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ENERGY POLICY FRAMEWORK DEVELOPMENTS IN INDUSTRIALISED COUNTRIES

Some observations on the relevancy for China

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Abstract

This study focuses on recent developments in the industrialised countries, in particular in Europe, that may have relevancy for energy policy formulation in China. At the request of the study commission special attention is paid to:

- Institutional aspects of energy policy design and implementation.
- Liberalisation in the power subsector.
- Experiences with restructuring the coal subsector.
- Regulatory reforms and liberalisation in the gas subsector.
- New policy approaches towards stimulating the commercialisation of renewable sources of energy.

CONTENTS

LIST OF ABBREVIATIONS AND ACRONYMS

APX	Amsterdam Power Exchange
CEC	Commission of the European Communities
CGEB	Central Electricity Generating Board (UK)
CHP	Co-generation of Heat and Power
CPUC	California Power Utilities commission
CRE	Energy Regulation Commission (France)
DSO	Distribution system Operator
EDF	Electricité de France
EEG	Renewable Energy Act (Germany)
EEX	European Energy Exchange
EU	European Union
FERC	Federal Energy Regulatory Commission
IPP	Independent Power Producer
ISO	Independent System Operator
KWKG	Co-generation of Heat and Power Act (Germany)
LPX	Leipzig Power Exchange
NETA	New Electricity Trading Arrangements (UK)
NFFO	Non-Fossil Fuel Obligation
NFPA	Non-Fossil Purchasing Agency
NGC	National Grid Company (UK)
nTPA	negotiated Third Party Access
OFGEM	Office of Gas and Electricity Markets (UK)
PG&E	Pacific Gas and Electricity (California)
PX	California Power Exchanges
RE	Renewable Energy
REB	Regulatory Energy Tax
REC	Regional Electricity Company
rTPA	regulated Third Party Access
SCE	Southern California Edison
SO	System Operator
TSO	Transmission System Operator

SUMMARY

Since more than two decades, the Chinese government is guiding a process of gradually introducing more market-oriented policies. China's imminent accession to the World Trade Organisation has speeded up this process. During the preparation of the 10th Five-Year Development Plan for the energy sector, the question arose as to whether recent developments in the energy sector in the industrialised countries, especially in Europe, may provide useful insights into the future policy options for the Chinese energy sector for further consideration. Therefore, ECN has been requested to provide a broad overview of recent major developments in the energy sectors of industrialised countries based on some specific questions outlined by the Energy Research Institute (ERI) of the State Development Planning Commission (SDPC). This report compiles contributions prepared by ECN - presented at a workshop on 10 November, 2000, in Beijing, hosted by ERI - and provides further references.

China's impending accession to the WTO will further highlight the urgency of both long-term cost competitiveness of energy services and energy supply security. *Social sustainability* raises the issue that with phasing out less competitive or environmentally harmful sources of energy supply, many jobs in the affected energy subsectors -especially in China's coal industry - may hang in the balance. The challenge is how the macroeconomic benefits of rationalising the energy industries can be channelled into boosting alternative economic activities in adversely affected areas and how to raise the qualifications of the labour force that has become idle as a result of the energy supply transition.

Environmental sustainability issues relate to ways to internalise local (and regional), and global external environmental costs and benefits into the decision-making processes in China. This might be achieved by market-oriented (pricing) or by command and control instruments (e.g. mandatory energy efficiency and environmental standards, mandatory shares for e.g. clean coal, gas or renewables).

This report shows that policy responses in the industrialised countries to issues related to social and environmental sustainability in the energy sector have been quite diverse. One point in case is constituted by the differences in government involvement in the energy sector and the institutional setting of this involvement. In most OECD countries, a single unit within a Ministry with wide responsibilities for economic and industrial policy is responsible for formulating energy policy. Yet the extent to which non-government institutions are responsible for implementation varies considerably between countries. In the EU, involvement of the European Commission in energy matters has grown considerably over the past decades. Not unlike in China, in the EU the rising prominence of environmental issues on the political agenda provided a rationale for increasing involvement at a centralised, European-wide level.

The three major issues in the energy policy area of the OECD countries over the past 10 years have been:

1. *Energy security*. The energy policy focus has been put on diversification of energy supply sources and, in particular, on the development of domestic sources of energy and on enhancing energy efficiency.
2. *Economic efficiency*. The focus is on liberalisation (with the public sector more and more in the role of decisionmaker and enforcer of 'the rules of the game' rather than as player) and introduction of regulatory frameworks that foster competition among energy suppliers. This includes the ongoing 'unbundling' of actors on the electricity and gas markets into producers, network operators (mostly public agencies), and whosal-

ers/retailers. In the electricity subsector, a notable recent development is the emergence of power exchanges.

3. *Protection of the environment*. In addition to local and regional air pollution control, increasing attention is being paid to the Climate Change issue. Notable recent developments in the power subsector - initiated in the United States and the Netherlands respectively - are emission trading (SO_2 and NO_x) and the introduction of administrative systems to enable a mandatory (minimum) share for renewables-based power supply.

In the coal subsector, social issues have dominated the focus of policymakers in Europe. In the U.K., high-cost coalmines have been closed at a high social price in the form of chronic unemployment in traditional coal mining areas, whereas in Germany high coal subsidies have retarded the decline in the mining of high-cost coal. At present, as a result of mounting environmental pressures and intervention by the European Commission also the German coal subsector is undergoing a - socially tough - transition process towards economic rationalisation. European experiences show that economic reforms in the coal sector have to be accompanied by well-designed and integrated regional policies to offset its adverse social impacts.

1. INTRODUCTION

1.1 Study background

The extent to which China will achieve sustainable development of the national energy sector is a crucial contingency for the realisation of the country's wider socio-economic development objectives.

Energy should be country-wide available at internationally competitive cost levels, while the environmental and social impacts of energy supply and use should be acceptable, in accordance with standards and objectives set by the Government of China.

For preparing China's energy policy it might be expedient to consider experience gained with energy policy making of the industrialised - that is, economically advanced - countries and to reflect on the extent to which this experience is relevant for future energy policy making in China. China constitutes a very special case in terms of sheer size of the country, its cultural-historic heritage and resource endowments. The appropriateness of copying of success show-cases elsewhere and possible adaptations should therefore be prudently weighed.

1.2 Study objectives and approach

The present study sets out:

- to concisely explain the way energy policies in (a selection of) industrialised countries are prepared and implemented,
- to identify and provide information on energy policy approaches, policy instruments in the industrialised countries that have met a fair amount of success in meeting their set objectives,
- to assess the extent the energy policy experiences gained in the study countries are relevant for China's energy policy making process,
- to give special attention to the issue of how the socio-economic, social and environmental sustainability of energy supply and use in China can be enhanced.

The study scope as such is quite wide. Given the available time and resource constraints, this study has a scoping character without going into many details. The main aim of this study is to signal successful policy approaches elsewhere that may be eligible for application in China with adjustment to the specific Chinese economic and energy situation. For more details on energy policy options discussed in this report, some useful references are given.

Most attention will be paid to energy policy making in the EU and some EU member states, but also the energy policy of the US and Japan will get some attention. Aspects with regard to energy policy making include:

- the institutional setting for policy formulation, policy implementation, monitoring and evaluation,
- the choice of policy instruments,
- programmes and their effectiveness.

Both the sector-wide and subsector energy policy levels will be considered. At the request of the project steering committee special attention will be given to the subsectors: power, coal, gas, and renewables.

2. ENERGY IN CHINA: SOME RECENT DEVELOPMENTS AND POLICY ISSUES

2.1 Introduction

This chapter provides a brief overview of the some key aspects of the Chinese energy sector and some main energy policy issues that the Chinese government will have to address. This will set the stage for a scan, in the next two chapters, of experiences gained in industrialised countries with energy policy making at sector and subsector levels. The thrust of this chapter is to provide some background - without going into details - to major energy policy issues in present-day China.

The main features of the Chinese energy system and the Chinese energy policy framework are sketched in Sections 2.2 and 2.3 respectively. Section 2.4, the final section of this chapter presents some major energy policy issues, the Chinese government are faced with.

2.2 Profile of the Chinese energy sector

With a population of nearly 1.26 billion (1999 end-year estimate), China is the world's most populous country accounting for approximately 20 % of the world's population. According to World Bank sources, China's per capita GNP in 1998 amounted to 750 USD. This compares to a per capita GNP level of 990 USD for the East Asia & Pacific region and 520 for the World Bank category of 'low-income developing countries'. Starting out from a very low base, since the introduction of the 'Open Doors' policy in 1978, China has witnessed an era of unparalleled economic growth (annual economic growth rates of typically between 8 and 14 % per year) with commensurate great strides in improving general standards of living and poverty eradication.

The Chinese economy is presently recovering from a remarkably mild backlash of the East Asian Economic Crisis in 1997-98. Annual economic growth rates decelerated to 7.8 and 7.3 percent in 1998 and 1999 respectively. The economy has to cope with the implications of ongoing restructuring of the State Owned Enterprises (SOEs) and the banking sector as well as increasing regional disparities. Greatly increased uncertainties in the life of the Chinese people translated into sluggish spending. The Chinese government has reacted swiftly with the implementation of massive infrastructure works and further economic reforms. This - helped by an export boom along with recently more favourably exchange rate developments - has put the Chinese economy back on the fast growth track with the economic growth currently topping the 8% per annum mark. Besides high economic growth, reducing regional imbalances is a top priority on the economic policy agenda of the Chinese government. Especially raising living standards in the countryside and western China is a problem receiving much policy attention.

Final energy demand in 1997 amounted to 808 MTOE, accounting for 12.1% of the world total (IEA, 1999b). Quite remarkably compared to most other developing countries, energy demand in China has grown much slower than the growth of the economy. Over the period 1981-1995 energy demand grew by slightly more than 5 % against 9 % growth of GDP according to official figures, with energy intensity decreasing by 5.6% per year. Even if a purchasing power parity adjustment to GDP is made, the decrease in energy intensity in the period 1981-95 (3.4% per year) remains impressive (IEA, 1998b).

In 1997, the breakdown of final energy demand over main final demand categories was:

- Industry sector: 42.5 %
- Transport sector: 8.8%
- Residential: 36.8%
- Other: 11.9%.

The IEA (IEA, 1998b) assumes that economic growth in China will somewhat slow down and projects energy demand in China to grow over the period 1995-2020 by 3.5%**.** The present share of the transportation sector in final energy consumption is quite low by international comparison. During the period 1995-2020, especially energy demand in the transportation sector is projected to grow relatively fast (by 4.8%).

Coal is the major domestic energy resource of China. Coal reserves at the end of 1997 were estimated at 114.5 billion tonnes or 57.2 billion TOE. This compares to oil and gas reserves of 3.3 billion TOE and 1.1 billion TOE respectively (IEA, 1999a). Most coal reserves are in Northwest and North China, quite far from the major energy demand areas (in the Eastern and Southern coastal areas and the Jangtse river basin).

China is a (relatively modest) net exporter of coal. Recently China has become an importer of oil in 1966 and the reliance on the international oil markets is expected to grow importantly. In 1999 China imported 43.8 milli0on tonnes of oil, covering 21.5% of China's domestic requirements. As for gas, China consumed and produced about 0.78 trillion cubic feet in 1998. Although currently being virtually self-sufficient in gas, China is expected to become a net importer of major importance. The expected growing dependence on international oil and gas markets increases the significance of energy supply security issues. In 1999 total (public) electricity generation in China amounted to 1,098 billion kWh, of which 80.4%, 18.4% and 1.2% based on fossil fuels (coal), hydropower and nuclear power respectively:
(www.eia.doe.gov/emeu/cabs/china).

Total primary energy supply (TPES) in 1997 amounted to 1099 MTOE (IEA, 1999b). The shares of coal, oil, gas, nuclear, hydro power and biomass residues in TPES in year 1997 are: 59.9%, 17.6%, 1.7%, 0.3%, 1.5%, and 19.0% respectively. Excluding (non-commercial) biomass residues, the share of coal boils down to 74%. Hence, a foremost feature of the Chinese energy economy is its dependence on (domestically produced) coal. The dominance of coal in the Chinese energy economy has major environmental impacts at local, regional and global levels.

2.3 Institutional framework

The institutional framework for energy policy making and implementation in China is quite complex. Some main characteristics follow hereafter. Two institutions at central government level of overriding importance are the State Development Planning Commission (SDPC) and the State Economic and Trade Commission (SETC) responsible for, among others, planning, appraising and approving large investments in the energy sector (SDPC) and operational and regulatory matters in the energy sector, especially the power sector (SETC). Both SETC and SDPC report directly to the highest government body, the State Council. The Ministry of Science and Technology (MoST), plays an important role in the organisation of energy technology research.

The China National Coal Industry Import Export Corporation (CNCIEC) is the major body for (licensing) import and export of coal and coal-related technology (IEA, 1999b).

In 1998, the Chinese government reorganised most state owned oil and gas assets into two vertically integrated firms, the China National Petroleum Corporation (CNPC) and the China Pet-

rochemical Corporation (Sinopec). CNPC is currently mainly active in north and west China, while Sinopec's activity base is mainly in southern China. CNPC holds significant oil concessions abroad (i.e. in Kazakhstan, Venezuela, Iraq, Sudan and Peru). Another important corporation for offshore production activities is the China National Offshore Oil Corporation (CNOOC). The still modest role of natural gas in the Chinese energy economy is expected to grow rapidly. China is rapidly expanding its gas infrastructure, that will enable China to increase domestic production and (embark on) imports, by pipeline or ship (LNG). Currently a 4300 km long pipeline project has been approved to supply gas to Yangtse River Delta Region, including Shanghai Municipality, Zhejiang and Jiangsu Provinces originating from Xinjiang. CNPC is seeking foreign investment in this project. China is expected to be connected to the Russian gas pipeline system in Siberia. Major coastal cities in the east and south (Tianjin, Shanghai, Guangzhou) are expected to get access to gas from proximate offshore fields or from LNG terminals. In Guandong province, an LNG project is already under construction (www.eia.doe.gov/emeu/cabs/china).

