



**Auctions for Renewable Support in Denmark: Instruments and lessons learnt**  
Report D4.1-DK, December 2015

**Kitzing, Lena; Wendring, Paul; Wigan, Fabian; Förster, Sonja**

*Publication date:*  
2015

*Document Version*  
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

*Citation (APA):*  
Kitzing, L., Wendring, P., Wigan, F., & Förster, S. (2015). *Auctions for Renewable Support in Denmark: Instruments and lessons learnt: Report D4.1-DK, December 2015*. Technical University of Denmark (DTU).

---

**General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Report D4.1-DK, December 2015

# Auctions for Renewable Support in Denmark: Instruments and lessons learnt



HORIZON 2020

## About the project

### **Auctions for Renewable Energy Support: Effective use and efficient implementation options (AURES)**

This project helps assessing the applicability of different auction types to renewable support under different market conditions. It also explores which auction types and design specifications suit particular requirements and policy goals in European countries. By establishing best practices and a knowledge sharing network, we contribute to informed policy decision-making and to the success of auction implementations across Europe.

**Target-oriented analysis:** Through analysis of empirical experiences, experiments and simulation, we will create a flexible policy support tool that supports policy makers in deciding on the applicability of auction types and certain design specifications for their specific situation.

**Capacity building activities:** We undertake specific implementation cases to derive best practices and trigger knowledge sharing amongst Member States. We strive to create a strong network with workshops, webinars, bilateral meetings, newsletters, a website that will serve as capacity building platform for both policy makers and market participants (including project developers, auctioneers, etc.). Wherever required, we can set up specific bilateral and multilateral meetings on specific auction issues and facilitate cooperation and knowledge sharing. Additionally, we offer sparring on specific implementation options, drawing from insights gained during the first phases of the project (empirical analysis of previous auctions in Europe and the world), conceptual and theoretical analysis on the applicability of specific designs in certain market conditions and for certain policy goals issues and facilitate cooperation and knowledge sharing. Additionally, we offer sparring on specific implementation options, drawing from insights gained during the first phases of the project (empirical analysis of previous auctions in Europe and the world), conceptual and theoretical analysis on the applicability of specific designs in certain market conditions and for certain policy goals.

**Project consortium:** eight renowned public institutions and private firms from five European countries and combines some of the leading energy policy experts in Europe, with an impressive track record of successful research and coordination projects.

This report deals with all past and ongoing auctions for renewable support in Denmark. Since 2004, five single-item, technology-specific offshore wind auctions were held, with one more currently ongoing. One multi-item, multi-site nearshore wind auction is currently ongoing.

The report contributes to the first and second of three tasks in work package 4 of the AURES project:

- T4.1 Providing a characterisation of the different auctions
- T4.2 Making an assessment of auctions and case-specific lessons learnt
- T4.3 Interpreting and summarise the general lessons learnt and resulting and thereby outline specific recommendations

For further information please contact: Lena Kitzing (lkit@dtu.dk)



Report D4.1-DK, December 2015

Auctions for Renewable Support in Denmark: Instruments and lessons learnt

Authors:

Lena Kitzing (DTU), Paul Wendring (DTU)

With contributions from:

Fabian Wigand (ECOFYS), Sonja Förster (ECOFYS)

Project deliverable:

WP4 - Empirical aspects of auctions for RES-E: Learning from real experiences.

Task 4.1 Characteristics of auctions

Task 4.2 Assessment of auctions and case-specific lessons learnt



Technical University  
of Denmark



## Table of contents

1. Characteristics of auctions in Denmark .....	5
Design elements for the assessment of auction schemes for RES-E .....	10
2. Evaluation criteria for the assessment of auction schemes for RES-E .....	17
Actor variety and social acceptability .....	17
Stakeholder dialogue in the Horns Rev 3 auction process .....	18
Policy effectiveness (effectiveness of auctions) .....	20
Static efficiency or cost effectiveness (including transaction and administrative costs) .....	21
Dynamic efficiency .....	22
Compatibility with market principles and integration .....	24
Distributional effects & minimisation of support costs .....	24
3. Lessons learnt: key best practices and pitfalls identified .....	25

# 1. Characteristics of auctions in Denmark

Table 1. Characteristics of auctions in Denmark

Characteristics	Description
<b>Country characteristics</b>	<p>Denmark has a population of 5.7 million and annual electricity consumption of 35 TWh (ca. 1% of EU-28). With peak load of around 6.6 GW and interconnectors totalling 5.5 GW, it is well integrated in the European electricity system. Denmark is one of the leading countries in the world in terms of deployment of new renewable energies (non-hydro). The focus on renewable energy in Denmark started after the oil crisis in the 1970s, leading to the now existing ambitious climate and energy policies. In 1985, the Danish parliament decided not to build any nuclear power plants. Instead the country is today among the world leaders in wind power technology. Wind power supplied 39% of the Danish electricity consumption in 2014, while in the same year 43.5% of total energy consumption was covered by renewable energy (including biomass). Among the ambitious energy targets are<sup>1</sup>:</p> <ul style="list-style-type: none"> <li>- Energy consumption covered 100% by renewable sources in 2050</li> <li>- Power and heat supply covered 100% by renewable sources in 2035</li> <li>- Coal totally phased out by 2030</li> </ul> <p>For the year 2020 the following targets can be expected to be achieved<sup>1</sup>:</p> <ul style="list-style-type: none"> <li>- 35% renewable energy in final energy consumption</li> <li>- 50% of electricity consumption covered by wind power</li> </ul>
<b>Market characteristics</b>	<p>The Danish electricity market can be characterised as a highly liberalised market. Denmark is part of Nordpool<sup>2</sup>, with two price zones (DK1 and DK2). Market concentration in DK2 is one of the highest in the Nordic region<sup>3</sup>. Overall, the two largest players own 50% of total installed capacity (Dong Energy 39% and Vattenfall 11%, in 2013).</p>

<sup>1</sup> <https://stateofgreen.com/en/focus/on-the-path-to-a-sustainable-2050>, 10.07.2015

<sup>2</sup> Nord Pool is a power exchange formed in 1993

<sup>3</sup> <http://www.nordicenergyregulators.org/wp-content/uploads/2014/06/Nordic-Market-Report-2014.pdf>

