Deloitte.

BASREC

Strategy outline for wind power development in the Baltic Sea Region

Presented by Martin Enevoldsen
Senior Manager | Strategy department
Deloitte Copenhagen

BASREC-wind stakeholder seminar, 27th April, Stockholm

Agenda of the presentation

- Strategic selection of attractive future offshore wind areas in the BSR
- How to get there: Lessons to be learned from the forerunners: DK and G
- Two scenarios for future development of offshore wind energy in BSR
- Recommendation of strategic initiatives for Scenario 1 and 2
- Benefits and costs of offshore wind power vs. alternative electricity supply in the BSR

1) Strategic selection of attractive future offshore wind areas in the BSR

- As part of the method to identify attractive areas for offshore wind deployment in the BSR, the following criteria have been applied:
  - **Cost of energy**. Conditions that determine the basic cost effectiveness of offshore wind sites (including wind speed, distance to shore, and water depth)
  - **Hard constraints** ("show-stopping" conflicting area interests)
  - **Soft constraints** in the form of shipping (ship transits) and fishery (kilo-tons landed),
  - **Regional electricity demand**
  - **Potentials for grid links to the continental power system**.
  - **Local employment and growth stimulation**.

1) Strategic selection of attractive future offshore wind areas in the BSR
- considering environmentally protected areas (I)

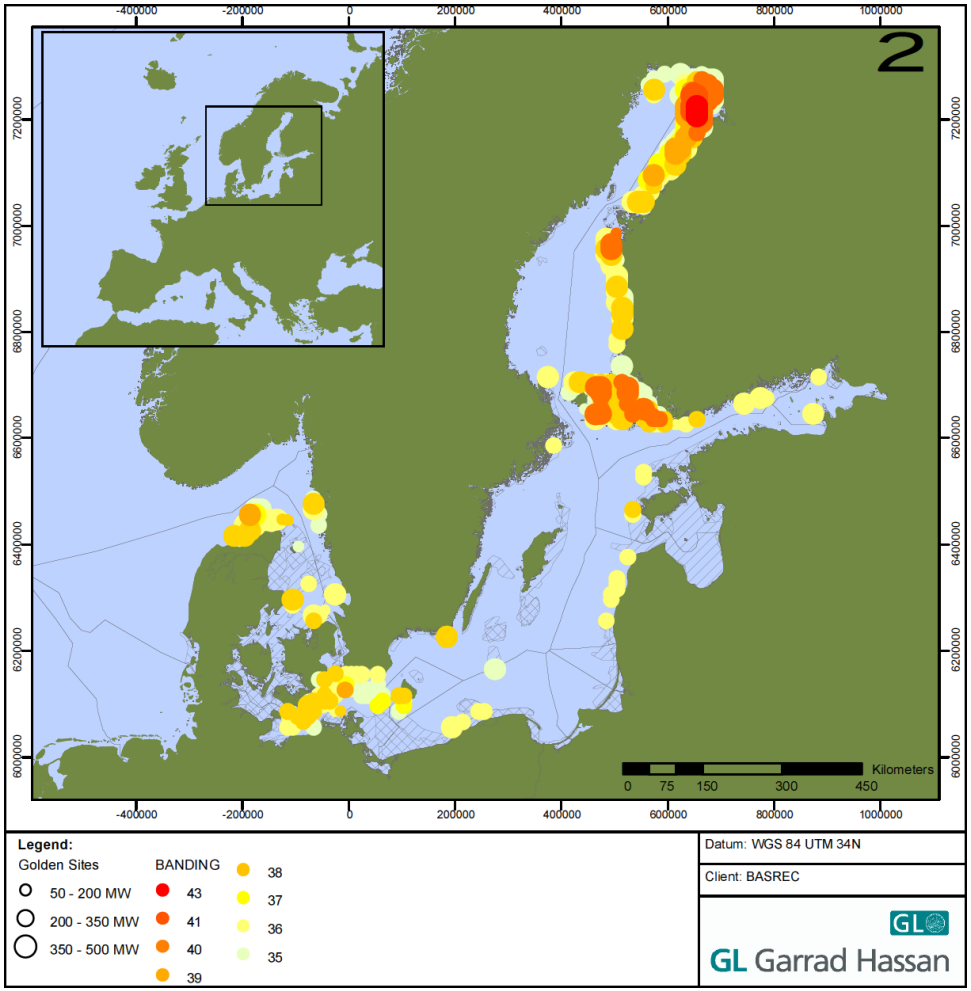
- **Enough attractive capacity remains** to make the countries fulfill their NREAP targets and even to become world-leading in terms of offshore wind energy deployment – even if environmentally protected areas and designated bird areas are excluded

