Evaluation of the Danish Electricity Reform

The Adoption of Renewable Energy to the Liberalised Danish Power Market

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Working paper on

The Adoption of Renewable Energy to the Liberalised Danish Power Market

by

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March 2006

Preface
This working paper is one out of six papers on the Danish electricity reform. The five other papers are the following:

Instruments in the Danish Electricity Reform by Anders Larsen, Jesper Munksgaard, Ole Jess Olsen, Lene Holm Petersen, Olaf Rieper and Eva Moll Sørensen (2004)

Price regulation of monopolies by Eva Moll Sørensen ("Indtægtsrammeregulering i den danske elreform", 2005)

Competition by Ole Jess Olsen ("Konkurrence på det danske elmarked efter reformen i 1999", 2006)

Unbundling by Ole Jess Olsen ("Reorganisering af elsektoren efter reformen i 1999", 2006)

Consumer protection by Anders Larsen, Kristine Bang Nielsen og Olaf Rieper ("Forbruger-beskyttelse og forsyningspligtselskaber", 2006 (forthcoming)).

The working papers contain the preliminary results from a research project on "theory-based evaluation of the Danish electricity reform" and constitute the background for a series of articles for international scientific journals written during the autumn of 2005.

All working papers are accessible on www.akf.dk

The research project is supported by the National Danish Research Council.

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Olaf Rieper
March 2006

Summary
The aim of the working paper is to investigate how subsidies to renewable electricity production, primarily wind power, have been influenced by the Danish electricity reform in 1999. Since 1981 electricity production based on renewable energy has been heavily subsidised. From 1 January 2003, however, subsidies to new wind-power capacity have been abandoned and a transition to market prices for wind power has been carried out. Consequently, private investments in wind-turbine installations have declined radically after the electricity reform. A transition programme, however, maintains a subsidy flow for a period of up to ten years to private wind-power producers having made their investment decisions in the pre-market regime. Subsidies are now collected from the electricity customers by the transmission company as part of the transmission and distribution price. The total value of the subsidy is comparable to past investment costs paid by the wind-power producer. It is therefore reasonable to interpret the transition programme as an aid to compensate private investors for their decisions made in a pre-market regime characterised by big subsidies. It appears that the total subsidy from electricity customers to wind-power producers per year has been pretty stable around 1.7-1.9 million DKK in the period 2001-2004 just after the introduction of the electricity reform. In the same period, however, wind-power production has increased more than 50% (from 4.3 to 6.6 TWh). This implies that the customers pay a relatively lower subsidy per kWh of electricity consumed. Presumably, the introduction of an EU market for CO_2 permits by January 2005 will make a new incentive to invest in wind power as the costs to be paid for CO_2 permits will reduce the competitiveness of competing power technologies based on fossil fuels. Thereby, the loss of pre-reform subsidies will be counterbalanced by a gain from the introduction of a market-based mechanism.

1. Background

In 1992 the EU Commission released a proposal about the guidelines for a liberalised EU market for electricity and natural gas. In June 1998 agreement was reached on directives for a process of the opening (liberalisation) of these markets. The directives pushed the Danish Parliament to agree on the introduction of the electricity reform in 1999.[1]

Within the process of electricity market integration and liberalisation, EU is also considering the need to increase renewable energy use in electricity production. In the White Book on renewable energy from 1997 (EU Commission, 1997) the EU Commission recommends an overall EU target for 2010 of 12% for renewable energy use as compared to total energy consumption in the EU and a target of 22.1% as compared to electricity consumption only. The Commission approves of subsidies to renewable technologies as a means to fulfil the target. However, the guiding principle for approval is that the environmental benefits should exceed the costs of deteriorated competition. The Council as well as the Parliament have agreed on the recommendations included in the White Book.

In 2001, a directive to increase electricity produced on renewable energy sources was agreed upon (Directive 2001/77/EF, September 27, 2001). The aim of the directive is to increase the use of renewable energy sources within the internal EU market for electricity. According to the directive each member country has to set up national targets for the consumption of electricity based on renewable energy sources as compared to total electricity consumption. Each member country is allowed to adapt suitable means to fulfil the national targets. Before October 2005 the Commission has to evaluate the progress of renewable electricity production and the appropriateness of the means which have been applied. If needed, the Commission will make a proposal for a common framework to support further development of renewable electricity production. Within such a framework transition subsidy programmes for at least sevens years have to be applied in order to maintain the reliability of investors having made investments in renewable energy production technologies.

In this working paper we investigate how the Danish electricity reform has transformed the regulation of renewable energy technologies from the past-reform regime characterised by huge subsidies and cost-of-service regulation into the liberalised market regime. Like in the other working papers from this project (see preface) we have applied the CMO (Context, Mechanism and Outcome) analytical approach as developed by Pawson and Tilley (1997). The CMO approach aims at identifying the mechanisms triggered by a political reform and to analyse whether the outcome of these mechanisms depends on a specific context. A brief description of the approach is given in Larsen et al. (2004) (in Danish).

