

Danish Experience in Wind Energy - Local Financing

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In the report is used Danish currency DKK, 1 €= 7.4 DKK

In the report the terms “windmill” and “windturbine” are used interchangeable.

The legislation referred to is all Danish legislation. The full text of the legislation is available in Danish from the Danish state’s legal information service, online at www.retsinfo.dk.

Introduction and Background.

The Danish Windmill Tradition

"As I rode my bicycle about in Northern Jutland on my lecturing tours before and during the last war, it was impossible to avoid noticing the many windmills on the farms. The farms were self-sufficient in electricity. At that time I did not know that this state of things originated in an idea issuing from the folk high school of Askov, and that it was not only a technical issue, but that a far-reaching social idea behind it: Giant business corporations must never be allowed to monopolize the power production. It should be taken care of in small local communities and on the individual farms."

This is how folk high school professor Richard Andersen saw the landscape of Jutland a little more than half a century ago (Quote: preface to H.C. Hansen: "Forsøgsmøllen i Askov", 1981). A statistical handbook from the beginning of the 20th century tells us that 35,000 "wind engines" were registered on Danish farms, to which number should be added 2,000 grain-grinding windmills. The classical Danish landscape was very much characterized by windmills.

The special Danish windmill tradition originated with the work of scientist and Askov folk high school professor, Poul la Cour. From 1891 on he conducted an extensive research and product development in the field of practical utilization of wind energy. The first experimental windmill was built - with subsidies from the state - at Askov in 1891, and as early as in 1895 Askov was illuminated by means of wind energy; certainly a breakthrough of world-wide dimensions. In 1897 a new and bigger experimental windmill was built; still in the "Dutch" style, like the old one.

From here the movement evolves that, from the beginning of the 20th century, equipped almost all larger farms in the Danish landscape with a "wind engine" or "klapsejler" (a windmill with the blades consisting of a system of adjustable narrow, horizontal slabs made from wood).

The windmills delivered mechanical energy for grinding, threshing, pumping of water and also for the production of electricity for lighting and radios resulting in enormous improvements of the living in rural areas. The windmills were providing nearly all the conveniences that otherwise could only be satisfied in the cities.

To meet the needs of installation and maintenance of the new energy source, Poul la Cour organized the education of rural electricians who became very valuable in the ongoing modernisation of Danish agriculture. For some decades prosperity and welfare improved and made the rural lifestyle attractive compared to neighbouring countries, which did not offer similar opportunities for the rural population. The windmill was a key factor in this development.

After a fire and a re-construction in 1929 the Askov windmill worked on until 1968, the year in which so many old things were discarded. It was also in the 1960's that the farmers effectively stopped maintaining the iron constructions of the windmills and finally pulled them down, because they could not compete with the cheap power supply from the central power plants.

Already in 1929 the writer, Poul Henningsen, wrote in a good-bye poem to the "wind engine": "No one can avoid the evening of life, the times are changing for the motor power. Everything has its

chance, and you have had it". The power station produced electric power, the petrol engine was triumphant, and few people thought that wind power had any future.

Among the few people who after the Second World War went against the spirit of the times was engineer J. Juul. In 1951 he started full-scale experiments, first with a two bladed 11 kW windmill, in 1953 with a three bladed, 45 kW asynchronous generator for alternating current, at the island of Bogø. In 1957 his research and innovative ideas resulted in an extremely successful experimental windmill in Gedser of 200 kW. Demonstrating high reliability and efficiency it was in continuous operation till 1968.

Nobody realized that this was building a bridge to the future. His epoch-making principles of construction are in fact the experimental point of departure for the pioneer work in the windmill area of the 1970's.

The Big Energy Crisis.

The historical turning point of the wind energy development was the 1973 energy crisis, which caused something like a shock to the Danes in their life of affluence. At the same time the debate on utilizing nuclear power in Denmark worked as a forceful stimulant for bringing alternative energy sources onto the agenda. The slogan "sun and wind" made it possible for the many people who were active in the movement against nuclear power to say not only "No", but also "Yes" to an alternative.

The energy crisis caused the set up of two scenarios. One was the movement "from above" originating from government and legislator initiatives, seconded by research at the atomic power experimental station Risø, mastered by the big central power stations.

But at the same time a movement "from below" arose, rooted in a new public awareness of energy and environment. Experiments were made and experience was exchanged with a will during the latter half of the 1970's, especially in Central and Western Jutland.

The media favoured in particular the giant and still operative almost 2 MW windmill at the Tvind Schools in Ulfborg with their attention, but many others were also in the run. Around 1978 the first initiatives to a commercial production were taken, and in the following years a quite new, dependable concept with a distinct "Danish design" emerged. During the 1980's the windmills came back in the Danish civilized landscape.

Through the years, windpower utilization has reached a popular level far beyond the calculations of the planners. In 2002 windpower is representing a total capacity of almost 3,000 MW including offshore wind energy, which is going to have increased importance. The goal of the energy plan has more than been fulfilled as the national target originally was 1,500 MW by 2005.

Local Ownership

Most of the windmills are installed by private consumers in Jutland as distributed generation (see the distribution of ownership of windpower capacity in Figure 1. In 2002 nearly 20 percent of the country's electricity consumption is coming from wind energy, with a much higher proportion west of the Great Belt that is dividing Denmark into 2 separate electricity systems without connecting cables. In the western part of the country independent power producers representing cogeneration, wind energy, biogas etc. delivers 60 per cent of the needs of electricity, replacing coal power from

central utilities. The bulk of this share has been achieved in less than 10 year and is of historical significance.

An important cause of this growth, which had hardly been anticipated at the end of the 1970's, was the guaranteed minimum price system of pollution free energy. In the original legislation the leading principle was that people living in their neighbourhood should own the windmills, and next that private individuals could only own shares in windmills corresponding to their household's private consumption. Farmers were allowed to install one windmill at their property. The intention had been to create broad public involvement and local ownership in the development of Danish wind energy.

Today this perspective may be less striking. The 1992 tax reform favoured windmills owned by individuals and did not give more favourable conditions to those owned by a cooperative. Furthermore, it became possible for a while to buy a tiny piece of land suitable for windmill installation and add it to one's own property, resulting in the loosening of the rule saying that you should live close to the windmill. The number of shares allowed was raised gradually from 9,000 kWh per family to 30,000 kWh per person over 18 living in the household.

Since January 2001 there has been no regulation of ownership. Anyone, also investors from abroad, may own windmills in Denmark in accordance to globalisation and liberalization policies. All this has resulted in a development that is increasingly making investments in windmills sheer investment projects.

The below graph shows how windpower ownership has developed over time:

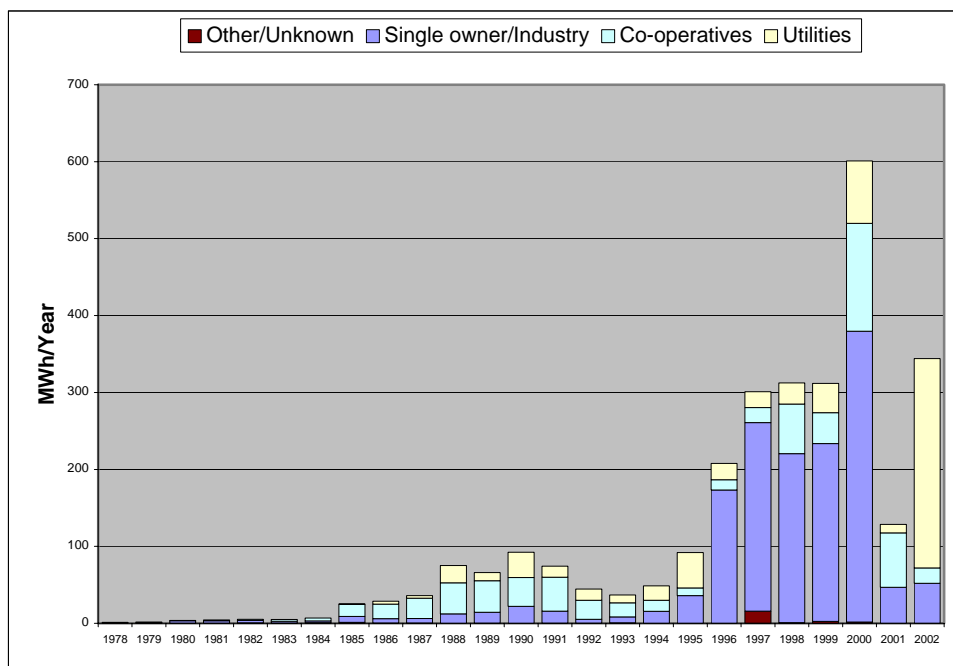


Figure 1. Development in installed windpower capacity (MW/Year) from 1978 to 2002 related to distribution of ownership. Figures for 2002 are estimated.

The first “boom” around 1990 and the second around 2000 were both driven by private investments, but of different kinds. Around 1990 co-operatives were the most popular form of investment, while

single ownership became most popular after 1994. The change of regulation was the key reason for this, but also other factors contributed to this change such as less perceived technical risks and developers' focus on farmers. The graph below (Figure 2) illustrates this change.

The category "Single owner/industry" is primarily farmers, but also includes a few industries and other commercial landowners that have installed windturbines on their land.