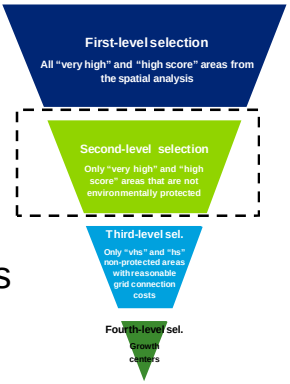
Total capacity in the very high and high score bands before and after excluding protected areas

Country	Constrained capacity [MW] – very high score areas (+40)		Constrained capacity [MW] – high score areas (35-39)	
	Capacity after hard constraints	Capacity after excl. protected areas	Capacity after hard constraints	Capacity after excl. protected areas
Denmark	1,607	201	44,345	21,430
Estonia	966	83	14,500	1,346
Finland	17,883	16,651	73,483	67,989
Germany	87	-	5,718	2,774
Latvia	-	-	5,839	2,542
Lithuania	-	-	1,830	107
Norway	-	-	-	-
Poland	-	-	4,698	2,003
Russia (Kaliningrad) + Leninggrad prov.	-	-	3,059	1,160
Sweden	203	-	22,441	14,507
Total (MW)	**20,746**	**16,935**	**159,911**	**113,857**

1) Strategic selection of attractive future offshore wind areas in the BSR
- considering environmentally protected areas (II)

Golden sites after excluding environmentally protected and bird areas



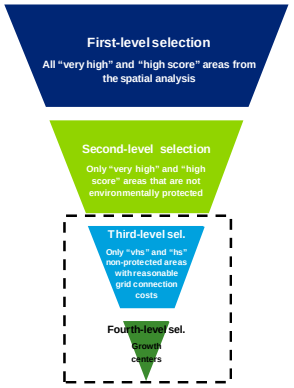


- **Conclusion**: environmental consequences should be considered very carefully before designating out areas for future offshore wind development in the BSR as it may be both costly and in the end prove infeasible to develop sites that conflict with environmental interests.
- On the other hand, all protected areas and bird areas should be ruled out on beforehand since in some cases there may be practical and technical solutions available to deploy offshore wind farms in small parts of such areas at low costs

1) Strategic selection of attractive future offshore wind areas in the BSR

- taking into account electricity demand and grid costs – and growth effects

- For some of the most attractive areas measured by the other criteria– such as the central and northern group in Finland and areas in Estonia, Latvia, Germany and Denmark – new transmission capacity must be constructed over very long distances in order to enable export of the electricity to areas where there is suffcient demand.
- This will entail significant addition capital costs which should be taken into account in site selection



Assessment of additional transmission costs in order to go beyond NREAP tagets

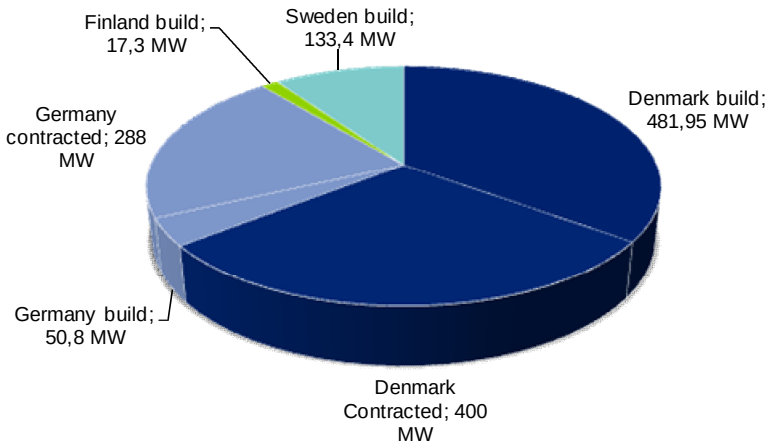
Country	Additional transmission capacity assumed [% of additional offshore wind capacity]	Assumed distance [km]	Transmission cost estimate [€/MW]	Fractional increase in offshore wind capital cost
Denmark	50%	800	0.68 M	20%
Estonia	100%	400	0.68 M	20%
Finland (southern and south-eastern groups)	Assume offshore wind capacity in this area is not large enough to require export	0	0	0
Finland (central and northern groups)	50%	1,600	1.36 M	40%
Germany	50%	800	0.68 M	20%
Latvia	100%	400	0.68 M	20%
Lithuania	100%	200	0.34 M	10%
Poland	100%	200	0.34 M	10%
Russia	Assume limited offshore wind development for local consumption	0	0	0
Sweden	0	0	0	0

