



Renewable Energy Auctions in Denmark: A Case Study on Results and Lessons Learnt

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Renewable Energy Auctions in Denmark

A Case Study on Results and Lessons Learnt





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Executive Summary

This report describes in detail all auctions for renewable energy support that have taken place in Denmark since 2016: multi-technology tenders for wind and solar in 2018 and 2019, a PV solar tender for projects with a capacity less than 1 MW in 2018, and the upcoming wind offshore auction for the Thor project. Moreover, the report contains a short summary of the auctions from before 2016 that had already been described in detail in previous AURES reports.

The report then assesses the described auction schemes in terms of actor variety, social acceptability, effectiveness, cost effectiveness (efficiency), realisation rates and ownership changes. Significant reductions in support levels have been achieved over the auction rounds in the recent past. There are only few players that have won in the auctions. A citizen-based consortium failed to pre-qualify for the Nearshore Tender.

With the introduction of the multi-technology tender in 2018, the Danish government has for the first time in its energy policy history taken a technology-agnostic approach in the offering of support. The first round of the multi-technology auctions have shown strong competition between the technologies, with winning and losing bids from both wind onshore and solar PV. This was also the case in the second multi-technology auction in 2019 – this time, also bids combining onshore wind and solar capacity in hybrid projects were presented and successful. The 2019 auction was the first auction in Denmark that was undersubscribed, while it also resulted in the lowest prices so far.

The report also describes a special arrangement in Denmark, where project owners must offer a certain amount of the project (20%) to the local citizens. The scheme has been amended over time, after some challenges became apparent.

The report concludes with a short listing of lessons learnt from the recent auctions for renewable support in Denmark.

1 Summary Case Study 2015

This first chapter summarises the AURES Case Study on Denmark published in December, 2015 [1], which details the five wind offshore auctions that were completed at that time: Horns Rev 2, the two tenders for Rødsand 2, Anholt and Horns Rev 3. In addition, this summary addresses the Pilot Solar Energy Auction carried out in 2016 that was presented in another AURES report in 2016 [2]. The Nearshore areas and Kriegers Flak offshore wind auctions (which also had been part of the AURES Case Study from 2015, but had not been fully completed at that time) are presented in further detail in this report, alongside the newly added auctions: multi-technology tenders for wind and solar in 2018 and 2019, the PV solar tender for projects with a capacity less than 1 MW completed in May 2018, and the upcoming Offshore Thor auction.

1.1 The first Offshore Wind Energy Auctions in Denmark

Until 2015, offshore wind auctions in Denmark had been single-item, technology specific auctions for projects with predefined size and location. **All auctions were pay-as-bid for sliding premium tariffs (two-sided Contract-for-Differences)** for a fixed amount of produced electricity (corresponding to approx. **12-15 years** support duration). Support payments were financed through a Public Service Obligation (PSO) charge on the electricity consumer bill.

Static sealed bid auctions were used in all cases. In the cases of Horns Rev 2, Horns Rev 3, and the first try of Rødsand 2, there were two rounds with a “first indicative offer” and a “best and final offer”. Meetings were held after the indicative offer with the bidders individually. The negotiations were primarily held to determine the conditions for the final bidding round. The auction for Anholt and the second try of Rødsand 2 consisted only of one final bidding round.

The first offshore wind energy auction carried out in Denmark was Horns Rev 2. It was announced in July 2004, and the final tender specifications were published 3 months later in October 2004. The final offers were received in February 2005, 8 months after the first announcement. Besides, the size of the project auctioned was 200 MW covered by one single bidder. The auction resulted in a contracted CfD strike price of 51.8 øre / kWh (approx. €6.9 cent / kWh) and the support will be paid for 10 TWh production (ca. 8-10 years). The winner was DONG Vind A/S, a subsidiary of the company today known as Ørsted.

In November 2004, while the Horns Rev 2 auction was being carried out, the conditions for the Rødsand 2 tender were announced. The tender resulted in a contracted price of 49.9 øre / kWh (approx. €6.7 cent / kWh) and the support was supposed to be paid for 10 TWh production. The winner of the first try was a consortium of E.ON Vind Sverige AB, Energi E2 A/S and DONG Vind A/S (Ørsted). However, the project had to be retendered after the winning consortium withdrew from the contract. The auctioned size was again 200 MW covered by one single bidder and the final bids were received in May 2006, 18 months after the first announcement. Both the first announcement and the final tender conditions were announced in February 2008, and the final bids were handed in two months later in April 2008. The contracted price this time was 62.9 øre / kWh (approx. €8.5 cent / kWh), significantly higher than the first try. The support will be paid for 10 TWh production. The winner this time was E.ON Vind Sverige AB who was also part of the first winning consortium.

One year later in April 2009, the first announcement for Anholt was presented along with the final tender conditions. The size of the auctioned project was 390-400 MW covered by one single bidder. After 12 months, in April 2010, the final bids were given, resulting in a contracted price of 105.1 øre / kWh (approx. €14.1 cent / kWh). The support would be paid for 20 TWh production. The winner of the Anholt auction was DONG Energy A/S (Ørsted).

Subsequently, the first announcement for the Horns Rev 3 tender was presented in December 2013, and the final tender specifications in June 2014. The size of the project auctioned was 390-410 MW and final bids were given in February 2015. The tender resulted in a contracted price of 77 øre / kWh (approx. €10.3 cent / kWh). It took 14 months from the first announcement to the final bids. In addition, the support was due to cover 20 TWh production. The winner was Vattenfall Wind Power A/S.

All auctioned Danish offshore wind projects have been realised at the contracted sizes. However, the first auction of Rødsand 2 did not lead to realisation as mentioned before. In regard to delays, the first two auctions (Horns Rev 2 and Rødsand 2) had the schedule for construction as part of the bidding offer and not previously determined by the contracting authority. The contracted and actual realisation dates were:

- Horns Rev 2: scheduled for 31.12.2009, realized on 17.09.2009;
- Rødsand 2: scheduled for 01.01.2010 (1st try) and for 30.09.2011 after the re-tender, realized on 15.08.2010.

For Anholt and Horns Rev 3 the realisation date was scheduled by the contracting authority and delay penalties were introduced. The contracted and actual realisation dates were:

- Anholt: scheduled for 31.12.2013, realised on 19.06.2013;
- Horns Rev 3: scheduled for 31.12.2020, realised in Aug 2019.

In the case of Rødsand 2 a project delay of 20 months assuming the first scheduled realisation date occurred, due to the withdrawal of the first winning consortium from the contract. They justified their withdrawal with heavily increased prices for turbines by the (at that time) only two suppliers of large offshore turbines (Vestas and Siemens). In this case, it can be discussed if underbidding took place, also considering the fact that the winning party of the re-tender was also part of the winning consortium in the first auction.

The following key lessons, which are presented more detailed in [1], were learnt during the analysis of the previously mentioned offshore wind auctions:

- High penalties and inflexible auction design can lead to low participation and high bidding prices;
- Open dialogue between investors and contracting authorities can lead to improved results;
- Penalty design can be improved taking investor considerations into account: a penalty scheme that reduces the duration of support and not the support level is seen as a relief by investors, as it, for example, puts them in a better position towards loan-giving banks;
- In the timing of the auction, simultaneity with other international auctions should be avoided;
- An early clarification of transferability options regarding the support concession increases investor security. They should preferably already be stated in the tender descriptions.

1.2 Pilot Solar Energy Auction Undertaken in 2016

In July 2016, the Danish and the German governments signed a cooperation agreement on the mutual opening of auctions for PV installations. It set the framework for two pilot auction rounds to be held in Denmark and Germany in 2016 allowing for cross-border participation of installations for the first time. The Danish process was designed as a multi-item, pay-as-bid, capacity based auction.

It was a partially open auction where the maximum total capacity accepted in the tender was 22.399 MW in Denmark and 4.799 MW for projects installed in Germany. The deadline for the final bids was in December 2016, resulting in 36 bids for a total of 79.45 MW. The auction resulted in 9 winning projects: three projects of 2.4 MW (Alternating Current (AC) rated capacity) from each of the three winning companies, with a total capacity of 21.6 MW (AC). The three winning companies belong to the parent company *Better Energy* and presented the same bid for each of the projects. Actually, these 9 projects can be divided into two parent projects both of them situated in Denmark: Project Vollerup (25 MW Direct Current (DC) rated capacity) which was grid connected on 4 Dec 2018 and Project Nees (7 MW DC) which was connected to the grid on 5 November 2018. The agreed support is consisted of a fixed premium of 12.89 Danish øre per kWh for 20 years for each of the projects. Although the tender was open to Germany, no offers were received regarding installations in the country.

2 Characteristics of Auctions for Renewable Energy Support in Denmark

This chapter presents the main characteristics of the different electricity auctions carried out in Denmark. It also includes detailed information about the important dates of each auction, the capacity auctioned and the support received by each winner.

