

Successful implementation of wind power

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Denmark is in *Globe and Mail*, July 11, 2008 described as a worst case example of the countries that use wind energy. The article *“Wind Turbine Manufacturers are full of hot Air”* is, however, just as absurd and misleading as many similar reports and articles that for 30 years have been published with that single purpose to stop one of the most successful clean, decentralized new energy forms. Denmark has focused on renewable energy since the first oil crisis in 1974 and will do so even more in the future. We already get 20% of the electricity from harvesting the wind which will increase to 30% by 2012 according to decisions in the Danish parliament.

It has been a change of energy policy with many challenges but the benefits are tremendous with increased employment, better environment, price stability, security of supply, independence of foreign fuels plus a fast growing new industrial sector with a gigantic export potential. But no renewable energy form can stand alone. Not least wind power has to be properly managed and combined with solar, easy-to-store biomass, and decentralized cogeneration (CHP) into fully autonomous intelligent energy systems.

Advanced weather forecasts in combination with short and long term storage systems that will include batteries in cars and homes, will facilitate the transition. The future systems will provide energy at a lower price than the present centralized supply structure. Renewable energy is basically small scale technology that in contrast to big power plants can be mass produced and cheap like our household appliances, cars etc. that are affordable to most people. When we change to renewable we need not care any longer about the fuel costs. The sun and the wind are abundant and belong to all.

Energy from the wind, the sun and from biomass is so important in Denmark that it is realistic to phase out the fossil fuels during the coming decades. Already back in the 1980s renewable energy proved so promising that official plans to build atomic power plants were ultimately shelved. In order not to commit political suicide no Danish politician has since then proposed to re-introduce nuclear power.

Wind power is more successful than any other modern energy technology even if only a handful of countries still have adopted policies to seriously harvest the energy of the wind. They have in return benefited highly. The change to CO₂ free energy creates new stimulus to the overall economy; the renewable energy industry already employs hundreds of thousands of people and has the potential of becoming much more important than the information technology not least because energy penetrates every part of life.

Worldwide 20,000 MW new capacity of wind power was added last year; the world total is now over 100,000 MW of which the five leading countries share 72 %. The currently installed

wind power capacity generates 200 TWh per year, equalling 1,3 % of the global electricity consumption. In some countries and regions, wind energy already contributes 40 % and more. As dozens of countries have the potential but no dedicated policies the world total could have been several times higher. Therefore small Denmark, even if no new wind capacity was installed for the last seven years still ranks as the sixth biggest.

For the last fifteen years the world growth rates have been between 20 and 30%. Since the 1990ies only Spain, Germany and Denmark have some maintained continuity in their transition from the fossil fuels based on coal, oil, natural gas and uranium to the renewable energies, solar, wind, biomass, geothermal energy etc. In less time than it takes to plan the building of an atomic power plant the three leading European countries already enjoy double-digit shares of the energy supply coming from the renewables.

However, the picture is rapidly changing. Facing depletion of fossil energy depots, climate change and sky-high oil prices, several countries are joining the renewable energy club and now invest in the clean energy forms leaving coal and uranium as the energy sources of the past. Therefore more and more countries focus seriously at the solar and wind energy in combination with biomass and hydro power that match perfectly in a 100% renewable energy scenario.

The biggest obstacle in this transition is the shortage of equipment. In such a seller's market prices of equipment have gone up with 20%. Wind turbines from the leading manufacturers like Vestas, Siemens, Enercon, Gamesa and many others may have two years of delivery time, and they do not include new customers in their portfolio. The wind industry now employs over 350,000 people after 300,000 employees in the year 2006 and may in a few years pass the one million mark. So it is still in its infancy which gives for countries and regions with a need for industrial innovation.

States like Michigan and Ontario have the extraordinary opportunity to replace their present dependence on the automotive sector with future oriented employment in the emerging renewable energy industry. This, however, requires political resolution. It is the lesson learned from Spain, Germany, and Denmark that the creation of a domestic market is the unconditional prerequisite for a successful wind turbine supply chain with its thousands of new jobs. Most recently two emerging countries, India and China have demonstrated this. They are now amongst the top five wind markets and in 2007 got three wind turbine manufacturers on the global top-ten list, which should be sufficient motivation for the governments to launch effective and substantial renewable energy deployment programs.

