INTERNATIONAL ENERGY AGENCY

Energy Policies of IEA Countries

FINLAND 1999 REVIEW

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SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Over the past few years, Finnish energy markets have undergone a period of reform and restructuring. Reform comprised the introduction of competition into the electricity market in 1995 and the successive adaptation to competition in the domestic market as well as closer integration with the Nordic electricity market. It also brought competition to the natural gas market in full compliance with the EU Directive. This reform was realised despite the fact that, as of early 1999, Finland was not interconnected to the European Union's natural gas network. Finally, Fortum Oyj was created in 1998 in a merger of Neste, Finland's largest oil company, and IVO, its largest electricity supply company.

Finland has designed its electricity market in an original way, in that regulation is limited and the market relies largely on competitive mechanisms, consumer choice, and consumer information. Finland has avoided some of the problems that competitive power markets experienced elsewhere. For example, the rules put in place to cope with transmission bottlenecks are straightforward and predictable but nevertheless provide proper incentives. The Finnish example may be worthwhile for other countries to study.

However, attention needs to be given to market power, especially in the electricity market. Finland and the wider Nordic market are still relatively concentrated. Finland does not rely on price regulation according to a fixed formula, neither a price cap nor revenue control. Prices are controlled through ex post plaintiff action by the competition or regulatory authority. This approach appears to be cumbersome. The authorities in charge are active, but it is not clear whether they are strong enough to prevent abuses.

Some of these concerns also apply to the natural gas market, especially price regulation. Finland's decision to introduce the full EU Natural Gas Directive is laudable. But before Finland is connected to the western gas grid, competition will remain limited and effective regulation will be necessary. The Government is well-advised to give its support to the two interconnection projects now under discussion.

Concerns about market power are particularly relevant to the creation of Fortum Oyj. The intention behind the creation of Fortum was to form a large player in the EU energy market. Yet Neste ownes Gasum, Finland's only gas transportation company, and so its merger with IVO has created diagonal integration between electricity and natural gas. The decision to oblige Neste to reduce its stake in Gasum was a very important precondition for workable competition in the domestic electricity market.

Climate change is another important issue in Finnish energy policy. The country has already exploited much of its energy efficiency potential, partly because of its cold climate and the scarcity of indigenous energy resources, but also because there is strong support for environmental protection in Finland. Finland was the first country in the world to introduce a carbon tax in 1990. Finland also has one of the highest shares of combined heat and power production in the world. Carbon dioxide emissions, however, continue to rise, and Finland is looking for ways to address this problem. Greater use of natural gas, especially in electricity and heat production, could be a promising strategy, provided that the gas market can deliver the additional quantities and that appropriate incentives for gas use are in place.

RECOMMENDATIONS

The Government should:

Energy Market and General Policy Recommendations

- Take care that there is sufficient antitrust surveillance of the energy market in general, and that there is sufficient regulatory oversight of remaining monopoly areas.

- Work toward extending and strengthening the cross-border links in grid-bound industries as soon as economically feasible.

- Ensure that, during the privatisation of energy companies, ownership is spread among a large number of players and that cross-ownership is reduced.

Energy Efficiency and Environment Recommendations

- Commit to a strategy to achieve its carbon dioxide emissions targets, prioritise a small number of key instruments, and implement them. The Government should clearly define what savings are aimed at, carefully monitor progress, and adjust the instruments if necessary.

- In its voluntary agreements, set concrete targets for the different sectors, based on thorough audits and estimates of likely trends, and further develop monitoring of the results.

- Continue its vigorous efforts to meet its international obligations in the area of climate change.

- Stabilise the structure of the CO_2 tax and avoid further dramatic changes in the near future.

Fossil Fuels Recommendations

- ☐ Continue the policy of non-interference in the oil market, combined with effective antitrust oversight.

- ☐ Continue, and if possible intensify, efforts to create alternative gas supply routes to diversify the supply of natural gas, by lending political support to the new pipeline projects that are under consideration in the gas industry.

- ☐ Supply the new Gas Market Act with an effective mechanism to regulate pipeline prices as well as prices for other services which are not competitive. Encourage new supply arrangements among different types of gas consumers.

- ☐ Ensure effective regulatory and anti-trust oversight.

Electricity Recommendations

- ☐ Ensure that all aspects of the electricity market that need regulatory surveillance are adequately supervised and in particular:

  • Ensure that the Electricity Market Authority (EMA) has all of the powers and resources it needs to monitor the market. Make sure EMA, perhaps with support from other institutions, develops a transparent and effective methodology to assess the "reasonableness" of prices and to identify and eliminate monopoly rents and internal subsidisation.

  • Ensure that the Office of Free Competition (OFC) continues to monitor market power in the wholesale market and, where necessary, uses the new provisions in the Competition Act. Exert adequate antitrust scrutiny. Concentration in the electricity market, including cross-ownership, should be closely monitored.

  • Ensure co-operation and division of work between EMA and OFC, since both are comparatively small organisations.

- ☐ Continue to ensure that end users are fully informed of electricity prices. Consider the introduction of a register for all electricity retailers which can easily be accessed by consumers. It would provide information, including information on prices, and a basic examination for good business practice in addition to the regular company register.

- ☐ Through EMA, monitor Fingrid's ownership and governance, making sure that the large shareowners do not significantly expand their ownership, and work toward broadening Fingrid's ownership base. Since Fingrid is at the core of the Finnish power market, all interests in the market should eventually be reflected in this company.

- Further strive to reduce information and transaction costs to small consumers through mandatory guidelines for billing and model power supply contracts.

- Consider involving EMA in the OFC's monitoring of district heating prices, especially cross-subsidies between heat and electricity supply.

Nuclear Recommendations

- Consider past electricity demand and supply trends and assess the role that nuclear power can play (through lifetime extension or nuclear capacity additions) in reducing CO_2 and air pollutant emissions, in helping to ensure security of supply and in diversifying input fuels. Clarify the future role of nuclear based on the economic, environmental and security impacts of all energy resources.

- Continue to ensure progress in the design and development of a final repository site for the disposal of high-level radioactive waste.

R&D Recommendation

- Take measures towards improving the use of R&D results.

2

ORGANISATION OF THE REVIEW

An IEA review team visited Finland in September 1998 to review the country's energy policies. This report was drafted on the basis of information received during and prior to the visit, including the Finnish government's official response to the IEA's 1998 policy questionnaire and the views expressed by various parties during the visit. The main author of the report is Gudrun Lammers. The team greatly appreciated the openness and co-operation shown by everyone it met.

The members of the team were:

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The team held discussions with the following organisations:

- The Finnish Ministry of Trade and Industry (Energy and Industry Departments)
- The Finnish Ministry of the Environment
- The Finnish Technology Development Centre (TEKES)
- The Electricity Market Authority
- The Office of Free Competition
- The National Consumer Administration
- The Consumer Ombudsman
- The Finnish Association for Nature Conservation
- The Confederation of Finnish Industry and Employers
- The Finnish District Heating Association
- The Finnish Electricity Association (SENER)
- The Finnish Energy Industries Federation (FINERGY)
- The Finnish Power Grid plc (Fingrid Oyj)
- Gasum Oy
- Helsinki Energy
- IVO (Imatran Voima Oy) Group
- Neste Group
- The Finnish Petroleum Federation

3

ENERGY MARKET AND GENERAL POLICY

OVERVIEW

Finland is located in northern Europe. Almost its entire national territory is situated between 60 and 70 degrees northern latitude, and a quarter of its surface area lies north of the Arctic Circle. One third of all people living north of the 60th parallel are Finns. The mean annual temperature in Southern Finland is 4 to 5 degrees C, in Lapland –2 to +2 degrees C. In January, the mean annual temperature in the northern two thirds of the country is -10 to -15 degrees C, in southern Finland it is –5 to –10 degrees C. Even in southern Finland, 30% of the annual precipitation stems from snow, which remains on the ground for about 4 months. In the winter season, there is a very limited amount of full daylight, necessitating electric lighting until late morning and as of early afternoon. The growth season is four months long. Correspondingly, the population-weighted average number of heating degree days for Finland is 5 000, much higher than the figure for Sweden and Norway (4 000). Thus Finland has the coldest climate in Europe.

Finland is large and sparsely populated: with 338 145 km^2, it is the fifth largest country in Europe and has a population of 5.1 million, i.e. 15 people per square kilometre. About two thirds of Finns live in urban areas; only 1.6% live north of the Arctic Circle. More than three quarters of the country is covered by boreal coniferous forests, and 10% by lakes and other water systems: only 9% is farmed. The forest and paper, metal and engineering and chemical industries represent about 80% of Finland's industrial production. These industries are very energy-intensive, and the forest and paper industry alone accounts for 63% of industrial energy consumption.

Finland has been an independent republic since 1917. Its neighbours are Sweden, Norway, Estonia and Russia. Finland joined the IEA on 1 January 1992, and became an EU member in 1995. Finland had close trade relationships with the former Soviet Union (FSU) in the form of a clearing account system, which was abolished in 1991. Finland's exports consisted of various industrial products like machinery and foodstuffs. Finland imported from the FSU energy products like crude oil, oil products, gas and electricity. In accordance with the agreements between the two governments, the volume of the trade was balanced yearly. However, the trading partners in Finland were private enterprises, goods with a clearly identifiable world market price were valued at that price, and imports and exports could be aggregated. Due to the system, a part of Finnish exports were nearly unaffected by events in the world economy. The vast majority of Finnish trade, however, has been with market economies such as Germany, Sweden and the UK.

The importance of exports to the FSU had declined gradually but steadily throughout the 1980s from its 1982 apex of 27%, and was already significantly reduced when the clearing account system was abandoned. Thus, a large section of the Finnish economy has always consisted of highly internationally competitive sectors, notably wood products, pulp and paper, and metals. Virtually all of these sectors are primary industries and highly energy-intensive.

In the early 1990s, Finland experienced a severe recession. Output contracted during three consecutive years (1991, 1992 and 1993), and unemployment increased from as little as 3% in 1989 to 20% three years later. This recession was the deepest in Finnish history. It was only partly due to the collapse of the country's Soviet exports; overheating during the boom years of the late 1980s significantly contributed to its severity. However, unemployment was particularly high in the shipbuilding and textiles sectors which had dominated trade with the FSU. The economy has recovered, although unemployment rates are still high: 16.7% in 1995, 15.8% in 1996, and an estimated 14.5% in 1997. 1997 was a boom year for the Finnish economy: GNP grew by an estimated 5.9%, a growth rate that was achieved only in 1979 and 1989.

Many of the large energy companies are majority state-owned: Neste-Gasum, the oil and gas conglomerate, Imatran Voima Oy (IVO), the largest electricity producer, and the peat producer Vapo Oy. Neste and IVO have merged into the new company Fortum[1]. These companies were created to supply the general public with energy products and services.

In the past, industrial companies in Finland's main export sectors were self-sufficient in energy use. They generated electricity, often by using their own production wastes (e.g. black liquor and industrial wood residues). When additional power supply was needed, industrial companies created Pohjolan Voima Oy (PVO) which was jointly owned. PVO was set up to supply power to its owners and it only sold surplus power into the general market. Since it also operated its own separate transmission grid, PVO functioned like a separate electricity market for industry alongside the open, public market. Today, non-industrial power retailing companies have an ownership share in PVO.

The Government is the initiator of new legislation, and the executive of existing legislation. It also has a role in designing and setting up the regulatory institutions, including nominating their president. In Finland the Government is also the owner of the largest energy companies. Finland has a tradition of light-handed regulation of natural monopoly elements in the energy market which largely relies upon the competition authorities and their mechanisms.

In the recent past, several consecutive governments have undertaken reform of the Finnish energy market, especially towards privatisation of the state-owned companies and the introduction of competition where feasible, notably in the electricity market. The Finnish Government considers the international dimension of the energy market to be very important; this is clearly reflected in its energy market reforms.

Although there clearly is the intention to privatise, there is no homogeneous overall programme; every privatisation decision is made according to the situation of the individual company and market conditions. Also, every privatisation requires a mandate from the Parliament. So far, the Parliament has been cautious in its

1 See section Fortum Merger.

mandates; it has not authorised the government to reduce its shareholding in energy companies to minority shareholdings. Whereas the government is allowed to reduce its stake in the steel corporation Rautaruukki or the chemicals group Kemira to some 30%, and has already sold the majority of its shares, the privatisation mandate requires it to keep a 50.1% majority stake in Fortum and a 75% stake in Vapo.

The Government (officially the Council of State) has, however, established a number of performance requirements for state-owned companies. They require that:

- the companies be profitable once they are established;
- they pay dividends comparable to the general practice in the market;
- they be allowed to be operated fully on commercial grounds, similar to privately-owned companies; and
- they be treated the same as privately-owned companies with respect to state aids.

The move towards privatisation and competition is also reflected in the government's new energy strategy for the future, adopted in May 1997. This strategy represents an attempt to balance the requirements of an internationally open, competitive energy market place and the imperatives of environmental protection, especially climate change. The main objectives of the strategy are:

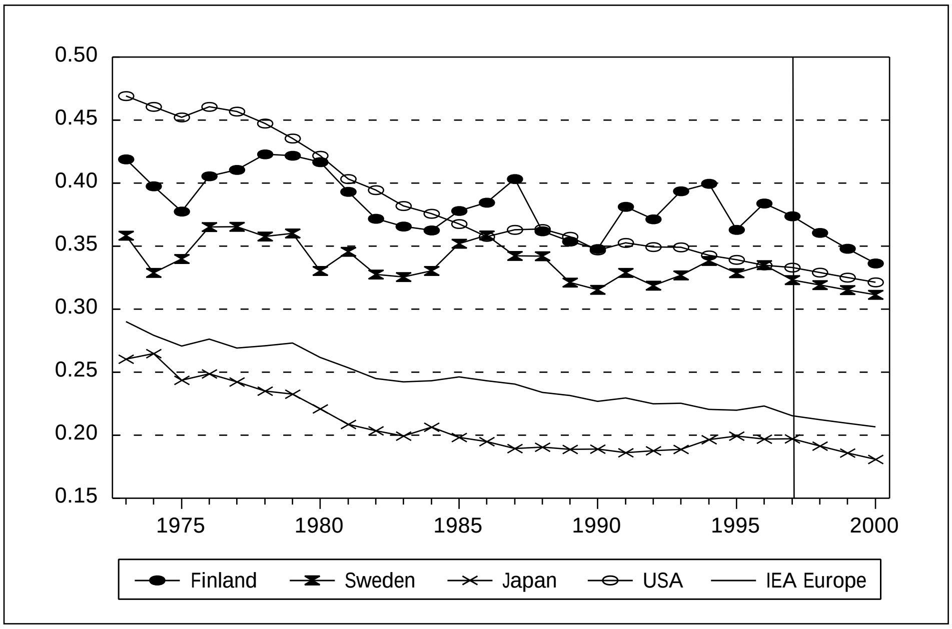
- developing the structure of energy production in a direction that involves reduced emissions of carbon dioxide;
- promoting the competitive energy market;
- ensuring diversified and economically advantageous energy supply;
- ensuring security of supply;
- ensuring continued sustainable economic growth;
- promoting efficient energy use and energy conservation;
- promoting the use of renewables, especially biomass, and other indigenous energy resources; and
- maintaining the high standard of energy technology.

Most of these objectives have been made operational in the energy strategy. The Government plans to halt the growth of energy demand within the next 10 to 15 years, while at the same time pursuing market liberalisation and leaving in place full consumer choice.

ENERGY DEMAND

Finland has one of the highest energy intensities in the IEA, both per capita and per unit of GDP. The rate of decline in energy intensity was slower in Finland than in

Figure 1
Energy Intensity in Finland
(Toe per thousand US$ at 1990 prices and purchasing power parities)



Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD), *National Accounts of OECD Countries* (Paris: OECD).

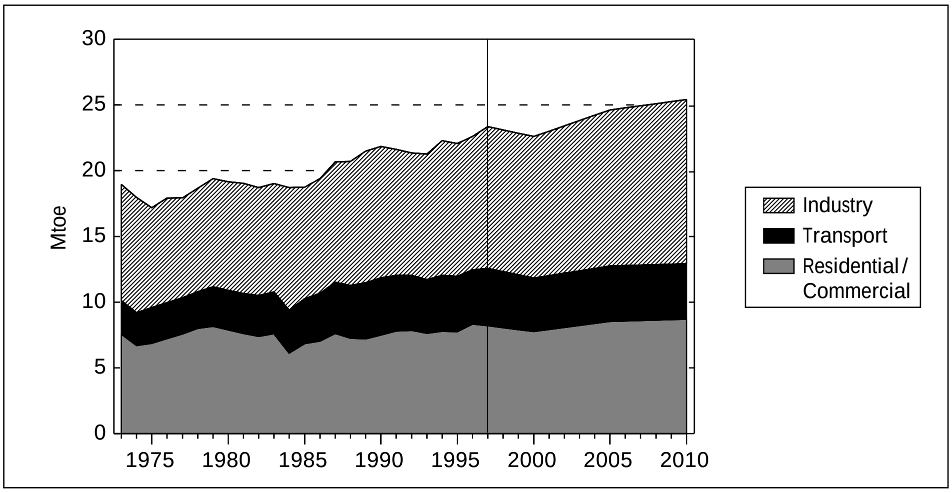
many other IEA countries between 1973 and 1999 (Figure 1). This can partly be explained by the deep recession in the early 1990s when GDP declined.

Finland's high energy intensity is due mostly to its cold climate, but primarily to its industrial structure which is based on energy-intensive export industries. Figure 2 shows total final consumption (TFC) of energy by sector. Whereas in most other IEA countries the share of industrial energy use has declined to 40% or lower, in Finland it still accounts for about half of all energy use.

Figure 3 illustrates this point even more clearly, showing industrial energy intensity in Finland far above the IEA average and comparable countries like Sweden, while transport and residential-commercial sector intensities are closer to average levels.

Figures 6, 7 and 8 show the relationship between demand for energy-related services and gross domestic product in purchasing power parities. The figures strongly reflect the deep contraction of the economy in the early 1990s. Whereas total IEA GDP continued to grow, Finnish GDP was only fully back to its 1990 value in 1996. In the transport sector, lower overall energy use accompanied the fall in GDP. Transport energy use is expected to rise, however; 1996 saw the registration of more than 100 000 new cars in Finland, almost twice the number of cars (56 000) that were registered in 1993 in the middle of the recession.

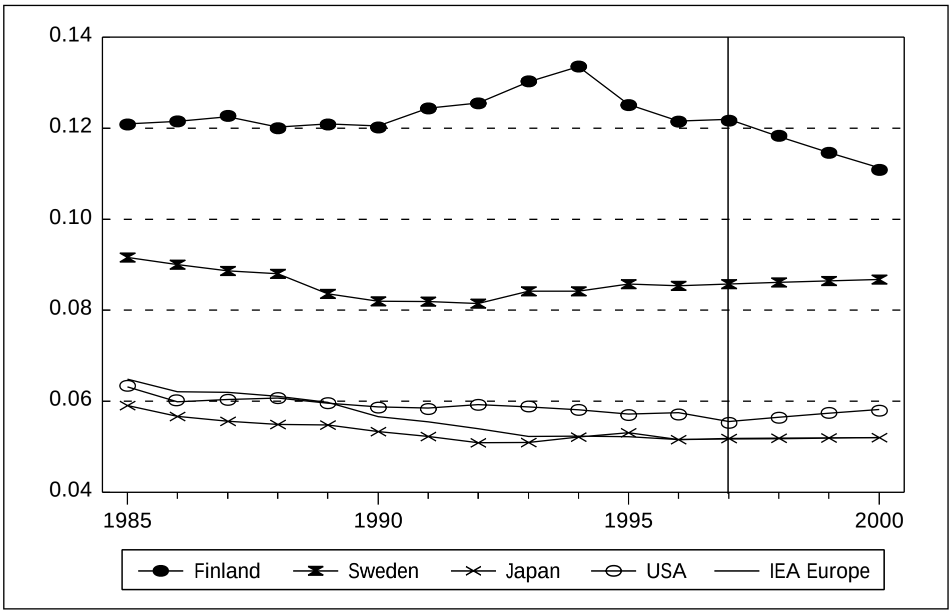
Figure 2
Total Final Consumption of Energy by Sector*
(Mtoe)



* excluding non-energy use.

Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD) and country submission.

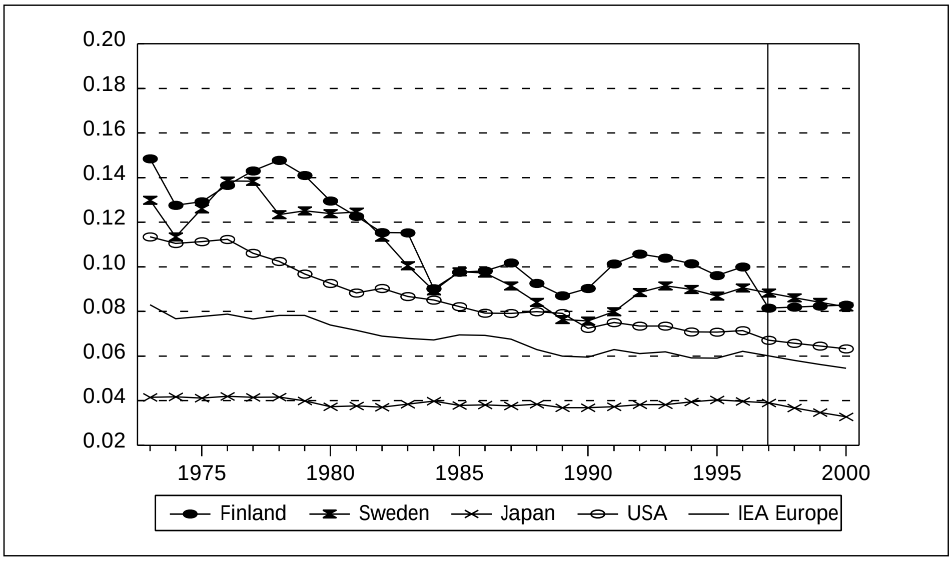
Figure 3
Industrial Energy Intensity in Finland
(Toe per thousand US$ at 1990 prices and purchasing power parities)



* excluding the non-energy sector.

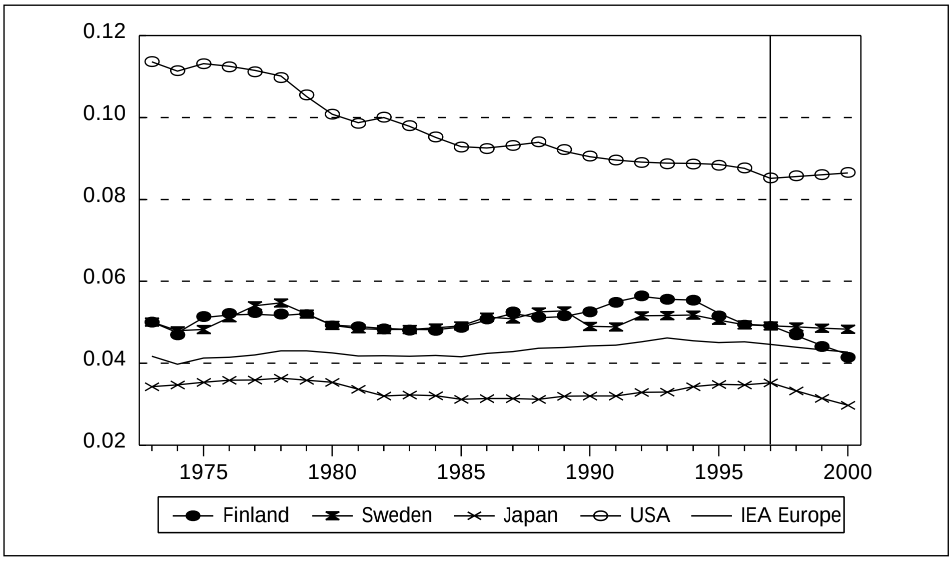
Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD), *National Accounts of OECD Countries* (Paris: OECD).

Figure 4
Residential-Commercial Energy Intensity in Finland
(Toe per thousand US$ at 1990 prices and purchasing power parities)



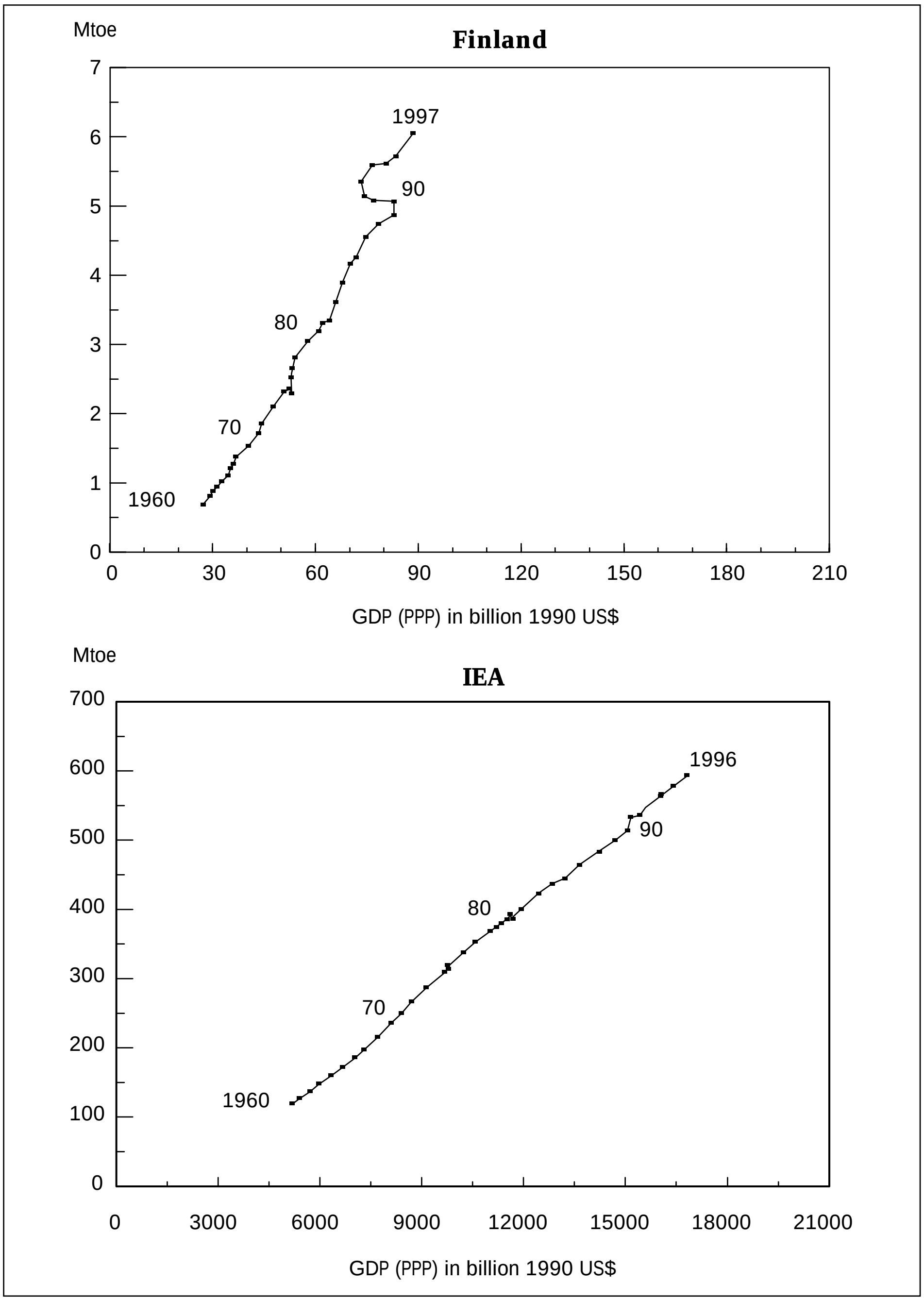
Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD), *National Accounts of OECD Countries* (Paris: OECD).