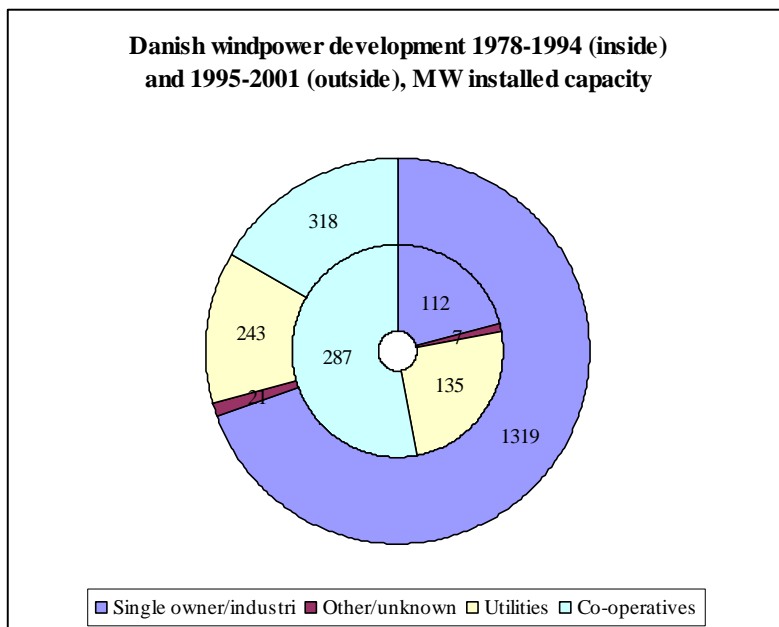


Figure 2. Change in ownership of installed MW windmill capacity between the development in the period of 1978-1994 and 1994-2001.

Windpower – a public initiated technological development

In a process running parallel with the government and power utility based initiatives, - grassroots, "do it yourself people" and black smiths have collaborated in an idealistic and business conscious approach to develop windmills. Since 1973, this joint effort has gradually formed the foundation of the present globally oriented, windmill industry in Denmark .

Seeing the standardized and elegant windmill concept that we now have become used to, it may be difficult to imagine the diversity and insecurity that reigned in the mid-seventies. A long series of technical options had to be tried out, and many disappointments to be experienced.

A broad exchange of experiences and openness in the field of information were decisive conditions for the development gradually leading to functional and efficient windmills. Engineer J. Juul's experimental work during the 1950's contributed strongly towards turning the development in the direction of what came to be the special Danish concept. It was, however, necessary to learn about his experiments from United Nation's renewable energy conference reports edited 1960.

During the bi-annual windmill sessions, initially arranged by the Organization for Renewable Energy (OVE), lively discussions and comparisons took place, contacts were made, strategies and initiatives were decided. It was possible to exchange the experiences harvested by many experimenting windmill builders, inventors and other creative people, that all were contributing to the development of the emerging windmill industry.

These sessions were the incubator that solved research and development challenges, which large professional laboratories and corporations did not have practical and economical solutions to. The early sessions, that were to be of decisive importance to the course of the technological development, were co-ordinated by Preben Maegaard, chairman of OVE and later director of the Folkecenter for Renewable Energy, and his workmate in OVE, Lars Albertsen.

Distributed Manufacturing

A key question was: how to get a real and professional manufacturing of equipment going? The Tvind school people had stipulated that their findings, however important, were not to be utilized for profit.

On the other hand, NIVE (the local development organization), represented by Preben Maegaard and Ian Jordan, was eager to find ways and means of making an industrial production of windmills possible. The idea/concept was to find ways to stimulate a regular serial production by involving the mechanical industry and organising consortiums covering the required production skills in already existing small and medium size companies especially motivated for entering into the emerging renewable energy sector. Instead of building on a total concept (e.g. the Riisager windmill, produced from 1976), NIVE recognised that it might be possible to produce windmills by seeing the windmill as a number of components coming from a variety of industries like tower building, fibre glass, electronic controls, machinery etc.

Especially the association of Danish black smiths showed serious understanding of this manufacturing concept using existing experiences of successful transfer of technological know-how within its membership of 2,000 independent companies. 25 year later the sector is still benefiting strongly from this production process as supplier to the windmill industry.

Sydthy – an Example of a Windpower Municipality

The municipality of Sydthy is a district of lovely landscapes. The 322 square kilometres between the North Sea and the Fiord offer an unusual variety of landscape, characterized by tracts of blown sands in the West and lush, rolling hills in the East with a large number of tumuli that bear witness that this is an area where people have been cultivating the land for thousands of years. 11,800 people live here.

Sydthy offers more space than most other places. The average population density is as low as 37 persons per square kilometre, compared to 122 in Denmark as a whole. But the households are larger here than in other places, averaging 2.4 persons.

It is a real rural community. Only half the population live in towns or villages, and farming is still of central importance. That means that the independence culture dominates the lives even of those who work for wages.

The average annual income for those in employment is 26.300 € In Denmark as a whole, it is 28.600 € This part of the country has always been frugal, but perhaps the quality of life is above average. That can hardly be measured, but the frequency of theft and violence is, anyhow, significantly lower than in most other areas in Denmark.

Windpower in Sydthy - the Story of a Success.

The 145 windmills that are harvesting energy out of the almost permanently blowing winds place Sydthy in a class of its own when you talk about energy policy. The majority of the wind energy is coming from 200 to 300 kW units but some of the newest windmills belong to the 600 kW class. Megawatt-size windmills have not been installed in Sydthy before 2002 but are appearing as part of a re-powering programme. During this programme large megawatt -size windmills replace small-size windmills, initially up till 150 kW. This leads to a significant increase in the energy production from the wind.

A large majority of the windmills of Sydthy are scattered throughout the agricultural landscape at sites that are well known for good wind resources. Out of the 145 units only 20 windmills are installed in regular wind farms in geometric patterns. Wind farms (small or big) are the preferred solution among the central landscape authorities but in general criticized by the local residents due to the remote placing from the owners and dominance in the landscape compared to the existing more dispersed siting that is supporting the contours of the landscape and the location of the of the farm buildings.

Before installation the wind potential is carefully investigated by means of the wind atlas method. Guaranteed electricity production by the windmill supplier is often achieved within 5 percent of the predicted annual production, which in itself provides high confidence in the investment from the side of the owners and the financial institutions.

At present the windmills in Sydthy produce more than 100 percent of the power consumed in the area and there are hardly any areas in the world that can show such massive utilization of the power of the winds (see Figure 3 below). This feat is the result of a development that has taken only a few years. It is no more than 20 years since experimenting master smiths built the first modern windmills.

Importance of local ownership

The scope of the following account is to offer an overview and give an explanation of this revolutionizing development, which not many people would have imagined to be possible.

Sydthy, situated between the sea and the fiord, is one of the most windswept areas in the country. But you could easily point out other areas favoured by the winds, where the exploitation of the energy is far from equally intensive. Other and more complex explanations are needed.

In order to evaluate the explanations it is necessary to move beyond the horizons of Sydthy. Sydthy may be seen as a focal point for wind energy where the energy policy conducted by the government and parliament joins forces with an unusually high degree of public activity.

One has to investigate to what degree NIVE and the Folkecenter for Renewable Energy have played a part as initiators and mediators. Add to this the role played by the local power utility as partners and opponents. Finally, the local and regional planning authorities became decisive agents, not least as during the 1990's the windmills developed fast as regards their capacity and size.

One might see Sydthy as the future laboratory of wind power, which has got its high share of wind energy by exploiting the prevailing natural energy resource. However, this has not caused the local

conflicts and rejection of windmills, which is the lesson learned from many other local communities where the residents have protested strongly against this new form of energy technology and thereby blocked for a future-oriented transition from atomic power and fossil fuels to the clean renewable energy solutions of the future.

In contrast an opinion survey from 1996 based on interviews of almost 1000 residents representative for the local population, clearly demonstrated a massive good-will in favour of wind energy. 80 percent expressed a positive attitude to the local windmills. Especially surprising was that people living closest to the windmills were the most positive. The negative minority primarily consisted of senior and retired citizens in the towns.

The conclusions of the investigation were quite clear: Ownership and direct economical participation in the installed windmills create a tolerance to the visual impact of windmills in the neighbourhood, which is significant.

Because the sympathy increases the closer you live to the windmills, we can observe a clear indication that in order to obtain a high share of wind energy, involvement by joint ownership paves the way for maximum utilisation and thereby transition to renewable energy without causing conflicts in the local community.

However, by the turn of the century the region is fighting against a number of new problems that other areas will also experience when the national targets with regard to wind power capacity is to be realized.

One question in particular becomes urgent: How to resolve the conflict between esthetical impact on the landscape and the demand for a continued growth in the utilization of renewable energy sources when you demolish relatively small community owned windmills and replace them by megawatt machines with predominantly single or non-local ownership, which clearly distorts the previous well balanced economical and ecological structure in the neighbourhood.

Windpower Export and Income

In the late 1990'ies more than all the electric power consumed in Sydthy was produced by privately owned local windmills, bringing the citizens an income of 7-8 million €per annum through sale of electricity (see Figure 4 below). As almost all the windmills are owned by people living in the area this has meant an extra average income of between 1500- 1800 €per household. That income did not exist before the coming of the windmills. Environmentally the power produced is replacing power, which would otherwise have had to be produced from coal from Australia and South Africa. This change from fossil fuels to the energy sources of the future is not exclusively a question of technology and planning but also of new ways of organizing and cooperating in the local community.

Renewable energy is by nature de-centralized, and in Thy it has been possible to organize things in a way that makes new technology a part of ordinary people's everyday life, thus not only serving local development and the environment, but also as a manifest instance of how the individuals and the households may play an active part in changing the social system and create a model reaching out far beyond the borders of the local area and the country.

This aspect gives rise to much interest to-day because it means that the windmills are regarded in the same manner as other human activities, while at the same time producing power that holds no future threat to the climate and international conflict to secure the necessary energy. Seen in the long perspective, a very great change has begun.