Structure in the paper is as follows: Section 2 sets up the aims of the paper. In Section 3 we describe subsidies to renewable energy within a historical context. Section 4 describes the interventions in the electricity reform aiming at promoting renewable power production. In Section 5 we have a closer look at the interventions directed to protect private wind-power producers. Section 6 sets up some indicators to evaluate the outcome of the interventions directed towards wind power. Finally, Section 7 concludes.

2. Aims

The aims of the paper are: First, to investigate how subsidies directed to increase electricity production based on renewable energy (with special attention to wind power) have been redesigned to meet the challenge of market liberalisation. Second, to investigate the influence

[1] See a description of the Danish electricity reform in Larsen et al. (2006).

of the electricity reform on the development of wind power. Third, we want to analyse if overall subsidisation of wind-power production has decreased after the electricity reform has been introduced.

3. Subsidies in Danish energy policy – a historical view

In Danish energy policy subsidies were introduced by law in 1977. The aim was to induce energy savings in the industry (Kristoffersen et al., 1997). Subsidies to renewable energy were introduced in 1981, cf. Law no. 2 of January 2, 1981. Since 1981 the law has been revised several times. The aim of the law was to subsidise investments in developing renewable technologies (e.g. solar heating, biogas and biomass) not yet prepared to compete with traditional technologies in the market. Subsidies to renewable energy were given as a maximum share of the investment costs and the share was dependent on the type of technology and the type of user (e.g. household, electricity company or industry).

The context for the development of renewable energy changed in 1987 when the Brundtland Report was published for an international audience. Like in other countries Danish politicians were inspired by the thoughts in the Brundtland Report. From being a means to reduce the dependency of oil imports renewable energy transformed into being a means to improve a sustainable energy development taking into consideration the environmental impacts of energy consumption. Inspired by the recommendations in the Brundtland Report, the energy plan *Energi 2000* (Energiministeriet, 1990) was released in 1990. The main aim of the plan was to reduce emissions of CO_2 by 20% in the period from 1988 until 2005. The same year the government decided to initiate the process to convert district heating into local cogeneration (i.e. combined heat and power production) based on natural gas and biomass.

Energi 2000 was followed by different means to reduce CO_2 emissions (Kristoffersen et al., 1997). The government decided on the introduction of a CO_2 tax in 1992. Subsidies to power production founded on renewable energy sources and local cogeneration plants were introduced in 1991 and 1992.[2] The conversion of coal-fired district heating plants into cogeneration on biomass was stimulated through investment subsidies. To compensate for the CO_2 tax a production fee (subsidy) of DKK 0.10 per kWh produced on biomass, wind, waste or natural gas was introduced. Moreover, a subsidy of DKK 0.17 per kWh electricity produced on renewable energy (wind, hydro, biogas, straw and wood chips) was decided.[3]

Within this developed context of sustainability a new energy plan – *Energi 21* – was released in 1996. The plan was the implementation of a sustainable energy development. Besides, to maintain the target of a CO_2 reduction of 20% a new aim was introduced: To develop renewable energy use by 1% per year up to a target of 35% of total energy consumption in year 2030.

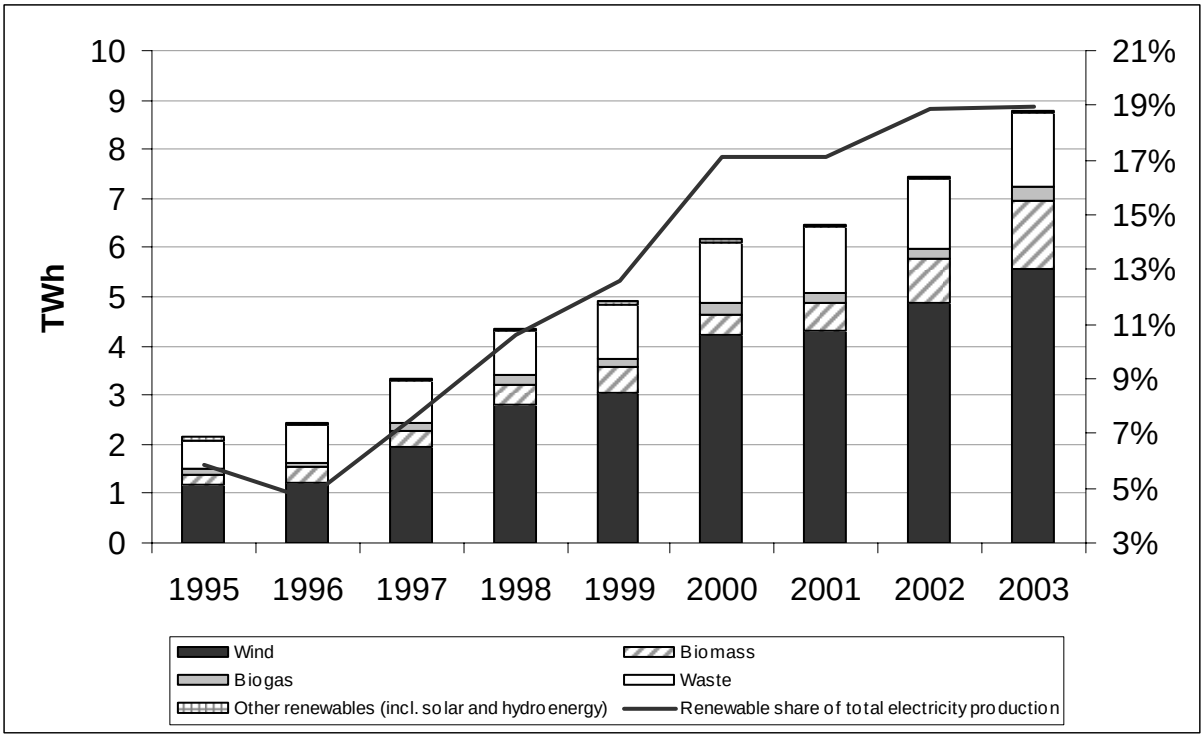
Especially in the electricity and district heating sectors there appeared to be a potential to substitute from fossil-fuel technologies to renewable technologies and there has been a