Table 1: Characteristics of Auctions in Denmark

Characteristics	Description
Country Characteristics	<p>Denmark has a population of approx. 5.8 million and the annual electricity consumption in 2017 was 31.3 TWh. without taking into account the grid losses. In the future, electricity consumption is expected to increase significantly due to the electrification of the transport and heat sectors, as well as the construction of new data centres [3]. The current peak load is around 6.5 GW. Denmark is highly connected to its neighbours via international transmission lines, enabling the integration of very high shares of fluctuating renewable energy.</p> <p>Denmark is one of the leading countries in the world in terms of deployment of new renewable energies (non-hydro). The total electricity production installed capacity is around 15 GW. From this amount, 8 GW consists of renewable energy [4], including 6 GW of wind energy and 1 GW of solar energy. Wind energy covered more than 40% of the electricity consumed in 2017.</p> <p>According to [3], the total share of renewables (RES) is expected to be 39.8% in 2030 in the absence of any new initiatives ('frozen policy' scenario). This would result in a shortfall of 10.2 percentage points relative to the goal of at least 50% renewables in 2030.</p> <p>However, the Danish government signed an energy agreement with the unanimous support of all parties in the Danish parliament on the 29th of June, 2018 [5]. This agreement includes support to build 3 offshore wind farms up to 2400 MW, solar auctions for PV plants lower than 1 MW, multi technology auctions for solar and wind power, support to biofuels and a reduction in energy taxes. The main goals for the future are:</p> <ul style="list-style-type: none"> • By 2020, Denmark is aiming to supply 30% of final energy consumption with energy from renewable sources • By 2030, 100% of the electricity consumption should be produced by renewable energy. • By 2030, 55% of total energy consumption should be produced by renewable energy. <p>Denmark plans to be a green low carbon society by 2050. The Danish government elected in May 2019 has put forward plans on a 70% reduction of greenhouse gas emissions by 2030 [6].</p>

Market characteristics	<p>Denmark is part of the power exchange Nord Pool, divided in two price zones DK1 (West) and DK2 (East). Several different instruments have been used for the promotion of renewable energy, including feed-in tariffs, tax incentives and sliding premiums.</p> <p>Auctions for renewable support have been used for PV solar farms, offshore and near shore wind farms. In addition, from 2018 multi-technological auctions are taking place, allowing onshore, offshore, and solar energy to compete among them, denoted by the government as "Technology Neutral" tenders.</p> <p>Previously, the support mechanisms included administratively defined sliding premiums (or, more precisely: two sided contracts for differences), and fixed premiums. The energy agreement from 2018 identifies fixed premiums as the support mechanism for the PV Solar and multi-technology tenders, with the reasoning that it allows for a more predictable support level.</p>
Name of auction scheme	<p>Two auction schemes have been used so far:</p> <ul style="list-style-type: none"> • "Udbud efter forhandling" which is a public auction with prequalification round. • "Offentligt udbud" which is a single-stage public auction.
Objectives	<p>The general objectives of the auctions are to efficiently achieve the ambitious renewable energy sources (RES) targets, by letting the market determine the exact level of support required.</p>
Contracting Authority	<p>Danish Energy Agency (Energistyrelsen)</p>
Main features	<p>Until now, offshore wind auctions have been single-item, technology specific auctions for projects with predefined size and location. All energy auctions are pay-as-bid. For the nearshore areas, a multi-site tender was introduced, with a maximum capacity of 350 MW distributed over 6 predefined areas. All these auctions provided sliding premium tariffs, corresponding for a fixed amount of produced electricity corresponding to 12-15 years of support, approximately.</p> <p>Multi-item tenders have been held in the pilot auction for Solar PV, the small-scale PV auction, and the multi-technology auctions for onshore wind, solar PV and nearshore wind. These auctions provided a fixed premium in øre per generated kWh added on top of the electricity price. This support is granted for 20 years, starting from the time of grid connection. In addition, price premiums will not be granted for electricity production during hours when the spot price for electricity is not positive. This time will not be part of the 20 years of support duration.</p> <p>Most auction volumes were based on a capacity limit, with the exception of the multi-technology tenders and the small-scale solar PV tender. The multi-technology tenders have a total financial budget of</p>

	<p>DKK 842 million for the period 2018-2019. This budget was allocated to DKK 254m for 2018 and DKK 588m for 2019 (2018 prices). However, in September 2019 it was decided by the government to reduce the budget for the tender in 2019 from DKK 597 million (2019 prices) to DKK 258 million (2019 prices). Within this budget frame the Danish Energy Agency will conclude contract(s) to the winning bids defined by the lowest price premium criteria. The budget for the small-scale solar PV auction in 2018 was DKK 107 million (2018 prices).</p> <p>Regarding offshore auctions, the parties of the Energy Agreement decided that the first of the three future planned wind offshore farms, which is named Thor, should be built in North Sea west of Nissum Fjord. The tender process is starting with first stakeholder dialogue meetings in the end of 2019 and the auction is expected to be undertaken in 2021.</p>
Technology focus and differentiation	<p>We can differentiate the main energy auctions in Denmark into three categories already mentioned before. Multi-technology auctions for onshore wind, solar PV and nearshore wind, offshore wind auctions, and small-scale solar PV auctions.</p>
Lead time before auction	<p>The information regarding auctions before 2016 was presented in [1]. The following list contains the auctions since 2016:</p> <ul style="list-style-type: none"> Nearshore areas: First announcement to final bid: 18 months First announcement: 25th February, 2015 Final tender specifications: 29th April, 2016 Final offers received: 1st September, 2016 Kriegers Flak: First announcement to final bid: 17 months First announcement: April, 2015 Final tender specifications: June, 2016 Final offers received: November, 2016 Thor (upcoming): First announcement to final bid: expected 20 months First announcement: September 2019 Final tender specifications: expected Q3, 2021 Final offers received: expected Q4, 2021 Technology neutral tender 2018: First announcement to final bid: 11 months First announcement: September, 2017 Final tender specifications: September, 2018 Final offers received: November, 2018 Technology neutral tender 2019 First announcement to final bid: 26 months First announcement: September, 2017 Final tender specifications: September, 2019 Final offers received: 27th November, 2019

	<ul style="list-style-type: none"> • Pilot Solar Energy Auction First announcement to final bid: 3 months First announcement: September, 2016 Final tender specifications: November, 2016 Final offers received: December, 2016 • PV solar tender lower than 1 MW: First announcement to final bid: 6 months First announcement: March, 2018 Final tender specifications: May, 2018 Final offers received: September, 2018
Min/max size of the project	The auctioned sizes for the offshore wind auctions were 350 MW for Near shore areas, 600 MW for Kriegers Flak, and 800-1000 MW for Thor. The multi-technology contained no limitations regarding the size of the projects. For the PV solar auction carried out in 2018 the maximum size of the projects were 1 MW.
What is auctioned?	<ul style="list-style-type: none"> • Near shore areas: 350 MW capacity, sliding premium for 17 TWh production • Kriegers Flak: 600 MW capacity, sliding premium for 30 TWh production • Thor (upcoming) 800-1000 MW capacity. • Technology neutral tender 2018: The budget for the tender was DKK 254 million (2018 prices) or 34.1 M€ approx. Fixed premium on top of electricity price is provided for the entire actual production of electricity during 20 years. • Technology neutral tender 2019: The budget for the tender is DKK 258 million (2019 prices) or 34.6 M€ approx. The budget has been reduced in September 2019 from the initially (in 2017) announced budget of 588 mio (2018 prices). Fixed premium on top of electricity price is provided for the entire actual production of electricity during 20 years. • Pilot Solar Energy Auction The maximum total capacity accepted in the tender was 22.399 MW in Denmark and 4.799 MW for projects installed in Germany. The support consists of a fixed premium for 20 years for all the projects. • Solar PV with capacity lower than 1 MW: The budget for the tender was DKK 107m. (2018 prices) or 14.36 M€ approx. fixed price premiums for 20 years.

