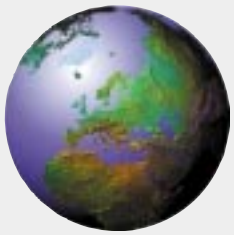

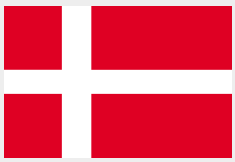

Photo: Sommer

**First-hand experience:** Danish politicians can see wind power at work directly in Copenhagen: At the Middelgrunden offshore wind farm and at the port jetty, where there are six Bonus turbines of 600 kW rated capacity each.

# Political prices or political quantities?

## A comparison of renewable energy support systems

**By Frede Hvelplund**

Two main renewable energy (RE) governance models are discussed here:

(a) The "Political price-/amount market" (PPAM) model, which has politically set prices for renewable energy based electricity, and where the produced quantity of renewable energy based electricity is determined on the market; and

(b) The "Political quota-/certificate price market" (PQPM) model, where the renewable energy based electricity quantity is politically fixed as a quota and the renewable energy based electricity prices are determined on the market.

The PPAM model has been successful in Germany, Spain, and Denmark, countries that boasted around 90% of the European wind power production in 2000.

In 1999 the Danish parliament approved a new law introducing a PQPM model for renewable energies (New Energy 2/99). Wind turbines contracted from 2000 and onwards are subjected to payment according to these not yet totally settled rules. Almost no contracts have been entered into under them, which has brought Danish wind power development to a very critical situation (New Energy 3/2001). Only offshore wind turbines are being built, as they are subject to specific "demonstration project" subsidies and payment rules. The 2000 wind power boom (around 600 MW) was contracted before the end of 1999 and is based on the old PPAM rules in effect until then.

In 2000 the German parliament approved a new advanced "Political price-/amount market" and in June 2001 the French parliament accepted a similar model. Recently the EU authorities accepted the use of the PPAM model in the proposed Directive for electricity from renewable energy sources (New Energy 4/2001). This keeps the question of the future regulation framework open. The PQPM model, therefore, is no longer the only possible future regulation model. This development has lately been supported by a European Court adjudication of March 2001, which says that the German "Political price-/amount market" model is not to be regarded as illegal state aid and is therefore acceptable as a way of supporting the development of renewable energies (New Energy 2/2001).

The main arguments for introducing a "Political quota-/certificate price market" system have been linked to the belief that a system with quota regulation and a price regulated on the market would increase competition between suppliers of renewable energies and results in getting more "value for money." Upon examining the various arguments and the dynamics of the debate, it is striking that there seems to be no thorough discussion of the fact that, compared to fossil fuel technologies, renewable energy technologies are characterised by:

a. A cost structure with a very high percentage of investment-fixed costs and very low running costs, which implies high investor risks on the market and increasing im-

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portance of keeping alive competition in the equipment market.

b. Different natural resource bases from location to location, making it necessary to establish a governance system that furthers an EU-wide "site efficiency" generating process rather than a "mono price" (one price on a European market) based price competition.
c. Being dispersed around the country, and often in residential areas, making it particularly important to involve neighbours and people from the region in the design, development and ownership of renewable energy projects.
d. Being newcomer technologies, thus having minor market shares and meeting resistance strategies from established technologies.

The PPAM model is a better governance model for any country, as well as for the EU, especially because it is well adapted to the above four specific demands to an RE regulation framework.

## Which governance model is a market model?

Before entering a discussion of the above four specific characteristics of renewable energy development, it is necessary to briefly discuss the "ideological question" regarding the "market" attributes of the two models.

The "Political quota-/certificate price market" system, with its politically set quantities (quotas), has persistently been touted as more market-oriented than a "Political price-/amount market" system with politically fixed prices and quantities determined on a market. This delusion has been so successful that it is now an almost undisputed "fact," that "Green Certificate" trading on the basis of a market plus quota regulation should be 'the genuine market' system. Table 1 illustrates why this is a delusion.

As illustrated in table 1, the PQPM model shows the political interference on the market at quantity and price levels in the Danish case. The only political intervention in the PPAM model is at the price level. The "Political quota-/certificate price market" model, therefore, is not more liberal or market- oriented than the advanced "Political price-/amount market" model. On the contrary, the Danish PQPM model, due to its 100% state-governed amounts, and partly state-governed prices, was closely related to the governance frameworks of former East European planned economies until around 1990.