SETC is the supervisory and legislative government authority for the power sector. The most important nation-wide operator in the Chinese power is the State Power Corporation (SPC), an independent company. The responsibilities of the erstwhile Ministry of Electric Power have been separately assumed by SPC and the Electric Power Department of SETC. The provincial power corporations are answerable to the SPC. There are five regional power transmission and distribution companies in China. At the provincial level, many provinces and autonomous regions have their own distribution utility.

2.4 Some major policy issues

China is a developing country. The principal long term goals for China are to develop the economy and to improve living standards. The target is to increase China's per capita income up to the level of the group of medium developed countries by the year 2050, but with much lower per capita energy consumption compared to the developed countries. To ensure a reliable, sufficient and efficient supply of energy will be a major task of the Chinese government. In 1994, the Chinese government published the 'Chinese Agenda 21', putting forward concrete programs for sustainable development of the society, economy and the environment Sustainable energy development is one of the major components of the Agenda.

In the Ninth Five Year Development (1996-2000) energy efficiency improvement, notably in energy-intensive industries, and technological upgrading of the coal and electric power subsectors were given prominent attention. Within the power sector much more emphasis should be put on coal cleaning technology and developing mines in Shanxi, Shaanxi, and Inner Mongolia. As for electric power, more reliance on mini-mouth power stations in combination with extra-high voltage emission lines should be obtained. Environmental considerations prompted emphasis on flue gas desulphurisation and development of renewable energy based power (wind power, marine energy, geothermal). Urban households should increasingly rely on the use of gas.

Faced with daunting environmental problems, the call for changing the energy mix away from coal - especially high-sulphur coal - is becoming stronger by the day. On the other hand, at the present energy pricing practices, China only disposes of large quantities of relatively low-cost energy sources in the form of coal. And even that would be the case to a much lesser extent if the full environmental costs were to be properly factored in. These issues raise the problem of how to diversify the energy supply mix in such a way that both average energy unit costs can remain within internationally competitive levels without jeopardising energy supply security.

China's impending accession to the WTO will further highlight the urgency of both long-term cost competitiveness of energy services and energy supply security. *Social sustainability* raises

the issue that with phasing out less competitive or environmentally harmful sources of energy supply, many jobs in the affected energy subsectors may hang in the balance. The challenge is how the macroeconomic benefits of rationalising the energy industries can be channelled into boosting alternative economic activities in adversely affected areas and how to raise the qualifications of the labour force that has become idle as a result of the energy supply transition.

Environmental sustainability issues relate to ways to internalise local (and regional), and global external environmental costs and benefits into the decision making processes of the myriad of economic actors in China. This might be achieved by market-oriented (pricing) or by command and control instruments (e.g. mandatory energy efficiency and environmental standards, mandatory shares for e.g. clean coal, gas or renewables). Evidently, in maintaining living standards absorbing the mounting costs of local pollution abatement will have to - and in fact *do* already by and large - get prime attention. Contingent on the outcomes of international 'Climate Change' negotiations and (further) scientific evidence regarding the nature of the underlying issue at stake, accounting for the additional costs *and benefits* (especially benefits from the Clean Development Mechanism) of CO_2 mitigation will also warrant increasing attention.

3. ENERGY POLICY MAKING IN SELECTED COUNTRIES

3.1 Government involvement in the energy sector

Governmental institutions for formulating and implementing energy and environmental policy take many forms in the OECD countries. In general, the institutional set-up in a particular country reflects the organisational response to problems, which are faced by society. For example, during the seventies in many countries the problem of acidification was considered to be a health problem. Consequently, the Ministry of Health held considerable influence with regard to formulating policies to mitigate acidification whereas Ministries of Environment had not been established and Ministries of Energy were still occupied with their main task of guaranteeing a secure supply of energy to the national economy. Gradually, it became evident that the problem of acidification is strongly linked to the use of fossil energy what triggering an enhanced involvement of the Ministries of Energy.

A change in the perception of national problems is a strong incentive to rearrange the institutional set-up. Once the changing circumstances have been acknowledged, a need for a change in the existing institutions better oriented towards the new situation will arise. This implies that governmental institutions for formulating and implementing energy policy vary widely over time and also between countries.

In all OECD countries, there is currently a single unit within a Ministry with wide responsibilities for economic and industrial policy for formulating energy policy. Only the United States still has a separate Department of Energy (DOE) responsible for the federal Government's energy policy. Denmark has a single ministry covering both energy and environment. The extent to which non-Government institutions are responsible for the implementation of the energy policy varies considerably between countries. For example, in the Scandinavian countries the government departments are small and much of the implementation of the responsibility for implementing the energy policy is entrusted to non-governmental organisations (for example, Danish Energy Agency).

All OECD countries have market economies and their governments realise that economic efficiency will be achieved if the pattern and level of energy production, supply and use are determined in first instance by market forces. All governments, nevertheless, intervene in energy markets to a greater or lesser extent. This is done to ensure a reliable and sufficient supply of energy and to provide the 'public goods', which are left out by the market forces. In the seventies government involvement in the energy sector was quite strong as a result of 1973-4 and 1979-80 oil crises causing the focus to shift away from markets and towards security of energy supply. In some countries the energy issue became the responsibility of an energy ministry, clearly putting the issue on the political agenda. In the eighties the abundance of energy on the world market was reflected in a significant reduction of government intervention in energy issues (apart from the nuclear area). Apart from the changing situation on the world oil market, energy matters became less important as a consequence of structural changes in the economy's energy demand patterns. The reduction of government intervention is evidenced in the lifting of price controls, reduced subsidies, the removal of barriers to energy trade and the partial transfer of state owned energy industries to the private sector. In the nineties however environmental concerns gave rise to renewed government interest and providing justification for continued involvement in the energy sector, though in a generally more arm's length fashion than in the past.

Governments use a number of instruments to intervene in the energy sector and to impact energy supply and demand. These instruments form the components of an overall energy strategy

and include economic/fiscal instruments(taxes, subsidies), trade instruments(tariffs and quota's on imports and exports), government administration(ownership of energy companies), regulation (price controls, market access rules) and energy R&D. These instruments are deployed to achieve the identified objectives and priorities contained in the energy policy. Government institutions for formulating and implementing energy policy vary widely over time as well as between countries.

Almost all OECD countries issue energy policy documents from time to time and these documents combine energy and environmental policies or strategies.

European Union

The European Union was established by the treaty on European Union by the fifteen Member States of the Union. The treaty entered into force on 1 November 1993. In 1993, the European Union comprised 369 million inhabitants accounting for 9% of world energy production and 17% of world energy consumption. The European Commission refers to the three Commissions formed by the treaty establishing the European Coal and Steel Community of 1951, the treaty establishing the European Atomic Energy Community of 1957 and the treaty establishing the European Economic Community of 1957. In 1965 the institutional structures and procedures of the three treaties were merged.

The involvement of the European Commission in energy matters has grown considerably over the past decades. This process started off in the sixties when the Commission developed the 'First Guidelines towards an EC Energy Policy'. This document noted the existing barriers to trade in energy within Europe and stressed the necessity of a common energy market. The document contained different measures to remove the barriers that prevented the establishment of a common energy market but because of resistance of the member countries and the unwillingness to transfer responsibility to Brussels, in practise these measures proved difficult to implement.

In the eighties, however, the role of the Commission in energy matters began to grow. Owing to a change in objectives towards the creation of a common energy market and the pursuit of environmental protection, the role of the Commission in energy matters became substantial. In particular the ascent of environmental issues on the political agenda was an opportunity for the EU to gradually integrate environment and energy and gain a higher profile in energy matters. This increasing role of the EU in energy policy making is reflected in the production of the White Paper on an energy policy for the European Union in December 1995. In the White Paper, the need for further development of the role of the EU in energy policy. In the White Paper the Commission argues that there is considerable overlap with various financial and trade policy responsibilities of the Union and that therefore there is a rationale for European-wide involvement in energy policy. In addition, the Commission argues that there are conflicting objectives within the energy policy itself which would benefit from reconciliation at the EU level.

In the nineties the Commission's involvement was reflected in the following proposals:

- Adoption by the EU of Directive 90/377/EEC in 1990 concerning the transparency of electricity and gas prices to industrial consumers.
- In April 1997, the Commission adopted a communication designed to make Community energy policy more transparent.
- In May 2000, a proposal on energy efficiency and an action plan outlining the policies and measures to realise the estimated potential of energy efficiency of over 160 Mtoe have been published.
- A draft Directive on the promotion of electricity from renewable energy sources was published in 2000.

However, the Community-level carbon tax proposed in 1996 to provide an EU-wide incentive for higher levels of energy efficiency, particularly in the industrial sector, and for the substitution of low - carbon energy sources remains deadlocked.

United States

The United States is the largest consumer and producer of energy in the world. In 1995, the population in the United States was 265 million. In 1996. In 1995, the United States accounted for nearly 20% of total world commercial energy production and 25% of total world commercial energy consumption. The energy net import share for the United States in 1995 amounted to 20%.

The United States has a federal system of government. Within the federal Government, the main responsibility for energy policy rests with the Department of Energy (DOE).The DOE provides the framework for a national energy strategy. The 50 state governments must comply with federal regulation, but states are free to follow their own course with regard to energy policy and these policies vary considerably among states.

The US Government relies primarily on market forces to achieve national energy policy objectives. However, the federal Government owns a substantial part of the nation's oil, gas and coal resources. The Comprehensive National Energy Strategy issued by the federal government in 1998 identifies the following main objectives:

- improved efficiency of energy system,
- energy security,
- environmental protection,
- energy R&D to provide future generations with a robust portfolio of clean and reasonably priced energy sources,
- international co-operation in energy issues.

Japan

Japan is a unitary country. In 1996, Japan counted 126 million inhabitants. In 1995, Japan accounted for only 1% of total world commercial energy production and 6% of total world commercial energy consumption. The share of energy import in 1995 amounted to 80%.

Responsibility for energy policy rests with the central Government, the Ministry of International Trade and Industry (MITI). The Agency of Natural Resources and Energy (ENRE) falls under MITI and is responsible for the rational development of mineral resources, energy supply security and promotion of energy efficiency.

The underlying goal of Japan's energy policy is to attain simultaneously the 3Es: energy security, economic growth and environmental protection.

3.2 Principal energy policy objectives in the OECD countries

Over the past 10 years there have been three major issues impacting the energy policy in the OECD countries:

1. Energy security
2. Economic efficiency
3. Protection of the environment.

Energy security
Energy security always has been and still is the prime goal of energy policies in the OECD countries, in particular for those countries with a high dependence on energy imports. Measures to achieve energy security are: 1) diversification of fuels away from imported fuels and 2) energy efficiency improvements for industry, housing and transport.

European Union
The EU is currently dependent on energy imports for approximately 70% and this share is likely to increase in the coming decades. The Commission reckons that the security of supply can substantially be improved by a further integration of the European market and by the extension of the EU. An improved management of the energy stock management systems among the EU member states by creating a Trans-European energy network, linking the networked energy systems (electricity and natural gas) is a key policy objective in the respect. Co-ordination among the EU member states of the efforts to secure a sufficient supply of energy can reduce the costs of security measures and can increase the effectiveness of these measures. In addition, the EU is also seeking to enhance the energy security through a variety of policy actions aimed at diversifying both Europe's internal fuel mix and its external sources of energy supply. Fuel substitution, promotion of the use of renewable energy and energy efficiency measures are the most notable initiatives.

The British government's policy with regard to security of energy supply consists of three components:
- promotion of competition in energy markets to secure flexibility, innovation and diversity among suppliers,
- selective support for energy R&D, for example in the clean coal technology and renewable energy technology,
- limited policy intervention in the market through fiscal instruments.

In Germany security of energy supply is also an important objective, given the country's heavy dependence on energy imports (96% for oil and 80% for natural gas). Germany relies for its security mainly on the creation of the Trans-European energy networks integrating the gas and electricity systems of all EU member States and linkages with non-EU countries such as Russia and Algeria. Germany favours the use of market-based mechanisms rather than government intervention to ensure supply security.

Italy faced major energy shortages during the 1970's oil crises. Since then, Italy has improved its efficiency, reducing import requirements, although it still imports a high percentage of total primary energy consumption (93% for oil and 84% for coal, respectively). Because of the high level of dependency of imports from Mediterranean countries, Italy tries to promote regional cooperation and development with most of its neighbours through bilateral technical assistance The creation of an integrated energy network in the European Union could help Italy to cope with short-term supply disruptions, but is unlikely to help Italy in long-term disruptions.

United States
In the 'Comprehensive National Energy Strategy' issued by the Department of Energy in 1997 energy security, including reducing the vulnerability of the US economy to disruptions in oil supply involves increased federal R&D support to increase domestic energy production. In addition, it is expected that newly to be developed technologies will considerably reduce oil demand.

Japan
Energy security is of utmost importance to Japan because of its high dependence on energy imports (more than 80% of primary energy supply). Measures taken to enhance Japan's energy security include:

- diversification of fuel mix (expanding indigenous sources such as nuclear and renewables),
- implementation of energy efficiencies measures for the industrial, buildings and transport sectors.

