Wind power development trends in Denmark: targets, legislation and social acceptance

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Summary

Denmark has very ambitious targets for development of wind power. The political targets are broadly supported in both parliament and public opinion. In legislation different incentive schemes and environmental protection acts ensure that the interests of the neighbours are protected. The industry works to reduce the cost of wind energy as well as reduce environmental impact. The interplay between well founded legislation and continued development towards lesser impact combine to ensure a high public support for wind power development both in general as well as in one's local community.

1. Introduction

Denmark is often used as a country of reference in regards to wind energy legislation and development. Today, Denmark has a political target of 50 pct. wind in the electricity system which demands a continued development of both on- and offshore wind. The target has a high level of support from the public both at national and at local level as opinion polls among the general public and wind turbine neighbours confirm.

A decisive factor in regards to fulfilling the renewable energy targets is the ability to continue to ensure support for the overall targets as well as for projects at local level. Especially at local level concerns regarding noise and health are not infrequently raised. Here the handling of the environmental impact from wind turbines is a key element in securing acceptance and support as well as meeting concerns from local residents through an inclusive and well executed planning procedure. A development which is supported through legislation including newly revised renewable energy schemes and environmental protection acts handling noise, low frequency noise, aviation obstruction ligting etc.

The paper will give insight into the Danish wind case high lighting development trends, key legislative acts and analyzing recent opinion polls of public and local opinions. The paper will briefly touch upon the offshore development trends and focus on the onshore development as this holds the most significant environmental impact.

2. Political targets and development trends

2.1 The Danish Energy Agreement

In March 2012 the Danish Parliament adopted a historically long and ambitious Energy Agreement. The Energy Agreement which is supported by 95 pct. of the Parliament is based on the long term goal that renewable energy shall cover the entire Danish supply by 2050.

The agreement sets the targets for the development of the energy sector until 2020. For wind the key target is that by 2020 50 pct. of the Danish electricity consumption should be supplied by wind power. Today, wind power supplies 30 pct. of the Danish electricity consumption. The 50 pct. target is to be reached through an estimated 4,300 MW new wind capacity which is to be developed both on- and offshore. The agreement thus continues the Danish political tradition of supporting the development of both on- and offshore wind energy. (Danish Ministry of Climate, Energy and Building, 2012a)

The onshore development estimated at 1,800 new MW by 2020 is to a large degree expected to take place through repowering. This means that the current 4,600 onshore turbines in Denmark are estimated to be reduced to fewer than 3,000 by 2020.

Significantly, this means that while wind power production will increase from 9.8 TWh today to 18 TWh in 2020, the number of turbines will decrease thus reducing the environmental impact from wind turbines.

2.2 Development trends

The Danish onshore market is characterised by a development towards fewer and more efficient turbines as mentioned in the previous section. An analysis of the development over the past five years show turbines with an average capacity of 2-3 MW and a height of 110-140 metres. (Danish Wind Industry Association, 2013) Towards 2020 the turbine size is expected to remain at this level with only slightly higher capacity of 2-3.5 MW and a height of 130-150 metres.

Due to a densely populated countryside the average project size is relatively low in Denmark, in general 3-5 turbines. However, both from project developers and planning authorities there is a move towards favouring larger projects. Currently no schemes allow the planning authorities to expand project areas[1] through the purchase of houses. In effect, this means that it is the project developers who work to expand the project areas by buying nearby houses as well as nearby turbines as the latter contributes to noise emission. This trend of working actively to expand the project areas is expected to continue over the next seven years possibly aided by a scheme directed at the planning authorities who have expressed a wish for such.

Offshore the development primarily takes place through tendered projects where the government authorities supply the EIA, technical reports and grid connection. Where the offshore development until today has been based on a similar turbine size to onshore projects, the 2,500 MW which is to be developed by 2020 is expected to

[1] “Project area” is defined as the area with a minimum distance to nearest neighbour of 4 times the total height of the turbine and within which the noise limits are complied with.

jump to the generation of larger turbines, i.e. turbines of 6-8 MW. The on- and offshore development will thus in the next 10 years be significantly different as opposed the past 20 years of offshore development where the turbines often have been of similar size and capacity.

3. Legislative frame work

The legislative frame work which the continued development of wind power in Denmark is based on consists of support and incentive schemes as well as a strong planning frame work which regulate the environmental impact from wind turbines. The key acts are the Promotion of Renewable Energy Act of June 2012 and May 2013, the Statutory Order on Noise from Wind Turbines of December 2011 and the Wind Turbine Circular of May 2009.