[2] "Subsidy to electricity production" (in Danish: Tilskud til elproduktion (Law no. 944, December 27, 1991) and "Subsidy to the development of local cogeneration and utilisation of biofuels" (in Danish: Tilskud til fremme af decentral kraftvarme og udnyttelse af biobrændsler (Law no. 3, January 3, 1992).

[3] This subsidy regime was slightly modified during the 1990s according to improved profitability of cogeneration based on natural gas and waste. However, the production fee of DKK 0.10 per kWh was maintained for small cogeneration plants having a production capacity below 3 MW as this segment of cogeneration plants suffered from severe economic problems. Also the total subsidy level of DKK 0.27 per kWh was maintained for renewable power production and the concept was even developed to take into account solar and wave energy.

significant progress in these sectors in the past decade. Figure 1 illustrates increased use of renewable energy in Danish electricity production over the last decade.

Figure 1. Renewable electricity production – 1995-2003



Source: Energistyrelsen: Energistatistik (2003).

Over the period 1995-2003 wind power has increased by nearly 400% equivalent to 1.2 TWh in 1995 and 5.6 TWh in 2003. Electricity based on biomass has also exhibited an impressive development. From 2002 to 2003 the production has almost doubled due to the start up of two CHP plants: Avedøre 2 and Herningværket. These plants reached full capacity use in 2003. From 1995 to 2003 Danish electricity production has increased by 26%.

4. Interventions in the electricity reform to protect wind-power production

The Danish Electricity Reform of March 3, 1999 responded to the directive put forward by the EU Commission to carry through a liberalisation of national electricity markets, cf. Section 1. One of the aims in the reform was to consider environmental aspects of electricity production. Several interventions to take into account environmental aspects were included in the reform:

1. Certification of renewable electricity production as a first step to develop a market for green certificates (in Danish: VE-beviser). A certificate market was meant to be fully implemented by January 1, 2003, but in June 2002 the initiative was postponed until it might be possible to establish a common EU market for green certificates.
2. An obligation to buy green electricity based on renewable energy and/or cogeneration (so-called prioritised production). The obligation to buy green electricity was abandoned at the end of 2004.
3. A subsidised (regulated) price for electricity produced on renewable production plants built before the end of 2002.
4. The subsidy of DKK 0.27 from the government to renewable power production was substituted by a subsidy paid by electricity customers. From being a public transfer to the power market, the subsidy turned into being a charge paid by electricity customers to the electricity company (system operator).

5. Subsidies to renewable electricity or cogeneration from plants owned by the power companies were restricted to a period of four years.

The intention to separate a green electricity market from the liberalised market was to protect owners of expensive renewable technologies from competition from more efficient large scale production technologies based on fossil fuels. To prevent consumers from buying all electricity on the low cost liberalised market an obligation to buy green electricity was introduced.

Until December 2004 only part of the Danish electricity production was traded on the electricity market. This was referred to as "market electricity" and was the part of the consumer electricity price which was liberalised on January 1, 2003. The remainder of the production, also referred to as "prioritised electricity", consisting of electricity produced on renewable energy production technologies was separated from the market. These technologies included wind power and local cogeneration plants based on renewable energy and natural gas.

From January 1, 2005 all electricity has been traded on the electricity market, and thus electricity produced with environmentally friendly production technologies has to compete with conventional production technologies on equal terms. The subsidy paid to renewable electricity production is now included in the PSO payment (Public Service Obligation) which is part of the distribution/transmission price.

