electricity charges. At the end of the 20-year support period, operators can sell electricity output on the wholesale market for another five to ten years before the operating license for the site expires.

In the past auction rounds of the transitional period, a bid bond of 100 € per kW of planned installed capacity had to be deposited by bidders. Under the central model, a bid bond of 200 € per kW will be introduced. Realization periods are determined in reference to the time of the award and the project's connection to the grid connection point. After having initiated the planning approval phase (*Planfeststellung*) within 12 months after the award decision, any additional steps by the bidder are not required until two years before the expected realization of the connection to the grid. Once the grid connection is completed, the offshore wind park needs to be realized within 18 months. Non-delivery at any of these milestones leads to the withdrawal of the license to build the project and the full or partial confiscation of the bid bond.

3.2.3.4 Innovation auctions

The EEG 2017 foresees one yearly technology-neutral innovation auction between 2019 and 2021 with tender volumes increasing from 250 MW in 2019 to 500 MW in 2021. So far, no auction round has been held and no specific auction date has been announced for 2019. In October 2019, the German Government adopted the InnAusV establishing the applicable auction design. As part of the ordinance, BNetzA is entitled to shift the first auction round and conduct it at its earliest convenience.

With the innovation auctions, new price mechanisms and auction procedures will be tested. Successful bidders will receive a fixed instead of a sliding market premium for a period of 20 years, thus conferring more market price risk to RES projects. Moreover, successful bidders will not receive payments in case of negative prices and endogenous rationing of auction volumes are introduced, i.e. in case the offered volume remains below the auctioned volume only 80 percent of submitted bids will be awarded.[9]

To contribute to a more stable feed-in of electricity from RES and thus to increase the system-friendliness of RE plants, technological innovations in the form of combinations between intermittent and dispatchable renewable energy may participate in the innovation auctions from 2020 onwards. In the 2021 auction round, only such combined installations are eligible to participate. Such physical hybrids may for example include combinations of onshore wind and biomass installations or solar PV installations and storage. However, at

[9] Note that the last bidder falling within the 80 % of the offered volume will be awarded with his full bid quantity, even if this exceeds 80% of the overall auction volume.

least one part of the combined installation must be an onshore wind or solar PV plant. Combinations of installations will still receive a fixed market premium.

In principle, the design elements applicable under the technology-specific auctions remain valid in the innovation auctions. However, the auction design is adapted where this is seen as necessary to comply with the goals of the innovation auction (e.g. fixed market premium, technology-neutrality) or because of varying characteristics of eligible installation types (i.e. combined vs. single-technology installations). As a result, the InnAusV establishes different ceiling prices for single-technology and combined installations. For combined installations, the ceiling price for the fixed premium that is paid on top of market revenues amounts to 7.5 cents/kWh, while the ceiling prices is set at 3 cents/kWh for single technologies. Moreover, bidders need to submit a bid bond of 60 € per kW for combined installations and combined installations need to be realized within 30 months after the announcement of the award decision. Otherwise, their support right is withdrawn, and the bid bond is confiscated. For single technologies the same conditions apply as provided for in the EEG 2017 on the respective technology-specific auctions.

4 Evaluation of the auction results

The first auction for renewables in Germany was held in April 2015 as part of the pilot auction scheme for ground-mounted solar PV. The scheme comprised six auction rounds until December 2016 and attracted a lot of attention as well as bidding volume. In 2017, auctions to allocate sliding feed-in premiums were introduced for all major RES technologies. Up until November 2019, 38 RES auction rounds with a total volume of 16.25 GW took place in Germany, see Figure 5.[10] With this, Germany chooses a different approach compared to some other countries, which conduct less auction rounds but higher volumes per round. The high frequency of auctions is intended to increase planning security for the bidders and to ensure a continuous RES development.

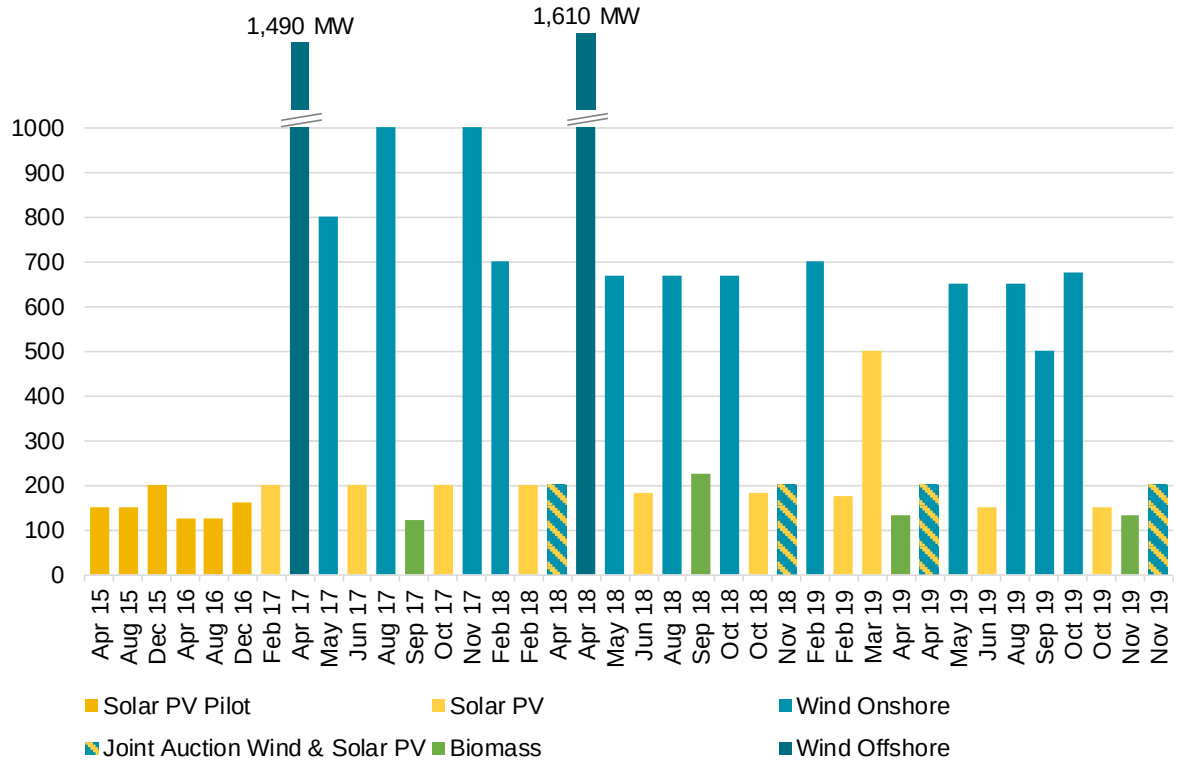

Figure 5: Auction rounds and volumes. Source: Navigant based on (BNetzA, 2019b).

Renewable auctions in Germany are largely technology-specific. However, also alternative auction formats like multi-technology auctions, cross-border auctions and innovative auctions have taken place or are foreseen (see section 3.1 for details). Most renewable auction rounds, 16 in total, targeted solar PV, followed by 12 auction rounds for onshore wind. In addition, there have been four biomass auction rounds, four multi-technology auctions for wind onshore and solar PV as well as two auctions rounds for offshore wind.

The auctioned volume for solar PV, the multi-technology auctions and wind offshore could be fully awarded. In contrast, some auction rounds for wind onshore and biomass were undersubscribed. The auctioned volume for these technologies could thus not be fully awarded, see Table 5.

[10] In addition to the national auctions, a first German-Danish cross-border auction took place in November 2016. The auction addressed solar PV and had a volume of 50 MW. For further information, please see the respective AURES report, available at http://aures2project.eu/2019/05/02/design-options-for-cross-border-auctions/.

