THE GREEN ELECTRICITY MARKET IN DENMARK:
QUOTAS, CERTIFICATES AND INTERNATIONAL TRADE

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Abstract: The presentation will focus on the Danish green electricity reforms as a means to reduce CO₂ in a cost-effective manner. The share of electricity produced from renewable energy sources shall be doubled to 20% by 2003. Each percentage point more green electricity reduces the CO₂-emission by approximately ½ percentage point.

Producers of renewable electricity (RE) will receive green certificates for the environmentally benign electricity delivered to the grid. The certificates are sold to the consumers on a national stock exchange. All consumers are obliged to purchase the certificates, as mandatory annual quotas for green electricity are imposed on all customers. The most cost-effective producers will automatically be awarded, demand and supply sets the price on the certificate market.

Large-scale producers, e.g. off-shore wind mill parks, central CHP on biomass, will be part of the certificate market. Open tenders will be undertaken for these large-scale RE-plants. The less mature technologies will be protected and gradually integrated into the certificate market. Denmark is among the first countries to adopt and implement a comprehensive certificate market. A number of other EU countries are preparing similar market reforms. International trade with certificates can exploit comparative resource advantages and lower costs, and a set of common rules is thus required and will be outlined.

Renewable electricity covers more than 10% of the Danish electricity consumption (excl. waste) and is a major means for CO₂-reduction. Denmark has no large hydropower, and renewable electricity (RE) has higher production costs than conventional electricity. Thus, Denmark has from the very start assigned priority to a cost-effective development of RE. Renewable electricity shall capture a rapidly growing market share during the next decades, and new cost-effective means will therefore be adopted. A so-called green certificate market will now enter force.

Firstly, the Danish targets for renewable energy and CO₂-reduction will be outlined, and the economic costs will be summarised. Secondly, the specific means adopted to pursue the targets, namely a green electricity market, will be elaborated upon. Thirdly, the possibility of international trade with RE-certificates will be discussed.
Danish targets for renewables

The present energy action plan, *Energy 21*, aims to reduce the national CO$_2$-emission by 20 pct. by year 2005 and 50 pct. by year 2030 as compared to the 1988 level. These ambitious targets will be pursued by two means: Firstly, substantial energy savings and increased energy efficiency shall take place. Secondly, the use of renewables shall increase sharply. In fact, coal shall be totally abolished as a fuel in Denmark and be replaced by renewable energy.

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<th>Danish Targets for Renewables</th>
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<td><strong>CO$_2$</strong></td>
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<td>• 20 % reduction from 1988 to 2005</td>
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<td>• 50 % reduction before 2030 (fix point)</td>
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<th>Renewable energy</th>
<th>Renewable electricity</th>
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<td>• (9 % by 1998)</td>
<td>- (10 % by 1998)</td>
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<td>• 12-14 % by 2005</td>
<td>- 20 % by 2003</td>
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<td>• 35 % by 2030</td>
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Thus, the utilisation of renewable energy in Denmark shall be raised from the present level of around 10 pct. to 12-14 pct. by 2005 and 35 pct. by the year 2030. This implies an increase in the use of renewables by almost 1 pct. per year till 2030 - a very ambitious goal indeed.

In March last year a specific target was adopted for renewable electricity (excl. waste and large hydro). The Electricity Reform Agreement stipulates that the contribution of green electricity shall be doubled to 20 pct. by 2003. As a thumb of rule it can be said, that when the consumption of green electricity increases by 1 pct.point, the national CO$_2$-emmission decreases by ½ pct.point. The types of renewables are especially wind power and biomass.
Total economic costs of renewable energy

Economic Costs of Renewable Energy and CO$_2$-abatement

- **RENEWABLE ENERGY:**
  Total extra cost for 1999-2010
  = 5% of total energy bill (200 mill. US$/year)

- **CO$_2$-REDUCTION**
  (renewables + energy efficiency):
  Total extra cost for 1999-2010
  = 8-10% of total energy bill (350-400 mill US$/year)

It is expected that the total extra costs for achieving the ambitious target for renewable energy in Energy 21 amount to 2.2 bill. US$ for the period of 1999-2010. Thus, 200 million US$ per year – including all kinds of capital costs and running costs (maintenance, salaries, etc.). This amount comprises 4-5 pct. of the total Danish energy costs. If renewables, energy savings and increased energy efficiency are included, the total costs range at 350-400 million US$ per year. Or 8-10 pct. of the total energy costs in Denmark - everything included.