Budgetary expenditures per auctions and per year	<p>The multi-technology auction held in 2018 had a total financial budget of DKK 254 million (2018 prices) and the multi-technology auction scheduled for 2019 has a budget of DKK 258 million (2019 prices). The total financial budget for the solar PV smaller than 1 MW was DKK 107 million (2018 prices). These budgets cover the whole supported period of 20 years.</p>
Frequency of auctions	<p>Until now 11 electricity auctions have been held:</p> <p>Feb. 2005: Horns Rev 2</p> <p>May 2006: Rødsand 2, 1st try</p> <p>Apr. 2008: Rødsand 2, 2nd try</p> <p>Apr. 2010: Anholt</p> <p>Feb. 2015: Horns Rev 3</p> <p>Sep, 2016: Near shore areas</p> <p>Nov, 2016: Kriegers Flak</p> <p>Dec, 2016: Pilot Solar Energy Auction</p> <p>Sep, 2018: PV solar tender lower than 1 MW</p> <p>Nov, 2018: Technology neutral tender 2018</p> <p>Dec, 2019: Technology neutral tender 2019</p> <p>Upcoming auctions:</p> <p>Thor expected for Q4, 2021.</p> <p>No fixed frequency of auctions can be determined</p>
Volume of the tender	<p>350 MW (2 x 175 MW) offshore wind capacity (Near shore areas)</p> <p>1 x 600 MW offshore wind capacity (Kriegers Flak)</p> <p>1 x 800-1000 MW offshore wind capacity (Thor)</p> <p>Technology neutral 2018 - DKK 254 million (2018 prices), resulting in:</p> <ul style="list-style-type: none"> • 165 MW onshore wind turbines • 101 MW solar PV installations <p>Technology neutral 2019 - DKK 258 million (2019 prices), resulting in:</p> <ul style="list-style-type: none"> • 135 MW onshore wind turbines

	<ul style="list-style-type: none"> • 117 MW solar PV installations <p>Pilot Solar Energy Tender - 22.4 MW in Denmark, allowing for a maximum 4.8 MW in Germany.</p> <p>Solar PV smaller than 1 MW - DKK 107 million DKK (2018 prices), resulting in: 19 MW (including 19 PV solar plants).</p>
Grid connection/access related costs	Until now the cost of the offshore substation and export cable was not included in the scope of the offshore tenders. However, there is a political agreement to include full grid connection cost into the tenders for offshore wind farms, starting with the Thor tender.
Balancing costs	Balancing costs are borne by the projects
Profile costs	Not part of the tender design

3 Design Elements for the Assessment of the Auctions

This chapter gives a detailed description of the main design elements for the auctions that had not been completed when the first Case Study [1] was published in 2016. This chapter includes information about the tenders for the wind energy nearshore Areas, Kriegers Flak, the multi-technology tender 2018/2019, and the PV solar tender lower than 1 MW.

Table 2. Design elements for the assessment of Nearshore Areas Auction [7].

Design elements	Description
Name of the auction	Near shore areas
Auction format	A multi-site tender was introduced, with a maximum capacity of 350 MW distributed over 6 predefined areas. Conditional bidding for two sites as well as mutually exclusive bids were allowed. There was a prequalification round followed by a final bid round.
Eligible technologies and participation technologies	Offshore wind energy
Auction procedure	Static sealed bid auction. A preliminary technical dialogue between potential bidders and the contracting authority was carried out.
Pre-qualification requirements	<ul style="list-style-type: none"> - Bidders must not have debt to public authorities exceeding DKK 100,000 (€13,417). - Upon conclusion of the Concession Agreement for construction and connection to the grid of the electric power generating plant, the tenderer must provide a guarantee of DKK 100 million. - Up to 5 references of development and management of construction regarding offshore wind farms, at least one with a minimum size of 30 MW installed capacity commissioned in the past 5 years - Minimum annual turnover of 4 billion DKK as average over the last 3 years available. In case of a consortium of bidders, the sum of all participating companies is taken into account - Equity ratio of 20% or above OR long term debt rating of BBB- or above (Standard & Poor's and Fitch) or Baa3 or above (Moody's).
Auction volume	Tender for the design, construction and operation of 350 MW offshore wind capacity in five nearshore areas on the coast of Denmark (North Sea south, North Sea north, Sæby, Smålandsfarvandet and Bornholm). Each area can be developed with up to 200 MW, except for the area of Bornholm, which can be developed with up to 50 MW.

	The auction resulted in two offshore windfarms "Vesterhav Nord" and "Vesterhav Syd" situated in the North Sea, with a capacity of 170 MW each of them.
Pricing rule	Pay as bid.
Award procedure	The Danish Energy Agency was to award Concession(s) to the tenderer(s) that enable the establishment of new wind energy capacity within the overall budget of 350 MW at the lowest total price. In the event of two (or more) mutually exclusive tenders of the same price, the bidder having offered the largest development was to be awarded the Concession.
Price limits	Only bids which lead to a sliding premium of no more than DKK øre 70 per kWh were accepted.
Support period	Bids submitted must state a DKK øre price per kWh for 50,000 full-load hours, including a specification of the number of MW the tenderer wants to establish and in which area. The energy produced while the electricity price is not positive will not be taken into account.
Favourable treatment of specific actors	Not part of the auction design
Realisation time limit	If less than 95% of the capacity of the wind farm is connected to the grid on 1 January 2021, the production eligible for price supplement will be reduced by 0.1 TWh. For each subsequent six-month period in which at least 95% of the capacity has still not been connected to the grid, the production eligible for price supplement will be reduced by an additional 0.1 TWh.
Monitoring of realisation progress	A soft regulation approach is used, i.e. the concessionaire has to send plans of the project and the construction to the contracting authority. Afterwards there is no physical control how the plans are executed. Nevertheless, the transmission system operator (Energinet) is monitoring the physical production of the wind farm, since it is responsible for the actual support payments, which are based on the measured production.
Exceptions, special rules	Not part of the auction design
Form of support auctioned	Sliding premium. The premium is calculated specifically for each hour as the difference between the price per kWh bid in the tender process (the 'target price') and the Nord Pool spot price for electricity in the relevant electricity grid price area in question (DK1 or DK2). In this context, the spot price is the day-ahead auction price. For hours in which the day-ahead auction price is higher than the target price, the premium will be negative. This amount will be deducted from the next positive premiums due to the

	beneficiary. In case the spot price is not positive, no premium is paid.
Transferability of support right	The transferability of the support rights is until this auction not explicitly stated in the auction conditions. The law, in which the payments have to be integrated, does not explicitly state the receiver of the payments .

Table 3. Design elements for the assessment of Kriegers Flak Auction [8].

Design elements	Description
Name of the auction	Kriegers Flak
Auction format	Single-item divided into two zones: western part with a maximum capacity of 200 MW and eastern part with a maximum capacity of 400 MW. There was a prequalification round followed by a final bid round.
Eligible technologies and participation technologies	Offshore wind energy
Auction procedure	Static sealed bid auction. A preliminary technical dialogue between potential bidders and the contracting authority was carried out.
Pre-qualification requirements	<ul style="list-style-type: none"> - Bidders must not have debt to public authorities exceeding DKK 100,000 (€13,417). - Upon conclusion of the Concession Agreement for construction and connection to the grid of the electric power generating plant, the tenderer must provide a guarantee of DKK 100 million. - Up to 5 references of development and management of construction regarding offshore wind farms, at least one with a minimum size of 150 MW installed capacity commissioned in the past 5 years - Minimum annual turnover of 15 billion DKK as average over the last 3 years available. In case of a consortium of bidders, the sum of all participating companies is taken into account - Equity ratio of 20% or above OR long term debt rating of BBB- or above (Standard & Poor's and Fitch) or Baa3 or above (Moody's).
Auction volume	The offshore wind farm must have a total capacity of min. 590 MW and max. 610 MW.

Pricing rule	Pay as bid.
Award procedure	The concession will be awarded to the tenderer quoting the lowest price. If, in the best and final offer phase, several bids are submitted quoting the same lowest price, the tenderers in question will be requested to submit a new bid with a lower "øre" amount/kWh.
Pricelimits	The Danish Energy Agency reserves the right to cancel the tendering procedure without awarding the Concession Agreement, if there is objective reason to do so. Such reason might be if the lowest tender price (the kWh price) is deemed too high.
Support period	Support is paid out for 30 TWh of production (corresponding to 50,000 full-load hours for 600 MW approx.). The energy produced while the electricity price is not positive will not be taken into account.
Favourable treatment of specific actors	Not part of the auction design.
Realisation time limit	If less than 95 % of the capacity of the farm is connected to the grid on the 1 st of January 2022, the production eligible for supplement will be reduced by 0.3 TWh to 29.7 TWh. For each six month-period thereafter in which at least 95 % of the projected capacity is still not connected to the grid, the production eligible for supplement will be reduced by an additional 0.3 TWh.
Monitoring of realisation progress	A soft regulation approach is used, i.e. the concessionaire has to send plans of the project and the construction to the contracting authority. Afterwards there is no physical control how the plans are executed. Nevertheless, the grid operator (Energinet.dk) is monitoring the physical production of the wind farm, since it is responsible for the actual support payments, which are based on the measured production.
Exceptions, special rules	Not part of the auction design.
Form of support auctioned	Sliding premium. The premium will be calculated for each hour and will be the difference between the price per kWh bid in the tender process (the 'target price') and the Nord Pool spot price for electricity in the relevant electricity grid price area in DK1. In this context, the spot price is the day-ahead auction price. For hours in which the day-ahead auction price is higher than the target price, the premium will be negative. This amount will be deducted from the next positive premiums due to the beneficiary. In case the spot price is not positive, no premium is paid.

