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

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2. Method

The research method used in this thesis is a comparative multiple case study. A qualitative assessment and comparison of national electricity sectors in the Netherlands, Denmark, Germany and the United Kingdom is made. Furthermore, the organisational structure of the Dutch electricity and waste sector are compared. It is assumed that differences in organisational structure of an electricity sector will be reflected in different performances regarding the energy conservation case studies selected.

Based on the empirical research, hypotheses on the relationship between energy conservation and electricity sector liberalisation are formulated. In the final stage of the research project these are evaluated by an international panel of electricity sector experts.

The core methodological issues of the research design are discussed in this chapter. It starts with an elaboration of the concepts 'energy conservation' and 'electricity sector liberalisation' as used in this project. Subsequently, the selection of countries to be studied, ways of data collection, the case study protocols developed and the evaluation method are discussed. Finally, the scope and limitations of the research project are outlined.

Energy Conservation

Energy conservation in practice is a rather ill-defined term. In a narrow interpretation, it is often used to denote measures that are directed at saving energy at the end-user level only. In this project, however, a much broader interpretation is adopted. In order to be able to examine not only demand-side effects of organisational changes in the electricity sector, but to take into account possible supply-side effects as well, energy conservation in this project is defined as *a reduction in the use of non-renewable primary-energy sources for electricity generation*.

With this definition, three major fields of energy conservation in the electricity sector can be identified:

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

Each of these individual fields of energy conservation in turn consists of a huge range of individual options. Therefore, for each of the three energy conservation areas one case study is selected to be studied in more detail.

These are, respectively, the development of:

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

Reason for selection of these cases is, apart from their apparently promising perspectives as energy conservation options at the time of starting this research project, their relevance to the Dutch situation: the Netherlands serve as a 'base case' for the other country studies.

Demand-Side Management activities in this dissertation are defined as *activities of organisations in the electricity sector directed at improving end-user energy efficiency and reducing end-user demand for electricity*. Despite their secondary environmental benefits, so-called 'peak-shift' activities of utilities - which concentrate on the influencing the time of electricity demand rather than reducing it - are not included in this definition. As the economic interest of utilities in the latter kind of activities is assumed obvious, attention focuses on incentives for utilities and other organisations to engage in a reduction, rather than in a shift in time of demand.

In the cogeneration case study, three kinds of cogeneration are distinguished: 1) *district-heating* cogeneration, which is directed at space-heating of districts of cities or villages and usually requires large external pipeline networks; 2) *industrial* cogeneration, of which the main purpose is to produce heat required in industrial processes; and 3) *small-scale* cogeneration, which is generally used for space heating of individual objects like greenhouses, hospitals or office buildings.

Although this categorisation turned out useful for research purposes, in practice the difference between district-heating and small-scale cogeneration is blurred. In Denmark in particular 'small-scale cogeneration' is also used as a term for space-heating of villages, as opposed to district-heating of towns. In order to fit with this national context, in the discussion of the Danish electricity sector in Chapter 4 the latter interpretation has been followed. For the understanding of the overall analysis in this dissertation, however, it has to be kept in mind that space-heating of villages, under the definition given above, has to be regarded as district-heating.

Electricity Sector Liberalisation

The process of electricity sector liberalisation in theory consists of at least two steps: 1) an administrative unbundling of business processes in the electricity sector which are related to the electricity grid from those who are not; and 2) the introduction of competition for those business processes which are not directly related to the grid. This means that, whereas high-voltage *transmission* and low-voltage *distribution* of electricity as grid-related functions remain a monopoly, competition is introduced in *generation* and end-user *supply* of electricity.

In practice however, the liberalisation process consists of a far more complex interaction of regulation and primary and secondary organisational changes which go way beyond the minimum requirements for liberalisation set out above. Examples of organisational changes that have already occurred in some countries in the light of the liberalisation process include a privatisation of formerly state owned utilities; a complete organisational unbundling of generation, transmission, distribution and supply of electricity; a re-integration of formerly 'vertically' unbundled utilities; mergers; and foreign take-overs of utilities.