However, the costs may exceed these cost-estimates, if cost-effectiveness is not promoted. Fixed feed-in tariffs have brought about an extensive deployment of renewable plants all over Denmark. But during the 1990’s, the technological developments lowered the actual production costs, and especially wind mills became over-subsidised, as the tariffs were not lowered accordingly. Therefore, to ensure cost-effectiveness, green market reforms has been adopted.

Green Electricity Market

On a green certificate market, the RE producer receives a market-determined premium in addition to the income from the sale of electricity. The RE producer sells electricity on the electricity market. All RE electricity has priority access to the grid. The utilities are obliged to receive and pay for the electricity. At the same time the RE producer receives green certificates in relation to the volume of electricity production. The green certificate is a financial security which, independent of the sale of electricity, can be sold on an exchange for trade in green certificates. Thus, the RE producer achieves a supplementary income for RE electricity.
Demand on the green certificate market is ensured by means of the quotas for purchase of RE electricity, which all electricity consumers must fulfil. Thus, annual quotas will be established so that 20% of electricity consumption in 2003 will be produced on the basis of RE (excl. waste and large hydro). The announcement of mandatory market shares for RE several years ahead is an incentive and a confidence building measure for the manufacturers of RE-equipment to promote new serial productions and development of new technical standards.

Two important main barriers must be noted. First, the price of electricity must be somewhat uniform. Otherwise, the value of a certificate differs from locality to locality. A common liberalised market for both electricity and green certificates is thus a pre-condition for a cost-effective market.

Second, a substantial market volume is required, if the transaction costs shall be acceptable. The running costs for an exchange, certification, quota control etc. amount to 1½-2 Million US$ per year. Therefore, the green certificate market in Denmark will not start before 2002, although the necessary administrative system for issue, registration, sale on the exchange and supervision of quotas can be established by 2001. 2002 forecast a market volume of 2.7 TWh.

Another competition-based system will promote large-scale parks. These types of RE, i.e. off-shore wind farms, may benefit from an open tender procedure, where the limited number of interested investors can bid at the same time and submit comparable offers according to pre-defined conditions. Certificates will also be given to these large-scale producers. The state decides scale and conditionalities, and suited RE-sites are appointed before the tender. Local acceptability will be promoted via local shareholding or ownership of adjacent parks.

### Danish RE-quota Market

- **Green certificate in stead of fixed subsidy**
- **Mandatory annual quotas for certificates**
- **National certificate exchange**
- **Revenue for RE-producer = electricity price + certificate price**
- **RE-plants installed voluntarily according to local needs and commercial opportunities**
Thus, the large-scale RE developments (offshore wind turbines and central biomass utilisation) will take place by central calls for tender. Small and medium scale straw- and wood-chip fired CHP plants, biogas, individually owned wind turbines etc. will be developed in a green certificate market where demand is regulated by stable, rising annual quotas with a point of departure in detailed prognoses and scenarios. The certificate market will have several frameworks that create stability.

**Tendering (quota) System**

- State decides scale and conditionalities
- Tender procedure suited for large-scale and capital intensive RE-parks and plants
- RE-sites appointed by central authorities
- Local acceptability ensured via shareholding or local ownership of adjacent parks etc.
- Revenue = Offered electricity price + certificate

Stable market infrastructure

A framework has been established for the certificates’ price fluctuation. The certificates have a minimum price of DKK 0.10 per kWh. This will take place by continuing the CO₂ tax refund for renewable energy, as RE is CO₂ neutral. There is also a maximum price. If consumers do not fulfil their quotas they will have to pay a tax of DKK 0.27 per kWh, which constitutes an indirect price ceiling. This price ceiling is identical to the present running cost subsidy, and the new premium in the form of certificates should at maximum be this amount – and preferably lower.

If the RE producer should want a fixed price for his certificates – between the minimum and the maximum price – this will also be possible. This central certificate exchange must offer long-term contracts. In contrast to the old system with administratively established feed-in tariffs, the exchange will offer market-determined long-term prices. Over-subsidisation can thus be avoided.
It is possible to utilise green certificates that have not yet been issued from coming years to fulfil the quota. Market disruption due to supply deficit in wind-weak years can thus be avoided. If future RE-supply is used to fulfil the annual quota, an annual interest of maybe 5 pct. more certificates will be added to the quota. Another flexibility measure is that quota fulfilment is calculated on 1 April in the subsequent year. Thus, green certificates from the first quarter of the coming year can form part of the quota fulfilment. Thus, the certificate market will be cost-effective, stable and with flexibility measures.