- Offshore wind farm construction generates much employment
- Conclusions on where the growth effects can be expected to be strongest and most beneficial from a social perspective would require detailed analysis far beyond the scope of this study.
- In Denmark there is a pressure for locating offshore wind farms in outer urban areas where there is more need for additional employment

2) How to get there: Lessons to be learned from the forerunners: DK and G

- Policy, regulation and institution-building:
  - In order to stimulate investments, it is important to set ambitious **long-term political targets** and publish specific action plans regarding the future national capacity-building offshore wind energy
  - It is also very important that the **financial incentives are sufficient and stable** which is best achieved by relatively fixed feed-in-tariffs including sufficient public subsidies

Offshore wind in operation, contracted/committed or under construction in the BSR



- Grid development, integration and financing
  - The vesting of responsibility for grid development within **one central, state-owned operator** (in Denmark Energinet.dk) stimulates fast and well-structured development of offshore wind integration into the grid
  - **Full or part state-financing of the grid development costs** stimulates investments and fast development (as opposed to the private developer bearing all costs)
- Research, development and demonstration
  - Specific initiatives should be taken to promote offshore wind farms for **demonstration and technology** testing
- Environmental planning and permitting
  - **Thorough spatial-environmental planning**, and sponsoring of environmental impacts assessments prior to consenting for offshore wind farm concessions ensures a higher realisation rate of offshore development projects
  - The Danish **one-stop-shop** is an example of efficient and fast coordination of the different permit requirements

3A) Scenario 1: Fulfilling the NREAP targets

- While none of the BSR countries set legally binding targets for wind energy, all EU countries did submit expected trajectories as part of their National Renewable Energy Action Plans (NREAPs).
- For some of the BSR countries, the NREAP targets for the share of renewable energies including wind energy are politically binding
- In general, the BSR countries are well underway fulfilling their 2020 NREAP targets. However, Finland., Estonia, Latvia and Poland have not yet begun the construction of their first offshore wind farms although they have ambitions to do so
- Other countries such as Sweden, Lithuania and Russia have so far rather limited ambitions with respcte to offshore wind