Characteristics	Description
	<p>Several different instruments are used for the promotion of renewable energy, including feed-in tariffs, premiums, and tax incentives<sup>4</sup>. Today, fixed premiums and sliding premium tariffs are the major schemes for new installations.<sup>5</sup> Auctions for renewable support are currently used for offshore and nearshore wind.</p>
<b>Name of auction scheme</b>	<p>Two auction schemes have been used so far:</p> <ul style="list-style-type: none"> <li>- "Udbud efter forhandling" (public auction with prequalification round) for offshore wind farms Horns Rev 2, the first try of Rødsand 2, Horns Rev 3 and nearshore areas: interested investors were pre-selected by prequalification criteria in a first round and discussions and negotiations took place between this first round and the final bidding round</li> <li>- "Offentligt udbud" (pure public auction) for the second try of Rødsand 2 and offshore wind farm Anholt: No prequalification criteria was used with only one bidding round and no negotiations between investors and authorities</li> </ul>
<b>Objectives</b>	<p>The general objectives of the auctions were to efficiently achieve the ambitious renewable energy sources (RES) targets, by letting the market determine the exact level of support, and also to find the most suitable investor for the specific wind farm.</p> <p>An objective of the latest auction processes was also to establish a good balance between the interests of the investors and the public represented by the Danish Energy Agency.<sup>6</sup> This is pursued by using a participatory approach.</p>
<b>Contracting authority</b>	Danish Energy Agency (Energistyrelsen)
<b>Main features</b>	<p>The offshore wind auctions are single-item, technology specific auctions for projects with predefined size and location. For the nearshore areas, a multi-site tender was introduced, with a maximum capacity of 350 MW distributed over 6 predefined areas.</p>

<sup>4</sup> Kitzing et al. (2012), Renewable energy policies in Europe: Converging or diverging?, Energy Policy 51, 192-201, <http://dx.doi.org/10.1016/j.enpol.2012.08.064>

<sup>5</sup> <http://www.res-legal.eu/search-by-country/denmark/>, 10.07.2015

<sup>6</sup> Analyse vedrørende fremme af konkurrence ved etablering af store havmølleparker i Danmark, Deloitte Report, April 2011

Characteristics	Description
	<p>All auctions are pay-as-bid auctions for sliding premium tariffs for a fixed amount of produced electricity (corresponding to approx. 12-15 years support duration).</p> <p>The first auction was a multi-criteria auction with a prequalification round. All subsequent auctions were single-criteria auctions. The prequalification round was temporarily abolished (for 2nd try of Rødsand 2 and Anholt) but re-introduced in the later auctions (Horns Rev 3 and nearshore areas) including a participatory approach.<sup>7</sup></p>
Year of introduction	Since 2004, five auctions were held, with two more currently ongoing.
Technology focus and differentiation	Only technology specific auctions for offshore wind farms of a given installed capacity (except from the nearshore areas where the size is flexible up to a maximum limit) and placed on a pre-defined location.
Lead time before auction	<ul style="list-style-type: none"> <li>• <b>Horns Rev 2:</b> First announcement to final bid: <b>8 months</b> (Jul '04 – Feb '05) Announcement of auction conditions to final bid: <b>5 months</b> (Oct '04 – Feb '05)</li> <li>• <b>Rødsand 2, 1<sup>st</sup> try:</b> First announcement to final bid: <b>18 months</b> (Nov '04 – May '06) The project had to be retendered after the winning consortium withdrew from the contract.</li> <li>• <b>Rødsand 2, 2<sup>nd</sup> try:</b> First announcement to final bid: <b>2 months</b> (Feb '08 – Apr '08) Announcement of auction conditions to final bid: <b>2 months</b> (Feb '08 – Apr '08)<sup>8</sup></li> <li>• <b>Anholt:</b> First announcement to final bid: <b>12 months</b> (Apr '09 – Apr '10) Announcement of auction conditions to final bid: <b>12 months</b> (Apr</li> </ul>

<sup>7</sup> Design features of support schemes for renewable electricity, ECOFYS Report, January 2014

<sup>8</sup> Note that the short lead time could only be realised because the auction was a simplified repetition from the previous one for the same wind farm.

Characteristics	Description
	<p>'09 – Apr '10)</p> <ul style="list-style-type: none"> <li>• <b>Horns Rev 3:</b> First announcement to final bid: <b>14 months</b> (Dec '13 – Feb '15) Announcement of auction conditions to final bid: <b>9 months</b> (June '14 – Feb '15)</li> <li>• <b>Nearshore areas:</b> First announcement to final bid: <b>expected 14 months</b> (Feb '15 – Apr '16) Announcement of auction conditions to final bid: <b>expected 11 months</b> (May '15 – Apr '16)</li> <li>• <b>Kriegers Flak (upcoming)</b> First announcement to final bid: <b>expected 18 months</b> (May '15 - Nov '16) Announcement of auction conditions to final bid: <b>expected 13 months</b> (Oct '15 – Nov '16)</li> </ul> <p>The auctions are first announced in the Official Journal of the European Union.</p>
<b>Min. / max. size of project</b>	<p>Auctioned sizes were 200 MW (Horns Rev 2 and Rødsand 2), 390-400 MW (Anholt) and 390-410 MW (Horns Rev 3), which had to be fully covered by one single bidder. In the nearshore areas, a total capacity of 350 MW is auctioned which can be covered by multiple bidders.</p>
<b>What is auctioned?</b>	<p>Capacity with guaranteed tariff (sliding premium) paid for produced electricity during a predetermined amount of production.</p> <p>In detail, the following capacities were tendered with the respective awarded tariffs:</p> <ul style="list-style-type: none"> <li>• <b>Horns Rev 2:</b> 200 MW capacity, support paid for 10 TWh production Contracted price: 51.8 øre / kWh (approx. €6.9 cent / kWh)</li> <li>• <b>Rødsand 2 (1<sup>st</sup> try):</b> 200 MW capacity, support paid for 10 TWh production Contracted price: 49.9 øre / kWh (approx. €6.7 cent / kWh)</li> </ul>