Table 5: Number and volume of auctions

Auction type	Number of auction rounds	Auctioned volume [MW]	Volume of winning bids [MW]
Solar PV	16	3,050	3,169
Wind onshore	12	8,685	6,500
Multi-technology auction wind & Solar PV	4	800	825
Biomass	4	615	186
Wind offshore	2	3,100	3,100
TOTAL	38	16,250	13,780

In the following sections, the results of the auctions are evaluated. The focus is on the auctions for solar PV and onshore wind. For the evaluation, the results of the completed auction rounds are compared against the following policy goals that are set out in the EEG (see section 3.1 for details):

- increased renewable shares and annual capacity additions
- steady RES development
- cost-efficiency
- compatibility with the grid system
- maintaining a high actor diversity

4.1 Effectiveness

To evaluate the effectiveness of the auctions two indicators are of relevance: first, the relation between the volume of the bids and the auctioned volume, i.e. whether the auction attracts sufficient bids to ensure competition; and second, the realisation rate of successful projects. The following sections will analyse the effectiveness of the auctions for solar PV and wind onshore respectively.

4.1.1 Solar PV

To evaluate the effectiveness of the German auctions for solar PV, we first take a look at the awarded volume. In all solar PV auction rounds held so far, the volume of bids exceeded the auctioned volume (Figure 6). In total, a volume of 3 GW has been auctioned between April 2015 and October 2019, while the volume of bids accumulated to 9 GW. It was therefore easily possible to award the scheduled volumes. The threefold oversubscription also indicates that it likely would have been possible to award more volume.

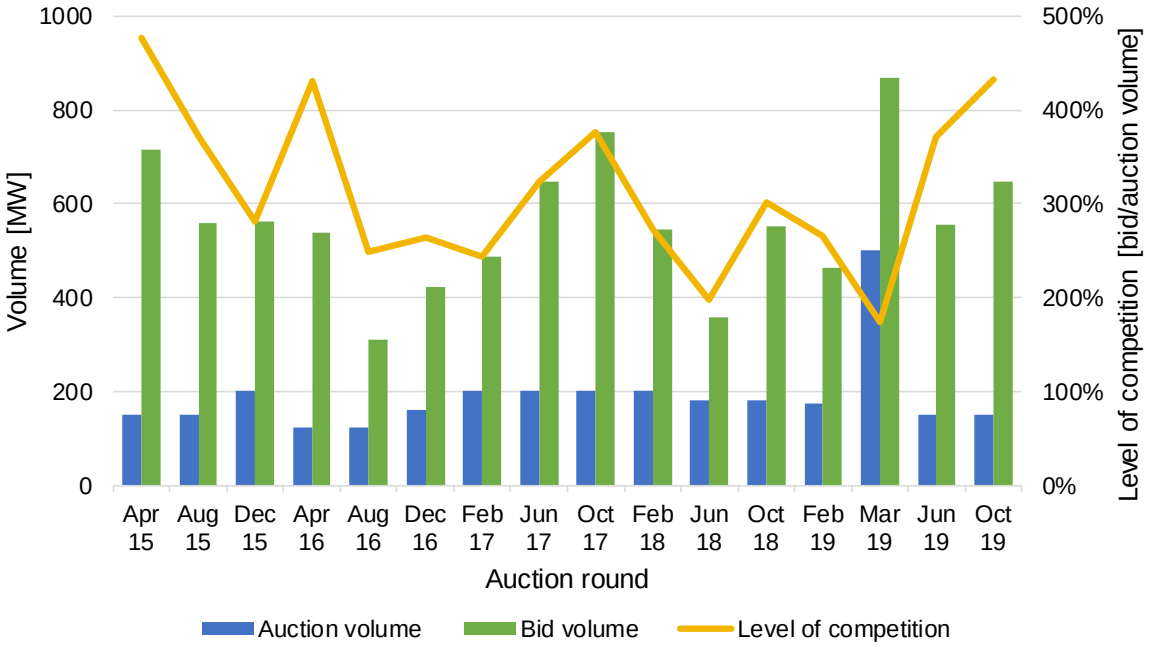

Figure 6: Solar PV auctions - volumes and level of competition. Source: Navigant based on (BNetzA, 2019b).

The level of competition, measured by the level of oversubscription (volume of bids divided by the auctioned volume), ranged from 177% to 477% in the auction rounds. Even when the auction volume was increased by around 250% compared to the other rounds in March 2019, the volume of bids exceeded the auctioned volume of 500 MW.

Thus, a sufficient number (and volume) of bids participated in the auctions for solar PV to fulfil the EEG capacity expansion plans. The next section analyses the realisation rates of the solar PV auctions.

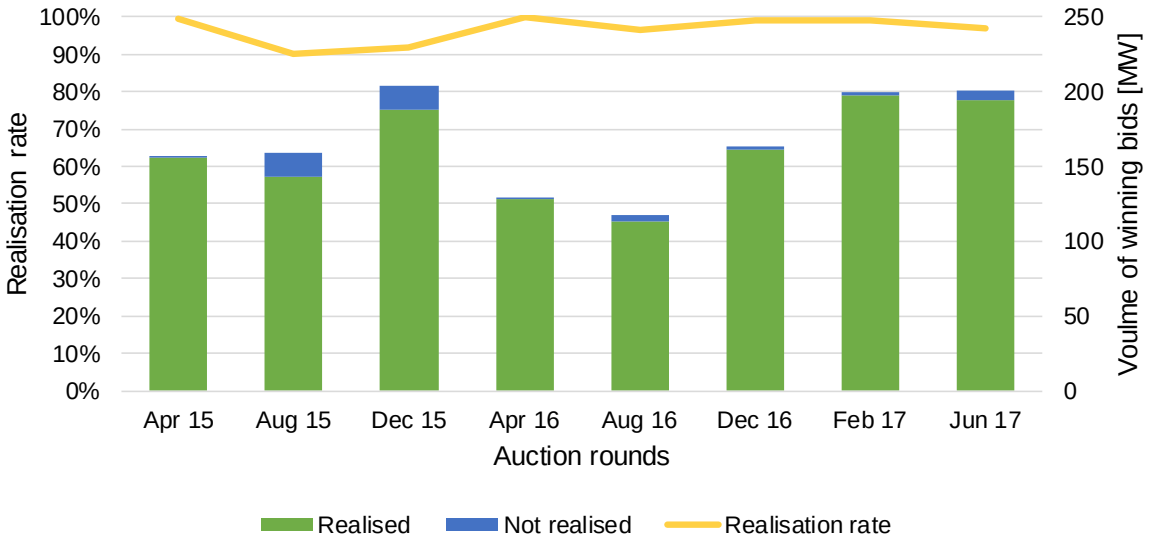

Figure 7: Solar PV auctions - realisation rates. Source: Navigant based on (BNetzA, 2019b).

Figure 7 depicts the realisation rates of the solar PV auctions from April 2015 to June 2017. These are the auction rounds with closed realisation periods and published realisation rates.[11] The realisation periods of the 2018 and 2019 auction rounds is still ongoing. As many projects are realised by the end of the individual realisation periods, preliminary realisation rates do not provide a sound basis to draw conclusions from and are thus not depicted here.

The realisation rates of the solar PV auction rounds with closed realisation periods are very high, ranging from 90 to 100% (Figure 7). A survey of bidders highlights, that in addition to effective penalties and pre-qualification requirements, the possibility to transfer the support right strongly contributes to the high realisation rates. 54 % of the respondents claimed to have used the possibility to realise the project within a different area. 40% of the surveyed stated, that without this option the realisation of the project would have been at risk. Another reason for high realisation rates, that is stated by the respondents is extended realisation periods with a proportionate penalty. (ZSW, Bosch & Partner, 2019).