Economic efficiency
Up to the 1980s, the energy utilities in the OECD countries were mainly monopolies. Since 1990s most OECD countries have started a process of deregulation of the energy sub-sectors, although the pace varies considerable among the different countries. The main reason for deregulating the energy industries stems from the fact that industries are increasingly forced to compete in an integrated global marketplace, where lower-cost producers have distinct advantages. Deregulation of the energy sector should result in an increase in economic efficiency and in lower energy prices and thus will improve the competitiveness of energy-intensive export industries.

Deregulation is brought about by enacting new laws to spur competition in the retailing of energy. Energy consumers are gradually allowed to choose from among different energy suppliers, which will remove the monopoly position of the supplier and will result in an improvement of the energy services in terms of quality and price.

European Union
In Europe deregulation of the energy market started off with two Directives published by the European Union, the Electricity Directive and the gas Directive. In 1996, the European Commission adopted a Directive for the internal Market for Electricity. Under this Directive, all Member States were required to open at least 26.8% (overall share of consumers using more than 40 kWh) of their electricity markets to competition as of February 1999. The Directive stipulates that by 2003, more than 87% will have been liberalised. Several countries are now ahead of schedule in liberalising their electricity markets (for example, in the United Kingdom the deregulation of the electricity sector was completed in 1998) such that by February 2000 more than 60% of the consumers will be able to select their power producer.

The EU Electricity Directive defines three basic models for network regulation, all designed to achieve comparable market access and an equivalent economic outcome:

- Regulated Third Party Access (rTPA): mandatory open access to the network at a regulated price.
- Negotiated third party Access (nTPA): mandatory access to the network at a negotiated price.
- Single Buyer (SB) Access: network access restricted to a single entity.

Most EU countries have opted for rTPA, except for Germany and Greece (nTPA) and Portugal (SB). Figure 3.1 shows the phasing for liberalisation of the electricity market in selected European countries.

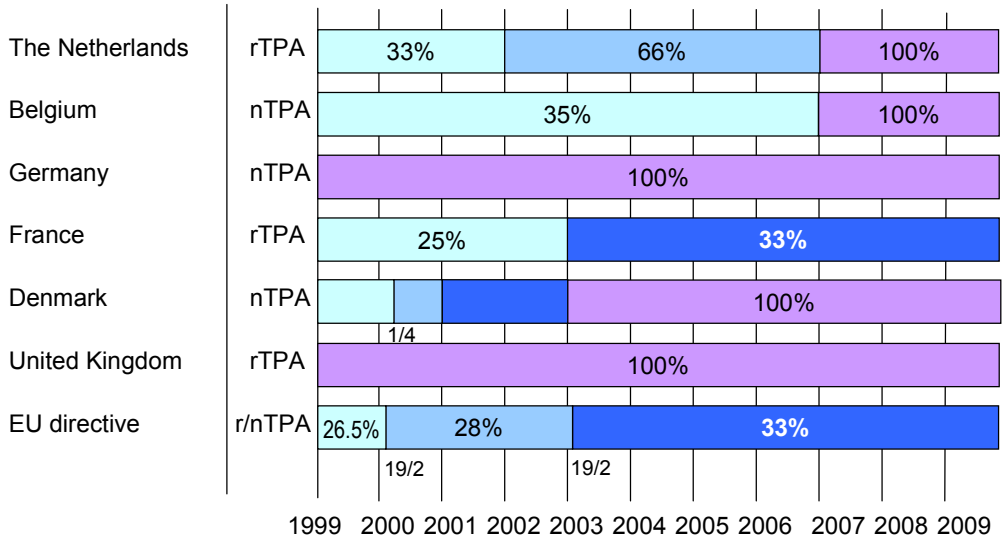

Figure 3.1 *Phasing for liberalisation of the electricity market in different European countries*

The EU Electricity Directive was the starting point for the liberalisation process in the energy markets of individual EU member states. For example, in the Netherlands the electricity act was approved in 1997, along with the Dutch Electricity Regulatory Office (DTe). The DTe is responsible for establishing all sorts of detailed rules, for example, grid tariffs.

The European Union approach to the internal market for natural gas is very similar tot the one for electricity. The EU Gas Directive was implemented in August 2000 and gradually allows certain consumers to benefit from competition. In a first step, final consumers taking at least 25 mcm/year should become eligible. After five years this threshold should reduce to 15 mcm/year and again five years later (August 2008) to 5 mcm/year.

Figure 3.2 shows the phasing for liberalisation of the gas market in different European countries.

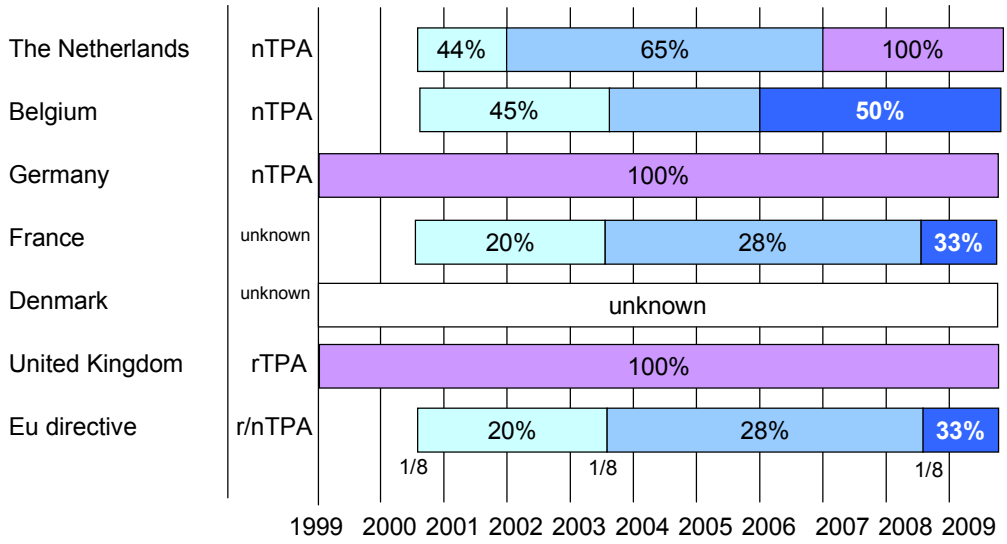

Figure 3.2 *Phasing for liberalisation of the gas market in different European countries*

United States

In the US the Energy Policy Act of 1992 requires electric utilities to open their transmission systems to power generated by other companies. However, unlike the situation in, for example, the EU countries, the process by which utility deregulation in the United States is being implemented is not driven by any overarching national policy but rather the direction and pace for utility deregulation is set by state-level decisions. Several states have been working on legislation to introduce competition in the retail sector. In 1998, California became the first State to completely deregulate its utilities and to allow all consumers to buy electricity from any supplier. Many other states are much slower in implementing the deregulation process and wait to learn from the experience in California.

Japan

In Japan the deregulation process started in the mid 1990s and involves the Petroleum sector, the natural gas sector and the deregulation sector. The Japanese have repealed laws that prohibited the import of refined petroleum products to create competition in the petroleum sector. New laws have been enacted to allow natural gas distribution companies to supply large industrial consumers outside their service area. In 1998, the Japanese Government adopted a programme for partial liberalisation of the electricity supply industry which allows customers connected to power lines with voltages higher than 2.2 kV to choose their own suppliers. Ten vertically-integrated utilities must unbundle their activities for generation, transmission and distribution and must allow third party access to their grids. The transmission tariff will be regulated.

Protection of the environment

During the last decade, the protection of the global climate has been one of the major concerns of the OECD governments and much effort has been devoted to the development of a comprehensive strategy to mitigate global climate change. At the Kyoto Protocol Climate Change conference in December 1997, the OECD countries and the former USSR countries committed themselves to concrete reduction targets of greenhouse gas emissions. Subsequently, policies have been developed to achieve these targets. Main policy options currently being considered are fiscal instruments, regulatory actions, and increased funding for research and development. In addition, the flexible mechanisms are also expected to help the OECD countries to achieve their target.

European Union

Environmental protection is one of the main objectives of EU energy policy. The Commission believes that the goals of greater economic competitiveness and environmental protection are not necessarily in conflict. The European Union is a party to the Framework Convention on Climate Change and a signatory of the Kyoto Protocol. The EU is playing a leading role in urging other industrialised countries to address the climate change. This was evidenced at the 1997 Kyoto climate change conference where the EU committed itself to a high 8% emissions reduction target from 1990 levels. Subsequently the EU issued a Community Strategy, specifying individual Member States' reduction targets that vary considerably among the EU countries.

The United Kingdom accepted a greenhouse gas emission target for the first budget period of 12.5% below 1990 levels. Due to the large-scale substitution of gas for coal in the power sector, the UK's carbon dioxide emissions are likely to be 4-8% below the 1990 levels by the year 2000. A further penetration of gas in the electricity sector is anticipated but this is not sufficient to meet the Kyoto target and the deployment of new energy technologies, particularly offshore wind and bio-energy will be required.

Germany has been a leading proponent of the international action to mitigate the climate change. Germany has committed itself to a 21% greenhouse gas emission reduction. The German government intends to achieve this target through a combination of policy measures including carbon taxes, renewable energy, legislation and voluntary commitments by industry.

Italy has committed itself to a 6.5% reduction of greenhouse gases emissions compared to the 1990 levels. Main measures envisaged include energy efficiency, increase use of renewable energy and a series of laws, decrees and regulations to reduce local atmospheric pollution from fossil fuel combustion.

United States
In Kyoto the US agreed to reduce carbon emissions by 7% from 1990 levels by the first budget period 2008-2012. Because of the high economic growth rates persisting for more than a decade now in the US, it becomes more and more difficult to achieve this emission reduction target. Formulating policies to reduce carbon emissions in the US is also complicated by the fact that there exists no agreement between the Clinton Administration and the Congress about the urgency of the threat of global change. The election this year also delays the implementation of an effective programme to reduce emissions.

Japan
The Japanese policy to achieve the Kyoto targets consists of a switch from coal to natural gas and increased nuclear power generation. In addition, it is expected that the flexible mechanism will also contribute to the achievement of the emission reduction target.

3.3 Instruments of Government intervention in the energy sector

There are a number of instruments available to the governments to pursue their energy policy objectives. The most important instruments are:
1. Energy research and development
2. Economic and fiscal instruments
3. Regulation
4. Government management and ownership
5. Trade instruments.

Energy research & development
Achieving the energy policy objectives will require investments in research and development. Government energy R&D usually falls under the Ministry entrusted with energy policy, although a number of countries have separate agencies to handle the government energy R&D programmes (the Danish Energy Agency, the national agency for Environment and energy Efficiency (Ademe), the Netherlands Agency for Energy and Environment (Novem). The funds made available for Energy R&D varied considerable over the past two decades and this reflects the varying importance of energy as an policy issue. Throughout the 1970s, energy was a central policy issue in the OECD countries because of the oil crises of 1973-74 and 1979-1980. Energy R$D constituted more than 50% of total research funds in most OECD countries. During the second half of the 1980s, energy intensity declined sharply and world oil prices collapsed. Energy became a less important issue that it previously was resulting in a decline of energy R&D funds. This trend continued till the present time and is even more prominent since the wide-scale liberalisation of the energy market. The total reported IEA government energy R&D budget was US$ 9087.3 million in 1990 and declined to US$ 7515.9 in 1997. In terms of Energy R&D per unit GDP the decline has been even more pronounced. Within the energy R&D research a shift in priority can be seen away from oil & gas, coal, and nuclear to energy conservation and energy system analysis.

European Union

The European Union makes available considerable amount of funds for research and development activities in many socio-economic areas. The main activity of European Union research is the Framework Programme for Research and Technological Development, a multi-year plan drafted by the European Commission and approved by the Council of Ministers and the European Parliament. The first Framework Programme was established ran from 1984 to 1987 with a budget of 6.4 billions US$. Currently the Fifth Framework is being implemented and the budget has increased to some 17.1 billion US$. Major research areas are information and telecommunications, materials research biotechnology, energy, medical research and the environment. The budget allocated for energy research in the first Framework constituted 50% (US$ 3 billion) of the overall budget. This share has declined to some 14% (US$ 2.1 billion) in the Fifth Framework.

United States

The investments in the US in research and development rose steadily from some 150 billion USD in 1985 to slightly more than 205 billion dollars in 1997. The share of private sector investments in total investments rose to nearly 65% in 1997, reflecting the strength of the US economy in the 1990s. Main areas of research are national defence, health, space, general science, energy and natural resources and environment. The energy R&D has experienced a sharp decline in the 1990s and amounted to some 8.2 billion USD (4% of total R&D) in 1997. The push for energy market deregulation in the US was severely reducing the private sector's investments in energy R&D in the United States.

Japan

In Japan, the emphasis on energy R&D is significantly greater than in other industrialised countries (in 1998 some 14% of total R&D investments). This is a reflection of the fact that Japan remains very dependent on import of energy. The Japanese energy R&D program is overwhelming focused on nuclear energy R&D, which accounts for 75% of the total budget. Energy efficiency R&D (8%) and renewable energy R&D (3%) receive relatively little support from the Japanese government.

Economic and fiscal instruments

Economic and fiscal instruments can be used to influence energy consumption and to stimulate or discourage energy technologies. These instruments include energy taxes, tax exemptions and direct or indirect subsidies.

Regulation

Regulation comprises market regulation (e.g., price controls, market access regulation and anti-cartel regulation), environmental regulation (e.g., emission standards), safety regulations and quality regulations.

Government administration and ownership

Government ownership of energy companies is an instrument to the government to influence energy production and consumption. In almost all OECD countries there is some public owned share in the energy sector.