Furthermore, some utilities - which are said to be 'horizontally' integrated - now combine electricity supply activities with gas and water supply, telecom, cable-tv and waste management activities. Completely new parties like primary-energy suppliers, independent power producers or energy service companies have appeared on the market. In addition, liberalisation of electricity sectors in the European Union involves a transition from a former national scale of electricity sectors to a single European market.

In order to provide a basic framework to study these organisational changes, in this project a simple actor network was developed. Central to this network are the utilities, which are seen here as 'organisations with as principal business aim generation, transmission, distribution or supply of electricity'.

Three main groups of actors are identified which in all countries influence the position of utilities externally. These are respectively policy makers, end-users and primary-energy suppliers (Figure 2.1).

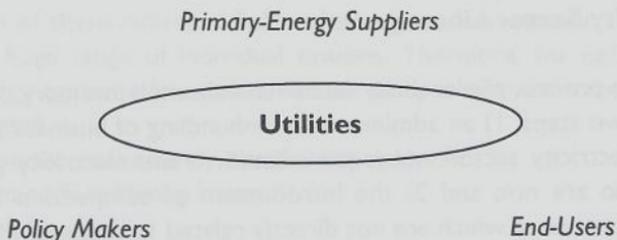


Figure 2.1 External Dynamics of the Electricity Sector

The organisational changes within the electricity sector as a result of the liberalisation process are allocated to three main categories (Figure 2.2):

- Changes in *vertical structure* of the electricity supply system. These in practice vary between a simple administrative separation and a complete organisational unbundling of generation, transmission, distribution and end-user supply of electricity;
- Changes in *market structure* of the electricity sector. In particular, these include the introduction of competition in electricity generation and end-user supply in former monopoly-based sectors.
- Changes in *ownership* of utilities. This generally amounts to a privatisation of formerly publicly owned utilities.

These categories of organisational changes are identified with the understanding that they obviously cannot reflect all organisational changes in electricity sectors that have taken place in recent years. Neither do the three categories of actors which are identified besides utilities represent a complete actor network of the electricity sector. Their purpose simply is to provide a basic means to categorise data in the case studies. Where other categories of actors show important, or other organisational changes are relevant to explain developments in the case studies, these are taken into account as well.

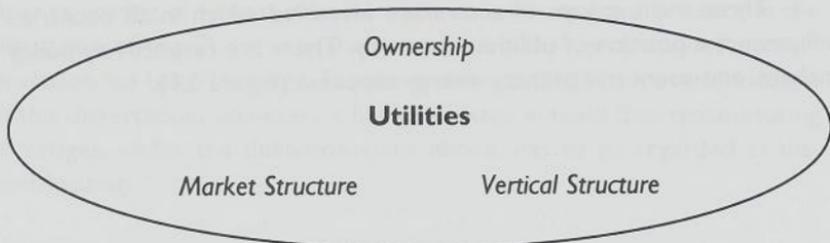


Figure 2.2 Internal Dynamics of the Electricity Sector

Country Selection

The selection of countries to be examined apart from the Netherlands is based on three general criteria:

1. There should be a variation in electricity sector structures concerning the operational variables vertical structure, market structure and ownership. On the other hand, countries should not be too different economically, culturally or geographically from the Netherlands;
2. There should be significant cogeneration, wind energy and demand-side management developments in each country to be studied; and
3. Practical collection of information should not be regarded too difficult beforehand - referring particularly to practical constraints such as languages spoken in a country as well as restrictions put to distances to be travelled by the research budget.

Based on a quick-scan of OECD countries (IEA, 1994), Denmark, Germany and the United Kingdom were selected as countries to be studied in more detail. In all three selected countries, substantial cogeneration, wind energy and demand-side management activities were found. Furthermore, these countries showed a large variation in electricity sector structures in terms of the analytical variables identified (Table 2.1). Nevertheless it was found impossible to select countries which in practice exactly fitted the analytical dichotomies of unbundled/integrated, monopoly/competition and public/private.