Characteristics	Description
	<ul style="list-style-type: none"> <li>• <b>Rødsand 2 (2<sup>nd</sup> try):</b> 200 MW capacity, support paid for 10 TWh production Contracted price: 62.9 øre / kWh (approx. €8.5 cent / kWh)</li> <li>• <b>Anholt:</b> 390-400 MW capacity, support paid for 20 TWh production Contracted price: 105.1 øre / kWh (approx. €14.1 cent / kWh)</li> <li>• <b>Horns Rev 3:</b> 390-410 MW capacity, support paid for 20 TWh production Contracted price: 77.0 øre / kWh (approx. €10.3 cent / kWh)</li> <li>• <b>Nearshore areas:</b> Total capacity up to 350 MW, support paid for 50,000 full-load hours of production</li> <li>• <b>Kriegers Flak:</b> 600 MW capacity, support paid for presumably 30 TWh production</li> </ul> <p>The duration of support is for all wind farms contracted for a fixed amount of production that corresponds to 50,000 full load hours. With a potential of around 4,000 full load hours per year, the expected support period is 12-15 years.</p>
<p><b>Budgetary expenditures per auction and per year</b></p>	<p>There is no limit on the annual expenditures through the support scheme. Support payments are financed through a Public Service Obligation (PSO) charge on the electricity consumer bill.</p> <p>There has been no price cap on the offshore auctions. The ongoing auction for the nearshore areas has a price cap of 70 øre / kWh (approx. €9 cent / kWh)</p>
<p><b>Frequency of auctions</b></p>	<p><b>5 auctions were held until now:</b></p> <p>Feb. 2005: Horns Rev 2  May 2006: Rødsand 2, 1<sup>st</sup> try  Apr. 2008: Rødsand 2, 2<sup>nd</sup> try  Apr. 2010: Anholt  Feb. 2015: Horns Rev 3</p> <p><b>Two auctions are in progress:</b></p> <p>Apr. 2016: nearshore areas</p>

Characteristics	Description
	Nov. 2016: Kriegers Flak  No fixed frequency of auctions can be determined.
Volume of the tender	2 x 200 MW offshore wind capacity (Horns Rev 2, Rødsand 2) 1 x 390-400 MW offshore wind capacity (Anholt) 1 x 390-410 MW offshore wind capacity (Horns Rev 3) 1 x 350 MW offshore wind capacity in nearshore areas (6 predefined nearshore areas)  1 x 600 MW offshore wind capacity (Kriegers Flak)
Auction design elements	See Table 2.

## Design elements for the assessment of auction schemes for RES-E

Table 2. Design elements of auction schemes in Denmark

Design elements	
Single- or multiple-item auctions	Single item auctions for large scale offshore wind farms where one tenderer has to provide the whole tendered capacity. In case of the nearshore areas, a multiple item auction is used where multiple bidders can be awarded up to the total auctioned capacity. 6 possible sites are predefined. Conditional bidding for two sites as well as mutually exclusive bids are allowed.
Auction procedure	Static sealed bid auctions were used in all cases. In the cases of Horns Rev 2, Horns Rev 3, the first try of Rødsand 2, the near shore areas and Kriegers Flak, 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. No information about the bid price of the competitors was published <sup>9</sup> . 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. For the nearshore auctions and Kriegers Flak, a preliminary technical dialogue between potential bidders and the contracting

<sup>9</sup> tender conditions for Horns Rev 3 Offshore Wind Farm of June 23, 2014

Design elements	
	authority were held before the tender specifications were announced the first time <sup>10</sup> .
<b>Pricing rules</b>	Pay-as bid auction was used in all cases. Since most auctions are single item auctions there was no clearing price and the winner of the tender received its bid price. Also in the multiple item nearshore auction, there will be no uniform price, but pay-as bid for each awarded investor.
<b>Ceiling price</b>	Only in case of the nearshore wind farms a price cap of 70 øre/kWh is introduced. No ceiling prices were introduced to the large scale offshore windfarms. Nevertheless, all final support levels have to be ratified by the national parliament and included into the renewable support law. In case of Anholt, prior to ratification, the energy ministry issued a third party investigation (by Ernst & Young) of the winning bid price, who considered it as reasonable <sup>11</sup> .
<b>Qualification criteria</b>	<p>A general prequalification criterion is that bidders must not have debt to public authorities exceeding DKK 100,000 (€13,417), which is standard for all public tenders in Denmark. For Anholt and the second try of Rødsand 2, no other criteria were specified. For the other auctions, the criteria are listed below:</p> <ul style="list-style-type: none"> <li>• <b>Horns Rev 3<sup>12</sup>:</b> <ul style="list-style-type: none"> <li>- Letter of intent from a financial institution of demand guarantee of DKK 100 million (€ 13.4 million)</li> <li>- 1 reference of operation and maintenance of an offshore windfarm of more than 25 MW installed capacity</li> <li>- Up to 5 references of development and management of construction regarding offshore wind farms, at least one with a minimum size of 100 MW installed capacity</li> <li>- Minimum annual average turnover of DKK 15 billion (€2 billion) over the last 3 years available</li> <li>- Equity ratio<sup>13</sup> of 20% or above <b>OR</b> long term debt rating of BBB- or above (Standard &amp; Poor's and Fitch) or Baa3 or above (Moody's)</li> </ul> </li> </ul>

<sup>10</sup> Summary of technical dialogue connected to nearshore wind farms, Energistyrelsen Okt. 2014

<sup>11</sup> Klima – og Energiministeriet, Tredjepartsvurdering af Anholt Havvindmøllepark, june 2010

<sup>12</sup> Contract notice for Horns Rev 3 for the official journal of the European Union, December 2013

<sup>13</sup> Total equity/total assets x 100

## Design elements

- Suggestions for the negotiations taking part between the two bidding rounds
- Social clause on apprenticeships, which ensures that a certain (individual) number of trainees is used in the construction of the wind farm
- Specification of type of turbine and foundation likely to be used in the project

In the case of Horns Rev 3 a maximum number of 10 applicants should be invited to the auction. If more applicants met the minimum requirements a reduction would have taken place on the basis of <sup>14</sup>

1. Most relevant references regarding project development and management of construction of offshore wind farms
2. Most relevant use of systems as Environmental, quality and risk management systems

Where more focus is put on the criteria under (1.)