Figure 5
Transport Energy Intensity in Finland
(Toe per thousand US$ at 1990 prices and purchasing power parities)



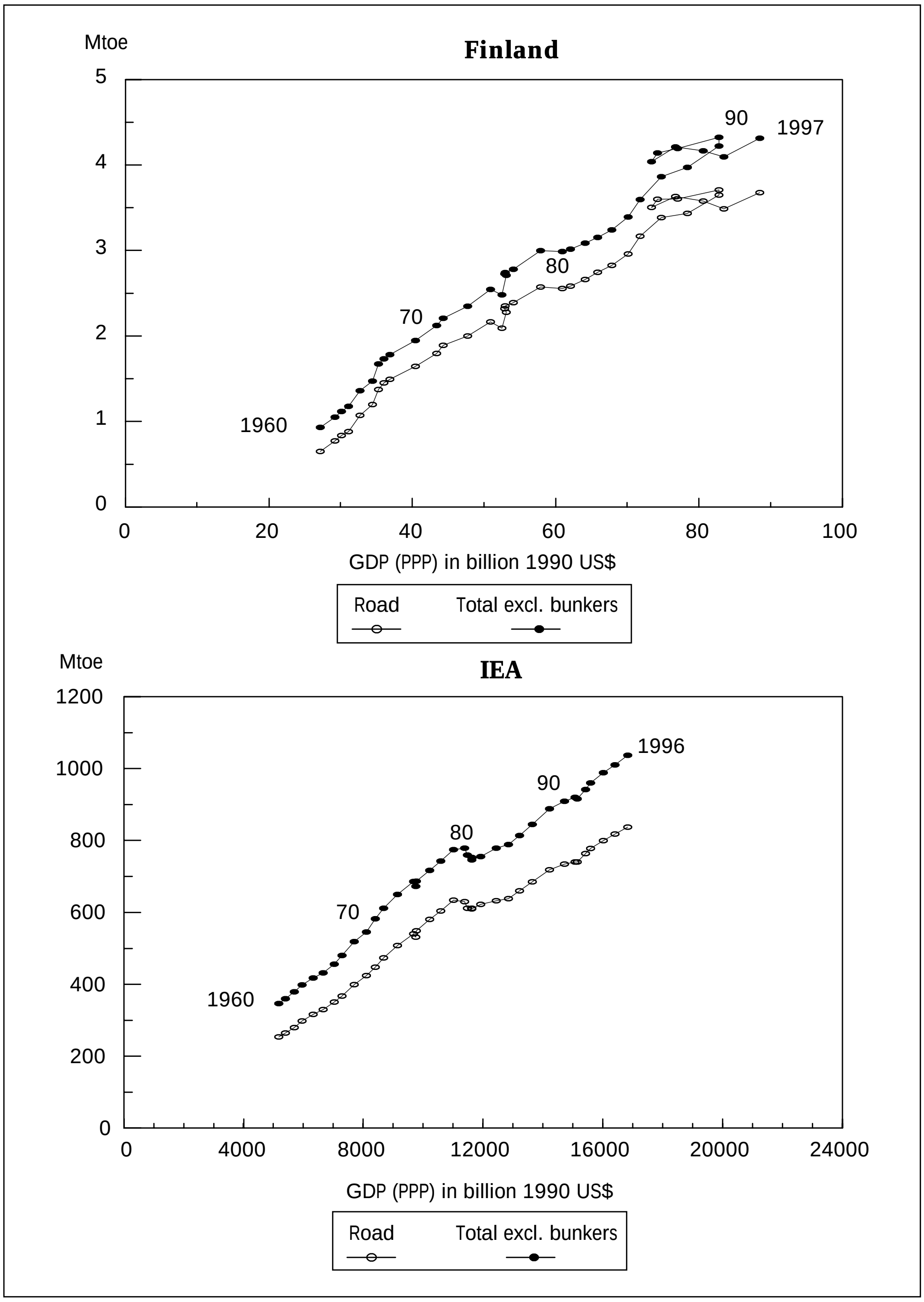
Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD), *National Accounts of OECD Countries* (Paris: OECD).

Figure 6
Electricity Consumption per GDP
(Mtoe and GDP in Purchasing Power Parities)



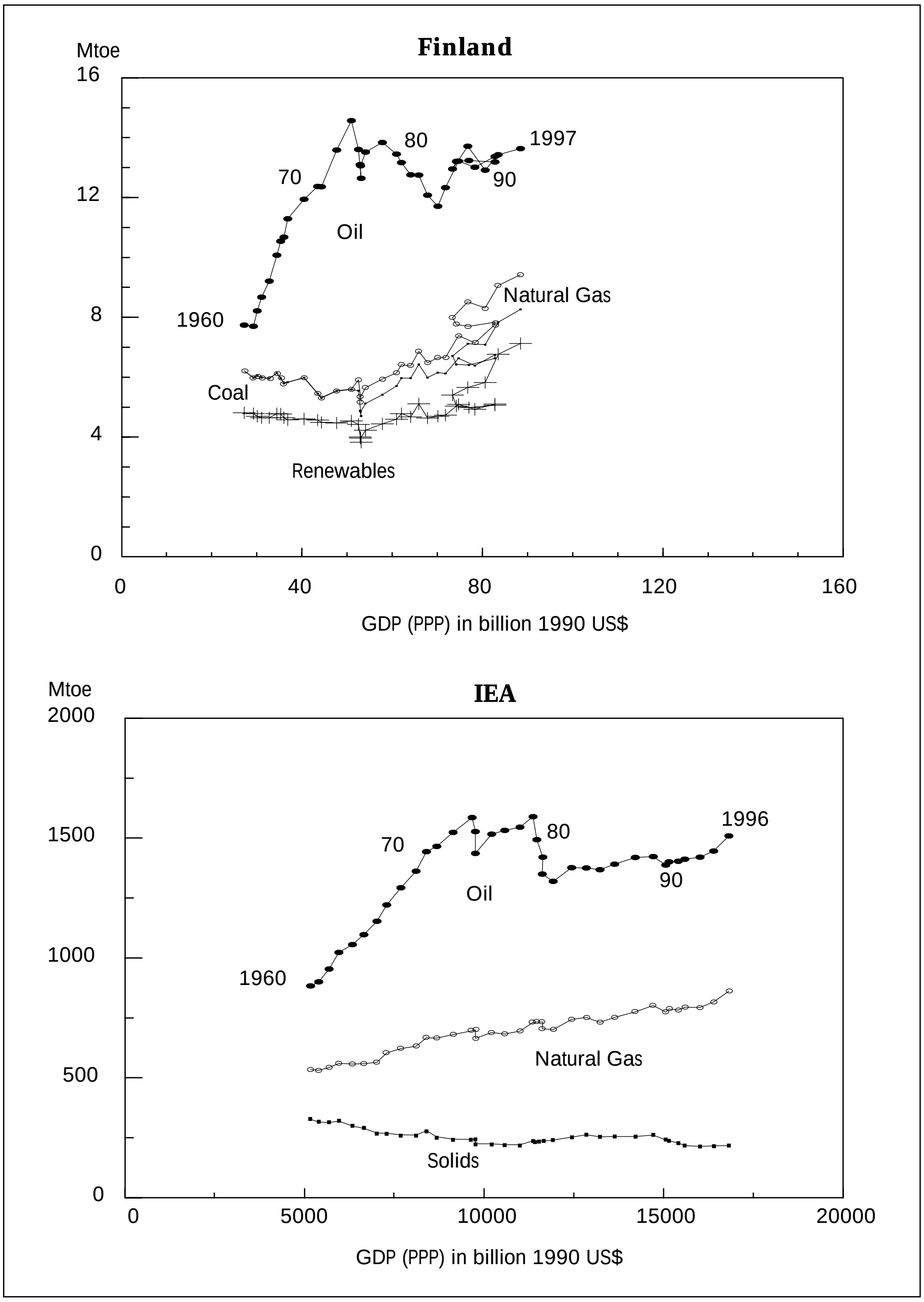
Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD), *National Accounts of OECD Countries* (Paris: OECD).

Figure 7
TFC in the Transport Sector per GDP
(Mtoe and GDP in Purchasing Power Parities)



Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD), *National Accounts of OECD Countries* (Paris: OECD).

Figure 8
Consumption of Stationary Fossil Fuels per GDP
(Mtoe and GDP in Purchasing Power Parities)



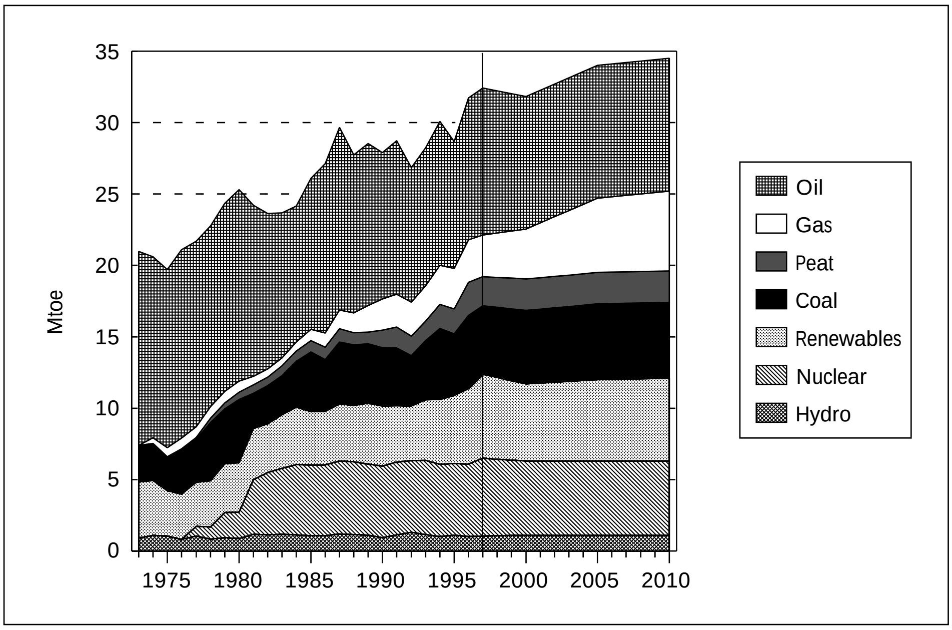
Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD), *National Accounts of OECD Countries* (Paris: OECD).

Overview

Total primary energy supply (TPES) in Finland is illustrated in Figure 9. The country's main energy input in 1997 was oil, 9.9 Mtoe and 31.4% of TPES. Solid fuel use was 6.9 Mtoe or 20.7% of TPES; of this, 4.8 Mtoe or 14.5% was coal, and 2.1 Mtoe or 6.2% was peat. Renewables accounted for 7 Mtoe or 20.9% of TPES. Most of the renewables use came from combustible renewables and wastes, i.e. mainly black liquor, wood combustion and wood wastes, which amounted to 17.7% of TPES (5.9 Mtoe) in 1997. Hydro power accounted for 3.2% (1.1 Mtoe). Finland has two nuclear power plants which provided 5.4 Mtoe or 16.5% of TPES. Electricity imports (0.7 Mtoe) accounted for the balance of 2.0%.

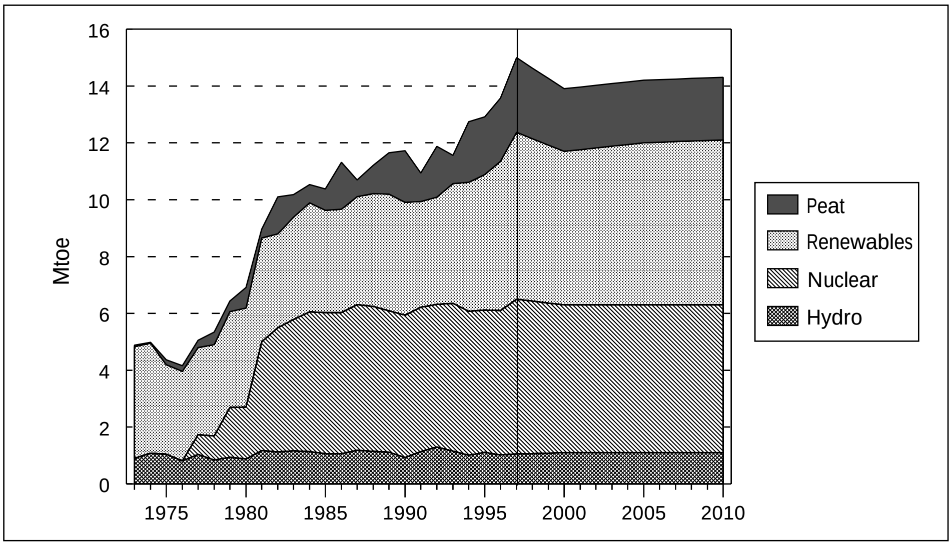
Combustible renewables, hydro power and peat are Finland's only indigenous energy resources, and together account for most of the country's energy production, as illustrated in Figure 10. The remainder is nuclear which is produced domestically from imported nuclear fuel. Figure 11 shows Finland's energy imports according to their country of origin.

Figure 9
Total Primary Energy Supply by Fuel, 1997
(Mtoe)



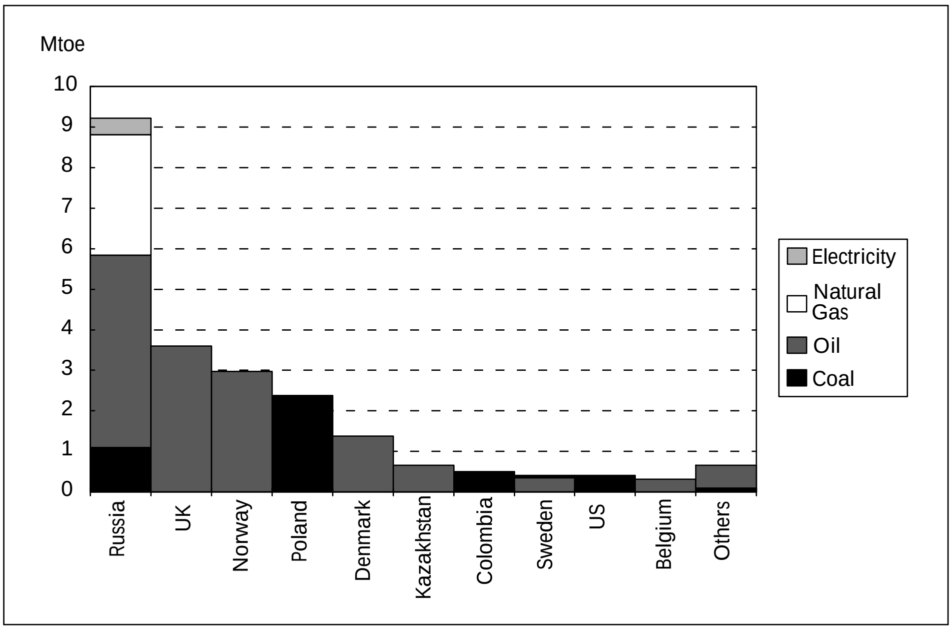
Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD) and country submission.

Figure 10
Energy Production in Finland
(Mtoe)



Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD) and country submission.

Figure 11
Energy Imports of Finland, 1996
(Mtoe)



Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD).

Fortum Merger

Major restructuring occurred in the Finnish electricity market in September 1997, when IVO's and PVO's transmission grid operations IVS and TVS were merged into a single national grid company, Fingrid[2]. Another important structural transformation took place in Finland's energy sector in 1998, the merger of the largest electric utility, Imatran Voima Oy (IVO) and the country's dominant oil and gas supplier, Neste Oy, into a new company called Fortum Oyj (Fortum plc). Both IVO and Neste were majority state-owned. The Ministry of Trade and Industry (Kauppa- ja teollisuusministeriö, KTM) held 95.6% of the shares of IVO and 83.2% of the shares of Neste. Neste itself is the majority (75%) shareholder of Finland's monopoly gas utility Gasum Oy[3].

In January 1998, the Government established IVO-Neste Yhtymä and became its sole shareholder. It then transferred its shares of Neste to the new holding company. The minority shareholders of Neste were offered an exchange of IVO-Neste shares or cash payments against Neste shares on 28 April 1998. Subsequently, the same operation was carried out for the shares of IVO. The Government changed the name of IVO-Neste Yhtymä to Fortum Oyj on 17 June 1998.

A vital amendment to the Finnish Act on Competition Restrictions, which provided for the control of mergers for the first time in Finnish history, was adopted by the Parliament on 24 March 1998. This amendment, however, only came into effect in autumn 1998. Hence the new provisions on merger control were not yet in force when the Fortum merger occurred. Otherwise, the merger would have come under national antitrust scrutiny, as the new provisions apply to companies above a threshold of Finnish Markka (FM) 150 million of individual turnover and FM 2 billion of combined turnover. In 1997, Neste had a turnover of FM 45.7 billion and IVO at FM 13.8 billion. Since both companies were also above the relevant thresholds of the corresponding European Union merger regulation[4], the case was referred to the European Commission, which delivered a decision on 2 June 1998.

The European Commission initially held the position that the Fortum merger created an undue amount of market power in the electricity market, as it integrated Finland's dominant electricity supply company with the country's dominant oil company and its monopoly gas supplier. The Commission, however, approved the merger under the condition that Neste reduce its 75% shareholding in Gasum to 25% by June 1999. 24% of the shares are to be offered to the Finnish Government, and 26% will be sold to Finnish or European companies independent from Neste and subject to the Commission's surveillance and approval. Another condition was

2 See Electricity chapter, especially sections Restructuring, and Transmission, for a detailed discussion.

3 All these companies and their business activities are described in detail in the Oil chapter (Neste), the Gas chapter (Gasum) and the Electricity chapter (IVO).

4 Council Regulation (EEC) 4064/89.

to structure Gasum's voting rights in such a way, that, together with the Government[5], Fortum would not be in a position to outvote the other shareholders.

In addition to the sale of Gasum shares under the Commission's merger approval, the Finnish Government also intends to privatise Fortum to a minimum government shareholding of 50.1%. The Government originally planned to privatise a minority stake of 20 to 25% in September 1998, but the flotation was delayed when analysis from the Helsinki Stock Exchange showed that the recent upheaval in world stock markets had reduced the expected earnings from the sale by 20%. The sale of shares began in November 1998. Fortum was listed on the Helsinki Stock Exchange in December 1998, and state ownership was reduced to 75.5%. Fortum will also undergo an internal restructuring into five business units: oil and gas; power and heat; operations and maintenance; engineering, and chemicals.

CRITIQUE

Overview

Finland is carrying out a programme of modernisation of its energy economy, and a thorough overhaul of energy policy is an important part of this programme. Far-reaching reforms have commenced in the electricity sector, with reforms in the natural gas sector expected to follow. Finland's reliance on market mechanisms and its open market philosophy are impressive. The current move towards a redefined role for government in energy markets, especially towards privatisation and deregulation, is very commendable. Finland is now among the countries which are furthest advanced in electricity liberalisation.

To the degree feasible, the international dimension has always been well integrated into every aspect of the country's energy policy. There is a long-standing tradition of cooperation and integration with its Nordic neighbours Sweden, Norway and (to a somewhat lesser degree) Denmark. Electricity imports from its eastern neighbours also have a long tradition.

However, in several areas, further work remains. Most importantly, despite the recent restructuring and the introduction of competition, the Finnish energy market is still very concentrated. The natural monopoly in the network parts of the grid-bound industries will have to remain regulated in the foreseeable future.

5 Gasum is currently owned 75% by Fortum and 25% by the Russian company RAO Gazprom, but the Government holds one K share which gives it special voting rights. Once ownership is rearranged, it will be as follows: Forutm 25%, Gazprom 25%, the State of Finland 24% + 1 K share, and other investors 26%. Each of these groups will be represented by two members on the supervisory board. As the Chairman of the board has a special casting vote, this means that the votes of three regular board members and the Chairman will always outvote the other board members. For this reason, Fortum has agreed to ensure that none of its members on the supervisory board will act as the Chairman.

Finland's approach of light-handed regulation, relying mainly on the competition authorities and their methods for the control of company behaviour, i.e. ex post litigation and compensation for abuses of market power, may have been well-adapted to the past. Public ownership was seen to rule out the most blatant abuses of monopoly power, and the Finnish competition authorities have been very active in pursuing abuses. Light-handed regulation is to be commended, not least because of its low administrative costs.

The Finnish experience, however, has shown that publicly-owned companies are no less frequently accused of market power abuses than private companies. The underlying assumption that public ownership is sufficient to ensure a company furthers the general welfare is not supported by the behaviour of companies in the marketplace. Therefore it remains to be seen whether the light-handed approach is sufficient to prevent anti-competitive behaviour in the concentrated Finnish energy market.

The privatisation of minority stakes of Fortum, Gasum and Vapo is planned, and the first part of the Fortum sale was completed in late 1998. The Gasum sale must occur before June 1999. Yet these are still only minority privatisations; the Government is retaining control over all of the key energy sector firms. The result is that government will continue to play a triple role as executive, regulator and owner of state-owned companies. This role can create a conflict of interest that does not favour impartial regulation. At present, the competition authorities are independent from the Government, as is the Electricity Market Authority (EMA), whose chairperson is appointed by the Government for an unlimited period of time and cannot be removed except for severe offences. Should experience show that closer control of the remaining areas of market power is necessary for consumer protection, the current arrangements might have to be revised, with a view to addressing the possibility of regulatory capture, while maintaining or even strengthening EMA's independence.

In general, however, the higher the degree of privatisation and of mixed ownership, the better it will be for the market and the consumer. The possible negative effects of dominant positions in the grid-bound industries could be diminished by increasing the size of the relevant markets through strengthening and extension of the cross-border network infrastructure as soon as economically feasible.

Fortum Merger

The Government created the oil-gas-electricity conglomerate Fortum to establish a Finnish company which would be strong enough to compete in the internationally competitive energy market place, and especially the EU internal energy market. The Government believes that large Finnish energy companies, especially capital-intensive ones, are better able to compete effectively in global markets.

The effects of competition from abroad should not, however, be overestimated. While the Nordic electricity market has developed very quickly, the same cannot be expected from the wider European energy market. The infrastructure allowing competition may not be in place - as is the case in the gas market - and it may take foreign companies longer than expected to be aware of business opportunities, especially since energy demand grows slowly. It seems likely that the Nordic market will remain the relevant energy market for Finland in the near future. Even the Nordic market is not free of concentration; there are at best three power companies other than IVO which can be considered serious competitors.

In view of this high concentration, the Fortum merger had the potential to weaken competition in the domestic market considerably, creating “diagonal” integration between electricity on the one hand and gas and oil on the other. Gas and oil are both inputs to electricity generation and are substitutes for electricity in some final energy markets, especially the heat market. Integrating dominant positions in all three markets into one holding company would have given Fortum both the incentive and the power to discriminate against competitors, probably by using gas prices[6]. It would also have eliminated the price ceilings that gas and oil provide in competition to electricity in the heat market. The European Commission’s decision regarding the Fortum merger provides a satisfactory solution. The Government should, however, ensure that during the partial privatisation of Gasum, ownership of the minority stake is spread among a large number of players. Once real competition is feasible, i.e. after interconnection with the European gas network, the Government might wish to consider selling part or all of its own direct stake in Gasum.

RECOMMENDATIONS

The Government should:

- Take care that there is sufficient antitrust surveillance of the energy market in general, and that there is sufficient regulatory oversight of remaining monopoly areas.

- Work toward extending and strengthening the cross-border links in grid-bound industries as soon as economically feasible.

- Ensure that, during the privatisation of energy companies, ownership is spread among a large number of players and that cross-ownership is reduced.

6 The potential for discriminatory pricing is kept in check to some degree via the public pricing system for gas, described in the Gas chapter.

4

ENERGY EFFICIENCY AND THE ENVIRONMENT

OVERVIEW

Climate Change

Air pollution and climate change are both strongly linked to energy use, and efficient conversion and use of energy, as well as fuel switching, address both problems. Air pollution can also be addressed by other strategies, including technologies such as catalytic converters, desulphurisation, or coal "washing". Policies aimed at reducing air pollution have been successful in most IEA Member countries in the past 10 to 15 years. Policy instruments are in place or at least available, and air pollution is no longer considered an insurmountable problem.

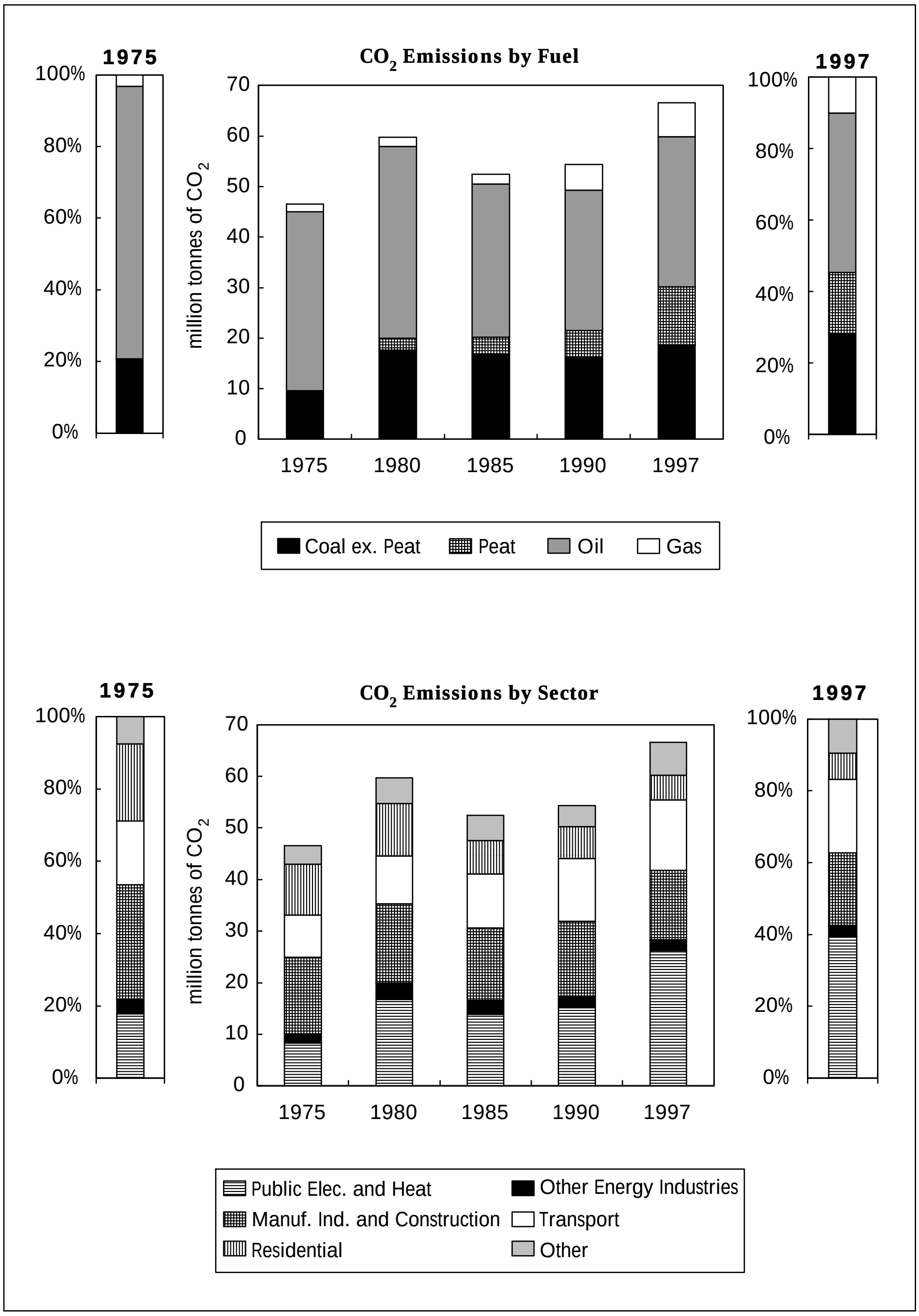
Climate change policy, and especially policies to reduce carbon emissions, are more difficult to implement because carbon removal from exhaust gases, although technically feasible, is not expected to be economically feasible given current technology and its foreseeable development. Aside from switching to less carbon-intensive fuels, improvements in energy efficiency are likely to be achieved only through technological change, government regulation, economic instruments such as carbon taxation or tradeable permits, voluntary agreements or any mix of the above.