4. ENERGY POLICY MAKING IN SELECTED COUNTRIES AT SUBSECTOR LEVEL

4.1 Introduction

This chapter will provide some more details on policy making at some key energy subsectors, i.e. *power*, *coal*, *gas* and *renewable energy*. The section on power, Section 4.2 reviews policies regarding the power (sub) sector in the European Union and California, the US state with the most far reaching liberalised legislation. Section 4.3 sets out how some European countries coped with their most ailing coal mining sectors, e.g. by (in some instances) introducing accompanying regional policies in the mining areas. Section 4.4 provide some insight into ongoing liberalisation in the gas sector of selected countries. Finally, some novel approaches to the introduction of market-based instruments to promote the deployment of renewable energy are introduced in Section 4.5.

4.2 Power

4.2.1 Liberalisation Policies and Institutions

In the past it was thought that electricity markets could not work in a competitive environment mainly because of the economies of scale and the security of supplies. Economies of scale in the electricity generation process means that per unit generation costs decrease as the total output increases. This feature characterised plants in the past, however the development of new technology disrupted this feature. Furthermore current experiences suggest that the liberalisation of electricity markets contribute to increase the security of supply.

The traditional power system was characterised by vertically integrated monopolistic electricity companies. In this industrial structure generally generation was not subject to competition and no one had any choice of supplier. A single company handled the production of electricity and its delivery to customers. These firms were not provided with incentives to increase efficiency due to the cost plus pricing system or Power Purchase Agreements, i.e. prices were set equal to that of the total costs of production. Setting energy payments to actual costs incurred gave the generators poor incentives to reduce their costs.

The liberalisation of the electricity industry means that the different sectors of the market are unbundled into separate accounts, and as a result customers can freely choose their own supplier. There is open access to the transmission and distribution grid and these sectors are kept regulated due to their monopolistic nature. The retail of electricity remains competitive. In this system strong incentives for efficient production and delivery of retail electricity are provided due to the marginal cost pricing system, by which competition between firms in encouraged. The price in this new system is determined mainly by the production costs, taxes and transmission tariffs. As taxes and transmission tariffs generally tend to be homogenous within regions, generating firms are encouraged to reduce costs and increase the quality of services to maintain or expand their market participation. During the last years many electricity sectors were increasingly liberalised in many regions around the world.

4.2.2 Experiences in selected countries and regions

European Union

In the European Union the Directive 96/92/EC, which involve the common rules of the internal market, was implemented in February 1997. The main points of this directive are the common rules for the generation, transmission and distribution of electricity. According to the directive the market opening should be made gradually in three steps, achieving a 33% by the year 2003, however each member state can freely choose for higher levels of liberalisation of the market. In practise most of the countries are opening their markets is a much quicker way than the directive defines.

The construction of new generation capacity can be followed either by authorisation or tendering procedures. The first allows the member country to set up a criterion for the grant of authorisations. If the authorisation is refused the candidate should be informed of the reasons, which must be objective and non-discriminatory. The second allows a member country to plan the construction of new capacity.

Regarding transmission and distribution activities the directive points out that member states should designate a System Operator (SO) that will be in charge of the operation, maintenance and development of the transmission system. This operator must act in an objective, explicit and in a non-discriminatory way. Furthermore according to the directive the ways to accede the network are through a negotiated Third Party Access (nTPA) or a regulated Third Party Access (rTPA). The first option is characterised by the fact that parties must negotiate with the system operator to be able to make use of the network. The second option provides a standard framework for the use of the transmission system that can not be negotiated and is expressed in published tariffs. These tariffs must be designed mainly by a Regulator Entity.

England

England was one of the first countries to liberalise and privatise its electricity sector. It started in 1990, when the power generation units belonging to the Central Electricity Generating Board (CEGB), the monopolistic generating company, were sold to National Electric and PowerGen. Currently the market is fully opened, as by May 1999 all consumers are able to choose their suppliers.

At the time of the privatisation National Electric was given 52% of the total available capacity, while PowerGen was awarded 33% of the capacity. The nuclear generating units were transferred to Nuclear Electric, a public company, and in 1997 were sold to British Energy. Since the liberalisation process started the amount of electricity generated by gas plants increased significantly and currently these types of plants generate 34% of the total electricity generated. Coal (33%), nuclear (25%) and renewables, oil and imports (8%) generate the rest. The market share of the two biggest firms, National electric and PowerGen, has been decreasing constantly mainly due to the development of Independent Power Producers (IPPs) that installed a significant number of combined cycle gas-fired generation units. The construction of new generation capacity is subject to an authorisation procedure. For plants bigger than 50 MW the Department of Trade and Industry is the competent authority, while for plants smaller than 50 MW the authority relies on local planning bodies.

The regulated TPA is the system adopted for the grid access in the region of England and Wales. The SO is the National Grid Company (NGC), which was initially owned by 12 regional electricity companies, but it is now a privately owned company. The NGC is responsible for electricity dispatching. The market regulator is the Office of Gas and Electricity Markets (OFGEM) and one of its objectives is to determine transmission and distribution tariffs.

Currently in England and Wales the market has been totally liberalised as vertically integrated monopolistic electricity companies were successfully unbundled. However empirical studies maintain that the two biggest companies were able to exercise horizontal market power by behaving strategically, i.e. they could manipulate the market clearing price by either withholding capacity or by bidding higher than their marginal production costs. According to the power exchange system implemented, all the trading has to take place through a central pool. In it pool prices are determined by bid schedules submitted daily by the utilities specifying the supply-prices for each of the units they own. This trading system was partly blamed for encouraging the exercise of market power. Consequently in November 2000 a different trading system will be introduced. The New Electricity Trading Arrangements (NETA) involves the abolition of the day-ahead Pool and will be substituted by three markets: the long-term bilateral and multilateral contract market, a short-term screen-based Power exchange and a real-time imbalance market. This new system aims at eliminating the current Electricity Pool of England and Wales especially the extremely centralised bidding and price setting processes.

Germany
Germany, the European largest electricity market, started its liberalisation process in April 1998 when all of its electricity market was liberalised in one step. This drastic action produced, as a result, a process of transformation characterised by the mergers of utilities and the reorganisation of the whole sector. Competition, over capacity and the determination of each participant to hold on to his share of the market has significantly lowered the prices, which earlier were by far the highest of all Europe. Another aspect of Germany's current electricity sector is the fact that a shift in the feed input can be observed, as there is some political willingness to terminate with nuclear generation units and increase significantly the amount of renewable energy sources. Currently 54% of the electricity is produced by coal, 29% by nuclear power, 10% by natural gas, 4% by hydro and less than 2% by oil power.

In 1998 the German legislation approved the new Energy Law, adopting in this way the EU Directive on electricity and gas. This law liberalised the entire electricity market. However, in the beginning for the small consumers competition was limited due to a lack of transparency, distance-related fees, high administrative costs and high transmission costs between different regional energy companies. This made it difficult for new entrants and for consumers to change suppliers, maintaining the number of parties that switched providers low. As a result of these events and under pressure of the government, in July 1999 the transmission companies had to reduce tariffs and increase transparency. Competition thereafter increased resulting in a significant reduction of prices; henceforth a drop in monopolistic profits for power companies.

Before the market was liberalised, the electricity sector in Germany was characterised by its large number of regional utilities, supplied by namely 8 Transmission System Operators (TSOs). The TSOs are the owners of the high-voltage grid, the grid connections to neighbouring countries and were responsible for the balance between production and consumption of electricity. The medium-voltage and the low-voltage grid are mainly in the hands of regional and municipal energy suppliers. With the liberalisation of the electricity sector the German government decided to introduce a negotiated Third Party Access (nTPA) system, therefore no system regulator was created and consequently no single Independent System Operator was designated.

In the new liberalised market there is a complete division between trading and transmission of electricity, making short-term trading possible. There are currently three Power Exchanges working with the German electricity market. The Leipzig Power Exchange (LPX), which operates a day-ahead market and trades in a double bid process and uniform price system, started working in June 2000. The European Energy Exchange (EEX) that started trading in August 2000 is situated in Frankfurt. The last one is the Amsterdam Power Exchange (APX), which on top of trading electricity in the Netherlands trades electricity in the German region.

As long as there are no transmission constraints the market clearing will be the same for all the regions. Currently all these exchanges only trade one-day ahead markets, however it is expected that when the trading volume increases a financial market will be introduced.

Germany has a Co-generation Heat and Power (CHP) Act (KWKG) and a Renewable Energy Act (EEG). The first one came into force on May 2000, and encourages the use of electricity from this source via feed in tariffs. According to the act the local system operator is obliged to buy electricity produced in CHP generation plants at a fixed price of around 0,45 US$/kWh. However the distribution system operator (DSO) is given a subsidy of 0,15 US$/kWh. This financial support will decrease by 0.25 US$/kWh every year. In order to recover the loss induced by the subsidy, the KWKG act gives the right to the TSOs to increase their power system charges. Analogically the EEG act obliges also the local system operator to buy electricity generated by renewable sources. The difference to the KWKG act is that the TSOs on top of supporting the DSO they also receive the electricity, equalising in this way the financial burden and electricity. Later the TSOs sell the renewable electricity to all traders at equal prices. It is up to the traders to increase their electricity price.

France
The French electricity market is concentrated in Electricité de France (EDF), which had a monopoly over the generation, transmission and most of the distribution activities. In order to comply with the European Union directive, the French government introduced the 10 February 2000, a law that reformed the market to meet the terms for a more liberalised sector. According to this law consumers consuming more that 16Gwh, which represent slightly over 30% of the market, are able to choose their supplier.

Currently 75% of the electricity generated is nuclear-based and 15% comes from hydroelectric sources. In the liberalisation process the French government chose the authorisation procedure to manage the building of new generation capacity. According to this, new producers hoping to create a new facility on the national territory are subjected, in conformity with the law, to an authorisation (for the installations having a power of over 4,5MW or power increases resulting in exceeding this level) or a simple declaration (below this level). The authorisation to build new plants is approved by the Ministry of Energy, and this depends on future planned generation capacity levels that are determined together with the system operator.

EDF owns the transmission and most of the distribution system. Non-nationalised local distributors are the other owners of the distribution sector. France implemented a regulated third party access (rTPA) system to regulate the access to the grid. An Electricity Regulation Commission (CRE) was created to favour the functioning of the electricity market without discrimination. The system operator, RTE (Gestionnaire du reseau de transport), was established and under its responsibility is the operation, maintenance and development of the public high voltage and extra high voltage power transmission systems. RTE ensures the constant matching of generation and consumption, power system operating safety, maintenance and technical development of the public electricity transmission system. Although it is part of EDF, RTE was set up as an independent operator.

The liberalisation of a first sector of the market already gave its first results. As of June 1, 2000, the number of eligible clients having changed supplier was low; however, a certain number of them obtained new contracts with EDF reflecting lower prices.

Electricity Trading in the Nordpool
The Nordpool, the power exchanges for Norway, Sweden, Finland and recently Denmark, is one of the most successful in Europe. In this region two ways of trading electricity exist, by bilateral contracts and by the Nordpool's auction market. The share of the first one is declining, consequence of the rise in the volume of the second market.

The price in Nordpool auction market is determined, whenever it is possible, by the intersections of the demand and supply curves. The Power Exchange trades electricity in a physical market and a financial market. In the former the most popular is the Spot Market, in which power contracts are traded daily for physical delivery in the next 24-hour period. The latter satisfies the needs for administration and risk management of customers who otherwise would sign bilateral contracts. The futures, options and forwards are therefore used to hedge the risk out of the electricity trading in the spot market. The reason for the Nordpool's success is the fact that the possibility by utilities of exercising market power has decreased significantly due to the creation of a unified market. This could only be achieved because the transmission system between the Nordic countries is strong enough and therefore the countries generally share one price.

United States of America
The liberalisation process started in 1992, when the United States Congress passed the Energy Policy Act, which authorised the Federal Energy Regulatory Commission (FERC) to issue orders that mandate open-access transmission of electricity. The wholesale electricity market was not opened to competitive power-generation suppliers until 1996 when the FERC ordered electric utilities nation-wide to allow other electricity providers to transmit electricity through utility transmission systems. The Commission is the Transmission System Regulator and its main goals are to promote competitive, well-functioning markets and to protect customers. As a result they are in charge of approving transmission rates for wholesale electricity sales of electricity and transmission in interstate commerce for third parties. The Public Utility Commissions are in charge, at a state level, of the regulation of the distribution sector. They have jurisdiction over the rate setting of distribution tariffs and customer tariffs.

California
According to the California Public Utilities Commission (CPUC), which regulates investor-owned electric utilities in California, the high cost of electricity is the reason behind the liberalisation of retail electricity markets. They aim at achieving a reduction in the price by increasing competition. In this process a Power Exchange was created to allow short time trading.

The California Power Exchange (PX) operates a day-ahead and hour-ahead market for energy, being the first one the most popular. Utilising a double auction format, it receives bids from the suppliers and demanders and sets a market clearing quantity at the intersection of the resulting aggregate supply and demand curves implied by all these bids. The PX is a financial market because firms can purchase or sell electricity in real time to change their day-ahead PX position in what is essentially an energy spot market run by the ISO.

In California the Independent System Operator (ISO) is in charge of co-ordinating the electricity market, i.e. has to continuously equal supply and demand. Therefore the ISO operates an imbalance market which is also called real-time energy market. Firms that move away from their planned schedules have to buy or sell electricity power from this market. Both the PX markets and the real-time clear at a uniform price.

It has been argued that in California, under the generation ownership that existed in 1997, the two biggest companies were able to exercise market power. Pacific Gas and Electricity (PG&E) and Southern California Edison (SCE) found it lucrative to withhold capacity under high demand levels. In this way they artificially increased the clearance price by holding back production capacity from the markets, forcing more expensive generation units to be dispatched. These actions were done under high demand levels because only then other generation capacity would not be able to provide supply. Other factors permitting the exercise of market power were very low price responsiveness of consumers, and transmission constraints from neighbouring regions.