- **Horns Rev 2:**
  - Information about the financial situation and the technical experiences of the applying company:
  - Documentation of the balance and turnover of the last available year together with a declaration that the actual financial and technical capacity is not significantly lower compared to that.
  - Documentation of experience in wind energy projects including offshore wind-farms with information about size of the project, pictures, technical capacity, participating companies and experience in quality management.

The exact selection criteria were not further expressed in advance, but the selection of prequalified bidders (maximum five) was based on the provided information above.<sup>15</sup>

<sup>14</sup> Contract notice for Horns Rev 3 for the official journal of the European Union, December 2013

<sup>15</sup> Contract notice for Horns Rev 2 for the official journal of the European Union, July 2004

Design elements	
	<ul style="list-style-type: none"> <li>• <b>Nearshore areas:</b> <ul style="list-style-type: none"> <li>- 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</li> <li>- 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</li> <li>- Equity ratio<sup>16</sup> of 20% or above <b>OR</b> long term debt rating of BBB- or above (Standard &amp; Poor's and Fitch) or Baa3 or above (Moody's)</li> </ul> </li> </ul>
<b>Penalties</b>	<p>For the first two auctions (Horns Rev 2 and Rødsand 2) no penalties were introduced. For the Anholt and Horns Rev 3, the following penalties were introduced, which had to be provided as bank guarantees until the conditions were fulfilled.</p> <ul style="list-style-type: none"> <li>• <b>Anholt:</b></li> </ul> <p>In case of <b>delayed grid connection of the first turbine</b>, the following is deducted from the contracted guaranteed price for the whole support period:</p> <ul style="list-style-type: none"> <li>- delay of 1-3 months: 1 øre/kWh (approx. €0.13 cent / kWh)</li> <li>- delay of 4-8 months: 2 øre/kWh (approx. €0.26 cent / kWh)</li> <li>- delay of 9-12 month: 3 øre/kWh (approx. €0.39 cent / kWh)</li> </ul> <p>In case of <b>delayed grid connection of the last turbine</b>, i.e. if not all turbines are online until 31.12.2013, the following penalties apply:</p> <ul style="list-style-type: none"> <li>- DKK 100 million (€ 13.4 million) if delay is announced within 5 months after entering the concession agreement</li> <li>- DKK 200 million (€26.8 million) if delay is announced within 12 months after entering the concession agreement</li> <li>- Otherwise DKK 400 million (approx. €53.7 million)</li> </ul>

<sup>16</sup> Total equity/total assets x 100

## Design elements

This penalty functions also as a non-compliance penalty. The fine of DKK 400 million (€53.7 million) amounts to approx. 2% of the total granted revenues (with the winning price of 105.1 øre / kWh or €14 cent / kWh).

The grid connection was contracted to start on 31.12.2012, approx. 32 month after the final bid was placed (07.04.2010). The grid connection requirement was formally declared to be met when the first kWh of electricity is delivered from the offshore wind farm to the grid<sup>17</sup>.

In the Anholt tender, a stand-by requirement was established, which obliged the second bidder to be stand-by for 6 month and overtake the project with the same time schedule at their own bid price in case the winner opts-out.

- **Horns Rev 3:**

In case of **delayed construction work**, i.e. if construction starts later than 01.01.2019, or if the concessionaire will not after all construct the electric power generating plant, the following penalties apply:

- DKK 100 million (€13.4 million) if delay announced within 4 months after entering the concession agreement
- Otherwise DKK 300 million (€40.5 million)

In case of **delayed grid connection**, i.e. if less than 95% of the wind turbines are connected to the grid by 01.01.2020, the production eligible to support will be reduced by 0.2 TWh and again by 0.2 TWh for each subsequent 6 months the 95 % grid connection is not yet achieved<sup>18</sup>.

Comparing Anholt and Horns Rev 3 taking the different wind farm sizes into account, we find that non-compliance penalty has been reduced by 50%. At the same time the penalty for delayed performance was relaxed, because it falls in the end of the support period and not stretched over the whole period as before (since the support duration is cut in and not the support level).

- **Nearshore areas**

- Non-compliance penalty, i.e. when withdrawing from an awarded

<sup>17</sup> Tender specifications for Anholt offshore wind farm, April 2009

<sup>18</sup> Tender specifications for Horns Rev 3 offshore wind farm, Appendix 1, part 5, December 2014

Design elements	
	<p>concession:</p> <ul style="list-style-type: none"> <li>- DKK 100 million (€13.4 million) per concession awarded</li> <li>- In case of delayed grid connection, i.e. if less than 95% of the wind turbines are connected to the grid by 01.01.2021, the following penalties apply: <ul style="list-style-type: none"> <li>- The production eligible for support is reduced by 0.1 TWh, and further reduced by 0.1 TWh for each subsequent 6-month period where 95% grid connection is not achieved.</li> </ul> </li> <li>• <b>Kriegers Flak</b> <ul style="list-style-type: none"> <li>- It is planned to use the same penalty scheme for delay as for Horns Rev 3.</li> </ul> </li> </ul>
<b>Monitoring of realisation progress</b>	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.
<b>Exceptions from requirements for small plants/developers?</b>	No exceptions from requirements were given. The participants in the offshore windfarm auctions were expectedly big companies. If a consortium of multiple smaller bidders wants to take part in the auction procedure, the prequalification criteria (if existing) have to be met for the sum of all companies involved.
<b>Support auctioned</b>	In all auctions three licenses concerning the conduction of preliminary studies, the construction of a power plant and the exploration of wind power for a certain total installed capacity were tendered. The award criterion was in all cases the price in øre per kWh produced electricity paid as a guaranteed fixed feed-in tariff until a certain amount of electricity is produced. The early tenders of Horns Rev 2 and Rødsand 2(in the first try) had additional award criteria, such as the placement of the farm in a specified area and the time plan for construction.
<b>Transferability of support right</b>	The transferability of the support rights is until now 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. <sup>19</sup>

<sup>19</sup> <https://www.retsinformation.dk/FOrms/R0710.aspx?id=167872#Kap5>, §37

## Design elements

In the past, several changes in ownership have taken place after signing the concession:

In 2013, E.ON *Vind Sverige* sold an 80% stake of Rødsand 2 to SEAS-NVE, retaining the remaining 20% stake.<sup>20</sup>

In 2011 (before the actual construction work began), DONG Energy sold a 20% stake of the Anholt wind farm to *Pensionskassernes Administration A/S* and a 30% stake to PensionDenmark.

