Policy failure in the introduction of renewable energy; wind power in the Netherlands

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1. SYNOPSIS.

After the 1973 oil crisis the Netherlands started with a policy on development and application of wind energy. This policy is failing, compared to other countries and looking at its official goals. The causes for failure are discussed.

2. SUMMARY.

The Dutch government started in 1975 a wind energy policy. A number of programmes on the development and implementation of wind power has been carried. Over a decade the official goal for wind power development is 1000 MW by the year 2000. About 150 MW had been installed at the end of 1994. A forecast of installed capacity in 2000 shows only 300 MW may be expected, which is far behind the official goal. This article deals with the failures of the Dutch governmental wind energy policy: relying on large scale application by utilities, stimulating capacity instead of energy yield, entanglement of energy policy and industrial policy, and most of all failure in the development of sites.

3. INTRODUCTION

Once wind power was the most important energy source in the Netherlands. From the start of the 17th century until the beginning of this century wind was the main power for polder-drainage, and for several industries. The renewed interest in wind power finds its origin in the energy crisis of 1973. The Dutch government radically changed its energy policy. The minister of Economic Affairs, mr. Lubbers, who later was prime minister from 1983 till 1994, presented a policy memorandum in which three outlines were sketched: more economic use, more economic exploitation of resources and pushing back external dependence (Energienota 1974). These lines are still the principles of the current energy policy. The second and third lines should be supported by a policy of diversification. As many different sources as possible had to be exploited and as much as possible Dutch sources. One of the instruments for this policy was a new research programme on wind power.

4. WIND ENERGY POLICY

4.1 Development programmes

In the first programme, the National Research-programme Wind energy (NOW1), 20 million guilders (9 m. ECU current rates) was spent on research till 1981. The research period took much more time than was expected in 1975. This was mainly caused by underestimating the technology needed, something that happened in all countries that started wind energy programmes. Wind appeared to be a much more complicated phenomenon than expected and reliable turbines only existed in the category of very small machines. Nevertheless the results of NOW1 were appreciated positive. It was estimated that 10% of the domestic electricity demand could be supplied by wind power, without complicated and expensive storage systems. The environmental impact of wind turbines seemed to be relatively small and hardly any obstacle was expected in the process of physical planning (Hack, 1986). An official policy goal was formulated on the basis of the results of the programme: in the year 2000 about 1500 MW large scale wind power capacity, and 350 MW of small scale decentralized applications should have been installed. However, these targets could not be based on experiences with siting and building wind turbines yet, as the installed capacity was only 1 MW at that moment.

The second programme, the National Development programme Wind Energy (NOW2), started in 1982. It was directed at research, development, demonstration projects and commercial application. From the start the developments should be directed at large scale applications. Energy utilities were defined as the key actors. They would be responsible for large scale, centralized applications. In 1982 the Ministry of Economic Affairs and the SEP (Co-operating Electricity Producers) allocated funds for the construction of a 5.4 MW demonstration windfarm of eighteen 300 kW machines.

Beside research, funds (37 million guilders; 18 m. ECU) were also used for subsidising the industry for development of large scale turbines. The aim was to stimulate Dutch turbine manufactures. For example, in 1983 the ministry ordered an engineering consultancy, an aircraft company and an electronics company to build a 3 MW turbine with a 80 metres diameter rotor. The same engineering consultancy designed a 1 MW prototype that was actually built in 1985. Now, this 1 MW machine is still the largest turbine ever built in the Netherlands.
At the end of the second programme the understanding grew that physical planning and environmental impact could not create major constraints for the installation of wind power capacity. The assessment of wind power potential was adjusted downward (see per.6.1). A new goal was formulated officially in January 1985: 1000 MW in the year 2000. This goal is still maintained as the official starting point of the wind energy policy.

4.2 Implementation programmes

After a period of mainly research and development, the third programme directed at implementation, the Integrated Programme Wind energy (IPW) started in 1986. The policy was directed at market stimulation and support for turbine manufacturers. Wind development projects were subsidised for installing wind turbines. The whole programme contained 31 million guilders (15 m. ECU) for industrial development and 69 million (33 m. ECU) for market stimulation. The situation at the start of the programme was that the previous programmes had provided a great deal of knowledge about constructing turbines. The assessment of the IPW was that the market was prepared to invest in wind energy, but first the prices had to fall (Hack 1986). However, the prices for new turbines remained high, as there was hardly a market because the number of new turbine installations was still considerably small. A home market was strongly needed to construct new machines in serial production.

The market stimulation line contained two subsidies. The first and largest one was the IPW subsidy of 35-40% of the investments in newly built turbines, issued by the minister of Economic Affairs. The condition for subsidy was the use of turbines with a safety and operational certificate. The subsidised projects should be realised in the year the subsidy had been granted, as the amount of subsidy decreased every year. Decreasing subsidies were based on the expected improvement of turbine performance resulting in more economic feasibility of new windfarms. Effectively it caused a severe pressure on the process of planning and issuing permits. The second subsidy, aimed at concentrating new turbines in selected areas considered as sites with limited environmental impact, was issued by the ministry of VROM (Housing, Physical Planning and Environment). The MilieuPremie (Environmental Bonus) contained a bonus for suitable areas and a bonus for a low noise turbines, of 21 ECU/kW each.

Linked to the implementation programme an intermediate goal was formulated in October 1986. Between 100 and 150 MW should be installed in 1991 at the end of the IPW programme. In practice this goal was separated from the industrial stimulation programme. It had the effect of growing competition among Dutch turbine manufacturers and manufacturers from abroad. The largest contribution to the capacity installed within the scope of the IPW was Europe largest windfarm (at the time it was built), the 7.5 MW windfarm near Urk. In this windfarm 25 turbines of 300 kW each were built by a Belgian constructor.

After ending the IPW an new programme started for the years 1991-1995, in which the official goals remained the same. In the Support Programme for Application of Wind Energy in the Netherlands (Toepassing Windenergie in Nederland; TWIN) 42 million guilders (20 m. ECU) was spent. Most of it for technology and product development (67%), the rest for market stimulation, including off-shore (a future perspective) and transfer of knowledge.

A number of utilities operating in the wind resource regions drew op a new project, called 'Wind Plan'. They would realize an extra 250 MW by the year of 1994, so the total capacity should be more than 300. This effort was stimulated by the introduction of the utilities' Environmental Action Plans (MAP's). These were a reaction on the national environmental policy plan aimed at stabilising CO_2 emissions in 1995 at the level of 1989 and a reduction of 3-5% to be achieved in 2000 (NMP 1989; NMPplus 1990). For several sectors the cooperation for achieving these goals was requested, so a new task for the energy supply sector was formulated (Nota Energiebesparing 1990). The sector should invest in energy conservation, efficient generating techniques, in particular co-generation, and renewables such as wind, solar and biomass. The utilities could generate funds for their MAP with a tax on distributed electricity, which they had to invest in carbondioxide reduction.

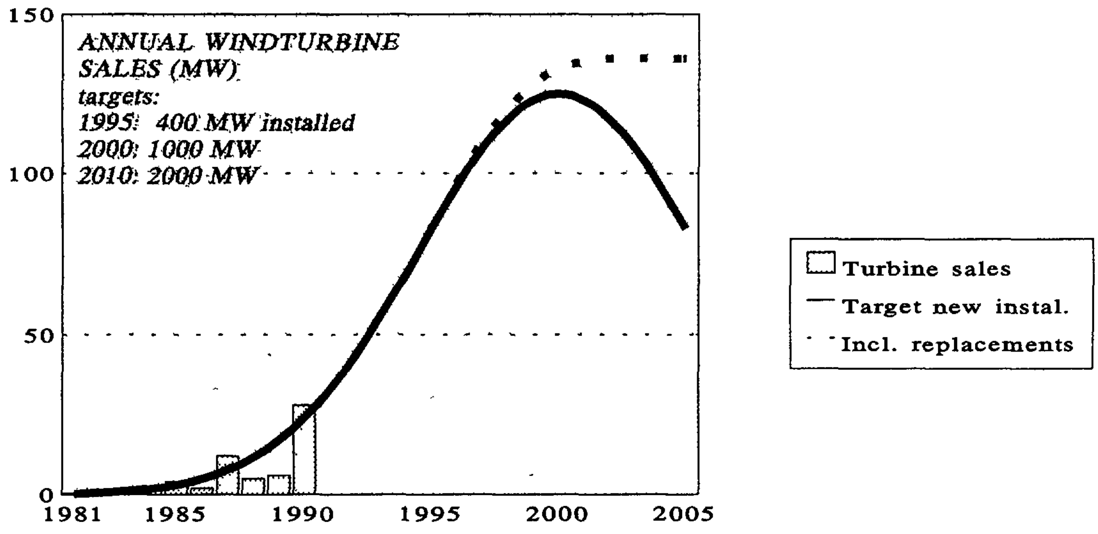

Figure 1. New wind turbines as projected in 1991 (Luken and De Bruijne 1991).

The governmental perspective at the start of the TWIN programme in 1990 was still rather optimistic. In Figure 1 this perspective is presented as the number of new turbine capacity that would be installed according to the programme and the official goals of 1000 MW in the year 2000 and the intermediate TWIN goals of 400 MW in 1995.