Consultants and scientists have for years delivered lip service to the conventional energy industry. They claimed that windmills are bird killers where professional investigations prove that our buildings, cars, the power lines and the cats kill 1000 times more birds. They claimed also that a wind turbine in its entire life time cannot produce the energy needed to manufacture it where reality is that it takes only three to four months. In the following 20 years it will deliver CO2 free power while it is completely ignored that the alternative, the

steam power plant, has to be fed with 3 kWh of CO₂ emitting fossil fuel for every kWh electricity produced.

And as an echo they now claim that wind power has no positive effect to the power supply with reference to experiences from Denmark. We have more wind power per capita than any other country in the world (5,3 million people, 3,200 MW wind power).

The article in the Globe and Mail is primarily based on analyses by two British energy experts, Hugh Sharman and Tony Lodge. However both of them think that the future energy system will be based on the same operational methods and philosophies as the old system that has caused most of the climate problems. In case we accept that their analysis also represents a future with an even bigger share of the growing Danish wind power production will to be exported it might be justified to talk about basic system problem.

When Mr. Lodge says *“it is not practical to turn coal-fired plants off and on as winds rise and fall - because ramping them up consumes more fuel (and emits more carbon dioxide) than running them at a constant rate”*, he demonstrates that he is not familiar with the basic operational conditions of the Danish power system. Firstly, it is in practise not a big problem to adjust the coal-fired plants as the wind rises and falls. The consumption is not constant. During a 24 hours cycle the need for power changes with a factor two or more and between summer and winter there are even bigger fluctuations, which the power system has to respond to without the dramatic problems described by Mr. Lodge. Secondly, it is the need for heat and not for power that has priority. Therefore it is just as impossible to determine whether the wind or the heat generated power causes the power overflow as to separate the cream from the milk.

The analysis of Mr. Sharman and Mr. Lodge is years behind the plans that in the meantime have been developed. Why should Denmark in future sell its clean energy at low prices on the European spot market? There are several ways to increase the domestic use of the surplus electricity that unavoidably appears especially in a small country with a high share of solar and wind power. On days with a high demand for heat combined with high wind, the CHPs and the wind turbines together feed much more power into the grid than needed by the consumers. While Europe as a whole has 10% of the efficient combined heat and power (CHP) in the energy system, the share in Denmark is 60%, the world's highest, which at the same time represent not only the problem mentioned but also its solution.

Following the plans and visions of the national power system responsible, energinet.dk, supply and demand can be balanced simply by dumping on windy days the additional wind power into electric boilers at the combined heat and power stations. It will be possible to stop the CHPs at periods when the wind power is sufficient for both the supply of power and heat and with no conversion loss where it is as high as 65% at conventional coal and nuclear power plants. Especially the natural gas based cogeneration in Denmark from around 600 decentralized CHP plants and more than 170 industrial autoproducers can be stopped and started within seconds and match ideally the renewable energy supply.

Till end of 2007 it was not possible due to taxation to use wind electricity in an economical manner for district heating but following a decision by the EU Commission use of wind power for heat has now become very attractive. While surplus electricity sometimes are being sold at the spot market for 0,02 CAD per kWh it will at any time when used for heating have a value equivalent to the fuel that it replaces or 0,07 to 0,08 CAD per kWh.

Denmark is a small flat country not blessed with high shares of hydro power like Norway, Switzerland and Canada. Hydro power makes it even easier quickly to balance the power system to the fluctuations of the solar and wind energy that gradually will make the conventional coal- and uranium-fired power plants obsolete. They are inefficient and have conversion losses that are unacceptable compared to contemporary decentralized solutions, they cause climate problems and the waste problems of the nuclear power has no solution it must be concluded after 50 years of research and endless millions of dollars in acceptable solutions.

Based upon the banal realities that the wind is fluctuating like the sun does not shine at night Neil Reynolds???? delivers arguments from the Danish energy sector that leaves the impression that the small Nordic country with the highest employment in Europe and a very healthy economy builds its energy future on totally irrational solutions. 20% of the supply of power already comes from the wind that according to the official energy plans in the coming decades will become a cornerstone in the Danish energy structure.