Transferability of support right	The Concessionaire may not, without written consent from the Danish Energy Agency, transfer to a third party its rights and obligations pursuant to the Concession Agreement. However, the Danish Energy Agency will grant its consent to a transfer if the third party in question is assessed to possess the required economic, financial and technical capacity.
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Table 4. Design elements for the assessment of Technology Neutral Tender 2018 [9].

Design elements	Description
Name of the auction	Technology neutral tender 2018
Auction format	Multi-unit.
Eligible technologies and participation technologies	Onshore wind turbines, open door offshore wind turbines (which construction license has not been put up for tender), and/or solar PV installations.
Auction procedure	Static sealed bid auction. On December 20, 2017, there was an invitation for consulting the conditions of the auction.
Pre-qualification requirements	<ul style="list-style-type: none"> - Bidders must not have debt to public authorities exceeding DKK 100,000 (€13,417). - With the bid the tenderer must submit a declaration of intent from a financial institution stating that said institution will provide a demand guarantee toward the Danish Energy Agency corresponding to the amount of the retention penalty established. The retention penalty depends on the capacity of the individual winning project and will be calculated as DKK 170 per MWh on the basis of the stated capacity in the bid and an estimated amount of full-load hours per year for each technology. This amount of money corresponds to 578 000 DKK per MW installed of onshore wind farms, 196 350 DKK/MW for solar projects, and 756 500 DKK/MW for offshore wind farms. This penalty would be paid related to the capacity of the wind farm that is not connected to the grid on time.
Auction volume	The intention is to conclude one or several price premium contracts until the total budget of DKK 254 million (34 M€, 2018 prices) has been spent.
Pricing rule	Pay as bid.
Award procedure	Lowest price premium, assessed as the amount of the offered price premium in øre per kWh for electricity production for 20 years from grid

	connection. If several bids contain the same price premium, the bids in question will be ranked according to the size of the expected production (the capacity offered multiplied by the pre-defined number of full-load hours), from the largest to the smallest.
Price limits	Bids above 13.00 øre per kWh are not accepted.
Support period	The fixed price premium is granted for the total electricity generated by installations covered by the price premium contract for 20 years from the time of grid connection.
Favourable treatment of specific actors	Not part of the auction design.
Realisation time limit	Within two years of concluding the price premium contract, a winning tenderer must have connected to the grid onshore wind turbines and/or solar PV installations. However, for open door offshore wind turbines the limit would be within four years of concluding the price premium contract. The obligation to connect to the grid will be considered met when 85% of the total installed capacity covered by the price premium contract is connected. Support will be received only for the capacity of the wind farm connected to the grid on time.
Monitoring of realisation progress	A soft regulation approach is used, i.e. the concessionaire has to send plans of the project and the construction to the contracting authority. Afterwards there is no physical control how the plans are executed. Nevertheless, the grid operator (Energinet.dk) is monitoring the physical production of the wind farm, since it is responsible for the actual support payments, which are based on the measured production.
Exceptions, special rules	Not part of the auction design.
Form of support auctioned	Support is given in the form of a fixed price premium in øre per generated kWh added to the electricity price.
Transferability of support right	The transferability of the support rights for this auction is not explicitly stated in the auction conditions.

Table 5. Design elements for the assessment of Technology Neutral Tender 2019 [10].

Design elements	Description
Name of the auction	Technology neutral tender 2019
Auction format	Multi-unit.
Eligible technologies and participation technologies	Onshore wind turbines, open door offshore wind turbines, and/or solar PV installations.
Auction procedure	Static sealed bid auction. On May 6, 2019, there was an invitation for consulting the conditions of the auction.
Pre-qualification requirements	<ul style="list-style-type: none"> - Bidders must not have debt to public authorities exceeding DKK 100,000 (€13,417). - With the bid the tenderer must submit a declaration of intent from a financial institution stating that said institution will provide a demand guarantee toward the Danish Energy Agency corresponding to the amount of the retention penalty established. The retention penalty depends on the capacity of the individual winning project and will be calculated as DKK 170 per MWh on the basis of the stated capacity in the bid and an estimated amount of full-load hours per year for each technology. This amount of money corresponds to 578 000 DKK per MW installed of onshore wind farms, 196 350 DKK/MW for solar projects, and 756 500 DKK/MW for offshore wind farms. This penalty would be paid related to the capacity of the wind farm that is not connected to the grid on time.
Auction volume	The intention is to conclude one or several price premium contracts until the total budget of DKK 258 million (34.6M€, 2019 prices) has been spent.
Pricing rule	Pay as bid.
Award procedure	Lowest price premium, assessed as the amount of the offered price premium in øre per kWh for electricity production for 20 years from grid connection. If several bids contain the same price premium, the bids in question will be ranked according to the size of the expected production (the capacity offered multiplied by the pre-defined number of full-load hours), from the largest to the smallest.
Price limits	Bids above 6.00 øre per kWh are not accepted.

Support period	The fixed price premium is granted for the total electricity generated by installations covered by the price premium contract for 20 years from the time of grid connection.
Favourable treatment of specific actors	Not part of the auction design.
Realisation time limit	Within two years of concluding the price premium contract, a winning tenderer must have connected to the grid onshore wind turbines and/or solar PV installations. However, for open door offshore wind turbines the limit would be within four years of concluding the price premium contract. The obligation to connect to the grid will be considered met when 85% of the total installed capacity covered by the price premium contract is connected. Support will be received only for the capacity of the wind farm connected to the grid on time.
Monitoring of realisation progress	A soft regulation approach is used, i.e. the concessionaire has to send plans of the project and the construction to the contracting authority. Afterwards there is no physical control how the plans are executed. Nevertheless, the grid operator (Energinet.dk) is monitoring the physical production of the wind farm, since it is responsible for the actual support payments, which are based on the measured production.
Exceptions, special rules	Not part of the auction design.
Form of support auctioned	Support is given in the form of a fixed price premium in øre per generated kWh added to the electricity price.
Transferability of support right	The transferability of the support rights for this auction is not explicitly stated in the auction conditions.

Table 6. Design elements for the assessment of PV solar tender lower than 1 MW [11].

Design elements	Description
Name of the auction	PV solar tender lower than 1 MW
Auction format	Multi-unit.
Eligible technologies and participation technologies	Solar PV installations

Auction procedure	Static sealed bid auction. On March 2018, there was an invitation for consulting the conditions of the auction.
Pre-qualification requirements	<ul style="list-style-type: none"> - Bidders must not have debt to public authorities exceeding DKK 100,000 (€13,417). - With the bid the tenderer must submit a declaration of intent from a financial institution stating that said institution will provide a demand guarantee toward the Danish Energy Agency. This amount corresponds to DKK 170 per MWh on the basis of the stated capacity in the bid, and an estimated 1.155 full-load hours per year for solar PV installations (DC).
Auction volume	The intention is to conclude one or several price premium contracts on the basis of the award criterion lowest price premium, until the total budget of DKK 107 million (14.36 M€, 2018 prices) has been spent.
Pricing rule	Pay as bid.
Award procedure	Lowest price premium, assessed as the amount of the offered price premium in øre per kWh for electricity production for 20 years from grid connection. If several bids contain the same price premium, the bids in question will be ranked according to the capacity offered in MWp, from the largest to the smallest.
Price limits	Bids about a fixed premium above 15.00 øre per kWh will not be accepted.
Support period	The fixed price premium is granted for the total electricity generated by installations covered by the price premium contract for 20 years from the time of grid connection.
Favourable treatment of specific actors	Not part of the auction design.
Realisation time limit	Within two years of concluding the price premium contract, a winning tenderer must have connected to the grid the solar PV installations. The contracts were signed in November 2018. Hence, the projects must be connected to the grid by no later than November 2020.
Monitoring of realisation progress	A soft regulation approach is used, i.e. the concessionaire has to send plans of the project and the construction to the contracting authority. Afterwards there is no physical control how the plans are executed. Nevertheless, the grid operator (Energinet.dk) is monitoring the physical production of the wind farm, since it is responsible for the actual support payments, which are based on the measured production.

Exceptions, special rules	Not part of the auction design.
Form of support auctioned	Aid is in the form of a fixed price premium in øre per generated kWh added to the electricity price.
Transferability of support right	The transferability of the support rights for this auction is not explicitly stated in the auction conditions.

4 Outcome of the Energy Auctions in Denmark

Table 7. Outcome of Nearshore Areas Auction.