## The high fixed cost RE characteristics

In a PPAM system the wind turbine factories are able to decrease their selling prices, increasing sales of wind turbines. It is due to this system that the per kWh cost of wind power has decreased by 80% since 1980. In a PQPM system, the quantity of wind power is politically decided several years ahead. Consequently, the wind turbine producers, as a group, can only increase their turnover by increasing prices. This motivates the wind power firms to establish "strategic collaboration" or mergers to try to win more market control. This mechanism constitutes an important problem as one of the general structural changes on the market: The decrease of value added on the market for electricity and the likely increase of value added on the market for energy equipment, seen as a proportion of the sales price at the consumer level. Concretely, the change to some types of renewable energy systems, such as wind power, represents an automation of electricity production, with 85-90 % as investment costs and the rest as maintenance costs. Once the wind turbine is built, hardly anybody works on it. It just produces electricity for 20 to 30 years and is usually maintained by service units linked to wind turbine factories. Therefore, the wind turbine will not work more efficiently because of competition with other wind turbines on the electricity market.

In a traditional electricity service supply system, the situation is totally different. At least in theory one might expect competition on the electricity market to put pressure upon the power utilities, which will then dismiss some power plant workers. A wind turbine can dismiss nobody, once it is built. Any potential personnel cutting can then only happen at the level of the wind turbine factory, because a wind turbine is, in principle, an energy automation.

At present, fossil fuel back-up systems are still being used. But in the future, a system with different types of storage techniques, such as hydrogen storage, might be developed. These systems also appear to be "automatic storage systems," which hardly require any maintenance performed by employees in an energy organisation.

Thus, when introducing renewable energy systems, the importance of the electricity market decreases, whereas the market for energy equipment becomes increasingly important. In Table 2 the relative importance of the market for equipment is compared within a fossil fuel system and a renewable energy-/electricity conservation system.

In the present situation of technological change, the "Political quota-/certificate price market" system ends up introducing price competition on a dwindling market and abolishing market competition on an expanding market. The advanced "Political price-/amount market" system supports market competition on the growing market for equipment, making it especially suitable for the present period of technological change.

| | Equipment market | Electricity market |
|---|---|---|
| Fossil fuel systems | 47% | 53% |
| Renewable and electricity conservation systems | 81% | 19% |

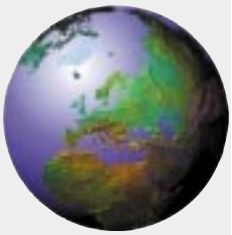
***Table 2:*** *Moving from fossil fuel to RE means a change in value added from the electricity market to the equipment market.*

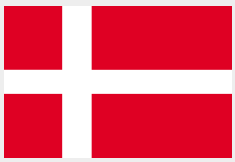
| | **"Political quota/certificate price-market" model** (Danish model from 2003) | **"Political price/amount market" model** (present German, Spanish and French model) |
|---|---|---|
| **Price determination** | Market and political | Political |
| **Amount determination** | Political | Market |

***Table 1:*** *Political and market determination of price and quantity in two regulation models.* ***Comment:*** *The price in the Danish "Political quota-/certificate price market" model is partly politically set, since the law determines that the price should not be below 1.32 €ct/kWh or above 3.57 €ct/kWh.*

## Different natural resource bases from location to location

As mentioned in the beginning, renewable energy technologies are





characterised by having different natural resource capacities from location to location. A wind turbine on an inland site in Germany produces only around 50% of the quantity produced on a very good coastal site in Ireland or Scotland. When dealing with nuclear, natural gas or coal-fired power plants, variations from location to location will mainly depend on differences in cooling facilities, with a coastal site being slightly cheaper than an inland site that needs cooling towers.