4.2.3 Liberalisation and the Environment

Environmental Taxes and Charges

In a market economy in which goods are allocated through price signals, the command and control instruments prove to be inefficient, i.e. the regulating targets are not achieved through the most cost-effective way. Therefore policy makers currently use a number of market instruments which namely are environmental taxes and charges and emission trading. The aim of these instruments is to achieve environmental targets through the most efficient way in a market economy.

Environmental externalities, which are results of processes of production and consumption, generate negative costs to society. An example of this is the health problems emission of SO_2 produce. Through the implementation of environmental levies these externalities are internalised in the decision making processes of agents via the price mechanisms. Therefore an increase in the price would discourage the agents to continue with this activity. The advantages of the environmental charges and taxes rely mainly on their cost-effectiveness, their raising revenue effect and on the fact that they encourage the innovation of environmentally friendly technology.

Energy related taxes in the Netherlands

Since 1996 the increase in the electricity and gas prices for households in the Netherlands is the result of the introduction of the Regulatory Energy Tax (REB). This tax is levied on the consumption of natural gas, electricity and mineral oil products when used as substitutes for gas by domestic users or commercial establishments. The revenue generated is returned to domestic users and business by way of reductions in other taxes. For the households in 1999, the share of REB in the gas price was 15% and in the electricity price 17%. This share will increase considerably when the intended increases of the REB take effect.

Emission Trading

The basic principle from emission trading is to reach the environmental goals at lower costs that would be possible if sector were limited to reduction options in its own borders. There are basically two different ways to implement emission-trading mechanisms. Firstly by introducing an emission cap and then by implementing an allowance trading and secondly by implementing credits trading. The main difference between them relies on the transaction costs. Generally credits are not a commodity per-se, therefore they have to be certified by the government, thus increasing the costs in the implementation of this mechanisms.

Emission trading works in the following way. A regulator entity introduces a quantitative target, which normally represents the sustainable level of a certain activity (i.e. emissions of SO_2 or greenhouse gases, etc). Later the allowances are distributed among stakeholders and when these stakeholders trade the allowances in between them, the cheapest options are executed. As a consequence the cost of achieving a environmental target are significantly reduced.

The U.S. Acid Rain Programme

The most successful emission cap and allowance trading system was the Acid Rain programme, implemented in the United States. This programme aimed at reducing industrial emissions of sulphur dioxide (SO_2), which causes acid rain and directly affects human health.

The Acid Rain Program applies to fossil fuel fired electric utilities in the United States and required the affected generating units to achieve, in sum, a reduction of 10 million tons of sulphur dioxide (SO_2) per year from 1980 emissions levels and a 2 million ton reduction of nitrogen oxide (NO_x) emissions annually by the year 2000. The programme set an emission cap and later allocated allowances among some 2,200 utilities based on their historic fuel consumption and a specific emissions rate. Later it authorised the stakeholders to trade emission allowances between their own facilities or with other utilities in order to decrease the costs in achieving the

emission caps. The programme achieved flourishing results as the objectives were over-achieved at lower than expected costs. The continuous monitoring of the emissions, high penalties for non-compliance and the self-reporting of both actual and trading activities to public databases were the main characteristics of the RAIN programme and the reason of its success.

4.2.4 Conclusions on Power Sector Liberalisation

The European Union and the USA are promoting the liberalisation and harmonisation of all its electricity industry. What was unthinkable some years ago is being currently achieved in a short time. The main reasons for the opening of the markets are a reduction in prices, an increase in service quality and in efficiency, all due to an expected rise in competition.

The sectors of the electricity markets are being unbundled. In this context the TSO are organised as separate legal entities from the supplies and generators affiliates. In some countries these are separately owned, like in England, and in other countries they have a separate management, like in France. However the unbundling of vertically integrated regulated monopolies does not guarantee a perfect competitive market, as generating firms can still behave strategically to exercise market power either by withholding capacity or bidding higher than their real marginal costs. This horizontal market power was observed in totally liberalised markets as England.

The liberalisation process is being adopted differently by the member states mainly due to diverse political approaches and dissimilar market structures. However there is a trend to increase the speed of the liberalisation of electricity markets. All the countries from the EU except Germany implemented a regulated Third Party Access.

Currently limitations to achieve a single market are transmission constraints and a non-harmonised market network. The former can play a very important role in price differences among countries and can be solved either by increasing transmission capacity or by implementing market mechanisms. A significant example can be seen in the Nordic market, where reduced transmission constraints have achieved a successful mostly unified market.

The member states have to follow the European Union Electricity Directive. Only if a rTPA has been implemented a regulator is created. In the United States of America, the Federal Energy Regulatory commission (FERC) regulates all the inter-state electricity trading. They approve the transmission system tariffs proposed by the transmission companies and protect the consumer's rights. In the local level the Public Utilities Commission regulate the distribution sector of the electricity market.

The liberalisation of the electricity market promotes the use of the so-called market instruments. Environmental Taxes and Emission Trading achieve certain environmental target and objectives in the most efficient way.

4.3 Coal

4.3.1 Introduction: Coal, Redundancy in Abundancy?

China has one of the largest coal reserves in the world and produces about 1,500 million tons of coal per year. More than five million people are working in 75,000 coal mines in order to achieve this production that covers about three quarters of China's energy needs. Presently the coal industry is going through a process of rationalisation. In this operation especially the smaller mines, mostly located in provinces where other employment opportunities are relatively scarce, are being closed or risk to be closed in the foreseeable future. Also more and more pressure is exerted to decrease the use of coal or to improve its quality or the quality of the processes in which it is used for environmental and health related reasons.

Against this background, the Netherlands Energy Research Foundation ECN has been asked to sketch ways in which some European countries have coped or are coping with similar processes and their outcome. Countries that will be discussed are Germany, Great Britain and the Netherlands. It goes without saying that developments regarding the coal industry in these countries can only be interpreted against their common background as members of the European Union (all three) and the European Community for Coal and Steel (Germany and the Netherlands). European policies that contribute to an accelerated restructuring and downsizing of the coal industry are the competition policy and the policy regarding state-aid to national companies. These policies have their legal foundation in the European Community Treaty, articles 85 and 86 for competition and articles 92 and 93 for state aid. Another strong influence is being exerted through environmental policy. Especially directives concerning the emissions of sulphur dioxide and nitrogen dioxide, both causing acid rain.

Given the importance of the coal sector, in many countries a pendular movement between state influence and private enterprise can be observed. The high level of production costs is the central problem in most European coal producing countries, but most governments are reluctant to fast solutions because of the large numbers of workers involved, and the importance that can be attached at secure supplies coal. Still, as a result of ongoing restructuring in the member states of the European Union production of coal and coal products is on the decline all over the Union and employment in the coal industry follows the same trend. Hard coal production for instance went down from more than 250 million tons in the early seventies to about 130 million tons by the end of the nineties (EU 97), and the number of personnel employed underground decreased from close to 400,000 in 1980 to just under 100,000 in 1997. At the same time productivity went up, be it with large differences among members. While the average productivity in underground workings for the EU as a whole stood at 745 kg/man-hour in 1996, in the UK this figure stood at 1423 kg, in Germany at 770, France 750 and Spain just over three hundred kilograms. It goes without saying that these differences are translated into cost differences. As a result the UK is the only producer with costs relatively close to the price of imported coal.

4.3.2 Experiences in Selected Countries

Germany

Hard coal and lignite historically are the backbones of electricity supply in Germany. Hard coal in particular has enjoyed large subsidies and protection from imports through quotas and levies. Under pressure from the European Commission import restrictions were abolished in 1995. Until 1996 it were the electricity consumers who paid indirectly for these subsidies, by means of a levy of 8.5% of their electricity bill. This money was then passed on from the utilities to the coal producers to offset their price disadvantage vis a vis foreign competitors.

Since 1996 these subsidies are paid directly from the national government and the governments of the Laender to the coal producers. Also in 1980 the German power sector had committed itself to buying a certain amount of German hard coal.

In 1994, Germany became the largest hard coal producer in the European Union, due primarily to the rapid decrease in UK production. Germany is the largest lignite producer in the world. In 1996, total coal production (lignite and hard coal) was 73.4 Mtoe, i.e. 81.5% of total coal supply and 52.2% of total domestic energy production. Germany is the largest hard coal consumer and producer in the European Union, and the largest lignite consumer and producer in the world.

Costs of hard coal production are more than three times the price of imported coal, leading to heavy subsidisation of domestic hard coal production. In 1997 a law was issued to put a progressively reduced ceiling on hard coal subsidies for the period 1998-2005. In addition hard coal subsidies have been made transparent.

Between 1973 and 1996, hard coal production decreased at an annual rate of about 3%, leading to a reduction of production by about one half. In 1996, hard coal production was 34.2 Mtoe (20.1 Mtoe of steam coal and 14.1 Mtoe of coking coal), and the workforce amounted to 85,200 at the end of the year.

Coal supply decreased quickly in the 1989-1992 period due to economic restructuring in the new Laender. In 1996, total coal supply amounted to 90.1 Mtoe, i.e. 25.8% of total energy supply. Figure 4.1 shows the development of coal production and imports.

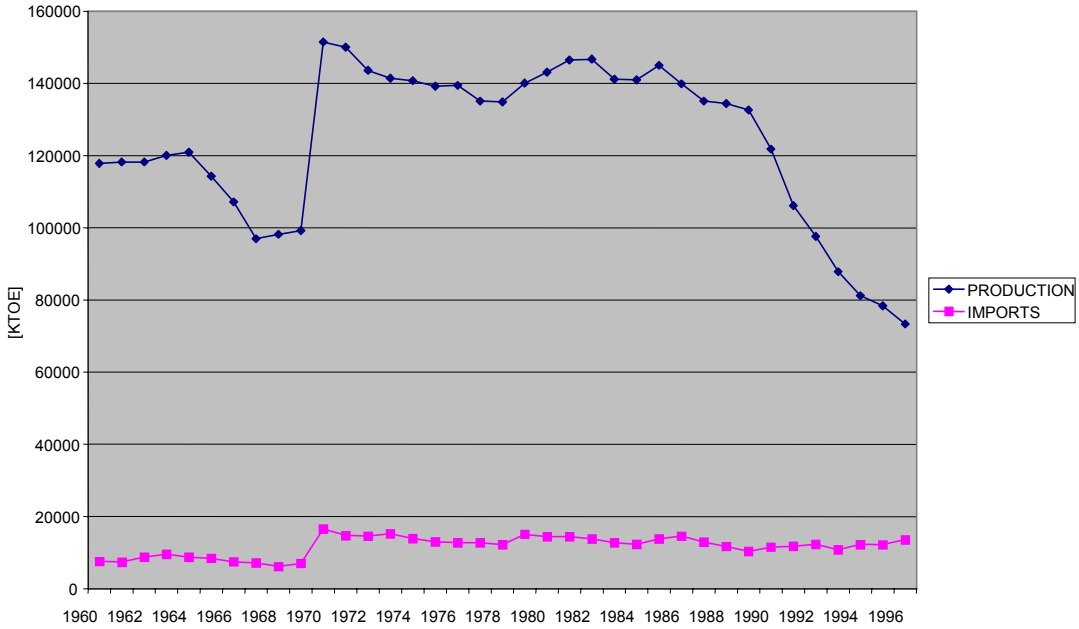

Figure 4.1 *Germany, production and imports of coal and coal products (source IEA)*

The two main hard coal producers in Germany are Ruhrkohle Bergbau, a 100% subsidiary of Ruhrkohle Group (RAG) and the second is Saarbergwerke AG (SBW) which produced 7.3 Mt of hard coal in 1996, i.e. 14% of total domestic production. They recently merged to form Deutsche Steinkohle (DSK), which accounts for 96% of German production. DSK is part of the larger RAG group, which intends to diversify its holdings and focus less on coal as the sector shrinks in coming years.

Production costs of hard coal in Germany have historically been higher than import costs. The average 1996 production cost of steam coal was estimated at DM 278/tce (DM 397/toe) compared with an average import price of DM 75/tce (DM 107/toe) at the border. Production costs are also higher for coking coal.

The following tables (IEA, 1998) state the different forms of assistance to coal producers, distinguishing between assistance related to production and assistance that is not. It is very clear that assistance is intended on the one hand to facilitate restructuring and helping the industry to survive and on the other hand to help solve the social problems related to the restructuring of the industry.

