Energy Conservation and Electricity Sector Liberalisation: towards a Green and Competitive Electricity Supply?

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Summary

Two fundamental trends determine the future of electricity sectors world-wide. On one hand liberalisation of the electricity sector is spurred by the aim to stimulate economic efficiency and to reduce electricity prices. On the other hand it is now increasingly realised that a stringent energy conservation policy is a prerequisite to mitigate adverse effects of global warming. Aim of the research project described in this thesis is to examine to what extent these two trends can be reconciled.

Energy conservation for that purpose is defined as *a reduction in the use of non-renewable primary-energy sources for electricity generation*. Based on that definition, three major fields of energy conservation in the electricity sector are identified. These are:

- End-user demand reduction and improved end-user energy efficiency;
- Increased use of renewable energy sources; and
- More efficient electricity generation with non-renewable primary-energy sources.

For each of these three broad areas of energy conservation in the electricity sector one case study is selected to be examined in detail. These are, respectively, the development of:

1. Demand-Side Management;
2. Wind Energy; and
3. Cogeneration.

In this project, the electricity sector structures of four countries are analysed: the Netherlands, Denmark, Germany and the United Kingdom. In addition, a comparison is made of the Dutch electricity and waste sector structures. Information is collected by way of literature study and interviews with electricity sector experts from utilities, Governments, non-governmental organisations, primary-energy suppliers, universities and research institutions.

Based on the empirical information collected, eleven key hypotheses on the relationship between energy conservation and electricity sector liberalisation are formulated (Table 1). These are subsequently presented to an international panel of twenty-four electricity sector experts who, in interviews and a questionnaire, are invited to give their opinion on the hypotheses. Results of this evaluation, together with the empirical information collected previously, are used as inputs for the final chapter in which all research results are integrated.

Table 1 Hypotheses on the Relationship between Electricity Sector Liberalisation and Energy Conservation

Cogeneration

1. 'The development of industrial and small-scale space heating cogeneration is stimulated by an organisational unbundling or by further liberalisation.'
2. 'If unbundling takes place *simultaneous* to the introduction of competition then industrial / small-scale space heating cogeneration could be expected to become a niche option rather than a dominant option for electricity generation.'
3. 'Unbundling *prior* to introduction of competition could particularly stimulate cogeneration development.'
4. 'District heating cogeneration is not likely to prosper in a liberalised situation without additional Governmental support.'

Wind Energy

5. 'In a liberalised situation, various regulatory support systems for wind energy and renewables can be maintained.'
6. 'Wind energy development is dependent on a regulatory support system rather than on the liberalisation process.'
7. 'Voluntary 'green electricity schemes' cannot replace regulatory support for wind energy and other renewables yet.'
8. 'Systems with a fixed remuneration for wind turbine investors so far are more effective in stimulating wind energy development than systems without such a fixed remuneration.'

Demand-Side Management

9. 'Demand-Side Management activities of utilities are dependent on the regulatory support system set up rather than on the liberalisation process.'
10. 'Integrated Resource Planning as an instrument to stimulate demand-side management is not likely to be fit for a liberalised situation.'
11. 'Commercial demand-side management and energy efficiency activities are not likely to be able to replace regulatory supported demand-side management activities in the near future.'

It is concluded that main incentives which determine attractiveness of cogeneration to investors are the existence of infrastructural networks and domestic resources, technological development, the rise of gas as a primary-energy source and environmental policies of Governments (Table 2).

A favourable heat-demand structure, the availability of district-heating and gas networks and the presence of domestic gas reserves are important prerequisites for cogeneration development. Decreasing scales and the rise of new technologies like the combined-cycle gas turbine are also found to play a role, as well as the rise of gas as a primary-energy source for electricity generation. In particular its substantially reduced price relative to other primary-energy sources due to diverse factors like decreasing world-market prices, direct policy support for domestic gas and gas sector liberalisation, as well as its low carbon- and sulphur-dioxide emissions contributed to the rise of gas in recent years.

Cogeneration development is also found to be substantially influenced by environmental policies of Governments. Measures like direct financial support in the form of investment subsidies, tax reductions and favourable loans, setting CO_2 reduction targets to utilities and end-users as well as the installation of independent organisations as 'brokers' for cogeneration projects support cogeneration development.

On the other hand, a reduced heat demand due to stricter policy-determined energy efficiency and insulation standards, although positive from an environmental point of view, provides a barrier to further cogeneration development. Another disincentive to cogeneration development, finally, is found in specific electricity sector regulation which impedes grid access of cogeneration plants, or due to which utilities can exert countervailing power to new generation capacity.