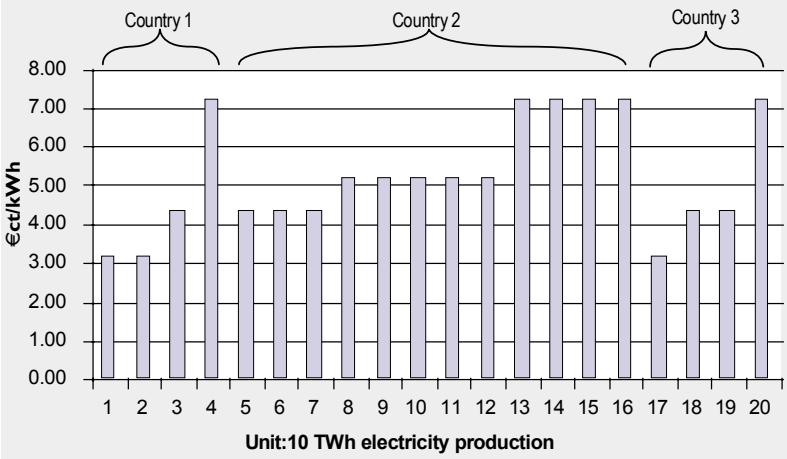
To meet the declared EU goal of increasing the percentage of renewable energy based electricity production (not including large hydro) from 3.2% to 12.5% from 1997 to 2010, it is necessary not only to exploit the best coastal sites for wind power, but also to use good inland wind sites all over Europe. With a "Political quota-/certificate price market" system for the EU, there would be only one certificate price for wind power in the EU.

Regarding wind power, Figure 1 shows the different production prices in a "model union" consisting of three countries.

*Figure 1:*

**Wind power production costs in the three countries**

**Wind power costs pr. kWh with equal technological resource efficiency in three countries.**

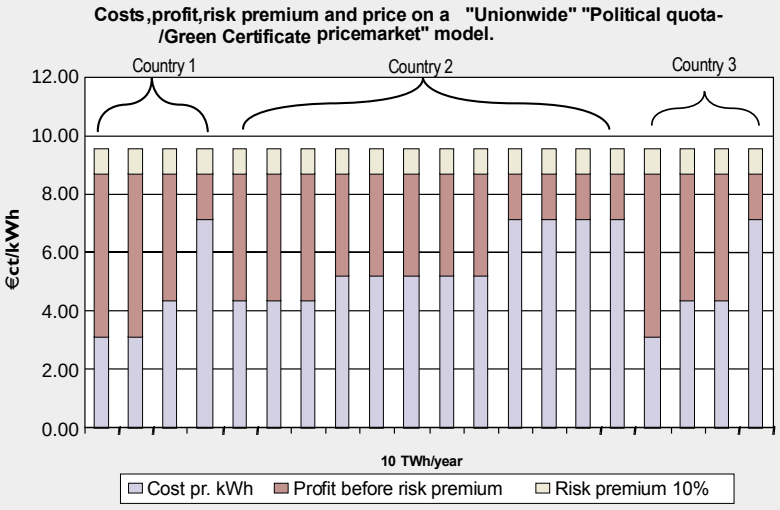



***Source:*** *"Renewable energy governance systems" Frede Hvelplund. To be published June 2001.*

The costs of producing wind power vary from around three €ct/kWh on a very good coastal site, in Ireland for instance, to around seven €ct/kWh on good inland sites in central Europe. As wind power production on inland sites is required, and there is only one marketplace and one price for "Green Certificates" in Europe, the price level needed in order to produce wind power on inland sites, especially in Central Europe, will be at around nine €ct/kWh. This price is required because some profit is necessary to stimulate investment. This price would result in very high profits on the good wind sites, with between 90-160% profits on the good (classes 0 and 1) sites. Hence, the problem of establishing a mono-price market for renewable energy in the EU.

*Figure 2:*

**Costs, profits and prices in a Union wide "Green Certificate" market (case example)**




***Source:*** *Same as Figure 1.*
*(**Assumptions:** 10% risk premium due to fluctuating prices. 20% profit demand on a wind class 3 site.)*

## *RE resources and the "Political quota-/certificate price market" model*

In the PQPM model, a quota politically regulates the amount of renewable energy based electricity. The price is determined on a market for electricity. In Figure 2 the three countries have introduced a common PQPM system. Linked to their different wind resources, this governance system entails the following wind power cost functions and profits for wind site and wind turbine owners: The figure shows that on this market there is one price for wind power all over the Union, namely the one developed in the EU certificate market. Politicians have established a quota system that ensures that an annual production of 200 billion kWh RE electricity is implemented. To reach this goal the kWh price on the market has to be at least high enough to make it profitable to use wind class 3 sites, which concretely translates into a price slightly above ten €ct/kWh. Additionally, the fluctuating prices on the certificate market imply that the investors demand a 10% risk premium, increasing the price to 9.8 €ct/kWh.