Power balance for Sydthy municipality:

Electricity consumption and local wind power production - 2001	Consumption of electricity - kWh	Local wind power production - kWh
Sydthy municipality, approx. 11,500 inhabitants	75,000,000	
Delivered to the 10 kV system local power utility, "Thy-Mors Energi"		58,000,000
Delivered to 60 kV system by "Sydthy Kabellaug", 26 windmills		18,000,000
Delivered to 60 kV system by 2 wind farms of 1,750 kW and 9,600 kW.		24,000,000
Total	75,000,000	100,000,000

Figure 3. Power balance for Sydthy municipality. Showing electricity consumption and local wind power production of year 2001. (evt. Rykkes op til link!)

Number of windmills in Sydthy in 2001	145
Feed-in price per kWh: 0.075 € 100,000,000 kWh x 0.075 €	7,5 million €(revenue of private wind power per year in Sydthy municipality)

Figure 4. Number of windmills in Sydthy and revenue of private wind power per year in Sydthy municipality.

Legal System

Through the 25 years of Danish modern windpower development, legislation for windpower has changed considerably: to support windpower development, to regulate it, and as results of other changes in legislation. The legislation regulates siting of windturbines (land-use planning), technical aspects, investments, taxation and sale of electricity produced. In this overview most emphasis is on investments and taxation, the aspects most important for local investments.

Investments

Investors of windturbines have been electricity consumers and to some extent electric utilities. These were the two types of owners recognized by the Danish legal system until 2001, when the limitations for windpower investors were removed.

Originally electricity consumers could only install windturbines in their own installations, and sell surplus to the grid. From the early 80's, electricity consumers were allowed to install windturbines in separate installations, and to share the ownership among several consumers within a short distance from the windturbine (typically 10 km or in the same municipality as the windturbine). Each consumer was allowed to own shares not exceeding his/her electricity consumption; thus maintaining the principle that owners were consumers that got a part of their supply from own (shared) windpower production.

In 1992, the rules were changed so farmers could install one windturbine on his/her land and the limitations for members of windpower co-operatives were relaxed: All inhabitants of the municipality, where the windturbines were sited and neighbouring municipalities could be members, even if they lived more than 10 km from the windturbine. Later the municipal councils were allowed to deviate from these criteria on a case-by case basis. In principle a municipality could allow all Danish electricity consumers to be members of a specific windpower co-operative. In spite of several attempts, consumers were not allowed to invest in offshore windturbines before 1997. This is part of the reason for the late offshore development of windpower in Denmark.

Utilities have always been allowed to invest in windpower, just as they could invest in other power plants.

In 1985 an agreement was made between the state and the utilities that they by 1990 should have invested in 100 MW of windpower, and in 1990 an agreement was made about another 100 MW by 1994. However, the utilities first fulfilled the agreements in 1992 and 1997 respectively. Still a third agreement of another 200 MW by 2000 was made in 1996, which at the end of 2002 has almost been met. Additionally in 1998 the utilities were required by the state to install 750 MW offshore windpower, but this was reduced to 300 MW in 2002.

In a few cases other investors have been involved, e.g. municipalities.

The main legislation that regulated ownership was:

- [Statutory order on grid-connection of windturbines \(October 7, 1992 BEK no. 838\)](#)
- [Statutory order on grid-connection of windturbines \(December 13, 1996, BEK no. 1148\)](#)

Grid-Connection

For private investors the investment in grid-connection and grid-reinforcement often gives disputes with the utilities about the payment. Because of these problems, the division of responsibilities for network connection was regulated in 1992. The rules are that the windturbine owner shall invest in a cable to the nearest high-voltage line (10/15 kV) incl. transformer from 400 V to 10/15 kV and the utility shall pay grid-reinforcement of high-voltage lines.

To distribute these costs, the utilities have made a fund for distribution of the grid reinforcement costs among all utilities. The grid-reinforcement costs distributed via this fund was 440 million DKK (59 million €) during the years 1994-2001, when 2,000 MW of windpower was installed. This equals 226,000 DKK/MW (30,100 €/MW) or about 3 percent of the total windpower investments in the period. New developments with large windturbines in areas with many windturbines give larger grid-reinforcements costs, in one case 500,000 DKK/MW¹.

The legislation that regulates payments of grid-connections is:

- *Statutory order on grid-connection of windturbines and tariffs (March 16, 2001, BEK no. 187)*

Taxation

For private persons that own shares in windturbines, a special tax-rule applies that allow them to have income from windturbine-shares up to 3000 DKK (approx. 400 €) without income tax. This rule makes windturbine-shares equal to investments in energy savings and local renewable energy such as domestic solar heating or PV electricity. The amount is chosen as a moderate household electricity bill, but applies to all grown-up persons (18 years and above).

For a person that owns larger shares in windpower co-operatives, 60 percent the income above 3000 DKK are taxed with income tax as normal income.

For farmers, utilities and other investors, there are no special tax rules for windpower investments.

The legislation that regulates the taxation of windturbine-shares for private persons are:

- Assessment Law (September 17, 2002, LBK no. 791, §8P)

Sale of Electricity

In 1984 the tariffs for sale of electricity from private windturbines was set to 85 percent of the (ordinary/regular) consumer price (equal to tariffs for consumers with an annual consumption of 20,000 kWh/Year).

Turbines connected in the owner's installation (e.g. a to a farm) got 70 percent of the consumer price for surplus electricity sold to the grid. When electricity taxation was introduced in 1977, windturbines were reimbursed from the tax. In the tax reform of 1992, the reimbursement was decoupled from the tax-level. The reimbursement was set to 0.27 DKK/kWh (3.6 €cent/kWh), as reimbursement of CO₂ and energy taxes, while the tax was increased.

¹ Information by the electric distribution company "Thy-Mors Højspændingsværk", the higher costs are caused by the need to increase the power of 15/60 kV transformers when the windpower capacity becomes higher than the peak-load of the consumers connected to the transformer.

In 1998 this system was changed to a tariff of 0.60 DKK/kWh (8 ¢/kWh), but only for the first 12,000 full-load hours (for windturbines of 600 kW and larger, smaller turbines gets the price for more full-load hours) and with no electricity or CO₂ tax reimbursement. This level was decreased to 0.43 DKK/kWh (5,7 ¢/kWh) for turbines bought after 1/1-2000, paid for the first 22,000 full-load hours. It will be further decreased by the end of 2002 to the electricity market price + a bonus of up to 0,10 DKK/kWh (1,3 ¢/kWh). If the sum of the electricity market price and the bonus exceeds 0,36 DKK/kWh (4,8 ¢/kWh), the bonus will be reduced accordingly. In addition, a special tariff applies to windturbines replacing old windturbines below 150 kW in the period 2000-2003. They can get additional 0.17 DKK/kWh during the first 12,000 full load hours for three times the capacity that they replace if they replace windturbines below 100 kW and for two times the capacity if they replace windturbines 100-150 kW.

Legislation for a special renewable energy certificate market has not entered into force, its implementation is postponed.

The legislation that regulates tariffs for sale of electricity from windturbines is:

- Statutory order on grid-connection of windturbines and tariffs March 16, 2001BEK no. 187

Land-Use and Siting

Siting of windturbines is part of Danish land-use planning. In 1994 all municipalities were asked to designate sites for windturbine groups and parks, and in 1999 the competence to revise the plans was given to the counties as part of their regional planning.

This system with designated sites simplified installation of windturbines in these sites, making development easier for many windpower developers. Most designated sites were used during the 90's. For new windturbines it is often necessary to designate new sites, which involve a longer planning procedure with an Environmental Impact Assessment.

Windturbine siting and planning is described in detail in the report "Spatial Planning of Windturbines"². The main legislation regarding windturbines is Law on planning (June 11, 2000, LBK no. 518) and Statutory order (following this law) on planning and planning permissions for windturbines in rural area (June 10, 1999, CIR no. 100).

Connection to the Grid/Grid-Reinforcement

With private and independent producers of wind energy and public utilities owning and operating transmission and distribution power lines, there is a special need for regulation and procedures of delivering electricity to the grid. However, this has been solved in several countries with due respect to the following basic aspects:

- The windpower supplier must have the legal right to connect to the grid
- The utility has the obligation to purchase the power from the independent producer

² Spatial planning for windturbines, OVE CLER and others, part of the PREDAC project, see www.predac.org (to be published 2003).

- Fair pricing principle for the supply of power from the independent producers to the grid

The point of connecting the windmill to the grid has to be defined from a combination of economical aspects. Basically, experience has shown that best results are obtained when the public utility is given the responsibility to connect the windmill and pay itself accordingly. The grid operator has the necessary data of the grid and is responsible to the costumers of maintaining the power quality standards. When the grid operator is doing the grid connection and necessary reinforcements, he will find the most economical solutions whereas he might be tempted to set higher requirements if the windmill owner should pay for the grid connection.

Power grids are in general designed for one-way supply of power from a central power station or power line to the consumers. However, when connecting a windmill to a distribution radial o a grid, situations will occur –especially at periods with high windpower production and low power consumption - where power has to be transported the opposite direction of which the supply system was originally designed. This may cause excessive voltage increases, which can be compensated for by grid reinforcements, the payment of which must be regulated by the political system. When the grid operator finds it preferable, he can establish special lines for the transport of electricity from windmills as this allows larger variation in voltage and cheaper grid solutions³.

³ This is done by some Danish utilities with several windturbines in the grid. They make dedicated 10 or 15 kV lines for windturbines, leading to 60/10 kV or 15/60 kV transformers.