Considering the sufficient volume of awarded bids in combination with the high realisation rates, the German solar PV auctions can be considered effective.

[11] The realisation period of the auction round of October 2017 is closed, too. However, updated realisation rates are yet to be published.

4.1.2 Wind onshore

The first three auctions for onshore wind in Germany saw high participation. These auction rounds in 2017, which included preferential rules for community energy projects (see section 3.2.1 for details), were on average oversubscribed by a factor of 2.7. Since then, the bid volume and level of competition decreased (Figure 8).

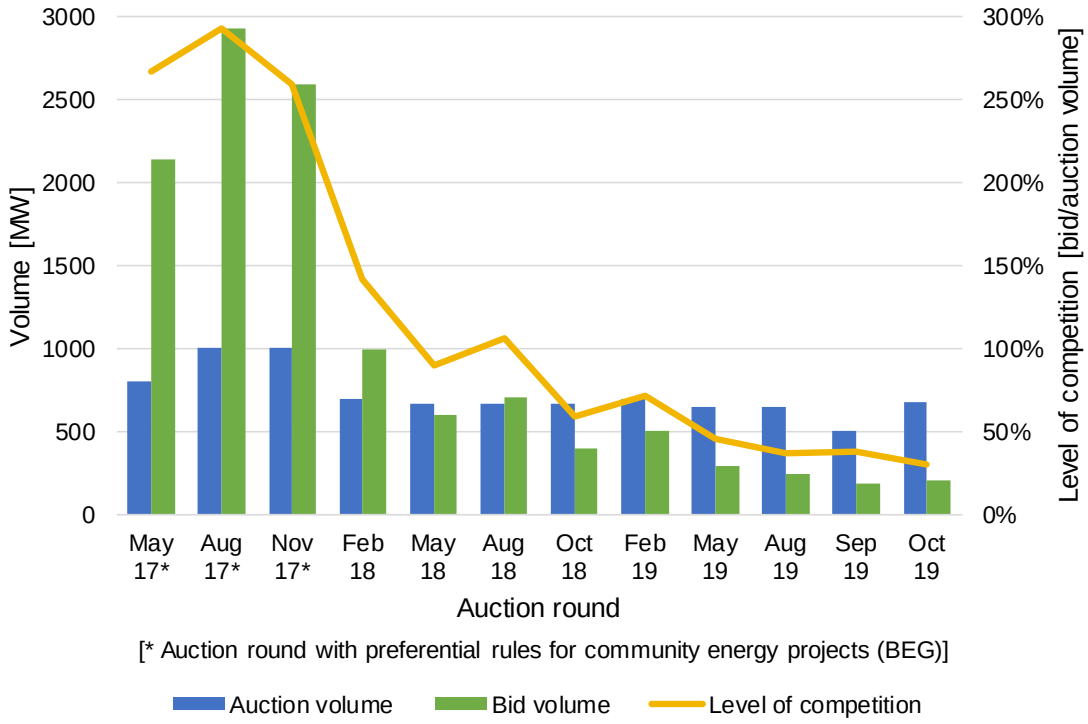

Figure 8: Wind onshore auctions - volumes and level of competition. Source: Navigant based on (BNetzA, 2019b).

From 2018 onwards, the preferential rules for community energy projects implemented in 2017 were put on hold. In line with this change, the bid volume declined significantly. The continuous decrease of bid volume led to a first undersubscription in May 2018. Despite slight increases in August 2018 and February 2019, the trend of a sinking bid volume and competition continues until today. In the latest auction in October 2019, only 30% (204 of 675 MW) of the available volume could be awarded.

Figure 9 shows the shares of community energy projects among the bid volume and the awarded volume. The strong effect that the preferential rules for community energy projects had on the auctions becomes visible once again. 71 to 88 % of the bid volume in 2017 and 95 to 99 % of the awarded volume was attributed to projects fulfilling the eligibility criteria for community energy projects (see chapter 3.2.1). In the following years, the respective shares decreased to under 20 %.

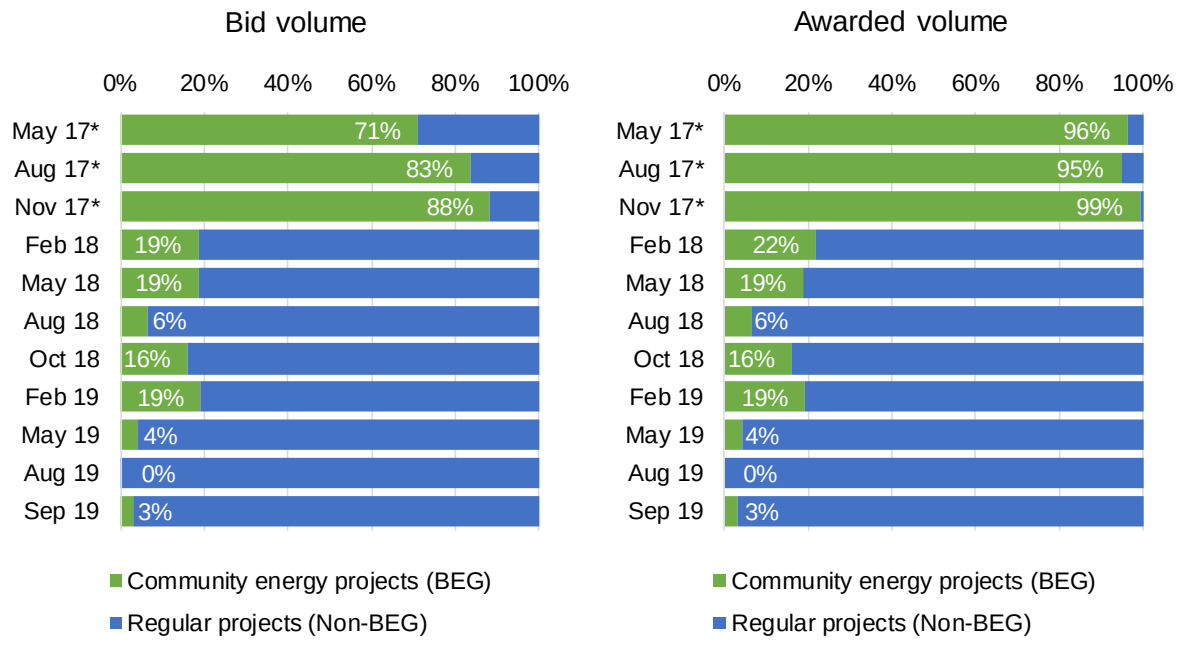

Figure 9: Share of community energy projects of the bid volume and awarded volume in the wind onshore auctions. Source: Navigant based on (ZSW, Bosch & Partner, 2019), (BNetzA, 2019b).