Figure 12 shows the historical development of CO_2 emissions from fuel combustion in Finland between 1975 and 1997 by fuel and by sector. Between 1988 and 1995, almost every year with increased emissions was followed by a year with reduced emissions, although emissions rose consistently and slowly. Thus, emissions were only marginally higher in 1995 than in 1990, but were much higher in 1996 and 1994 than in the previous years.

Over the past two decades, coal has increasingly substituted for oil. More recently, gas has also substituted for oil. A shift in the share of emissions away from the residential sector and towards electricity and heat production has also taken place over the past 20 years due primarily to the substitution of cogenerated district heat for direct fossil fuel use in households.

CO_2 emissions from transport are comparatively high in Finland. With 37 cars per 100 inhabitants, Finland is among the IEA countries with the highest ratios of private cars, and Finns also drive their cars more than most others. This is largely due to the size of the country and its low population density.

Figure 12
Carbon Dioxide Emissions by Fuel and by Sector
(Emissions from Fuel Combustion, Mt of CO_2)



Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD) and country submission.

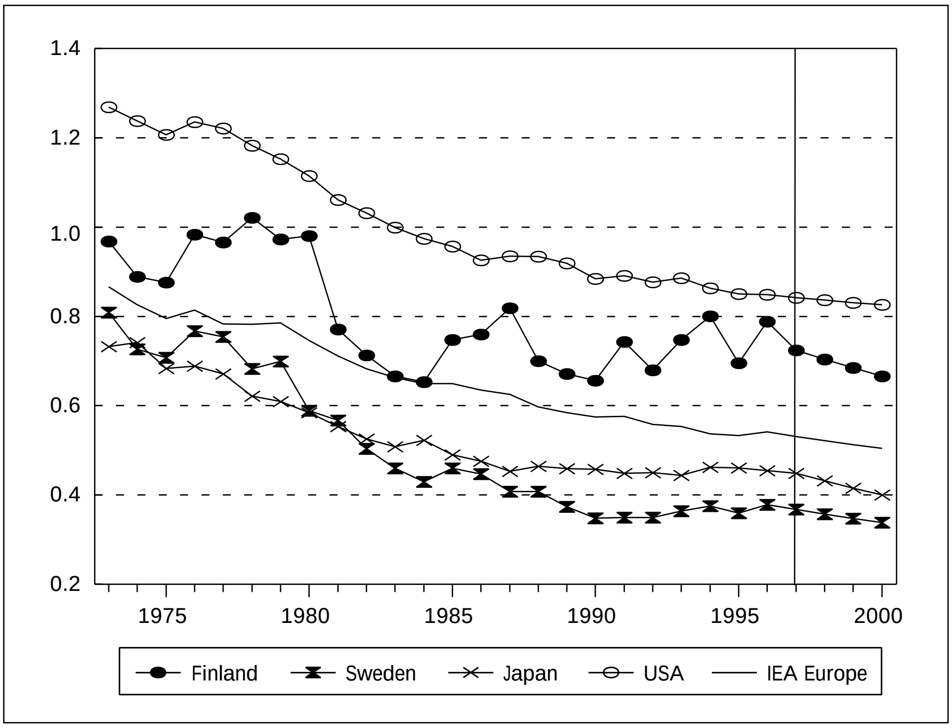
Finland's cold climate and scarcity of indigenous energy resources have amplified awareness of efficient energy use. Building codes requiring effective insulation came into force as early as the 1960s, and a requirement for triple glazing for all new buildings was adopted in the 1970s. The country also has one of the largest shares of combined heat and power production (CHP) and district heating (DH) in the world: one third of electricity is produced in CHP plants, and 50% of the building stock is connected to the district heating network. This allows extraction of 80 to 90% usable energy out of primary energy resources, as opposed to about 40% for electricity generation from condensing power plants and up to 60% for combined-cycle gas turbines (CCGTs). These high conversion efficiencies can reduce the need for fossil fuel inputs by up to 30% for each unit of usable energy.

In its latest (1997) forecast, the Government built three scenarios for future energy use and CO_2 emissions for 1995 to 2025. The three scenarios are based on the assumption of 2.5% average annual GDP growth. The energy market scenario (EMS)

Figure 13

Carbon Dioxide Emissions per Unit of GDP

(thousand US$ at 1990 prices and purchasing power parities)



Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD), *National Accounts of OECD Countries* (Paris: OECD).

extrapolates current trends and preferences for energy use ("business as usual"), and yields a 40% increase in total energy consumption and a 70% increase in power demand in 2025, compared with 1995. Based on the assumption that there are no significant changes in the use of power generation input fuel, this translates into CO_2 emissions 50% higher than in 1995, i.e. 87 million tonnes per annum.

The energy policy scenarios (EPO1 and EPO2) contain several assumptions with a restraining effect on energy use: higher world market energy prices, higher taxation, more stringent regulatory measures and faster penetration of new, energy-saving technologies. EPO1 contains the assumption that natural gas will replace coal in power generation, both in conventional condensing as well as in CHP plants. EPO2 contains the assumption of the construction of an additional 2 000 MW of nuclear capacity before 2010, and less use of natural gas compared with EPO1. Under the EPO scenarios, the growth in total energy consumption between 1990 and 2025 does not exceed 20%. In all scenarios, CO_2 emissions continue to rise at least until the year 2005.

In October 1997, the Finnish Parliament adopted an Energy Strategy built on the above mentioned scenarios. One of its principal objectives is the stabilisation of primary energy demand within the next 10 to 15 years. Subsequently, CO_2 emissions are to be reduced. This is to be achieved without jeopardising economic growth and without unnecessarily restricting consumer choice, i.e. within the context of increasingly competitive electricity and gas markets.

The Government has defined a number of target areas which are to contribute to attaining the objective. It intends to work towards the following subgoals:

- Increasing energy efficiency and the market deployment of new, low-carbon or energy-saving technologies;
- Increasing the use of wood and other "bioenergies"[7] and renewables;
- Increasing the use of natural gas;
- Directing the production of final energy, and especially electricity, toward an energy balance with lower carbon content;
- Keeping the nuclear option open;
- Promoting the energy market;
- Maintaining the high standard of energy technology.

The Energy Strategy also lists a number of tools which could be used to achieve these subgoals, including an array of energy efficiency measures such as voluntary agreements, norms, energy auditing, or higher taxation of energy products. Nearly all

7 The term "bioenergy" is used by Finland to expand the notion of biomass, usually defined as renewable energy, to include peat. Peat, its carbon emissions, and its IEA classification as a solid fossil fuel rather than a renewable energy resource is dicussed in the Fossil Fuel chapter.

of these instruments are already in use in Finland, but the Strategy proposes intensified efforts in all areas. No decision has so far been taken as to which instruments will be strengthened, and to what degree. A follow-up report to the Energy Strategy was prepared in autumn 1998 and submitted to the Government. The report contains a discussion of fuel choice, and in particular the role of natural gas and its impacts on CO_2 emissions. The new Government elected in March 1999 currently discusses this issue.

The objectives and strategies developed by the Finnish Government have to be compatible with the overall climate change strategy of the European Union. The EU as a whole committed itself in Kyoto to reduce its carbon dioxide equivalent emissions[8] by 8% below its 1990 emissions level between 2008 and 2012. In EU-internal negotiations, Finland was given the obligation to achieve stabilisation at 1990 levels. However, 1990 was an unusually wet year in the Nordic Countries, and a year with an unusually mild winter. These special climatic circumstances reduced the need for space heating and allowed replacement of indigenous coal-fired power generation by imported hydro power from Norway and Sweden, and thus lowered Finland's CO_2 emissions below normal levels. In the negotiations on base line and methodological corrections which are to be held under the aegis of the Conference of Parties to the UN Framework Convention of Climate Change, this would correspond to an upward correction of 8.3 million tonnes of CO_2 in 1990 emissions.

Air Pollution

With respect to long-range transboundary air pollution, Finland is committed to the following international reductions targets:

- Reduction of SO_2 emissions from large combustion plants by 40% by 1998 and by 60% by 2003 (1980 baseline, EU directive on large combustion plants);
- Reduction of total sulphur emissions by 30% by 1993 and 80% by 2000 (1980 baseline, Helsinki and Oslo Protocols);
- Stabilisation of total NO_x emissions at 1987 levels by 1994 (Sofia Protocol), 30% reduction of NO_x emissions from large combustion plants by 1998 (1980 baseline, EU directive on large combustion plants), and 30% reduction of total emissions by 1998 (1986 baseline, Sofia Declaration); and
- Reduction of emissions of volatile organic compounds (VOCs) by 30% by 1999 (1988 baseline, Geneva Protocol).

In addition to these international agreements, Finland has adapted its limit values for concentrations of SO_2, NO_2, particulates, ozone and lead in ambient air to the relevant EU directives in September 1996, with more stringent values in place for large new industrial plants.

8 This carbon dioxide equivalent covers six greenhouse gases. Carbon dioxide from energy generation and use covers around 75% of the total.

The sulphur targets were already reached in 1994, and in 1996 total sulphur emissions stood 82% below their 1980 level. Stabilisation of NO_x emissions was reached in 1992, and a 30% reduction of NOx emissions from large combustion plants was achieved by 1997. The Ministry of the Environment estimates that the 30% reduction target for total NO_x emissions will only be reached in 2004. Overall, NO_x emissions per unit of GDP remain 70% higher than the OECD average. VOCs were reduced some 18% between 1988 and 1996.

ENERGY EFFICIENCY PROGRAMMES

In 1997, the Finnish Government adopted a programme entitled Decision on Energy Conservation. According to this programme total primary energy consumption in 2010 will be reduced, by 10% in electricity generation and by 15% in fossil fuels from what it would have been under a business-as-usual scenario. This programme includes:

- Development and wider use of voluntary agreements;
- Further development and promotion of energy auditing activities;
- Targeted information activities; and
- Promotion of research, development, demonstration and dissemination of new, energy-efficient technology.

A central role in this programme is played by Motiva, the Information Centre for Energy Efficiency. Motiva, founded in 1993, is a government-funded organisation whose original purpose was mainly to disseminate information regarding energy efficiency. Its activities have expanded significantly since its foundation, along with its funding and staff. In early 1999, it had a staff of 17 persons and an annual budget of FM[9] 12 million.

Motiva has developed guidelines and standards for energy auditing, training of energy auditors, and a computer-based monitoring system for the audits. The Ministry of Trade and Industry provides a subsidy of 40 to 50% of the cost of the audits. Some 15% of industrial, commercial and public buildings were audited from 1992 to 1997, yielding average savings of 15% of heating energy, 4.5% of electricity and 7% of water consumption. An average of one third of the savings could be implemented without extra investment. Where investment is needed, the Ministry of Trade and Industry grants a subsidy of 30% maximum of total investment costs for energy-efficient new technology and of 10% maximum for conventional energy-efficient technology.

The Government estimates that the cumulative savings from these audits amounted to some FM 500 million in the same time period. The average pay-back time of the

9 One Finnish Markka (FM) was 0.188 US$ in 1998, and 0.193 US$ in 1997. One Finnish Markka is 0.1682 Euros (€) in 1999.

realised measures was two to three years, and the total cumulative government subsidy on energy audits amounted to some FM 45 million. The Government aims to have completed energy audits of 80% of all municipal and industrial energy use by 2005.

Voluntary agreements are a relatively new tool in Finnish energy efficiency policy, but are the main mechanism used in industrial energy efficiency policy. The Government signed six new framework agreements on energy efficiency with the organisations of industry and employers, energy producers, energy distributors and municipalities in 1997. These agreements run until 2005. Currently, some 70% of industrial energy use is covered by voluntary agreements. The corresponding figures for other sectors are: 70% of electricity generation, 40% of electricity distribution, more than 30% of district heating, about 20% of municipal energy use, and about 95% of energy use in the Government's buildings, which are maintained by entities called Real Estate Units. The Government plans to extend the agreements to the commercial and transportation sectors.

The agreements consist of an energy audit or analysis of the entity's energy consumption, an energy conservation plan that the organisation draws up itself, and of investment for and training in energy conservation. The organisations have to report back once a year. The Government intends to make resources available for Motiva to assist implementation and monitoring of the agreements.

Motiva's activities in the transport sector comprise courses for energy-efficient driving for all drivers, including professional drivers, and educational projects on car pooling and demand-based public transport. The eco-driving courses for professional drivers led to energy saving of 8 to 12% at higher average transportation speed, lower service costs and less road accidents.

In the residential and commercial sectors, energy efficiency efforts have focused on energy audits for commercial buildings and condition assessments for apartment blocks, energy labelling of household appliances and office equipment, revisions of the already-strict building codes, and implementation of the efficiency standards of the European Union.

ENERGY TAXATION

Taxation is one of the main policy instruments related to climate change and environmental policy in Finland. In a major reform of energy taxation in 1986, significant rebates in value added tax (VAT) were established for wood, peat and natural gas use - energy resources that were, at the time, considered environmentally beneficial and/or domestically available.

In 1990, Finland introduced a CO_2 tax on fossil fuels. This tax was replaced by a combined CO_2 and energy tax in 1994. The tax was split into a 75% CO_2 tax component levied on the carbon content of the fuel and a 25% energy component levied on its energy content, with heavy fuel oil as the calculatory basis. Special taxes on nuclear electricity, hydro power and imported electricity were also introduced.

Renewables were exempt from taxation. In 1996, the CO_2 tax component was FM 38.3 per tonne of CO_2, and the energy tax was FM 3.5 per MWh. In that year, the CO_2 and energy tax yielded a revenue of FM 2.6 billion, in addition to FM 11 billion from the regular excise taxes. Some 60% of the revenue came from the carbon component and 40% came from the energy component of the tax.

When Finland became a member of the European Union in 1995, it had to harmonise its VAT with EU requirements, and the tax rebates introduced in 1986 had to be abolished. The full rate of VAT is 22%, and, although there are two lower VAT rates of 12% and 6% for certain commodities, all energy products are subject to the full rate.

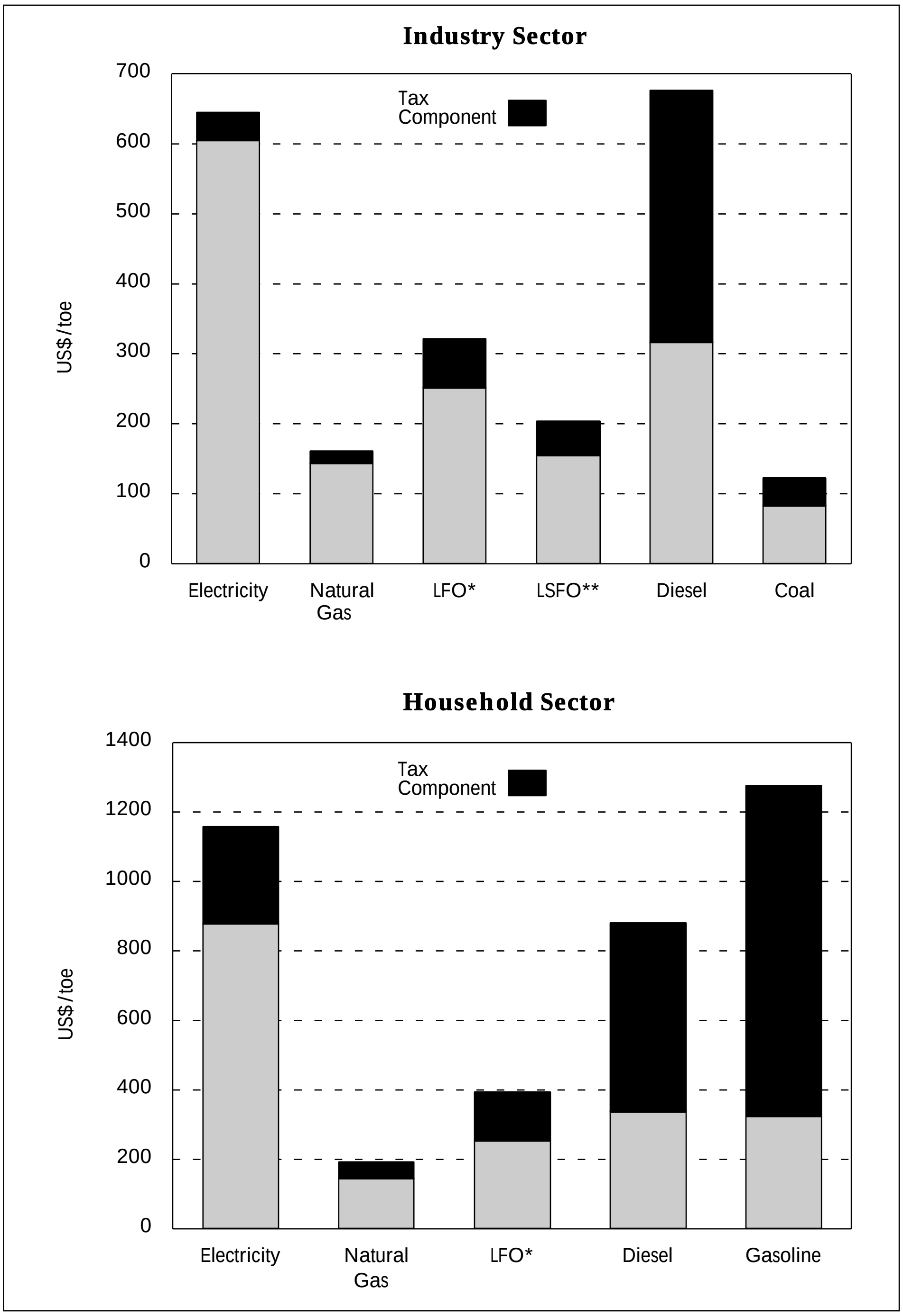
In 1997, a new tax reform was undertaken to bring Finnish taxation in line with taxation in the other Nordic countries. The 1997 tax reform was a major change particularly with respect to taxation of electricity input fuels. Taxation of input fuels for electricity generation was abolished in favour of higher taxation on electricity at the distribution level.This tax is now called an electricity consumption tax because it applies to all uses of electricity. Its rate stayed roughly the same as in the old system for industrial consumers but doubled for all other consumers. Since the electricity consumption tax is a blanket tax that applies to all electricity including renewables, electricity generated from wind, from small hydro plants and from small wood- and peat-fired CHP plants (up to 40 MVA) was granted a tax refund to retain their competitiveness. The tax on imported electricity was removed.

In contrast, the CO_2 tax component on fossil fuels (coal, peat, light and heavy fuel oil and natural gas) for purposes other than electricity generation, i.e. The "heat production tax", was retained. For fossil fuels, the energy component of this tax was abolished in the 1997 tax reform, and the CO_2 component was almost doubled to FM 70 per tonne of CO_2. In addition, petrol, diesel oil and fuel oil are subject to regular excise taxes. Coal, oil, gas and electricity are also subject to a precautionary stock fee, and there is an additional oil pollution fee. Figure 14 shows end user fuel prices in 1997 for the industrial and residential sectors including their tax component.

In 1998, two sets of changes were made to energy taxation. The first one, a minor change coming into force in January 1998, brought an upward adjustment of most tax rates, but also an extension of the tax refund to all wood-based generation.

The second one came into force in September 1998, and extended the system of tax refunds for electricity generation from certain waste gases and raised the refund for wind power. It also introduced tax relief for energy-intensive industries. Under the latest reform, industrial companies can obtain a refund of paid energy taxes if they have paid energy taxes in excess of 3.7% of their value-added. The refundable amount is 85% of the tax which exceeds 3.7% of the firm's value added. However, the refund is only paid for that part of the refundable tax amount which exceeds FM 300 000. Table 1 shows the tax rates applicable under the latest tax reform. Figure 15 shows the development over time of the implicit CO_2 tax in Finnish energy taxation. The CO_2 tax was raised under every tax revision; the final revision in 1998 was by 24%.

Figure 14
Fuel Prices and Taxes by Sector



Source: IEA/OECD: *Energy Prices and Taxes*, 4th Quarter 1998. Paris, 1998.

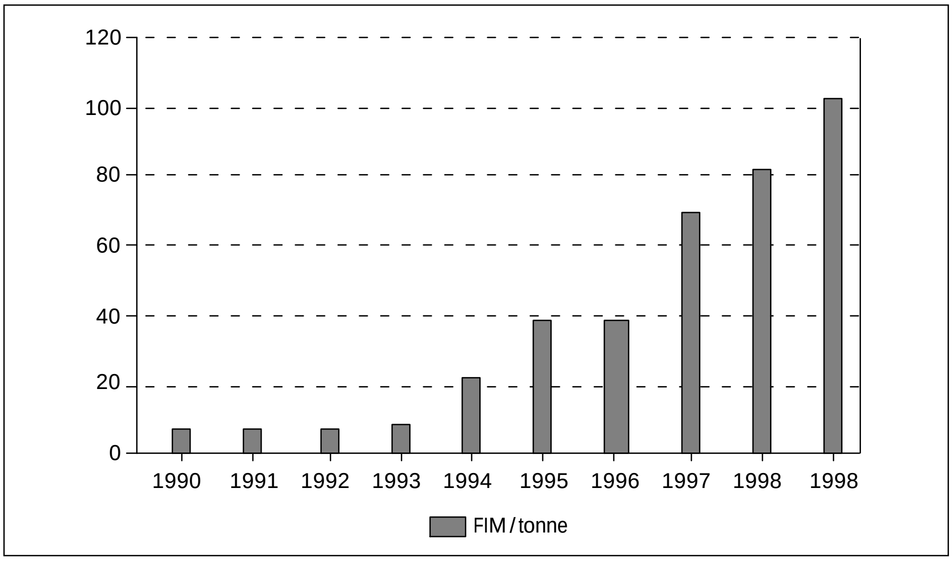
Table 1
Excise Tax and Carbon Dioxide Tax in Finland
(Tax Rates as of 1 September 1998, in Finnish Markka)

Fuel	*Excise Tax*	*Carbon Tax*
Petrol (FM/l)		
– unleaded	3.094	0.239
– leaded	3.544	0.239
Diesel oil (FM/l)	1.666	0.269
Fuel oil		
– light (FM/l)[1]	0.109	0.270
– heavy (FM/kg)[1]	–	0.321
Coal (FM/tonne)[1]	–	246
Peat (FM/MWh)[1]	–	9.0
Natural gas (FM/m^3)[3]	–	0.103
Electricity (FM/MWh)		
– residential + commercial	–	41[2]
– industry + greenhouses	–	25[2]
Pine oil (FM/kg)	0.321	–

1 = zero tax rate for electricity production.
2 = energy tax.
3 = m^3 = cubic metre.

Source: Ministry of Finance.

Figure 15
Evolution of the CO_2 Tax in Finland
(Finnish Markka per tonne of CO_2)



Source: Ministry of Trade and Industry.

CRITIQUE

Climate Change and Energy Efficiency

Finland is very environmentally conscious, as reflected in its high share of combined heat and power production and district heating, and in its high efficiency requirements for the residential sector[10]. During the last two decades, per capita heating energy use in buildings decreased by 30%. The impetus for this and other achievements did not stem from a political desire to increase energy efficiency alone but was a rational response to economic incentives brought about by the scarcity of energy resources, the cold climate and the corresponding effects on consumers' energy bills.

Finland recognises the importance of internalising externalities into energy prices, as demonstrated by its introduction of a carbon tax before any other country. However, a high proportion of the energy savings potential has already been exploited. Despite the country's efforts and achievements, energy consumption and CO_2 emissions are still rising, in close parity with economic growth, which is of course in itself one of the Government's core objectives, not least due to high unemployment. This continued growth in emissions and in energy demand may make it difficult for Finland to meet its emission reductions targets.

The array of instruments Finland has put into place contains all of the policy tools used in national energy efficiency policy throughout the IEA. The combination of voluntary agreements and energy audits is laudable. To broaden its range of policy instruments, the Government should consider the application of the new flexibility mechanisms of the Kyoto Protocol, especially the clean development mechanism, in its climate change policy.

While the tools in place, for the most part, are clearly working successfully, the hardest part of the work lies ahead. Success has been achieved on a small scale, but now the overall trend of increasing energy demand must be faced. The Government should make sure it defines the measures for reaching the targets in a concrete way. It should develop a coherent assessment strategy including the methods for evaluation of sectoral and sub-sectoral achievements, and, most importantly, decide upon priority measures. Steps towards tackling this task were taken in the form of the follow-up report to the Energy Strategy, which is now under consideration by the Government. Based on this report, it is expected that the fuel mix in electricity and heat generation, and especially the possibility for greater gas use, will play an important role. This is a reasonable approach given that the share of coal in total CO_2 emissions has grown to a comparatively high share in the last two decades.

10 For instance, Finland has had a requirement for triple glazing in new buildings since the mid-1970s when many IEA member countries have yet to phase in a double glazing requirement.

The Government has recently started to use voluntary agreements with the industrial sector and municipalities on a broader scale, and intends to extend its use to cover most of the Finnish energy market. Voluntary agreements, a flexible and efficient instrument, are used most efficiently if concrete targets are set with each organisation, and if their achievement is closely monitored. Target setting should be based on audits and forecasts including the likely "business as usual" improvements. Attention should also be given to the transport sector, taking into account possible externalities and the cost of road infrastructure. The Government set up a working group in August 1997, which is an encouraging sign.

Finland is advanced and successful in its energy efficiency policy, but some further efforts need to be made. The same applies for classical air pollutants, where major successes were made in the sulphur programme but further efforts are still needed regarding nitrogen oxides.

Energy Taxation

Regarding the internalisation of environmental externalities into energy prices through economic instruments, Finland is among the most progressive countries. It was the first country in the world to introduce a CO_2 tax in 1990.

Since its introduction, the CO_2 tax has been modified and adjusted many times. The modifications reflect the attempt to achieve two principal objectives: adjustment to the underlying externalities and adaptation to the economic and political realities, notably that most of Finland's competitors in its main export markets are not subject to CO_2 taxation. These two objectives are often in conflict, and a trade-off will necessarily have to be made.

In Finland, the search for an optimal trade-off has meant, on the one hand, an increasing CO_2 tax component and an extension of taxation to those non-fossil fuels that cause significant environmental externalities other than climate change, i.e. large-scale hydro (habitat destruction) and nuclear (radioactive waste). These adjustments improved the efficiency of environmental taxation.

On the other hand, the trade-off has brought a shift away from uniform taxation of all environmentally harmful energy inputs at the source, and towards more piecemeal taxation closer to the point of consumption, including tax refunds to energy intensive industries. These refunds were introduced to shield Finnish industry from disadvantages in international competition; among other things in preparation for the Nordic electricity market. Thus, the effectiveness of the tax was reduced, since substitution possibilities earlier in the conversion chain were foregone, and (even more piecemeal) remedial action had to be taken. For example, when the tax was changed from a fuel input tax to an electricity output tax in 1997, a tax refund for renewables had to be introduced because renewables, although practically free of net carbon emissions, were under the blanket output tax.

Given the current absence of international harmonisation regarding the internalisation of externalities, Finland's approach reflects the realism necessary for a small country active in very competitive world markets. The Government should strive to stabilise the tax structure and to avoid further dramatic changes in the near future, taking into account EU developments. Also, despite the increases in the CO_2 tax since its implementation, the level of Finnish energy prices is still relatively low in international comparison, although this is partly due to market forces. To the extent that technological change opens new possibilities for substitution by capital, further upward adjustment of the implicit tax rate may be warranted as the system of environmental taxation is developed further.

RECOMMENDATIONS

The Government should:

- Commit to a strategy to achieve its carbon dioxide emissions targets, prioritise a small number of key instruments, and implement them. The Government should clearly define what savings are aimed at, carefully monitor progress, and adjust the instruments if necessary.

- In its voluntary agreements, set concrete targets for the different sectors, based on thorough audits and estimates of likely trends, and further develop monitoring of the results.

- Continue its vigorous efforts to meet its international obligations in the area of climate change.

- Stabilise the structure of the CO_2 tax and avoid further dramatic changes in the near future.

5

FOSSIL FUELS

SOLID FUELS

Coal

Finland has no domestic coal production and imports all of its coal, mainly from Poland (59%) but also from Russia and the United States. Coal imports totalled 7.4 million tonnes in 1997. Almost all coal is used for electricity and/or heat production, only 1 million tonnes are used in the steel industry.

