The History of Wind-Power in Denmark

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The first Three winged wind-turbine with a 45 kW asynchronous generator was constructed in 1953 by the utility company SEAS, and designed by the engineer Johannes Juul

In 1957 SEAS erected a 200 kW wind-turbine, this turbine worked well for the next 10 years – and then were almost forgotten

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In the sixties, oil took over in Danish electricity production

It went well until the Energy-crises in 1974

After that the government began investigations for oil and gas in Denmark

The utility companies investigated the possibilities for Nuclear-power

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The people started up the organisations:

- **OOA, founded in '74, against Nuclear**
- **OVE, founded in '75, for Renewables**
- **SEK, founded in ' 77, for Renewables (in 1986 – 2001 supported by ministerial funds)**

This NGO's participated in the acceleration for developing of Renewable Energy

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Because of the increasing numbers of wind-turbines, a number of owners founded the organisation "Danish Wind-power", DV in '78

To day DV have 13,000 members private and co-ops. The co-ops represent 70,000 shareholders

Craft firms and SMEs began their experiments and constructions in 1974 and the first two commercial turbines (22 kW) were erected in '76.

The price was 6,500 € and they produced in more than 15 year round 30,000 kWh/year

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One of the owners was the journalist Torgny Møller from the newspaper Information.

He often wrote about his turbine and about wind-power in general

"Information" became an important partner for the NGO's in their fight against nuclear and for renewables and surveying for oil and gas

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During the first years several firms constructed and sold turbines.

It was therefor necessary to establish a national test-centre in 1978

Because of the second energy-crises in '79, the government decided to accelerate the establishing of renewables

It was therefore decided to support wind-turbines and solar plants economical by up to 30 % of the investments in plants

In '79 there were erected 20 new turbines

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In the period 1980 – 84 the yearly erection of turbines was approx. 150 (11 – 55 kW)

From 1981, an increasing part of the turbines was owned by co-ops, typical organised by villages all over the country

The price for one share in the first co-op turbine was 533 €

In '81 the economical support decreased to 20 %

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"Helped" by the Parliament, the utility companies, the producer of turbines (DVF) and the owner of turbines (DV) agreed a price in '83 for wind-produced electricity

The agreement was a price approx. 85 % of the price the consumers paid for electricity from the utility companies (excl. of VAT)

The green majority in the Parliament stopped further planning for Nuclear-power in 1985

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The national economical support for turbines was reduced to 10 % in 1988

In '89 the support was cancelled

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But in 1990 the Parliament changed the payment for wind-electricity to:

0.43 D.kr = 85 % of the normal price
0.10 D.kr = CO_2 free production
0.17 D.kr = production support
0.60 D.kr/kWh = 0.08 €/kWh

This price was almost fixed the rest of the nineties

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In the late nineties "the Energy Agreement Parties" in the parliament decided to decrease the price paid for electricity from wind-turbines

The last chance for a "high payment" was to erect turbines before the end of 2000

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On Samsoe it accelerated the planning for turbines on land (www.veo.dk)

11 turbines, each 1 MW was erected in March and August 2000

9 owned by local farmers and 2 by a local co-op

And then the island was self-supplied concerning electricity

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A co-op is organised as a "Partnership"

The turbines guaranteed production (from the factory) are the basis for the calculated price for 1 share per 1 MWh yearly production

The 2 co-op turbines on Samsoe was guaranteed a yearly production of 4700 MWh, that gives 4700 shares

The shares were sold to 438 shareholders, with a limit of max. 30 shares per shareholder (a national rule for co-ops)

The price per share was 415 € = investment per turbine, approx. 975,000 €

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The price per sold MWh was 80 €, but only for the first 12,000 "full loaded production hours" corresponding to 4 – 5 years

Then the price is guaranteed to 57 € up to the next 5 – 6 years

In year 11 the co-op (and the farmers) might be on the liberated green electrical market

A larger group of co-ops and private in Denmark are organised in a trade company for this market (the Windmill Owners Energy-company)

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The pay-back time for the 1 MW turbines are approx. 6 years, un-financed and without appropriations

The amount of appropriations in the co-ops are decided by the selected board and general meetings

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Offshore turbines

The first two small offshore wind-farms in Denmark were erected in 1991 (10 x 450 kW) and 1995 (10 x 500 kW)

Both farms is owned by utility companies

In 2001 a national co-op and a utility company erected 20 turbines each 2 MW near by Copenhagen

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In 2002 a utility company erected 80 turbines (2 MW) in the North Sea

And in the same year, a national test-centre for large wind-mills opened in the windy west Jutland

A utility company opened a wind-farm 72 x 2.3 MW in December '03 in the Baltic Sea

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On Samsoe the planning for offshore turbines began in 1998, supported by the Danish Energy Agency

Contract for a turn-key project was signed in 2002

And the wind-farm (10 x 2.3 MW) opened in February 2003

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5 turbines is owned by the municipality,
3 turbines by local firms and farmers,
1 turbine by a local co-op and one outside investor and

1 turbine by a nation wide co-op

Offshore wind-farm

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The local co-op turbine are owned by 340 islanders and one large shareholder outside Samsoe

The price per share was 415 € (7765 shares)

The price per sold MWh is 65 € in 3 – 4 years (because of a scrap arrangement)

For the next 6 – 7 years the price per MWh will be 57 €

It gives a pay-back time of 7 years, un-financed and without appropriations

The amount of appropriations are decided by the board and general meetings

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Some reasons for the wind-power success I Denmark:
- **Historical traditions (technical and organising)**
- **A strong political movement and lobby for Renewables**
- **Reasonable politicians**
- **Far-seeing SMEs and factories**
- **Economical support**
- **Fixed el-prices (at least for a fixed period)**

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The developing of wind-power in Denmark

	Number of Turbines	Installed Power (MW)
1979	43	3
1984	686	25
1994	3162	519
1999	2019	1,236
Total	6000	1,783
2001		2,556
2002		2,886

An example of the complexity of a consumer bill per 01.02.04

Yearly consumption 15,114 kWh (household and heating)

	Amount	D.kr/kWh	D.kr	€
Environmental electricity	6,564 kWh	0.4430	2,908	388
Free Market electricity	8,550 kWh	0.2980	2,548	340
PSO-tariff	15,114 kWh	0.0400	605	81
Regional Grid tariff	15,114 kWh	0.1178	1,780	237
System Grid tariff	15,114 kWh	0.0190	287	38
El-payment, household	4,000 kWh	0.5260	2,104	281
El-payment, heating	11,114 kWh	0.4610	5,124	683
CO_2 tax	15,114 kWh	0.1000	1,511	201
El-distribution	15,114 kWh	0.0400	605	81
			17,472	2,330
VAT, 25 %			4,368	582
			21,840	2,912
Total price, 1 kWh D.kr 1.4450 € 0.193				
Subscription, incl. of VAT			524	70
			22,364	2,982