The research results suggest that electricity sector liberalisation is likely to have positive effects on industrial and small-scale cogeneration. Better conditions for grid access, more market parties offering cogeneration and a reduction of the countervailing power of existing parties holds promises for tailor-made applications of these flexible gas-based technologies.

Unbundling of utilities plays a particular role here. Although it is by itself probably not sufficient to stimulate cogeneration, a step-wise regulated liberalisation starting with unbundling may offer incentives which can direct the expected increase of new generation capacity after reorganisation into a cogeneration boom. In case of an introduction of competition simultaneous to unbundling, it is far more difficult to set limits to the kind of generation capacity to be constructed. The empirical evidence suggests that in the latter case in particular non-cogeneration gas-based power plants will be a very attractive option to investors.

Further development of district-heating cogeneration, on the other hand, is likely to remain predominantly dependent on Governmental

support. The large networks required make district-heating a relatively expensive and inflexible option. Although still often efficient from an energetic point of view, without additional long-term guarantees by Governments district-heating investments by market parties in a liberalised situation appear unlikely.

Table 2 Underlying Factors Cogeneration Development

Incentives
• *Existing Infrastructure and Resources*
- Heat Demand Structure
- District-Heating and Gas Networks
- Gas as a Domestic Primary Energy Source
• *Technological Development*
- New Technologies (e.g. 'Combined-Cycle Gas Turbines')
- Decreasing Scales of Cogeneration Plants
• *The Rise of Gas*
- Decreasing World-Market Prices
- Direct Policy Support for Domestic Gas
- Gas Sector Liberalisation
- Low (CO_2, SO_2) Emissions
• *Environmental Policies of Governments*
- Direct Financial Support for Cogeneration (investment subsidies, tax reductions, favourable loans)
- Cogeneration as a Means to Attain CO_2 Targets set to Utilities and End-users
- Installation of Independent Organisations as 'CHP Brokers'
Disincentives
• *Environmental Policies of Governments*
- Reduced Heat Demand due to Stricter Energy Efficiency and Insulation Standards
• *Sector Regulation*
- Limited Grid Access and Countervailing Power of Existing Utilities

Environmental policies of Governments, technological development and, to a lesser extent, voluntary support for wind energy by utilities are found to be key underlying factors for wind energy development in recent years (Table 3).

Table 3 Underlying Factors Wind Energy Development

Incentives
• *Environmental Policies of Governments*
- Direct Financial Support for Wind Energy
(investment subsidies, tax reductions, favourable loans)
- Subsidised kWh-Rates for Electricity fed into the Grid:
i. price-based systems
ii. quantity-based systems
• *Technological Development*
- Increasing Scales of Wind Turbines
• *Voluntary Support by Utilities*
- Motivated for Environmental or Commercial Reasons
Disincentives
• *Opposition to Wind Turbine Siting*
- Countervailing Power Exerted by Local Authorities, Citizens and NGO's
• *Sector Regulation*
- Opposition of Utilities to Price-Based Support Systems

Governments provide support to wind energy in the form of investment subsidies, tax reductions and favourable loans. A key component of support, however, are the subsidised rates for electricity from wind energy delivered to the grid.

Two different methods for providing this support are applied in practice. In the first, 'price based' system, a fixed kWh price to be paid by utilities to wind energy investors feeding electricity into the grid is set by way of Governmental decision or legislation. The quantity of renewable energy to be supported in this way depends on the number of investors and is not limited beforehand. In the 'quantity' based system on the other hand, the amount of renewable energy to be supported is preset via a Governmental target, whereas the price is determined by competition between renewable energy generators. Rapidly increasing

scales of wind turbines and voluntary support by utilities have also contributed to the rise of wind power in recent years.

Nevertheless, the position of utilities towards wind energy is ambivalent. In many cases utilities have also tried to hinder further development of wind power. Utility opposition to price-based support systems is particularly vehement. Another major disincentive to wind energy development found is the resistance of parties like local authorities, citizens and non-governmental organisations to the construction of wind turbines on specific sites.

Since wind power development is found to be mainly dependent on Governmental support, effects of liberalisation are expected to be limited. The rise of so-called 'green electricity schemes' set up by utilities is not considered to be able to replace policy support in the near future. Research in this thesis indicates that it is possible to maintain quantity-based as well as price-based support systems for wind energy and other renewables in a liberalised situation. The former kind of systems is generally considered more efficient from an economical point of view and, because of the price competition, regarded more suitable for a liberalised electricity sector. However, empirical evidence shows that the price-based systems so far have been far more successful in initialising and raising wind power industries.