Financing

Several banks have included financing of windturbines as part of their normal portfolio, and they regard windturbine financing as a low-risk investment similar to investments in real estate. There is a distinct difference between financing of shares in co-operatives and investors that purchase a whole windturbine. Banks with windturbines as part of their normal portfolio will often give loan to buy shares in windpower co-operatives without assessing the private economy of the buyer, if they trust the development project. On the other hand, buyers of whole turbines can get the lowest interest rates, and they have the possibility to use mortgages.

One bank with experience in windpower financing has the following criteria for financing windturbines:

Financing shares in windpower co-operatives:

- The project must be economical sound, defined as payback of debt and interest with income from the windturbine within a period not exceeding 10-12 years, with a reasonable assumption of future electricity price and bonus, and with the income based on 90 percent of the estimated production (see below).
- The windturbine should have guarantees and insurance against defects in the turbines and against productions lower than 90 percent of the estimated production for the first 5 years.
- The shares act as security for the loan.
- Income from the shares is paid to the bank to service the loan, fully or partly.
- For loan to 5 shares or less (where income is tax –free), the bank requires only that the investor be not registered for bad credits (in Riber's register for persons with bad credits). For loans to buy more shares, the bank will evaluate the economy of the investor.

Financing a large turbine, one investor:

- The project must be economical sound, defined as payback of debt and interest with income from the windturbines within a period about 8 years, with a reasonable assumption of future electricity price and bonus, and with 90 percent of the estimated production (see below).
- The windturbine should have guarantees and insurance against defects in the turbines and against productions lower than 90 percent of the estimated production for the first 5 years.
- The windturbine acts as security for the loan.
- Income from the turbine is paid to the bank to service the loan, to payback the loan in about 8 years.
- The investor must have free capital equivalent to 20 percent of the investment, but the loan can be up to 100 percent of the investment, if it can be paid back in about 8 years.

The interest offered compared with interest offered for loans to houses are given in Figure 5 below. The bottom of the bars indicates the interest of loans from the Danish National Bank to commercial banks. This part of the interest is variable. It is currently (Nov. 2002) 3.45 percent, which is low, compared with historical values. The average interest have varied between 2,85 and 5,60 percent during the last 5 years. The top of the bars is the interest paid to cover the costs of the bank, including transaction costs and risk costs. This part is low for a large loan to a whole windturbine because of the relatively low transaction costs and higher for a small loan to buy shares.

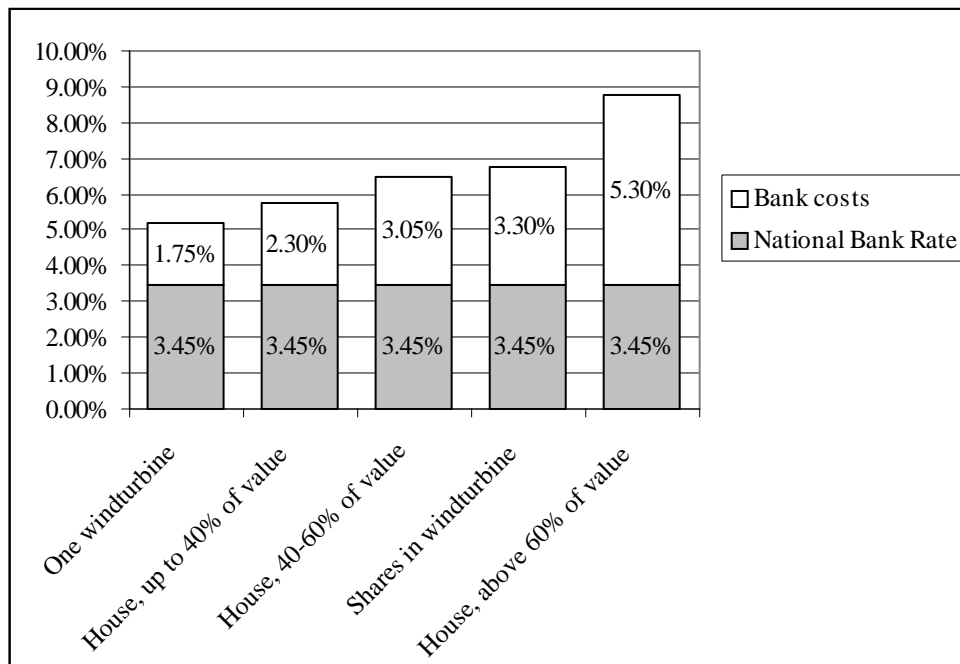


Figure 5. Comparison of interest of loans to windturbines and to private houses, status 1/10-02. Loans to houses are split according to the priority of the loan in the financing of the house. The rates are indicative and will vary from case to case.

Single windturbines can also be financed with mortgages, based on sale of bonds. The benefit of this is that it gives a fixed interest rate, and thus fixed payments for the loan.

The limitation of project financing

The available financing is one of the limitations to realise a project. The below table gives some example of projects that can be realised with the above financing, and the assumption of an average future interest rate of the Danish National Bank of 5%.

Investment in 1 MW windturbine, Denmark	Co-operative, 100% loan 12 year repayment	Co-operative, 100% loan, 12 year repayment with income + max. tax deduction*	Single owner 100% loan, 8 year repayment	Single owner, 80% loan, no interest for owner's share before year 9	
Investment	6500,000	6500,000	6500,000	6500,000	DKK
Loan payment 12/8 years	876,200	732,550	1077,700	862,160	DKK/year
O&M, administration ⁴	200,000	200,000	200,000	200,000	DKK/year
Annual costs	1076,200	932,550	1277,700	1062,160	DKK/year
Fraction of DK 2000 projects, tariff: 0.60 DKK/kWh, (tariff offered until 2000)**	82% (1794 hours)	90% (1554 hours)	37% (2130 hours)	82% (1770 hours)	
Fraction, tariff 0.43 DKK/kWh (tariff offered 2000-2002)	16% (2503 hours)	35% (2169 hours)	5% (2971 hours)	19% (2470 hours)	r
Fraction, tariff 0.32 DKK/kWh (estimated market price 2003 +	<1% (3363 hours)	9% (2914 hours)	<1% (3993 hours)	1% (3319 hours)	r

⁴ Operating costs for a 1 MW windturbine is expected to be 150,000 DKK/year, and administration costs 50,000 DKK/year for co-operatives. Costs for major renovations that can come after 10 years, are not included. Administration costs can be lower for a windturbine with a single owner

bonus)					
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Table 1 Investments in 1 MW windturbine for different investors and fraction of Danish turbine capacity from 2000*** that would have positive economy with the proposed financing in a normal wind year. Figures in () gives the corresponding full-load hours/year.

*Payment of interest are tax deductible with 40% tax for private people. In this example is included that this tax deduction is also used to repay the loan, and no tax is charged on the income (requires that each member has income from the windturbine below 3000 DKK/year).

**The rate was only offered for 12,000 full load hours, equivalent to 4-6 years of operation.

*** The figures are based on a comparison of the full-load hours in the () and the distribution of realised full-load hours in 2001 for the 104 MW of windpower capacity that entered the statistics published in "Vindstyrke" in the year 2000, scaled up with the ratio between 2001 windpower production and a normal wind year (in Denmark, 2001 had only 80,4% of the average wind energy)

From examples given in Table 1 it is obvious that it does not make economic sense to invest in windturbines in Denmark based on the tariff for 2003 and onwards, unless investors do not need loan and have very low requirements of interests. An exception is projects that can use the special support for windturbines replacing older windturbines (re-powering) offered 2000-2003.

Production Insurance

One factor that reduces the risk for the investor is an insurance against lower electricity production than estimated during project planning. Such insurance is available from some Danish insurance companies. It insures the investors for a period of 5 years against electricity production less than 90 percent of the estimated production, scaled with the average wind energy of the year compared with an average year. The premium for the insurance is paid as a one-time payment when the windturbine is installed. The amount of this one-time payment is according to one insurance company 2.7-3.1 percent of the value of the insured production, including insurance against losses caused by defects of the windturbine and also including liability of the windturbine owner.

This insurance is common in Denmark, where there is a large experience in evaluating wind energy for a given site. It has also been used in Sweden, made by Danish insurance companies. To be used in other countries, a national insurance company must introduce the product and there must be a reliable wind index for the windturbine sites that are to be insured.

Development of a reliable wind index for a given site requires long-term measurements from a site in the same region, e.g. 10 years measurements from a station within 50 km from the site, as well as at least one year of measurements from the site or from a site with the landscape characteristic within e.g. 10 km from the site, depending of the character of the landscape. With such a wind index it should in principle be possible to make a production insurance in EU countries similar to the ones used in Denmark.

Financing of project development

While windturbine investments usually are regarded as low-risk investments in Denmark, the investments in developing windturbine projects have considerably higher risks. If the project is successful, these costs are borne by the investor. Though if not they are shared between the investor, the developer and to some extent the windturbine manufacturer. For a user-driven co-operative, the investment is typically as follows:

- A local initiative group forms a windturbine co-operative as a legal entity. The work of the initiative group and of the board of the co-operative is voluntary; - the investment is the time of the people involved.
- The board asks a windturbine manufacturer to evaluate the wind energy production from a turbine placed on a proposed site. The manufacturer makes such an evaluation for free.
- Once the co-operative is formed as a legal body, the board asks the members to pay e.g. 50 DKK/share (6,7 €share) (1-1.5 percent of the investment) as a fee to reserve the shares. These funds are used to develop the project and are not paid back if the project is not successful.
- Usually the board involves a consultant or developer with experience in windpower development. The payment for this consultant is often depending on the success of the project, thus the consultant often shares the risk of development.

For a developer-driven project, the developer makes the initial steps, sometimes in co-operation with a windturbine manufacturer, and takes most of the initial risks.