The contracting authority (Danish Energy Agency) has to a priori approve ownership changes. Here, they differentiate depending on where in the process (of construction or operation) the wind farm is. The more time has passed since the auction, the easier an ownership change will be. It is expected that new owners must at least fulfil all pre-qualification criteria.

For the most recent auction (*Kriegers Flak*), new information regarding the issue of transferability was published in June 2015<sup>21</sup>. This is a pro-active step by the Danish Energy Agency to enhance legal and economic investor security. It is envisaged that the transferability will be decided by the Danish Energy Agency on a case-by-case basis. In general, it will be possible to accept changes resulting from universal or partial succession into the position of the initial concessionaire, following corporate restructuring, including takeover, merger, acquisition or insolvency. Transfer of the contract to a 100% owned and controlled subsidiary is expected to be possible. All parties taking part in a possible transfer must at least fulfil the prequalification requirements for the tender.

<sup>20</sup> <http://www.eon.com/en/media/news/press-releases/2013/11/13/eon-sells-80-percent-share-of-rodsand-ii-offshore-wind-farm-to-seas-nve.html>, 07.08.2015

<sup>21</sup> "Subsequent changes of a tenderer", new offshore wind tenders in Denmark, Energistyrelsen, 18.06.2015

## 2. Evaluation criteria for the assessment of auction schemes for RES-E

*From here onward, the auctions of the nearshore areas and Kriegers Flak are only partly taken into account since they are still in an early stage.*

### Actor variety and social acceptability

Mainly big, experienced energy companies were taking part in the auctions. This is partly due to the large scale nature of offshore wind projects, and partly due to the pre-qualification criteria requiring significant experience in the construction and operation of offshore wind farms. Nevertheless, the actors were mainly Danish, Swedish and in one case Dutch investors. Thus, a low level of international participation was achieved. In the first two auctions the auction material was only published in Danish, while in the following auctions the material was also available in English.

In the nearshore auction, two of the three prequalified participants have not taken part in any of the previous offshore auctions in Denmark.

As a measure to increase local support and social acceptability of the nearshore development, the concessionaires have to offer least 20% of the ownership shares of the nearshore wind farms to local citizens at cost price (option-to-purchase scheme, similar to onshore requirements).

The following investors took part in the auction:

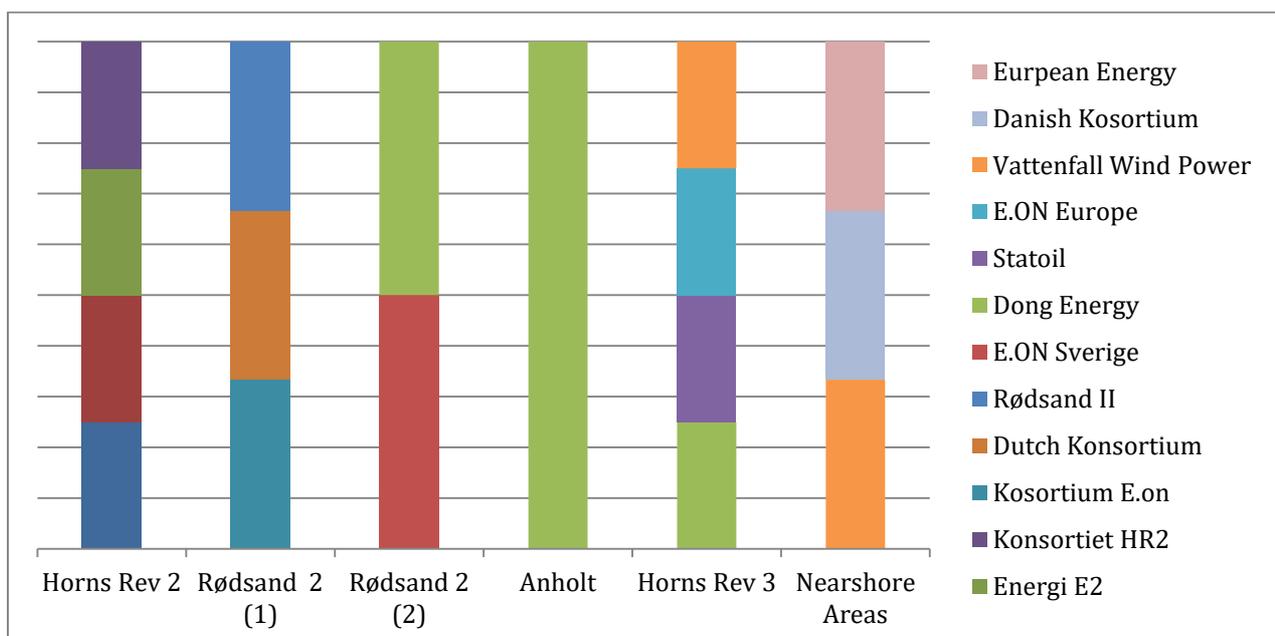


Figure 1- actor variety in the different auctions

- **Horns Rev 2:**
  - DONG Vind A/S (**winner**)
  - Elsam Kraft A/S
  - Energi E2 A/S
  - Konsortiet Horns Rev 2 (including 7 construction and investment companies, which are namely: Skovgaard Invest ApS, Petri Holding ApS, Dansk Vindenergi ApS, PMN Holding ApS, GK Gruppen ApS, Vindenergi ApS, samt Wind Investment ApS)
- **Rødsand 2, 1<sup>st</sup> try:**
  - Konsortium of E.ON Vind Sverige AB, Energi E2 A/S and DONG Vind A/S (**winner**)
  - Dutch consortium of Ballast Nedam Infra BV and velop BV
  - Rødsand II A/S (Vattenfall Wind Power A/S as main shareholder)
- **Rødsand 2, 2<sup>nd</sup> try:**
  - E.ON Vind Sverige AB (**winner**)
  - DONG Energy A/S
- **Anholt:**
  - DONG Energy A/S (**winner**)
- **Horns Rev 3:**
  - Statoil ASA
  - E.ON Wind Europe AB
  - Vattenfall Wind Power A/S (**winner**)
  - DONG Energy A/S
- **Nearshore areas:**
  - wpd/HOFOR Danish Offshore Consortium (wpd AG and HOFOR A/S)
  - European Energy Nearshore Consortium (European Energy A/S and two international investors)
  - Vattenfall Vindkraft A/S
- **Kriegers Flak**
  - 8 companies applied for pre-qualification