Table 4.1 *IEA Estimates of Assistance to German Coal Producers [mil. DM or DM per tonne]*

Assistance Category [a]	1991	1992	1993	1994	1995	1996 p
I ASSISTANCE INCLUDED IN PRODUCER SUBSIDY EQUIVALENT						
1) Direct aid to current production						
a) Investment grants/grants to promote innovation	0	0	0	0	0	0
b) Miners' bonuses	127.5	120.0	104.0	96.8	*95.1*	84.3
c) Special grants and debt claim payments	305.3	305.3	232.9	212.8	30.2	30.2
d) Special grant to promote sales of coking coal [d]	3,436	3,390	3,192	2,753	*2,588*	2,517
e) *Equalisation for area price differences/low volatile coal*	429.9	401.5	411.7	244.8	181.9	164.0
f) *Special grant to promote sales of thermal coal*						7,500
Subtotal	4,299	4,216	3,941	3,307	*2,895*	10,296
2) Indirect aid to current production						
g) Special capital depreciation measures	5	2	0	0	0	0
h) Excess deficit payments to miners' pension fund	270.4	402.2	443.1	491.0	500.0	510.0
3) Price support						
i) Refunds through the thermal coal levy [d]	4,972	5,488	4,970	6,071	5,787	0
j) Estimated additional consumer payments for:						
- thermal coal [b]	1,931	2,206	2,007	3,000p	3,000p	0
- coking coal [b]	0	0	0	0	0	0
Total,PSE	*11,479*	*12,316*	*11,361*	*12,870*	*12,183*	*10,806*
DM per tonne produced [c]	157.9	170.6	177.0	223.4	206.8	203.2
II ASSISTANCE NOT BENEFITING CURRENT PRODUCTION						
4) Aid to promote industry contraction						
k) Closure bonuses and other aid to help cover companies expenditures resulting from industry contraction	0	0	0	0	0	0
l) Early retirement aid and other 'adaptation' money	369.2	402.2	460.6	508.5	515.6	525.0
5) m) Aid to control water contamination from closed mines and to help prevent subsidence damage	216.3	199	196	140.2	190.7	197.3
6) n) Research and development aid [e]	82.6	71.4	45	40.9	30	23
7) Miscellaneous assistance						
o) Aid to maintain 'security stocks'	60.2	8.4	0	0	0	0
p) Aid to encourage CHP and district heating	13	3	0	0	0	0
q) Deficit payment to miners' pension fund [f]	10,834	11,131	12,933	12,442	12,000	12,000
Total of Category II	*11,575*	*11,815*	*13,634*	*13,131*	*12,736*	*12,745*

n.a. Not available.
r Revised data shown in italics.
p Preliminary data, subject to revision.
[a] Definitions of categories are in Appendix D of *Coal Prospects and Policies in IEA Countries: 1987 Review* (Paris: OECD, 1988).
[b] Support additional to Item 3)g) arising from differences between domestic and external market prices.
[c] 1996 production was 53.2 Mt.
[d] The ceiling for coking coal subsidies paid to producers out of the Federal budget and that of the mining state North-Rhine Westphalia was DM 2.5 billion in 1996, and the ceiling for subsidies paid out of the Federal budget to producers for the sale of hard coal to electricity enterprises was DM 7.5 billion in 1996.
[e] Assistance directly related to coal production and transformation.
[f] Obligatory payments under social legislation for mining-related industries. About 70 percent can be attributed to hard coal workers.
Source: Adapted and updated from *Energy Policies of IEA Countries: 1996 Review* (Paris: OECD, 1997).

Apart from direct subsidies to the industry, national social security programs directed at individuals are in place and regional development programmes, sponsored by the federal government, the laendern or the European Community can be in place as well. On top of this the municipalities may have their own programmes as well.

In March 1997, the German government, the mining industry, and the unions reached an agreement on the future structure of subsidies to the German hard coal industry. Subsidies to the industry are to be reduced from over DM10 billion ($5.5 billion) in 1997 to DM5.5 billion ($3 billion) by 2005. The agreement called for closure of 7-8 of Germany's 19 hard coal mines (14 of which are in operation as of October 1999), resulting in an estimated decline in employment from 76,000 miners in 1997 to 36,000 by 2005.

In order to improve the effectiveness of policy and the reform process, the Federal, Land and municipal authorities should strive for increased co-operation in carrying out energy policy in general and policy related to the social consequences of restructuring in particular. Lack of information on measures taken at all levels of government can cause overlap and reduce the effectiveness of the measures.

The United Kingdom
After World War II the Coal Industry Nationalisation Act (1946) was passed in the United Kingdom. With it the National Coal Board (NCB) was established. the NCB took control of the country's 1,647 mines, formerly owned by 850 private coal companies and coal owners were paid £164,600,000 in compensation. At first the NCB pursued a two-track policy of increased production and better wages and working conditions.

However, in the 1980s during the administration of Margaret Thatcher, policy was changed and NCB was engaged in streamlining operations by closing unprofitable pits and laying off mineworkers. In this process the weight and role of the trade unions were greatly reduced. The social and economic problems caused by the decline of the industry from a quarter of a million employees in 1981 to a workforce of fewer than 9,000 at present has been and remains a problem especially in areas where the coal industry heavily dominated as an employer.

The restructuring in the UK is known to have been a hard one. From the preceding figures can be seen that the process, in terms of employment, has nearly come to an end. Still it has left former mining areas with above average unemployment figures.

UK coal production fell from 130 Mt in 1980 to 50 Mt in 1996. Production has been stable since the privatisation of the industry in 1994.

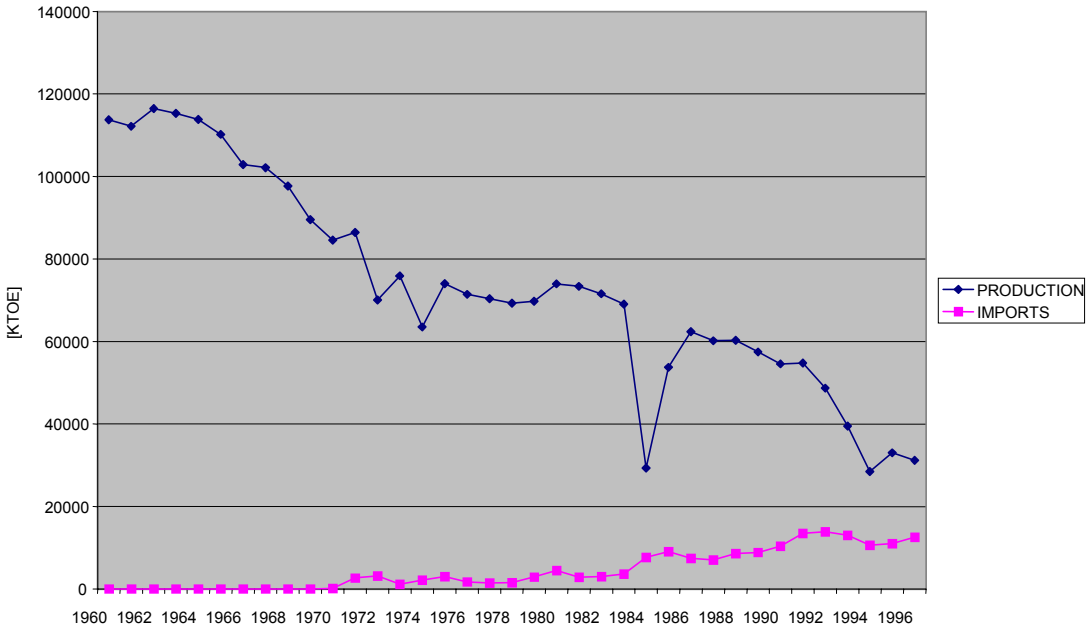

Figure 4.2 *United Kingdom, production and imports of coal and coal products*

The position of coal in the UK is challenged in several ways: import competition, competition with gas for supply to power stations, and environmental restrictions. As mentioned in the introduction productivity in British mines increased considerably and ensuing prices are only slightly higher than those of imported coal. The remaining mines are on average profitable.

The Netherlands

In the Netherlands the Dutch government decided in the middle of the 1960s to close down all coal-mining operations in the country. At its heights 12 million tons of coal were mined and 56,000 people employed. Geographically coal mining was heavily concentrated in the southernmost part of the Netherlands in the province of Limburg. Moreover, the whole mining industry consisted of one single company, the Dutch State Mines (DSM), fully owned by the state and operating four mines. These mines at the time were among the most modern, most efficient and safest coal-mines in the world, but produced at prices above world market level. The latter fact and the expectation that this situation was irreversible, coupled with the then recent discovery of major natural gas resources in the Netherlands, and a great confidence in nuclear technology, lay the foundation for the decision, taken in 1965, by the government to close down all coal mining operations. At that time 56,000 people were employed by the different mining companies belonging to the Dutch State Mines, and tens of thousands were reckoned to be active in the supplying industries.

Doubts about the future of coal in the Netherlands started in 1958 From that point onwards labour was shed from the mines. At first, trough a policy of non replacement of retirees, employment decreased by 10,000 jobs. Subsequently alternative employment was found for 30,000 employees. Part of this group took early retirement right away. So at the beginning of 1971 only 15,000 remained in the employment of the mines. Notwithstanding the 1971-74 oil crisis the policy to close the mines was further pursued and the last two mines closed their doors in 1974.

While imports initially declined together with the production of coal, a diversification drive ignited by the oil crisis, pushed imports of coal up. As can be seen from Figure 4.3 imports of coal increased by a factor six over the period 1980 -1996 and reached a level of 22 million tons in 1999 (ECN). Since 1974 the share of coal in power generation increased again to about one third at present.

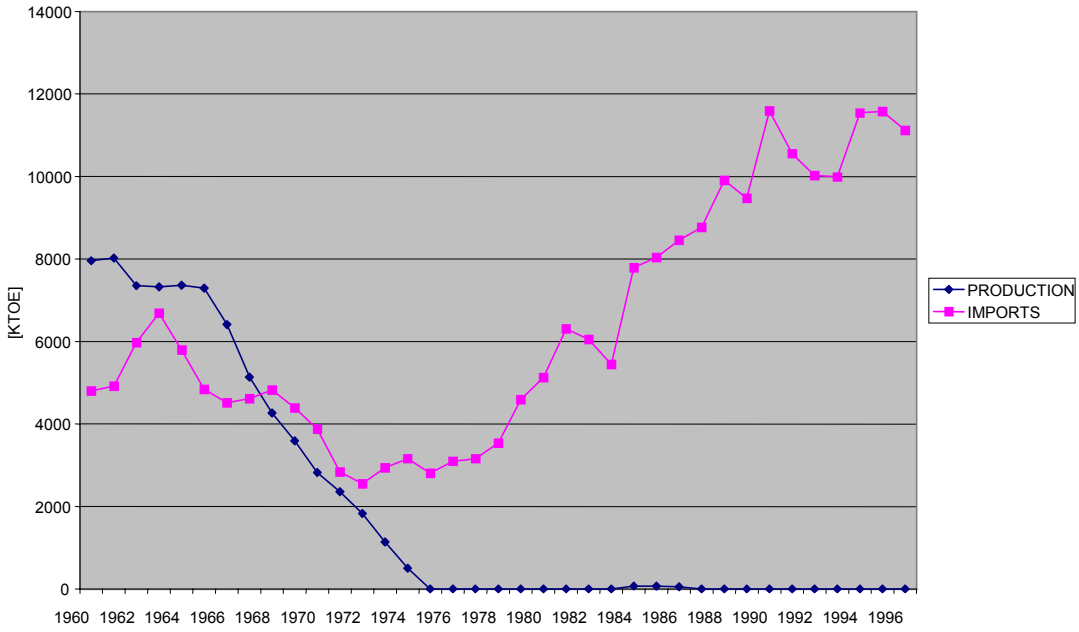

Figure 4.3 *The Netherlands, production and imports of coal and coal products*

The province of Limburg gained lots of experience with policies of integrated restructuring after the closure of the mines in the 1960s. At the time this kind of policy was rather innovative. After some less successful policy initiatives the Policy paper 'Perspectives for Southern Limburg' was issued in the second half of the seventies. This paper was the first of its kind to promote an integral approach. Integral was conceived in two ways, a first line bringing together several policy fields like socio-economic, land-use planning and socio-cultural and a second line linking up the different tiers of government (National, Provincial and Municipal). Policy contained in the 'Perspectives Paper' is generally considered to have been successful. Next to benefits received at the individual level by redundant miners, like general social security and some extra financial provisions especially designed to help redundant miners cope, a framework of regional development policy could be developed aiming at restructuring the regional economy and combat unemployment. In this way the Dutch State Mines (DSM) was turned into a chemical conglomerate. A car manufacturing firm could be convinced to set up shop in the region by offering special advantages and some government services like the Central Bureau for Statistics, were wholly or partially moved to Limburg. Also a new university was founded in order to improve the variance in jobs and market outlets. Although the whole operation left scarce in the region from a national point of view it is generally considered a success.

4.3.3 Conclusions

Restructuring seems to be a structural element in the coal industry worldwide. Generally speaking such processes take decades rather than years to complete in connection with strategic importance often attached to the coal industry and the vast numbers of workers involved.

Foreign experience learns that:

- fast or cold sanitation are socially most harmful and are relatively speaking cheaper,
- An integrated, both with respect to government levels as to issues, policy approach seems to lead to the most acceptable results.

In view of the growth of projected demand for energy in China of at least 5% per annum over the next ten years and a stable or slightly increasing share of coal in total primary supply, would indicate that important numbers of miners can be re-employed in the coal sector. This produc-

tion growth will be realised by more efficient and less labour intensive mining operations but could still absorb part of the redundancies caused by the closure of the smaller mines. Other measures, provided mobility, are schooling/training of the miners in fields where there is a local/regional demand.

4.4 Gas (and oil) subsector

4.4.1 Liberalisation Policies and Institutions

In the late 1970s and early 1980s, gas market reforms were launched in North America as a reaction on gross market distortions and supply shortages. Wellhead price controls were removed and competition in the wholesale supply introduced, through unbundling of gas trading and transportation services and mandatory third party access (TPA) to interstate pipelines. In Britain reforms began in the 1980s and have been taken further than in North America with TPA to wholesale as well as local distribution networks and market opening to all end users, including households (IEA, 1998).

The experiences in North America and Britain are used in liberalising the gas markets in Continental Europe. However, some differences between these markets have implications for the way competition and pricing could develop in Europe. Europe depends for a large part on gas supplies from non-European countries. There is a relatively small number of large suppliers, with the bulk of supply coming from Russia's Gazprom, Sonatrach in Algeria, Gasunie in the Netherlands and the centralised gas marketing organisation GFU in Norway. Moreover, several EU countries, such as Greece, Portugal, Denmark and Spain still have immature gas infrastructure, which is still being amortised (IEA, 1998).

Gas liberalisation in Europe is driven by the market as well as by regulation and legislation. Pressure from electricity generators and large industrial consumers for lower prices is the main driving force. Competitive third party access to gas infrastructure is one of the main stumbling blocks. Table 4.1 summarises the main drivers and barriers in the EU for gas market liberalisation.