This chapter is based in information from:

- Ringkøbing Bank, Ringkøbing, Denmark
- Insurance company CODAN, windpower department, Jan Pedersen, Denmark
- Energy & Environment Data (www.emd.dk), Aalborg, Denmark

Planning Procedures, Cast for Development of a Windpower Project

Distribution of Competencies in Windpower Planning

The statutory order on planning and planning permissions for windturbines in rural area of June 10, 1999 gives a number of national criteria for siting of windturbines and gives the competence of windturbine planning to the counties' regional planning. The counties shall as part of their regional planning:

- Designate areas specifically for windturbines, indicating size of area and maximal height of windturbines. For each area the county should provide an evaluation of the turbines impact on neighbouring dwellings, nature, landscape, cultural heritage values, agricultural interests, as well as the available wind energy.
- Consider the possibility for renovation of existing windpower areas.

The municipalities can include designated areas for windpower in their municipal planning, but only among those designated by the regional planning

To obtain planning permission for windturbines it is required that they are placed in designated windpower areas in regional or municipal plans. Usually a local plan is made (i.e. a plan for a specific new development) indicating the turbines exact places, number, height (within a range), and outline. If more than 3 turbines are installed or the total height of the turbines is above 80 metres, an Environmental Impact Assessment (EIA) is required (usually the 80 metres total height criteria apply to windturbines above 1 MW). If no EIA is required, the local plan must address the visual and other impacts of the turbine on neighbouring dwellings, nature, landscape, cultural heritage values, and agricultural interests. It must also address how the exact siting contributes to the wind energy production.

A local plan for windturbines can only be made for designated windpower areas in regional or municipal plans.

A single, small windturbine, below 25m total height, can be placed without local plans and outside designated areas if it is placed in connection with existing building structures.

Regional plans, municipal plans, local plans and EIA all involve public hearings, and the county respectively the municipality has to address the written responses given by the public.

Complains about most decisions made by the counties and municipalities regarding planning of windturbines can be brought to the Nature Complains Board (Naturklagenævnet) by:

- Ministry of Environment,
- involved parties with a legal interest in the case, and
- national nature protection and user associations with at least 100 members.

The complaint must be given not later than 4 weeks from the decision is made public. While the case is under consideration in the Nature Complains Board, constructions must be postponed. Complains about decisions can also be brought for the courts. This must be done within 6 months from the decision is made public.

Legal Status of Planning

The regional planning should include all relevant interests, including aviation interests, radio communication, defence, etc.

The decisions following the county's planning process can only be overruled by:

- A decision by the Nature Complains Board.
- A court decision.

If a planning permission is given, the utilities are obliged to extend the grid to the border of the designated area and let the developer make the grid-connection there, if the development is at least 1.5 MW. The utilities should pay necessary grid reinforcement costs to this point.

Criteria

When permission for windpower development is given, a number of criteria are used, and an assessment is made. Some of the criteria are given in the "Statuary order on planning and planning permissions for windturbines in rural area". Others are given in the regional plan and in the eventual local plan. An overview of national criteria is:

- Windturbines should preferably be placed in groups and ordered in an easily recognizable geometrical pattern. (single turbines are also allowed)A harmonic relation between hub height and rotor diameter is recommended, e.g. that they are within 10 percent from each other.***
- Windturbine plans must give thorough considerations to the influence on the landscape. New windturbine groups must be clearly separated from existing groups. Considerations must include the character of the landscape, the new turbines maximal height and the sites of existing turbines. If a windturbine development is closer than 2.5 km from another designated windturbine area, the planning must include both sites. In coastal zones (up to 3 km from the coast), planning with special consideration of landscape and nature interests should apply (Recommendation on planning and administration of coastal areas.) Nature areas and valuable landscapes should be kept free for windturbines (Recommendation).***
- New windturbines must not be closer to neighbours than 4 times their total height. Plans for windturbines closer than 500 metres from dwellings must have a special analysis of negative impacts on neighbouring dwellings.
- The noise outside neighbouring dwellings in open land must not exceed 45 dB(A) in 1.5 metres height, when the wind is 8 m/s in 10 metres height. *
- The noise in dwelling areas, near institutions, in summer house areas, in garden house areas and in recreation areas must not exceed 40 db(A) in 1.5 m height, when the wind is 8 m/s in 10 metres height.*
- The aviation authority can demand that turbines with total height above 100 metres should be marked (with light). Turbines above 150 metres should always be marked.**
- It is recommended that shadows from the turbines are not reaching neighbouring dwellings more than 10 hours/year (with average cloud cover).***

- In general no change should be made of the landscape closer than:-100 metres from the coast-100 metres from pre-historic sites-150 metres from lakes above 4 ha and from rivers****
- There must not be new constructions closer than 300 metres from forests.****

* Statuary order on noise from windturbines (May 14, 1991, BEK no. 304)

** Law on aviation (June 13, 2001, LBK no 543)

*** Recommendation on planning and planning permissions for windturbines in rural area

**** Law on Nature Protection (February 4, 2002, LBK no 85)

The counties can apply special criteria in their planning, and can deviate from the criteria in special projects.

Success of Planning

The Danish regional and municipal planning for windpower has given a framework for integration of windpower in the Danish landscape that has given room for more than 2600 MW currently with minimal disturbance of neighbours . This is definitely a success of spatial planning, but the planning does not include the “social landscape”, and the windpower development guided by the current planning regime has created more local opposition than the previous development of windpower. Thus, the planning has not contributed to the broad local involvement that is necessary for local support for windpower. In annex 1 is given an opinion on the relation between the movement against windpower and the planning regime.

Cast for Development of Windturbines

Based on current Danish legislation, the steps in development of windturbines could be as described below for a development of a site by a co-operative that will own a group of windturbines. Development by developers or farmers will include most of the same steps.

Initial phase:

- Environmentally concerned people living in the neighbourhood form an initiative group. Often such a group includes persons with experience from existing windturbine co-operatives or they are involved in Energy & Environment Offices affiliated to OVE.
- The group seeks a site that is designated for windpower use in the county's land-use planning.
- If it finds an appropriate site that is not designated for windpower, the group has to propose to the county to designate it for windpower. Designation of new sites requires political support in the county council and if the turbines are larger than 80 metres, it also requires an Environmental Impact Assessment (EIA). The county will make the EIA and will organise the public hearing involved, but it will often require that the project developer provide data on the impacts of the development to the environment. This includes typically noise, flicker and visual impacts.
- In parallel to the contact to the authorities, the group will contact the land owner(s) to get his agreement to the project, and discuss payments for allowing the use of the land. The payment has in some cases been paid with shares in the windturbine, but it is often either a fixed payment for use in 20 years, or an annual payment. The payment is a question of negotiation, and is determined according to the wind energy at the site.
- The initiative group estimates the energy production from a windturbine at the site and estimates the economy for the co-operative. Often this includes contact to a windturbine manufacturer that estimates production and gives a price for a windturbine.
- Once reasonable prospects for using a site, the group calls a public meeting to discuss the establishment of a windpower co-operative. At the meeting, interested participants sign up for participation in the co-operative and elect a preliminary board.

Establishment of co-operative:

- The preliminary board elaborates bylaws for the co-operative and continue negotiations with authorities and land owner(s).
- The preliminary board call a founding meeting, where the co-operative is formed as a legal body, bylaws approved and a board is elected.
- The board asks members to pay a fee per share that they want to buy. This is typically 50 DKK/share (6,7 €share), equivalent to 1-1.5 percent of the investment.
- The board involves a consultancy to assist with obtaining permissions and negotiating contracts.
- The board advertises for more members until all shares are sold.

Finalizing preparations:

- The board and the consultancy ask for planning permissions at the county and the municipality.
- The board and the consultant conclude a contract with the landowner.

- The board and the consultant conclude an agreement with the electric utility about connection fees and technical specifications for the connection.
- The board and the consultant make a tender for the windturbines, or take quotations from relevant windturbine manufacturers.
- The board and the consultant take quotations from companies to make foundation, electric connections etc.
- When all contracts and permissions are ready, the board calls a general assembly of the co-operative for a final decision about the project.

Project implementation:

- The windturbine is usually installed in 3-6 months including foundation work and grid connection.

Examples

One Example from the Early Phase of Large-Scale Development (by FC): Simonshøj

During the mid-eighties people began to form windmill cooperatives (guilds) on a shareholder basis. The Helligsø windmill cooperative (or guild), "Simonshøj" may be seen as an example of this bottom-up movement.

Initial Phase

The cooperative was formed in March 1988. The initiative came from a local teacher, Bjarne Ubbesen. At that time there were only two major windmills in the area. Bjarne Ubbesen was inspired to start his work by taking part in meetings of people who took an interest in windmills.

The driving force was not a dream of economic gain. The enterprise was quite insecure; what they wanted was to produce pollution free energy. According to calculations, a windmill could be called "pollution free" when it had operated for one year in the sense that the energy production had by then made up for the consumption of resources necessary for the building of the windmill.

Bjarne Ubbesen began to gather people who were interested in the project, concentrating on the local area and limiting himself to families living within a radius of about 5 km. It was very important for him to make the families living nearest to the site to join. Only one refused, he was against windmills on principle. But his sons joined the project.

The most important reason for hesitation was the size of the investment in the light of the insecurity of the profit. The guild (co-operative) was formed on March 3 by 51 members as owners of the 200 kW windmill.

At that time it was possible to own eight shares at 1,000 kWh per family. The return from eight shares was approximately 700 € per annum, making an additional income of 270 – 450 € per annum after payment of instalments and interest.

Grid Connection

The greatest challenge for the windmill cooperative was the co-operation with the local power utility (Thy Højspændingsværk). The ruling principle was that the windmill guild would have to pay the actual costs of connecting the windmill to the power utility for making the necessary grid reinforcements.