It is questionable to what extent the shareholder constructions that participated and/or were awarded in the auction rounds in 2017 constitute community energy projects in a strict sense. Through special shareholder constructions, larger players were able to develop projects that fall under the EEG definition of community energy projects. Especially project developers that have already specialised in supporting or jointly developing projects with citizens, made use of this loophole. An in-depth analysis of the auction round in May 2017 by Weiler et al. finds that for 80 % of the awarded capacity project planners have cooperated with natural persons in order to benefit from the preferential rules. Only 13 % of the awarded bids went to open community energy projects. Although some project developers are also involved in the management of these projects. (Weiler, Weber, & Holstenkamp, 2019)

In total, 6.5 GW of onshore wind capacity has been awarded between May 2017 and October 2019, while 8.7 GW were auctioned. Thus, there has been a lack of bids currently amounting to a total of 2.2 GW. There are several reasons for this gap. Among them are the following:

- The change from the administratively set support level to auctions led to strong capacity additions within the transition phase of the old system. In 2017, 5.5 GW of onshore wind capacity has been added. This is 2.7 GW above the targeted addition and likely led to a lack of matured wind projects able to participate in the first year(s) of the new auction system.
- German wind projects are increasingly being opposed with lawsuits. This does not only affect the realisation of projects but also the bidding phase (Deutsche WindGuard, ZSW, 2019).
- The strong competition in 2017 and related low prices in combination with the current situation of undersubscription and respective high prices lead to reviews of project realisations. In many cases, it is economically attractive for bidders to pay the penalty for not-realisation of their bid awarded in 2017 and enter a current auction with the same project to receive a (much) higher price.

Currently, there are no measures planned to close the increasing gap between the envisaged capacity additions and the awarded volume. This might change with the next amendment of the EEG, which is foreseen for 2020. Tackling the reasons for missing bid volume that lie outside the auction is likely the most effective way to increase competition in the onshore wind auctions.

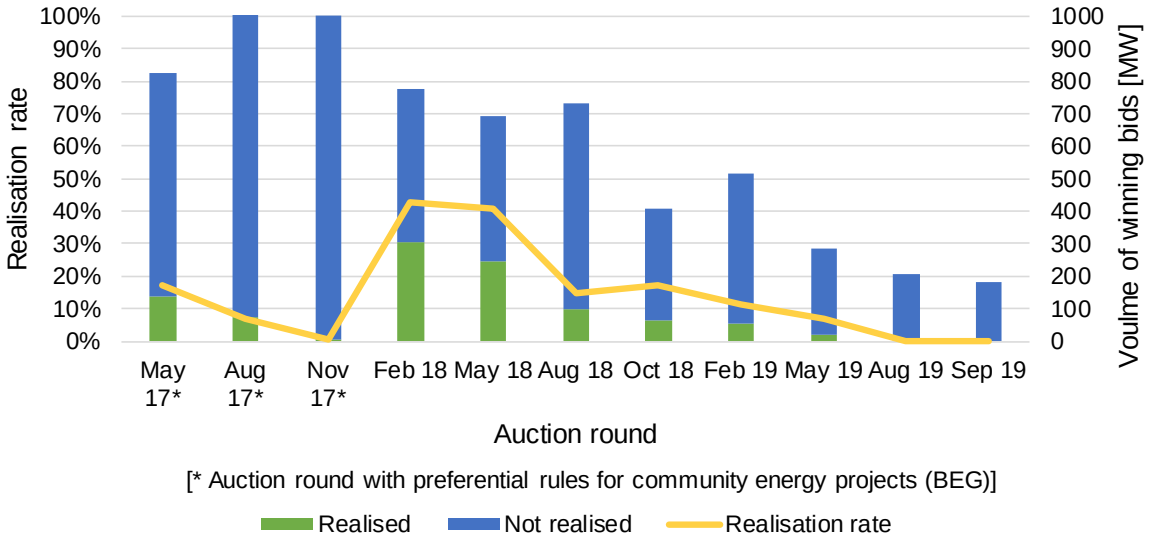

Figure 10: Wind onshore auctions - realisation rates. Source: Navigant based on (FA Wind, 2019b).

Figure 10 shows the realisation rates of the onshore wind auctions. So far, only a minor share of projects that were successful in the auctions has been realized. For almost all awarded projects, the realisation period is still open[12], therefore it is not yet possible to make a conclusive statement about the realisation rates of the onshore wind auctions. Less than 10 % of the volume awarded in 2017 has been realised yet. This is primarily due to the fact that community energy projects have 54 months to implement their projects. As a result, the realisation period for community energy projects from the auction round of May 2017 is open until November 2021. The implementation of the 2018 auction rounds has made significant progress. 43 % of the auction volume from February 2018 and 41 % of the volume of May 2018 have been realised until November 2019.

The following points summarise the evaluation of the onshore wind auctions regarding its effectiveness:

- Unsteady RES development: The latest annual capacity additions for onshore wind were 5.5 GW in 2017 (2.7 GW above target), 1.8 GW in 2018 (1 GW below target and under 400 MW until August 2019. The onshore wind auctions have, thus, missed the target of steady development and sufficient capacity additions.
- Insufficient competition: The structural undersubscription since May 2018 shows that it was not possible to attract sufficient competition
- Realisation rate: The effectiveness in terms of the realisation of awarded projects cannot be evaluated yet, due to open realisation periods for almost all auction rounds. However, there is a risk that a significant number of community energy projects will not be realized on the basis of their bid level awarded in 2017. Instead, they may pay the penalty for non-realisation of their awarded bid from 2017 and re-enter current auction rounds to achieve higher bids. In many cases this is financially more attractive than to realise the project with the awarded support level from 2017.

Considering these results, the German onshore wind auctions cannot be considered effective.

[12] A penalty-free realization is possible within 24 months from the publication of the award decision. The support payment is suspended after 30 months. 24 to 29 months after the award, a realisation is still possible, but implies a penalty. Community energy projects of the auction rounds of 2017 received 24 additional months on top of the regular realisation period. Thus, by November 2019 the realisation period closed for non-community energy projects of the May 2017 auction round. For non-community energy projects of August and November 2017 a realisation with penalty is still possible until February and May 2020 respectively. For all other auction rounds, the realisation period is still open.

4.1.3 Other auctions

The following sections present the results of the biomass and multi-technology auctions regarding their effectiveness. As the focus of this case study is on the technology-specific auctions for onshore wind and solar PV, which are at the core of the German renewable support scheme, the following analyses will be brief. Results for the innovation auction are not presented, as no auction round of this format has taken place so far. The results of the wind offshore auction are discussed in section 4.2.3.3.

4.1.3.1 Biomass

Until November 2019, four auctions for biomass took place in Germany. Despite the low auction volume, all four auctions were undersubscribed. Only 185 MW of the auctioned 615 MW could be awarded, this equals 38%. In contrast to the other auction formats, existing installations are allowed to participate in the biomass auction. They provide the largest share of bids within the auction.

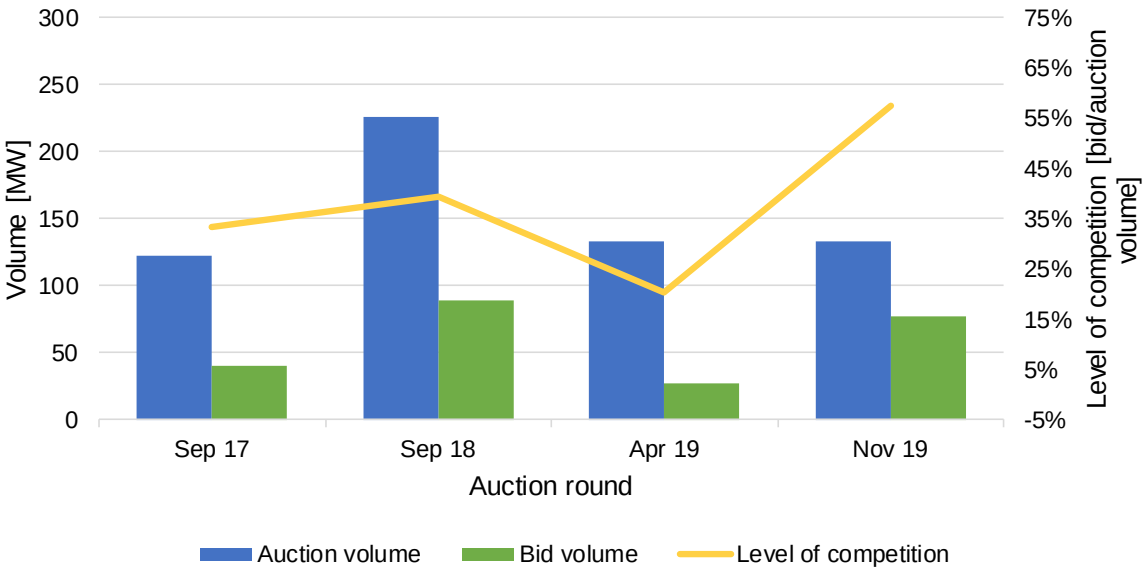

Figure 11: Biomass auctions - volumes and level of competition. Source: Navigant based on (BNetzA, 2019b).