Besides the interventions mentioned above, the electricity reform also introduced CO_2 permits (quotas) for power production in order to restrict the use of fossil fuels in order to fulfil the Danish CO_2 target. By restricting the use of fossil fuels or increasing the fossil fuel costs by adding a cost margin for certificates, the competitiveness of renewable power production was improved. From January 2005 an EU market for tradable CO_2 permits has been introduced. The EU market also takes into account CO_2 emissions from big industries, but does not take into account small consumers.

5. A transition programme directed towards wind power

The description in Section 4 might give the impression that the subsidies and privileges given to renewable power producers before the electricity reform were intended to be maintained after the reform. However, this was not so. From the motivation given to the electricity reform it appears that political consensus exists to initiate a process towards a full liberalisation of the electricity market including a transition programme for renewable power production. The transition programme was agreed upon in June 1999 (Danish Wind Turbine Owners' Association, 2005). Special attention was paid to private wind-power producers in the transition programme. The programme was established to soothe the transition to market liberalisation. The transition programme (the intervention) was intended to maintain a payoff from investments made prior to the reform by private investors.

The transition programme for wind power takes into account different criteria for subsidisation:

- *Time of investment*: A distinction is made between wind turbines bought before and after the electricity reform was decided upon so as to protect private investors having made their decisions on wind-power investments before the electricity reform was decided. On the contrary, investors deciding to invest in wind turbines after the electricity reform have to adapt to the market paradigm

- *Ownership*: A distinction is also made between private versus power companies, so that only private wind-power producers are compensated for the expected loss from liberalising the electricity market
- *Size of installed wind power capacity*: The subsidy is conversely scaled to the installed capacity of the wind turbine, i.e. so that small and less efficient wind turbines receive more subsidy than bigger and more efficient ones. A distinction is made between small (up to 200 kW capacity), medium (201-599 kW) and big (more than 600 kW) wind turbines. Size is only a relevant criterion for turbines established before 1999.

In a transition period up to ten years a subsidy of DKK 0.27 is given to private wind-power producers having made their investments in wind power before the reform. However, a minimum subsidy equivalent to a specific amount of full load hours is guarantied.[4] The total value of the minimum subsidy given to pre-reform wind-power producers is shown in Table 1. To illustrate the magnitude of the subsidy, investment costs per kW installed capacity are shown.

Table 1. Total subsidy to pre-reform private wind turbines as compared to investment costs

Category	Assumed capacity kW	Total subsidy DKK/kW	Investment costs DKK/kW
Small	150	6,750	7,700
Medium	450	4,050	6,970
Big	1,000	3,240	5,260

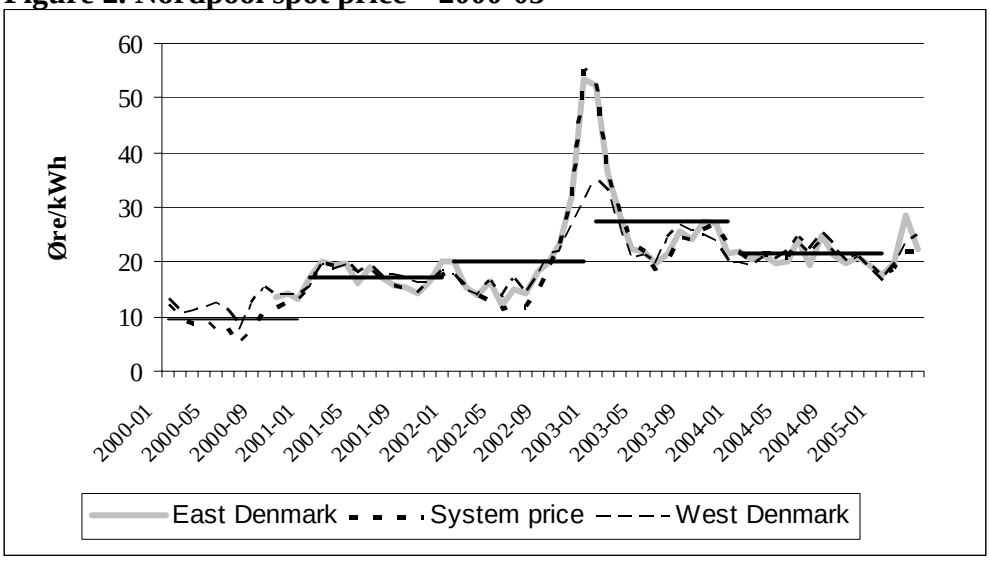
Note: Total value of subsidy is estimated by the following relation: Wind-power capacity (kW) x amount of full load hours x (0.17 + 0.10 DKK/kWh). Investment costs are based on Munksgaard et al. (1995).