The cost was 45,000 € and the guild had good reason to be dissatisfied because costs varied very much from one place to another. Several other cooperatives paid only 3,000 € for being connected. Despite much attention from the national television and writings in the press the windmill guild did not succeed in altering these conditions.

Bjarne Ubbesen was of opinion that the attitude of the power utility was "political" in the sense that the station profited from the connection with the windmill to generally renew its power lines.

After Realisation

The guild had an annual general assembly attended by 40-50 members combined with a social dinner, enjoyed after the results of the year had been presented, accounts approved and the coming year's budget decided.

In the early phases when the project was being built and while it was new it gave many good talks among neighbours, as everybody was eager and curious. During the first years, many members visited the windmill regularly to keep an eye on the energy production meter.

The windmill guild has strengthened the local community and thus counteracted the tendency towards the closing down of functions within the village culture.

The 200 kW windmill turned out to be a far better business enterprise than anyone had dared to hope for. The price of the windmill was 160,000 € to which came expenses for buying land 3,000 € and expertise 2,000 € and finally the unfortunate 45,000 € for being connected to the power station. The windmill has proved to run with very great stability. The costs of maintenance have been between 700 – 1.400 € per annum, primarily the costs of regular servicing.

Economically the windmill has been a success. The original expectation of the guild had been an interest return rate of 12-13 percent, but the actual rate has been more than 25 percent per annum.

One Example from Main Period of Large-Scale Development: Lynetten

Background for the Initiative

Most of the windturbines in Denmark are placed in the open land or near small villages, but after the first successes in the open land, several city people also wanted to take part in the development. In the middle of the nineties some of these people formed a wind co-operative in Copenhagen, practically at the same time, when the movement against windturbines in the open land started. Lynetten Windmøllelaug I/S (Lynetten Wind Cooperative) represents local people from Copenhagen and neighbouring municipalities. Their plan was to establish 7 windturbines on a dike built near the harbour on a location called "Lynetten" which is the Northern end of the island of Amager. It is a so-called "technical landscape"⁵*, an industrial area in Copenhagen.

Risk, insurance and financing.

Most co-operatives, including Lynetten, were formed as an "Interessentskab" (I/S) which was a condition for the income from the shares to be tax free. The conditions for an I/S is that the shareholders has full, joint responsibility for the project. To reduce the risk for each shareholder, the co-operatives make the shareholders pay the entire investment so that the cooperatives would be free from debt from the beginning of the project. This way each shareholder only can be held

⁵ A technical landscape is an area, where several industrial activities are gathered. It can be near the harbour, close to power plants or similar facilities. The idea of placing windturbines in these areas is, that the harmonies of the original natural landscape are damaged already.

responsible for the windturbines. Danish insurance companies make insurance for the electricity production, which reduces the risk for the shareholders.

Forming the Co-operative

The Cooperative was founded at a founding general meeting March 18, 1995. At this meeting also a board was elected to take care of the operation.

Lynetten Wind Cooperative became responsible for establishing 4 of the windturbines. The last 3 windturbines were established by the local power supply company called "Gas and electricity Services of Copenhagen" (Københavns Belysningsvæsen, now Copenhagen Energy).

Discussions of Environmental Impacts

Normally a project like this would go through a public hearing, either to develop a local plan for the project or as part of an Environmental Impact Assessment(EIA). This project was in a special situation, which was used in a very intelligent way. Some years before the windpower project the "Lynetten Waste-water Treatment Plant" needed extension and a new dumpsite for sludge. For this project was made a local plan, which included building dike east of the waste-water plant. This local plan had been in a public hearing already when the windpower project started. In this local plan, The Energy- and Environment Office of Copenhagen succeeded to get in a sentence that contained the possibility of building windturbines on the dike.

This existence of this local plan meant, that the wind Cooperative did not have to go through another public hearing. All assessments of the environment were made by the municipality of Copenhagen and all the approvals for building the dike were obtained already.

Of course the wind Cooperative needed a separate building permission for the windturbines. In 1995 there was no law for a special EIA assessment, but they needed to get the authorities' approval for the safety of the project. Therefore was made a hearing of all authorities of relevance (the Energy Agency, the Defence Agency, the Sea- and Shipping Agency etc.) and to organisations with interest in questions about energy and environment. This hearing had the result that they should change the planned pattern of the windturbines. They had to move the windturbines closer together so that the visibility of light from a nearby lighthouse was not disturbed.

By using existing plans the wind cooperative had few problems to get permissions. In spite of this, the board of the cooperative wanted to get into a dialogue with the local people. They were very active in writing about the project in the newspapers and they participated in local events to give further information. By these activities they got a lot of statements from the local people, but they were all positive. The people in the board does not remember any negative statements or any protests against their project. They find that they did not get protests because they made a good information work and participated in the local debate. Of course, the fact that they could use an existing local plan, that had been in a public hearing, also meant a lot for carrying out this phase.

Final Preparations

The cooperative is growing.

From March 1995 till summer 1996 the shares were for sale. Early in the project the cooperative grew to be the biggest in the world. With nearly 800 shareholders there was never seen as big a windpower cooperative before. A large part of the shareholders had used the possibilities to reserve shares in advance. Some of these dropped out of the project and their shares became for sale again. From 1995 till 1996 several meetings were organised by the board of the cooperative in Cupertino with the Copenhagen Energy and Environment Office. At these meetings came local people from Copenhagen and the neighbouring municipalities. All with the same interest: establishing of windturbines.

Project Implementation

Before establishing the windturbines was built the dike that separated a dumpsite for sludge from the sea. The windturbines were to be erected on that dike. The construction of the dike gave several problems of both constructional, economic and scheduling characters. The co-operative should build one part of the dike – and the Gas and electricity Services of Copenhagen should build the other part. They chose the engineering Company “Carl Bro” to be in charge of the construction. In the middle of April 1996 the work on the foundation started. This work was about to break the time schedule of the project, because the underground was more soft than expected. This involved some extra days work and at this time a delay in the schedule could mean several weeks delay at the end of the project. The delay gave problems for the schedule of the of the big crane, that should place the windturbines on the dike. In Denmark there are only a few mobile cranes that can deal with this size of work. The construction process was changed so that the overall time schedule could be kept unchanged. The changes required a faster installation of two of the windturbines. Another problem during the construction was the official opening of the new part of the “Lynetten Waste-water Treatment Plant”. This opening required good roads to the plant, that was nearby to the location where the construction company was working for the wind cooperative. The top of the dike and an area around the plant should be covered with asphalt for the opening. This asphalt could be a problem when the wind cooperative later in the process should transport the windturbines over the area. If the cooperative had to pay for repair of damages in the asphalt it could be very expensive and ruin the budget. Fortunately it was the construction company which worked for the co-operative that also won the tender for putting asphalt in the area around the plant. The result was that they negotiated with the plant and got the final finishing of the asphalt work delayed to avoid extra expenses. There were several problems like this, that could delay the project and give more expenses than expected. In spite of the problems, the cooperative succeeded in keeping the overall time schedule for the construction.

The opening ceremony of the cooperative was in September 1996, but the electricity production started already in August 1996.

During the project, the work of the Gas and electricity Services of Copenhagen company also was delayed. One of their jobs was to connect the windturbines to the electricity grid and make sure that the transformers could manage the production from the windturbines. Their technicians made some minor mistakes as well as a larger mistake which was that they made electricity connections only 6 windturbines with a total capacity of 3 MW. In the final project there were established 7 windturbines each 700 kW – a total capacity of 4,9 MW. The safety switch was made too small with the effect that the windturbines stopped, when the production was over 320 A. One result of this was that the cooperative lost some sale of electricity.

The shares from “Lynetten Wind Cooperative I/S” were popular.

Until September 2001 there were still many local people, who were interested in buying shares from Lynetten Wind Cooperative. In the cooperative's newsletter from September 2001 the board mention that there are 40 people on the waiting-list. In January 2002 there were 909 members of the cooperative. Today at the end of 2002 it is uncertain if the people on the list still would be interested in the investment.

Interested neighbours

When the windturbines were established, the cooperative had several calls from people telling them, that the windturbines were out of work. Each time it was a mistake. It was never the cooperative's windturbines that were out of order – but the three turbines owned by the gas and electricity company.. This story is a good example of local peoples interest and participating in a common project – even if they are not always personally involved.

Economy

When the 7 windturbines were planned and established the tariff on electricity from windturbines was quite favourable. The electricity company should by regulation pay about 0.648 DKK/ kWh (including 0.10 DKK/ kWh for reimbursement of CO₂-tax, 0.17 DKK for partly reimbursement of other electricity taxes and about 0.38 DKK/kWh for the costs of the electricity production in Copenhagen) and the income from the of electricity was tax free for the owners of the shares. Each shareholder could own 9 shares if they had an electricity consumption of 6.000 kWh a year or less. If the consumption was over 6.000 kWh they could buy 1,5 share for each 1.000 kWh of the consumption.

The windpower manufacturer Bonus had assessed that the production would be 4.000.000 kWh a year and therefore guaranteed a production of 3.600.000 kWh a year. This production forecast was essential for the economy of the project. The insurance would cover the losses if the production was less than 95% of the guaranteed production.

In its prospects for potential members, the co-operative use the following budget:

Investment budget, 4 wind turbines:each 600 kW

Price for 4 windturbines (600 kW each)	DKK: 12,200,000,-
Price for foundations	1,200,000,-
Electricity connection and transformers	1,250,000,-
Consultants	200,000,-
Establishing of wind cooperative	200,000,-
5 years total insurance	500,000,-
Remote monitoring and control system	50,000,-
Other expenses	150,000,-
Total ⁶	15,750,000,-

The expected amount of shares were 3.600, each representing the annual "guarantee" electricity production of 1000 kWh. With a budget 15,750,000 DKK, each share would cost 4372 DKK.