It is to be expected that the number of bids in the next tenders will continue to rise as more and more existing biomass plants, whose current EEG support is running out, will be seeking follow-up funding (Fraunhofer IEE, 2019). However, under the current circumstances the biomass auction cannot be considered effective.

4.1.3.2 Multi-technology auctions

The four multi-technology auctions held so far saw good participation and were all oversubscribed. Altogether, the results are similar to the results of the technology-specific solar PV auctions due to the fact that solar PV constitutes the large majority of bids within the multi-technology auctions. So far, only solar PV projects were awarded in the multi-technology auctions. In the first auction, 18 out of 54 bids came from wind projects. Only one wind project placed a bid in the second auction and no single wind project participated in the latter two auction rounds.

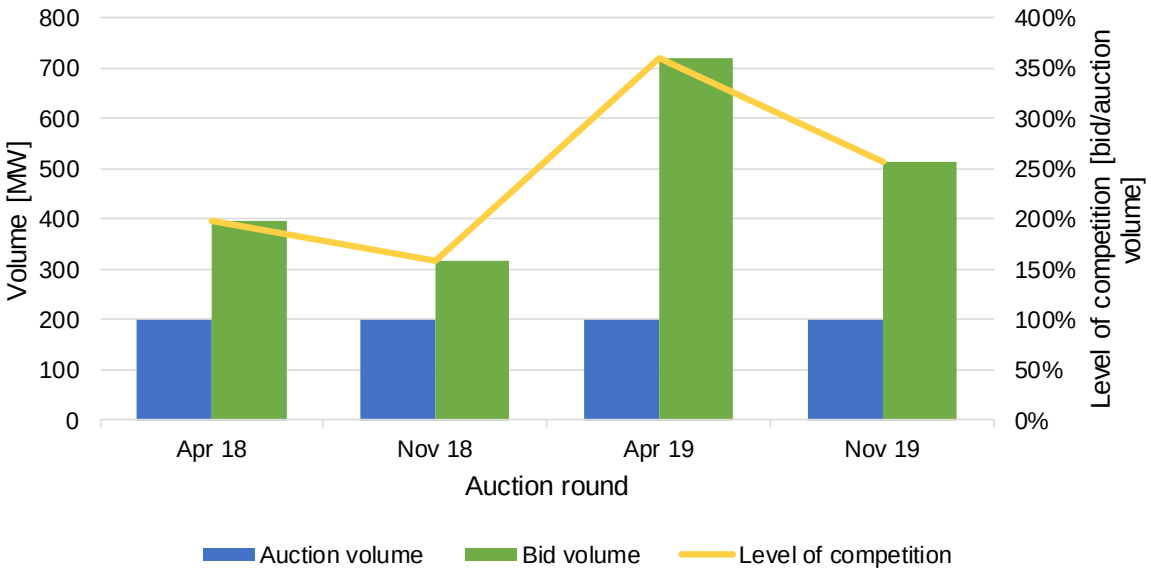

Figure 12: Multi-technology auctions - volumes and level of competition. Source: Navigant based on (BNetzA, 2019b).

4.2 Cost effectiveness

Cost effectiveness (or static efficiency) measures whether a predefined target can be fulfilled at the lowest possible overall costs. For auctions to be cost-effective, there needs to be a sufficient level of competition. In general, the level of competition is considered sufficient when the volume of bids exceeds the auctioned volume.

Two additional indicators support the evaluation. First, the weighted average price of successful bids can be compared to the ceiling price. And second, the development of the weighted average price of successful bids can be observed, also in relation to prices before the introduction of auctions.

4.2.1 Solar PV

Since the introduction of the auction scheme for solar PV, the weighted average price of successful bids went down substantially. Starting from 9.17 ct/kWh in the first auction in April 2015, we saw a decrease of 47% to 4.9 ct/kWh in the latest auction in October 2019. Prices went down continuously from 2015 to early 2018. The all-time low for Germany was reached in February 2018, with an average of 4.33 ct/kWh. Since then, prices slightly increased again. This development is likely related to the increase in auction volume that is a result of an increasing frequency of auction rounds since then.

The price decrease within the auction scheme can be considered a continuation of the significant price decrease of the past. The decrease within the auction scheme between 2015 and 2019 is not steeper nor more shallow compared to the decrease in the years before the auctions, but rather in line with the development.

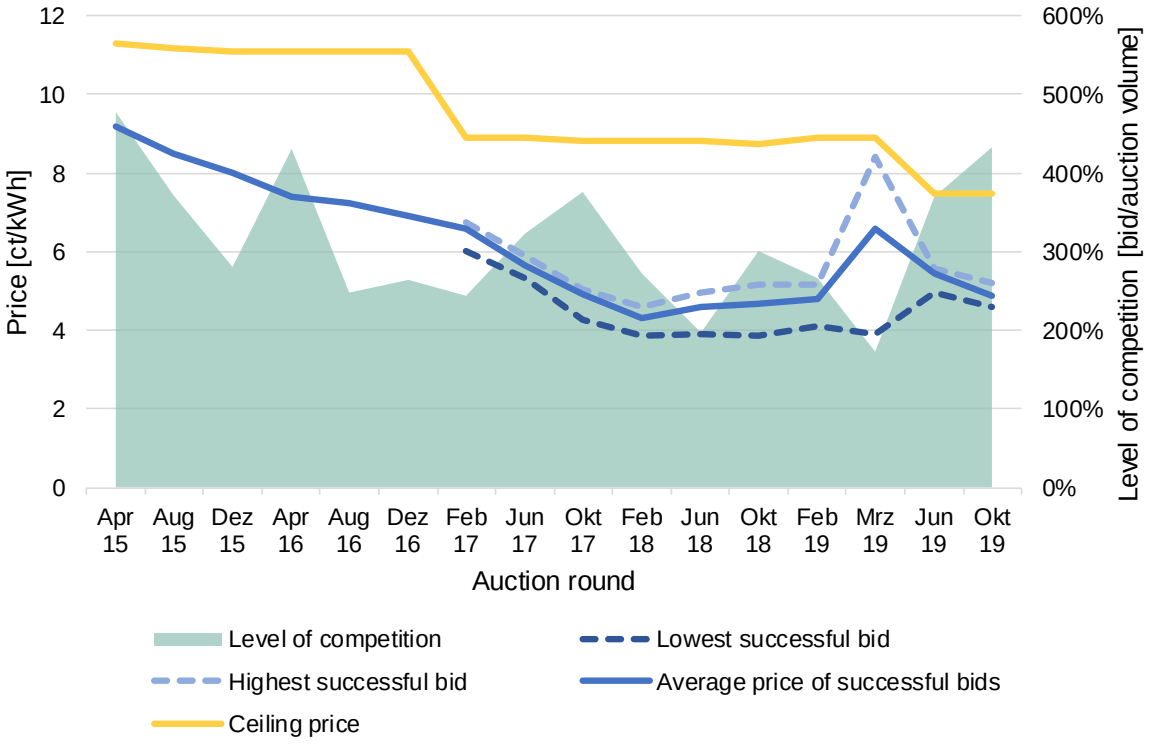

Figure 13: Solar PV auctions - price level. Source: Navigant based on (BNetzA, 2019b).