3.1 Support and incentive schemes

The Promotion of Renewable Energy Act of June 2012 establishes the support scheme for onshore energy. From January 1st 2014 a new support scheme will enter into effect and replace the current scheme from 2008. The new support scheme will introduce a cap on the combined feed-in-premium and spot price thus reducing the support level.

The new support scheme will also introduce a weighted model which has the aim to minimize the span of average subsidy over 20 years of production. The current model based on generator size will be replaced by a combined model with 70 pct. weight on the rotor and 30 pct. on the generator. The aim of the combined model is to ensure that it is the incentive to choose the most suited turbine for a given site and avoid that turbines are chosen based solely on generator or rotor size.

The new support scheme is estimated to reduce Public Service Obligation-payments with approximately 60 mio. € in 2020, when the forecasted amount onshore wind turbines are up and running. The fully implemented effect of the weighted model will result in an additional annual saving on 10 mio. € because the wind target on 50 pct. will be reached with fewer and more efficient turbines compared to the existing support scheme.

The reduction of the support level is a response to reduced Cost of Energy of onshore wind. From both political and industry side continued reduction of Cost of Energy of wind energy is viewed as an important factor in maintaining strong political and public support. The gradual reduction of support and introduction of new and more efficient models is therefore also backed by the industry.

The Promotion of Renewable Energy Act of May 2013 revises the current incentive schemes which are aimed at ensuring support for continued development of wind power at local level. The most significant changes have been made to the option-to-purchase scheme which ensures that at least 20 pct. of the wind turbine project is offered for sale to the local population. The scheme has been revised to ensure a more even division of shares between local shareholders as it is a political wish that the shares are divided between as large a number of people as possible.

In addition to the option-to-purchase scheme the incentive schemes include a guarantee fund with the purpose to give local initiative groups the opportunity to initiate preliminary investigations, etc. A green scheme which pays approximately 12,000 € per new MW to the local municipality and a loss-of-value scheme which ensures that neighbours are compensated for any loss of property value due to the erection of the turbines.

3.2 Planning and environmental protection

The planning process is in Denmark the responsibility of the local municipality which leads the process of appointing suitable areas and performing the project specific planning such as the EIA etc. The planning process goes through several public consultations where the general public is invited to participate and bring forward concerns and suggestions. To assist the local municipalities with legislative and technical questions the Ministry of the Environment has established a team that gives direct support the municipalities on questions in relation to planning.

Planning of wind turbines is primarily regulated by the Wind Turbine Circular of May 2009 and the Statutory Order on Noise from Wind Turbines of December 2011. In Denmark the two key requirements are the set-back-distance of minimum 4 times the total height of the turbines and the noise regulation. The set-back-distance was introduced mainly as a tool to mitigate visual impact of the turbines. The set-back-distance with the aim to reduce visual impact is supplemented with a recommendation that shadow flicker at neighbors does not exceed 10 hours on yearly average. The Danish 10 hours recommendation considers meteorological conditions and site-specific calculations of the potential exposure to shadow flicker is included in the EIA

The other key regulation is the noise regulation which defines the noise limits at 6 and 8 m/s at noise-sensitive land use and in the open country. Further a limit for low frequency noise at 20 dB was introduced January 1st 2012.

The background for the low frequency noise limit was public debate and concern over low frequency noise and not a response to a major, general problem. (Jakobsen, Jørgen, 2012 p. 245). The noise limit was first introduced in a legislative act for the National Test Centre in Østerild for prototype turbines. During the debate in relation to the test centre it was politically decided to implement a new regulation for low frequency noise, as noise had been one of the discussed issues. It was subsequently politically decided to introduce low frequency noise limits for all future turbines in Denmark. It was therefore a political response to a public debate and not a decision based on technical development or concern over health effects/annoyance. Today, the low frequency noise regulation remains singular both in comparison to other Danish noise regulation and in an international perspective.

3.2.1 Impact of low frequency noise regulation

Prior to the introduction of the revised Statutory Order on Noise from Wind Turbines January 1st 2012 the Danish Wind Industry Association estimated that the new regulation would impact 15-20 pct. of projects under planning as the project areas would be reduced due to the new legislation. Evaluating the impact of the regulation 1½ years after its implementation, project developers report that the regulation has

influenced projects primarily in two ways, firstly through the need to buy and remove nearby older turbines in order to comply with the noise limits and secondly through a change in choice of technology.