As shown in Table 1 the subsidy given to private wind-power producers covers the main part of the investment costs. Investment costs are based on a study from 1995 having the benefit of reflecting investment costs of the period before 1999, which is the target of the transition programme. Due to increased efficiency we expect investment costs have decreased since 1995, so that subsidies are even higher compared to actual investment costs.

It is reasonable to interpret the transition programme for wind power as a burden-sharing policy aiming to compensate private investors for their decisions made in a pre-market regime characterised by big subsidies to renewable power producers. This conclusion is not even taking into account the subsidy included in the price guarantee of DKK 0.33 per kWh over a ten-year period. This price is much higher than the past prices at the Nordpool spot market as shown in Figure 2.

[4] Full load hours: Maximum capacity use for one hour of production, i.e. when wind speed is optimal a 600 kW wind turbine produces 600 kWh in one “full load hour”.

Figure 2. Nordpool spot price – 2000-05



Source: Nordpool. www.nordpool.com

Beyond the scope of the transition programme are wind turbines owned by the power companies and wind turbines installed after January 1, 2003. These wind-power producers have to face the market price of electricity and are consequently considered to bear the full risk from market liberalisation themselves.

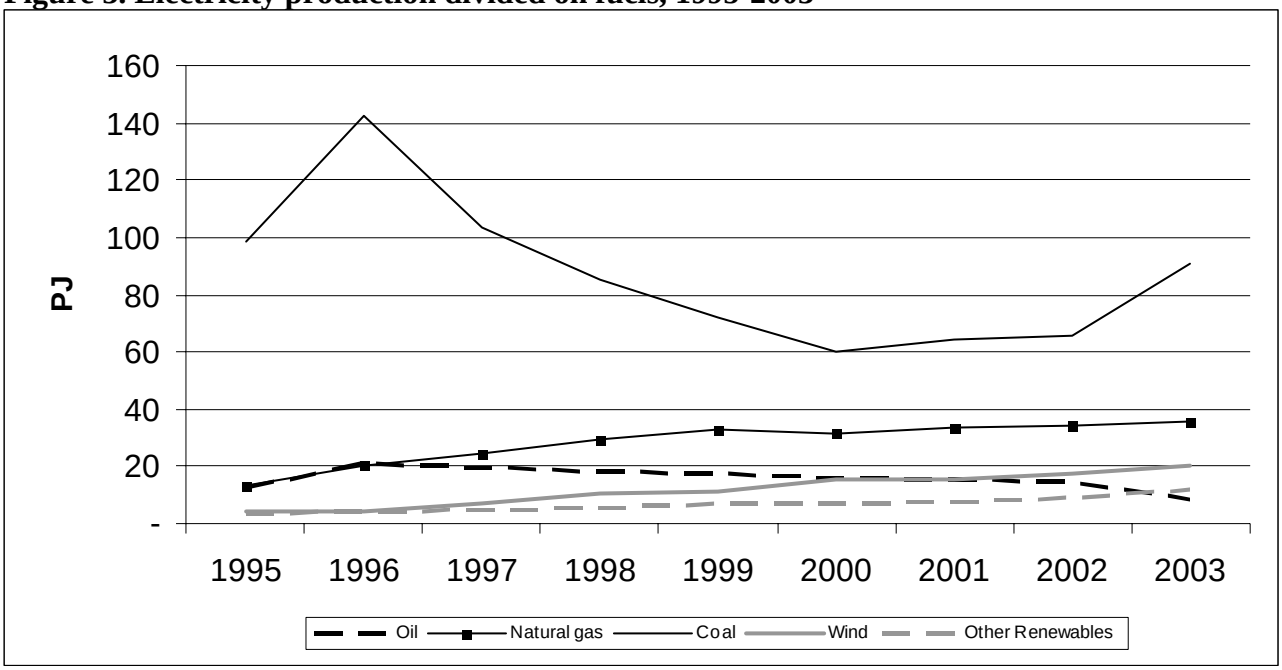
6. Outcome of transition programme for wind power

In this section the outcome of the transition programme will be assessed. To do this we define the following indicators:

- Share of renewable energy used for electricity production before/after the reform
- New wind-power capacity raised before/after the reform
- Subsidies to wind power.