Overall, the price development in the solar PV auctions can be considered a success. Bringing down the prices by half within four and a half years, the auction scheme can be considered cost-effective.

4.2.2 Wind onshore

The high level of competition in the auction rounds of 2017 also led to a steep decrease in prices (Figure 14). From a weighted average price of the successful bids of 5.71 ct/kWh in May 2017, prices went down to 4.28 ct/kWh in August 2017 and 3.82 ct/kWh in November 2017.

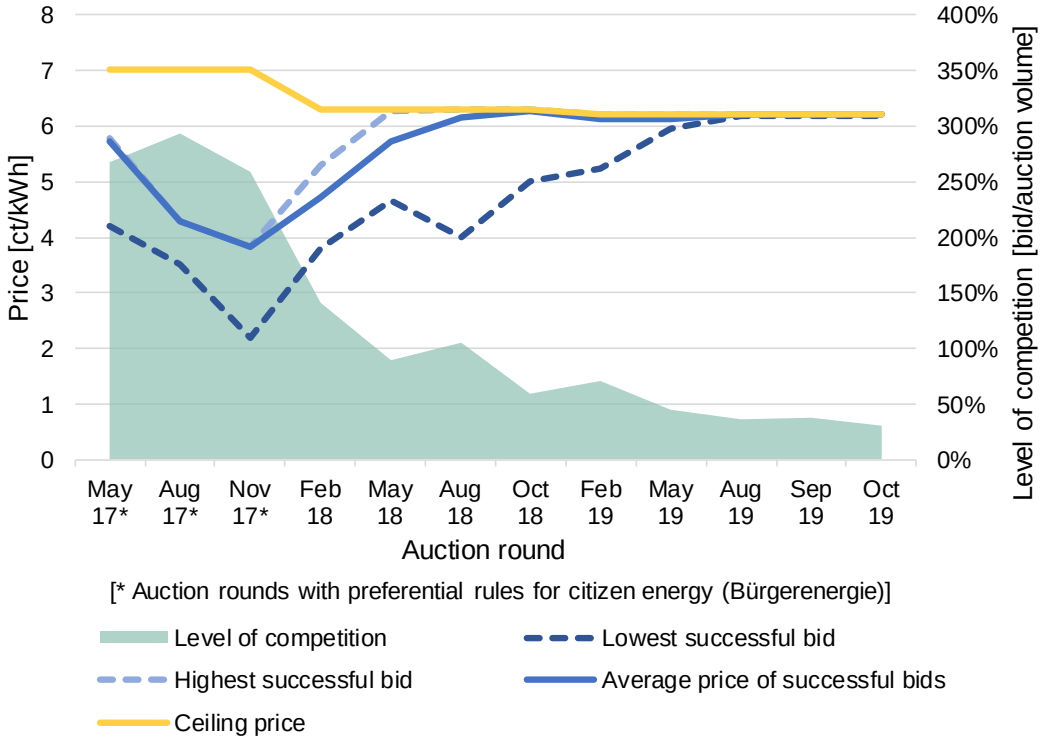

Figure 14: Wind onshore auctions - price level. Source: Navigant based on (BNetzA, 2019b).

The bid volume went down in the following auction rounds, and with it the level of competition. In May 2018 the auction was undersubscribed for the first time and since October 2018 all auction rounds for onshore wind have been undersubscribed. This situation is also reflected in the price development, as visible in Figure 14. After the decline of prices in 2017, the average price of successful bids has increased steadily, getting close to the ceiling price from August 2018 onwards and reaching it in August 2019.

The price development in 2017 showed, that the onshore wind auction has the potential to be cost-effective. However, considering the prevailing problems of missing bid volume and its effects on prices over the last years, the onshore wind auctions cannot be considered cost-effective.

The current stagnation of onshore wind in Germany is among other reasons due to acceptance issues, delays in the land-use planning, emerging minimum distance rules on state level and the structural organisation of lawsuits against wind projects. In addition, the announced change of the support mechanism towards auctions led to a peak in wind projecting and capacity additions at the end of the old administrative support scheme (5.5 GW in 2017 alone). This resulted in a depleted wind project pipeline and missing bid volume in the wind auctions. Combined with extended realisation rates for community energy projects in 2017, there has been a slump in the deployment of onshore wind.

This situation highlights that a (well designed) auction scheme is not the silver bullet to ensure continuous RE development, as an auction can only function with sufficient bid volume. Factors like a stable and affirming regulatory framework, acceptance among the citizens (especially among local residents) and the mitigation of boom and bust cycles through forward-looking regulation are crucial factors and a precondition for a successful auction scheme.

4.2.3 Other auctions

The following sections present the results of the biomass and multi-technology auctions regarding cost effectiveness. As the focus of this case study is on the technology-specific auctions for onshore wind and solar PV, the following analyses will be brief. Results for the innovation auction are not presented, as no auction round of this format has taken place so far.

4.2.3.1 Biomass

Figure 15 depicts the price level of the biomass auctions. The lack of competition is clearly visible, especially in the first two auction rounds where the average price of awarded bids approached the ceiling price. In the third and fourth auction, the average price of successful bids decreased slightly. However, in all auction rounds the highest successful bid equaled the ceiling price.

Analyses show, that the electricity generation costs of many biomass plants lie above the ceiling price of the auction. Thus, it is no surprise that the participation in the auction is limited (Fraunhofer IEE, 2019).

Due to the limited number of auctions that have taken place so far, a conclusive judgement regarding the cost-effectiveness of the auction scheme is difficult.

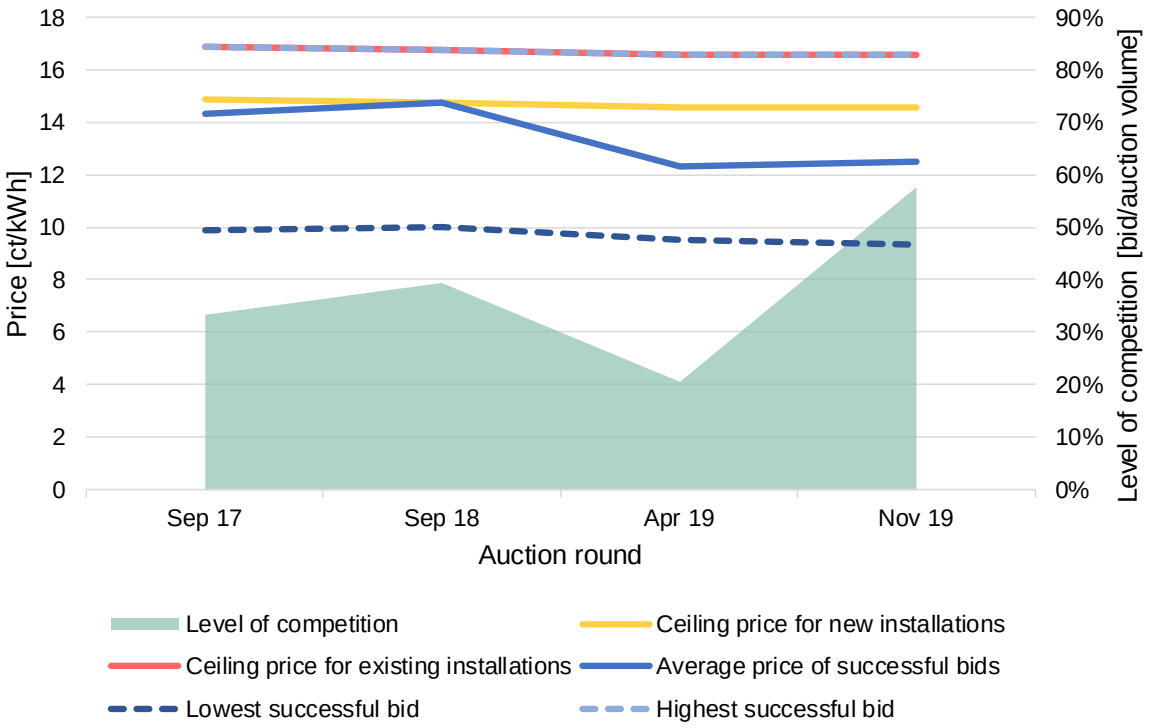

Figure 15: Biomass auctions - price level. Source: Navigant based on (BNetzA, 2019b).