Elements	Description
Name of the auction	Near shore areas
Prices	The auction resulted in two offshore windfarms “Vesterhav Nord” and “Vesterhav Syd” situated in the North Sea. Support in the form of a sliding premium for 17 TWh production. Contracted price: 47.5 øre / kWh (approx. €63.8/ MWh for 11 y). Both “Vesterhav Nord” and “Vesterhav Syd” will receive the same amount of support.
Awarded Volume	“Vesterhav Nord” and “Vesterhav Syd” will have a capacity around 170 MW each of them. The owner of both wind farms is Vattenfall.
Level of Competition	Three prequalified companies submitted their bids: European Energy, Danish Kosortium and Vattenfall Wind Power.
Realisation rate	There have been problems related to the realisation of the projects awarded during this tender. Following complaints from local residents, Vattenfall’s construction permit was withdrawn when the construction of the wind farms was close to start which will cause a significant delay. More details about the delay were presented in [12]. It is possible that the complaints are related to the local citizens not being allowed to participate in the tender, topic that is covered by Chapter 6.

Table 8. Outcome of Kriegers Flak Auction.

Elements	Description
Name of the auction	Kriegers Flak
Prices	Sliding premium for 30 TWh production Contracted price: 37.2 øre / kWh (approx. €50/ MWh for 11 y.)
Awarded Volume	600 MW to Vattenfall Vindkraft Vesterhav Syd/Nord P/S.

Level of Competition	Seven out of eight companies which applied to be prequalified for this auction were eligible for bidding. The prequalified companies that took part on the tender were: EnBW, a consortium formed by wpd, Hofer, and Stadtwerke München, European Energy gathered with Boralex, Vattenfall, a group formed by Statoil and E.ON, ScottishPower Renewables, and Dong Energy (Ørsted).
Realisation rate	The construction of the wind farm has started in the end of May 2019 according to Vattenfall. It is expected to be fully operating at the end of 2021.

Table 9. Outcome of Technology Neutral Tender 2018 [9]

Elements	Description
Name of the auction	Technology neutral tender 2018
Prices	The weighted average price premium on top of electricity price of the winning bids for the auction is 2.28 øre / kWh (approx. €3.1/ MWh)
Awarded Volume	<p>165 MW onshore wind turbines and 101 MW solar PV installations.</p> <p>Onshore wind turbines:</p> <ol style="list-style-type: none"> 1. NRGi Wind V A/S - 28.8 MW capacity Fixed premium 1.89 øre / kWh (approx. €2.5/ MWh) 2. K/S Thorup-Sletten (EuroWind) – 77.4 MW capacity Fixed premium 1.98 øre / kWh (approx. €2.7/ MWh) 3. SE Blue Renewables DK P/S – 59.3 MW capacity Fixed premium 2.50 øre / kWh (approx. €3.4/ MWh) <p>Solar PV installations:</p> <ol style="list-style-type: none"> 1. Solar Park Rødby Fjord ApS (EuropeanEnergy) – 60 MW Fixed premium 2.84 øre / kWh (approx. €3.8/ MWh) 2. Solar Park Næssundvej ApS (EuropeanEnergy) – 30 MW Fixed premium 2.84 øre / kWh (approx. €3.8/ MWh) 3. Better Energy Frederikslund – 11.5 MW Fixed premium 2.98 øre / kWh (approx. €4/ MWh)
Level of Competition	The Danish Energy Agency received in total 17 bids with projects of approx. 260 MW onshore wind turbines and approx. 280 MW solar PV installations.

Realisation time	There is no information about the status of most of the projects since they have until Q4 2020 to be operating. Better Energy expects that the bulk of their projects will be grid connected no later than 2020 Q2.
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Table 10. Outcome of PV solar tender lower than 1 MW [13].

Elements	Description
Name of the auction	PV solar tender lower than 1 MW
Prices	The weighted average of the winning fixed price premiums is equal to 12,97 øre/kWh (approx. €17.4/ MWh).
Awarded Volume	19 MW, most of which belong to the company Better Energy, which has confirmed that the bulk of the projects is expected to be connected to the grid no later than 2020 Q2 since they are in a late development stage.
Level of Competition	In total, the Danish Energy Agency received 18 bids from 11 bidders regarding 21 installations of a total of 21.1 MW. However, the majority of the projects belong to companies whose parent is Better Energy.
Realisation time	There is no information about the status of most of the projects. Better Energy expects that the bulk of their projects will be grid connected no later than 2020 Q2.

Table 11. Outcome of Technology Neutral Tender 2019 [14]

Elements	Description
Name of the auction	Technology neutral tender 2019
Prices	The weighted average price premium of the winning bids is 1.54 øre per kWh (approx. 2.1€ /MWh).
Awarded Volume	<p>135 MW onshore wind turbines and 117 MW solar PV installations.</p> <p>Onshore wind turbines:</p> <ol style="list-style-type: none"> Overgaard 1B K/S - 36.0 MW capacity Fixed premium 1 øre / kWh (approx. €1.35/ MWh)

	<p>2. Wind Estate A/S – 36 MW capacity Fixed premium 1.97 øre / kWh (approx. €2.64/ MWh)</p> <p>Solar PV installations:</p> <p>1. Solar Park Harre ApS – 38.1 MW Fixed premium 1.84 øre / kWh (approx. €2.47/ MWh)</p> <p>2. Solar Park Agersted ApS – 26.4 MW Fixed premium 1.84 øre / kWh (approx. €2.47/ MWh)</p> <p>3. Solar Park Holmen ApS – 18.2 MW Fixed premium 1.84 øre / kWh (approx. €2.47/ MWh)</p> <p>Combined onshore wind and solar PV installations:</p> <p>1. Eurowind Energy A/S – 37.8 MW onshore wind turbines and 15.2 MW solar PV. Fixed premium 1.48 øre / kWh (approx. €1.99/ MWh)</p> <p>2. Eurowind Energy A/S – 25.2 MW onshore wind turbines and 18.9 MW solar PV. Fixed premium 1.48 øre / kWh (approx. €1.99/ MWh)</p>
Level of Competition	The Danish Energy Agency has received in total 7 bids with projects of 135 MW onshore wind turbines and 117 MW solar PV installations (DC capacity). The 7 contracts corresponds to DKK 157 million or 61% of the tender budget, and thus DKK 101 million (2019 prices) or 39% of the tender budget is not allocated.
Realisation time	There is no information about the status of the projects.

5 Evaluation Criteria for the Assessment of Auction Schemes for RES-E

5.1 Actor Variety and Social Acceptability

As also noted in the first Case study in 2016 [1], the majority of the companies taking part in the offshore wind auctions have a large experience in the construction and operation of offshore wind farms. This fact, together with their big size allows them to fulfil the pre-qualification criteria required by the Danish Energy Agency. In Chapter 6, an analysis of how this pre-qualification requirements may have excluded certain types of actors participating in the auction is discussed.

The amount of bids received during each energy auction is not easily compared due to the diverse characteristics of the tenders. For example, the number of prequalified companies increased from 3 in Nearshore Areas to 7 in Kriegers Flak even though the prerequisites were more restrictive. Multi-technology tender 2018 resulted in 6 winning projects out of 17 bids, while 7 out of 7 bids resulted in winning projects in the Multi-technology tender 2019. In addition, the PV solar tender for projects smaller than 1 MW received bids regarding the installation of 21 MW from which 19 MW resulted in winning projects.

Regarding the offshore wind energy auctions, Vattenfall was the winner from both Nearshore Areas and Kriegers Flak. The winners of the multi-technology tender 2018 were NRGi, EuroWind, and SE Blue Renewables with onshore wind projects, while European Energy and Better Energy also had successful results with PV solar projects. In addition, Better Energy dominated the PV solar tender lower than 1 MW since it is the parent company of the majority of the winning projects.

The legal framework established in Denmark to improve the local acceptance has been presented in [15], in which it is possible to find a detailed description of the different measures that the Danish Government is applying to achieve this objective. These measures can be divided into three different targets: a compensation scheme for citizens whose properties' value has decreased due to the installation of a wind farm; a community benefit scheme, that uses funding derived from the PSO-tariff to promote local nature restoration projects or the installation of renewable energy sources in public buildings; and the possibility of co-ownership, which allows local citizens to purchase shares from wind energy projects. This last procedure is called *Køberetsordningen* and it is covered in Chapter 7.

5.2 Effectiveness of Auctions

All tenders were successfully realised, except for the first try of Rødsand 2. The rest of the energy auctions have been realised in time until now. In the case of Nearshore Areas, as mentioned before, an extension of the deadline for the grid connection has been required due to a mismatch between the initial Environmental Impact Assessment (EIA) and the final project presented by Vattenfall. Further delay may be expected due to permitting issues caused by local protests about the location of the wind turbines in Vesterhav Syd [16]. Vattenfall has requested a three-year extension for the connection to grid deadline, from the end of 2020 to the end of 2023.

5.3 Cost Effectiveness

The Danish government is promoting offshore wind energy in technology-specific, single-item auctions. Here, the objective is not overall lowest cost per unit of renewable energy in the short term, since, until now, offshore wind energy has had expectedly higher cost than e.g. onshore wind energy. With the introduction of the multi-technology tender in 2018, the Danish government has for the first time in its energy policy history taken a technology-agnostic approach in the offering of support. These auctions are then in fact selecting the lowest cost projects between different technologies. The first round of the multi-technology tender have shown strong competition between the technologies, with winning and losing bids from wind onshore and solar PV.