Peat

Hydro power, wood-based fuels and peat are Finland's only large-scale indigenous resources. Peat is responsible for some 6.2% of TPES, and about 20% of combined electricity and heat production for district heating. At the current rate of use, Finland's technically retrievable peat resources should last for 600 years. Today's commercially usable peat resources were estimated to be 16 billion[11] cubic metres, spread over 622 000 hectares, and equivalent to around 7 300 TWh of energy per year. Only a small part of this resource, some 11%, is currently in use, all of it from cultivated peatlands. Of this, 10% is used for horticulture, but 90%, between 1.6 and 2.0 Mtoe, is used as a fuel. The Government expects peat use to decline in the future.

Peat is decayed matter from certain plant families that grow in wetlands, notably mosses such as the Sphagnum species. The living plants form the uppermost layer of peatlands, then follows a layer of fast decomposition by aerobic bacteriae, and eventually the lowest and thickest layer where the decay is based on anaerobic bacteriae and occurs more slowly. The anaerobic decomposition is due to the high water table which is generally found in peatlands and is the principal reason for peat accumulation. The decomposed plant matter is harvested by draining the peatland, removing the top layer of living plants and harvesting the peat itself, which is then dried on the field and either milled or cut to sods and burned in power plants, often mixed with wood chips and other wood-based fuels.

11 1 billion = 10^9 = 1000 million.

Due to its location and its humid climate, Finland has the highest proportion of peatlands in the world: almost one third or 10 million hectares was originally peatlands, whereas most of the rest was forest. Industrial use of peat as a fuel and for horticulture dates back to 1876. Development of a large-scale peat industry, notably for peat fuel, started in 1968, when the Government decided to increase annual peat production from about 0.2 million cubic metres to 10 million cubic metres (1 Mtoe) by 1980. The state-owned company Vapo Oy was made responsible for peat production, and the Government lent financial support for drawing up inventories of potential peat production areas and their preparation. Electricity and heat generation from peat received investment aid until 1996. The first combined heat and power plant was commissioned in the city of Kuopio in 1972, with a capacity of 30 MW of electricity and 60 MW of steam for district heating. After the first oil crisis the annual target was doubled to 20 million cubic metres.

At present, there are two major peat producers, Vapo Oy and Turveruukki Oy. Vapo Oy also generates electricity from peat and other fuels. About two thirds of all the peat used as power plant fuel is used in combined heat and power generation in industry and for district heating. There are currently 36 industrial CHP generating units and 17 CHP/district heating (DH) units using peat.

Peat production is highly weather dependent and thus can fluctuate considerably. Intensive technological development has caused the real price of fuel peat to decline by over 40% between 1982/83 and 1996, and some further decline is expected[12]. In areas which lack access to other energies, especially to the natural gas pipeline grid and to port facilities, which would allow cheap import of coal, the costs of peat-based and of coal-based combined heat and power generation are comparable. These areas are essentially found in the sparsely populated central and northern parts of Finland. The cost of using peat for power generation has declined significantly since the 1980s, and peat is broadly competitive with oil, although the cost conditions depend on the site and plant configuration.

The Government provides investment subsidies for new technology, including renewables, of up to 30% of investment cost. Other investment support for energy sources that increase the security or diversity of energy supply can reach 25% of total investment cost. These subsidies also apply to CHP/DH plants which use wood-based fuels. Peat, however, does not directly benefit from this support. To improve their combustion properties, wood fuels are often mixed with peat, which can thus benefit indirectly. But eligibility of each project is assessed individually, and the subsidy is only allocated to projects whose costs are close to market levels. The plant's prospective CO_2 emissions are also taken into account. In 1998, state aid was FM 30 million, doubling its 1997 level. It is the Government's intention that subsidies remain at the 1998 level.

12 Vasander, Harri (ed.): *Peatlands in Finland.* Finnish Peatland Society, Helsinki. 1996.

OIL

Finland's oil industry is dominated by the state-owned company Neste Oy, established in 1948 to secure Finland's oil supply. The company was listed on the Helsinki stock exchange in November 1995. At this time, 16.8% was sold to pension funds, insurance and other investors; 83.2% remained in the hands of the State of Finland. In 1998, Neste was merged with Imatran Voima Oy (IVO), Finland's dominant state-owned electricity supply company, forming the new energy company Fortum Oyj. Fortum Oyj became the sole shareholder of Neste after receiving the shares held by the state and after Neste's shares held by private investors were exchanged against Fortum shares. Since IVO is not active in the oil market, this merger has not directly affected the market structure in the oil market. The merger is discussed in chapter 3, energy market and general policy.

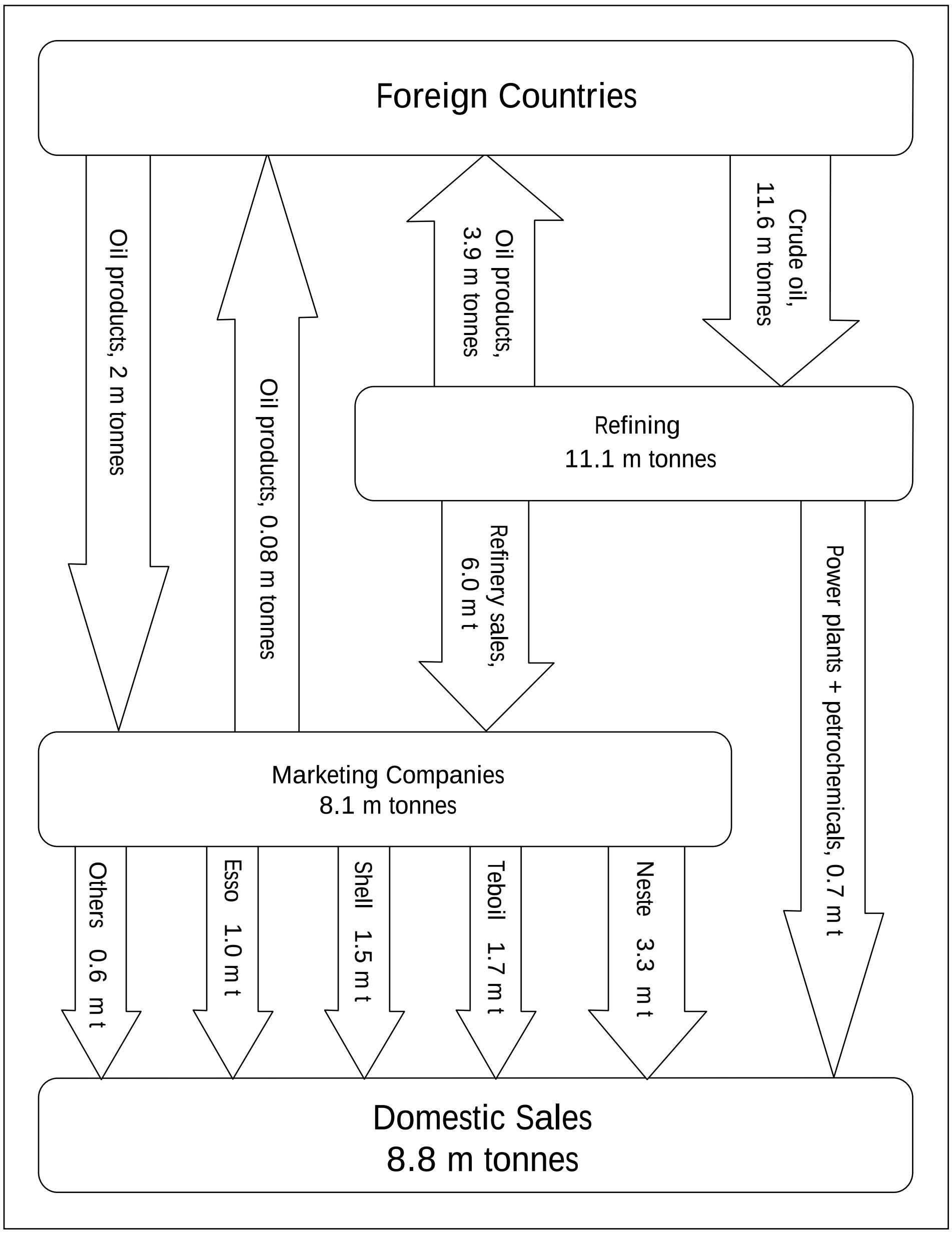
Neste has a market share of 100% in crude oil imports and refining, a 95% share in oil products exports, and accounts for more than 80% of domestic sales of petroleum products. These shares have remained virtually unchanged over the last five years, although there have not been any import restrictions since 1991.

Finland does not have any domestic oil resources, and no exploration or production activities are taking place inside the country. However, Neste produces about 1.6 Mtoe of oil and 0.1 Mtoe of gas from its holdings in the Norwegian Brage and Heidrun fields in the North Sea and in several fields in Oman, the most important of which is the Safah field in the Suneinah concession. Neste intends to increase its oil and gas production to a total of 3 Mtoe by 2000, primarily through deliveries from the Asgard field located in the Haltenbanken area of the Norwegian continental shelf, in which Neste holds a 7% stake, and increases from the fields in Oman. Neste also holds four off-shore exploration licences off the Norwegian coast, in addition to on-shore licences in Algeria and Northern Russia, the US, East Africa and Indonesia. In most of these areas, exploration wells have been drilled.

In addition to its own production abroad, Neste also imports crude oil. In 1996, almost half of all crude oil imported into Finland came from Russia: 4.81 Mtoe or 48%. Norway delivered 26%, Britain 14%, and Denmark 11%. Finland has two refineries, Porvoo, located east of Helsinki, with a capacity of 10 million tonnes per annum, and Naantali, on the south-west coast, with a capacity of 2.8 million tonnes. Both refineries are owned by Neste, but the company also holds a 50% stake in two small refineries in Sweden (both in the vicinity of Nynäshamm). Figure 16 shows a simplified energy flow chart of the Finnish oil market.

Oil product imports accounted for some 22% of total oil product sales in Finland, mainly from Russia but also from the Nordic and other European countries. Neste's competitors in the domestic market are Shell, Esso, the Russian company Teboil, and a number of other, smaller companies. Among these, the newcomer Station-1, predominantly under UK ownership, is the only one with a supply chain which is completely independent from Neste. Station-1 markets the Norwegian company Statoil's products and imports them via two oil product terminals, one at Kotka in

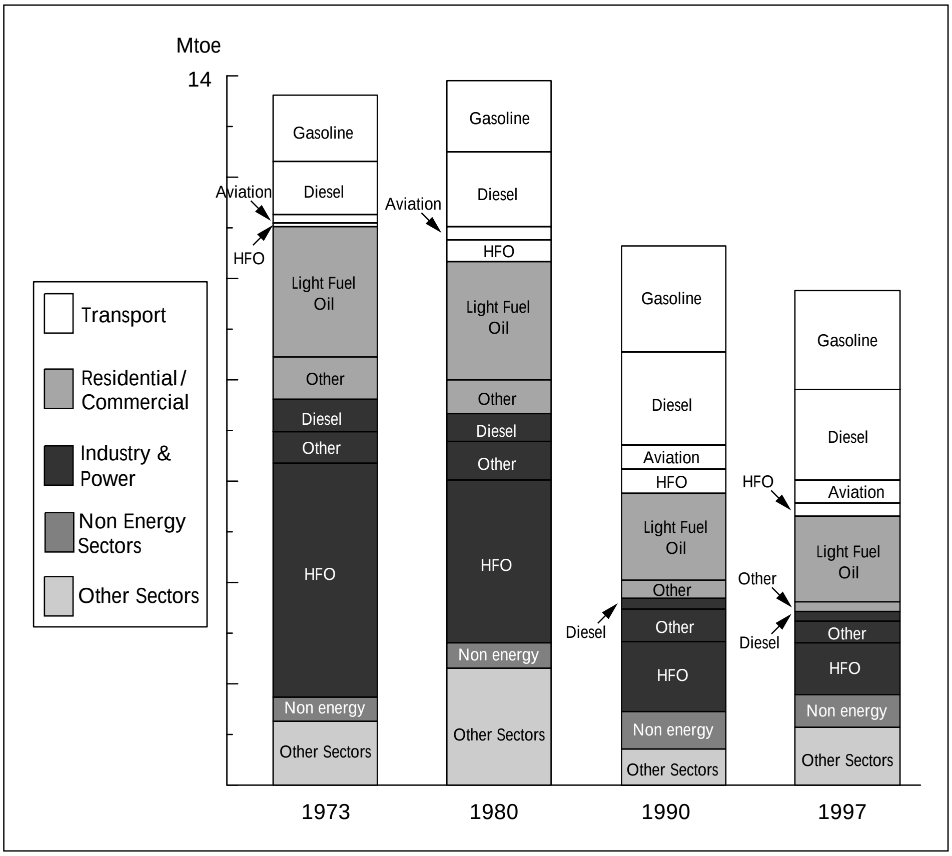
Figure 16
The Oil Market in Finland



Source: Finnish Petrolum Association.

the south-east and a new one at Tahkoluoto near the city of Pori on the west coast. All other retailers either buy Neste's oil products or use its product terminals. Figure 17 shows the consumption of oil products in Finland.

Figure 17
Consumption of Oil Products in Finland
(Mtoe)



Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD) and country submission.

Finland also exports oil products, mainly to Sweden, Estonia and the US. Gasoline is the most important oil product for export; slightly more than half of Finland's gasoline production is exported. A significant part of exports to Sweden, the US and the UK is special-grade gasoline and diesel, with the very low sulphur content of 0.005% by weight. In 1998, 99.9% of all diesel consumed in Finland was this type of very low sulphur diesel, compared with only 85% in 1996.

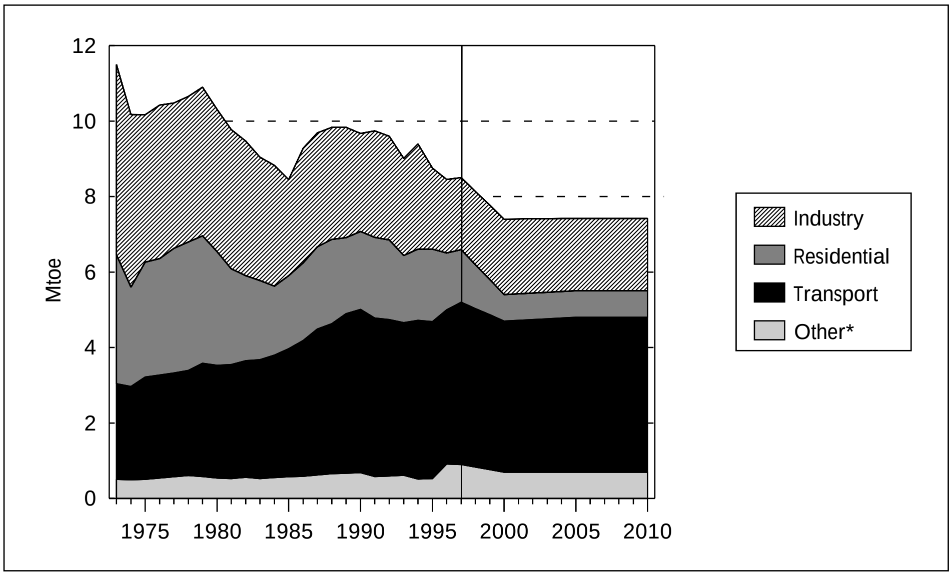
Since the late 1980s, the Finnish retail market for oil products has been restructured, with the entry of new competitors and a transformation of traditional service stations into unmanned stations, in some years at the rate of 100 transformations per year. This trend slowed during 1997, when only 20 stations were converted. During the last 10 years the number of conventional service stations has fallen from about 2 000 to 1 300 stations. Simultaneously, the number of unmanned stations has risen sharply from zero to 500 stations.

Neste's market share in the retail market in 1997 was 40.5%. By oil product, it was 33.5% in gasoline; 44.2% in diesel; 41.3% in light fuel oil; and 44% in heavy fuel oil. Due to high taxation on gasoline, diesel cars have become more popular; in 1997, nearly 15% of the stock of new private cars were diesel-powered. Neste operated 1 143 filling stations at the end of 1997. This number increased in 1998, since Neste and Kesoil, a company partly owned by Neste, decided in autumn 1997 to fully merge their retailing activities, to become effective in 1998.

The next most important oil retailers are: Teboil (22%); Shell (18.5%); and Esso (13.1%). Taken together, these four companies account for over 94% of the retail market. The remainder is shared between a number of very small companies. The new chains that entered into the retail market in 1996 and 1997, notably Du Pont Jet and Station 1, have market shares of under 1%, but they have aggressive pricing policies and strategies to reduce costs, often operating with unmanned filling stations.

Pre-tax prices mirror world market prices for oil almost on a daily basis, but due to high taxation consumer prices are comparatively stable. Consumer prices are determined by local competition between suppliers. In 1997, there were comparatively wide gaps in prices of up to FM 1 per litre between regions, and due to aggressive competition for local market share, prices fluctuated by up to FM 0.40 per l litre in a single day. Figure 18 shows oil consumption by sector.

Figure 18
Final Consumption of Oil by Sector
(Mtoe)



Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD) and country submission.

FINLAND'S OIL EMERGENCY RESPONSE MEASURES

The IEP (International Energy Programme) Agreement was implemented in Finnish legislation through the Act on the Application of IEP Agreement (enacted in 1991). Finland maintains its stock level well above the 90 days' level, and these extra stocks can be used by Government decision as the first means in IEA response measures including an oil supply shortage under 7%. The Emergency Act (enacted in 1991) gives the right to the Government to control widely different activities in case of a severe crisis.

The Security of Supply Act (enacted in 1992) is the legal basis for ensuring supplies of various basic materials including oil in the case of emergency situations. According to a Government decision of the beginning of the year 1996, the target for stocks of imported fuels corresponds to 7 months' average consumption. Based on the Act, the National Emergency Supply Agency (NESA), a subordinate agency to the Ministry of Trade and Industry, was formally founded in 1993 for the development and maintenance of security of supply. The NESA is the national stock holding agency of Finland.

The Department of Energy in the Ministry of Trade and Industry is responsible for general energy issues and issues related to security of supply both in normal times and in a crisis situation. The Department is the core of the National Emergency Sharing Organisation (NESO) of Finland. The NESO would also include personnel from the NESA and the National Board of Economic Defence. Industry experts in the Finnish Petroleum Federation are nominated on stand-by basis to join the NESO in case of emergency.

Emergency Reserves

Finland has two categories of emergency reserve of crude oil and products to meet the IEA emergency reserve commitment. Both are under the control of the NESA.

a) Compulsory stocks held by importers under the Act on the Compulsory Stockpiling of Imported Fuels (enacted in 1994). The stock holding obligation applies to crude oil, other refinery feedstock (gas condensates) and oil products. The obligation to hold stocks lies on importers. The obligation is based on the actual net imports of each product and crude oil. The compulsory stock level is two months' average imports of previous calendar year.

b) State-owned stocks held by NESA under the Security of Supply Act. State-owned stocks are held by the NESA. Part of these stocks is held exclusively to meet IEA's stock holding obligation.

It is a general policy of the government to release compulsory stocks held by importers first and state stocks are generally not available until commercial industry stocks and the compulsory stocks are used.

Demand Restraint

Because the current stockpiling target corresponds to 7 months' average consumption and because the Finnish economy is so energy dependent, the current policy naturally favours the drawdown of stocks rather than demand restraint measures. Despite this, the Government maintains preparedness to implement both "light and heavy- handed" restraint measures.

The Emergency Act and the Act on IEP agreement specifies the conditions and measures for demand restraint and identifies the authorities in charge of the decision. Since the stockpiling position of Finland is quite good, there is enough time to prepare, decide upon and implement demand restraint measures required by the situation.

A study was made recently about savings of oil products resulting from the price effect, lowering of room temperature, introducing lower speed-limits and certain restrictions for the use of cars.

NATURAL GAS

Industry Overview

Finland has no indigenous natural gas reserves. All gas is imported from Russia via RAO Gazprom and its subsidiaries. Imports flow through one pipeline, which brings Russian gas via the Northern Lights pipeline, St. Petersburg and the Karelian Isthmus to Finland. The gas originates in Urengoy in the Western Siberian gas field, 3 000 kms away from Finland.

Only one company is responsible for gas import and transportation: Gasum Oy, founded on 2 June 1994 as a joint venture between Neste Oy (75% share ownership) and RAO Gazprom (25%), and commercially active since 1 July 1994. Beforehand, import and transportation had been handled directly by Neste. At the same time, a new 20-year supply contract with Gazprom was signed which provided for future growth of natural gas supply.

Gasum is responsible for the operation, maintenance and extension of the high-pressure gas transportation grid. In addition to this, the company also supplies large customers and distribution companies directly from the high-pressure grid and produces liquefied natural gas (LNG) for research and small quantities of compressed natural gas (CNG) used as a transportation fuel. Gasum has 72 customers, including 37 gas distribution companies, who also supply electricity and/or district heat. Two gas distributors are owned by Gasum: Helsinkikaasu Oy in the south including the Helsinki area and Kotkan Kaasuenergia Oy. Gasum's distribution companies have a market share of 5%.

Gas consumption in Finland started in 1974. At first gas was used only in the forest industry in South Karelia and Kymenlaakso, in the south-eastern part of Finland, but its use spread westward to the south of Finland and to other consuming sectors over time.

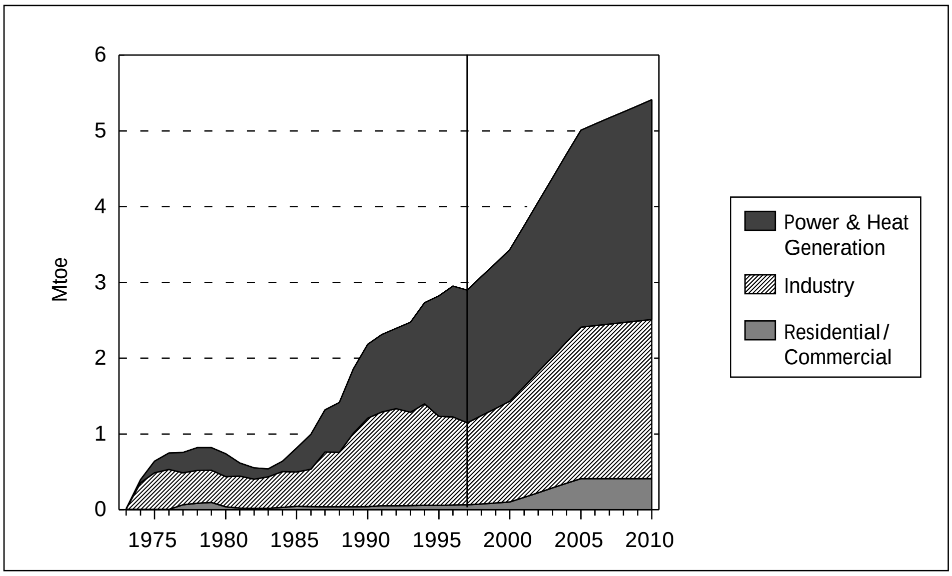
In 1997, Finland imported and consumed some 3.4 billion cubic metres (bcm) or 2.9 million tonnes of oil equivalent (Mtoe) of natural gas, which amounts to 8.8% of the country's TPES, significantly less than in many other IEA countries. In the part of Finland that lies in the vicinity of the pipeline and that has access to gas, consumption accounts for roughly one third of total energy consumption.

Gas use is distributed between the consuming sectors in the following way:

- Households: only a tiny fraction, 2.2% (1997), is delivered by regional distributors to residential, commercial and agricultural customers in the form of gas. In the residential sector, gas use for cooking is much more popular than it is for heating: whereas 31 300 Finnish households use gas for cooking, only 1 790 one-family houses and a mere 420 apartment houses use it for heating (1998).
- Industry: the bulk of Finnish gas consumption goes to energy and power retailing companies as well as industry. Industry consumes more than half (51.4%). With a share of 16% (1997) of industrial energy demand, gas is industry's second most important fuel, the most important being concentrated liquors from pulp and paper manufacturing.
- Heat and power generation: The remainder (46.7%) is supplied to ultimate customers in the form of heat or electricity: 36.2% is used in combined heat and power production, 5.5% for district heat production in heating-only plants, and 4.7% for power generation only. Figure 19 shows the development of natural gas use by sector since 1973.

Gasum expects significant growth in natural gas consumption to around 50 TWh per annum in 2007, a significant increase over the current demand of 34 TWh (approximately 3.25 bcm). Growth is expected to come in equal parts from power generation in condensing power plants (i.e. non-CHP) and CHP. Gas use in Western Finland, which is still to be connected to the grid, is also expected to be significant.

Figure 19
Natural Gas Consumption by Sector
(Mtoe)



Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD) and country submission.

The Gas Grid

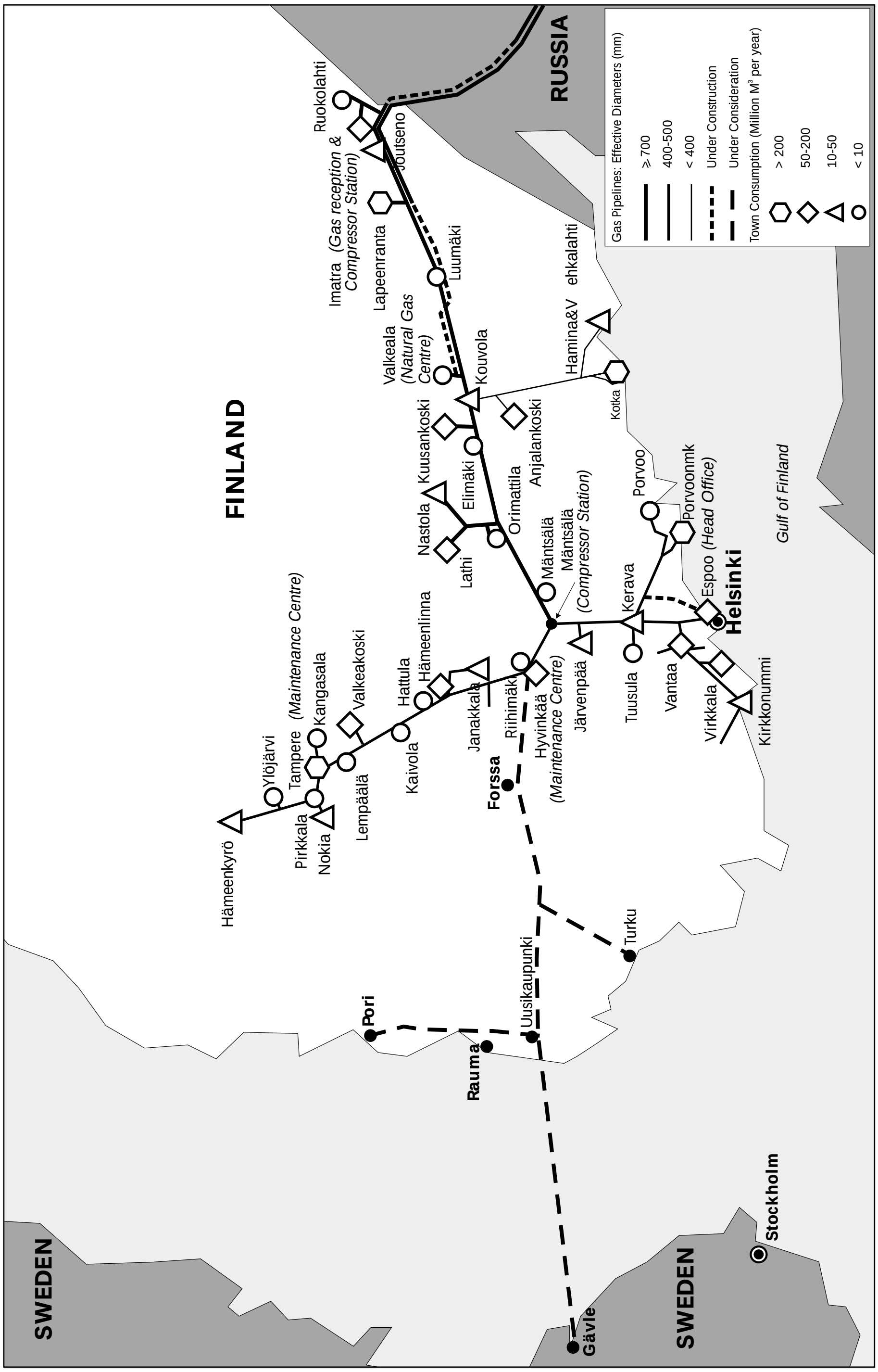
The Finnish part of the gas pipeline starts at Räikkölä near the town of Imatra, where it crosses the Russian border. For the first ten years after natural gas was introduced in Finland, the pipeline extended only to the towns of Kouvola and Kotka. In 1986, the extension of the gas pipeline to Helsinki, to the industrial city of Tampere and to their surroundings was commissioned.