1300 MW new capacity will be added in the coming years so by 2012 30% of the consumption of power will come from the wind. And we will be able to handle it without all the negative aspects that is claimed in the article in Globe and Mail. Already now in Jutland-Funen, the western leg of the Danish energy sector with more than half of the national power market, 30% of the electricity comes from the several thousand wind turbines with no negative impact on the power quality or increased consumer prices.

In some regions like the Thy peninsular with its 48,000 inhabitant, the 250 windmills cover 92% of the annual need for electricity and has become an important source of income to the local farmers. On days with strong wind the wind turbines may even produce four times more than the actual consumption and the power quality still lives up to the highest standards. The local utility, Thy-Mors Energi has demonstrated real-time management of such big quantities of wind energy to visitors from all parts of the world.

The surplus power on windy days is still being exported to the neighbouring regions but in the coming years we will also find a solution to this. 80% of all space heating in Denmark is community district heating. Like in the rest of the country people in towns and villages in Thy get their heat from hot water pipelines in the streets. What can be better environmentally and economically than to dump the surplus wind power in the big hot water reservoirs of the local district heating suppliers and thus save fossil fuel in stead of exporting the surplus power to Sweden and Norway sometimes at low spot market prices.

We expect in 2025 to have 50% wind power in Denmark where the periodical surplus will be stored in the district heating system, in hydrogen, in the hydro power reservoirs in Norway and not least in the 1,5 million electric cars where the batteries will become part of a diversified national energy storage system. Sometimes when the wind is strong they will be charged, and sometimes when solar and wind is not sufficient to cover the power needs a computerized power management system will ask the batteries in the cars and homes to deliver power back to the grid.

Of course the transition from few big centralized, fossil fuel based power stations to thousands of wind turbines, solar installations for heat and electricity, combined heat and power stations using biomass or natural gas is a tremendous technological and structural challenge. As we see it in Denmark the shift to renewables takes some decades where there be a mix of conventional and renewable energy technologies. We have around 7000 MW of centralized power plants, 3000 MW independent combined heat and power and 3200 MW wind power that will increase to 4500 MW by 2012. With more and more decentralized CO2 neutral capacity the centralized plants can gradually be phased out which will stabilize consumer energy prizes and fulfill international climate commitments.

The change from the fossil fuels and atomic energy to the renewables is not caused by technical or economical obstacles. They are political, organisational and cultural. The article in the Globe and Mail referred used as its primary sources two British experts that evidently do not have the sufficient basis of analysing an energy system like the Danish that is no longer unidirectional and controlled by a few oligopolies but involves thousands of independent power producers.

Compared to the general acceptance that the decentralized energy forms enjoy on the continent, the Anglophone way of thinking within energy is in itself obviously a barrier to sustainable solutions. A prominent author like James Lovelock is an example of a scientist that tries to analyse whether renewable energy is a realistic solution for his country and comes to the conclusion that atomic energy is the only realistic way to. Lovelock is not aware of the limited uranium resources, cannot imagine that with Europe's best wind resources it is much easier and less costly to develop wind power in Britain than in Germany and Denmark. The British have tried several times to launch renewable energy programs but what by nature is decentralized they put into a centralized structure and it failed more or less. Now they have involved the big power oligopolies in their offshore project but centralized offshore cannot stand alone.

In Denmark in 2002, the neoliberalistic government tried to follow the British example and closed all renewable energy programs. But renewable energy is so rooted in the Danish population as the only realistic long term solution that the prime minister six years later declared, that Denmark will focus at a 100% renewable energy society.

Generation at Danish power plants is characterized by a major share of cogeneration (CHP). 13 out of 15 "central" generating plants (sites) generated and sold both electricity and heat. In addition cogeneration is taking place on around 600 decentralized CHP plants and at more than 170 industrial autoproducers. Cogeneration of electricity and heat causes a better utilization of fuels to the benefit of both economy and environment. It is important to be aware that while electricity generation basically is determined by competitive market conditions, heat production is determined by local/regional heat demand.

The Danish transmission system is divided into two parts, as there is no physical interconnection over Storebælt. However, the interconnections with abroad are very strong with international standards. The total import capacity is 5 300 MW, which is 83% of maximum load in Denmark during 2007.