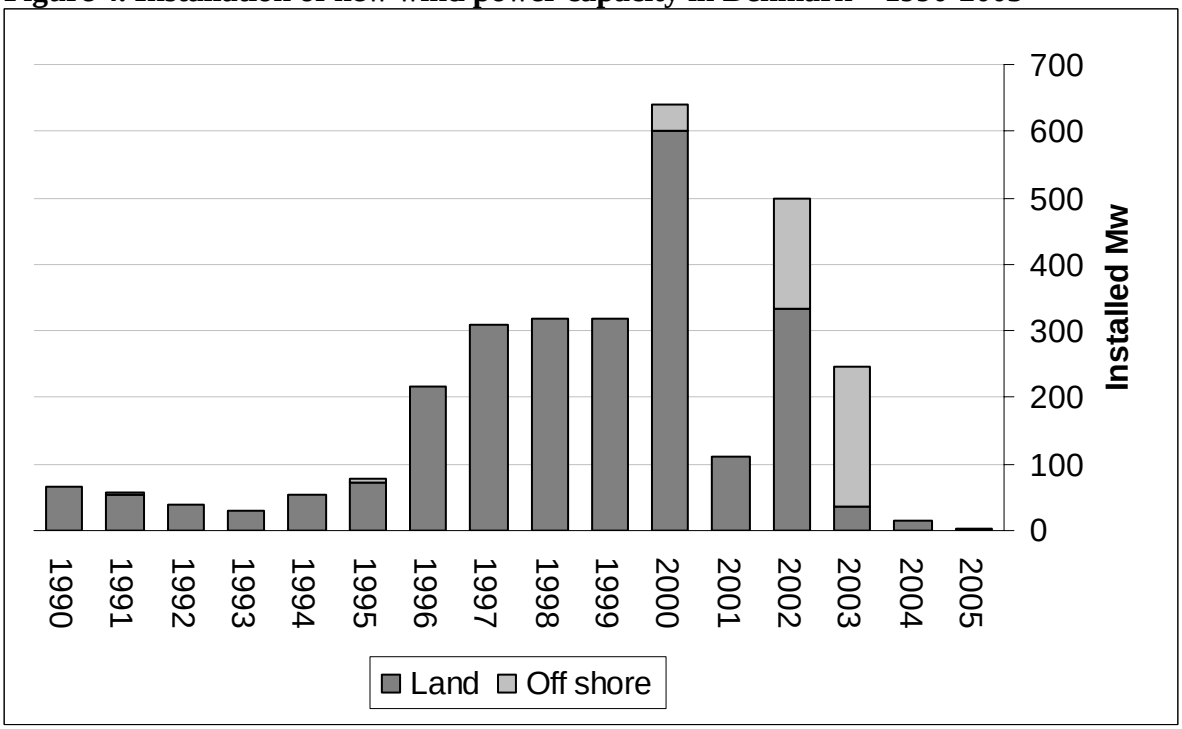
Since the introduction of the electricity reform in 1999 renewable energy used for electricity production has increased more than coal and natural gas. From 1999 to 2003 wind power has doubled and the use of other renewable energy (primarily biomass) has more than doubled as shown in Figure 3.

Figure 3. Electricity production divided on fuels, 1995-2003



One should, however, be cautious when interpreting the development in wind-power production as shown in Figure 3 as the number of new wind turbine installations has declined radically after the electricity reform. This development is shown in Figure 4.

Figure 4. Installation of new wind power capacity in Denmark – 1990-2005



Source: Stamdataregister. Energistyrelsen http://www.ens.dk/sw11668.asp
Note: 2005 registration is per 1. May 2005.

Though the favourable transition subsidies are dedicated to wind turbines bought before the end of 1999 Figure 4 shows a peak in wind-power installations in 2000 where approximately 600 MW wind-power capacity was installed. The changing revenue regime has speeded up wind power projects in order get high pay off from investment carried out under the 1999

transition programme. The wind turbines were simply bought in 1999 and installed in 2000. Investments were reaching the bottom in 2004, where no wind turbines were installed under the existing transition programme. The few wind turbines installed were either installed under the old programmes, or granted an exemption, or were installed as "private house wind turbines" (capacity less than 25 kW). According to Per Nielsen, EMD (Energi og Miljø Data), only two wind turbines have actually been installed under the new market regime, (e.g. market price plus 10 øre) which were implemented by 1 January 2003. Contrary to the decrease in land-based wind power, off-shore wind projects have been carried through by the power companies in the period of transition.

The increased wind-power production and wind-power capacity as shown in Figures 3 and 4 have a positive influence on the total amount of subsidies paid by the electricity customers. Table 2 shows estimated subsidies paid by electricity customers to wind-power producers. Subsidies have been estimated by the electricity company Eltra (Eltra, 2050) by comparing the actual price paid by the customer with the market price. Estimations are based on the scenario: How much will the consumer price be reduced if all wind-power electricity is substituted by electricity bought on the Nordpool market.[5]

Table 2. Subsidies from electricity customers to wind-power producers

		2001	2002	2003	2004
Subsidies from private consumers to wind-power producers	Million DKK	1,803	1,928	1,667	1,943
	Øre/kWh	5.09	5.51	4.77	5.50
Total electricity consumption	TWh	35.4	35.0	35.0	35.3

Source: Eltra (2005).
Note: The calculations have only been completed for the period 2001-2004 and not for any years preceding the reform. It has not been possible to obtain the data required to make a comparison of the subsidies given before and after the electricity reform. The comparison is complicated because the subsidies are paid by different institutions. Before the reform the subsidies were given as a public transfer from the public accounts, while after the reform the subsidies have been collected from the electricity customers.