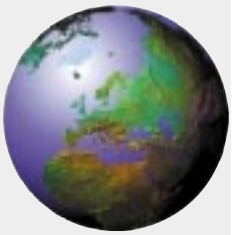
## *RE resources and the advanced "Political price-/amount market" model*

We call the model "advanced" because of its ability to foster a competition process, which increases "site efficiency" in a non-bureaucratic way. Figure 3 illustrates the effects of this type of regulation. The price performance of the advanced PPAM model is shown for the three countries. The Figure displays exactly the same cost structure as in Figures 1 and 2. The only difference is that the advanced PPAM model has a politically defined, site-dependent price framework, which makes it possible to decrease the profit on good wind sites without destroying the economy of inland wind sites.

## *Renewable energy is "dispersed" and often close to residential areas*

One of the main historical secrets behind the Danish wind power success was that a system of public regulation promoted co-operative neighbourhood and local ownership, creating more than 60,000 wind turbine owners in Denmark. People like wind turbines when they own them and are not annoyed by the noise and visual inconveniences, especially when getting a fair compensation. However, with a system of distant utility or shareholder owners, the local inhabitants get only the disadvantages and no compensation. This is seen as unjust and increases local political resistance to wind power. It is as simple as that.

The new Danish "Political quota-/certificate price market" system results in very fluctuating prices due to a range of different factors. The cost structure of wind turbines results in a

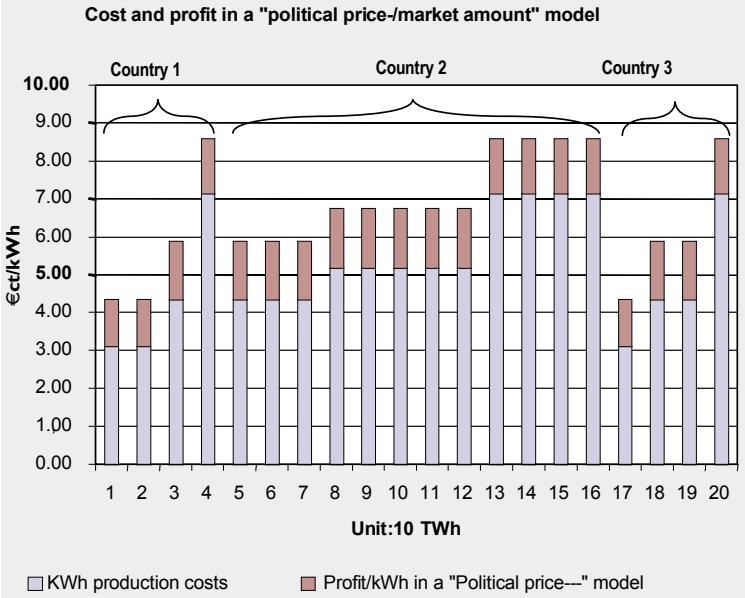


very vertical supply curve. Once wind turbines are built, they will not close down production, as the majority of costs are fixed. Annual wind resources vary with up to 30%, making it impossible to govern by quotas, as the annual change in wind resources will surmount the size of a quota increase. Furthermore, the market will be characterised by large players able to manipulate market prices.

Altogether, this causes the certificate prices to fluctuate heavily and often in a manipulated way, making it impossible to draft trustworthy wind power project budgets. Consequently, the old procedure of financing a wind turbine project together with the local bank is no longer possible. Only large financial investors and power utilities are left in the market. This means that the number of investors and, consequently, the competition between them decreases, driving up project prices. Moreover, it stokes local and regional political resistance against wind power.