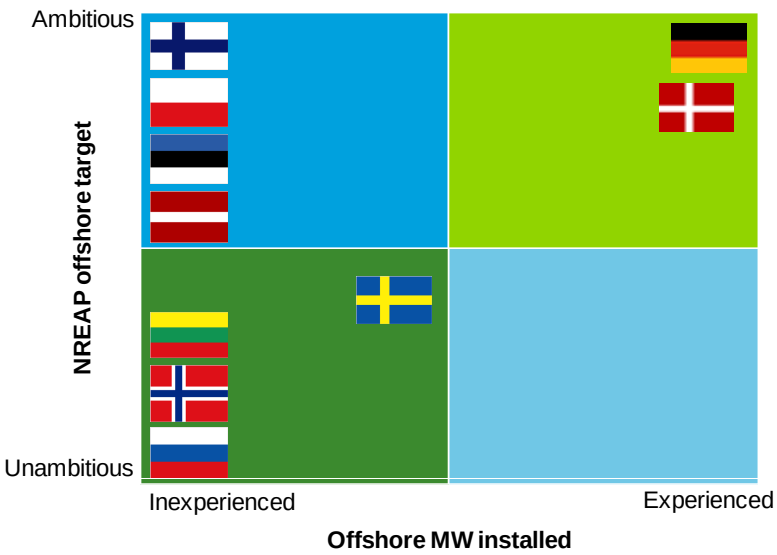


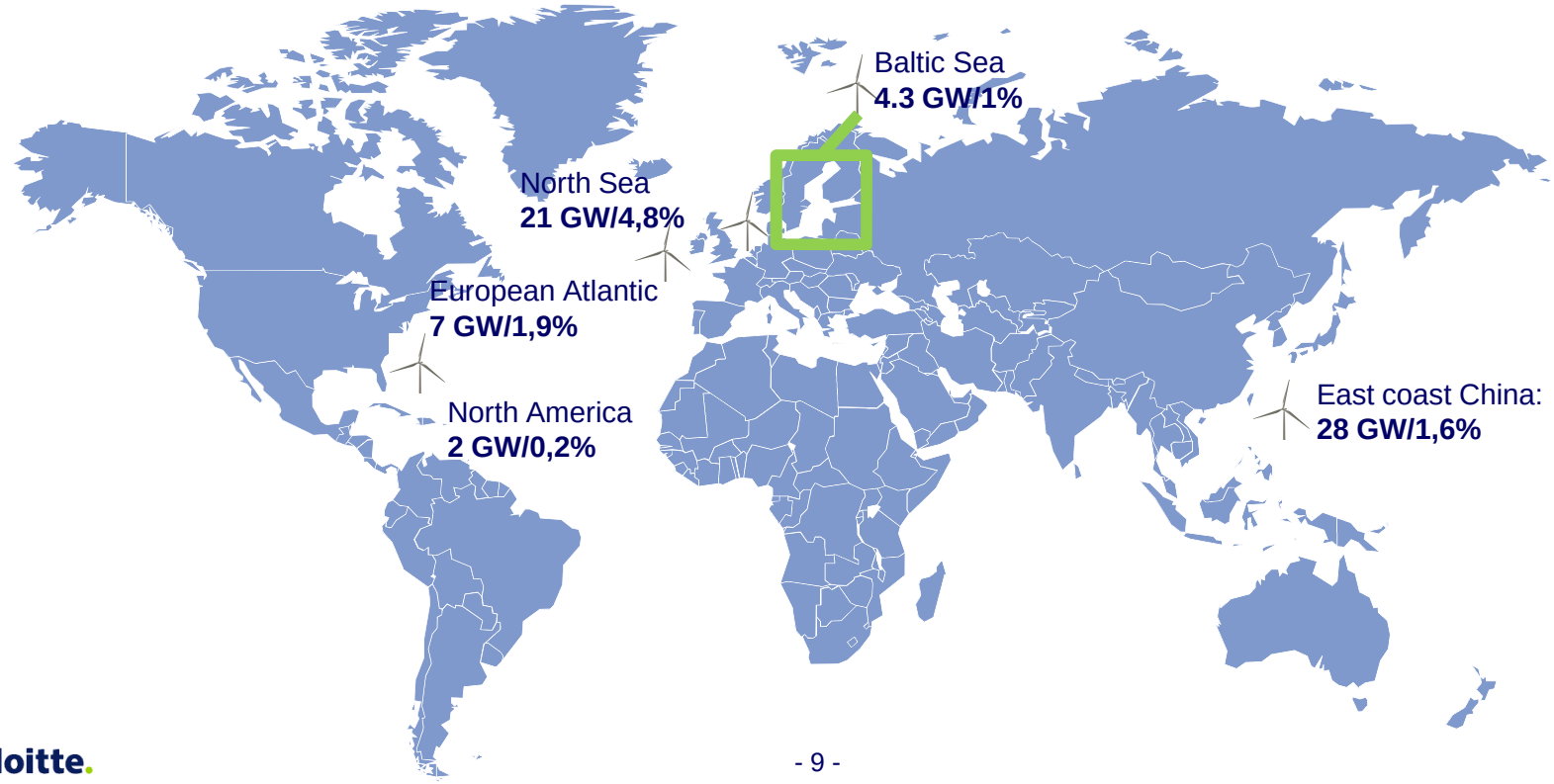
Table: BSR countries' progress towards 2020 targets for deployment of offshore wind

Country	Electricity demand 2020 [TWh/a]	Offshore [MW] 2020 targets NREAP/similar	Offshore MW installed or C/C* 2010	Offshore MW yet to be installed
Denmark	37.7	1,339	1,268 (incl. 400 C/C*)	**71**
Estonia	10.9	250	0	**250**
Finland	101.6	900	0	**900**
Germany	561.9	10.000	3,007 (incl. 2,887 C/C*)	**6.993 (699 in BSR**)**
Latvia	13.9	180	0	**180**
Lithuania	8.7	0	0	**0**
Norway	115	Assumed small	2	**0**
Poland	169.8	500	0	**500**
Russia (Kalingrad)	n/a	Assumed small	0	**0**
Sweden	154.6	182	133	**49**
Total BSR	1,174	13,351	4,410	**8,943**

3B) Scenario 2: BSR to become world leading in 2050

- The figure illustrates that even though the BSR fulfills the NREAP 2020 targets of 4.3 GW, the Baltic Sea will be very far from leading in terms of deployment of offshore wind. Instead, the east coast of China and the North Sea will be the leading regions.
- Furthermore, other projections show that from 2020, North America will possibly see massive growth in offshore wind with up to 54 GW although this is highly uncertain (cf. GL Garrad Hassan, Bridging note).