## Stakeholder dialogue in the Horns Rev 3 auction process

In the auction process of Horns Rev 3 a strong focus was placed on stakeholder dialogue. Meetings with pre-qualified bidders were reintroduced, after the lack of possibility for investors to discuss the auction conditions before submitting the final offer had been identified as a reason for the low participation in the Anholt auction

process<sup>22</sup>. These meetings were described as very helpful for the overall process by the contracting authority as well as the interested investors. For that reason further details of the content and the organisational framework are described below.

The following figure shows the timeline of the auction procedure for Horns Rev 3:

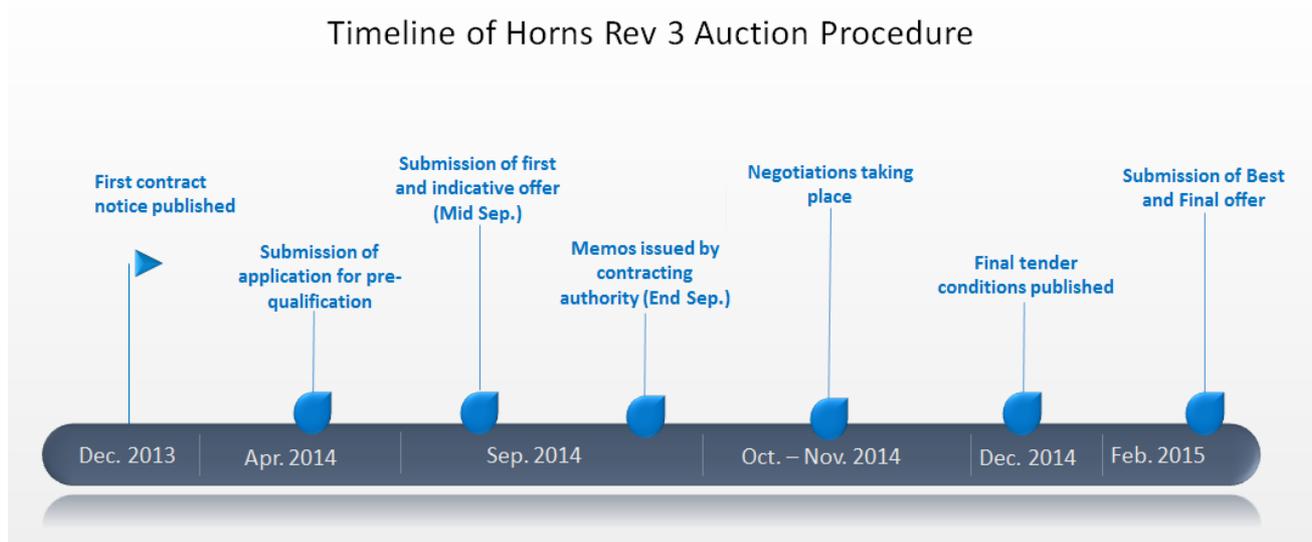


Figure 2: Timeline of Horns Rev 3 Auction Procedure

The meetings took place at the facilities of the Danish Energy Authority directly after the submission of the first and indicative offer of the prequalified investors. In relation to that, the potential investors were asked to prepare a document of maximum five pages stating seven suggestions for adjustment of the tender material which would help reducing the costs of construction and operation of the offshore wind farm and result in a lower final offer. In these, the estimated total impact of the suggestions on the final bidding price should be stated in øre/kWh.<sup>23</sup>

However, the following elements were excluded from negotiation:

- The location and area of the wind farm
- The permitted size of the offshore wind farm (min 390 MW and max 410 MW).
- Award criteria, including the method of settlement.
- The completion date.
- The penalty for non-compliance.
- The decommissioning obligation - but not the guarantee in connection to this.

After receipt of the first indicative offers and prior to the meetings, the Danish Energy Agency issued a memo with the subjects and questions to be negotiated. It was stated that at least one separate negotiation meeting

<sup>22</sup> Analyse vedrørende fremme af konkurrence ved etablering af store havmølleparker i Danmark, Deloitte Report, April 2011

<sup>23</sup> Preliminary tender conditions for Horns Rev 3 Offshore Wind Farm, June 23, 2014

will be held with each potential investor and that all will be invited to the same amount of meetings with the same time allocated to each. However, the exact number of meetings as well as the minutes of the meetings or even the topics discussed was not published. The meetings were not public and treated confidentially. The participants received minutes from the meetings in which they have participated but not minutes from meetings with other potential investors.<sup>22</sup>

After all meetings have been held the Danish Energy Agency decided to implement the following significant changes to the tender conditions<sup>24</sup>:

- The time for submission of best and final offer was postponed by 14 days to the 16 February 2015.
- A number of dates regarding information and deliveries from the concessionaire have been postponed by 1-3 months in order to provide more time for the concessionaire to comply with its obligations.
- The period in which the bidders are obliged to uphold their offers has been reduced to 5 months.
- The deadline for the legislative amendment has been shortened to 15 July 2015.
- The buffer zone to be kept clear has been extended from 2/4 km to 4/6 km. Part of the extension is limited in time until 2032.
- The cap for compensation in case of delayed grid connection has been increased from DKK 400 million (€53.6 million) to DKK 800 million (€107.4 million).
- The guarantee requirement for the decommissioning obligation has been reduced from DKK 600 million (€80.5 million) to DKK 400 million (€53.6 million). It is at the same time emphasised that security requirements cannot be made until 12 years after connection to the grid of the first turbine. This, however, does not change the fact that the concessionaire is obliged to pay all costs of decommissioning the farm, irrespective of whether the costs are above or below this amount.
- Preliminary studies may be undertaken by the concessionaire directly, so that the concessionaire does not have to await the end of the 4 week time period in which complaints against the concession decision may be brought up. Use of the license, however, is the responsibility of the concessionaire.
- If investigations and removal of UXOs (unexploded bombs at the sea-bed) significantly exceed what should reasonably have been expected by the concessionaire on the basis of the preliminary studies carried out by Energinet.dk, a time extension may be applied for the construction of the offshore wind farm.