From an industry view point the legislation has had an impact on planning of wind turbines, however, it has been possible through the two above-mentioned measures to implement planned projects without significant reductions in capacity.

3.3 Legislating with attention to environmental impact

Danish legislation relating to wind turbines is in general established with attention to the environmental impact that not only the wind turbines themselves but also the legal requirements inflict on the local community.

The newly revised Regulation on Aeronautical Marking of Wind Turbines of March 2013 is an example of this. The existing regulation was revised on the basis of a report which looked at the need for aeronautical marking taking into consideration three points of view, i.e. flight safety, frame work conditions for wind power expansion and consideration for people living near turbines. The new regulation has aimed for solutions and requirements that take all three aspects into consideration with precedence to the need for flight safety. This has resulted in a regulation that significantly reduces the impact from lighting on people living near turbines and is a positive example of how regulation takes into consideration the importance of the social acceptance of renewable energy.

4. Technological development trends

A decisive factor in regards to a fulfilment of the 2020 target will be the ability to ensure continued support for both the overall political targets and for the projects at local level. In Denmark two main aspects are pivotal in maintaining both political and public support. That is continued efforts to reduce Cost of Energy and ensuring a good planning process and projects where environmental impact for people living nearby is at an acceptable level.

The awareness of these two aspects is also reflected in the technological development from industry side. In Denmark technological development trends are analysed by the Megavind Partnership. Megavind is a partnership between industry, government and research environment and it formulates the joint recommendations for the Danish effort of research, development and demonstration within wind power. The partnership thus gives important, strategic guidelines for the future technological development trends and needs e.g. for test facilities.

Reducing Cost of Energy is a key strategic recommendation from the partnership as well as the recommendation to look at technology based solutions for reducing environmental and other local impacts of wind turbines. (Megavind, 2013)

These two aspects which are central to political and public support are thus also key areas for efforts within research and development.

5. Public Opinion and acceptance of wind power

Both at national and European level public opinion polls show high approval and support of a continued development of wind power. (Megafon, 2009; Megafon, 2012a; AnalyseDanmark,2012; Eurobarometer, 2011) In a recent survey more than 60 pct. confirmed that their support is for the continued development of both on- and offshore wind (A&B-Analyse, 2013)

While vocal resistance in response to projects at local level is not unfamiliar, surveys indicate that the very vocal resistance might not be representative of the general opinion among neighbours. Surveys show that support for continued wind power development also stretches to support of development of wind power projects at local level as figure 1 shows.

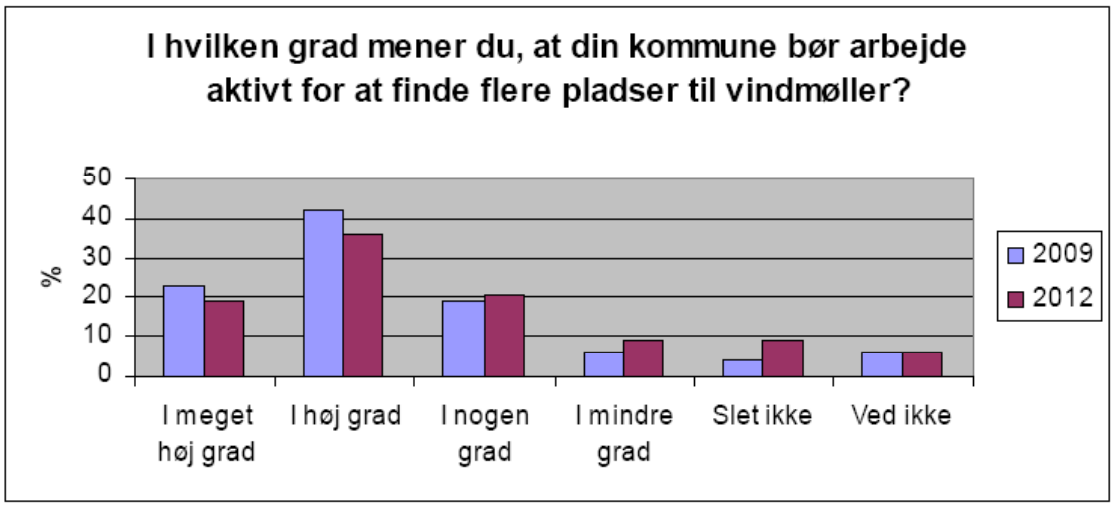

Figure 1: Comparison of Megafon 2009 and 2012 surveys. Question: to what degree do you think your local municipality should work actively to find more sites for wind turbines? (answers: very high, high, some degree, lesser, not at all, do not know). Source: Megafon 2009 and 2012a and Danish Nature Agency 2013.