⁶ In some of the calculations the total expences for the establishing was expected to be 16.000.000 DKK, in the final pahse the turbines became 700 kW each and the budget was increased.

Annual budget of co-operative after installation (in DKK):

	Income from sale of electricity	Interests earned ⁷	Expenses
1 share	648,-	16,-	64,-
9 shares	5.832,-	144,-	576,-
3.600 shares	2.332.800,-	57.600,-	230.400,-

The shareholders would have an income of 600 DKr. for each share – or DKr. 5.400,- for nine shares. When each share would cost 4.500 DKr. the annual income would be about 13,3% of the investment.

The budget was made in 1995 and before the major changes of the Danish electricity regulation in 1998-99. The budgets from 1995 are therefore made without considering a change in the payment for the electricity. The expectation was that the windturbines could have a lifetime of 20 years with same income in all these years.

Financing

The small common savings bank “Sparekassen Fælleskassen” had made a deal with Lynetten Wind Cooperative. Each shareholder could take a loan representing his/her total investment by giving the shareholder-certificates as security in the bank. The interest-payment of the debt is tax deductible. The economic risk in the project was minimal. The expectations were that the project would give a nice economic input for each shareholder.

Special Assessments for this Case

About the Shareholders

To public meetings, where the project was presented to potential shareholders, came a few students, older people, and non-academic people. An investigation made by RUC (Roskilde University) concluded that the members of the cooperative represented a much wider part of the population. There were more academic people, people above forty years, and people with an expected good, personal economy in the membership than at the public information meetings. These members did never join the meetings and did not participate in the discussions.

One question about members of windpower co-operatives is if the ownership of windturbines makes the owner more “green” so they would change their environmental behaviour. Some expected that a commitment to e.g. a wind farm would give an increased understanding for environmental issues and for the aspects of the environment that this organisation is dealing with. In an investigation made by some RUC students, some of the members from the co-operative was interviewed. In the rapport they made the conclusion that these expectations only are correct for a certain part of the members. The members that were interviewed had an environmental green attitude, but it is not possible to prove, that it is their commitment to the cooperative that is the reason. On the other hand, the members are responsible for spreading positive information about the project they are committed to. This means that the higher number of members – the more

⁷ The interests earned of the free capital of the cooperative is paid to the members.

ambassadors do the project have, and the more people get interested. This could be one of the reasons why windturbines with only one owner often has a hard time to be accepted.

The liberalisation and it's consequences for "Lynetten Wind Cooperative I/S".

As a preparation to the electricity liberalisation, the Danish Government has changed the regulations for production of electricity. This preparation resulted in a reform of "Law of electricity" in 1999. In this reform were several changes, and among them were new rules for the payment of electricity produced by windturbines. These rules changed several times. Initially the payment was 648 DKK/ kWh. The starting price for electricity was 0.378 DKK/kWh – with the reform this price was reduced to max. 0.33 DKK/ kWh. Furthermore the 0.17 DKK/kWh that was paid as an electricity tax refund was abolished after some year's production. For the co-operative the reform meant that the tariff became 0.60 DKK/ kWh for the first 12,000 full load hours (electricity production = installed capacity * 12,000) – and then reduced to 0.33 + 0.10 DKK /kWh in total -a reduction of 34%. As the cooperative also had larger expenses than expected this meant a 50% reduction of the shareholders income. After the electricity liberalisation is fully implemented, the prices are even lower than expected in 1999 The budget for the project assumed that the shareholder's (??) loans were paid back after ten years. After the new rules, they could expect that it will take three more years. The conditions from the bank were unknown and no-one knew if they were willing to extend the maturity periods of the loan. Finally it turned out that the economy in the cooperative was healthy enough to finance the loan in some extra years, but shareholders had to bear the loss and as a result they only received about 50% of the expected income.

The co-operative is till receiving the payment of 0.60 DKK/kWh. When they have received this payment for 12.000 full-load hours they will be receive 0.43 DKK/ kWh until 2006. After that they can only receive the 0.36 DKK/kWh

One Example from the Latest Development: Aeroe

The story of planning for wind farms on Ærø from 1997 until 2002.

Background for the Initiative

Ærø is a small island placed south of Funen near the Western end of the Baltic Sea. In 1985 the island had the world's largest wind farm consisting of 11 windturbines each with a capacity of 55 kW. In June 2001 12% of the islands electricity consumption was covered by 22 windturbines. In 1997 the co-operation "VE-Ø Organisation Ærø" (the renewable energy island co-operation Ærø) later renamed to "VE-Organisation Ærø" (renewable energy co-operation Ærø) was established. The co-operation was formed in connection with the Danish Governments nomination of the renewable energy island of Denmark. The title went to the island of Samsø but the "VE-Organisation Ærø" decided to continue the plans with or without the title of being the Danish renewable energy-island. In Ærø's sustainable island project from 1997 it was essential that 100% of the island's energy consumption should be renewable energy and/ or on environmentally benign energy technologies. After the plans were published the island received several public grants to continue the plans.

In 1998 there was made a plan for windturbines on Ærø. Following this plan was prepared plans for two wind farms on each 3 windturbines with a capacity of 12 MW in total. Before these plans were

prepared, there had been several other plans and discussions, as described below. It is important to know that there were two groups, which co-operated through the years from 1997 till 2002. The VE-Organisation Ærø was the initiative group. Parallel to this group was established a co-operation of the existing owners of windturbines: Ærø Wind Co-operation ApS. The main plan was that the 22 existing windturbines should be replaced by the new and much bigger windturbines. The tasks of the Co-operation was to establish the new windturbines when the permissions were obtained – and to take down and remove the old windturbines.

The Initial Phase

The initiative group (VE-Organisation Ærø) was composed of the two mayors of the island's two municipalities and their municipal directors, the chairman for the local electricity supply, two chairmen from two local district heating systems, a member from a local agricultural union, and a member from the board of the local energy- and environment office (affiliated with OVE, The Danish Organisation for Renewable Energy). These 9 persons represented the local peoples energy supply, the energy planning and the agricultural interests on the island. It was a strong group, who had a massive support by the local people.

In the sustainable island project from 1997 they assumed that the windpower capacity should be enlarged by 16.4 MW. In the revised plans from 1998 they reduced the capacity to about 14 MW. The electricity consumption on the island was in 1996 on 40 mill. kWh. With a contribution from energy savings, the consumption required an establishment on 9 big windturbines of at least 1,5 MW pr. turbine to cover the electricity supply⁸. The plan was that all the electricity from start should be produced by windpower. Later the electricity production could be supplied by solar energy, biomass etc.

The local dialogue.

The initiative group had the following arguments for establishing windturbines on land:

- contribution to the local economy
- income from sale of electricity
- buying local energy means that the money remains on the island
- being in front with sustainable energy will help the energy-tourism to remain on the island

Off-shore windturbines were not interesting because of the lack of local income. The arguments and the information was given on several meetings with local people. There was a high level of local dialogue and many discussions among between local people and the initiative group.

Approval in principle.

In February 1999 there was a meeting between the two municipalities on the island, the Danish Energy Agency, the Forest and Nature Agency (Skov og Naturstyrelsen) and the county of Funen (Fyn). The purpose of the meeting was to discuss the contents and the approval in principle of the plans for windpower on the island. The meeting concluded that there was room for two wind farms on the island. This conclusion was based on the government's new planning procedures (introduced

⁸ The turbines would produce the amount of electricity that will be consumed on the island after energy saving measures are implemented, but not necessarily at the same time. Cables to the mainland will give the necessary balance of the electricity supply and demand.

in 1999) where the distance between wind farms was a consideration and where increased emphasis was put on the harmony of the landscape. The two areas that were pointed out had good wind conditions and were placed in the south of the island where the population density is low. The initiative group's plans for windpower were now reduced from a need of about 14 MW and nine windturbines to the possible, which suddenly appeared to be 6 windturbines in two areas. Each windturbine's capacity was assumed to be 2 MW and the possible power 12 MW in total. Each 2 MW windturbine is expected to produce 6,788,000 kWh a year, similar to the consumption of 1.700 households. In spite of the reduction in capacity, the organisation expects that the production from the two parks will cover the electricity consumption nearly 100% when the plans for energy savings are implemented.

Discussions of Environmental Impacts

The initiative group (VE-Organisation Ærø) started the planning procedures for the first wind farm with 3 windturbines in the year 2000.

When the windturbines are higher than 80 meter the legal planning procedure demands that there must be made:

- a proposal for amendment of the regional (county) plan
- a statement for the project
- an Environmental Impact Assessment (EIA)-analysis

These documents were made by the VE-Organisation Ærø and was read by the authorities in October 2001. The purpose of the EIA-analysis is to describe which essential effects and consequences the project can or will have on further planning, nature, and environment. In additions must be assessed if there are alternatives to the project such as alternative locations, alternative heights of the windturbines.

Summary of the non-technical part of the EIA-Assessment.

The following extract from the overview of the assessment is included to give a small example of such a document:

The project includes 3 windturbines each with a total height just under 100 meter above the ground. Each turbine has a capacity of 2 MW. The windturbines are placed in a straight line with a mutual distance of 375 meter. (Here follows a description of the exterior of the windturbines: colour etc.) Then are described the changes in the area around the windturbines including access roads and working area for the construction.