Inclusion of the United Kingdom in particular was regarded important, as this was the only country which fitted the criteria for all three energy conservation options, and simultaneously had a largely competitive electricity sector in 1994 already.

Table 2.1 Electricity Sector Structures in 1994, as found in quick-scan for selection of case study countries (adapted from IEA, 1994)

	<i>Vertical Structure</i>	<i>Market Structure</i>	<i>Ownership</i>
<i>Netherlands</i>	Unbundled	Monopoly	Public
<i>Denmark</i>	Practical integration	Monopoly	Public
<i>Germany</i>	Mixed	Monopoly	Mixed
<i>United Kingdom</i>	Unbundled	Mainly competitive	Mainly private

The structures of the Dutch waste and electricity sector are furthermore compared in this project to allow for an exchange of data with the concurrent research project in the research programme (Jong, 1999). From a theoretical point of view, the waste sector shares with the electricity sector the organisational problem of having to provide a reliable service against as low as possible costs, whereas simultaneously a reduced use of waste treatment facilities would be desirable for environmental reasons.

Data Collection

The case studies in this project are conducted conform a methodology described by Yin (1994). Empirical data are collected by literature and document search, followed by interviews with researchers, policy makers, utility employees and non-governmental organisations in each country. The interviews are used for two purposes: to check validity of the data previously obtained and to gain additional information.

Two separate research protocols are developed in the project: one for the country studies, and another one for the comparison of the waste and electricity sector.

The country study protocol (Table 2.2) was developed after examination of the Dutch electricity sector structure and is used for all other country studies, including the country comparison in Chapter 8. As all country studies are individually published, each starts with a general outline of the main research question in this project and its background. Subsequently, an overview of the electricity sector structure is given, followed by the individual case studies. The order of these case studies in practice varies, depending on which results are regarded most conclusive.

Within each of the three case studies per country, first an examination of recent developments is made. In the cogeneration and wind energy case studies, for recent years a time-series analysis in terms of installed capacity in MW per year is made. As such a quantitative overview of developments cannot be given in the demand-side management case, exploration of developments is qualitative there.

After this introduction to case study developments, their relative degree of 'success' is assessed based on a comparison with developments in the other three countries examined, and on a comparison with events world-wide. In addition, the success of a development is measured against the policy targets set in a country.

Table 2.2 Country Study Protocol

1. Introduction

Outline of the main research question and its background: 'What is the relationship between energy conservation and electricity sector liberalisation?'.

2. General Overview of the Electricity Sector

Description of the existing electricity sector structure and recent developments. Particular attention is paid to changes in vertical structure, market structure and ownership of utilities and to the position of policy makers, end-users and primary-energy suppliers.

3. Case Studies: Demand-Side Management, Wind Energy and Cogeneration

- *Development.* Exploration of developments for each case study in the country examined.
- *Assessment of 'success'.* Normative decision as to the relative degree of 'success' of developments in a case study.
- *Underlying factors.* Establishment of key underlying factors for the case study development by way of literature study and interviews.
- *Link to the liberalisation process.* Discussion of the link between case study developments and the analytical variables of the liberalisation process identified previously.

4. Conclusions and Recommendations

Analysis of what overall conclusions can be drawn regarding the main research question if the results of all three case studies are regarded.

In the third stage of the case study analysis, it is tried to identify underlying factors for the developments by way of literature study and interviews: if so, why is a particular development successful? Previous analyses of other researchers are also used in this phase if these are available. Interviews are used to check the validity of the information gained previously, and to collect additional information.

Subsequently, a discussion is provided as to what extent underlying factors of case study developments can be linked to the liberalisation process. In particular, it is tried to link the underlying factors for developments by way of an argumentation with the liberalisation factors vertical structure, market structure and ownership.