In Figure 1 the evolution of the support level required by the different offshore wind energy auctions is presented. After the high support level achieved in Anholt which was already discussed in [1], the required support level has decreased significantly for the Nearshore Areas and Kriegers Flak as compared to previous auctions. Most of this trend is certainly due to a general decrease in technology cost, but may also be influenced by an increase in competition between the different actors together with an improved design of the energy auctions.

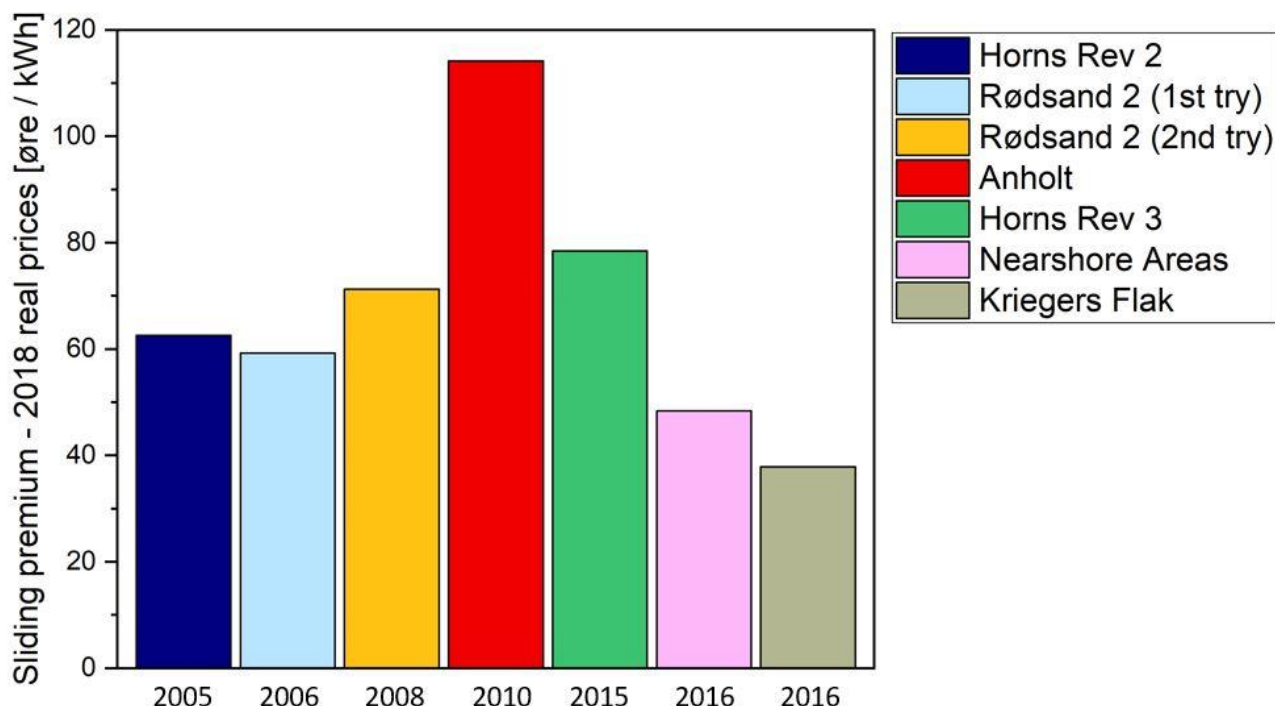


Figure 1. Comparison between the strike prices achieved in the different offshore wind energy auctions realised in Denmark until 2018. The support is provided in the form of a sliding premium tariff and it is presented in 2018 real prices.

It is important to notice that there is a difference of approx. 10 øre / kWh between Nearshore Areas and Kriegers Flak even though their final bids were presented less than three months apart. This may have been caused by physical or technological differences, which can have a significant impact in the overall cost per unit of energy produced. In addition, Kriegers Flak windfarm has almost twice the size of both windfarms in the Nearshore Areas together, which may have allowed for a lower bidding price. Last but not least, the level of competition was higher during Kriegers Flak auction since there was seven prequalified companies versus the three companies that were prequalified for Nearshore Areas. This fact could have also contributed to push the prices down. It should also be noted that the tenders for the Nearshore projects include grid connection up to an onshore connection point, whereas for Kriegers Flak, the offshore substation is provided for by Energinet.

After the successful Pilot Solar Energy Auction realised in 2016, two new types of multi-item renewable energy auctions were designed: the Solar PV tender for projects with capacity lower than 1 MW, and the multi-technology tender for onshore wind, solar and open-door offshore wind energy. In Figure 2, the support level achieved by each of the auctions is presented. It is possible to see how the weighted average of the winning fixed price premium is similar between the Pilot Solar Energy Auction (2016) and the PV solar tender lower than 1 MW (2018), despite the fact that the latest was realised 2 years later. The limitation on the size of the projects may increase the cost per unit of energy produced. This fact is supported by the results obtained during the multi-technology tender realised the same year (2018), in which the solar winning projects only required an average of approx. 2.86 øre / kWh. Here, again, the level of competition may have played a role, as oversubscription was higher in the multi-technology tender than in the small scale solar PV auction.

Focusing on the results of the multi-technology tender 2018, the weighted average support required by the winning onshore wind projects is approx. 2.15 øre / kWh, significantly lower than the 2.86 øre / kWh required by the winning solar projects. In addition, the multi-technology tender 2019 presented a new record with only a fixed premium of 1 øre / kWh required by the cheapest onshore wind project. It is followed by 1.48 øre / kWh required for projects combining onshore wind and PV solar projects, 1.84 øre / kWh for solar PV projects, 1.84 øre / kWh for solar PV projects and 1.97 øre / kWh for the most expensive onshore wind project of the tender.

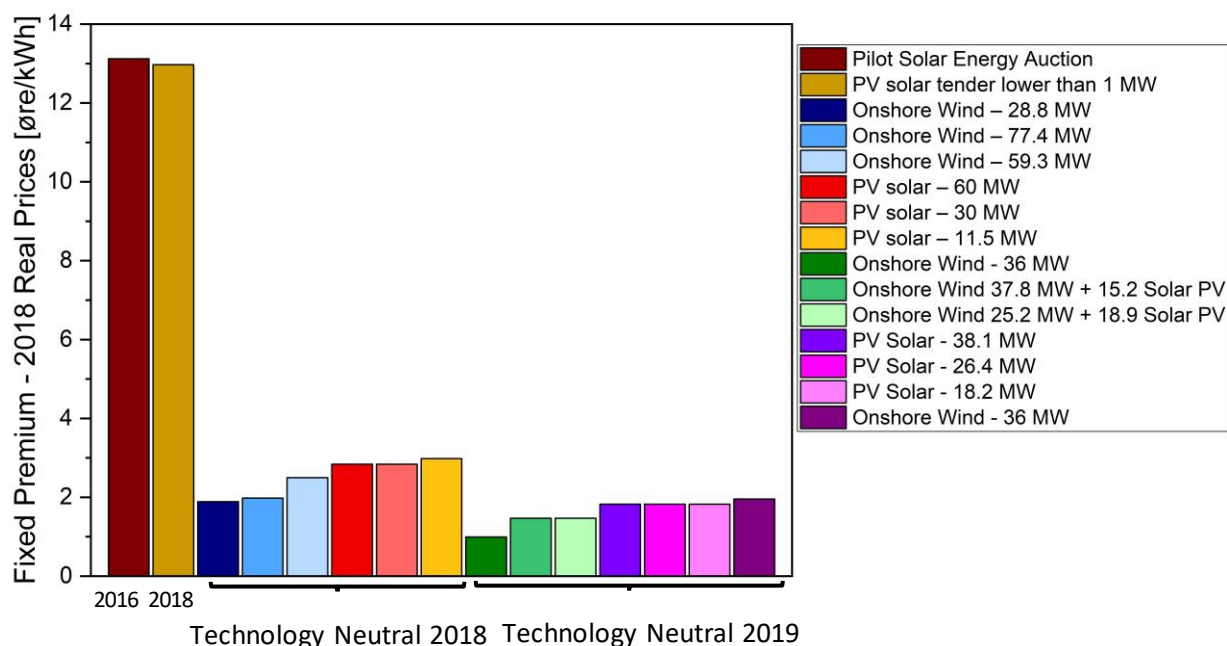


Figure 2. Comparison of the support levels achieved in the Pilot Solar Energy Auction, the PV solar tender for projects with less than 1 MW, and the multi-technology tender 2018/2019. The support is provided in the form of a fixed premium on top of the electricity market price and it is presented in 2018 real prices.