5. POLICY PERFORMANCE

After 1985 the installation of wind power capacity accelerated. As the total capacity at the end of 1986 was 9 MW, one year later it grew with a rate over 100% to 22 MW. This growth included the first large 7.5 MW windfarm that was built with the help from the IPW subsidy. Its operation started even before the experimental windfarm of the SEP, the cooperating electricity producers, that resulted from the previous programme.

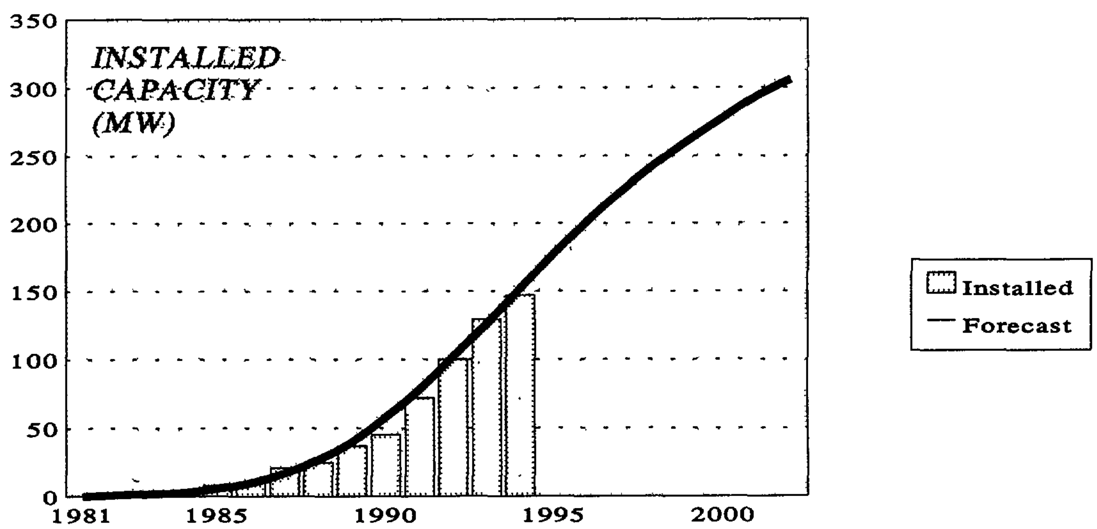

Figure 2. Development of wind power capacity in the Netherlands.

The installed capacity doubled in 1987, but the capacity-growth in the following years was not sufficient to reach the intermediate goal of the programme. At the end of 1991 about 50 MW was operational instead of 100-150. Although not even half of the intermediate goal had been achieved, the programme management and the authorities stayed were rather optimistic about the long term (Figure 1). Now in 1995 the conclusion has to be that the official goal of 1000 MW will not be reached. In Figure 2 the development of installed capacity in the Netherlands is shown, accompanied by an assessment for the coming years. The actually installed capacity in 2000 will probably be about 300 MW, 30% of the target.

How do we have to judge this performance? In the field of wind power the Netherlands have been the third country for many years behind the US (in particular California) and Denmark. Now the Netherlands are passed by Germany and the United Kingdom. In the near future it will be passed by India and probably by Sweden. In comparison with these countries, the Dutch policy seems to be rather ineffective. The difference is illustrated in Figure 3. The capacity-growth in the Netherlands is compared with the development in Germany. As a matter of fact, Germany is much larger than the Netherlands. Therefore the coastal Bundesland Schleswig-Holstein, with a similar wind potential, was chosen for the comparison in Figure 3.

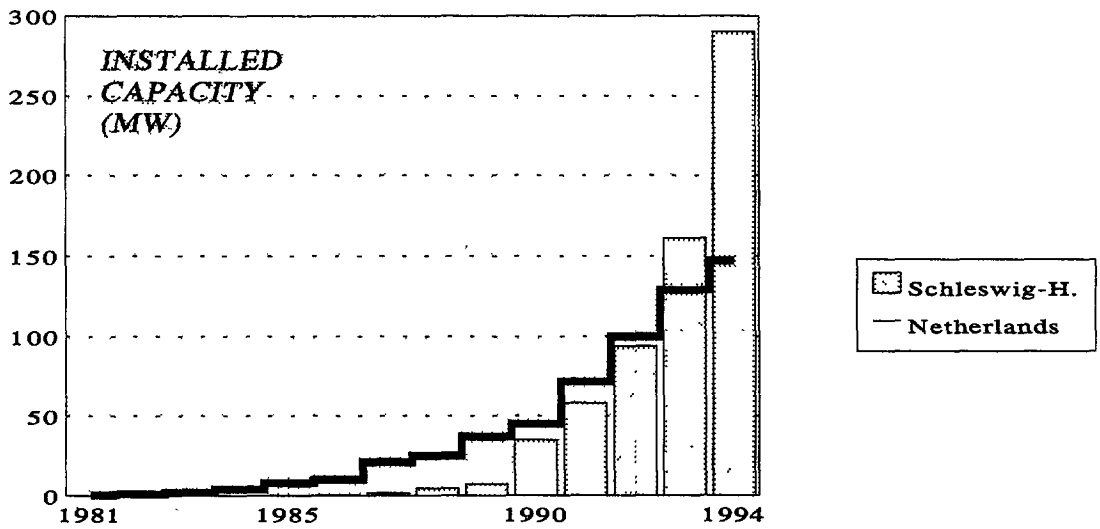

Figure 3. Development of capacity in the Netherlands and Schleswig-Holstein. sources: DEWI; Novem.

It is obvious that the performance of the Netherlands considering the development of installed capacity is not good. The situation is even worse when we taken official national targets into consideration. As the official goal of the Dutch wind energy policy is 1000 MW in the year 2000, the German target was 250 in 1995. The German goal was reached before that time, as 643 MW had been installed at the end of 1994 (Keuper 1995). The conclusion is that the German policy makers used a far more realistic goal.

In May 1994 elections for the Second Chamber of the parliament ended in a new government and large new cut-backs on all budgets. Within the budget of Economic Affairs the largest cut back in expenditure is in the field of energy policy. All subsidies on energy saving techniques (70 million guilders) and all subsidies on wind energy (37 million) should be discarded (EZ 1994). Even the mid term assessment of wind power capacity as presented in Figure 2, is based on continuation of certain forms of market stimulation, needed as long as energy prices stay at the present low level. Now the subsidies will probably disappear and it may be expected that many investors in wind energy, primarily the utilities, will become more hesitant in investing in wind power. Without an alternative policy replacing these subsidies the result may be that even 300 MW becomes an illusion. For the time being, subsidies are continued for one year.

6. WIND ENERGY POTENTIAL

The wind energy policy, the instrument as well as the goals, was based on assessments of wind energy potential. However the meaning of wind power potential can be interpreted and calculated in various ways with different outcomes.

6.1 Physical planning potential

Estimations of potential mostly start with a assessment of wind resources: the meteorological potential (Jahraus et.al, 1991). The next step is an assessment of potential sites, as many places with high wind speed are not available for building turbines because other reservations prevail. Many studies on wind energy potential in the beginning of the renewed interest in wind energy were calculated assessments of site potential (table 1). Nevertheless these assessments are still overestimating the actual possibilities.

Wind power potential is also determined by technical conditions, such as performance of available turbines and possibilities for grid connection, and economic conditions. For all available sites a cost-benefit analysis based on the yield of energy, technical feasibility, energy prices for competing sources and implementation costs, leads to an economic potential for wind energy. Most assessments of potential wind energy application end here and policy goals are often based on these economic potentials. Nevertheless in practice this economic potential will only be partially realized. The calculation of an economic potential by no means indicates that this potential will actually be implemented. Decisive is "the motivation of the operator to invest in this technology, and the acceptance of the utilisation of wind energy by investors, but also by the public." (Jahraus et.al. 1991. p.527).

Study	potential capacity	type of siting turbines	type of potential
Van den Berg et.al., 1978	15 000 MW	centralized	meteo / site potential
BEOP, 1981	2 500 MW	centralized	economic/ technological
Verkuijlen et.al, 1986	4 000 MW	decentralized	site + local demand
Arkesteyn et.al. 1987	I 600 MW	centralized + decentralized	current physical planning potential
	II 2 000 MW	centralized + decentralized	flexible physical planning pot.

Table 1. A selection of wind energy potential studies for the Netherlands.

The essential question in assessing the feasible potential is whether or not investors decide to built wind turbines and the society is accepting these plans. In table 1 the best potential study is shown, that took physical planning aspects into consideration (Arkesteyn et.al. 1987). The lower Figure of 600 MW is the assessment of capacity that may be sited without problems from physical planning point of view. The higher number of 2000 MW requests very flexible planning conditions. This study dated from 1987 and was carried out by staff members of the Physical Planning Service of the ministry of VROM. The conclusion could have been that the official wind energy policy was based on rather unrealistic assumptions, but the aim of the study was to point out that for an extension of the potential over 600 MW an early anticipation in the wind energy policy was needed, particularly in the policy line of site-development.

6.2 Political potential

Implementing economically feasible renewable energy or energy saving techniques wind may not be taken for granted. In the following sections it will be explained that in the case of power developments this was the major mistake of the Dutch wind energy policy [1]. Often this question is translated in terms of physical planning. Most siting studies concentrate on physical planning aspects and physical planning procedures, in particular formal conditions for building permits, environmental standards (such as noise standards) and the procedures for getting these permits.