4.2.3.2 Multi-technology auctions

Due to a healthy level of competition among solar PV bidders, the average prices of successful bids in the multi-technology auction remained well below the ceiling price. Thus, the multi-technology auctions can be considered cost-effective.

The average price of successful bids increased slightly from April 2018 to April 2019 but remained on a constant level in general. Based on its participants, the multi-technology auction rounds can be interpreted as additional solar PV auctions. Therefore, it is no surprise that the price level is comparable to the price level in the technology-specific solar PV auction. It seems that bidders use the solar PV results as orientation regarding the level of competition and price.

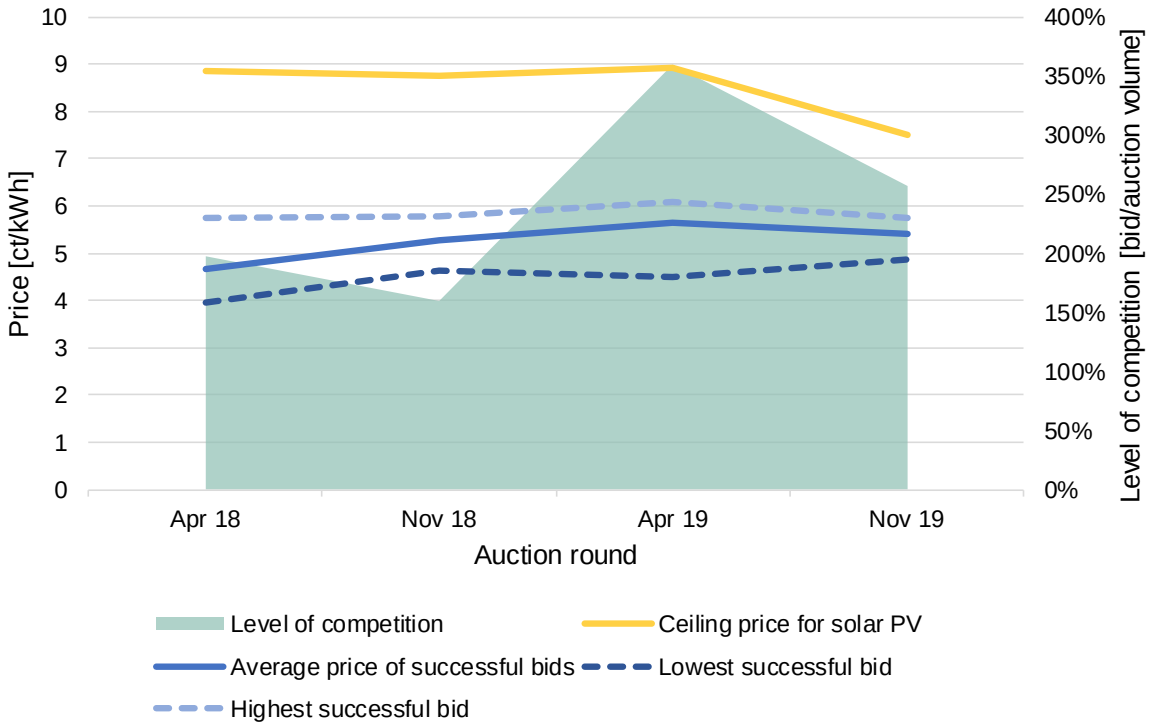

Figure 16: Multi-technology auctions - price level. Source: Navigant based on (BNetzA, 2019b).

As the German regulatory agency (BNetzA) states in their press releases accompanying the publication of the results of the multi-technology auctions, the Distribution Network Component (VNK, Verteilernetzkomponente)[13] had little to no influence on the auction results. Most bids are within the Distribution Network Expansion Areas (VAG, *Verteilernetzausbaugebiete*). However, the applied malus did not change the order of awarded projects for most cases. In a single case within the first auction round, the award of a wind project has been hindered by the VNK. (BNetzA, 2018a), (BNetzA, 2018b)

Even with the high frequency of solar PV and multi-technology auctions, the individual auctions are oversubscribed. This shows that more solar PV capacity could be auctioned in Germany.

[13] The VNK intends to limit capacity additions in districts in which installed renewable energy capacities exceed peak load. For the evaluation of bids, a malus is added to bids within the respective districts, thereby worsening the bid by a small amount (see section for details 3.2.3.2).

4.2.3.3 Wind offshore

So far, two auction rounds with an overall auction volume of 3.1 GW were held in April 2017 and 2018 as part of the transition period (see section 3.2.3.3 for details). The goal of these auctions was to allocate grid connection capacity and support payments to pre-developed projects, so-called "existing projects". Thereby accounting for the fact that several projects had already obtained permits for the construction of offshore wind parks at certain sites. Thus, this model created competition between pre-developed projects at predetermined sites.

Table 6 provides an overview of the awarded projects of the two held auction rounds. In April 2017, four projects with a total volume of 1.49 GW were awarded. Three of the four bids were zero subsidy bids, which came as a surprise. This means that the bidders saw no need to secure a support payment but participated in the auction to ensure a grid connection which is provided free of charge to successful bids. In the second auction round of April 2018, six projects with a total volume of 1.61 GW were awarded. Also, in this round, at least two zero subsidy bids appeared, while two award prices were not made public.

Table 6: Wind offshore auctions - overview of awarded projects

Project	Awarded volume [MW]	Award price [ct/kWh]	Auction round
Gode Wind 3	110	6	April 2017
OWP West	240	0	April 2017
Borkum Riffgrund West 2	240	0	April 2017
He Dreiht	900	0	April 2017
Gode Wind 4	132	9.8	April 2018
Borkum Riffgrund West 1	420	0	April 2018
Baltic Eagle	476	6.5	April 2018
Wikinger Süd	10	0	April 2018
Kaskasi	325	Not public	April 2018
Arcadis Ost	247	Not public	April 2018

The zero subsidy bids of some bidders can be interpreted as a bet on future market conditions. Two major factors are of relevance regarding the realisation of the projects: first, increasing electricity market values, and second, technological developments towards much larger wind turbines. In addition, the penalty for non-realization was relatively low. At present, the awarded bidders appear to be planning to realise the projects, but it is also a realistic scenario that individual projects will not be realised.

5 Conclusion

The experiences made with renewable auctions in Germany are mixed. The results of the various German RES auction formats highlight the fact that the level of competition is a key success factor for renewable auctions. While the auctions for solar PV and offshore wind saw sufficient competition and provided satisfying auction results, the auctions for onshore wind and biomass suffer, for different reasons, from a lack of bid volume.