Finally, an overall assessment is made of what conclusions can be drawn taking the results of the three case studies together. In the chapters on the Netherlands, Denmark and Germany recommendations are given applying the results to the Dutch context. With information from more countries becoming available, in the later stages of the research project more general recommendations beyond the context of individual countries are provided. The chapters on the United Kingdom and the overall country comparison reflect the latter approach.

For the comparison of waste and electricity sector, a separate research protocol was developed (Table 2.3).

Table 2.3 Protocol for Comparison of Waste and Electricity Sector

1. Introduction

Outline of the main research question and its background.

2. Overview of Dutch Electricity and Waste Sector

Comparison of the organisational structure of the electricity and waste sector. Identification of shared impediments to source reduction initiatives by organisations in the waste and electricity sector.

3. Hypothetical Intervention

Proposal of a hypothetical organisational intervention that could counteract the key organisational impediments to source reduction initiatives found.

4. Discussion and Conclusions

Evaluation of the feasibility of the proposed organisational model.

After introduction to the main research question of the project, an overview of the Dutch waste and electricity sector is provided. As a guideline, similarities in vertical structure between the two sectors are used. It is argued that the electricity and waste sector share two fundamental impediments to source reduction initiatives by organisations in these sectors:

- Profits of organisations in the waste and electricity sector are linked to the quantity of waste and electricity handled by them. Source reduction initiatives are therefore generally directly counterproductive to the economic performance of these organisations;

- Vertical integration between organisations in both sectors compounds this impediment, since electricity generators and waste incinerators as organisations with high initial investment costs are more in need of a constant waste flow and electricity production than other organisations.

In a final stage of the analysis, a hypothetical organisational intervention is proposed aiming to remove the constraints found. The feasibility of the proposed intervention is evaluated based on three criteria: effectiveness - does the proposed intervention result in an incentive for demand reduction? economic efficiency - does it entail excessive costs? and reliability - does it interfere with the reliability of service provided?

Evaluation

Based on the empirical research, hypotheses on the relationship between energy conservation and electricity sector liberalisation are formulated. The validity of these hypotheses is subsequently evaluated by a panel of Dutch and international electricity sector experts. Policy makers, utility employees, researchers and persons working at non-governmental organisations as experts in the Netherlands are interviewed in person, whereas a parallel questionnaire is sent to a similar group of experts in other countries. Results of this evaluation are discussed in Chapter 9.

Scope and Limitations

Two major limitations of the project are apparent. In the first place, the project represents a 'snapshot' in time of liberalisation developments and their link to energy conservation. This snapshot is taken in the period 1994-98. As empirical information varies over time, and the pace of organisational changes in electricity sectors seems to be still increasing, this information surely will become outdated.

However, the relevance of the project has to be found particularly in that a relatively early picture is obtained of developments which are likely to be of crucial importance for the development of electricity sectors in the decades to come. An attempt is made here to assess the meaning of these developments and their relationship to each other.

A second limitation of the project is that of external validity of analyses from individual case studies. Only four countries are examined, in each country only three energy conservation options are analysed, and a limited number of key organisational variables is identified. As marked in Chapter 6 however: 'in every country there are specific variables - such as geographical position, overall industry structure and availability of primary-energy sources - which to a substantial extent set the borders for the organisational development of a national electricity supply system. Wider cultural and political factors, which are difficult to trace within the limited context of a study focusing on electricity sectors, also play a role'. Care should therefore be taken when trying to apply results to other situations.

Nevertheless it is held that the analyses in this thesis reveal patterns and trends of a general character that makes them relevant to other situations and countries as well. Hence, within the limitations identified, the scope of this project is to provide an insight into some important energy conservation developments in recent years, to examine underlying factors for these developments and to analyse their link to the liberalisation process. Goal is to reveal general trends and patterns which are important to in particular policy makers wishing to reconcile energy conservation and electricity sector liberalisation in the future.

Literature

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