The survey backs the conclusion of an analysis from 2011 which showed that of 279 negative debate articles published over a six months period, more than 67 pct. were written by the same five persons. (Danish Wind Industry Association, 2011) Even though the debate scene today is populated by more people surveys cannot support an image of widespread opposition towards onshore wind.

Decidedly, even surveys among people living close to wind power projects show that the majority of neighbours experience no or very few nuisances from wind turbines and figure 2 and 3 show. (Jysk Analyse, 2012a and 2012b; Megafon, 2012b)

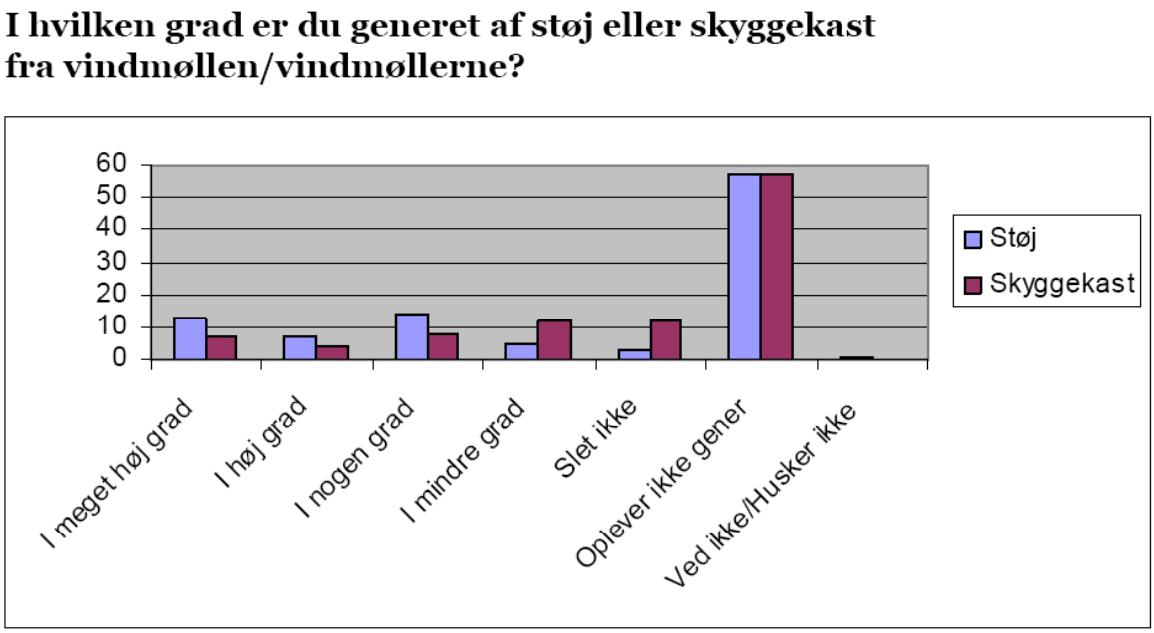

Figure 2: Question: to what degree are you annoyed by noise or shadow flicker from the wind turbine/turbines? (answers: very high, high, some degree, lesser, not at all, do not know). Blue: noise, purple: shadow flicker. Question put to neighbours within 1 km of a wind turbine. Source: Megafon, 2012b and Danish Nature Agency, 2013.