It appears from Table 2 that after the reform the subsidy has been pretty stable around 4.8-5.5 øre per kWh. However, in the period from 2002 to 2004 the proportion of green electricity has increased from 21.1% in 2002 to 29.5% in 2004 (Energistyrelsen, 2004), which means that even though more electricity originates from environmentally friendly production the consumer has not been paying a higher subsidy per kWh.

The burden sharing between the electricity customers and wind-power producers has changed, so that wind-power producers now have to accept lower production revenue. This is demonstrated in Table 3, which shows annual electricity production in kWh from wind turbines and expenses paid by electricity customers to the wind-power producers (in million DKK as well as DKK per kWh from 1998 to 2004).

[5] In the analysis it is assumed that the electricity produced by wind power had no effect on the market price. This is not so as production under good wind conditions will press down the market price (Danish Wind Turbine Owners' Association: Faktablad 3, 2004).

Table 3. Average payment to wind-power producers – 1998-2004

	1998	1999	2000	2001	2002	2003	2004
Wind-power production (GWh)	1,888	2,137	3,645	4,309	4,881	5,560	6,550
Cost of production (million DKK)[1]	600	922	2,149	2,505	2,728	2,946	3,189
Payment to wind power DKK/kWh[2]	0.32	0.43	0.59	0.58	0.56	0.53	0.49
Average Nordpool system price	-	-	9.5	17.3	20.0	27.3	21.5

Source: Eltra, Jesper Stryhn.

Note: The subsidy paid to wind-power production by the Danish government before the reform in 1999 is not included in the above calculation. This explains the sudden increase in payment after 1999. The subsidy amounted to DKK 0.27 per kWh and should be added to the payment for wind power in 1998. In 1999 it is a bit more complex, as the reform was implemented in August 1999. This entails that electricity produced before August 1999 received a subsidy from the government (not included in the final price) and electricity produced after August 1999 received a consumer paid subsidy (included in the final price).

1) "Cost of production" is the total amount paid for the electricity by the system operators: Eltra and Elkraft. Electricity bought as "duty electricity" as well as the remaining electricity bought on the market is included.

2) "Payment" is the price per kWh paid for the electricity by the system operators: Eltra and Elkraft.

As seen above the price paid for wind-power production has decreased since the implementation of the electricity reform. In 2000 a wind-power producer was paid 0.59 DKK per kWh on average compared to 0.49 DKK in 2004. At the same time the Nordpool price has increased, which implies that in general the subsidy paid to wind-power producers has decreased over the period. A further decrease in the payment to wind-power producers is expected as more wind turbines will leave the transition programmes over the next decade.

7. Conclusion

Since the introduction of investment subsidies to renewable energy technologies in 1981, subsidies to renewable energy technologies have been redesigned in a stepwise process to meet the challenge of market competition. By the introduction of the CO_2 tax in 1992 investment subsidies were transformed into production subsidies given as a government fee per kWh produced by renewable energy production technologies. Thereby the incentive was redesigned from targeting long-term investment decisions to target short-term production decisions. The government subsidy to the electricity market in form of a production fee was transformed by the electricity reform in 1999 into a subsidy paid only by the electricity customers. In that way the subsidy to renewable electricity was internalised into the electricity market – so to speak. Since January 1, 2003 subsidies to new wind-power capacity have been abandoned. A transition programme, however, maintains a subsidy flow for a period up to ten years to private wind-power producers having made their investment decisions in the past market regime. Subsidies are now collected from the electricity customers by the transmission company as part of the transmission and distribution price. The transition programme implies the obligation for electricity customers to buy and to subsidise wind power.

The protection from reduced income included in the transition programme addresses wind turbines installed by private producers before the electricity reform. The calculation carried out in the paper shows the total value of the subsidy to be comparable to past investment costs paid by the wind-power producer. Consequently, it is reasonable to interpret the transition programme as a burden-sharing regime aiming at compensating private investors for their decisions made in a pre-market regime characterised by big subsidies to wind-power producers.

The transition to market prices for wind power had obviously an extensive effect on the incentive for wind-power investments. The number of new wind-turbine installations has declined radically after the electricity reform. According to Per Nielsen, EMD, only two wind turbines have actually been installed on land after the new market conditions have been introduced. However, a number of offshore wind turbines have been installed after the reform.

It appears that the total subsidy from electricity customers to wind-power producers has been pretty stable in the period 2001-2004 just after the introduction of the electricity reform. Considering, however, the fact that the proportion of green electricity has increased from 21% in 2002 to 30% in 2004, this implies that the customers are paying a relatively lower subsidy per kWh of electricity consumed.