The approach of a high frequency of auction rounds combined with comparatively low auction volume per round was chosen to keep disruptions of the transition towards an auctions'-based system limited, support continuous RES deployment, reduce uncertainty in the industry and thereby mitigate boom and bust cycles that could negatively affect the development of the RES sector. However, this approach was only partially successful. While deployment of solar PV has been steady over the past years, the onshore wind industry has seen a boom in the final phase of the old (pre-auction) system and has struggled so far under the auction system. The task to align envisaged RES capacity additions and bid volumes while maintaining a sufficient level of competition proves to be challenging.

The case of solar PV auctions in Germany has proven that auctions can be an effective tool to award support in a competitive manner, drive down support costs and at the same time ensure steady RES deployment with high realisation rates. Regarding the consistent oversubscription, it is likely that more volume could be awarded. However, an increase of auction volume should be implemented and monitored carefully, to avoid risks related to missing bid volume. As the auction rounds for solar PV in spring 2019 show, the price level of the auctions reacts sensitively to an increase of the auction volume.

The effectiveness of onshore wind auctions, on the other hand, has been hampered by two challenges. The first challenge was related to the attempt to balance disadvantages of community energy projects in the auction by defining differing conditions for their participation in 2017 (in this case material prequalification and the realization period for community energy projects). The introduction of preferential rules has produced unforeseen negative impacts. The experience of 2017 shows that differing conditions of participation for a subgroup of bidders can have a strong effect on the auction in general and that forecasting the reaction of the bidders to such rules is challenging. Thus, introducing diverging conditions for different actors within the auction comes at a risk.

The other challenge relates to a missing bid volume. Reasons for the lack of bids are not directly related to the auction scheme or the auction design itself but are a result of the transition from the old support mechanism to auctions and of increasing challenges in the pre-development of projects. The announced change of the support mechanism towards auctions led to a peak in wind projecting and capacity additions at the end of the old administrative support scheme (5.5 GW in 2017 alone). This resulted in a depleted wind project pipeline and missing bid volume in the first years of the auction scheme for onshore wind. Combined with extended realisation rates for 2017 community energy projects and current challenges in the pre-development of projects due to acceptance issues, delays in the land-use planning, emerging minimum distance rules on state level and lawsuits against wind projects, there has been a slump in the deployment of onshore wind which started in the middle of 2018 and continues until today.

Similar to the wind onshore auctions, the auctions for biomass are undersubscribed. However, the reasons differ. As opposed to wind onshore and solar PV installations, which have very low operational costs, biomass plants depend on feedstock with limited availability and have high operational costs. Therefore, the development of new biomass plants is limited. Existing installations can participate in the auction to secure follow-up support and take up the majority of awarded bids. However, their participation is limited as well, as the ceiling price of the auction is not attractive for them under current conditions. The current EEG support of a large share of existing installations will run out within the next years. Thus, it is likely that the auctions will attract more participation in the future.

The offshore wind auctions have led to a very low average bid level, in many cases bids of 0 ct/kWh, which exceeded all expectations. Whether the awarded projects will be realised is to be seen in a few years' time. The awarded zero bids provide an outlook on a system with matured RES technologies which are able to refinance their investments on the market.

Although the EEG aims to ensure steady RES development and provides forward-looking capacity addition

plans, the outlook regarding the details of the different auction format is uncertain. The latest EEG amendments have brought significant changes and the amendment foreseen for 2020 will likely bring further changes.

References

Agora Energiewende and Sandbag (2019). *The European Power Sector in 2018. Up-to-date analysis on the electricity transition.* Retrieved from https://www.agora-energiewende.de/fileadmin2/Projekte/2018/EU-Jahresauswertung_2019/Agora-Energiewende_European-Power-Sector-2018_WEB.pdf

BMWi (2019). *Energiedaten: Gesamtausgabe.* Retrieved from https://www.bmwi.de/Redaktion/DE/Artikel/Energie/energiedaten-gesamtausgabe.html

BNetzA (2018a). *Pressemitteilung - Ergebnisse der gemeinsamen Ausschreibung von Wind- und Solaranlagen.* Retrieved from https://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Allgemeines/Presse/Pressemitteilungen/2018/20180411_GEMA.pdf?__blob=publicationFile&v=3

BNetzA (2018b). *Pressemitteilung - Ergebnisse der zweiten gemeinsamen Ausschreibung von Wind- und Solaranlagen.* Retrieved from https://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Allgemeines/Presse/Pressemitteilungen/2018/20181119_gema18-2.pdf?__blob=publicationFile&v=2

BNetzA (2019a). *Monitoringbericht.* Retrieved from https://www.bundesnetzagentur.de/DE/Sachgebiete/ElektrizitaetundGas/Unternehmen_Institutionen/DatenaustauschundMonitoring/Monitoring/monitoring-node.html

BNetzA (2019b). *Ausschreibungen für EE- und KWK-Anlagen.* Retrieved from https://www.bundesnetzagentur.de/DE/Sachgebiete/ElektrizitaetundGas/Unternehmen_Institutionen/Ausschreibungen/Ausschreibungen_node.html

Deutsche WindGuard, ZSW (2019). *Vorbereitung und Begleitung bei der Erstellung eines Erfahrungsberichts gemäß § 97 Erneuer-bare-Energien-Gesetz. Teilvorhaben II e): Wind an Land.* Retrieved from https://www.erneuerbare-energien.de/EE/Redaktion/DE/Downloads/bmwi_de/deutsche-windguard-vorbereitung-begleitung-erfahrungsbericht-eeg.html

FA Wind (2019a). *Hemmnisse beim Ausbau der Windenergie in Deutschland.* Retrieved from https://www.fachagentur-windenergie.de/fileadmin/files/Veroeffentlichungen/Analysen/FA_Wind_Branchenumfrage_beklagte_WEA_Hemmnisse_DVOR_und_Militaer_07-2019.pdf

FA Wind (2019b). *Die ersten 1.000 MW mit Zuschlag aus der Ausschreibung sind am Netz.* Retrieved from https://www.fachagentur-windenergie.de/fileadmin/files/Veroeffentlichungen/Analysen/FA_Wind_1000_MW_mit_Zuschlag_in_Betrieb12-2019.pdf

Fraunhofer IEE (2019). *Vorbereitung und Begleitung bei der Erstellung eines Erfahrungsberichts gemäß § 97 Erneuerbare-Energien-Gesetz. Teilvorhaben II a: Biomasse.* Retrieved from https://www.erneuerbare-energien.de/EE/Redaktion/DE/Downloads/bmwi_de/fraunhofer-iee-vorbereitung-begleitung-eeg.html

Weiler, K., Weber, A., & Holstenkamp, L. E. (2019). *Kurzbericht zur Akteursstruktur der Ausschreibung für Windenergie an Land vom Mai 2017* . Retrieved from https://www.umweltbundesamt.de/sites/default/files/medien/372/dokumente/20190822_kurzbericht_ausschreibungsrunde_mai-2017.pdf

ZSW, Bosch & Partner (2019). *Vorbereitung und Begleitung bei der Erstellung eines Erfahrungsberichts gemäß § 97 Erneuerbare-Energien-Gesetz. Teilvorhaben II c: Solare Strahlungsenergie.* Retrieved from https://www.erneuerbare-energien.de/EE/Redaktion/DE/Downloads/bmwi_de/zsv-boschundpartner-vorbereitung-begleitung-eeg.html

AURES II is a European research project on auction designs for renewable energy support (RES) in the EU Member States.

The general objective of the project is to promote an effective use and efficient implementation of auctions for RES to improve the performance of electricity from renewable energy sources in Europe.

www.aures2project.eu

AURES II has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817619