Although research on public acceptance showed a large support for the application of wind power, authorities had been warned that the major constraint in the building of wind turbines is the acquisition of enough available sites: "Finding these sites is perhaps the greatest hurdle for wind power developers to overcome" (EWEA 1991). Now the trouble at the local level for siting wind turbines has become the major impediment in increasing installed capacity in the Netherlands. There was no programme on the development of sites, there were no instruments to stimulate crucial actors in the process of decision making of sites. It started a vicious circle. Economic feasibility has not been reached, because there is no mass production of turbines. This again is caused by the lack of available sites.

The problems with creating available sites for has been underestimated for a very long time. In 1991 Novem, the organisation that managed the IPW, officially propagated the idea that the wind energy had a great future, thanks to the governmental stimulation programmes. "The prospects for the application of wind energy are favourable. It has already been established in the past that the Netherlands, despite its high population density, the potential for wind energy permits a substantial wind capacity in the country." (Luken and De Bruijne 1991). In 1991 the idea was still that the potential for wind energy as calculated from wind resources, economical conditions and physical planning constraints could actually be realized. At the ministry of Economic Affairs, as well as at the ministry of VROM the policy belief system (Sabatier 1987) was that almost any site that was considered appropriate for wind turbines could actually be used for building them.

This opinion was fortified by the favourable public opinion on the application of wind energy. When people are asked what they think of wind power as such, a large majority of about 90 percent reacts positively. This figure represents the general popularity of wind power (Wolsink 1989). Nevertheless a small fraction was established also that does not support it.

Several studies in various other countries have also shown that wind power is a popular source of energy (Carlman 1986; Thayer and Hansen 1989; Lee et.al. 1989). Policies that promote wind power enjoy wide support. A before-after study resulted in a conclusion that was interpreted by the central policy bodies as an encouragement. A comparison of public opinion before and after the construction of the first large wind turbine (1 MW) in the Netherlands, the opinion after building appeared to be improved (Wolsink 1988).

As the idea was that an overwhelming majority of the public supports wind energy application, it was expected that the sites necessary for building turbines would become available without trouble. At the local level decisions about site selection and building permits must be taken. The positive intentions of the governmental policy should be followed by positive decisions of regional and local authorities. The governmental policy was based on the expectation that local authorities would take these positive decisions. However, according to the study of Arkesteijn shown in table 1, this would not even be sufficient. Without changing actual preferences in physical planning only 600 MW could be reached. In this figure negative decisions of regional and local authorities for whatever reason ar not included yet. The question is whether or not local politics is taking positive decisions about wind energy projects. This is the political potential of wind power, based on politics at the local level. Local politics may be quite different from national politics, but it is definitely politics. Not only national authorities have a policy, local authorities have policies of their own, with their own objectives as well.

7. CRUCIAL POLICY CHOICES

7.1 Utilities and large scale application

After the new electricity law of 1989 the electricity distribution utilities became responsible for electricity generating units below 30 MW. They should become the major investors in wind energy. Although the first investors in wind power were private, one of the basic choices in the Dutch policy always has been that wind power capacity should be built by utilities.
The decision for concentrating on large scale application and of high responsibility for utilities was made at the start of the NOW2 programme in 1982. At that moment there were no reliable large scale turbines. The main responsibility was given to the SEP, which had hardly any experience with small scale generation. The experimental windfarm appeared to be a failure, both in the stage of planning the project as well as in the operational phase.

In 1991 the utilities of the most windy areas agreed to built 250 MW before 1995 as a part of the MAP (section 4.2). This project called Wind Plan faltered because of the trouble utilities meet when they need sites. They did not have experience with small scale physical planning and local politics. As they were relying on short term capital subsidies they started projects from a perspective that is creating many conflicts at the level of local politics. This general problem will be further discussed in section 8.2. The second failure of Wind Plan was that it worked as a monopolist toward the wind turbine manufacturers. In Wind Plan technical requirements were dictated that were rather uncommon and manufacturers faced many problems in meeting these requirements.

Looking back, the choice for large scale application was made too early and it was one-sided. Small scale application by private investors was not stimulated. The latter would have stimulated the home market much more, as it did in Denmark. In the next section we will see that the utilities also held a crucial position in determining the economic feasibility of private wind power projects.

7.2 Subsidies on capacity

From the start subsidies were directed at installed capacity. Indeed, from 1985 these subsidies did stimulate the construction of wind turbines. Financial incentives were affective in that situation. Nevertheless, some disadvantages are linked to the way subsidies were granted.

The primary goal of the wind energy policy was directed at installed capacity. Generator capacity is only an instrument for creating energy yield and that is what it is all about after all. There was only a subsidy on capital investment, no incentive for performance. A comparison of turbines built and installed in several countries shows a typical result of subsidizing generator capacity. "The capital subsidy led Dutch manufacturers to artificially boost the kilowatt rating of their turbines to maximize the subsidy ". (Gipe 1995). This system existed till 1991, when it was changed in a capital subsidy on the rotor swept area. Although this is a better indicator for energy production, the subsidy still leads to a non-optimal investments, because the performance of the turbine in terms of energy yield is less important that the investment subsidy.

Subsidies targeted on energy yield, particularly incentives based on kWh production, have proven to be more effective. The number one country in Europe always has been Denmark. Their application has always been ahead and it started as a result of electricity rates. Most small turbines in the seventies and eighties were grid connected private machines. The rates for electricity delivered to the grid (buy back tariff) are very low in the Netherlands compared to all other major wind energy countries. This is crucial as the price paid to the utility at moments of low wind speed is much larger than the money paid by the utility for the same amount of energy supplied to the grid at moments of high wind speed. In 1994 Dutch buy back rates are 55% of consumer prices. This is very low compared to Germany (85%), Denmark (142%) and the United Kingdom (189%) [2]. These are the countries that perform better on wind energy indeed. No specific regulations for buy back tariffs were made by the Dutch government. The fundamental idea was that the utilities are responsible for the development of wind energy. Some of the utilities paid 1 or 2 cents/kWh more for wind, but most of them did not. One of the reasons is that paying more for electricity generated by private owners is also competitive for the utilities' own wind power activities.

Negotiations about buy back tariffs have lasted more than ten years. First they were held with the central electricity producers (SEP). In 1982 these discussions concentrated on the capacity credit of wind power. As theoretical statistical studies indicated wind power capacity might be taken into account in planning generating capacity (Haslett and Diesendorf 1981). The SEP held the view that the capacity of wind turbines could not be counted as the production is zero during calm. So they only counted the fuel costs that were saved by wind power. In later years simulation studies based on time series analysis on energy demand, supply and wind data proved that the capacity credit of wind power in the Netherlands is about 18.4%. (Van Wijk et.al. 1990). These discussions did not lead to a significant rise in the buy back tariffs, because decisions were left to the electricity sector itself.

The main reasons for better prices paid for wind generated electricity are to be found in the external costs of the various kinds of electricity generation. The comparatively high rates in Germany for example, are based the recognition of high external costs for non renewable, mostly fossil fuel generated electricity. These external costs mainly concern environmental impact of coal, oil, natural gas and nuclear power. Hohmeyer (1992) estimated these costs for wind power at 0,16 DM/kWh (0,07 ECU/kWh). As in most countries some kind of external costs are included in the buy back tariffs, the Netherlands has no regulations for alternative energy sources, not even based on the conservative avoided costs approach (Van Wijk 1990).

7.3 Industrial policy

From the start one of the goals of the wind energy policy was the stimulation of a Dutch turbine industry. Large amounts of money were given to the industry in the R&D programmes. These were meant for the development of reliable wind turbines that could compete with the ones from manufacturers abroad that also took advantage of R&D subsidies. From 1981, when no reliable turbines from Dutch manufacturers larger than 10 kW existed, and no windfarm was built anywhere in Europe, the ministry of Economic Affairs decided to promote large scale application. The price of wind turbines stays at a high level as long as serial production was not possible. Therefore the local market had to be stimulated to buy Dutch turbines. The Wind Plan consortium of utilities also gave preferential treatment to Dutch turbines, which provoked a protest from abroad, in particular Danish manufacturers. These protested because of biased competition, not according to rules of competition in the European Community. In the end Wind Plan collapsed, almost killing the Dutch industry, "leaving manufacturers with designs ill-suited for the international market place" (Gipe 1995). The conclusion is that all effort directed at the turbine industry were certainly no help for wind power application. This could have been done with reliable machines available on the international market.

7.4 Siting policy

For wind energy application sites with a good wind regime have to be developed as well as reliable turbines. Available sites have to be found within the country. Nevertheless almost all effort was directed at developing technology and industry. For example: the budget of the programme of 1986-90 (IPW) included 19% for research, 48% for the industry, 20% for the experimental SEP windfarm, 5% on technology transfer, and only 8% for environmental problems and public planning (Hack 1986).

At the moment the Dutch wind turbine industry is still in the vicious circle of the lack of good home market. Because of siting trouble the number of new wind energy projects is too small to create a market that is sufficient for serial production. At least for the large machines used in utility projects, because a manufacturer of smaller machines (less than 200 kW) had much success with selling to private investors as well as abroad.