In conjunction with the creation of Gasum and the new supply agreement with Gazprom, a major upgrade of the Finnish gas pipeline system was undertaken in 1994 and was completed in 1997, to schedule and within budget. This upgrade included the construction of a 48 km parallel pipeline between Imatra and Lappeenranta, and an extension of the pipeline westward of the Helsinki/Espoo area, from Kirkkonummi to Virkkala near Lohja, as well as three new compressor stations. This upgrade increased Finland's natural gas transmission capacity by one third.

Today, the Finnish gas transportation system consists of some 1 970 kms of pipe, of which 900 kms are the large-diametre (up to 900 mm) steel trunk lines owned by Gasum. The rest is owned and operated by distribution companies and consists of polyethylene, steel and cast iron pipes. The transportation system has three main compressor stations, at Imatra, Valkeala and Mäntsälä, with a total of nine compressor units, and 180 gas take-off points. Figure 20 shows the development of the gas grid in 1997.

Figure 20

The Finnish Natural Gas Network



Source: Gasum.

On the Russian section of the pipeline, the transmission capacity has also been increased. Gas from the Northern Lights pipeline can be routed to the St. Petersburg area via two branch lines, and the Russian compressor station at Severnaja, in the north-west of St. Petersburg and 150 kms from the Finnish border, can be fed via two pipeline strings. The existing pipeline already consists of two parallel strings between Severnaja and the Russian city of Vyborg, some 54 kms from the Finnish border. Gazprom's subsidiary Lentransgaz is constructing a new section that will close the gap in the second string, and an additional compressor unit has also been completed at Severnaja. These upgrades will allow a much greater supply of gas to enter Finland.

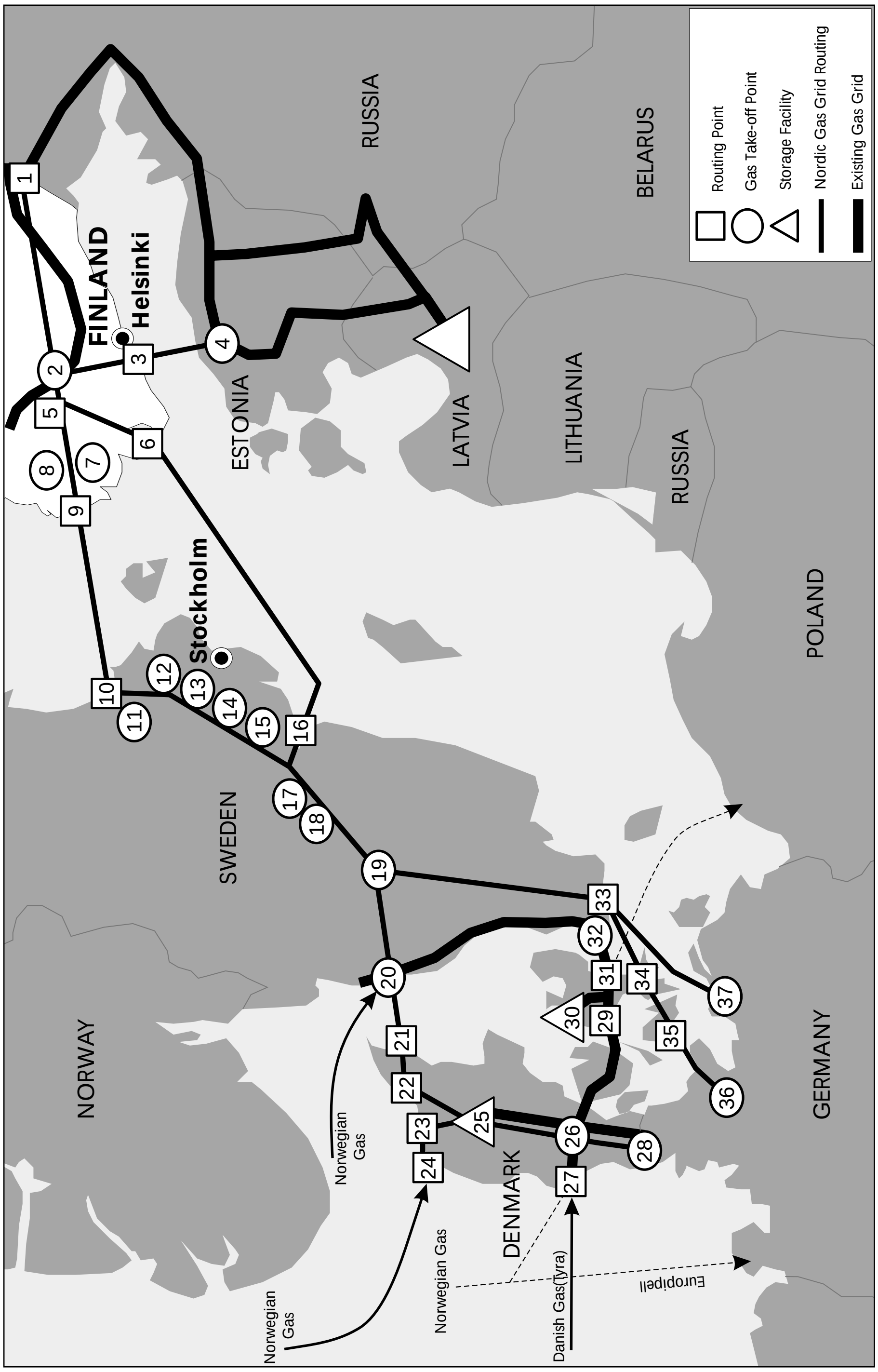
The gas industry as well as the Government consider the dependence on only one pipeline and one supplier clearly inconvenient, and discussions about interconnecting all Nordic countries date back from the second half of the 1980s. Finland sought interconnection to the European gas network through a pipeline crossing Sweden that would allow imports of gas from the Norwegian fields in the North Sea. Until recently, there was never enough gas demand in Sweden to justify such a pipeline. Sweden only has one pipeline running from Malmö to Gothenburg on its west coast, and plans to increase natural gas use and the pipeline system were abandoned in the early 1990s.

However, interconnection to the European natural gas network is still seen as a vital priority in Finland, subject to economic feasibility, and there are now two new proposals to extend the Finnish grid to the west and south. The first is the Nordic Gas Grid Project (NGG), undertaken by a consortium of Neste and Gasum from Finland, Dansk Naturgas A/S from Denmark, and four Swedish energy companies, Vattenfall Naturgas AB, Sydgas AB, Göteborg Energi AB and Mellansvenska Naturgaskonsortiet AB. As it was listed as a project of common interest in the framework under Trans-European Energy Networks legislation, it was co-financed by the European Commission. The related feasibility study was completed in October 1998.

The NGG project is expected to integrate the natural gas networks in Finland, Denmark and Sweden with supplies from Norway, Denmark and Russia, to create a northern transmission route from Russia to continental Europe, and to open the possibility of linking the Baltic States to the European grid, which would offer access to ample storage facilities in Latvia. According to the results of the feasibility study, the project, if constructed, would fetch high market shares in the target market, i.e. The Nordic countries. Sweden would be supplied by the NGG to 100%, and its market share would be in excess of one third in Finland, and of one quarter in Denmark. Even in the transit market (Germany, France, Belgium, The Netherlands and the UK), the market share of gas routed through the NGG could still be as high as approximately 15% (Belgium, base case). However, no decision has been made regarding the construction of the pipeline. Figure 21 shows the suggested routes for the NGG.

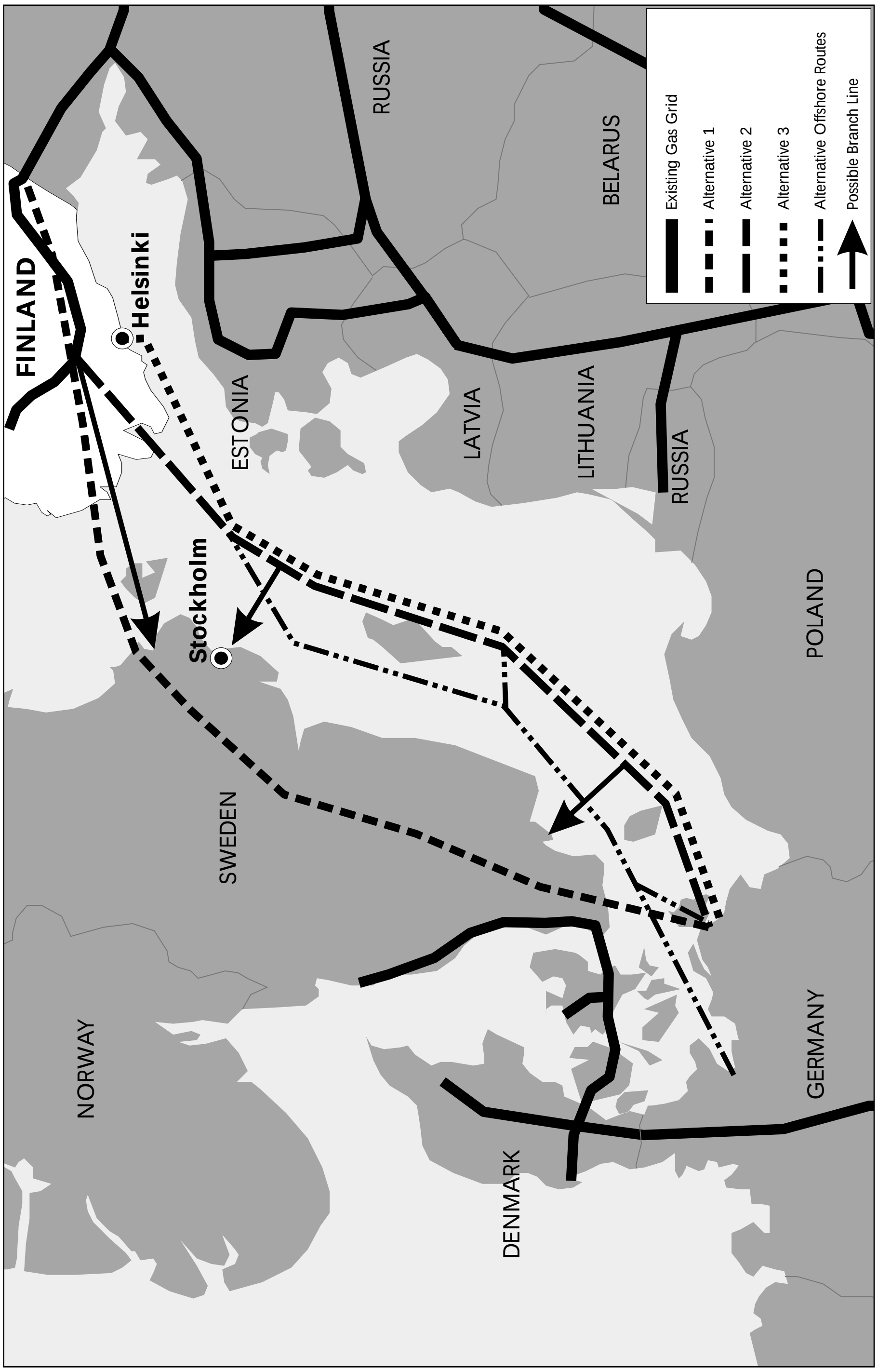
The second proposal is under development by a consortium, called North Transgas Oy, owned 50% by Neste and 50% by Gazprom. The purpose of the project is to connect the Finnish gas pipeline system to continental Europe with or without Swedish participation (see the suggested alternative pipeline routes in Figure 22).

Figure 21
Proposed Pipeline Routes in the Northern Gas Grid Project



Source: Gasum.

Figure 22
Proposed Pipeline Routes in the North Transgas Project



Source: Gasum.

This would provide an alternative, northern route for Russian gas to western Europe. The project will not receive any EU funding. Its feasibility study is to be completed by March 1999, the negotiations phase is to last until 2000, and the project's implementation phase is scheduled to be 2000 to 2005.

Since the project may involve a section of some 3 000 kms through the Baltic sea, the main tasks in 1998 were a survey of the bottom of the Baltic sea and the design of the system including optimisation between the alternative routes.

Regulatory Reform and Competition

The natural gas industry in Finland has so far been virtually unregulated. Safety regulations are in place but no gas-specific legislation concerning the control of market power exists. In principle, this situation is bound to change soon because, as an EU member country, the new EU Directive opening up the gas market also applies to Finland.

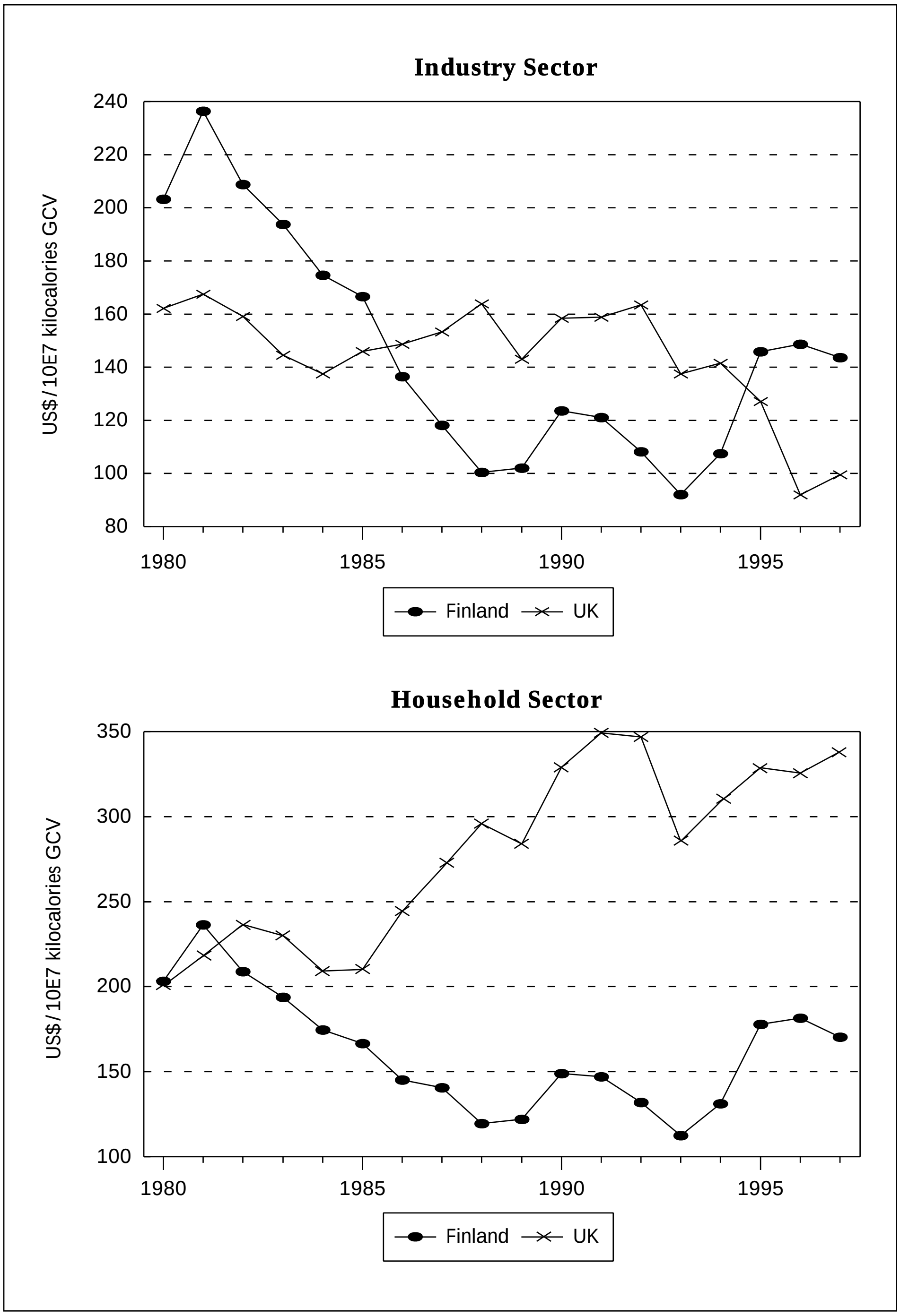
Finland, however, will only have to apply part of the Directive. Since the country is not interconnected to the European grid, provisions on opening up the Finnish gas network to other gas suppliers do not have to be implemented. These provisions will only come into force once the infrastructure is put into place.

Finland does have to implement some of the Directive's provisions, notably those on transparency and unbundling of accounts, regardless of interconnection to the EU grid. The Ministry of Trade and Industry has set up a working group with the aim to prepare new legislation following the spirit and the letter of the entire Directive, even if there are as yet neither significant competitors to Gasum nor a link to the European grid. The working group delivered a proposal for a Gas Market Act, setting out the rules for competitive trading between gas retailers and gas users, at end January 1999.

The only other important industry-specific regulation in the Finnish gas market was a decision made by the Office of Free Competition (OFC) in 1992. In this decision, the OFC obliged Gasum's predecessor in the gas transportation business (and parent company) Neste as well as gas retailers to publish prices for gas supply and connection services under a format that contains separate price elements, such as a capacity fee, a commodity fee, and a fee linked to the number of take-off points that a customer uses. This pricing system is called the public pricing system and was intended to replace the long-term supply contracts used exclusively beforehand. However, customers have no obligation to use the public pricing system, and they can revert back to their old long-term contracts if they find those benefit them more than the new system.

In practice, not all gas customers were willing to switch to the public pricing system. In a statement of 23 March 1998, the OFC acknowledged that switching from one system to the other, although allowed under the 1992 decision, might not be feasible in the middle of the contract period, and that the profitability of long-term investment might suffer from such a move. If a market participant called the

Figure 23
Natural Gas Prices to Industrial and Residential Consumers



Source: IEA/OECD: *Energy Prices and Taxes*, 4th Quarter 1998. Paris, 1998.

OFC into action, it would investigate and decide case by case. There is a case pending before the OFC, in which Gasum complained to the OFC about Helsingin Energia's (Helsinki Energy's) unwillingness to switch to the public pricing system, on grounds that its long-term supply contract distorted the natural gas market. Figure 23 shows the development of Finnish gas prices to industrial and residential consumers since 1980, compared with the UK.

Security of Supply

Depending on only one major trunk line for its gas supplies, Finland has prepared for the possibility of supply disruptions. Most major natural gas users are able to switch to oil as a backup fuel; over 90% of natural gas consumption can be replaced by light or heavy fuel oil.

The 10% of demand that cannot be switched includes residential customers, restaurant kitchens and industries that use gas in direct heating processes or infrared heating. This applies to the glass, metal, food and paper industry. Supply to these customers can be sustained by the gas stored in the pipeline (line pack) for a number of days. A long-term disruption is covered by a plant built at Neste's Porvoo refinery, which can manufacture an air-propane mixture that can replace natural gas. The plant has a capacity of 350 MW, which is more than enough to cover the gas-specific uses in Finland. In addition, several electric utilities have smaller air-propane plants.

CRITIQUE

Peat

The advantages of making use of Finland's vast peat resource are obvious: together with hydro power and wood, it is one of the very few indigenous energy resources. Since the country is highly dependent on imported energy, and has only one gas pipeline and one supplier, peat may have a role in ensuring security of supply. However, peat is not a direct substitute for natural gas, due to its location. It can substitute for oil or coal, and is often used together with wood-based fuels.

The most economic peat deposits are located in areas where other energy sources and other employment opportunities are scarce. Since the cost of peat used in CHP has fallen quite drastically over the last two decades, it has approached economic competitivity with other fuels in the areas where it is produced.

Peat use does have a major drawback: its effect on the environment. Peat use causes a number of environmental emissions, including air pollutants such as ash, sulphur dioxide, nitrogen oxides and volatile organic compounds, carbon dioxide, and water pollutants.

With respect to carbon dioxide and other greenhouse gases (mainly methane), the situation is more complex. In their natural state, peatlands can be either net sources or net sinks for greenhouse gases, depending on the local hydrological conditions, plant species, etc. During their growth, the peat-forming species absorb CO_2, but during their decay they emit both carbon dioxide (from aerobic decomposition) and methane (from anaerobic decomposition). These emissions occur naturally without human intervention. Peatlands most commonly used are sedge fens which are methane emittors and have a fairly low rate of carbon sequestration in their natural state. The net greenhouse effect of these sites is often positive, i.e. they contribute to global warming.

Drained peatlands emit CO_2 as the anaerobic decay turns into the much faster aerobic decay. If the drained peatlands, however, are not subsequently used for agriculture, they become forests in about 100 years. Over this period, the growth in tree stand sequesters significant amounts of CO_2. Subsequently, the forest reaches a steady state and carbon sequestration levels out. These effects are the same as in regular afforestation. However, the development of forests in peatland areas only occurs if the system of drainage ditches is maintained; otherwise the water will filter back into the soil and the development is reversed. Hence, turning peatlands into carbon sinks requires human action and involves costs. Such new carbon sinks, both forests and new peat bogs, have been created since 1990 and would be considered new human-induced CO_2 sinks according to the Kyoto protocol.

Burning the peat releases all the sequestered carbon into the atmosphere[13]. It is estimated that the amount of carbon released at this stage is three times as high as the amount released immediately after drainage. If the peat is subsequently allowed to grow back, the carbon will be absorbed again. Overall, the amount of carbon sequestered in peat is much higher than in a forest of the same size, but peat has a much slower absorption rate than forests: it takes 2 000 to 2 500 years to regenerate instead of 100 years or less for wood and other biomass[14]. The use of peat will thus increase CO_2 emissions during the critical time horizon when emissions are supposed to be reduced. But even though it takes more than two millennia for the peatland to regenerate to its pre-production volume, considerable carbon stores are already formed in 500 to 1 000 years and absorption can be as high as 30 tonnes of carbon per hectare during the first 100 years. Peat-forming vegetation is presently sequestering CO_2 in large areas in Finland and the Northern hemisphere in general.

13 This stage is the only one taken into account under the IPCC's methodology for greenhouse gas inventories.

14 It is sometimes argued that peat is a renewable resource – albeit on a slow regeneration cycle –, since it obviously grows back. This argument is, of course, correct, but it does not take into account that all fuels are eventually renewable, even coal and oil – on a very slow regeneration cycle of hundreds of thousands of years. This applies equally to uranium, which is constantly produced in innumerable suns throughout the universe. Whether a fuel should or should not be called renewable depends on the time scale of regeneration compared to human life and environmental problems. 2 500 years is too long a time span for carbon sequestration since avoiding major climate change requires reducing greehouse gas emissions over the next 100 years or so.

Since methane is a more powerful greenhouse gas than carbon dioxide, it is estimated[15] that the amounts of methane released from undrained peatlands, left in their natural state, can have a climatic impact at least as big as the one from peat cultivation and combustion. The outcome depends on the rate of peat use compared to the size of the total natural resource. This might suggest that peat as a fuel could be neutral with respect to climate change, because the methane emissions occur naturally.

Oil

Although Neste still has a very dominant position in the Finnish oil market, real competition has emerged. Competition is now very strong in the retail market, and it is moving upstream into the oil products market due to the first two product terminals totally independent of Neste. This is a very positive development for a small, relatively isolated oil market whith at best stagnant demand.

The increased competition is due to effective antitrust oversight. At the time of the last IEA in-depth review in 1994/95, an antitrust case was pending before the Competition Council and the European Commission, because Neste had refused to offer wholesale prices to a competing retailer, Suomalainen Energia Osuuskunta (SEO), a co-operative group of service station dealers. Neste was forced to treat SEO as a wholesale customer, and the company is now established as a regular retailer with a total market share of 2.4% and a share in the gasoline market of 5.7%. The Government can afford to - and should - continue its policy of avoiding direct interference while keeping appropriate oversight which it has applied over the last few years.

Natural Gas

The Finnish gas market is not a mature market. Gasum, who owns and operates one pipeline has a substantial amount of market power. This situation may be unavoidable at present. It appears that before the current changes were set in motion, notably before 1992, when Neste was responsible for the entire gas market as well as enjoying a dominant position in the oil market and when the public pricing system did not yet exist, Neste's gas supply unit was free to behave like a nearly unregulated private monopoly.

Oversight by competition authorities, effective as it can be in those cases where it is applied, is essentially an *ex post* remedial action that requires a plaintiff. Investigations may be very protracted and it may take a long time before decisions are made, thus it is likely that only significant offenses will ever be reported.

15 Gorham, E.: Northern Peatlands: Role in the Carbon Cycle, and Probable Responses to Climatic Warming. In: *Ecological Applications* 1/1991.

Interfuel competition acts as a price ceiling on gas due to possible substitution of gas by coal, or, more frequently, oil. But interfuel competition, which can keep the abuse of market power within certain limits, may also have been weakened because oil, the closest substitute for gas, was equally in Neste's hand, due to Neste's ownership of Finland's two refineries. Imports of oil products stood at 42% of the market in 1996 and 35% in 1997, which indicates competition from foreign refineries. But it was only very recently that one of Neste's competitors constructed its own oil product terminals. Neste's market share of deliveries of oil products was around 80% in the early 1990s.

Nestle's monopoly position may be somewhat limited because only a very small fraction of the gas market is totally captive: that of the small consumers which use gas directly. Power, heat or CHP plants are arguably larger customers and have more substitution possibilities, which gives them a more advantageous negotiating position. Energy companies and industry have a wider range of fuels at their disposal, including coal, peat and liquors from pulp and paper manufacturing.

However, since there is no regulation regarding either electricity or district heating prices, it is possible that excessive prices charged by Neste in confidential long-term contracts could in the past have been passed on to the consumer virtually unchecked. The situation has changed somewhat for electricity prices due to the competitive electricity market, but district heating prices still cause some concern.

The situation today appears to be no less complicated. The Fortum merger, brought about by the Government, would have aggravated the situation: Neste's daughter company Gasum, both gas importer and pipeline owner now finds itself owned by the same holding company as one of its major clients, Finland's biggest power utility that also has interests in district heating. This gives Fortum both the incentive as well as the possibility to distort Gasum's gas prices in favour of IVO. As discussed in chapter 3, the European Commission anticipated these concerns about market power and made its approval of the merger subject to the obligation that Fortum reduce its shareholding in Gasum to a non-controlling 25% within 12 months of the merger, i.e. by June 1999. This is a wise move that could re-establish a balance in Gasum's governance, depending on the future share ownership.

The Finnish Government's intention to implement all of the provisions of the EU Gas Directive, regardless of whether the physical infrastructure allows much transboundary competition, is laudable, because it will allow users to re-sell their gas if they do not need it. The decision sends an early signal to gas users, potential entrants, and pipeline capacity developers that the Government is serious about the introduction of competition. Implementing the Directive will mean unbundling of the pipeline business from import and supply. If Gasum takes this fully into account, and sees good business opportunities for itself in the pipeline business, it will continue to press ahead with pipeline infrastructure development at the current pace. If not, the projects for link-up to the European gas market might get stalled, because it is this link-up that will bring the possibility of real competition.

It remains to be seen to what degree Gasum will adapt itself to the new situation. In all likelihood, the Finnish pipeline system will be connected to the European system, if only to create a northern transportation route from Russia to the EU market that does not run through the territories of third countries which divert the gas for their own purposes. Before the infrastructure is in place and before new entry has occurred, the only competition that can emerge is between gas distributors and retailers and larger consumers re-selling their gas to ultimate consumers, provided this is not prohibited in the latters' supply contracts. In order to bring about competition as soon as possible, the Government should therefore lend support to the interconnection projects. The Finnish Government is striving to facilitate the development of economically viable projects without introducing subsidies. This approach is commended by the IEA.