Offshore wind power projections 2020 for leading regions in GW and as a % of 2020 electricity consumption



4) Recommendation of strategic initiatives for Scenario 1 and 2

Policy and regulation initiatives - discussion

- Policy and regulation initiatives for scenario 1

- Development of the BSR action plan with quantification of the expected contribution of offshore wind power similar to the NREAP targets but more binding, long-term (e.g. till 2030) and manifested in a strong political mandate.
- Finland, Poland, Estonia and Latvia to develop financial incentives through regulation making it sufficiently attractive for developers to construct offshore wind farms. The design of new regulation might be facilitated through cooperation projects with wind pioneer countries (e.g. Denmark) targeting a feed-in tariff approach with differentiated subsidies for onshore and offshore wind, perhaps in combination with temporary incentives such as a sprinter bonus etc.

- Policy and regulation initiatives for scenario 2

- Development of a binding target of offshore wind deployment to 2050 for the BSR.
- Setting up of a BSR policy framework that harmonizes rules and legislation within offshore wind including a joint or similar financial incentive scheme for all the BSR countries. The rules should be formulated in accordance with the EU and in close cooperation with other regions with wind ambitions.

- Discussion: any comments or further initiatives?

4) Recommendation of strategic initiatives for Scenario 1 and 2

Grid development and integration initiatives - discussion

- Grid development initiatives for scenario 1

  - Poland and Sweden to tackle back-log problem with large number of applications to the TSO for wind farm connection, for example. through upfront application fees.
  - Finland, Poland, Estonia and Latvia to decide on a cost structure such as a shared cost structure that to a greater extent divides cost and risk between developer and authority.

- Grid development initiatives for scenario 2

  - Establishment of integrated grid connecting the BSR, EU and Russia.
  - Socialization of grid connection costs throughout the entire BSR so that the state rather than the developers carry the major burden.
  - The BSR cross-country implementation body to lead the development of an integrated grid system including development of a smart grid. The purpose of the body would be planning and managing of further grid investments including coordination with other countries and institutions.

- Discussion: any comments or further initiatives?

4) Recommendation of strategic initiatives for Scenario 1 and 2

Spatial and environmental planning and permits - discussion

- Spatial and permit initiatives for scenario 1

- Finland, Estonia, Latvia and Poland to conduct an initial screening of the economic exclusive zones and the coastal zoning thereby informing developers of which areas that are suitable for offshore wind projects seen from an environmental point of view.
- Further and more detailed environmental screening of potentially attractive areas and sites to be carried out by all the BSR countries that plan additional offshore wind energy capacity.
- One-stop-shop approach to permitting to be adopted in all the BSR countries.

- Spatial and permit initiatives for scenario 2

- The BSR countries to adopt a common consenting approach e.g. open-door.
- The BSR decision makers to establish a BSR cross-border screening body that will identify relevant sites in the BSR and handle constraints not considered with the relevant national authorities.
- Establishment of cross-country permitting body to coordinate all the BSR countries one-stop-shop permitting approach.
- Potentially, HELCOM might play a central role as a body promoting the above-mentioned cross-border coordination.

- Discussion: any comments or further initiatives?

4) Recommendation of strategic initiatives for Scenario 1 and 2

Research and development - discussion

- R&D initiatives for scenario 1

- Estonia, Latvia (and perhaps Poland) to engage in cross-country demonstration projects that will support the deployment of the remaining offshore wind energy to realize their 2020 targets. The demonstrations projects may include physical demonstration projects, for example in the Gulf of Riga, testing for both technical and environmental issues.
- Finland and Sweden to engage in cross-country offshore wind demonstration projects in the northern part of the Gulf of Bothnia testing for foundation and rotor problems related to sea ice loading, and how the harsh conditions in general affect installation and operation of the wind turbines and the grid connection.
- 'Virtual demonstration projects' to be carried out as a supplement to the above in for example Gulf of Riga, the upper or middle parts of the Gulf of Bothnia between Sweden and Finland, and The Middle Bank area between Poland and Sweden.