*Figure 3:*

**Price, profit and costs in the "Political price-/amount" model (case example)**




***Source:*** *Same as Figure 1.*
*(**Assumptions:** Profits are a percentage of costs: 40% on wind site 0; 35% on wind site 1; 30% on wind site 2 and 20% on wind site 3. These profit percentages are approximations of the profits that we have calculated on the basis of the new German prices. Since prices are politically guaranteed, there is no need for any risk premium.)*

## *Characteristics of "newcomer" technology*

The competition between renewable energy technologies and existing fossil fuel and uranium based power companies is very often a win/lose situation. If wind power production increases, then the profit of the power companies, ELSAM in Denmark, EON in Germany, etc., decreases. Due to the excess capacities of these power companies, when they own renewable technologies they are often competing with their own short term marginal costs.

Hence, these old fossil fuel and uranium-based companies have no real economic interest in investing in renewable energy plants. That makes it

| | **"Political price-/amount market" model** | **"Political amount-/certificate price market" model** |
|---|---|---|
| **(a) Is it a market model?** | The price is political, the amount is decided upon a market. | The amount is political, the price is partly decided upon a market, partly politically set. |
| **(b) Does it further competition between equipment producers?** | The equipment producers as a group can expand sales and profit by lowering production costs. | The equipment producers face a 6-8 year politically set annual production quota. They can expand profit by lowering costs and especially by increasing sales prices. |
| **(c) Can it differentiate the price between good and bad "politically desired" wind sites?** | Yes, as happens in the German model. | No. In this "mono-price" model, the same price is paid to the very good coastal sites as to the good inland sites. |
| **(d) Can it price-differentiate between the first years and the last years of the production of a given RE plant?** | Yes, as happens in the German model. | No. The same price has to be paid during the whole lifetime of an RE plant. |
| **(e) Can it lower the price in parallel with RE productivity improvements?** | Yes, as happens in the German model. 2002 wind turbines are getting 1.5% lower kWh prices than 2001 wind turbines. | No. The quota has to be set for a 6-8 years period and new improved wind turbines are getting the same certificate price as less efficient wind turbines built at an initial stage of development. |
| **(f) Does it support neighbour and local investors?** | Yes. The foreseeable prices make it possible for local groups to borrow from local banks. | No. The very fluctuating and possibly manipulated prices make it too risky to invest and difficult to borrow from local banks. |
| **(g) Does it put a cost pressure on equipment producers?** | Yes. Almost the same cost pressure is put on investors at good wind sites as on investors at inland wind sites. | In general, no. The mono-price system gives very high profits to owners of good coastal sites. This increases site prices and weakens the cost pressure on equipment producers. |
| **(h) Does it support investor groups independent of uranium and fossil fuel interests?** | Due to the above (f), yes. | Due to the above (f), no. |

***Table 3:*** *A comparison of the "political price-/amount market" model with the "political amount-/certificate price market" model.*

**Main source:**
Renewable energy governance systems
A comparison of the "political price-/amount market" model with the "political quota-/certificate price market" system (the German and Danish cases).

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important for politicians to establish development tracks, where independent investors not having "sunk costs" can further the renewable energy technologies linked to the old fossil fuel and uranium technologies. As argued above, the "political quota-/certificate price market" system tends to hamper the possibilities of such independent neighbourhood and local investors. Hence this governance system leaves the economically unmotivated uranium and fossil fuel utilities alone in regard to investments in the RE market. This is not the case with the "Political price-/amount market" system, which, with its foreseeable prices, makes it possible for independent "neighbour and local" investors to establish wind turbine projects.

## Concluding remarks

The PQPM system introduces inefficient competition between energy robots and weakens the increasingly important competition between equipment producers. It hampers the competition between investors by making it difficult for neighbours and local investors to invest in wind turbines. Due to its mono price character, it gives too high profits to wind turbine owners at very good wind sites and inadequate profits to wind turbine owners at poor wind sites. The "political quota-/certificate price market" system is very far from being a market model, as the RE amount is politically decided and the certificate market price is also politically influenced. Table 3 summarises our conclusion.

The conclusion, therefore, is that it is time to find an RE governance model that addresses the specific needs and characteristics of RE technologies. The present analysis strongly indicates that a "political price-/amount market" model in this connection is far better than the "political quota-/certificate price market" model.

Furthermore, a common EU model, based on the principle of site efficiency, would be much more flexible, cheaper and easier to pursue than the "political quota-/certificate price market," or mono price model, which is designed for uranium and fossil fuel technologies and represents a governance model designed for the technologies of yesterday. ●