Similar to wind energy, demand-side management development is found to be predominantly dependent on environmentally motivated Governmental support (Table 4).

Table 4 Underlying Factors Demand-Side Management Development

Incentives
• *Environmental Policies of Governments*
- Direct Support for Demand-Side Management
i. 'integrated resource planning'
ii. quantity-based systems
- Installation of an independent 'Energy Saving Trust'
- Equipment- and Installation-Standards
Disincentives
• *Sector Regulation*
- Demand Reduction conflicts with Profits of Utilities in Monopoly Situation

Two support systems are found in practice: 'integrated resource planning' and quantity-based systems. The first method obliges utilities to give a detailed account of demand reduction options for their area in so-called 'integrated resource plans'. In this system, no pre-set Governmental targets for demand-reduction are formulated. The starting point of the second method is exactly such a Governmental target set for demand-reduction activities to be carried out by utilities. These activities usually are to be financed by a levy charged to end-users. Additional support for demand-side management activities can be provided by the installation of an independent 'Energy Saving Trust', as well as by setting equipment- and installation standards at the end-user level.

On the other hand, a main disincentive to demand-side management found is its apparent conflict with profits of utilities. This holds particularly in a monopoly situation, in which there is no need for utilities to bind customers by value added services like energy efficiency. This conflict is compounded if large investments in generation capacity have to be recovered by integrated companies.

The effects of electricity sector liberalisation on demand-side management appear limited, as Governmental support is found to be the key underlying factor. The level of commercial activities developed so far is found way too low to replace Governmental support if targets set are to be attained. In addition, if prices fall after liberalisation end-user demand for energy efficiency could be expected to drop as well. It is furthermore argued that a system of integrated resource planning on a national level is not likely to be compatible with a liberalised electricity sector.

In Table 5, the likely effects of electricity sector liberalisation on energy conservation based on this research project are summarised. Main positive effects of liberalisation expected are the increased dynamics, which will provide opportunities to new parties and reduce countervailing power of existing parties. This will improve in particular chances of technologies like industrial and small-scale cogeneration, which are close to competitive with conventional options. The improved market- and grid access will also give better chances to innovative suppliers of energy conservation options like cogeneration, wind energy or demand-side management and energy efficiency. Liberalisation will also focus attention on customer demands, which could lead to an increase of energy services currently provided such as green electricity schemes or energy efficiency activities.

On the other hand, electricity sector liberalisation is likely to lead to an increased focus on short-term profits, which will negatively affect

long-term solutions such as district-heating. The possible drop of electricity prices after liberalisation could also endanger the future competitive position of renewables, and reduce attention of end-users for energy efficiency and demand-reduction options.

Table 5 Main Effects of Electricity Sector Liberalisation on Energy Conservation

Main Positive Effects
• *A More Dynamic Situation*
- More Parties, Less Countervailing Power of Existing Parties: Better Chances for e.g. Industrial and Small-Scale Cogeneration
• *Better Market- and Grid Access*
- Better Chances for Innovative Suppliers of Cogeneration, Renewables and Energy Efficiency
• *More Attention to Customer Demands*
- Development of Energy Services, e.g. Green Electricity Schemes and Commercial Energy Efficiency
Main Negative Effects
• *More Attention to Short-Term*
- Fewer Chances for Long-Term Solutions like District-Heating
• *Possible Drop of Electricity Prices*
- Competitive Position of Renewables Endangered, Less Attention of End-Users to Energy Efficiency

Hence, electricity sector liberalisation is likely to have positive as well as negative effects on energy conservation. More important, however, appears the way liberalisation and the accompanying regulation are implemented. In this respect, two conclusions of the research project deserve are particularly relevant. Research has shown:

- the benefits of a step-wise regulated liberalisation process, and in particular an organisational unbundling of utilities prior to the introduction of competition, to the development of cogeneration;
- the benefits of renewable energy support systems based on a fixed price per kWh, which have, despite their claimed economic inefficiency, shown to be very effective in creating an initial wind energy market.

Market-based energy conservation initiatives are concluded to be able to support, rather than to replace, Governmental support in a

future liberalised electricity sector. Close monitoring of these activities is therefore recommended. Without such monitoring, fine-tuned regulation, and the intention of Governments to stimulate energy conservation activities where necessary it is concluded that attainment of present energy conservation targets set is far from likely in a future liberalised electricity sector.