Table 4.1 Main drivers of, and barriers to, liberalisation in the European gas markets

Drivers:	
	The UK-Interconnector (Gas pipeline between Bacton in the UK and Zeebrugge in Belgium with a capacity of 20 bcm per year and since October 1998 in operation).
	Oversupply.
	Pressure from large consumers.
	Electricity liberalisation (See Appendix for differences between gas and electricity).
	The EU Gas Directive.
	The move downstream by Gazprom (e.g. Wingas).
Barriers:	
	Dominance of incumbent monopolies.
	The lack of third party access.
	The lack of price transparency.
	The low levels of competition expected by the EU Gas Directive.
	The lack of political pressure from Member States.
	The availability of surplus gas is under the control of a handful of companies.
	The limited number of counter parties, which limits the potential for a spot market developing.

The European Gas Directive is meant to bring about more competition and so a higher level of welfare. Its key component is gradually allowing certain consumers to obtain their gas from the supplier of their choice (see Table 4.2).

Table 4.2 *Agreed EU gas market opening*

	2000	2003	2006
Power producers	all	all	all
Other final customers	> 25 million m^3	> 15 million m^3	> 5 million m^3
Minimum opening	20%	28%	33%

The 'network' nature of the gas sector prevents that eligibility of consumers automatically results in more competition. Third party *access* to the transportation and distribution network is a major prerequisite for competition, therefore the (implementation of) regulations mainly focus on this issue of TPA[1]. The countries can opt for regulated TPA or negotiated TPA. With rTPA, natural gas companies and eligible consumers have the right to access the system on the basis of published tariffs and/or other terms and obligations for use of that system. In case of nTPA, gas companies and eligible customers can get access to the system by negotiating with the operator of the network. The network operator is required to publish the terms for use of their system annually. TPA is supported by the *unbundling* of the companies' trading activities from network activities, in order to be able to allocate costs to the separate activities. It is possible for Member States and gas companies to derogate from the Gas Directive in case of 1) serious economic and financial difficulties because of existing take-or-pay commitments, 2) strong dependence on one main external supplier and poor gas interconnection with other Member States, and 3) emergent markets that still need investments. In the Appendix, a more detailed overview of the EU Gas Directive is given.

[1] Pipeline-to-pipeline competition serves as an alternative in the transition to effective TPA. Without mandatory TPA, gas companies may construct their own (parallel) pipelines, as the example of Wingas in Germany shows.

Traditional (monopolistic) integrated gas market arrangements cannot be maintained in a liberalised gas market. Competition in the supply of gas as a commodity has to be established, but also the provision of transportation and related services will be de-monopolised (in the pricing sense). Networks are still owned by one company, however, effective TPA and unbundling ensures a more competitive pricing.

4.4.2 Pricing and contracting

The traditional mechanism to price natural gas is known under the name of 'market value'. It essentially means that gas is priced to sell it in competition with and by reference to alternative fuels, almost always fuel oil or heating oil. This pricing mechanism helped to develop the European gas market by a great deal, because it enabled to take the risks of investing large amounts of money into the exploration and exploitation of new gas fields and infrastructure.

A key element in liberalised pricing arrangements is a differentiation of the price for the commodity and for transport (and other) services. For the time being, it is expected that the commodity price for gas in continental Europe will keep its strong link to the oil price. Only when substantial competition is established, as the example of the UK shows, the commodity price will more and more be based on real supply and demand on the spot market. While the commodity price is the same for all consumer groups, the prices for transport and other services are mainly determined by load factors, i.e. the ratio between total annual volume and maximum capacities necessary. Tariffs for transportation and storage usually remain tightly regulated on a cost-of-service basis[2].

Experiences in North America and Europe have shown a shift towards short-term gas trading contracts and a decline in take-or-pay commitments in the longer-term contracts. Moreover, spot and future markets have emerged. Although still small in size, spot and future markets gain importance because spot gas prices are used to index the prices in mid- and long-term contracts.

4.4.3 Applicability in China

The relevance of experiences with liberalisation in Continental Europe, the UK and North America to China depend on some important characteristics of the gas market in terms of the number of suppliers, the dependence on external suppliers, the state of upstream infrastructure, market trends and the maturity of the network (IEA, 1998).

At the end of 1999, proven reserves of natural gas in China where 1.37 trillion cubic metres, with an R/P ratio of circa 56 years. China produced 24.3 billion cubic metres of natural gas in 1999, a 10 per cent growth with respect to the previous year. Gas consumption totalled a 21.4 bcm in 1999, representing an 11 per cent growth with respect to the previous year. China is not involved in any substantial trade (import or export) of natural gas and LNG (BPAmoco, 2000).

Gas is used mainly as feedstock in chemicals and fertilisers, but in the future it is likely to penetrate the residential and commercial fuel mix in China. For environmental reasons, the use of gas in urban areas is encouraged. Gas networks already exist in many large cities, however, natural gas and LNG infrastructure remains underdeveloped, especially when compared to upstream developments in the gas industry (IEA, 2000).

'The pressure for a more competitive gas market in most countries has tended to increase as the markets have matured. Monopoly is commonly regarded as appropriate during the early stages of a gas industry, because of high marginal costs, the technical and financial risks, and the low returns intrinsic to the business. Once the large capital investment in infrastructure has been

[2] Cost of gas transportation may also be determined by the price resulting from secondary trading of released pipeline capacity.

largely depreciated, marginal costs and risks fall and returns tend to rise. The lack of transparency in the pricing of bundled gas and transport services, coupled with the spectacle of very high profits, tend to lead to pressure for government action. The pressure comes from gas producers and consumers and other energy providers deprived of the opportunity to share in the economic rent.' (Citation from IEA, 1998)

The IEA (1998, pp. 51-52) summarises the lessons learned from liberalisation in the UK and the US as the need for:

- Transparency in access terms. In order to prevent discrimination between gas traders, to encourage competition and an efficient operation of the industry, conditions of access to the pipeline and storage facilities have to be clear.
- Unbundling. Effective TPA and efficient regulation implies effective separation between gas supply and trading from pipeline and storage functions. It ensures that costs are allocated to the proper activities.
- Regulation of pipeline tariffs. In order to prevent the abuse of monopoly power, related to the ownership of networks (natural monopoly), some rate-of-return or price regulation is necessary.
- Clearly defined responsibilities for regulation, either by governmental bodies or independent authorities. It is important to avoid short-term political interference in the day-to-day regulation of the gas sector and to ensure transparency and consistency in decision-making.

4.5 Renewable Energy Policy in Europe

In 1998 the Commission of the European Communities (CEC) set the indicative target to increase the level renewable energy in the form of electricity, heat and biofuels to 12% of the community gross energy consumption by 2010 (CEC, 1997). This is equivalent to a share of 22.1% of the total EC electricity production. The overall community target is differentiated to indicative targets for each of the individual Member States (CEC, 2000). According to the principle of subsidiarity, it is left to the Member States to develop their own policies to realise their target. This has led to a situation in which different countries of the European Union (EU) have different mixes of renewable energy support mechanisms. This section first describes the role of renewable energy in the EU electricity generation mix. Consequently, the main renewable energy support mechanisms that are applied in the Member States are discussed. This overview of renewable energy policies is limited to electricity only.

4.5.1 The Role of Renewable Energy in the EU Electricity Generation Mix

Renewable Energy (RE) sources as defined by the European Commission refers to renewable non-fossil fuels. More specifically, this means wind, solar, geothermal, wave, tidal, small hydro (<10 MW), biomass from agriculture, forestry, residues from agriculture, forestry, horticulture, and the food processing industry, untreated wood, and cork waste (CEC, 2000). Table 4.3 gives the contribution from renewable sources to the electricity generation mix in each of the EU Member States.

Table 4.3 *Electricity generated from renewable energy sources in % of total electricity consumption in 1996*

	Incl. Large hydro		Excl. Large hydro	
	1996	1997	1996	1997
Austria	66.0		8.7	
Belgium	1.1	1.0	0.9	0.9
Denmark	6.3		6.3	
Finland	24.1		9.2	
France	15.5		2.2	
Germany	4.4	4.5	2.3	2.4
Greece	10.0	8.6	0.4	0.4
Ireland	4.0		1.1	
Italy	16.5	16.0	4.7	4.5
Luxembourg	1.6		1.6	
Netherlands	2.8	3.5	2.8	3.5
Portugal	44.6		4.7	
Spain	23.8		4.0	
Sweden	38.2		5.3	
UK	1.6	1.7	0.7	0.9
Total	13.5		3.0	

Source: European Commission.

4.5.2 Renewable Energy Support Mechanisms in the European Union

The focus in this paragraph is on economic support mechanisms for Renewable Energy (RE) in the European Union (EU). Economic RE support mechanisms in the EU can be distinguished in quota based systems, such as tradable green certificates and tendering systems, and direct price support mechanisms, such as feed-in tariffs and subsidies. Moreover, fiscal measures that seek to internalise the cost of environmental pollution can be employed to improve the competitive position of renewable electricity generation. Detailed information on EU-wide and Member State RE policies can be found on the following website: http://www.agores.org. The discussion below draws on Kühn et al. (1999), Schaeffer et al. (1999).

Subsidies

The most widespread instrument to stimulate RE sources has been subsidies. Subsidies are used mainly for two purposes, stimulating the development of RE technologies and enhancing the competitiveness of RE technologies in the market. The latter can generally be divided into subsidies on RE capacity and subsidies on renewable electricity generation. Subsidies on capacity only stimulate capacity instalment, but do not stimulate generation and demand of renewable electricity. To stimulate the development of less economical RE technologies, such as rooftop photovoltaic systems, these technologies generally receive higher subsidies than technologies that are closer to the market, such as wind.

Uncertainties in subsidy schemes arise from budgetary issues, and the administrative process by which they are established and allocated. For instance, subsidies on installed capacity might be unfairly distributed if the total amount of subsidy is limited. In general, if the subsidised technology becomes too widespread, the subsidy may have to be abolished because of the high cost. These issues are particularly sensitive if the total subsidy budget is subject to annual government appropriation.

Feed-In Tariffs

Feed-in tariffs are a special case of subsidies on renewable electricity generation. They come in the form of guaranteed premium prices in combination with a purchase obligation by the utilities. The levels of guaranteed prices and the basis on which they are established varies considerably from country to country. In several countries the feed-in tariff is based on the avoided cost of the utility that has the purchase obligation. Furthermore, the tariff can be differentiated according to season, time-of-day, and continuity of supply.

The German electricity feed-in law (Stromeinspeisungsgesetz) provides for a fixed price for all renewable generators. Grid operators are obliged to accept renewable electricity produced in their area at the fixed feed-in price. To protect the grid operators against high financial loads, a toughness condition is included in the law. A regional limit of 5% renewable electricity is set. If the renewable electricity production surpasses this threshold in a supply area, the operator is exempted from the obligation to purchase and refund.

Feed-in tariffs have proved to be very successful in promoting the deployment of renewable energy sources. However, utilities that are located in areas with a large potential of renewable energy sources will likely be offered more renewable electricity, and will therefore have to pay more premium tariffs. In a liberalised electricity market this puts these utilities at a competitive disadvantage relative to utilities in areas with low renewable energy potentials. Some kind of compensation mechanism could be designed to avoid this problem.

In the short term, fixed feed-in tariffs give maximum investment security to RE developers. However, as the contribution from renewable sources to the generation mix increases, the cost of a fixed feed-in tariff system would become to high in the longer term, and political support for the system will diminish. Thus the long-term investment security is low because of the inherent political instability of the system.

Contrary to competitive market-based support mechanisms, such as tendering systems and green certificate trading systems, fixed feed-in tariffs do not provide incentives for innovations and cost reductions. To counter this deficiency the appropriate regulatory authority may lower the fixed tariff to reflect falling prices caused by technological and operational progress. However, this may be resisted by existing renewable electricity generators.

Tradable Green Certificates

Rather than stimulating supply of electricity from RE, a green certificate system seeks to stimulate the demand. The green certificate system is based on the separation of electricity as a physical commodity, and its ‘greenness’ emanating from the use of renewable sources. The ‘greenness’ is incorporated in the green certificate, which is issued at the moment of production, and which can be traded separately from the physical commodity. Certification provides an accounting system to register production, authenticate the source of electricity, facilitate trade, and to verify whether demand has been met. Demand may be voluntary, based on the customer’s willingness to pay for green electricity, or it can be imposed by the government. In the latter case, penalties are applied if the demand obligation is not met.

The principle advantage of trading in green certificates is that it provides a cost-effective means of achieving a RE generation target. Furthermore, the level of ambition of the target or obligation is reflected in the price of the green certificates. This can provide a clear price signal to potential investors in RE projects. Moreover, green certificate trading stimulates competition between RE producers, which will lead to declining costs of renewable electricity generation.

The critical issues in the design of a green certificate trading system are the definition of renewables to be used, the timing aspects of the obligation, the penalty for not reaching the target and the parties bearing the demand obligation. With regard to the timing aspect, the targets, the window for meeting the obligations and the time validity of the certificates should be determined. Moreover, the number of years that the demand obligation will be in force affects the uncertainty faced by RE project developers.

Green certificates can be traded, banked and consumed like any other commodity. In several EU Member States they are predominantly traded through bilateral contracts, but it is expected that both a spot market, and a forward and options market to hedge against price risks, will develop for green certificates. Forward prices will provide a powerful price signal for the development of new RE projects.