If competition cannot be counted on to reduce prices quickly, regulation of network services and surveillance of monopoly positions will become even more important. The competition authority has tried to address the potential effects of market power and to establish a level playing field through the public pricing system for the natural gas wholesale market. However, a larger number of customers than expected have decided to remain with their old long-term contracts. It is unclear whether these contracts were revised in order to just undercut the prices in the public pricing system or whether they just happened to be more favourable for these consumers while preventing them to enter flexible supply contracts with other customers.

Currently, two types of contracts co-exist in the market: the old-style confidential and unregulated contract, and the public pricing system, which allows a minimum amount of oversight and whose terms and prices are public. The existence of two different contracts causes asymmetric information which can affect the companies' competitive position in the electricity market. The Office of Free Competition acknowledges that this co-existence is problematic. Those who use the long-term contracts know how much users on the public pricing system pay and can exert pressure to receive lower prices. If the supplier has an incentive to do so, this can easily be used to discriminate between users. The new Gas Market Act should remedy this situation by establishing a uniform pricing mechanism for all gas deliveries or by removing constraints on potential transactions between third parties.

Finally, the dependence on a single pipeline and a single supplier, namely Russia, gives rise to concern about security of supply. Russia has been a very reliable supplier to Finland throughout the last 25 years, and appropriate measures are in place to bolster the effects of a supply crisis. Interconnection to the European gas grid as soon as it is economically viable, however, will increase security of supply as well as competition, by opening up an alternative supply route as well as access to storage. Finland has practically no storage of its own because its geography does not lend itself to the construction of storage capacity.

RECOMMENDATIONS

The Government should:

- Continue the policy of non-interference in the oil market, combined with effective antitrust oversight.

- Continue, and if possible intensify, efforts to create alternative gas supply routes to diversify the supply of natural gas, by lending political support to the new pipeline projects that are under consideration in the gas industry.

- Supply the new Gas Market Act with an effective mechanism to regulate pipeline prices as well as prices for other services which are not competitive. Encourage new supply arrangements among different types of gas consumers.

- Ensure effective regulatory and anti-trust oversight.

6

ELECTRICITY

MARKET OVERVIEW

General

Finland's electricity market includes around 400 power plants, owned by some 120 power producers. The two largest electricity producers are Imatran Voima Oy (IVO) and Pohjolan Voima Oy (PVO), a private power generation company which sells electricity to its owners. PVO is largely owned by energy-intensive industries such as the pulp and paper industry, but is co-owned by numerous other smaller investors such as pension funds, including electricity companies who are not industrial autoproducers.

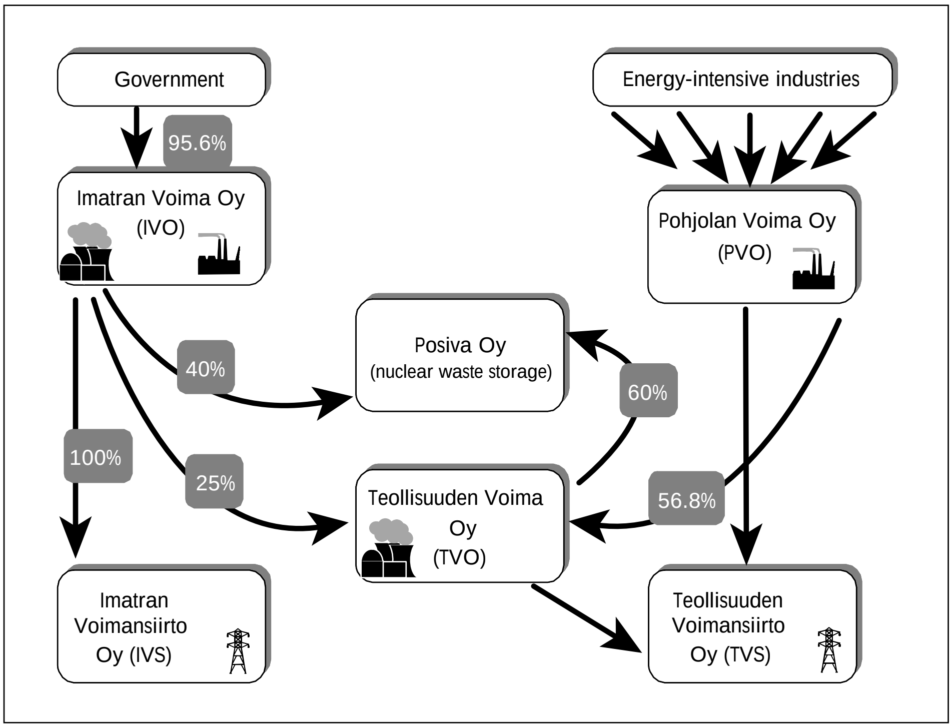
IVO is fully owned by Fortum, the 75% state-owned energy company formed in 1998. Beforehand, IVO was 95.6% state-owned. Before 1996, IVO owned and operated about 80% of the national transmission grid through its transmission company IVS. Also before 1996, PVO's transmission company TVS owned and operated most of the remaining sections of the transmission grid. IVO generates some 40% of all electricity sold in Finland. PVO generates about 20% of total electricity supply. About 20% is generated independently by industrial autoproducers, and the remaining 20% is generated by a multitude of other companies, mainly vertically integrated municipal companies which cogenerate heat and power.

Industrial autoproduction of electricity is very large, mainly due to the large share of electricity intensive heavy industry in Finland. Since PVO principally generates electricity for its owners - energy-intensive industrial companies and electricity distribution companies - and in the past only sold surplus electricity into the general market, total industrial autoproduction amounts to about 40% of all electricity supplied in Finland: 20% by PVO and 20% directly by the consuming industry. PVO sells around 5 TWh to the market but buys more than this from the market.

Both IVO and PVO operated as vertically integrated power companies until 1997, when their transmission assets were merged into the new national transmission company Fingrid[16]. Figure 24 shows the ownership structure of IVO and PVO their transmission companies IVS and TVS before the creation of Fingrid.

16 See section Restructuring.

Figure 24
Ownership of IVS and TVS
(1996, before the Creation of Fingrid)



Source: IEA.

More than 30% of Finland's electricity supply is produced in CHP (combined heat and power[17]) plants. CHP-based electricity generation is the highest in the world in absolute numbers and the second-highest in percentage share after Denmark[18]. CHP is discussed in more detail in a separate section below.

There are some 115 distribution companies in Finland, mainly owned by municipalities. 25 among them are governed directly by the municipality, while about 50 are limited companies with predominant municipal ownership. The box below shows the players in Finland's electricity market[19].

17 Cogeneration or combined heat and power production is the joint generation of electricity and heat, i.e. the steam that cannot be transformed into electricity and would be released as waste heat in normal (condensing) power plants is used for heating purposes.

18 Finnish CHP statistics reflect actual electricity generation more accurately than most international statistics because they are based upon actual CHP production, excluding possible condensing power production in the same plant.

19 Detailed information on these institutions can be found in the sections below.

Market Participants in the Finnish Electricity Market

- The national grid (Fingrid) and its licensed operators.
- Regional network operators.
- Local distribution network operators.
- Electricity generators and retailers.
- Electricity users.
- The electricity exchange (EL-EX).

Generation

Overview

The Finnish electricity supply industry produced some 69.2 TWh of electricity in 1997. Of this, 23.2 TWh (35%) was produced in cogeneration plants. Of the remainder, 12.25 TWh (17.7%) came from hydro power, 20.9 TWh (30.2%) from nuclear, and 10.9 TWh (17%) from fossil fuels used in conventional condensing power plants. Indigenous production was completed by imports from Sweden, Russia and Norway to yield total supply of 73.8 TWh in 1997.

Total installed capacity in Finland is 14.9 GW; including firm imports under already concluded import contracts, total available capacity amounts to 16.1 GW. Figure 25 shows the development of electricity generation in Finland between 1973 and 1997; the future development to 2010 is based on government forecasts.

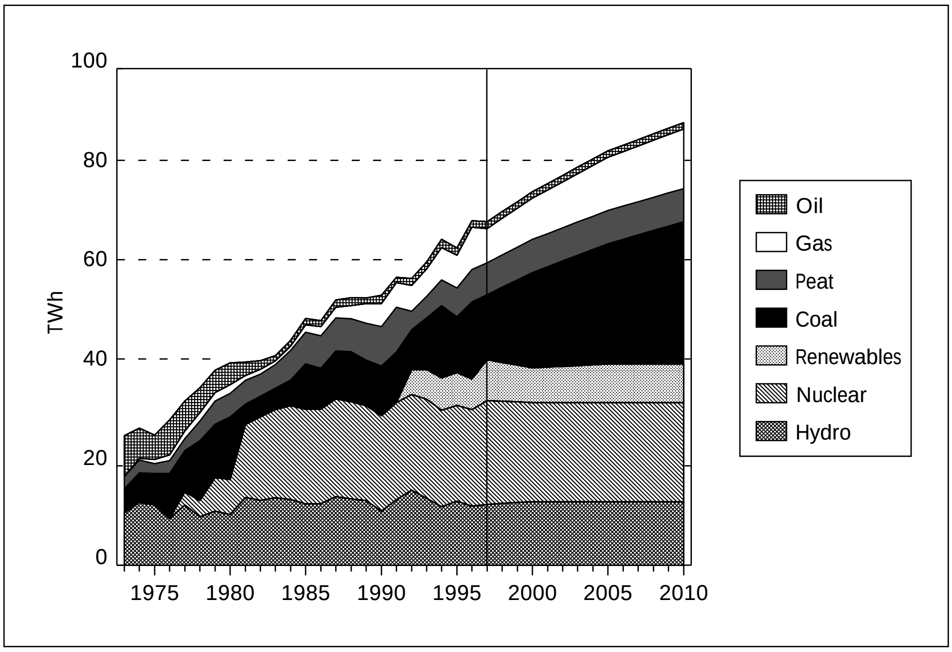
Finland has two nuclear power plants, owned and operated by IVO and TVO. Share ownership in TVO's plant is spread over a large number of power companies which are entitled to purchase fixed amounts of nuclear electricity corresponding to their shareholding. Nuclear power generation is discussed in more detail in a separate chapter below.

The economics of new investment in generating plant suggest that new plant capacity is very likely to be fossil. In an ongoing series of generating cost studies carried out jointly by the IEA and the OECD Nuclear Energy Agency (NEA), it was estimated that in 1992[20] the cheapest option for new plant commissioned in 2000 or shortly after would be nuclear at a 5% discount rate, and natural gas at a 10% discount rate. The 1998 update of the study[21] for capacity ordered between 2005 and 2010 determined

20 OECD Nuclear Energy Agency/International Energy Agency: *Projected Costs of Generating Electricity - Update 1992*. Paris, 1993.

21 OECD Nuclear Energy Agency/International Energy Agency: *Projected Costs of Generating Electricity - Update 1998*. Paris, 1998.

Figure 25
Electricity Generation in Finland, 1997
(TWh)



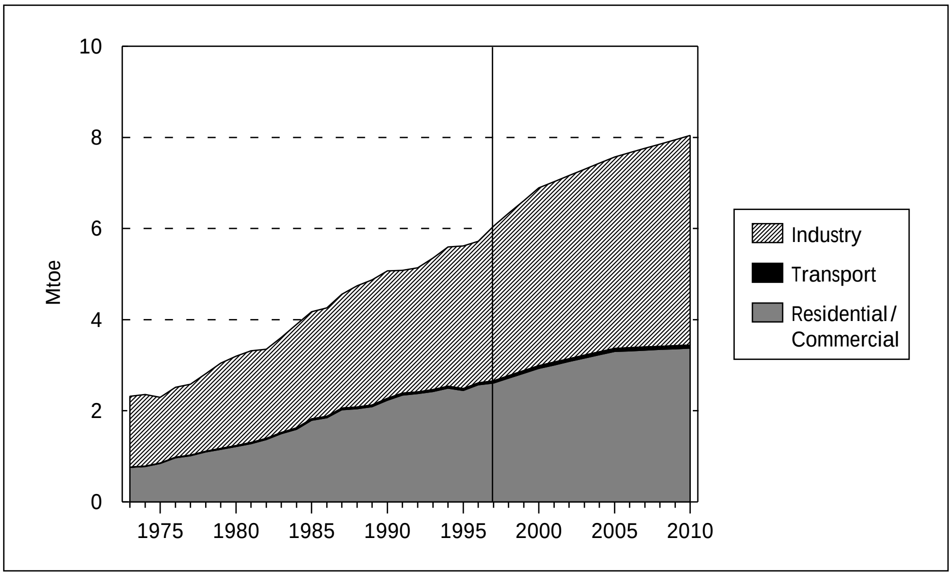
Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD) and country submission.

that coal would be the cheapest option both at 5% and at 10%. At 10%, however, natural gas use was extremely close to the cost of coal-fired plant: gas-based generation would cost 4.1 US cents per kWh, while coal-based generation was 3.9 US cents per kWh. Nuclear was the most costly option under both assumptions, 5.6 cents per kWh at a discount rate of 10%[22]. A real discount rate of 5% is extremely low and would occur only rarely in free markets. A discount rate of around 10% is thus more realistic.

Finnish energy intensity is among the highest in the world, due partly to its cold climate, but even more so to the country's industrial structure based on energy and electricity intensive industries, especially forestry, pulp and paper manufacturing, chemistry, iron and steel and non-ferrous metals. Figure 26 illustrates the high share of industrial electricity consumption: slightly more than half of all electricity is consumed by industry.

22 These calculations do not include any carbon or energy taxation. As explained in the section Energy Taxation, electricity input fuels were taxed according to their carbon and energy content between 1990 and 1997. Since 1997, a blanket electricity output tax applies that does not differentiate between input fuels, except for renewables. The IEA/NEA generating cost study considers neither the former electricity input tax nor the current electricity output tax.

Figure 26
Electricity Consumption in Finland, 1997
(TWh)



Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD) and country submission.

Combined Heat and Power Production

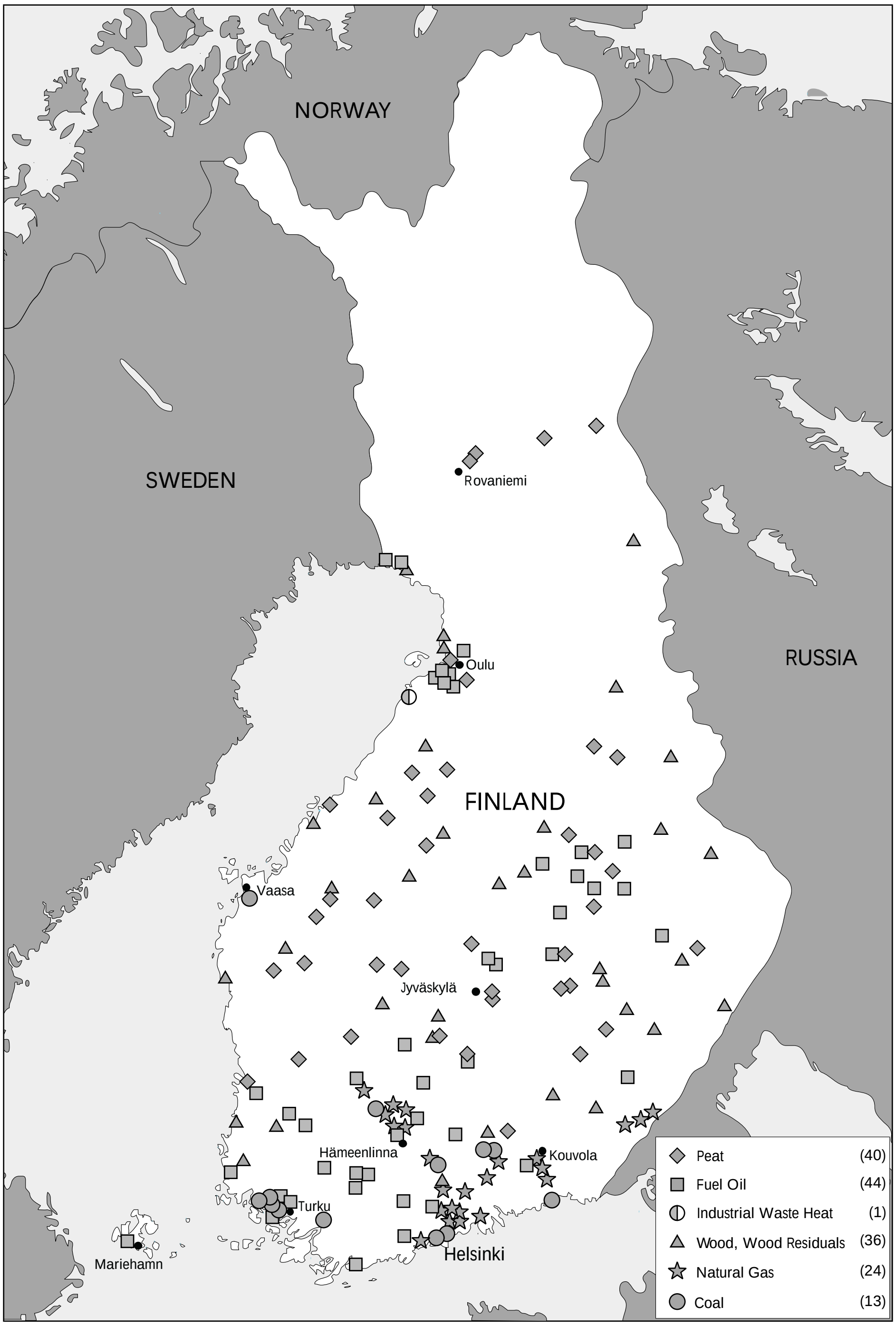
Combined heat and power production is applied widely in Finland for the heating of communities and industrial processes. Some 53% of cogenerated power was produced in district heating plants in 1997, and about 47% in industrial CHP plants in the same year.

District heating supplies 27 TWh of heat, about half of the total demand for space heating in Finland. 50% of the building stock[23] is connected to the district heating network. Slightly more than three quarters of district heat is cogenerated. The remainder comes from heat-only plants. The district heating networks were built during the 1950s and 1960s in the larger cities and after the first oil crisis in small towns. Today, there are almost 160 district heating plants and over 200 heat distribution utilities in Finland, and district heating systems cover practically all parts of Finland where district heating is profitable. The profitability of district heating is higher than in other IEA countries because buildings have to be heated during most of the year, due to the cold climate. Approximately one fifth of energy consumption is used for space heating in Finland.

23 The 50 % figure refers to total heated space, measured in cubic metres.

Figure 27

District Heating Plants and Their Main Fuel Inputs, 1997



Source: Finnish District Heating Association (Suomen Kaukolämpö Ry).

Figure 27 shows main district heating plants and their fuel inputs. About half of the plants use indigenous fuels: there are 40 power plants that use peat as the main fuel, and an additional 36 plants that use mainly wood residues (bark, wood chips, sawdust, and sludges). In most cases, peat, coal or natural gas are added to the wood wastes to increase the efficiency of the combustion. 44 plants use fuel oil, and the rest use coal or gas.

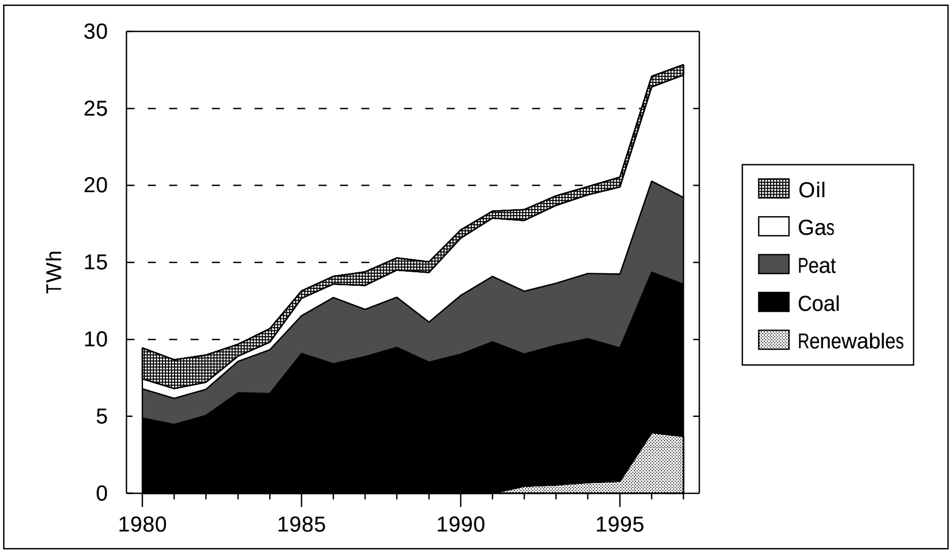
Industrial CHP covers about one quarter of total industrial electricity demand. The first industrial cogeneration plants in Finland were built during the 1920s and 1930s, often using local energy sources or located in industrial plants where waste fuels from industrial processes could be used, e.g. wood residues or waste liquors from pulp and paper production. Today, there are some 70 industrial back-pressure (CHP) plants in Finland, amounting to some 1 500 MW of capacity. Nearly 85% of these plants are owned and run by the forest or wood products industry. Manufacturing of pulp and paper products accounts for about 60% of industrial electricity use and one quarter of industrial energy use. Figure 28 shows the development of electricity production from CHP plants since 1980, including the fuels used. Peat furnishes some 8% of total electricity output and some 15% of total CHP output.

The use of CHP for district heating is not expected to grow significantly because the most profitable areas have already been covered. According to both

Figure 28

Electricity Generation from CHP Plants

(TWh)



Source: IEA, *Energy Balances of OECD Countries* (Paris: OECD).

Note: Renewables were reported as a separate category as of 1992.

the Finnish Government and the Association of Finnish Industry, the future growth of industrial CHP depends crucially on the future development of the forestry industry. The Finnish Energy Industries Federation expects significant growth in the forestry industry, and a corresponding increase in industrial CHP of about 5 TWh between now and 2010, corresponding to additional capacity of about 900 MW.

Renewables

Biomass

In 1997 the share of renewables in Finnish TPES was 20.9%. 17.7% were combustible renewables and wastes, and 3.2% hydro. Their combined share of electricity output was higher: 29.5%, or about 17.7% from hydro and 11.8% from combustible renewables. Combustible renewables are wood-based fuels such as industrial wood residues (wood chips, bark, and sawdust) black liquor and firewood. Finland's wood use is the highest in the industrialised world.

The figures for renewables exclude peat which is classified by the IEA and the EU as a solid fossil fuel. Peat contributes an additional 6.2% to TPES[24]. Wood-based fuels are most heavily used in industry, where they are often burned together with peat or other fossil fuels in CHP plants to increase combustion temperatures and thus efficiency. Wood-derived energy accounts for 44% of energy consumption in the industrial sector, of which 12% are wood residues and 32% is black liquor, a waste product from pulp and paper manufacturing.

Despite the high share of wood use, a considerable amount of wood which cannot be used economically is left in the forests. These are mainly logging residues (tree tops and branches) and small trees. The Technical Research Centre of Finland (VTT) estimates that the additional annual harvestable wood energy reserve amounts to a maximum of 1.9 to 2.8 Mtoe, of which about 1.5 Mtoe is economically viable. Based on its current figures for the use of wood-based biomass, 5.7 Mtoe in 1997 (IEA figure: 5.9 Mtoe), VTT estimates that future total use could rise to between 6.6 and 7.2 Mtoe in 2000 and between 7.4 and 8.8 Mtoe in 2010. These estimates represent a technical maximum and require government support. The Government expects wood use rise to 6.0 Mtoe in 2000 and to 7.0 Mtoe in 2010.

In April 1994, the Finnish Parliament adopted an action programme for the promotion of "bioenergy". The term bioenergy originated in Finland and includes renewable biomass, essentially wood, as well as peat. The programme aims at increasing the use of bioenergy by at least 1.5 Mtoe (over its 1992 level) by 2005, and especially promoting wood as a fuel for CHP and district heating. This increase will be achieved through various means, including investment subsidy, the refund of the electricity tax, support to technology development, information and training, as well as regulations.

24 See Fossil Fuels chapter for a discussion of peat and its classification as a fossil fuel rather than a renewable energy resource.

The general investment subsidy applies to all new and renewable technology and can rise to a ceiling of 30% of investment cost. Conventional technologies or fuels that increase the diversity and security of energy supply can obtain support up to 25% of total investment cost. Studies pertaining to renewables or to energy efficiency can receive government support of up to 50%. These aids form part of a government energy subsidy which doubled to FM 130 million in 1998. Other parts of the energy subsidy are granted to investment in wind energy and new energy-efficient technology. The Government intends for the support to remain at its current level.

Subsidies are also granted for the management of young forests and the harvesting of wood for energy. These subsidies amount to between FM 12 and 15 per MWh.

Wind and Solar

Finland has favourable wind conditions on the coast, in the archipelagos and in the fell areas. Its wind capacity increased considerably in recent years: in 1992, capacity was below 2 MW and generation stood at 2.4 GWh; in 1997, capacity was 12 MW and generation 16.6 GWh. Due to the location of part of the wind resource, this involved development of arctic wind technology. The capacity expansion was a result of a wind energy promotion programme, launched by the Ministry of Trade and Industry in 1993, which aims to reach a total wind capacity of 100 MW in Finland in 2005. The means intended to achieve this expansion are the investment subsidy referred to above, the refund of the electricity tax, land use planning, agreements between utilities and the government, and information dissemination. The general investment subsidy to renewables can be increased to 40% in the case of wind, if high investment risk is associated with the new technology.

There are some 1 940 kW of photovoltaic systems installed in Finland, mainly off grid on some 35 000 holiday cabins and on the 1 700 navigational aids on the coast. There is also one 30 kW solar plant at Inkoo, which is the northernmost solar plant in the world, and one demonstration plant at Orivesi. Due to the long hours of daylight in the summer, insolation is relatively good between March and September.

Small-scale Hydro

There are around 200 small-scale hydro power plants with capacities ranging from 50 kW to 10 MW in Finland. These plants are mainly owned by electricity distributors and industry and generate some 0.9 TWh or about 9% of hydro generation, amounting to little more than 1% of total electricity generation. However, they are quite important locally to even out sudden load changes. In addition, there are numerous old dams and abandoned small hydro power plants, once used as the power source for flour and saw mills. Total hydro capacity (including large dams) was 2.9 GW in 1997.The government supports small-scale hydro (below one MW) through the refund of the electricity tax and the investment subsidy.

In addition to the measures listed above, the Ministry of Trade and Industry has started preparation of a new comprehensive programme to promote the use of renewable energy. The programme will cover all forms of viable renewable energy in Finland. It will act as a national implementation programme of the strategy set out in the EU's White Paper on renewable energy sources.

THE INTRODUCTION OF COMPETITION

Reform Legislation

Electricity Market Act of 1995

Finland's electricity supply industry has operated according to the principles of competition ever since the Electricity Market Act (386/1995) came into force on 1 June 1995. Up to June 1995, the Finnish power industry had been regulated in a comparatively light-handed manner; for example, there had not been any ongoing price control but only antitrust oversight. The Electricity Market Act, however, marked the transition to competition by introducing the following vital provisions:

- It required all owners of transmission and distribution networks to provide access to their networks for all consumers whose power requirement exceeded 500 kW, subject only to the limits of transmission capacity. This threshold was removed in January 1997, in accordance with the schedule provided for in the Act.
- It removed the licensing requirement on power plant construction, cross-border trade of electricity, and abolished any exclusive licences for power retailing.
- It required separate accounting for electricity generation, transmission, distribution and supply.
- It established the Electricity Market Authority (EMA).

The Electricity Market Authority is responsible for:

- granting, cancelling or changing network licences, including for new construction of power lines;
- supervising grid access and pricing;
- supervising unbundling;
- gathering statistics and information; and
- assessing the efficiency of the network companies.