8. POLICY BELIEFS

The number one drawback for wind energy application, the lack of a good siting policy, was never considered a major problem, as the public acceptance for wind energy was high. The analysis of the reasons for this crucial miscalculation is based on the concept of policy belief systems (Sabatier 1987).

8.1 Planning hierarchy

The basic idea of Dutch physical planning is prescriptive zoning in municipal zoning schemes with a legally binding effect. Construction and building permits will not be granted, when a project proposal does not accord to an approved zoning scheme. Existing schemes seldom contain zoning for wind turbines, so these schemes have to be altered to fit the nature of the development. For wind power, a new development, new zoning schemes have to be designed and politically accepted before building permits can be issued. This is a time consuming process that is absolutely necessary, as building permits may not be issued otherwise.

Changing zoning schemes is a local political decision. Application of wind policy is governmental policy and the way of thinking at the central level is different. Their policy belief is a top down hierarchy inherent to the Dutch planning system (fig.4), but its is mainly a myth. Central authorities have legal competence for instructing local authorities about specific parts of their zoning schemes. In practice these powers are hardly used as they contradict with the principles of physical planning and legal protection of civilians. For large scale developments, such as rail-tracks, roads and waste incinerators, the hierarchical competence of the central authorities was strengthened (Wolsink 1994). This 'nimby-policy', referring to the not in my backyard-syndrome, has been severely criticized. There is doubt whether it will help to provoke municipalities to change their zoning schemes.

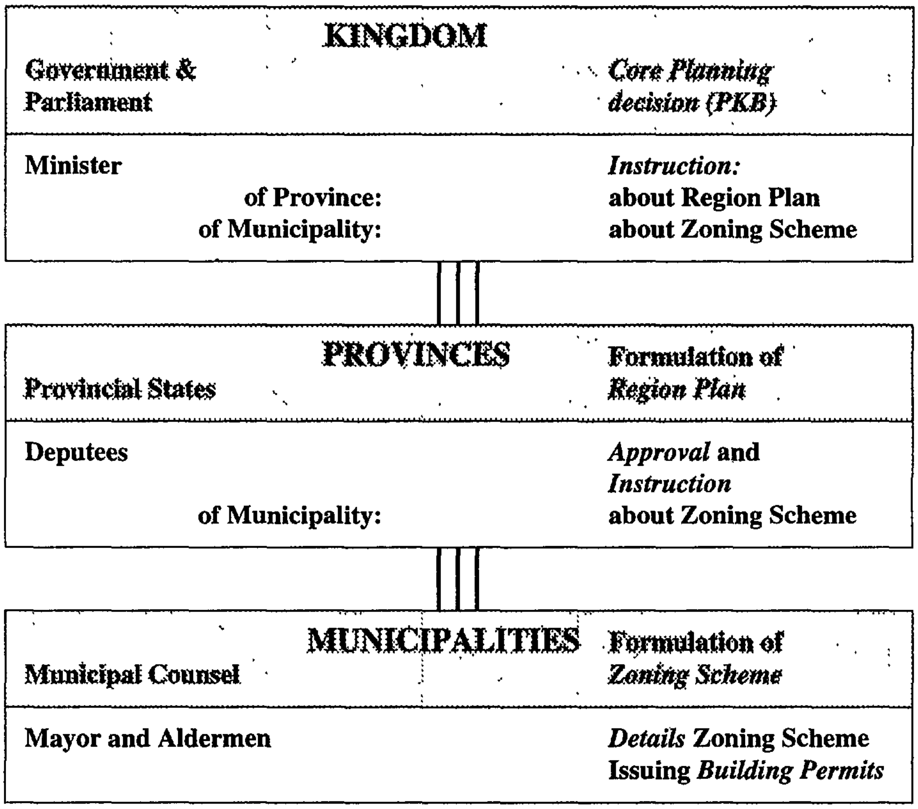

Figure 4. Top down planning hierarchy in the Dutch physical planning system.

The ministry of VROM operated according to the planning hierarchy as it made an agreement with provinces [3]. In the agreement a goal for all seven provinces with appropriate wind resources was formulated and the provinces will be held responsible for reaching their goal. Provinces have the legal authority of making region plans. However these plan only give rough indications. So in a region plan it may indicated that a region fits wind energy, but actual zoning requests details which can only be determined in municipal zoning schemes. Region plans may be appropriate for blocking wind energy in certain regions, but not for instructing to built them. The crucial actor in the decision making process of wind turbine siting is the municipality. Although there is a large number of relevant municipalities (200) it would have been more effective to make an agreement with them than with provinces without effective power in siting issues.

8.2 Public acceptance

In many cases proposals for new turbines or windfarms cause intensive local public discussions. In spite of the overall positive public attitude towards wind energy, when turbines have to be sited there arise local problems of acceptance. Opposition to facility siting is usually referred to as the 'familiar' not in my backyard (nimby)-syndrome. This phenomenon has been analysed before in cases such as the hazardous waste facilities, nuclear facilities, power plants, oil drilling etc. The content of the nimby concept is rather confusing, however. The popular view is "people are in favour of wind power, but are opposed to wind turbines in their own living environs". Since research suggests that the nimby syndrome may lie at the root of acceptance problems, policies are often based on this common view. Obviously it is also the policy-belief of the Dutch government in the case of wind energy. As the minister of Economic Affairs pointed out: "It will be a hard job to find sites of which everybody will say: indeed the right site; of course it should not be the neighbours backyard." [4] Later he declared to the parliament that the new nimby policy (section 8.1) would be an appropriate instrument for siting turbines.

Opposition can be defined in terms of negative attitudes, or alternatively described in behavioural terms. The behavioural component is the resistance against a wind energy project. An analysis of the oppositional behaviour in several wind energy projects shows that the authorities as well as the initiators of projects have wrong ideas about the backgrounds of local opposition (Wolsink 1989; 1990). Although the figures of public acceptance of wind energy indicate that only a minority of the people is considering opposition against a project, it may cause serious problems.

Legal procedures against permits issued by local authorities may be initiated by one single opponent that will be available on most locations. Public conflict over local developments has become the rule rather than the exception (O'Hare et.al. 1983). It is true for wind power as well. Wide spread negative feelings towards a technique, as in the case of nuclear power, are not a necessary condition for conflict. In the wind power case there is no dominant negative trend in the public debate. If the press coverage is taken as an indicator, the image of wind power projects appears to be favourable. The average picture from newspaper content is positive, without prejudice. In all cases critical notes appears in press reports as well, but positive views outnumbers the negative (Wolsink 1991). Nevertheless, in all cases a public and political debate was started by proposals for a wind power project. Discussions about new windfarms always reach the agenda of municipal counsel.

A positive attitude towards wind energy does not automatically imply a positive attitude to all wind energy projects. Siting a wind turbine has many more aspects than generating renewable energy. The major factor in the formation of attitudes is the evaluative judgment of the visual impact of wind turbines on the landscape. Attitudinal opposition is caused by negative feelings about wind turbines in the landscape. A belief in wind power contributing to less pollution, less need of coal and nuclear power plants and a limited use of fossil fuel comes only second when people form their attitude. This latter factor is outweighed by the factor landscape and scenic value. The third significant factor is beliefs about interference such as noise, shadow flicker, and impact on birds and nature.

Looking at the behavioural component of opposition arguments that are not concerning the local situation do not have any direct impact on behaviour. The environmental arguments for wind power may influence wind energy attitudes, but have no direct impact on intentions of resistance or acceptance of a local windfarm. In the analysis (Wolsink 1990) special attention was given to the existence of nimby-attitudes. It was found that the nimby-syndrome actually exists, but that it is a minor factor in the motives of most opponents. The classical phrase "wind power is perfect, but not in my backyard" is a poor explanation for the opposition against wind power developments.

Behavioural opposition is based on concerns about the consequences of a wind power plant: impact on landscape in the first place and interferences as a secondary concern. The problem is that these concerns become salient at the moment that a project is introduced to the public. Even the opinion about the use of wind power anywhere grows more critical in the planning phase of a project. Concerns about building wind turbines are not of a global nature, they are always dependent on local variables. Type of landscape on the proposed site is the most important factor determining scenic beauty ratings of landscapes with turbines. Obviously the concerns about interference (mainly noise) are also dependent on the location and distance to the buildings as well. Thus, any intentions to resist are determined by the characteristics of the selected location, not by nimby-attitudes.

9. DISCUSSION

The way a plan for a windfarm is introduced tends to be ultimately crucial. A Decide-Announce-Defend approach (dad; Ducsik 1987) as often used by utilities and sometimes by the Municipality or the Province, evokes opposition. Any procedure that does not offer all involved parties real opportunities for influence on projects will make people more opposed than necessary. The dad-strategy often starts an escalating conflict. For example: once confronted with public opposition authorities and industries that have taken the initiative for a facility think that the discussion is dominated by a small group of opponents and that the discussion does not reflect the actual public opinion. As their feeling is they already integrated all aspects in their decisions they believe that people who remain silent are accepting the project. This way of thinking is se+ective perception and may be called the 'planners fallacy' (O'Hare et.al. 1983). As they act according to this belief, the opponents are not taken serious, with the effect of strengthening their resistance.