## Policy effectiveness (effectiveness of auctions)

In the end, 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 - the winning consortium suggested renegotiation of the support price and finally withdrew from the contract, so the auction had to be repeated. Looking into delays, we find that in the first two auctions (Horns Rev 2 and Rødsand 2) the schedule for the construction of

---

<sup>24</sup> Final tender conditions for Horns Rev 3 Offshore Wind Farm, December 2014

the farm was 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<sup>25</sup>, realized on 17.09.2009
- **Rødsand 2:** scheduled for 01.01.2010<sup>26</sup> (in the 1<sup>st</sup> try) and for 30.09.2011<sup>27</sup> after the re-tender, realized on 15.08.2010

For Anholt and Horns Rev 3 the realization 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<sup>28</sup>, realized on 19.06.2013
- **Horns Rev 3:** scheduled for 31.12.2020<sup>29</sup>

In the case of Rødsand 2 a project delay of 20 month assuming the first scheduled realization 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)<sup>30</sup>. In this case, it can be discussed if underbidding took place, also considering the fact that the winning party of the re-tender was E.ON Sverige, who also was part of the winning consortium in the first auction.

### Static efficiency or cost effectiveness (including transaction and administrative costs)

As the auctions were specifically undertaken for offshore wind, they did not have the objective to select the lowest cost option per unit of renewable energy production possible (offshore wind is still approx. twice as expensive as e.g. onshore wind). The auctions should, however, ensure that the projects are realised at least costs. Total generation costs can in this respect be minimised by two elements: 1) ensuring that the investor with the least cost (the best efficiency, highest synergies, etc.) realises the project; 2) avoid unnecessary increases of private transaction cost or administrative costs.

In the Anholt tender, only one bidder participated in the auction. Here, it is questionable that the auction helped identifying the least-cost supplier. In an analysis of the Anholt auction process, Deloitte<sup>31</sup> identified the main reasons for investors not taking part in the auction as: 1) the high penalties connected to delays combined with a tight schedule; 2) the possibility of participating in offshore auctions on financially more attractive markets at the same time, especially in UK. Furthermore a clear policy for future Danish wind farms was lacking and so synergy effects to possible later projects were difficult to estimate. Overall, the inflexible design of the auction without the possibility of negotiations and proposals made the participation unattractive.

---

<sup>25</sup> Tilladelse til etablering af elproduktionsanlæg samt internt ledningsnet Horns Rev 2, Energistyrelsen March 2007

<sup>26</sup> <http://ing.dk/artikel/ingen-vil-bygge-dansk-havmøllepark-84309>, ingeniøren 21.12.2007, looked up at: 12.07.2015

<sup>27</sup> Tilladelse til etablering af elproduktionsanlæg Rødsand 2 med internt ledningsnet, Energistyrelsen May 2008

<sup>28</sup> Tender specifications for Anholt offshore wind farm, April 2009

<sup>29</sup> tender conditions for Horns Rev 3 Offshore Wind Farm of June 23, 2014

<sup>30</sup> <http://ing.dk/artikel/molle-fiasko-fordobler-danskernes-regning-gron-strom-84319>, ingeniøren 21.12.2007, looked up at: 12.07.2015

<sup>31</sup> Analyse vedrørende fremme af konkurrence ved etablering af store havmølleparker i Danmark, Deloitte Report, April 2011

Regarding private transaction cost, while in the first two auctions (Rødsand 2 and Horns Rev 2) all preliminary studies and impact assessments had to be undertaken by the market players, these costs are now in their entirety minimised in the sense that e.g. environmental impact assessments are undertaken before the auction and thus do not have to be repeated several times by different actors. Also, the national TSO is responsible for grid connection from an offshore substation to land, and thus bidders are relieved of that burden.

There has been made no estimation about the transaction and planning costs related to the realisation of the auctions yet. Roughly 1.5 – 3 person years (full-time equivalent) were required for the preparation and realisation of the auctions for Horns Rev 3 and Kriegers Flak.

The bidders do not have to pay a certain fee in order to compensate the contracting authority for their expenses.

Furthermore, there has been no special training or education of staff before the auction processes. Several types of consultants have been used for technical, economical and legal questions (as Deloitte or Ernst & Young). A budget of DKK 12 million (€1.6 million) to be used between 2012 and 2015 was dedicated to preparation and marketing of the Danish auction implementation in the political agreement from 2012 (energiaftale)<sup>32</sup>, which was used for consultants and the (international) marketing of the auctions.

## Dynamic efficiency

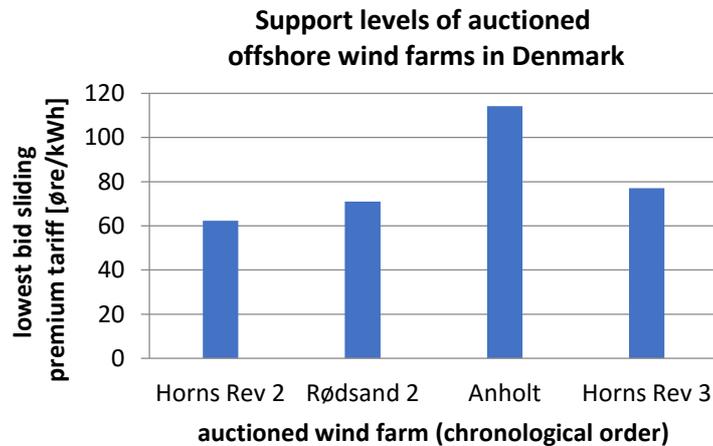
Since all auctions have been technology specific auctions for offshore wind farms, they support the development of offshore wind technology, with respective cost decreases to be expected. The described auctions increased the total installed wind capacity in Denmark from 455.2 MW before the auctions to currently 1271.5 MW, and 1671.5 MW including the already contracted Horns Rev 3.