1998 Amendments

The Electricity Market Act was modified by an amendment adopted by Parliament on 24 March 1998 (332/1998), which came into force on 1 September 1998. This amendment contains a number of important modifications to the Electricity Market Act. Notably, small electricity consumers, using a maximum current of 3 × 63 Ampère or a maximum power of 45 kW (residential and small-scale commercial and industrial consumers) are no longer required to obtain an expensive hourly meter but can become eligible based on load profiling. In load profiling, real measurements of the consumption patterns of typical consumers are used to develop estimated profiles for the whole consumer group. The ultimate consumers' invoices continue to be based on the regular meter, but reimbursements between retailers are based on load profiles and metered total energy. Load profiles are developed for every significant consumer group, such as residential consumers with or without electrical heating.

Further amendments concern load balancing and system reliability. Both functions were originally the responsibility of Fingrid. However, the new Electricity Market Act expands Fingrid's responsibility in both areas and organises them in a more market-oriented manner, approved by the Electricity Market Authority (EMA). Both the old and the new regime, which is to come into force officially on 1 January 1999, are described in the section System Balancing and Reliability below.

Several other pieces of legislation were also amended to better adapt them to the competitive electricity market. Firstly, the Act on Competition Restrictions was supplemented with a provision that gives the Finnish competition authorities the power to prohibit mergers if the resulting market share in electricity distribution and supply exceeds 25% nationally. This amendment came into force in October 1998.

Secondly, the relevant legislation governing the "EL-EX" Electricity Exchange, the Act on Trading with Standardised Derivative Instruments, was amended, coming into effect as of September 1997. The Act was supplemented with an electricity-specific provision that gave the Electricity Market Authority a clear supervisory role alongside the Financial Inspection Authority[25].

Regulatory and Antitrust Surveillance

In Finland, several institutions are involved in the regulation of the electricity supply industry. The most important regulatory institution is the Electricity Market Authority (Sähkömarkkinakeskus, EMA). EMA regulates the wires business (both transmission and distribution), EL-EX (together with the Financial Inspection Authority), and the supply of captive consumers. At present, the organisation has eight professional staff. This is seen as insufficient by the

25 The Financial Inspection Authority is the general surveillance authority for the banking and finance sector in Finland.

government, and two more professional staff were budgeted for 1999. EMA's budget is FM 5.5 million in 1999. Almost 90% of this stems from supervision and permit fees on the wires business, the small remainder is financed directly from the government budget. The organisation is divided into three divisions (see box).

Organisation of the Electricity Market Authority

Tariff Unit

- Monitoring and investigating network prices in distribution and regional networks
- Controlling the prices of captive consumers
- Collecting and analysing price data, accounting information and key economic and financial indicators

Technical Unit

- Monitoring and analysing transmission prices set by the national grid (Fingrid)
- Developing and analysing key technical figures of network operation
- Monitoring the electricity exchange EL-EX
- Controlling system reliability, load balancing and balance settlements
- Monitoring network maintenance and expansion

Judicial Unit

- Developing electricity market legislation (i.e. participation in various working groups and committees, and developing proposals for amendment)
- Legal surveillance of competition in the retail and wholesale market
- Legal surveillance of contracts and contract terms
- Issuing distribution licences
- Handling consumer protection issues

Following the 1998 amendments, EMA's main tasks are to:

1) Promote the development of the competitive electricity market;

2) Grant licences to network operators and construction permits for transmission lines of 110 kV and above. Construction of high voltage transborder lines require a licence from the Ministry of Trade and Industry;

3) Oversee the operation of networks and network prices, and ensure compliance with the Electricity Market Act and the conditions on which licences and permits were granted;

4) Compile the data required for monitoring;

5) Advise other authorities, companies and consumers in matters relating to the Electricity Market Act and its amendments.

EMA's paramount task is the surveillance of network operators, both in transmission and distribution. The Electricity Market Act, EMA's founding legislation, specifies a number of requirements that network operators have to adhere to and that are specifically monitored by the Market Authority. Network operators must:

1) Maintain and develop their systems;

2) Connect electricity generators and users to their network at "reasonable" prices;

3) Sell network services (connection, transmission, metering) at "reasonable" rates;

4) Supply electricity to consumers who cannot otherwise obtain it competitively (suppliers of last resort);

5) Publish the terms and prices for network services as well as the principles upon which pricing is based; and

6) Publish data illustrating the efficiency, quality and profitability of their operations.

With respect to tasks 3) and 4), the Electricity Market Act provides that the following principles must be observed: prices must be "reasonable" and "moderate", prices must be the same over the whole supply area in question (no geographic differentiation), electricity users must be able to obtain all relevant services from the operator to whose network they are connected, and all prices must be published. EMA monitors the network operators' compliance with these principles.

Regarding the regulation of prices in particular, there is no ongoing price regulation in Finland. Power companies set their prices autonomously without having to submit their price menus or plans to raise prices to regular investigation. EMA has the right to initiate investigation but so far has mainly become active upon instigation by a plaintiff. There is no price cap or other formula to determine maximum prices, and to date, no organisation in the Finnish electricity market has developed any ready-to-use formula to define what reasonable prices are. EMA is working on guidelines for the future. In current practice, EMA uses yardstick regulation, i.e. comparisons among broadly comparable utilities, but it also analyses utilities' costs and applies a reasonable rate of return on those assets that are involved in the prices under consideration, e.g. transmission assets for transmission pricing[26].

26 Based on this type of analysis, EMA has recently issued a ruling against a company called Megavoima. EMA undertook a detailed investigation into the company's network operation costs in 1996-97. After applying to this a "reasonable" profit margin, EMA found that Megavoima's transmission prices were excessive. The Autority may order Megavoima to pay compensation to its customers who may also seek court-ordered damages.

Both the Electricity Market Authority and the Office of Free Competition (OFC) supervise the market and become active if there is abuse of a dominant position. EMA acts as the first instance in the case of an electricity-related dispute. An EMA ruling can be appealed to the Supreme Administrative Court of Justice. The rulings of the Office of Free Competition can be appealed to the Competition Council (a tribunal body) and further to the Supreme Administrative Court of Justice.

The Office of Free Competition has only recently acquired the right to exert merger control. On 24 March 1998, the Parliament adopted an amendment to the Act on Competition Restrictions. This amendment introduced for the first time ever the control of concentration and gave the competition authorities the power to prohibit acquisitions of firms or parts of their business operations, mergers and joint ventures if the turnover of the parties involved exceeds FM 2 billion, or if the turnover of any two parties involved exceeds FM 150 million. Until this amendment was passed, the Office of Free Competition and the Competition Council could only monitor the conduct of companies, not the structure of the market. Today, the competition authorities have to be notified in advance of merger activities that meet the turnover requirements specified above. The competition authorities have the right to ban mergers before they occur, to cancel them after they occurred, or to attach conditions to them.

Within the same amendment, an electricity-specific provision was included that restricts any single electricity company to less than 25% of the electricity transmitted in the 400 V network (the distribution network). At present, no company has a market share exceeding this indicator; in future, the indicator will function as an upper boundary for mergers and joint ventures.

To date, the OFC has not disallowed any merger. However, it has become active a number of times in the area of behavioural regulation. In 1997, OFC investigated the company TSM (Teollisuuden Sähkönmyynti Oy, Industrial Electricity Sales Ltd.), which is an electricity marketing organisation founded on 19 June 1995 by PVO and five other large industrial electricity generators, UPM-Kymmene Oy, Enso Oy, Kemira Oy, Etelä-Pohjanmaan Voima Oy, and Metsä-Botnia Oy. Meanwhile, five more companies have joined TSM: Ahlström Energia, Helsingin Energia, Kokkolan Energialaitos, Kyro Power Oy, and Vantaan Energia Oy.

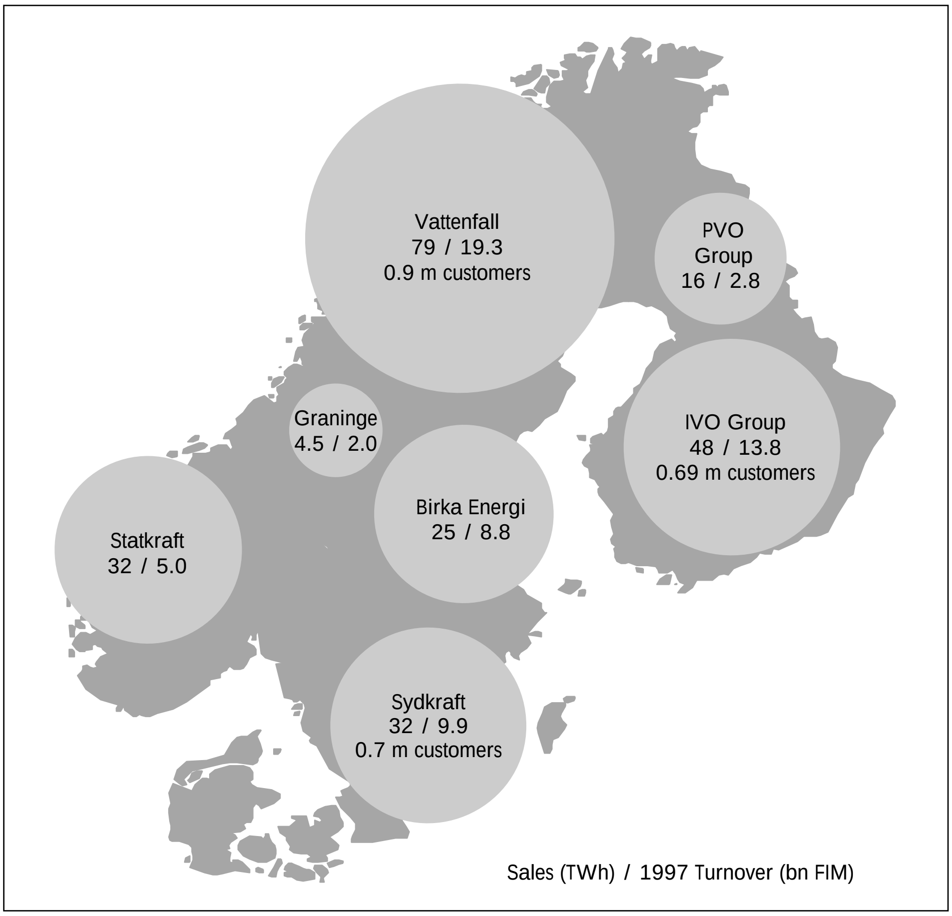
The Office of Free Competition has found that the purpose of TSM is co-ordination and harmonisation of the member companies' behaviour and restriction of competition between them, which in OFC's view is tantamount to price collaboration, an offence under Article 6 of the Act on Competition Restrictions. In December 1997, it nevertheless granted a provisional exemption from further pursuit under Article 6, valid until 31 December 2002, under the condition that TSM allows its members to sell electricity independently from TSM, as well as to import and export freely. The reasons for this exemption are:

■ TSM has in the past allowed its members to sell electricity independently;

■ TSM is in some cases the major or only alternative supplier to IVO or the Swedish power company Vattenfall; and

■ TSM has benefitted consumers in the past by providing more reliable electricity supply, especially for very large consumers, than any of its member organisations alone. Figure 29 shows the major electricity companies in the Nordic market.

Figure 29
Power Companies in the Nordic Market
(31 December 1997)



Source: IVO.

In another case, the Office of Free Competition expressed concern about certain marketing chain agreements IVO concluded with certain retailers under the name IVO Partners. The OFC stipulated that IVO sell wholesale electricity at the same prices and terms to any retailer regardless of whether or not they are members of IVO Partners, and that no retailer be bound by an exclusive sales agreement with IVO.

OFC is currently investigating two further cases. The first one was triggered by the association representing the distribution companies in Finland (SENER), which complained about a high degree of concentration in the Finnish wholesale market, and in particular about abuse of its dominant position by IVO. OFC is reviewing the position and pricing of IVO's daughter and parent companies as well as the long-term supply agreements IVO has concluded with distribution companies and the corresponding prices of electricity.

The second case involves Helsingin Energia (Helsinki Energy). The company is under investigation for alleged abuse of dominant position, especially relating to the "unreasonableness" of its electricity and district heat prices and cross subsidisation between the two branches of business.

Consumer interests are further taken into account by the National Consumer Administration and the Consumer Ombudsman, who has made a number of suggestions to amend legislation in the past, and whose suggestions are reflected in the new Electricity Market Act. Together with the Electricity Market Authority and the Ministry of Trade and Industry, the National Consumer Administration publishes information leaflets which explain the competitive electricity market to small users, one of which even includes a call for tender form for electricity supply for the use of small consumers.

Restructuring

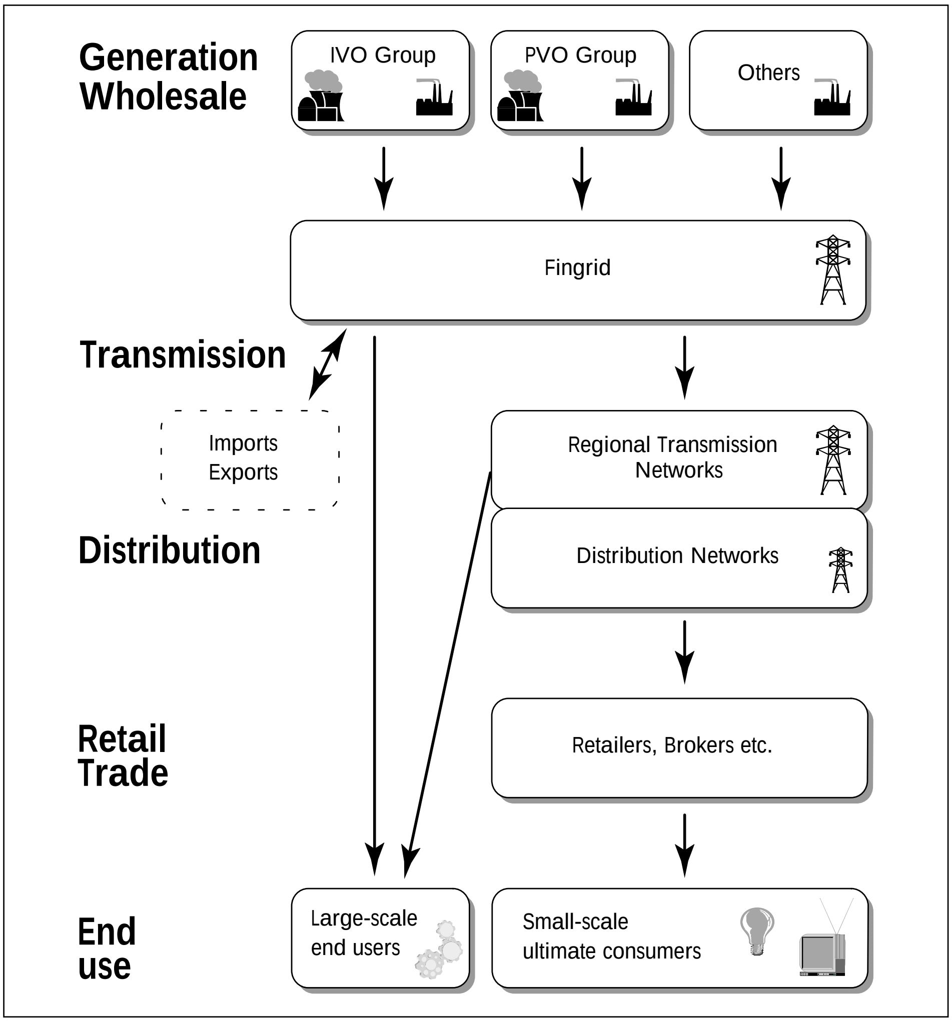
Since competition became effective in the Finnish electricity market in 1995, far-reaching restructuring has occurred in the market, both driven by market forces and government intervention. The biggest change to date remains the creation of Fingrid in 1997 as the national high-voltage transmission company.

Creation of Fingrid

Fingrid (Suomen Kantaverkko Oyj / Finska Stamnät ABP Stamnät / Finnish Power Grid plc) was established by the Government on 29 November 1996. The company bought the transmission assets of IVS and TVS and the cross-border lines, which had previously been owned by IVO, for FM 7 billion, which represents the biggest financial transaction ever carried out in the domestic financial market. Commercial operation started the following year, on 1 September 1997. Figure 30 shows the structure of the market today.

Behind the creation of Fingrid stood the government's intention to adapt the Finnish electricity market to conditions in the other Nordic countries, notably Sweden and Norway, which work together in the Nordic electricity market. Both

Figure 30
Structure of the Finnish Electricity Market
(1998)



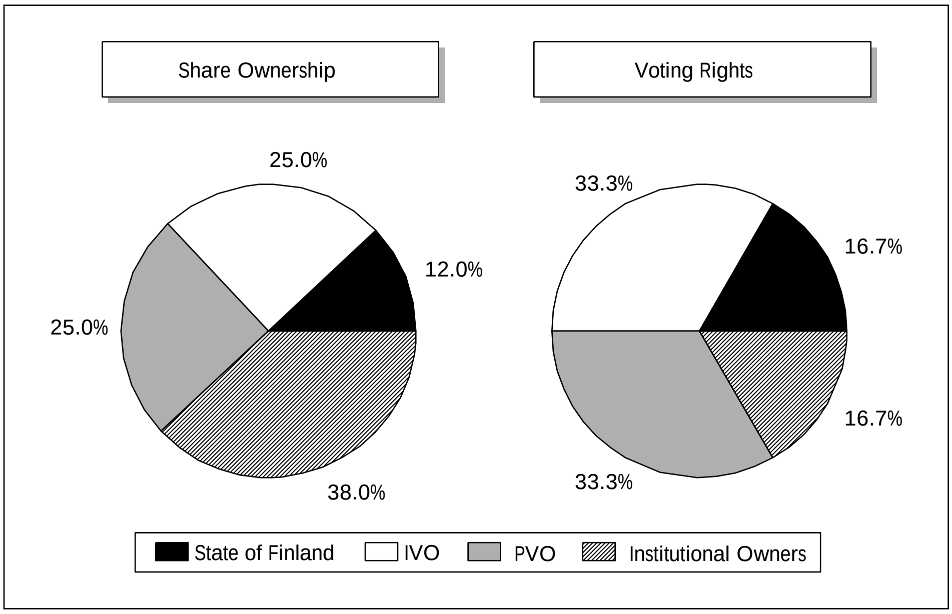
Source: Ministry of Trade and Industry.

Sweden and Norway had fully unbundled transmission companies. Fingrid operates as a common carrier[27], and the Government perceived a need to arrange Fingrid's ownership in such a way as to exclude any possibility of discrimination against competitors. Figure 31 shows share ownership and voting rights in Fingrid.

27 One important feature of a common carrier is the fact that it has to carry the load of every customer who wishes to use it. This includes the duty to extend the infrastructure if it is insufficient. In contrast, a contract carrier doest not have the obligation to extend its infrastructure in order to cope with extra demand. Fingrid's duties make it a common carrier (see Transmission section).

The institutional owners of Fingrid are the Pohjola, Tapiola and Sampo insurance groups. IVO, PVO and the Government have acquired shares with greater voting rights, which gives IVO and PVO one-third of the voting rights and the Government one-sixth. This accounts for the difference between the two pie charts in Figure 31. However, all major decisions require a three-fourths (75%) majority. For this reason, the two big shareholders IVO and PVO cannot simply outvote the smaller participants.

Figure 31
Share Ownership and Voting Rights in Fingrid



Source: Fingrid.

Other Market Structure Changes

After the creation of Fingrid, the next important structural change was the merger in the first half of 1998 between IVO and the state-owned oil company Neste, forming the new company Fortum. This merger is discussed in detail in the section "Fortum Merger" above.

In addition to these government-induced changes, market forces have brought about numerous mergers, acquisitions and joint ventures. IVO has, for example, bought the Swedish power company Gullspang Kraft in central Sweden. Gullspang and the neighbouring utility Stockholm Energi are now planning to merge into a new company whose name would be Nya Birka Energi. The company would be 50% owned by IVO and 50% by the city of Stockholm.

As Figure 32 shows, the Swedish purchase is not the only acquisition IVO has made abroad. Apart from Gullspang, IVO owns four subsidiaries in Sweden: Enernet

Figure 32
IVO Group's Holdings in Electricity Companies
(31 December 1997)

Source: IVO.

Sverige, Infraodteknik, Transelectric and IVO Energi, in addition to minority shareholdings in other Swedish companies.

Swedish companies have also entered the Finnish market, especially Sweden's state-owned utility Vattenfall which has bought two Finnish distribution companies, Hämeen Sähkö Oy and Lapuan Sähkö Oy. Within the Finnish market, several power companies have plans for mergers.

Trading Arrangements

When competition was introduced into the Finnish market in 1995, the legislation did not create a mandatory spot market, nor did it stipulate the creation of an organisation for central dispatch. The only foundation for competition was the provision that network-owning power companies had to open their grids up to their competitors and transmit or distribute their electricity for them. This left generators, retailers and consumers free to conclude supply contracts with each other. Power companies could continue dispatching their own plants only and trade with others for surplus power.

Despite the fact that the Government made no attempt to legislate the creation of a spot market for electricity, such a market emerged immediately. The Finnish Electricity Exchange EL-EX (Sähköpörssi Oy) was founded in 1995 by the Finnish Options Market (OM Finland/HEX Oy)[28], a financial institution which had long-standing experience with commodity markets. In November 1995, almost simultaneously with EL-EX, another trading exchange was founded: Voimatori Oy, a regional power exchange in which some 45 local power distribution and supply companies were trading surplus power. Voimatori Oy joined EL-EX in the Spring of 1996. Its accession helped raise the number of participating companies in EL-EX to above 30; failure to achieve this had delayed the deadline for the start-up of its commercial operation twice. EL-EX eventually started trading on 16 August 1996.

From the outset, the intention of the founding institutions was that EL-EX should be made compatible to Nordpool, and that the two organisations should eventually merge their operations into one big Nordic power exchange. EL-EX was expected to quickly develop into Finland's central trading institution for electricity, similar to the Norwegian/Swedish spot market Nordpool, and to achieve a trading volume comparable to Nordpool, which handles about one third of all electricity sold in Sweden and Norway. As an intermediate step, EL-EX aimed for a market share of 5% of all supply deals negotiated in 1996.

Subsequently, the hoped-for trade volumes did not materialise. In 1997, EL-EX's share in domestic supply deals still stood at 3% (5% in 1998). In January 1998, Fingrid purchased all shares of EL-EX from HEX Oy, and in May 1998, half of those shares were sold to the Swedish grid company Svenska Kraftnät in order to strengthen EL-EX's

28 OM Finland is actually a company in Swedish ownership. Its parent company is the Stockholm-based OM International.

integration into Nordpool. In June 1998, close co-operation with Nordpool was achieved, and EL-EX became the official representative of Nordpool in Finland. Today, EL-EX has 49 member companies, 35 from Finland, 12 from Sweden, and 2 from Norway. Among them are producers, distributors, power brokers and large consumers.

EL-EX offers a variety of products, ranging from a day-ahead market to a physical forward market with a delivery term of three years:

1) EL-EX offers spot trading on ELSPOT, the 24 hours ahead market, every weekday. In this market, trading occurs once daily, i.e. bids for the following day have to be submitted before 1 p.m. on the trading day; price levels are calculated by 4 p.m. ELSPOT is a physical not a financial market, which means that the electricity contracted for is physically delivered on an hourly basis.
2) ELSPOT is complemented by trading of financial forward and futures contracts on ELTERMIN. In this market, participants can buy and sell electricity weeks, months, and years ahead - trading goes up to three years ahead. They can trade electricity for short time periods but also for weeks, blocks and seasons. Trading occurs continuously every weekday by telephone or via an electronic system called Power Click. The system price in ELSPOT is the reference in ELTERMIN contracts, which essentially act as risk management tools.
3) EL-EX is the institution that manages the new market for short-term adjustments. This new market is called ELBAS. Trading occurs every day on the actual day, during 20 hours of that day. This balance market allows trading as close as two hours before the delivery hour.

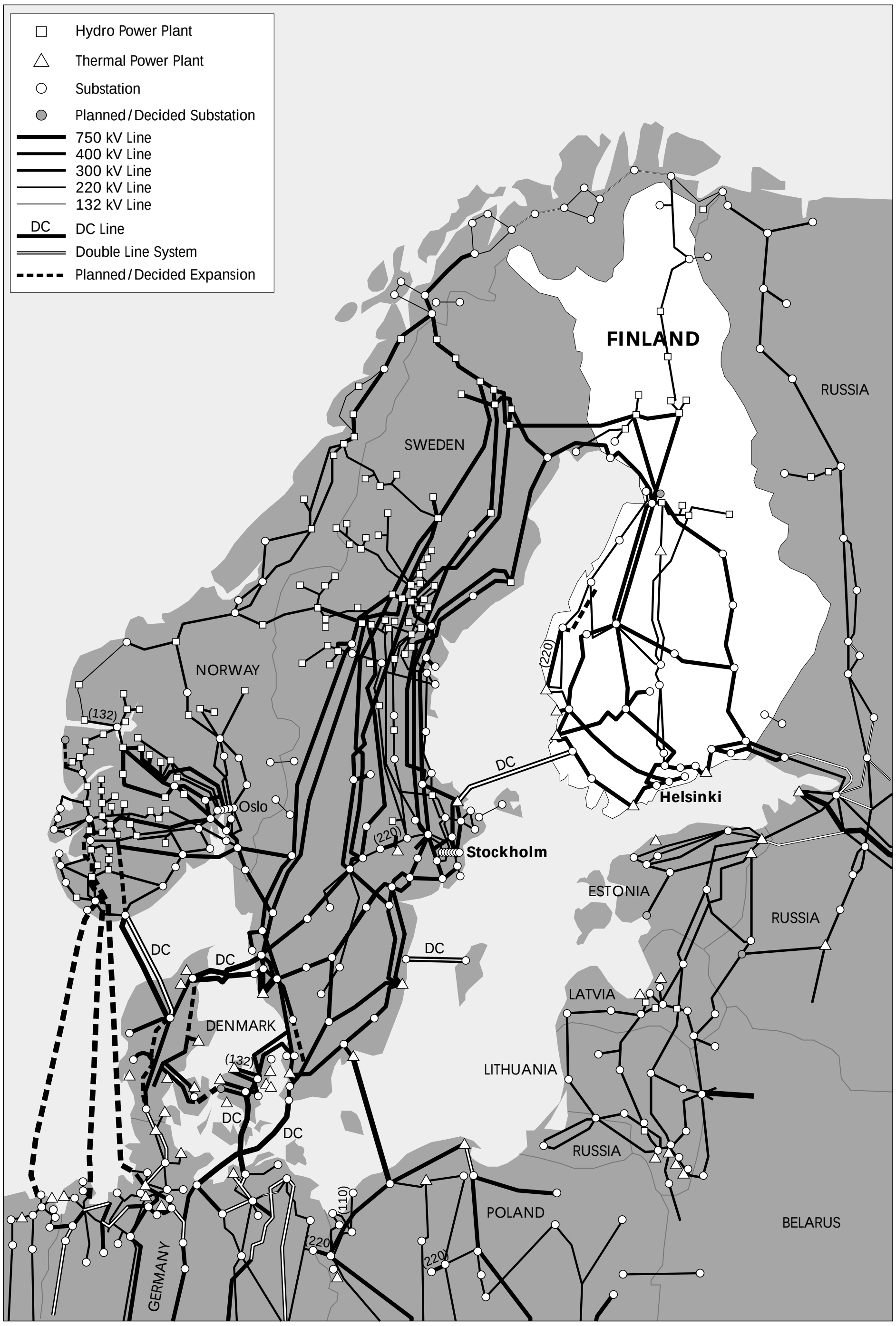
Since EL-EX co-operates with and is co-owned by one of the owners of Nordpool, Svenska Kraftnät, both markets function nearly as one (see the section "System Balancing and Reliability" below).