Green certification systems have only recently been introduced in the Netherlands, Denmark and Belgium. In the Netherlands the system and demand obligation is currently based on a voluntary agreement between all electricity producers. The certificates are only valid in the year in which they are produced. The price is therefore very sensitive to annual weather variability. Furthermore, as most certificates are traded bilaterally, the market is not very transparent. Only a small fraction (3%) of the certificates is traded through the spot market. The relatively small number of market players in the Dutch electricity market does not encourage the development of the spot market. This reduces the investment incentive that green certificates can provide. Moreover, it poses a problem for determining the penalty rate. Currently the penalty rate is defined as 150% of the average annual certificate market price. This has the benefit of not putting a cap on certificate prices. On the other hand it is hard to determine a representative average market price if most trades are bilateral.

Tendering Systems

In tendering systems a limited subsidy on output is awarded to a restricted number of investors. Potential investors have to compete for this subsidy through a competitive bidding system. In each bidding round only the most cost-effective offers will be selected to receive the subsidy. The bidding may be differentiated in bands of different technologies and RE sources. This means that wind projects compete against other wind projects but not against, for example, biomass projects. The marginal accepted bid sets the price for the whole technology band. The government decides on the desired level of electricity from each of the renewable sources, their growth rate over time, and the level of long-term price security offered to RE generators over time. The bidding is accompanied by an obligation on the part of electricity providers to purchase a certain amount of electricity from renewable sources at a premium price. The difference between the premium and market price is reimbursed to the electricity provider, and is financed through a non-discriminatory levy on all domestic electricity consumption.

The UK has a tendering system known as the Non-Fossil Fuel Obligation (NFFO). The NFFO obliges the Regional Electricity Companies (RECs) to buy a certain amount of renewable electricity at a premium price. These specified amounts are met with NFFO contracts that are awarded as a result of competitive bidding within a technology band on a pre-arranged date. The cheapest bids per kWh within each technology band are awarded contracts. The NFFO generators are paid the premium price per kWh. The Non-Fossil Purchasing Agency (NFPA), a wholly owned accounting body of the RECs, reimburses the difference between the premium price and the pool selling price to the RECs. This difference is paid for by a Fossil Fuel Levy on electricity, paid for by all electricity consumers.

The NFFO has been very successful at bringing down the price of renewable electricity. Since 1990 five tendering rounds have been held, NFFO-1 to NFFO-5. From NFFO-3 to NFFO-5 the average price of renewable electricity has dropped by almost 40%. The average bid price under NFFO-5 was only about 0.1 p/kWh above the reference market price for bulk electricity supply.

Depending of the duration of the contract offered to the RE generator, a tendering system gives more or less revenue security in the long term. Long term obligations, accompanied with long term contracts increase revenue security and can lower the cost of finance of RE projects.

The cost to RE project developers of preparing for a bidding round is significant, with a high risk of being declined. This high up front risk will lead to larger companies being the main bidders, rather than small local enterprises.

From the government point of view tendering systems may have several advantages. Tendering in technology bands allows taking other interests into consideration, such as stimulating domestic industry, local employment and the country's export potential.

Fiscal Measures

Several EU countries support renewable electricity via their tax system. The form of these schemes may range from rebates on general energy taxes, rebates from special emission taxes, proposals for lower Value Added Tax (VAT) rates, tax exemption for green funds, to fiscal attractive depreciation schemes. In these countries the gap between renewable and non-renewable electricity cost has declined. However, because of considerations of international competition these taxes have never been put at such a level that they contribute substantially to the deployment of RE sources. Harmonisation of green tax systems across the EU would be needed to avoid this problem.

Overview of European Union Renewable Energy Support Mechanisms

Most EU Member States employ several policy instruments in parallel to promote the generation of electricity from renewable sources (see http://www3.jrc.es/projects/eneriure and http://www.agores.org). Tabel 4.4 lists the main and additional policy instruments per Member State. It should be noted that, in addition to specific RE policies, other policies, such as grid access and tariff regulations or local spatial planning procedures, may also be very important to the development of the RE projects. Both often impose significant barriers to RE project realisation.

Another aspect that deserves some attention is the quality of the installed equipment. RE technology often has to meet certain safety requirements. These can be technology specific, as is the case for wind turbines, or they can coincide with sector or industry codes, such as building codes for the integration of photovoltaic systems in rooftops. There are no requirements concerning the operational quality of the equipment, such as the amount and reliability of output and the conversion efficiency. Incentives to maintain and increase operational performance can be tied to the support mechanism that is used. Subsidies on output provide a strong incentive to improve operational performance, since the amount of subsidy is directly proportional to the output that is generated. Support mechanisms that are based on competitive mechanisms, such as tendering and tradable green certificates, also reward RE generators for maintaining and improving continued generation, reliability and efficiency. Moreover, competitive mechanisms provide an incentive to reduce the cost of renewable electricity generation at the same time.

Tabel 4.4 *Overview of renewable energy policy instruments per EU Member State*

	Investment subsidy	Feed-in tariff	Tender	Fiscal or tax	Green certificates
Austria	o	+	o		
Belgium		o		o	+
Denmark		o		o	+
Finland	+			o	
France	+	o	o		
Germany	+	+			
Greece	+	+		o	
Ireland	+		+	o	
Italy		o		o	
Luxembourg		o			
Netherlands	+			o	+
Portugal		o			
Spain		o		o	
Sweden	+	o			
UK			+		

+ = main instrument
o = additional instrument

4.5.3 Conclusions

In this section considers several economic RE support mechanisms that are currently used in various EU Member States. These support mechanisms can be distinguished in competitive quota-based mechanisms, i.e. tendering and tradable green certificates, and non-competitive subsidies and feed-in tariffs. Furthermore, support may be targeted towards RE capacity or RE generation. Support mechanisms that reward a RE generator for its generated output provide a strong incentive to maintain and improve operational performance and to increase the generator's output. This is preferable to capacity support if a government seeks to increase the share of electricity from renewable sources in the overall generation mix. Output subsidies and feed-in tariffs, however, can become very costly as the renewable electricity generation increases. Contrary to output subsidies and feed-in tariffs, quota-based mechanisms stimulate competition and thereby provide a strong incentive to reduce the cost of renewable electricity. Furthermore, fiscal instruments can be employed to reduce the cost differential between renewable and non-renewable electricity generation. In practice most EU countries use more than one support mechanism at a time. In addition to economic policy support mechanisms several other policies, such as grid access regulations, safety regulations, building codes and spatial planning procedures, play an important role in the implementation of RE projects.

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RECOMMENDED WEBSITES

http://www.agores.org: Overview of RE policy in EU member states.
http://www3.jrc.es/projects/eneriure: Overview of RE policy in EU member states.
http://www.europa.eu.int/comm/energy/en/elec_single_market/implementation/index_en.html: European Union: The Internal Market for Electricity. Implementation by the member States.
http://www.nordpool.no: Nordpool, Nordic Power exchange.
http://www.apx.nl: APX, Amsterdam Power Exchange.
http://www.lpx.de: LPX, Leipzig Power Exchange.
http://www.eex.de: EEX, European Energy Exchange.
http://www.eia.doe.gov/emeu/cabs/china.html
http://www.iea.org

APPENDIX A DIFFERENCES BETWEEN ELECTRICITY AND GAS MARKETS IN EUROPE

The main differences between the electricity and gas market are:

Production - There is more production of electricity and electricity production is more flexible and decentralised. Gas production is dependent on the location of gas fields and is subjected to long lead-times and huge investments.

Ownership - Electricity production is generally publicly owned and it is an integrated part of the market. Gas production is generally privately owned. Most gas producers are not integrated in downstream activities. However it can be expected that liberalisation of the European gas market stimulates the participation of gas producers in downstream operations. The advantage of this integration is that it allows the producers to capture a part of the downstream rent and it decreases risk (profits become less dependent on upstream gas prices).

Market structure - As a result of the difference in production, the market structure and degree of competition differ. The gas market is an international market with international players. Gas-to-gas competition had already developed before the realisation of the Gas Directive, except for distribution of gas to smaller customers. The electricity market is a national market with mostly national players. Competition is (mostly) induced by the Electricity Directive.

National interest - The national interest in the production of gas is larger. The government wants to be sure of a long term secure supply and -in the Dutch case - of a considerable State income from gas production. This national interest makes a gradual and orderly opening of the market more important than with electricity. Failing results into reduction of exploration and production.

Existing legislation - Electricity market (production and prices) has been heavily regulated from the beginning. The regulation of the gas market is restricted to the licensing of production. Today every consumer is theoretically free to choose its gas supplier.

APPENDIX B EU GAS DIRECTIVE

The single most important aspect in nowadays gas market policies in the EU is the establishment of the internal market for natural gas. During the discussions for the preparation of the EU Gas Directive (Directive 98/30/EC), which was adopted by the European Parliament and the Council in June 1998, individual countries already began to take steps towards liberalisation of their national gas markets and are expected to do so in the next years. Member States have to take care that the Directive is implemented into their national laws by 10 August 2000. The Directive basically takes over the principles of the Directive on electricity (Directive 96/92/EC). This means the regulation of access to the system, reciprocity, subsidiarity and the gradual opening-up of the market, while taking account of the specific features of the natural gas market.

Scope
The Directive establishes common rules for the transmission, distribution, supply and storage of natural gas. It lays down the rules relating to the organisation and functioning of the natural gas sector, including liquefied natural gas, access to the market, the operation of systems, and the criteria and procedures applicable to the granting of authorisations for transmission, distribution, supply and storage of natural gas.

General rules for the organisation of the sector's public service obligations
Member States must ensure that natural gas undertakings are operated in accordance with the principles of the Directive, with a view to achieving a competitive market in natural gas. They must not discriminate between these undertakings as regards either rights or obligations.

The two approaches to system access laid down in the Directive must lead to equivalent economic results in the Member States and hence to a directly comparable level of opening up of markets and to a directly comparable degree of access to natural gas markets.

Member States may impose on undertakings operating in the natural gas sector, in the general economic interest, public service obligations which may relate to security, including security of supply, regularity, quality and price of supplies and to environmental protection. These obligations must be clearly defined, transparent, non-discriminatory and verifiable.

Member States may refrain from applying certain provisions of the Directive with regard to distribution insofar as these provisions would obstruct natural gas utilities in the fulfilment of the obligations imposed on them in the general economic interest. However, non-application of these provisions must not affect the development of trade between Member States to a degree that would be contrary to the Community's interest.

Opening-up of the market
Member States will specify eligible customers, meaning those customers inside their territory, which have the legal capacity to contract for natural gas. Member States will take the necessary measures to ensure that at least the following customers are designated as eligible customers:

- All gas-fired power generators are eligible. Member States may introduce a threshold for the eligibility of combined heat and power producers in order to safeguard the balance of their electricity market.
- Other customers who consume more than 25 million cubic metres (mcm) of gas per year (on a consumption site basis) are also indicated as eligible.

The definition of eligible customers must result in market opening of at least 20% of the annual national gas consumption. This percentage will increase to 28% five years after the Directive becomes active, and to 33% after ten years. The percentages come with thresholds for eligible customers, other than gas-fired power generators, of 25 mcm, 15 mcm and 5 mcm per year on a consumption site basis.

Table B.1 *Agreed EU gas market opening*

	1998 (2000)	2003	2008
Power producers	all	all	all
Other final customers	> 25 million m^3	> 15 million m^3	> 5 million m^3
Minimum opening	20%	28%	33%
Optional maximum opening	30%	38%	43%
EU average	33.3%	36.7%	42.5%
Latest estimate	70% by August 2000		80%

Source: Geil, 1999.

Organisation of access to the system
For the organisation of access to the system Member States may choose between two procedures (negotiated access or regulated access) which must operate in accordance with objective, transparent and non-discriminatory criteria.

- Negotiated access (nTPA): natural gas companies and eligible customers inside or outside the territory covered by the system can get access to the system by negotiating with the relevant natural gas undertaking. The natural gas undertaking will be required to publish their terms for use of the system annually.
- Regulated access (rTPA): Natural gas companies and eligible consumers have the right to access the system on the basis of published tariffs and/or other terms and obligations for use of that system.

For the independent use of storage facilities (that is independent from using the network system) there are no provisions in the Directive. It is argued that the use of storage is always related to the use of outlet pipelines, it cannot be viewed as separate from the network.

Unbundling
Integrated undertakings in the gas sector must keep transparent and separate accounts for their natural gas transmission, distribution and storage activities (administrative unbundling) in order to avoid discrimination, cross-subsidisation and other distortions of competition. Accounts for non-gas activities should also be separated.

Derogations
For Member States and natural gas undertakings it is possible to apply for derogation of the Gas Directive. The following exceptional situations may be qualified for derogations:

- If a natural gas undertaking encounters serious economic and financial difficulties because of its take-or-pay commitments (some of their customers could decide to purchase their gas elsewhere), it may ask derogation from the requirement to allow access to the system by third parties.
- If a Member State is not connected to the interconnected system of any other Member State and has only one main external supplier (i.e. a supplier having more than 75% market share).
- If a Member State is an emergent market (or has a geographically limited area that is emerging) which will experience substantial problems when adopting the Directive, with a view to encourage investments.

The derogation may also be granted in case of capacity constraints of the network. The Member States are obliged to establish a dispute settlement entity in their country, to which one can turn for appeal on these derogations. The Member State and/or commission may grant the derogation. The derogations can only be temporary and may not disturb the functioning of the common market.

Production regulation
Production activities are not covered by the Directive on natural gas. Gas production activities are regulated by a separate Directive adopted in July 1994. The aim of this Directive is to ensure that undertakings shall enjoy equal access to oil and natural gas production activities, and to enable them to exercise such activities under economic and competitive condition. To this end, the Directive establishes common rules for granting authorisations and licenses and common conditions for exercising the upstream activities. The Directive represented a first step for the realisation of a competitive gas market, by giving equal possibilities to production companies for the exploitation of gas fields.