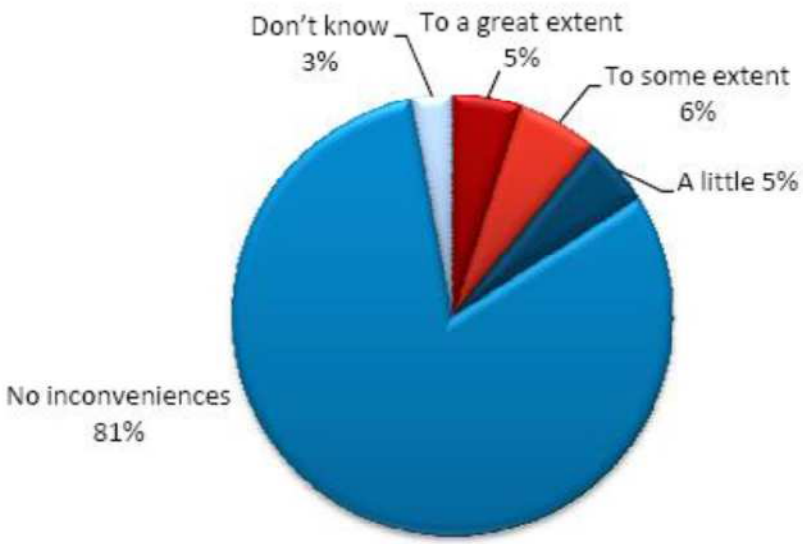

Figure 3: Question: to what extent do you experience that there are inconveniences connected to living close to wind turbines? Population: people living within 2 km of a wind turbine. Source: Jysk Analyse, 2012a.

And the question arises whether opposition to onshore wind primarily is a matter of concerns of the unknown. When neighbours were asked how living next to turbines had effected their view point 23 pct. answered 'more positive', as figure 4 indicates.

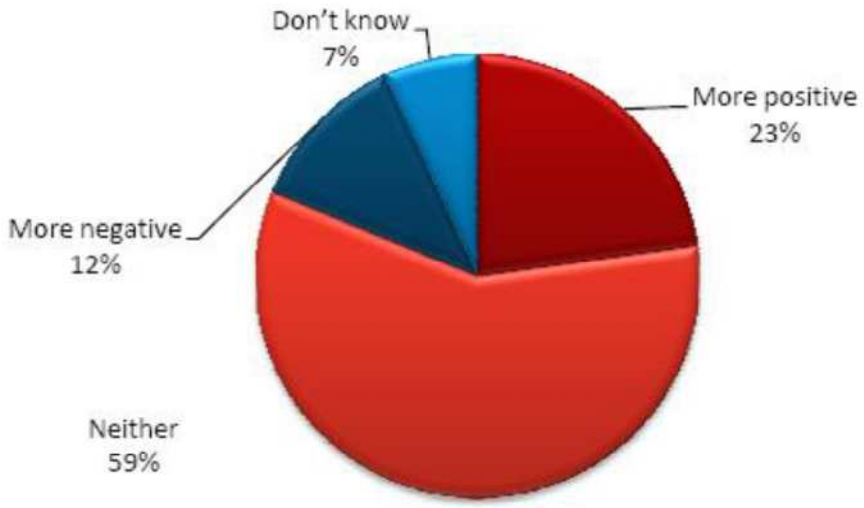

Figure 4: Question: compared to before the wind turbines were erected, do you feel differently about being a neighbour now, i.e. are you more positive or more negative? Population: people living within 2 km of a wind turbine. Source: Jysk Analyse, 2012a.

5.1 Reflections on public opinion and acceptance

However, in spite of high general support of onshore wind power development, concerns and opposition towards the erection of wind turbines are not infrequently a factor during the planning process. Concerns and opposition tend to contribute to lengthening of project lead times and to the shelving of some projects altogether.

Such delays, setbacks and uncertainty in regards to return of investments increase the risk for project developers and counteract industry efforts to drive down Cost of Energy. Further, it stresses the importance for the wind industry and authorities alike to meet concerns from local residents through an inclusive and well executed planning procedure and to continue to reduce the environmental impact from wind turbines, in order to maintain a general high public support.

6. Conclusions

Onshore wind energy is to play a significant role in the continued transformation of the Danish and European energy systems towards still higher penetration of renewable energy sources.

Denmark has a long history of developing wind power and also has very ambitious renewable energy targets. The interplay between legislation and technology development is key to maintaining a high degree of public support.

From legislative side the concern to both the create incentives to develop wind power as well as schemes that give create opportunities for local investments. In addition strong environmental protection acts ensure the protection of neighbours from noise, flicker and visual impact.

From the view point of technological development and research, the understanding and mitigation of mechanisms behind concerns at local level as well as development of technologies that reduce nuisances and annoyances generated from wind turbines are important focus areas.

Reaching the 2020 targets and beyond will depend on the ability to keep legislation and technological development in harmony with public opinion as has been the case for the past 30 years of wind power development in Denmark.

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