5.4 Post – realisation period: realisation rates, ownership changes after auctions

As mentioned before, so far all energy auctions but the first try of Rødsand 2 were realised in time. In addition, there has not been any ownership changes in the energy auctions realised from 2016. However, Better Energy has recently announced its partnership with HOFOR (Greater Copenhagen Utility) presented in [17]. Besides, Better Energy has also concluded a Power Purchase Agreement (PPA) with Google in order to cover the electricity consumed by their new data center which is being built in Fredericia. This PPA will include the production of five solar parks in Denmark with an installed capacity of 160 MW in total. The five solar parks will be located in Morsø, Gimming at Randers, Norddjurs, Rødby Fjord on Lolland and at Næstved. The solar farms located in Morsø and Rødby Fjord will be constructed by European Energy while Better Energy will construct the ones located in Randers, Norddjurs and Næstved.

One fact worth to highlight is the successful results obtained by Better Energy on all the energy auctions that included PV solar energy. They have obtained winning projects regarding 21.6 MW (AC) or 32 MW (DC) in the Pilot Solar Energy Auction, 11.5 MW (AC) in the multi-technology tender, and at least 11 MW (AC) in the PV Solar lower than 1 MW. Regarding this success in multiple solar energy auctions, Søren Dyrlynd Jessen, Analyst in the Project Development & Project Finance department of Better Energy, declared to the authors of this report:

"One of the key factor that enables Better Energy to bid lower than many of our competitors is our fully integrated value chain. Integrating all areas of a solar life cycle have made it possible to reduce the development, construction and operational costs and thus made the projects less dependent on high subsidies".

6 Citizen Involvement (case of Nearshore Areas tender)

This chapter summarises the case presented in [18], in which the possibility for non-profit organisations to participate in Danish energy tenders is examined. The report describes in detail the procedure followed by Wind People's foundation to participate with a popular project, called Wind & Welfare, in the Nearshore Areas tender. After a deep analysis of the actions and experiences presented by the non-profit organisation through a series of interviews, the report concludes that "it is not possible for non-profit organisations to participate with popular projects in connection with tenders for nearshore wind turbines in Denmark under the current framework conditions".

The prerequisites for the Nearshore Area tender presented in Table 2 are:

- Up to 5 references of development and management of construction regarding offshore wind farms and, at least, one with a minimum size of 30 MW installed capacity commissioned in the past 5 years. This technical requirement has the objective of ensuring that tenderers have the necessary experience to ensure the quality of the project.
- Minimum annual turnover of 4 billion DKK as average over the last 3 years available. In case of a consortium of bidders, the sum of all participating companies is taken into account.
- Equity ratio of 20% or above OR long term debt rating of BBB- or above (Standard & Poor's and Fitch) or Baa3 or above (Moody's).

In addition, another requirement with significant influence is the requirement for 'joint and several liability' (as termed in the tender conditions) in case that a consortium is formed. This requirement creates contract security for the Danish Energy Agency since in case of one of the consortium members going bankrupt, the other consortium members are still liable, and the contract will still be completed.

Wind People was founded in 2009 and it has been involved in different onshore wind turbine projects before its attempt to participate in the Nearshore Areas offshore wind tender. According to the report, the main barriers that non-profit organisations experience when trying to prequalify to this type of energy auctions are: the relatively short time period between the publication of the tender material and the final bid submission deadline, the average minimum turnover of 4 billion DKK required by the pre-qualification criteria, and the requirement that forces all partners in a consortium into joint and several liability for the project.

6.1 The structure of the consortium

The main objective of Wind & Welfare was to develop a project in which Danish electricity consumers are able to purchase shares that compensate their electricity consumption. To do so, it is necessary to establish a consortium that enables the project to meet both financial and technical requirements announced by the Danish Energy Agency for the prequalification. Every detail about the forming process of the consortium is exposed in [18].

The consortium comprises three parties: the limited partnership Wind & Welfare, formed by Wind People and electricity consumers through the purchase of shares; the Ærø Foundation, founder of the consortium with an equity ratio of over 20%; and a company expected to join the project with a turnover of at least 4 billion DKK over the past three years which also has an equity ratio of at least 20%. Wind people is liable for the loans provided outside the consortium and founded an insurance company to protect both Ærø Foundation and the company which enters the consortium.

The 70% of the project investment was to be financed by a loan that requires a project budget of an extra 10% which can cover unexpected expenditures. Since both Ærø Foundation and the company which enters the consortium are exempted from financial responsibility, according to Wind People, the consumers buying the shares are primarily the ones at risk. In case that the project costs exceed the budget by more than 10% the bank was to seize the assets and private investors would lose their investment. Wind People uses this fact to question the relevance of the prerequisite for joint and several liability. In addition, in order to satisfy the technical requirements, a cooperation between Wind & Welfare and K2 Management was constituted, as

the experience in offshore wind projects by the consulting company would be accepted as sufficient by the Danish Energy Agency.

6.2 Prerequisites as a barrier for non-profit organisations

According to [18], the requirement for an average turnover of 4 billion DKK over the past three years, presents the most significant barrier for non-profit projects bidding in energy auctions in Denmark. Wind People argue that this requirement controls which companies have the opportunity to participate in the tender. At the same time, the organisation suggests that the size of the revenue required have a significant impact on the level of competition of the tender.

Non-profit organisations are normally dependent on fundraising for project development since they often have a small or no turnover from their activities. This fact together with the revenue requirement makes impossible for this type of organisations to participate on the tender without the formation of a consortium. As mentioned before, this consortium needs to be established with a company able to provide the average turnover of 4 billion DKK during the past three years. This may make the project less popular with the public, since business companies expect a certain rate of return. In addition, the case study affirms that “it is impossible to find a company willing to be part of a consortium with economic risk and limited project ownership”. Wind People failed in its attempt to find a company that fulfils this requirement, which resulted in a rejection in the pre-qualification phase of the tender.

Regarding the technical capacity requirement, the Danish Energy Agency has designed the tender in a way that it is possible to hire consulting engineers that fulfil the requirement without making them direct project partners. This requirement is not an impediment for non-profit organisations since they can obtain the expertise needed from external companies. In addition, meeting the 20% of equity requirement was also possible to fulfil.

Furthermore, the case study also identifies as a barrier the short period between the publication of the final tender conditions and deadline for pre-qualification. In the case of the Nearshore Tender, it was only 3 months between the publication of the final tender material and the final bid. This made it difficult for organisations like Wind People to structure the project in such a short period of time. Wind People suggests that “no considerations have been made relating to the fact that not all tenderers will be able to stand alone”, and forming a consortium requires a significant amount of time.

6.3 External factors

Apart from the intrinsic barriers corresponding to the pre-requisites of the tender, there are multiple factors that influence the possibility for a determined actor to participate in the auction. The case study [18] express that the different stakeholders competing in the industry have a significant influence on the other’s possibilities to participate in the tender. It is normal that advisors, consultants, and suppliers, have premade agreements with competitors already established in the market. This implies that an agreement with a new actor in the market, like Wind People, could cause a conflict of interest, which resulted in difficulties for the organisation to make those agreements. Regarding this topic, the case study concludes that: “It is evident that the market for offshore wind turbines is an already established market, dominated by a few large actors who have established cooperation with turbine suppliers, advisors, lawyers, banks and other consultants in the industry, making it difficult for new actors to enter the market”.

Last but not least, the composition of a non-profit organisation tendering with a popular project was new for all of the stakeholders in contact with Wind People. As a result, most of them were reluctant to collaborate with the new unknown actor as identified in [18].

7 **Køberetsordningen: Local citizens' option to purchase wind turbine shares**

In order to promote the local acceptance for wind energy projects, the Danish Renewable Energy Act requires windfarm developers to offer a minimum of 20% of the shares of the project to local citizens. In Act no. 1392 of 27 December 2008 on Renewable Energy (which was replaced by the Consolidated Act No. 1074 of 8 November 2011), the basis for local citizens' option to purchase shares of renewable energy projects are regulated. The most relevant points can be summarized as:

- Any person who installs one or more onshore wind turbines of at least 25 m. in height, or offshore wind turbines established without a tendering procedure shall offer at least 20% of the ownership shares.
- The shares can be purchased by any person over 18 years old, who at the time of the offer for sale, has his or her permanent residence in the municipality in which the wind turbine is to be installed. In addition, residents living closer than 4.5 km. to any wind turbine will have priority to purchase.
- The offer for sale of ownership shares have to be advertised in a local newspaper covering the areas of the persons entitled to make a purchase offer. The advertisement shall contain information about the number and price of the ownership shares offered for sale, the type of company and the extent of the liability per share, time limits and conditions for submitting purchase offers.
- The time limit for submitting an offer shall be at least four weeks from the date the sale is advertised.
- The proceeds of the sale shall cover a proportional share of the developer's project costs, so that the developer and the buyers pay the same amount per share. The ownership shares shall be offered at a price calculated on the basis of a production of 1,000 kWh / year per share.