The question is: why do utilities and authorities operate the way they do? Why are they planning windfarms using strategies that at least look like the dad-strategy? The first explanation may be the delay that always occur in cases of the implementation of new techniques or policy lines. Even when economic feasibility has been achieved application of new techniques or implementation of new policies may require changed social conditions. Economist have explanations for the phenomenon of a delay in reaching a new economical equilibrium that is more optimal, and sometimes even why an obvious optimum outcome will not be reached at all (David, 1985). Even large scale windfarms are mostly not even 10 MW, so wind energy is basically a small scale decentralized way of generating electricity. The process of siting many small facilities is quite different from planning a few large ones. One has to deal with different actors, many more actors and on several very different locations. It requires expertise in 'social engineering' and utilities don not have that expertise. At the same time central authorities do not have the ability for planning many small scale units either. Often they are facing tremendous problems already with planning large projects. They tend to work top down automatically, as illustrated by the agreement with the provinces. The actors that actually execute the power over siting decisions do not participate in the agreement with the central government.

The efforts for developing wind turbine sites, including financial and other incentives, has been marginal. The result is a policy that is failing to achieve its goals. An improvement of the wind energy policy has to include
* The start of a program for long term site development.
* Taking away the main responsibility for wind power development and the gatekeeper-role from the utilities.
* The creation of incentives targeted at energy yield instead of capital investments, based on avoided social costs.
* Creating an interest in wind power development for actors on the local level, including municipalities.
* A strictl separation of wind power policy and the industrial policy towards manufacturers.

NOTES

1. Economical feasibility is mostly a conditio sine qua non, but it is not sufficient. In many cases feasible techniques are never applied (David, 1985).

2. Wind Power Monthly, Vol. 10, October 1994: Little consensus on pricing, p.39.

3. Administrative agreement of government and provinces on the issue of siting wind energy facilities. Ministry of VROM. The Hague, July 1991.

4. The minister of Economic Affairs, mr. Andriessen at the opening of the EWEC '91, European Wind Energy Conference 1991, in Amsterdam.

REFERENCES

Arkesteijn, L., G. van Huis, E. Reckman. 1987. Ruimte voor wind. Rijksplanologische Dienst, The Hague.

Beurskens, H.J.M. 1984. The Netherlands wind energy R&D programme; State of the art. in W. Palz (eds.) Eur. Wind Energy Conference 1984 Hamburg. Stephens and Ass. Bedford, UK. 957-962.

Carlman, I. 1986. Public opinion on the use of wind energy in Sweden. in W.Palz (ed.) Eur. Wind Energy Conference Rome Vol.II, A. Raguzzi, Rome, 569-573.

David, P.A. (1985) Clio and the economics of qwerty, papers and proceedings. American Economic Review 75 (2) 332-337.

Ducsik,D., (1987) Citizen participation in power plant siting: Alladin's lamp or Pandora's box? in: R.Lake(ed), Locational Conflict. Rutgers Ctr. for Urban Pol. Res., New Brunswick.

EWEA, European Wind Energy Association) 1991. Wind Energy. Time for Action. EWEA, Rome.

EZ, Ministry of Economic Affairs. Letter to the 2nd Chamber of the States General 'Invulling ombuigingen EZ--begroting', 11 October 1994.

Energienota. Second Chamber of the States General, 1974, TK 13122.

Gipe, P. 1995. Wind energy comes of age. John Wiley & Sons, New York.

Hack, R. 1976 The Netherlands Wind Energy Research and Development Programme. in W.Palz (ed.) Eur. Wind Energy Conference Rome, A. Raguzzi, Rome, 137-142.

Hasslet, J., M. Diesendorf. 1981. The capacity credit of wind power; a theoretical analysis. Solar Energy 26 (5) 391-401.

Hohmeyer, O. 1992. Renewables and the full costs of energy. Energy Policy 20 (4) 365-375.

Jahraus, B., M. Lassen, W. Maier, K. Müller. 1991. Forecast of wind energy capacity in operation by 2005 in the Federal Republic of Germany. P.Smulders et.al (eds.) Wind Energy: Technogoly and Implementation. Elsevier, Amsterdam, p.526-529.
Keuper, A. 1995. Windenergienutzung in der Bundesrepublik Deutschland; Stand 31-12-1994. DEWI Magazin 6 (Februar) 12-24.
Lee, T.R., B.A. Wren, M.E. Hickman (1989) Public responses to the siting and operation of wind turbines. Wind Engineering 13 (4) 188-195.
Luken, E., R. de Bruijne, 1991. The Netherlands wind energy stimulation programme; the success of a continuous effort. P.Smulders et.al (eds.) Wind Energy: Technogoly and Implementation. Elsevier, Amsterdam, p.158-163.
NMP, Nationaal Milieubeleidsplan. 1989 (National Environmental Policy Plan) Second Chamber of the States General, 1989, TK 21137. nr.2.
NMP plus, Nationaal Milieubeleidsplan Plus. 1990 (National Environmental Policy Plan Plus) Second Chamber of the States General, TK 21137 nr.21.
Nota Energiebesparing (Policy memorandum on Energy Conservation) 1990. Second Chamber of the States General, 1994, TK 21570 nr.2.
O'Hare, M., l. Bacow, D. Sanderson. 1983. Facility siting and public opposition. Van Nostrand Reinholt, New York.
Sabatier, P.A. 1987. Knowledge, policy-oriented learning, and policy change. An advocacy coalition framework. Knowledge: Creation, Diffusion, Utilization 8 (4) 649-692.
Thayer, R.L., H.Hansen. 1989. Consumer attitude and choice in local energy development. Dep. of Environmental Design, Un. of California Davis.
Verkuijlen, E., C.A. Westra, D. IJtsma, M. Wolsink. 1986. Capacity estimate. in W.Palz (ed.) Eur. Wind Energy Conference Rome Vol.II, A. Raguzzi, Rome.
van Wijk, A. 1990. Wind energy and electricity production. University of Utrecht.
van Wijk, A., N. Halberg, W.C. Turkenburg, 1990. Capacity credit of wind power in the Netherlands. in Van Wijk 1990, p.109-137.
Wolsink, M. 1988. The social impact of a large windturbine. Environmental Impact Assessment Review 32, 8 (4): 301-312.
Wolsink, M. 1989. Attitudes and expectancies about wind turbines and windfarms. Wind Engineering 13 (4) 196-206.
Wolsink, M. 1990. Maatschappelijke acceptatie van windenergie. Thesis Publishers, Amsterdam.

Wolsink, M. 1991. Publicity about wind energy: analysis of news paper content. P. Smulders et.al. Wind Energy: Technogoly and Implementation. Elsevier, Amsterdam, p.526-529.

Wolsink, M. 1994. Entanglement of interests and motives: assumptions behind the nimby-theory on facility siting. Urban Studies 31 (6) 851-866.

The Danish CO2 tax scheme
- experiences and proposal for revision

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1. SYNOPSIS

In 1993 Denmark introduced CO2 taxes on the energy consumption in the industrial and commercial sectors of the economy. This was combined with a tax refund scheme based on energy audits for energy intensive industry. The energy audits have been evaluated and its effect on efficiency improvements has been identified. The Government has proposed to increase CO2 taxes in order to reach CO2 emissions goals.

2. ABSTRACT

In 1990 the Danish Government decided that CO2 emissions in 2005 should be 20% lower than the 1988 emission level. Based on the 1992 energy plan a range of new initiatives targeted towards all sectors of the economy was implemented. As part of this, a CO2 taxes on industry and commerce was introduced in 1993. Because the tax was introduced unilaterally, it was necessary to make special provisions for energy intensive industries. This was done by using a tax scale with a stepwise decreasing marginal tax as function of energy intensity. Furthermore, very energy intensive companies can obtain a tax subsidy, which neutralises the tax if they perform an energy audit and carry out certain efficiency improvement from a specified list. The effect of the energy audit has been evaluated, and the results show that the audit scheme can work as a way to solve the problems for energy intensive productions due to a unilaterally imposed CO2 tax. The Danish Government has proposed a significant increase in the CO2 tax. Analysis have showed that a higher tax is the most cost-effective measure to achieve the CO2 target in 2005. However, no decision has been made yet (April 1995).

3. INTRODUCTION

Following the 1987-UN report on environment and development the Danish Government in 1990 published a comprehensive energy plan "Energy 2000" calling for a reduction of CO2 emissions by 20% in 2005 compared with the 1988 emission level. Considering the increase in production, this target is ambitious.

3.1 Danish industry and energy

Total final energy consumption in Danish industry amounts to around 104 PJ (1992). Oil represents 33% of final consumption, natural gas 20% coal and coke 11%, renewable 4% and electricity 33%. Production of electricity is mainly based on coal. The energy intensity of Danish industry is low compared to international standards. The proportion of basic, energy intensive industry is low. Energy intensity decreased following international trends from the beginning of the 70's until 1986. Since then Denmark - apparently more than other western nations - has faced a flattening out of industrial energy intensity improvements.

3.2 Energy 2000

Following the plan "Energy 2000" several government and utility programs for industrial energy efficiency have been initiated or strengthened. Introduction of a CO2 tax on industrial energy consumption has become the cornerstone of the public program for industrial energy efficiency.