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ALTERNATIVE ENERGY

Wind turbine marketers are full of hot air

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OTTAWA -- Republican presidential candidate Senator John McCain travelled to Oregon in mid-May to deliver the definitive climate change speech of his campaign. He spoke in Portland, at the U.S. headquarters of Vestas Wind Systems AS, a Danish company that markets wind turbines around the world. He started on a self-deprecating note. "Today is a kind of test run for this company," he said. "They've got wind technicians here, wind studies and all these wind turbines. But there's no wind. So now I know why they asked me to come and give a speech."

It was perhaps his most perceptive statement of the day. Five sentences later, Mr. McCain made perhaps his least perceptive. "Wind," he said, "is a predictable source of energy."

Really? Define predictable. Wind turbines operate occasionally with remarkable efficiency at 100 per cent capacity. More often, they operate with 20 per cent capacity. Once in a while, they operate with subzero capacity - taking electricity from the grid to keep themselves running until they get hit again by a restless wind.

British energy consultant Hugh Sharman, based in Denmark, documented wind power's capacity for subzero performance in a report published by Civil Engineering magazine in 2005. With more wind power per capita than any other country, Denmark (population 5.4 million) is the world's showroom nation for this highly fashionable form of renewable energy.

Liberal Leader Stéphane Dion (who used Earth Day to champion wind power this year) and legendary U.S. oilman T. Boone Pickens (who called this week for massive U.S. investment in wind power) illustrate the widespread popularity of wind power.

Although the United States and Germany generate more wind power in absolute terms, Denmark boasts the world's greatest "wind density" - wind power per capita. With 19 per

cent of its electricity now generated by more than 6,000 wind turbines, Denmark produces 80 times as much wind power per capita as Britain.

Why, then, does Denmark export almost all of its wind power - at a revenue loss? Why, then, does Denmark still operate all of its conventional coal-fired power plants? In a phrase, Mr. Sharman says, the reason is Denmark's "wildly fluctuating wind power."

It turns out that Denmark's vast array of turbines often produce minimal electricity when demand is high, maximum electricity when demand is low. Basing his analysis on data from a single year (2002), Mr. Sharman reported that wind power produced less than 1 per cent of the country's electricity supply on 54 different days. On one of these 54 days, the wind turbines took more power from the grid than they produced. (Wind turbines consume considerable electricity whether winds are blowing or not blowing.)

British author and energy analyst Tony Lodge makes the same point in a report by the Centre for Policy Studies, a London think tank. "Not a single conventional power plant has been closed in the period that Danish wind farms have been developed," he says. "Because of the intermittency and variability of the wind, conventional power plants have had to be kept running at full capacity to meet the actual demand for electricity and to provide backup."

Mr. Lodge says it is not practical to turn coal-fired plants off and on as winds rise and fall - because ramping them up consumes more fuel (and emits more carbon dioxide) than running them at a constant rate. Thus Denmark relies almost exclusively on coal-fired plants for its own consumption and exports its wind power at whatever off-peak price it can get.

Only 3.3 per cent of Denmark's wind power gets "accepted" on the grid for domestic consumption. In 2003, Denmark exported 84 per cent of its wind-generated electricity at money-losing rates. And CO₂? In 2006, Denmark produced 36 per cent more carbon emissions than the year before.

Denmark has provided generous subsidies for wind power developments since the 1970s and now has a sophisticated wind-dependent industry that - think Vestas - flogs subsidized turbines to naive U.S. presidential candidates. The industry's reliance on subsidies has apparently not lessened in the past 30 years. Mr. Lodge says Danish consumers paid \$517-million (U.S.) in wind power subsidies in the first six months of 2007 alone.

Messrs. McCain, Dion and Pickens notwithstanding, winds do not blow predictably. Without an energy storage battery the size of Mount Everest, most wind-powered electricity will be wasted and will almost certainly increase a country's carbon emissions - albeit inadvertently. When your power plant operates at only 20 per cent capacity (or less), you have to build four or five times as many plants as you need. For reliable backup, you still need either coal, gas or nuclear power - all of which are cheaper than wind.

The conclusion seems self-evident. Apparently it isn't. Fortunately, you can test wind power for yourself. Go outside on a hot and humid day. Feel the breeze. Or don't.