- R&D initiatives for scenario 2

- Strengthening of government R&D support for offshore wind energy.
- Development of a *Baltic offshore fund raising body* consisting of authorities and research institutions across the BSR countries focusing on the utilisation of EU funds such as the Interreg Baltic IVB and national funds for development of offshore wind technology projects.
- Development of a Baltic Sea Fund for innovation and research

- Discussion: any comments or further initiatives?

5) Benefits and costs of offshore wind power vs. alternative electricity supply in the BSR

- As a strategic, domestic and largely untapped resource, offshore wind power is one of the key technologies for achieving energy and climate goals. The benefits include:
  - Emission free electricity generation
  - Regional employment, growth and technology export
  - Cost-efficient in the long-run
    (onshore wind in she short run, offshore wind in the medium and long run)
  - Security of supply

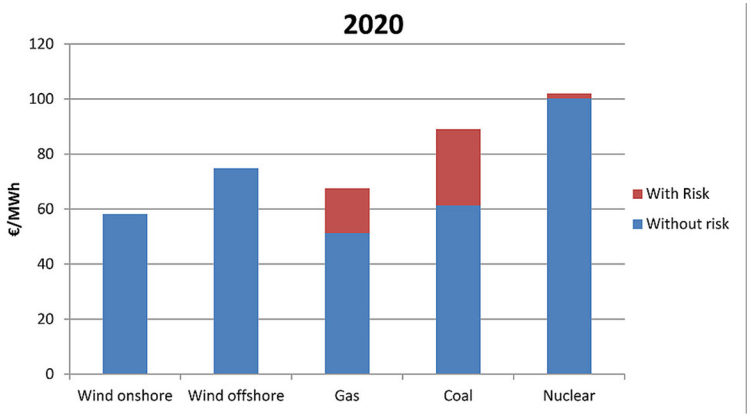
"So far offshore wind has been a quest for the holy grail"

- comment by a Swedish reviewer of the strategic outline

5) Benefits and costs of offshore wind power vs. alternatives

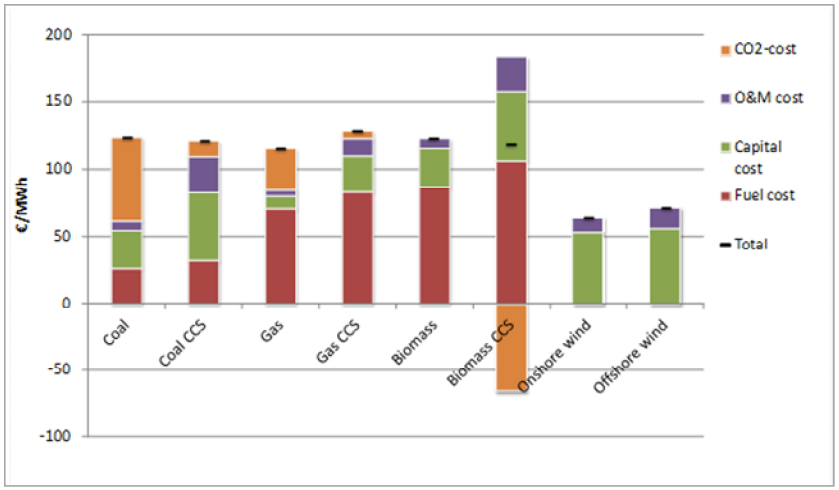
- Comparing the cost-efficiency of wind energy vs. the alternatives

Expected levilised cost of electricity – 2020



Source: EWEA, Cost of Wind Power compared to Other Technologies

Figure 1. Expected levilised cost of electricity – 2050



Source: EEA Energy Analyses, *Energy Policy Strategies of the Baltic Sea Region for the Post-Kyoto Period,* Draft version Prepared for BASREC, 18.12.2011.

- Already by today onshore wind energy is very cost-effective whereas offshore wind still needs further support
- Over time the cost differential between onshore and offshore wind is expected to be substantially reduced. In addition offshore wind has a number of advantages over onshore wind:
  - Less area conflicts with neighbours
  - Very high levels of wind energy penetration will not be possible solely by the means of onshore wind energy
  - Employment effects are very significant in the case of offshore wind farms due to the large scope of construction works