When taking the required support level as a proxy for the technology cost, we see that it has an increasing trend over the time from 51.8 øre / kWh or €7 cent / kWh (Horns Rev 2, 2005 prices) to 77 øre / kWh or €10 cent / kWh (Horns Rev 3, 2015 prices) as can be seen in the following graph (prices are adjusted for inflation<sup>33</sup>):

---

<sup>32</sup> "Aftale om den danske energipolitik 2012-2020", march 2012 : [http://www.ens.dk/sites/ens.dk/files/politik/dansk-klima-energipolitik/politiske-aftaler-paa-energiomraadet/energiaftalen-22-marts-2012/Aftale\\_22-03-2012\\_FINAL\\_ren.doc.pdf](http://www.ens.dk/sites/ens.dk/files/politik/dansk-klima-energipolitik/politiske-aftaler-paa-energiomraadet/energiaftalen-22-marts-2012/Aftale_22-03-2012_FINAL_ren.doc.pdf)

<sup>33</sup> Yearly inflation rates by consumer price index of Danmarks Statistic



The high price in the Anholt auction has been justified (in the third party investigation of Ernst & Young<sup>34</sup>) by the increased costs of wind turbines and installation equipment (especially construction ships). This was mainly caused by supply bottlenecks caused by many simultaneous offshore wind projects in other European countries<sup>19</sup>.

Such distortional external effects should be taken into account when evaluating the long-term impact technology cost.

Furthermore, the overall cost of offshore wind farms are very much depending on locational and environmental factors. Major driving factors include distance to shore and water depth. An overview of these is shown in the following table.

wind farm	distance from center to shore [km]	depth range from [m] to [m]	
<b>Horns Rev 2</b>	32.6	9	17
<b>Rødsand 2</b>	9.0	6	12
<b>Anholt</b>	22.6	12	19
<b>Horns Rev 3</b>	29.6	11	20

Distance to shore and water depths do not seem to be the major reason for price increases. However, it can be seen that for example the higher price for Horns Rev 3 compared to Rødsand 2 can be partly caused by higher depth and longer distance to shore.

Additionally, the support levels are not a perfect proxy for technology costs, as they also depend on electricity market price forecasts, which play an important role for the time after the support period (12-14 years from start of operation). Here, we can see that forecasts had previously included much higher price expectations than in the years during and after the crisis.

<sup>34</sup> Tredjepartsvurdering af Anholt Havvindmøllepark, Klima – og Energiministeriet june 2010

## Compatibility with market principles and integration

All auctioned wind farms receive sliding premium tariffs as support scheme. Therefore, the operators have to participate actively on the spot market and are well integrated in the liberalised electricity market.

The sliding premium is paid out as the difference between the guaranteed price and the spot price and calculated specifically for each hour, using actual hourly based measured production of each wind farm individually as reference production. Forecast risks and balancing costs thus apply for the offshore wind farm operator in the same way as for 'normal' market participants. Participation of the operator on the balancing market does not affect the support payments.

The sliding feed in premium is designed as a firm cap, leaving no market price upside to the operators. In case the spot price is higher than the guaranteed price, no support payments are paid out and additionally, the gained upside is used to offset the support payments in the following accounting period.

For the last two auctions (Anholt and Horns Rev 3), production is not eligible for support payments whenever negative spot prices occur. This measure minimises the adverse incentive of producing in spite of negative prices that premiums usually give and incentivises the operator to shut down wind production in periods where production is larger than demand.

## Distributional effects & minimisation of support costs

Regarding minimisation of support costs, Denmark has technology-specific targets, so the minimisation is not regarded across all technologies, but rather per wind park development. Here, the pay-as-bid pricing in the auctions should in principle lead to lower support costs per plant than e.g. a less flexible feed-in tariff where support levels are determined by law. This then leads in terms of distributional effects to relatively higher consumer surplus in relation to producer surplus, meaning that windfall profits for producers are minimised.

We find that the first two auctions (Horns Rev 2 and Rødsand 2) led to a support level of 51.8 øre / kWh (€6.9 cent / kWh) and 62.9 øre/kWh (€8.5 cent / kWh) respectively. This is arguably a low level compared to other European offshore wind farms in UK or Germany.

The Anholt auction with 105.1 øre / kWh (€14.1 cent / kWh) led arguably to a high support costs, for the reasons explained above.

Horns Rev 3 resulted in a support level 77 øre/kWh (€10.3 cent / kWh), which has been deemed a successful minimisation of support cost for an offshore wind park in the Danish discussions<sup>35</sup>.

Overall, the support of renewable energy in Denmark makes today approx. 10% of a typical household electricity bill<sup>36</sup>, which is relatively low in a European comparison considering the large share of renewables in the Danish system. In 2014, the support for offshore wind (mainly determined from the auctions) made 53% of

---

<sup>35</sup> see e.g. <http://www.4coffshore.com/windfarms/horns-rev-3-winner---vattenfall-@-%800.1031-per-kwh-nid1402.html>

<sup>36</sup> Kitzing, L. (2014), "Risk Implications of Energy Policy Instruments", PhD Thesis, Technical University of Denmark, <http://orbit.dtu.dk/en/publications/risk-implications-of-energy-policy-instruments%288d770b85-a75c-45c3-9a2e-e5740b0b907e%29.html>

the total support payments. This dominance is expected to increase to approximately 70% after Horns 3 and Kriegers Flak are implemented<sup>27</sup>. Auction design is thus a highly significant factor for the minimisation of support costs in Denmark.

### **3. Lessons learnt: key best practices and pitfalls identified**

- 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 e.g. puts them in a better position towards loan-giving banks.
- In the timing of the auction, simultaneousness with other international auctions should be avoided.
- An early clarification of transferability options regarding the support concession increases investor security. They should be best already stated in the tender descriptions.