The strategy in the industrial energy efficiency program is composed of three main elements:

- Increase of energy prices by means of a CO2 tax
- A CO2 tax refund scheme for very energy intensive firms
- A subsidy scheme recycling part of the CO2 tax revenue back to industry

In addition, the Government will introduce efficiency standards for certain kinds of commercial and industrial equipment and strengthen technology procurement. This paper will, however, concentrate on the CO2 tax scheme and the associated refund and recycling schemes.

The logic behind the introduction of the CO2 tax was straightforward:

- The decrease in energy prices after 1986 is the decisive factor in the flattening out of the decreasing energy intensity trend.
- Market prices of energy usually do not reflect environmental consequences and costs caused by its use. By means of taxes energy users can be confronted with such external costs.

Also, it was realised that the markets for energy efficient technologies and practices are characterised by many well-known barriers hindering economic optimal take-up. The attention barrier was considered very important. Because energy costs are only a few percent of the operating costs, companies only give limited attention to energy matters.

4. DESCRIPTION OF THE DANISH CO2 TAX SCHEME

From January 1993 a CO2 tax of 50 DKK equalling 7 ECU per ton CO2 was levied on the industrial and commercial sectors. This translates into a tax of 18 ECU per ton heavy fuel oil and 7 ECU per MWh electricity (1 ECU = US $ 1,32 = 7,25 DKK) . The CO2 tax caused price increases from 8% (natural gas) to 27% (coal) in industry.

The new tax should be seen in relation to energy taxation on households: Private households in Denmark have been paying very high energy taxes since 1986 (e.g. 230 ECU per m3 of heating oil and 40 ECU per MWh electricity). The energy taxation regime for households was also changed marginally along with the CO2 tax for private business, but the taxation level remained much higher for households.

In Denmark energy intensive firms and industries are characterised by production of bulk products with little product differentiation. The competition is strong and often companies are faced with tight profit margins. To take one example, the only national cement producer would face a CO2 tax equalling their normal profits, if the CO2 tax was imposed with the same rates for all industries.

In parallel with the introduction of a national CO2 tax, Denmark has promoted the idea of a common CO2 tax within the EU. A common EU scheme would eliminate many problems facing energy intensive productions. So far the efforts to introduce a joint CO2 tax in the EU have not been successful.

4.2 Refund scheme for energy intensive firms

As a member of the European Union, Denmark cannot protect domestic industry by means of import tariffs. Consequently, a full imposition of the CO2 tax could result in a shift of some energy intensive productions to neighbouring countries. A refund scheme for energy intensive firms had to be included in the CO2 tax scheme. The refund scheme is complicated and only the main characteristics will be described here. The refund scheme consists of two elements:

- An automatic refund: A tax rate related to an energy intensity indicator (EII) of the firm. The lowest marginal tax rate is only 10% of the full rate.

- The CO2 subsidy: The few very energy intensive firms can get a subsidy equalling the CO2 tax.

4.1.1 The automatic refund

The automatic refund is related to an energy intensity indicator (EII). The EII of a firm is the CO_2 tax (before the automatic refund) divided by a proxy for the value added.

$$EII = CO_2 \text{ tax}/(\text{Total sales} - \text{total purchases})$$

A refund will be obtained automatically if the EII amounts to more than 1%, i.e. if the CO_2 tax is more than 1% of value added. For an EII between 1% and 2% the refund is 50% for the part of the CO_2 tax beyond 1%. For an EII between 2% and 3% the refund is 75% for the part of the CO_2 tax beyond 2%. For an EII beyond 3% the refund is 90% for the part of the CO_2 tax beyond 3%. The mechanics of this tax rate system are illustrated in fig. 1.

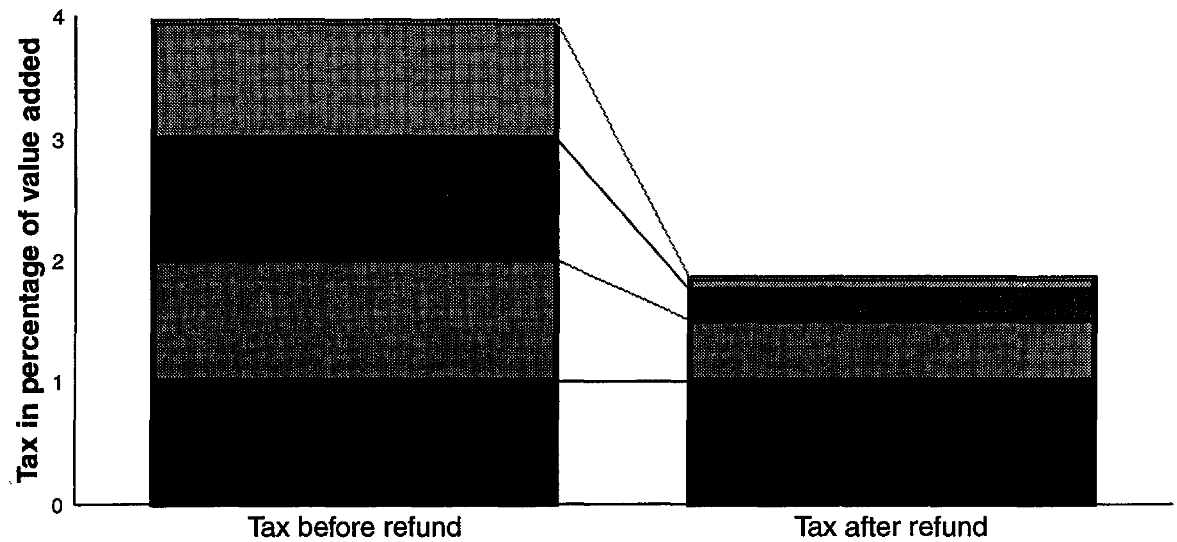

Figure 1. *The automatic refund. A company with EII = 1% will pay tax corresponding to 1% of the value added. When EII > 1% there will a refund. E g a company with EII = 2% will pay tax corresponding to 1,5% of the value added*

4.1.2 The CO2 subsidy

Very energy intensive firms with an EII > 3% can apply for a CO_2 subsidy almost equalling the residual CO_2 tax after the automatic refund, if they are considered energy efficient. Such firms are effectively exempted from the CO_2 tax. To be considered energy efficient the firm must fulfill four demands:

- An energy audit must be carried out by an authorised consultant.
- Certain projects from a list of technologies must be carried out if the pay back time is less than two years.
- The company must establish energy management and annual reports must be available to the Danish Energy Agency (DEA)
- New investments in energy equipment with an annual energy consumption of more than 12.000 ECU must meet certain energy efficiency criteria. Eligible investments must be reported in an annual report made available to DEA.

The tax subsidy is given for three years. After this period, the firm has to carry out a new audit and apply for the subsidy.

4.2 Energy audits

Guidelines for the energy audit are specified in a departmental order. The energy audit for each company must include the following:

- A survey resulting in an energy balance with a detailed breakdown of energy consumption on end uses

Description of profitable energy efficiency projects. Possible projects within a list of technologies must be treated separately. This list comprises standard energy technologies like boilers, compressed air, ventilation systems, lighting, etc.

The energy audit should provide the firms with information on what can be done to improve energy efficiency. This is achieved by providing the expert advice of the consultant and by involving the staff of the firms in the audit together with the consultant in such a way, that they update their knowledge of energy matters relating to their firm, and thus contribute to overcoming the information cost barrier.

To ensure that the consultants were all well qualified, an authorization procedure was set up. Only consultants that could prove that they had the necessary qualifications were authorised to perform audits. The question of the integrity arises because the auditors are private consultants, who perform audits on a part time basis. For the rest of the time they do ordinary consultancy work, including work for the same firms they are auditing. Therefore, they could, in theory, be subject to pressure. This was solved by drawing up a set of rules for the authorised specifying the duties of the consultants. Consultants who do not act according to the rules or who fail to perform audits at the level specified by the departmental order, can lose their authorization.

Today, 600 energy audits have been done. Among them 150 in industrial firms and 450 in green house firms. 137 industrial energy audits were performed when the scheme started in 1993. The 137 industrial firms uses a major part of the energy consumption in Danish industry: 77% of the total fuel consumption and 30% of the electricity consumption. Energy cost in these companies is in the order of 3.000.000 ECU per year.

4.3 Energy management

The requirements of the departmental order on energy management are general in nature, but a few specifics could be mentioned: Each plant must appoint an energy manager. A set of relevant key figures must be developed to keep track of energy intensities of different production processes. Necessary meters must be installed, and energy use monitored. Analysis based on developments in key figures must be carried out and presented in an annual report available for DEA.

Energy management is regarded as the main tool for industries to improve energy efficiency in daily operation by own efforts. Only firms with a good understanding of its energy use and employees responsible for energy stand a chance to undertake systematic energy efficiency improvements.

A study carried out in 1989 proved that energy management practices even in energy intensive industries were not satisfactory. Therefore, the establishment of reasonable energy management practices is required as a condition for receiving the tax subsidy.