**Stable Market Infrastructure in DK**

- Certificate has min. and max. price
- Option for long-term contracts for certificates on national stock exchange
- Future certificates can be used to fulfil the annual quota (as the certificate supply fluctuates with strong or weak wind years etc.)

**Production of RE technologies that are not yet commercially mature**

The RE market will be so designed that the RE technologies that are not yet commercially mature (typically biogas and biomass gasification technologies) will not be outstripped by wind as a consequence of the short-term higher costs.

Market maturity of RE technologies can be organised by gradually phasing out the fixed electricity tariff for these plants. Or an additional electricity production subsidy per kWh could be granted to the less competitive biomass technologies. The size of this PSO-financed subsidy will be adjusted annually for new equipment in accordance with the technological progress.
Support for less matured RE technologies

- Gradual phase out of fixed tariffs or fixed subsidies per kWh
- Capital investment grants, R&D
- Stand alone wind mills and small hydro power plants (up till 25 kW) and all PV is exempted from the marked. A net-metering scheme or fixed tariff scheme is considered.

The very small-scale RE-plants, i.e. stand-alone wind mills and hydro plants below 25 kW and PV’s, may be supported by separate means. The transaction costs and administrative requirements to be involved in the market would typically disfavour this category of producers.

Gradual introduction of the RE market

Introductory scheme for new plants up to the end of 2002:

To ensure that the new investors have stable economic conditions until the market is fully developed and functional, guaranteed electricity prices will be used. The new plants, which are constructed before the end of 2002, will obtain a 10-year fixed feed-in tariff before the end of 2002. From 2003 they will go over to the market price of ordinary electricity.

Transition schemes for existing plants:

All existing RE plants will be ensured reasonable financial conditions. Special feed-in tariffs and terms have been established for these plants. Transition schemes for these plants are very detailed with a view to safeguarding reasonable and ‘just’ financial conditions for the many different types of plants and technologies.
Utility owned RE-plants:

All existing RE plants owned by the utilities will not be part of the certificate market, as they have received full been fully financed up front due to the previous special rules for utilities.

What is required of the internal EU market for green certificates?

An internal EU market for green certificates requires common rules.

Firstly, it should be possible to distinguish the different RE technologies from each another. Some countries do not define waste as RE. Other countries do not allocate certificates to electricity from large hydropower plants (typically over 10 MW) as these very profitable types of RE do not need premiums.

Secondly, the different countries’ subsidy scheme should be transparent and information about them generally available. If not the projects will compete on additional subsidy rather than inherent cost-effectiveness. Tax concessions will usually be a rather opaque form of subsidy as the individual producers often have different tax and depreciation conditions. Capital support and allocation of extra financial support per kWh (as a fixed subsidy pr. kWh or fixed electricity tariff) will be a more uniform and transparent form of support.

Thirdly, It should be guaranteed that Danish quotas are fulfilled by genuine growth in total RE electricity production. It should be possible to use foreign green certificates for quota fulfilment if they represent RE production that would not have taken place without the trade. This requires binding quotas in the country of trade. Therefore, fulfilment of the Danish
RE quotas should only take place with certificates from countries which also have quotas. Therefore, the same principle applies as regards CO₂-trade: imported CO₂-certificates can only be used for national CO₂-reduction, if the exporting country has a binding target for CO₂-reduction – the so-called Annex 1-countries. Or as CDM projects in other countries.

### International Certificate Market

- Common certification procedure
- Definition of RES (large hydro, waste)
- Transparency of national subsidies
- Quotas required if international trade
- Certification of origin: Country, producer, production date, RES-type, support pr. kWh, etc.

Fourthly, there should be common, minimum subsidy rules for RE technologies. A joint, lowest common denominator for, for instance, allocation of extra certificates or additional support per kWh, national quotas, the size of fines for failure to fulfil a quota, phasing out of transition and introductory rules etc. are necessary.

Fifthly, common rules should exist for approval of RE producers, registration of and trade in certificates, the period of validity of the certificates, public access to information about actual market prices etc.

A possible solution could be to allocate a special serial number to each certificate, which provides information about the country of origin of the RE electricity, producer, date of production, RE technology, support pr. kWh etc.

These and other clarifying questions are now appearing on the international agenda in step with the increasing spread of the quota certificate model. In the recent year the nature of the discussion has undergone a change from focusing on which model to how to implement the model. EU Commission will now issue a draft directive for RE electricity, which may be a driving force for a true international market for RE certificates.