An evaluation of the results of the first projects that were under this regulation was published in [19], in which different recommendations were made in order to improve the framework that was in place at that time (October 2011). The evaluation concluded that the objective of increasing the local interest and support for setting up new wind turbines through a broad local co-ownership was not fully achieved. According to the data published by the Danish Energy Agency, only in few of the projects the total amount of shares offered were purchased (5 out of 22 at that time). Furthermore, they had, to a significant extent, been sold to a few large investors, not contributing to the final objective of local citizens supporting new wind energy projects.

In a large number of projects, only very few shares were sold. According to [19], this could be explained by the fact the local community is strongly opposed to the specific project or due to the owner of the project not having an incentive to promote the scheme. The unsold shares return to the developer, which represents a conflict of interests reducing the willingness of the owner to sell the shares. The uncertainty about the amount of shares purchased by the citizens presents a drawback for the project owner: On the one hand, losing 20% of the ownership and the related profits can have a significant impact on the attractiveness of developing the project; on the other hand, not selling 20% of the shares means that the project developer should have a secondary source available to finance it.

It is important to notice that it is regulated that the price of the shares has to be equal to the developer's project costs, so that the developer and the local buyers pay the same amount per share. Project owners complained about the fact that making public detailed information about project budgets gives an advantage for competitors in the future. This advantage could e.g. be used when competing for wind turbines from the same suppliers or in future energy auctions.

Another problem has been caused by the so-called 'wind energy nomads', as described in [15]. The term refers to investors who decide to purchase properties inside the municipality of the project, being this way eligible to take part in the co-ownership scheme. Once the shares are auctioned, they terminate their

residence. Some of the recommendations that [19] presented to avoid the problems presented before are:

- Better information about the shares: advertising them in more than one local newspaper, and organising meetings about the buyer right scheme with the participation of Energinet
- Extension of the minimum shares tender period from 4 to 8 weeks
- Inserting a ceiling on how many shares the citizens who have preferential right can buy
- Ensure that the tender is carried out at the latest possible date, after the project receives the building permit and before the grid connection.

After this evaluation, in order to avoid that citizens with preferential right (living closer than 4.5 km) keep the total amount of shares, an amendment to the Act now restricts the amount of shares that one single investor inside this area can purchase to 50 (corresponding to a 'standard' production of 50,000 kWh / year).

Until 2019, around 114 projects that include the option for local citizens to buy shares have been approved in Denmark. They had an average share price of 3,230.5 DKK (or approx. 433.6 €). Since every share represents the production of 1,000 kWh / year, a rough estimation can be done assuming a lifetime of the project of 20 years, resulting in an approximated average cost of 16.1 øre DKK per kWh of energy produced (or approx. 21.6 € per MWh).

From the total amount of 1,059,416 shares offered, approx. 490.000 have been purchased by local citizens, representing 46.2%. This fact implies that there is a significant number of projects in which shares are not purchased by the local citizens.

Figure 3 illustrates how the average share price decreases with time. This is related to the fact that wind energy projects have become less expensive during the last years. The amount of shares purchased increased significantly from 2010 to 2014, decreasing drastically during 2015 and 2016 and spiking again in 2017. Further research should be carried out in order to understand the decrease that occurred during 2015-2016.

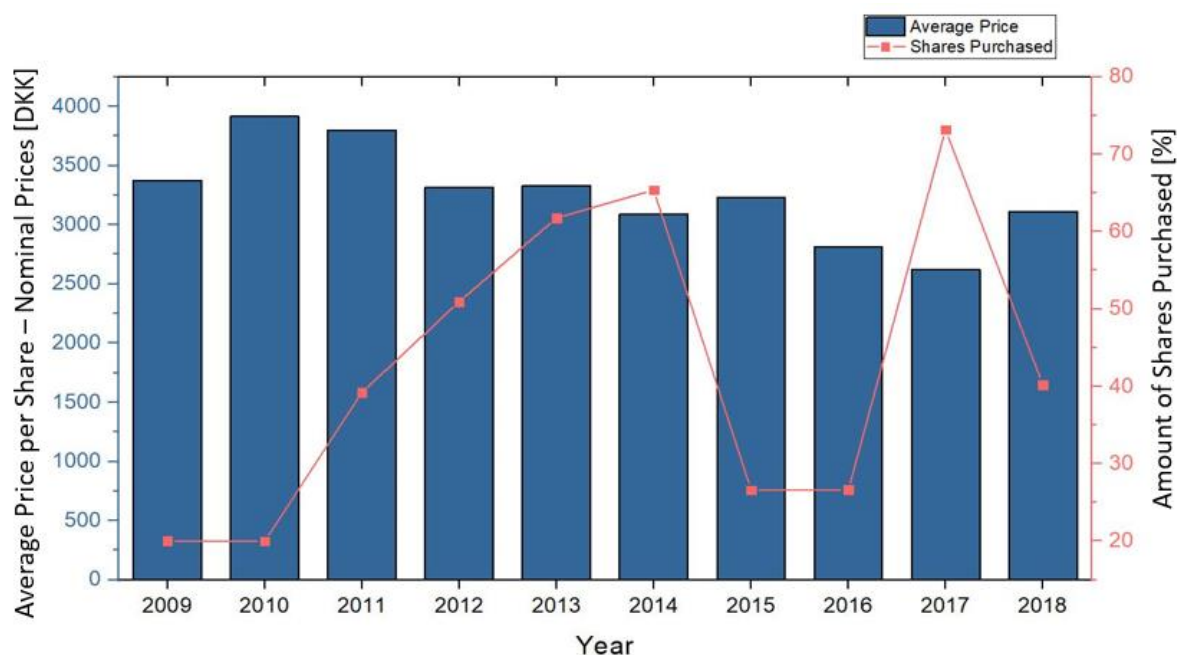


Figure 3. Evolution of the shares price (blue) and percentage of shares purchased from the total amount of shares offered (red) from 2009 to 2018. Data source: Danish Energy Agency.

During 2015, only 1 out of 9 projects succeeded in allocating the total amount of shares offered by the owner. One representative example is Klim Fjordeholme, a 67.2 MW onshore windfarm owned by Vattenfall, in which 22 new Siemens wind turbines replaced the 35 old wind turbines existing in the wind farm at that time. It was the biggest onshore windfarm in Denmark, now surpassed in size by the 77 MW Thorup-Sletten windfarm (2019). From the 45,155 shares that Vattenfall offered, only 5,274 were purchased by the local citizens, representing 12%. A possible mitigation to this low percentage could be to enlarge the area that allows local citizens to purchase shares, potentially depending on the size and location of the project, so that large projects could be required to offer shares in an area larger than the municipality when placed in less populated rural areas.

However, considering the case of the Nørhede-Hjortmose 66 MW wind farm built in 2013, the results were completely different. According to the information provided by the Danish Energy Agency, every share offered by the project owner was sold resulting in 44,437 shares purchased by the local citizens. And this was only 700 shares less than those offered by the Klim Fjordeholme wind farm. It would be interesting to perform a comparison about the characteristics and methods used to advertise the different projects, in order to understand the underlying conditions that led to these diverging results. On a side note, there was a significant transaction in 2018 when the German company Encavis AG presented an offer to purchase the 22 Nørhede-Hjortmose wind turbines. Further information about this transaction can be found in [20].

8 Lessons learnt: key best practices and pitfalls identified

This report has described in detail all auctions for renewable energy support that have taken place in Denmark since 2016: multi-technology tenders for wind and solar in 2018 and 2019, a PV solar tender for projects with a capacity less than 1 MW in 2018, and the upcoming wind offshore auction for the Thor project. Moreover, the report contained a short summary of the auctions from before 2016.

Some key learnings are:

- Much has happened in Danish auction design since 2016. The previous focus on single-item auctions for offshore wind with a sliding premium tariff has been supplemented with multi-item and multi-technology auctions with a fixed premium. Fixed premium allows a better prediction of the amount of support provided by the government, since it is independent from the electricity market.
- The achieved reductions in support levels are significant. Solar PV and wind onshore have shown strong competition with winning and losing bids from both technologies in both 2018 and 2019 multi-technology auctions. Hybrid projects with solar PV and wind have entered the market in 2019. The ceiling prices (caps) of 70 øre / kWh (approx. €94 / MWh) for the sliding premium tariff in the Nearshore Tender, and of 6 øre / kWh (approx. €8.05 / MWh) for the fixed premium in the multi-technology tender 2019 were undercut by far.
- A citizen-based consortium had difficulties to pre-qualify for the Nearshore Tender. They claim that three months between publication of final tender specifications and final bid in the Nearshore wind energy tender was insufficient time for a citizen-owned project to assemble the consortium, structure the project, secure financing and meet all pre-qualification criteria. Currently, the Nearshore projects are on hold following complaints by local residents.
- The right given to local citizens to purchase shares was only partially successful in terms of shares sold. Project owners have ambiguous incentives towards the offering, and results are very much divergent between projects.

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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.

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