4.4 Energy efficient investments

Investments in equipment expected to consume energy corresponding to more than 12.000 ECU annually must comply with certain general rules: The most energy efficient solutions must be looked for. Marginal investments in improved energy efficiency with pay back time in less than four years must be undertaken. Meters must be installed for equipment using more than 250 MWh electricity or 500 MWh fuels per year. Also, several specific requirements for regulation of boilers, efficiency of electric motors, compressed air installations, etc. are specified.

The backgrounds for these requirements were several casestudies showing that industry often invested in energy consuming equipment without any search efforts at all for more efficient technologies or solutions and ignoring large and cost-effective efficiency improvements

4.5 Recycling of CO2 tax revenue

Total gross revenue from the CO2 tax on private business is more than 160 mill. ECU annually. Exemptionschemes add up to 45 mill. ECU annually and reduce net revenue to around 115 mill. ECU.

Another 23 mill. ECU of the revenue is recycled to industry as subsidies for energy efficiency investments, demonstration projects, energy audits etc. Energy audits are subsidised by 50%. All private firms can apply for subsidies of up to 30% of investment cost of energy efficiency projects if pay back period (before subsidy) is between three and seven years. The pay back criterion was introduced to limit the free rider problem, e.g. when giving subsidy to very profitable projects that the company is likely to carry out anyway. However, early evaluations show that the problem is not eliminated by this rule. The upper limit is meant to concentrate the subsidy for the most profitable projects and to avoid paying subsidy for projects with most advantages in other areas than energy savings.

4.6 Implementation of the CO2 tax-scheme.

The CO2 tax scheme was set up very quickly. After the legislation was passed by Parliament, there was very little time to work out the details of the tax subsidy scheme, energy audits and investment subsidies. Furthermore there was only limited experience on the use of energy audits as a means to improve or to test energy efficiency. It was inevitable that the implementation of the scheme was based on a set of assumptions, which had not been tested in real life. The DEA, which was responsible for the implementation and administration, therefore decided, that it would ask independent institutions to perform evaluations of various aspects of the system when enough data were collected, and use these results to adjust the guidelines and details of the schemes.

An evaluation of the first energy audits has been made (Ravn et al. 1994). Evaluations of the companies energy management, energy efficient investments and the investment subsidies are planned for the near future.

5. EVALUATION OF THE FIRST INDUSTRIAL CO2 AUDITS

The experiences from the first CO2 energy audit can be described by use of three sources:

1. General statistics on the 137 industrial firms that have performed an energy audit before the beginning of 1993.

2. A questionnaire to all authorized consultants.

3. Case studies including 11 firms. The case studies consisted of interviews, in which the firms were given the possibility to express their opinion on the performance and results obtained through the energy audit. The instructions of the departmental order were discussed and the firms were encouraged to make suggestions to improve the instructions. The firms were asked whether they would carry out the energy saving proposals. If not, they were asked to give reasons for this. The energy audit reports were examined and the consultants who had performed the energy audits were interviewed. The 11 companies in the case study, have been chosen at random, after they were weighed after the size of the CO2 tax they would have to pay. Therefore, the companies in the case study have higher than average energy cost.

5.1 Results

The cost of the energy audits was in average 0,7% of the energy cost - less for the larger companies. The recommended savings correspond to 6% of the energy cost. Table 1 show the energy expenses, the refunded tax, cost of audit and energy savings.

The companies in the case study had only carried out 1/5 of the recommended savings (measured in energy). The realized energy savings of 0,6% corresponds to 40.000 ECU per year for each company. If a short time horizon of three years is used (after that the energy audit must be repeated) it is estimated that there is balance between the cost (investment, free to the consultant and the time used by staff) and benefits (energy savings). If a longer time horizon is used a surplus emerges.

The quantification of the recommended savings is based on the description in the consultants' reports. No control measurements have been made and the firms were not asked whether they would have implemented some of the projects anyway, i.e. the extent of the free rider effect was not evaluated (See Hansen 1993 and Togeby 1993).

Table 1: Key values on energy audits

Average per company	Energy cost	CO_2 tax payable (after refund)	Consultants fee	Recom-mended savings	Realized energy savings
	ECU per year	% of energy cost			
All 137 companies	2.700.000	2,5%	0,7%	6%	?
11 companies in case study	6.600.000	3,4%	0,5%	3%	0,6%

All companies in the case studies said that they only made an energy audit in order to get the CO2 tax refunded. If the possibility of getting the CO2 tax refunded did not exist, none of the companies would have initiated an energy audit.

5.1.1 Many projects rejected.

The 11 companies in the case studies were asked of to give their assessment of the energy saving proposals. According to this, the status of the energy saving proposals (171 projects) can be divided into four groups:

1 Projects that have already been realised or will be realised soon: 19% of the recommended energy savings.

2 Projects the companies are considering to carry out: 5% of the recommended energy savings.

3 Projects the companies have not decided about or projects that are not going to be carried out because the pay-back time is considered too long: 30% of the recommended energy savings.

4 Projects that have been rejected because the firms believed important aspects such as operating conditions or safety precautions have not been considered: 47% of the recommended energy savings.

According to the interviews 52 projects were rejected. The reasons for this can be categorised as follows (the percentage gives their weight compared with the energy savings in all rejected projects).

1 Wrong technical and/or economical assumptions (38%)

2 Problems with reliability of operation (37%)

3 Problems with security or internal or external environment (19%)

4 Problems with product quality (6%)

The many rejected projects show that the dialogue between consultants and the companies must be improved. Occasionally the consultants have sent the report to the company without arranging a meeting or in other way ensuring that the report was understandable to the company. From the questionnaire to the consultants it is known that most of the consultants were pressed for time when doing the energy audits.

Sometimes the firms have accepted all the energy saving proposals at a meeting held before the energy report was sent to the authorities. Later the companies have rejected one or several recommended savings because of operating problems and a rise in the costs. It is only natural that some projects recommended by the external consultants will be rejected for reasons like the mentioned. Nevertheless, it should be possible to reduce the percentage of rejected recommendations.

5.1.2 Few savings in the process equipment

Only few energy savings are recommended in relation to the core process equipment. Less than 10% of the recommended energy savings projects involved the process equipment. The instructions of the departmental order concerning equipment other than production machinery are detailed. The consultants therefore have paid more attention to this equipment than was originally intended in the departmental order.

The consultants are qualified to identify efficiency projects concerning the technologies of pressurized air, cooling systems, lighting etc., however, their expertise on the specialised technology used in the core production processes is not always sufficient. The problem is most serious in small sectors with one or two enterprises in Denmark. Three firms point out that process-technical expertise is only to be found abroad.

All the firms participating in the evaluation are energy intensive and consider the ability to reduce energy expenses as essential to ensure the competitiveness of the company. All firms have one or several members of staff whose sole responsibility is to reduce the energy consumption of the company. They often consult relevant research institutes on how to improve the production and energy efficiency, and some firms consider themselves as specialists in efficient energy use. Therefore these firms have doubts about whether the energy consultants are capable of finding any energy saving proposals in the production process. 6 of the 11 companies said that the energy consultant did not have sufficient knowledge about the production process in the company.

5.2 Conclusions on energy audits.

The early evaluation of the CO2 energy audits show that the system forms a sound basis for the continued regulation of Danish industries. The evaluation also suggests adjustments, which will improve the effect of the audits.

One thing that could be done is to specify more clearly that the consultant should concentrate his efforts on equipment with large energy consumption. It could be specified that if a piece of equipment has an energy consumption less than, e.g. 2% of the total energy consumption and the expense are less than, e.g. 30.000 ECU per year it should not be examined in great detail. On the other hand it should be made mandatory for the consultant to examine equipment with energy consumption more than, e.g. 20% of the total consumption.

To improve the dialogue between the consultant and the firm, the departmental order should specify that the firms give an early assessment of each energy efficiency proposal. The intention of this is to involve the firm in the audit and thereby make the consultant more aware of the particular conditions of the production of the firm before he draws up his final recommendations.

It should also be considered to offer the consultants supplementary education to improve their abilities to detect energy savings in the production processes, or support the use of other experts with expertise on the process equipment.

6. NEW CO2 TAXES?

In 1993 the Danish Government initiated a comprehensive review of energy policy. The review showed, that the 20% target for CO2 reductions could not be achieved unless supplementary measures were taken. On this basis a civil service committee to describe specific models for the introduction of "green" environmental taxes was established. The committee should describe combined taxation and models for recycling the revenues that would not affect the competitiveness of Danish industry negatively. Several reports have been published in 1994 and 1995.

The committee made a review of Danish environmental policy objectives and international obligations in order to delimit the objectives and/or obligations that could not be met with existing policy instruments. This showed that the objective that most urgently required supplementary action was the CO2 objective. It was estimated that current developments within the transport and energy sectors meant that only a 15% reduction in emissions could be achieved by measures implemented so far. The most cost-effective way to achieve the target was estimated to be an increase in taxes on energy consumed by industry, agriculture, commerce etc. The average necessary level of taxation was estimated to be at least 23 ECU per ton of CO2 .

This conclusion reflects the fact that the main focus of energy policy in Denmark historically has been placed on the energy consumption of the household sector, and on production and distribution of energy. The energy consumption in industry has not been given much attention before the introduction of the CO2 taxation scheme. Therefore, cost-effective potentials for energy efficiency in households and within energy production are limited whereas there are still untapped possibilities in industry (Hansen and Togeby, 1993).