The price paid for wind-power production has decreased since the implementation of the electricity reform. In 2000 a wind-power producer received DKK 0.59 per kWh on average compared to DKK 0.49 in 2004. Over the same period the average Nordpool price has increased from DKK 0.10 to around DKK 0.20, which implies that the margin paid to wind-power producers has decreased even more over the period.

Presumably, the introduction of an EU market for CO_2 permits by January 2005 will make an incentive to invest in wind power as this will reduce the competitiveness of competing power technologies based on fossil fuels. Thereby, the loss of pre-reform subsidies will be counter-balanced by a gain from the introduction of a market-based mechanism. Despite the subsidies changes in the market price of CO_2 permits will of course introduce a element of risk to the investor facing a future investment in wind power as compared to the price guarantee included in the transition programme.

References and data sources

Aagaard, P. and B.O. Gram Mortensen (2003): *Varmeforsyningsloven med kommentarer*. Forlaget Thomson.

Bruntland, G. (ed.) (1987): *Our common future: The World Commission on Environment and Development*. Oxford, Oxford University Press.

Danish Wind Turbine Owners' Association (2004): *Faktablad 3*.

Danish Wind Turbine Owners' Association (2005): *Faktablad 5: Afregningsregler for vindmøller*. http://www.dkvind.dk/fakta/fakta_pdf/O5.pdf

Eltra (2005): Personal communication with Jesper Stryhn from Eltra.

Energiministeriet (1990): *Energi 2000 – Handlingsplan for en bæredygtig udvikling*. Energiministeriet. Copenhagen, 115 sider + baggrundsrapporter.

Energistyrelsen (2004): *Energistatistik 2003*. www.ens.dk

EU Commission (1997): *Energy for the future: Renewable sources of energy*. White Paper for a Community strategy and action plan, COM (97) 599 (final).

Kristoffersen, H-E.; J. Munksgaard and M. Jensen (1997): *Kortlægning af afgifter og tilskud inden for energiområdet*. akf forlaget, Copenhagen.

Larsen A.; J. Munksgaard, O.J. Olsen, L.H. Pedersen, O. Rieper and E.M. Sørensen (2004): *Virkemidler i den danske elreform: Foreløbige antagelser om sammenhænge mellem kontekst, mekanismer og resultater (outcome)*. akf working paper.

Larsen, A.; L.H. Pedersen, E.M. Sørensen and O.J. Olsen (2006) (in press): Independent Regulatory Authorities in European Electricity Markets. *Energy Policy*.

Legal information (Retsinformation): *The official on-line legal information system of the Danish State*. *http://www.retsinfo.dk/*

Miljø- og Energiministeriet (1996): *Energi 21 – Regeringens energihandlingsplan 1996*. Miljø- og Energiministeriet, Copenhagen,
http://www.ens.dk/graphics/publikationer/energipolitik/e21dk/energi21.pdf

Munksgaard, J.; M.R. Pedersen and J.R. Pedersen (1995): *Samfundsmæssig værdi af vindkraft. Delrapport 1: Snæver samfundsøkonomisk vurdering.* akf forlaget, Copenhagen.

Pawson, B. and N. Tilley (1997): *Realistic evaluation*. Sage Publications.

Wind power

Danish Wind Industry Association (DWIA) (Vindmølleindustrien) www.windpower.org
The webpage contains information about the Danish wind-power industry and about wind power in general.

Danish Wind Turbine Owners' Association (Dansk vindmølle forening) www.dkvind.dk
Independent association with the aim of taking care of the wind turbine owners' mutual interests regarding the authorities, political decision-makers, utilities and wind-turbine manufacturers and to inform about the wind-power status in Denmark.

Energy data sources
Danish Energy Authority (Energistyrelsen) *www.ens.dk*
Responsible for reporting the national energy balance. Publishes Energy Statistics once a year, which contains many relevant time series. Time series are easily downloaded in excel format.

*Nordpool***:** *www.nordpool.com*
Multinational exchange for trading electric power. Reports spot prices on an hourly basis for the Nordic countries.

Association of Danish Energy Companies (Dansk Energi) *www.danskenergi.dk*
Rosenørns allé 4, 1970 Frederiksberg C.
Industrial association and umbrella organisation for associations and groups of energy companies in Denmark. Publishes "Dansk Elforsyning Statistik", which contains key figures about electricity prices, consumption, production, occupation etc. Data are easily downloaded in excel format.

Eltra: *http://www.eltra.dk/*
Fjordvejen 1-11 7000 Fredericia
System operator for Western Denmark.

Elkraft System: *http://www.elkraft-system.dk/elkraft/dk/Nyheder.nsf*
Elkraft System, Lautruphøj 7, 2750 Ballerup, Tlf.: +45 4487 3200, Fax: +45 4487 3210
System operator for Eastern Denmark.