The most important part of the statement is the impact on nature (flora and fauna), landscape (cultural and natural harmonies), socio-economy, and the environment. In the statement it is described how the windturbines will impact the landscape with its appearance in the nature of the island. The statement contains a description of the project's negative impacts on the cultural landscape (churches and historic monuments). There is also a description of the visual improvement when the 11 existing windturbines are replaced with the three new turbines. The description also contains an impact assessment of the flora and fauna. The conclusion is that there will be a very small effect if any. The socio-economic effects are assessed to be positive.

The effects on the environment contains a discussion of the water supply and of the noise from the windturbines. Regarding the noise there is chosen a special type of windturbines which noise level can be regulated.

The statement is a "discussion" for and against establishing windturbines on the proposed location. The conclusion is that the location – as expected – is very suitable for new windturbines.

Forming the Cooperative

Ærø Wind co-operation ApS.

An ApS is a company, where the members has no personal economic responsibility. The co-operation was formed by the existing wind cooperatives on the island. The board of the new co-operation was elected from representatives from the boards of the old cooperatives: Græsvænge Windpower, Højsten Windturbine, Skovby Windpower, The Trousløkke Windmill, Ærøskøbing District Heating, and Ærø Windfarm. The tasks of the new Ærø Windco-operation was to take care of the sale of windpower shares and to install the three windturbines. Thanks to a co-operation with Global Windpower A/S Thisted (www.gwp.dk) Ærø Windco-operation ApS succeeded to get 0.60 DKK/kWh for all electricity⁹ for all shareholders.

⁹ * 0.60 DKK/kWh is the feed-in tariff given to owners of new windturbines that replaces old windturbines and that are installed before 2003 (replacement turbines installed in 2003 get a lower tariff based on the electricity exchange price +a premium). The replacement (or re-powering) windturbines can have maximal two-three times the capacity of the old windturbines that they replace, in order to get the high tariff for all electricity produced. The owners of the old windturbines, that are scrapped, get a scrap-proof. These scrap-proofs can be sold if the owner don't want to use them. Replacement windturbines receive a payment of 0.60 DKK/kWh for the first 12,000 full load hours (i.e. the electricity production equal to the capacity of the windturbine multiplied with 12,000). For the windturbines on Aerø this high tariff is expected to last for the first 4,2 years. Then the payment will be 0.43 DKK pr. kWh for the next 10,000 full-load hours, i.e. the next 3 - 4 years. The price after the first 22.000 full load hours is uncertain, but it is expected to be

In the bylaws of Ærø Windpower ApS it is described that when the three windturbines are established and in production they will be given over to a new co-operative: Ærø Wind I/S.

Ærø Wind I/S.

When all approvals were obtained there was established a new co-operative: Ærø Wind I/S. In the "I/S" structure the members has full liability (see the case of Lynetten). This legal structure has been used by several windpower co-operatives and has never caused any problems. This new co-operative was formed by the shareholders in the new windturbines and the company's task is to take care of the operation and maintenance as well as to sell the electricity. The bylaws for the co-operative describes among other things, that:

- Adults (age over 18) with registered permanent address on Ærø can be partners.
- Adults without permanent address on the island can be partners when they are owners of property on the island.
- Registered companies or institutions with permanent address on Ærø can be partners.
- All partners will be included in a list of partners with name, address, number of shares etc..
- The partnership is divided in ideal shares. One share equals 1000 kWh of annual "guarantee" production)
- There must be no burden of debt in the company

Final Preparations

Sale of shares for the new wind farm.

The period for sale was planned to be from August 7 until September 13, 2002. In this period people from Ærø could reserve a number of the shares with a payment of 30 DKK pr. share. In this first subscription each person could book a maximum of 20 shares. If a single person wanted more than 20 shares, they could join a pool of reserves, that would be for sale, when the period was over. The 30 DKK pr. share will later be deducted from the price of the shares. The final payments were made immediately after the permission to build the windturbines were obtained.

Project Implementation

In December 2002 the three new windturbines were installed.

The fate of the windturbines that were taken down.

The permissions to establish the three new windturbines was originally on the condition that 11 old windturbines were taken down. Finally three of the old windturbines were kept because they were too large to get scrap-proofs. This means that only eight old windturbines were taken down. They were taken down and turned into second hand resources. The Windcooperation Ærø ApS took care of the activities and the expenses.

about 0.33 DKK/ kWh until the turbines become 20 years old. After this date the payment will follow the market price for electricity.

Economy

The wind farm's calculated production is 18.863.000 kWh/year. To be absolutely sure, the production used in the budget is 10% less (the so-called guaranteed production): 16.977.000 kWh a year. The price for each share is expected to be 2.970 DKr, based on below budgets.

Budgets for the project:

Investment budget in DKK

3 Vestas windturbines (V80-2,0MW) incl. All-risk warranty, service, 5 years insurance	35.220.000,-
Foundation	2.200.000,-
Phone connection	60.000,-
Roads	600.000,-
Low tension, connection for the windturbines	120.000,-
Project, design and establishing	1.000.000,-
Consultants	200.000,-
High tension connection, transformer etc.	900.000,-
EIA Analysis	295.000,-
Remove old windturbines	850.000,-
Price for scrap-proofs 845 kW	2.384.507,-
Price for old turbines for scrapping (ca.1155kW)	2.887.500,-
Price for 3 windturbines, 200 kW each, to be kept	1.692.882,-
Price for rent of site (30 years)	1.300.000,-
<u>Interests on loans during construction, misc.</u>	<u>200.000,-</u>
Net investment in total:	49.909.889,-

Income from shares 16977 shares x 2.970 DKr.	50.421.690,-
<u>Investment</u>	<u>- 49.909.889,-</u>
Initial free capital for Wind cooperative Ærø	511.801,-

Annual budget, first 12,000 full load hours:

Sale of electricity 16,977,000 kWh x 0.60 DKK	10,186,200,-
Administration costs (office, meetings etc.)	- 184,000,-
Operating costs (service, taxes to the electricity company etc.)	225,000,-
Net income for shareholders, year 1-4	9,777,200,-
Net income per share, year 1-4	575,-

Economy for different typical partners:

Shares paid in cash:

Number of shares	Investment DKK.	Taxes	Income in DKK		12. year	Total 1.-20. year
			1. year	10. year		
5	14,850	0	2,874	1,309	1,295	34,389
10	29,700	900	4,847	2,527	2,500	62,483

Shares financed fully with a loan:

Number of shares	Investment DKK.	Taxes	Income in DKK		12. year	Total 9.-20. year
			1-8. year	10.year		
5	14,850	0	0	1,309	1,295	16,810
10	29,700	900	0	1,434	2,500	25,925

Why such a long preparation-phase?

An obvious question to ask is: why did it take 5 years to realise the plans? The main reasons were:

- the movement against windturbines in Denmark
- some local opposition against the change from smaller (below 200 kW) to large (2 MW) turbines that have larger impacts on the landscape
- because of some political opposition against the owners of the windturbines and their income from this activity (for a period it was a good business to own a windturbine in Denmark),
- the procedures for planning, and
- several changes in regulation of tariffs for windpower. As the rules were changed, the project had to change their budgets, prospects etc.

Only in the summer of 2002 the Windcooperative Ærø was allowed to use scrap-proofs to get the tariff of 0.60 DKK/kWh. The project has several times been in danger because of all the changes and an expected bad economy. The fact that both local population, local politicians and local authorities really wanted the project, finally made it succeed.

Annex 1

The movement against windturbines in Denmark and Planning Procedures

Marianne Bender, OVE

When you consider the period where the movement against windturbines on land were started in Denmark, you also have to consider if there is a connection between the opposition and the implementation of planning procedures. The more detailed planning procedures started in the middle of the nineties, where also the opposition started. The start was a request from the government to the municipals to make plans for windturbines in their municipal and local plans. The planning should be ended by summer 1995.

Planning creates barrier

At first this request created a political barrier among the local politicians. They didn't have any experience and there was no training in planning for windpower. Many municipalities at first denied to make these plans and this started a discussion in the newspapers. In the newspapers were raised questions like: "Are we at all going to have windturbines in our backyard?" – and: "Is it fair that all municipalities have to make a plan for windturbines – no matter how the wind energy is in the local area?". The politicians in a part of the municipalities felt that they were forced into a planning, that they did not really want.

Planning and Commercialisation

At the same time the interest for establishing windturbines was moved from the local people to commercial consultants. The planning resulted in designation of areas where the windturbines could be established. This had an effect on the commercial consultants who immediately took contact to the farmers who owned the land in question and tried to get reservations of the spots where the windturbines should be.

The focus on the need for windturbines was moved from the local people to the government and the commercial consultants. Local people in many areas felt that the windturbines were forced into the landscapes and they created a massive opposition against windturbines. In the years from 1995 to 2000 the ownership changes from many local owners to only a few, each owning one large windturbine. Farmers established many windturbines and the broader local involvement in these projects disappeared.

Difficulties for local Initiatives

The opposition and movement against windturbines in the landscape caused new procedures for the planning. The authorities admitted that establishing windturbines on land created some problems and the new procedures were a lot more restrictive than earlier concerning placing the windturbines. As a result it became more difficult to install windturbines and the local societies who still wanted to go on with this activity got a lot of problems and got many difficulties by getting an approval from the authorities.

The conclusion must be, that there could be a connection between the movement against the windturbines and the planning for windpower. Although the planning was meant to make it easier to

establish windturbines, the planning at the same time forced the windturbines into the designated areas. The opposition came from both some local politicians and from some local people.

Ways to address this problem could be to reserve designated areas for local initiatives and to involve the local population much more in the planning than was done in Denmark in general (but some municipalities did a very good job in involving the local citizens). Another proposal is to require that people that live near windturbines be offered shares.