6.1 Macroeconomic impact of higher CO2 taxes

The macroeconomic impact of new CO2 taxes was analysed by studies on the macroeconomic ADAM-model normally used by the Ministry of Finance. The main purpose of this was to see how the economy as a whole would be affected by a unilateral increase in the CO2 tax to the level necessary to reach the CO2 target.

As an example, the impact of the gradual introduction of new CO2 taxes over a period of four years was analysed, starting from the actual average level of 4 ECU per of CO2 to 23 ECU per ton of CO2. (The actual tax rate is 6 ECU per ton. Taking the existing refunds and tax subsidy into consideration, the average tax rate is only 4 ECU per ton of CO2).

Such an increase in taxes on energy will have many different effects on the economy. The macroeconomic impacts are illustrated on table 2 by two indicators: marginal employment and gross value added at factor cost of the private sector (GVA).

First, the tax will make energy consumption more expensive. The direct effect of this is that the cost of production will increase. The sections of the economy exposed to international competition will not be able to pass on the increase in energy cost to the consumers as price increases without losing market shares. The tax will therefore have a contractive effect on the economy. The direct effect will be loss of exports, loss of jobs, loss of revenue all amounting to reduction in welfare. This is seen on section 1 of table 2.

*Table 2. **Macroeconomic effect of CO_2 tax increase from US$ 5.4 to 30 per ton of CO_2, phased in over a period of 4 years starting from 1996***

Unit: Percent.	1997	1999	2001	2003	2005
Section 1. Taxes with no recycling					
Employment	-0.5	-1.5	-2.1	-2.3	-2.0
GVA	-0.5	-1.4	-1.8	-1.8	-1.6
Section 2. Taxes with recycling through income tax reductions					
Employment	-0.2	-0.9	-1.2	-1.1	-0.8
GVA	-0.2	-0.7	-1.0	-0.8	-0.5
Section 3. Taxes with recycling through wage subsidy					
Employment	0.0	-0.2	-0.3	-0.4	-0.5
GVA	0.0	-0.1	-0.3	-0.3	-0.3
Section 4. Taxes with recycling through wage subsidy and substitution					
CO_2 emissions	-2	-4	-5	-5	-5
Employment	0.2	0.3	0.3	0.2	0.2
GVA	0.1	0.2	0.2	0.2	0.1

Second, the new CO2 taxes will lead to an increase in government revenue, which can by used to reduce other taxes. This reduction will have the opposite effect to the contraction caused by the tax. If the revenue is used to reduce income taxes industry and commerce will suffer a loss in the short and medium term, while the consumers will increase their purchasing power. In the longer term the increased costs of production will be passed on to the wage earners as reduced wage increases. However, in the interim period production volume and employment will go down because of a temporary loss of competitiveness. This is illustrated on section 2.

If the revenue is recycled back to industry directly, this temporary loss can be limited depending on the way this is done. Employment and GVA will be affected less because the time lag implicit in the wage adjustment mechanism is avoided. Direct recycling to the industry, commerce, agriculture etc. was modelled as a general wage subsidy, i.e. the revenue is recycled by giving all employers a subsidy in proportion to wage expenses. It is seen on section 3 of table 2, that employment and GVA are less affected when direct recycling is used.

Third, the new taxes on energy, will give the energy consumers an incentive to reduce energy consumption. In the short term the price increases will give an incentive to pay more attention to energy matters and therefore reduce the attention barrier mentioned in paragraph 3.2. Good energy management practices will become more widely used, information on efficiency will penetrate more easily throughout industry and thereby give rise to an increase in energy efficiency.

In the medium and longer term higher energy prices will change the composition of production factors by substitution of energy with capital and labour. When renewing the production equipment, firms will buy more energy efficient equipment, which may be more expensive or which requires use of more labour. In the longer term higher prices will also induce technological development towards higher energy efficiency, however, this effect will be weak, if the taxes are imposed in Denmark unilaterally.

The direct consequence of these substitution effects will be the creation of new jobs and higher investments in capital goods. In the longer term the same substitution will also lead to marginal reduction in labour productivity, which will lead to a small loss in growth. The accumulated effect of the imposition of the tax, direct recycling and substitution between production factors is shown on section 4 together with effect on CO2 emissions. It is seen that the CO2 target is met, while employment and growth in the time horizon considered show positive growth although the effect is only marginal.

The economic adjustment will invariably carry some friction costs with it, since the taxes will induce structural changes in the economy. Certain jobs in energy intensive industry will be lost and other jobs will be created. There will be costs connected to the relocation and retraining of the workforce. These effects should be seen relative to the structural adjustment that is taking place anyway because of the technological development, new consumer preferences, the internationalisation of the economy etc. Seen against this background, the friction cost caused by new CO2 taxes will be just a small ripple on the surface. Furthermore, if an increase in CO2 taxes is introduced gradually and announced in advance, the economy will have time to prepare the necessary adjustments so that friction costs can be kept at a low level.

The results presented in this paragraph should be treated with caution because of the element of uncertainty in macroeconomic forecasts. The results have been compared to other model calculations and several sensibility analyses have been done. The results of this do not lead to a modification of the main conclusion: The CO2 target can be met by increasing CO2 taxes on industry, agriculture, commerce etc. and that the tax increase can be introduced unilaterally in such a way that the national economy is not affected. In the short and medium term certain small beneficial effects on employment may arise.

6.2 Governmental proposal

The Government presented in April 1995 a package on how to achieve reduction in the CO2-emissions from the industrial and commercial sectors. The package consists of a combination of three elements:

1. Increasing the CO2-taxes.
2. Tax exemptions for energy intensive productions if the company undertake the obligation to achieve energy efficiency (individual agreement on energy efficiency).
3. Full recycling of revenue by reducing labour costs and subsidies for investments in energy efficiency. The whole program will be revenue neutral for the Government.

As far as the tax-element is concerned the package is less ambitious than originally expected. Instead of introducing a single, high tax-rate covering all energy consumption, differentiated rates are introduced. Energy consumption for space heating, for energy intensive processes and non-intensive processes are taxed with different rates. The tax rate for space heating is high and equals the tax paid by households. This corresponds to 83 ECU per ton of CO2. The tax rate for energy intensive processes, on the other hand, is low corresponding to 3,4 ECU per ton of CO_2. The rate for non-intensive processes is between these two rates and amounts to 12 ECU per ton of CO_2.

The single high tax rate was abandoned because it was found too complicated to devise a recycling mechanism that did not lead to unacceptable redistribution effects from energy intensive industry to the less intensive sectors. Although such redistribution can be considered beneficial from an environmental point of view, the unilateral introduction of high CO_2-taxes in Denmark would lead to a loss of competitiveness for energy intensive industries that could result in the relocation of these industries to other countries with no taxes.

On the other hand it was shown that the tax component on space heating can be recycled through a reduction of labour costs in a way that all sectors are compensated equally and so that redistribution effects are marginal. The tax on energy intensive and non-energy intensive processes are limited and the investment subsidy can be considered as a way of recycling this component.

The tax-exemptions for energy intensive processes are intended to work in combination with a system of agreements on energy efficiency between companies and authorities. The tax exemption or tax rebate is only given if the company signs an agreement on energy efficiency with the DEA. The agreement implies, that the company has to draw up and set up an action plan for energy efficiency within the company. This can consists of a set of efficiency projects such as combined production of heat and power, establishment of energy management, process integration etc. To insure the quality and thoroughness of the action plan, they must be approved by certified, independent consultants before they are submitted to the DEA for negotiation. The realisation of the action plan must be reported yearly to the DEA, and compliance with the plan is a condition for maintaining the tax exemptions. It is estimated that about 50% of the energy consumption in industry will be covered by agreements.

The investments subsidy scheme is an extension of an existing scheme. Subsidies will be given to a wide range of investment projects that lead to energy efficiency or other environmental goals. Special emphasis will be put on the introduction of new, energy efficient technology. Furthermore the subsidies will be used to promote integrated energy and environmental measures within industry, agriculture and the service sectors.

It is estimated that the package will result in reduction of CO_2-emissions with 4.5% of the emission level in 1988. This is not enough to achieve the goal of a 20% reduction by 2005. Therefore the Government is planning a review of the national energy plan, Energy 2000, during 1995. Furthermore, it is anticipated to evaluate the measures included in this package thoroughly by 1998, to make the necessary adjustments before the target year of 2005.

It must be stressed, however, that this package has not yet (April 1995) been adopted by Parliament, and that the details can undergo changes in the Parliamentary process.

7. REFERENCES

Hansen, Henning and Mikael Togeby: "Electricity audits in large industrial companies". Proceedings of the 1993 ECEEE Summer Study. The European Council for an Energy Efficient Economy.

Ingerslev, Christina and Mikael Togeby: "Evaluation of Energy Audits in the Danish Energy Efficiency Program". European Congress on Economics and Management in Industry. April 1994, Portugal.

Ravn, Ole, Mikael Togeby, and Christina Ingerslev: "Evaluation of the CO2 energy audits" (In Danish). 1994.

Togeby, Mikael: "The control problem in relation to electricity conservation". Proceedings of the 1993 ECEEE Summer Study. The European Council for an Energy Efficient Economy.

Department of Finance: Green taxes and private firms. (in Danish). 1994