Transmission

Since the creation of Fingrid, the bulk of the Finnish high-voltage transmission network is owned and run by Fingrid. Fingrid owns 97% of the domestic transmission grid, including nearly all of the 400 kV power lines, all of the 220 kV lines, the 110 kV trunk lines and substations, and all major cross border lines. Slightly more than half of the 110 kV grid (8 000 kms) is still owned by companies other than Fingrid (see Figure 34). Out of the current total supply of about 70 TWh annually, approximately 25 TWh is transmitted via these regional lines only. Fingrid is responsible for the remaining 45 TWh. The total length of Fingrid's transmission system is approximately 13 600 kms, out of a national total of 21 600 kms, and Fingrid intends to buy most of the sections presently owned by other companies at present.

The Finnish transmission grid and its interconnections to Norway, Sweden and Russia are shown in Figure 33. Finland's total transboundary transmission capacity amounts to 17% of total available capacity of 16 100 MW (including both domestic generation capacity and import contracts). Most other European countries have

Figure 33
The High-Voltage Transmission Grid in the Nordic and Baltic Countries



Source: Fingrid.

higher interconnection capacity. Total technical transmission capacity between Finland and Sweden is almost 2 000 MW, but since the interconnectors are also needed for load balancing and system stabilisation purposes, commercial capacity can at times be much smaller. Maximum commercial transmission capacity is therefore only 1 800 MW. Table 2 details the maximum available interconnector capacity per link. Construction of a new 300 MW DC interconnection for power imports from Russia is under consideration.

Table 2

Transmission Interconnections Between Finland and its Neighbours, 1998

(Maximum Technical Capacity in MW)

Countries	*Cable*	*Flow Direction*	*Capacity*
Finland-Sweden	Northern Link	Import Export	1 400 900
	Sea Cable (Gulf of Bothnia) (DC)	Import/Export	515
Finland-Norway		Import Export	100 70
Finland-Russia	(DC)	Import	1 000

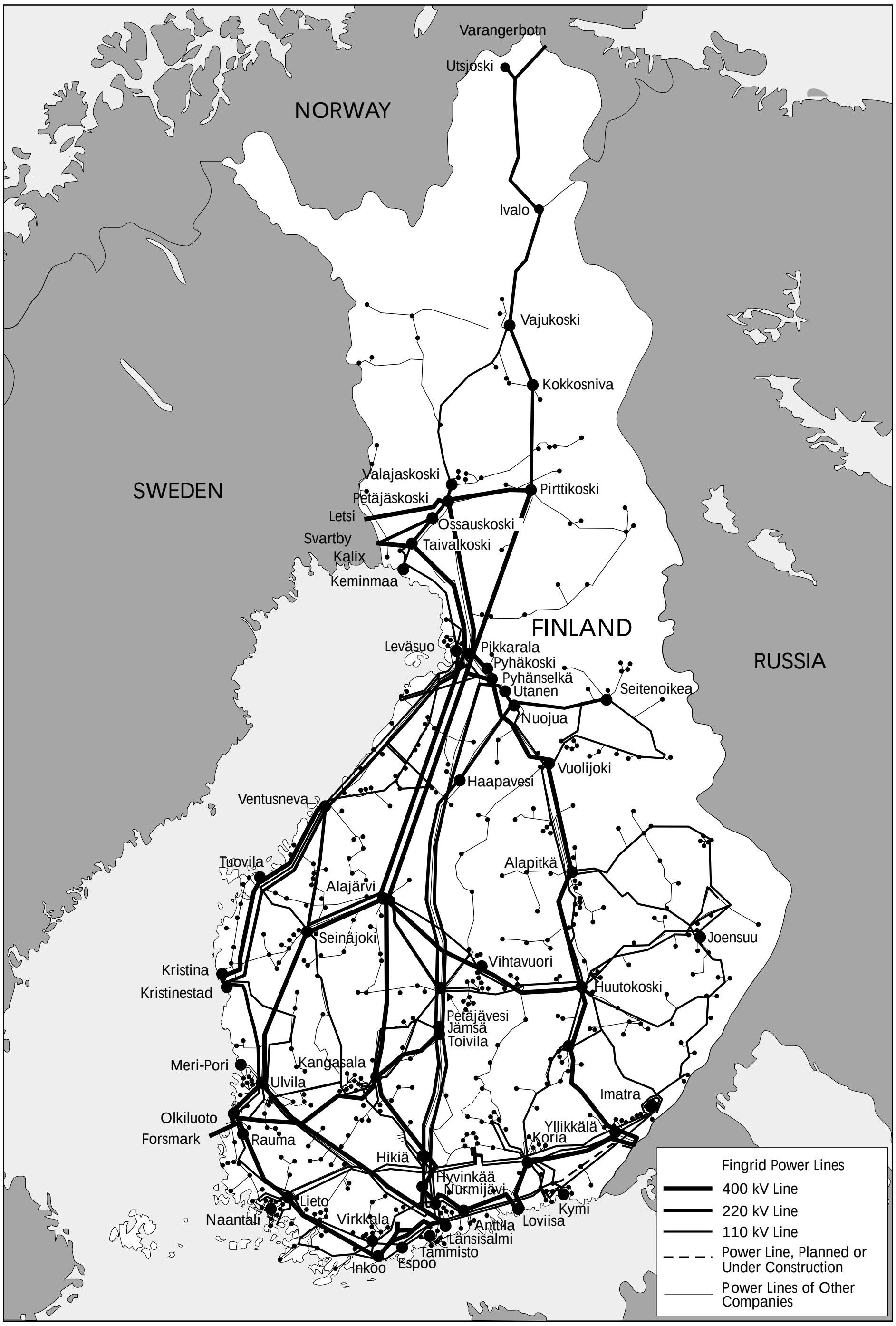
Source: Fingrid, Ministry of Trade and Industry.

Fingrid operates Finland's transmission grid as the country's transmission grid operator (TSO) under a licence from EMA. One of its responsibilities as the system operator is transmission of any customer's electricity, subject to availability of transmission capacity. It must also connect all power generating installations and consumption sites within its area, develop and expand the transmission network and interconnections according to load growth, maintain the grid to adequate technical standards, balance the system, ensure the provision of ancillary services (frequency control, voltage control, etc.) and manage disturbances. Fingrid is even involved in the siting and licensing of new generating plant.

Fingrid does not have a statutory monopoly on transmission facilities; in principle, any interested entity can construct a power line, subject to a licence. Such licences are to be issued by EMA except in the case of cross-border lines, when they are issued by the Ministry of Trade and Industry.

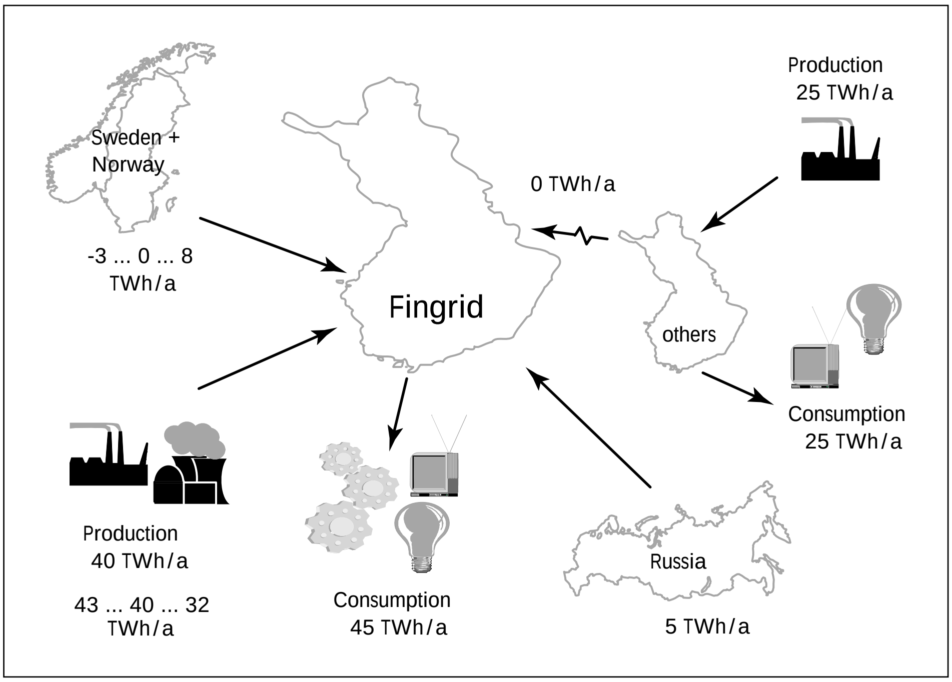
Due to the ownership situation relating to the 110 kV grid, not all distribution companies are Fingrid's customers: only 75 out of the 115 distributors buy electricity from the main grid. These can be both sellers or buyers, according to the market situation. The same holds for the 20 power-intensive industrial companies that are directly connected to the national network. In addition, 10 power producers deliver electricity to Fingrid.

Figure 34
The Finnish High-Voltage Transmission Grid



Source: Fingrid.

Figure 35
Electricity Flows Involving Fingrid and Regional Transmission Grids



Source: Fingrid.

The Electricity Market Act of 1995 and its 1997/98 amendment do not stipulate any price ceilings or formulae for price regulation, nor do they provide for any specific transmission pricing system. The Electricity Market Authority merely controls the "reasonableness" of pricing. As with prices for ultimate consumers, EMA's assessment of the reasonableness of prices occurs on a case-by-case basis, using company-specific information, benchmarking analysis, etc.

Fingrid therefore sets its own transmission prices, which consist of a number of distinctive elements, listed in Table 3 below. Fingrid's intention in designing its transmission prices was to develop a structure that combines cost-reflectiveness and simplicity. For simplicity, nodal pricing is not used. Nor are any price elements distance-sensitive, which would, in Fingrid's view, have entailed deviation from the true cost conditions in the grid.

The prices in Table 3 reflect a new structure that came into force on 1 November 1998. Fingrid's previous transmission pricing contained all elements listed below, but with different weights; the new structure places more emphasis on consumption as the price base, results in lower overall loss fees, is simpler and generates more predictable cash flow for Fingrid. Total transmission prices are also 10% lower than before, with a further reduction of 5% anticipated for the year 2001.

Table 3
Transmission Prices in Finland
(1 November 1998 Finnish Pennies per kWh)

Price Element	*Price Base*	*Price Level*
1) Market Place Charge	Take-off from grid	0.65
2) Operation Charge		
Peak	Take-off from grid	2.30
Off-Peak	Take-off from grid	0.40
3) Loss Charge		
	Feed-in into grid	0.15
Peak	Take-off from grid	0.25
Off-Peak	Take-off from grid	0.15
4) System Service Charge	Take-off from grid	0.10

Source: Fingrid.

All of these price elements vary with grid use; there is no fixed charge. Grid use is determined via physical measurements in the grid; the sales arrangements between buyers and sellers that cause those physical power flows are not used to calculate grid charges. Items 2) and 3), in Table 3 the Operation Charge and the Loss Charge, are subject to variation according to peak and off-peak time zones. The peak zone is defined as wintertime working days, i.e. from 7 a.m to 10 p. m. Monday to Saturday between 1 November and 31 March. All other times are off-peak.

1) The Market Place Charge is levied on consumption of electricity behind the take-off point of electricity from the Fingrid network, to be paid by Fingrid's customers, either retailers or ultimate consumers. It compensates the opportunity the customer has to buy electricity in a nation-wide market place. This price element covers sunk costs from historic investments in the transmission grid and was placed on the customers, not the producers. Fingrid's rationale for this was that in a fully competitive power market with bilateral trading arrangements the customer decides upon the amount of transmission used, once all power plants have been sited.

2) The Operation Charge is also levied on consumption, to be paid by Fingrid's customers, at the same point on the grid as the Market Place Charge, but it is differentiated into one peak and one off-peak rate and thus covers, at least partly, the cost of congestion. There is a significant difference between the two rates.

3) The Loss Charge directly covers grid losses (both corona losses and resistance losses). Grid losses cause costs because the electricity that is lost between the sending and the receiving point has to be generated by other power plants. The Loss Charge is supposed to cover the average procurement cost for this replacement power. In the old transmission pricing system, the Loss Charge was

point-specific, but now it is only differentiated between peak and off-peak periods. The differentiation was made to reflect grid losses which are higher when the grid operates near capacity. The Loss Charge is based on average incremental losses. Since these losses are influenced by decisions made by both generators and consumers, the loss charge is applied to all power delivered to and taken out of the grid.

4) The Systems Service Charge covers the cost of procurement and maintenance of production reserves and of cross-border electricity trade for load-balancing purposes. The Systems Service Charge is levied on consumption behind the grid connection point, paid by Fingrid's customers.

The new pricing structure also implied a revision of the pricing for cross-border transmission. Until mid-1998, a special, energy-related price was charged for every transaction that involved use of the interconnectors. This charge, amounting to FM 4 per MWh was abolished on 15 June 1998. An additional fee on imports of FM 5 per MWh will be abolished the first half of 1999. These fees were meant to cover a part of the cost of transmission between Finland and Sweden, which amounts to some FM 5 per MWh for imports and 10 Swedish Crowns (SEK) per MWh for exports (non-baseload). In the new structure, the cost of using these facilities is included in the Market Place Charge in such a way that, for exports, a Finnish generator would pay the transmission charge for the Finnish section of the line, and a Swedish importer would pay the use of the Swedish transmission system. Thus by paying the transmission charges of their own system, the agents have access to the entire Nordic transmission network.

System Balancing and Reliability

In addition to its responsibility for allowing normal operation of the transmission grid and for providing the ancillary services related to it, Fingrid is also responsible for other important functions of a Transmission System Operator, notably

1) reconciling the electricity exchanges desired by the trading parties – such as producers, brokers, retailers and consumers – with the existing transmission capacity, and

2) maintaining system stability and reliability when the actual sales volumes differ from the contracted-for volumes, e.g. when more electricity is drawn from the grid than was previously contracted for, or when less electricity is produced than agreed.

To match function 1) with the decentralised Finnish system, Fingrid was designed as a market participant which engages in "counter trading". Counter trading functions in the following way: assume market participants in the south of Finland desire to buy 1 350 MW from a cluster of hydro power plants situated in the north, due to low prices of hydro power (see figure 36). This causes problems because the transmission infrastructure can carry only 1 250 MW. In this situation, Fingrid sells

100 MW of power south of the transmission constraint, which it buys at the prevailing high prices from thermal plant in the south but sells at the low prices of hydro power in the north. This way, Fingrid has reduced the power flow across the transmission constraint by 100 MW, and the flow now exactly matches transmission capacity.

In doing this, Fingrid has incurred a loss of 100 MW multiplied by the price differential between expensive southern thermal power and cheap northern hydro power, which corresponds to the cost of redispatch. If situations like this occur frequently, Fingrid's profitability is jeopardised. Such losses from inadequate transmission capacity are thus thought to act as a trigger for investment in line reinforcement or new power lines, since the investment will reduce losses and thus improve profitability. Counter trading is also applicable for grid faults and across borders. If, for example, the interconnections to Sweden become congested, Fingrid engages in counter trading with Svenska Kraftnät, the Swedish grid company. This triggers the same incentives to relieve bottlenecks or to improve maintenance.

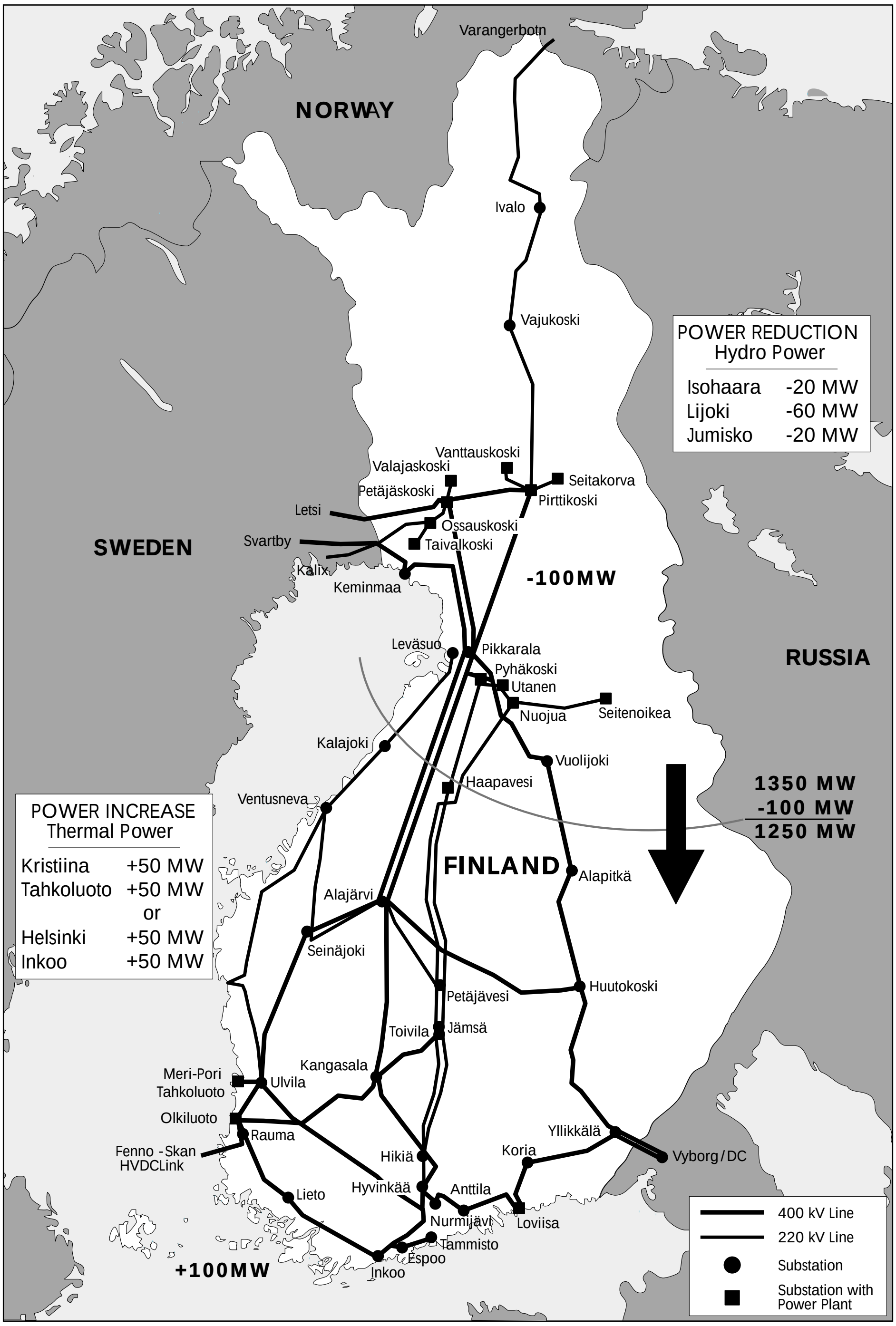
Function 2) has been re-organised in a similarly market-oriented way by the amendment to the Electricity Market Act which came into force on 1 September 1998.

EL-EX/Nordpool is the market place where longer-term power trade occurs. However, on the actual delivery day there are always discrepancies between the contacted-for quantities and the amount of electricity that users actually choose to consume, for example due to the unpredictability of weather patterns. The additional electricity needed to supply this extra demand is called balance power. Balance power is also needed if a supplier cannot supply the power he is supposed to deliver.

Before the amended Electricity Market Act came into force, Fingrid as the Transmission System Operator was already responsible for load balancing. This was done via a mechanism called the Power Balance Deviation (PBD). The Power Balance Deviation was specified in the system agreements between all those Nordic parties that have system responsibility, i.e. besides Fingrid, also the Swedish, Norwegian and Danish system operators in the interconnected Nordic network. According to this specification, the need for balance power had to remain within ± 200 MW as an instantaneous value and within 125 MWh per hour. If the need for balance power exceeds the upper boundary, Fingrid's frequency control reserve, i.e. power generation that was set aside under specific contracts as an ancillary service to stabilise technical problems in the grid, would automatically be triggered. Afterwards, it would be remunerated as the ancillary service, which is comparatively expensive.

Under the new arrangements, Fingrid retains the responsibility to rectify these discrepancies, but does so via a market, the balance power market. This market is not identical with ELBAS. ELBAS is a physical market for power adjustment, which is administered by Fingrid's subsidiary EL-EX, and allows trading for time

Figure 36
Counter Trading in the Finnish Electricity Market



Source: Fingrid.

periods shorter than those on ELSPOT, i.e. until two hours before delivery. The market for balance power functions during the delivery hour and is administered directly by Fingrid.

One of the core features of the balance power market is the fact that every market participant (excluding small-scale consumers) must ensure that they can obtain power from another entity, the open supplier, to back-up or top-up their regular supply contract. This applies throughout all stages of the electricity supply chain, i.e. retailers who have a regular supply contract for a fixed quantity with a power broker must have another power broker or generator as open supplier for balance power. All power brokers and generators must themselves also have an open supplier. This pyramid ends with Fingrid's own balance service at the top. Suppliers who are situated so near the top of the pyramid that they only have Fingrid's balance service as their open supplier are referred to as Organisations with Power Balance Responsibility (OPBRs). At present, the pyramid has three levels: organisations active at the distribution network level, OPBRs and Fingrid.

Fingrid's balance power market has two functions: 1) balance power management (regulating power market) and 2) balance settlement:

1) Balance power management occurs during the actual delivery hour of electricity. Fingrid buys and sells power based on competitive bidding in the regulating power market, and balances consumption and generation at a national level, including agreed imports. All generators whose power plants allow variations of output (regulating power), and end users whose load can be disconnected, can bid on this market. This regulating power market is the source of power which is then supplied to OPBRs as balance power.

The adequacy of the market for regular load balancing as well as coping with disturbances is ensured through a rapid disturbance service, co-operation with the system operators of the other Nordic countries, and a guiding price structure. The price structure provides for hourly balance power prices which are tied to the prices in the regular spot market ELSPOT as well as to the prices in the regulating power market, in order to ensure that all generators and suppliers have an incentive to offer power in the balance market.

2) Balance settlement occurs after every hour of electricity trading and serves to determine which power exchanges have actually taken place. In order to determine what has actually happened in the market, balance settlement data are processed from the bottom up: every market participant determines how much power they have used in comparison with their own production and contractual agreements. Quantities in excess are counted as purchases from their open suppliers, shortfalls are counted as sales to their open supplier. Imbalances are cumulated upwards according to the pyramid of open suppliers, until the national balance is determined. Imbalances at a national level mean that electricity has been imported from or exported to neighbouring countries. The quantities of balance power thus determined are then weighted with the price of balance power prevailing during the respective trading hour, and payments are made.

Distribution and Supply

Almost all Finnish distribution utilities are also retailers of electricity, and most of them also own power plants or at least a stake in a generating plant. The Electricity Market Act of 1995 attributed to each utility a licenced area for distribution, but they do not have any exclusive supply rights. Utilities have to grant their competitors access to their grids, and to keep separate accounts for the wires business and for supply. They must also have non-discriminatory distribution tariffs, differentiated according to voltage level (in practice: high, low, and medium voltage).

As with other parts of the electricity supply industry, the Electricity Market Authority monitors reasonableness of network prices and equal treatment of customers and competitors. Figure 37 shows the development of electricity prices for the industrial and residential sectors since 1980.

Electricity supply was opened to competition for consumers with a load of 500 kW on 1 November 1995, in accordance with the Electricity Market Act of 1995. At the beginning of 1997, the scope of competition was broadened to all consumers, including those small-scale users who were willing to buy an hourly meter. From 1 November 1998, small-scale customers can participate in the competitive market without this expensive meter: the time variation of their consumption is estimated using load profiling[29].

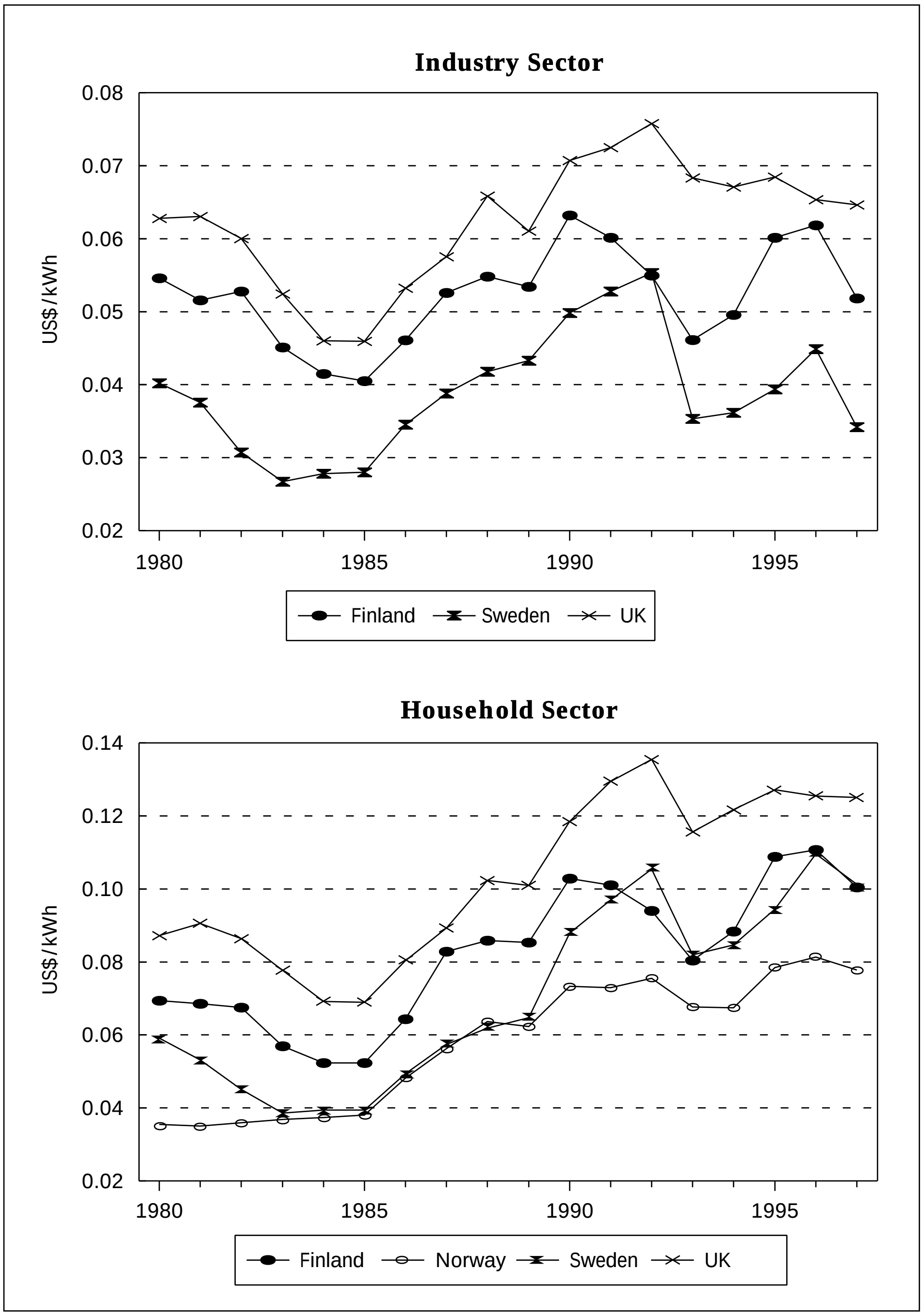
The law does not stipulate any specific structure for supply prices, and while EMA has issued some guidelines regarding equal treatment, no organisation so far has issued any recommendation regarding the structure or the overall level of these prices.

Both the level and the structure of prices to ultimate consumers can vary considerably, even among adjacent distributors/suppliers. Having to separate their accounts, incumbent distributors/retailers often simply split their prices into a distribution part and a supply part without revising the structure in both parts.

Despite the differences in concrete tariff schemes, both distribution and supply prices retain a two-part structure in most cases. They contain a fixed charge that, in the case of supply prices, often depends on the size of the consumer’s main fuses, and an energy charge. For larger consumers, the energy charge is often differentiated at least into to two time zones, i.e. winter workdays (peak) and all other times (off-peak). This pricing structure requires a dual-works kWh-meter. The relative size of the fixed rate and the energy charge may vary greatly between utilities. The largest consumers may have an additional charge which is connected to peak load. New facilities and buildings are subject to connection fees. Figure 38 shows the average share of various cost elements and taxation in end user prices for Finnish residential customers.

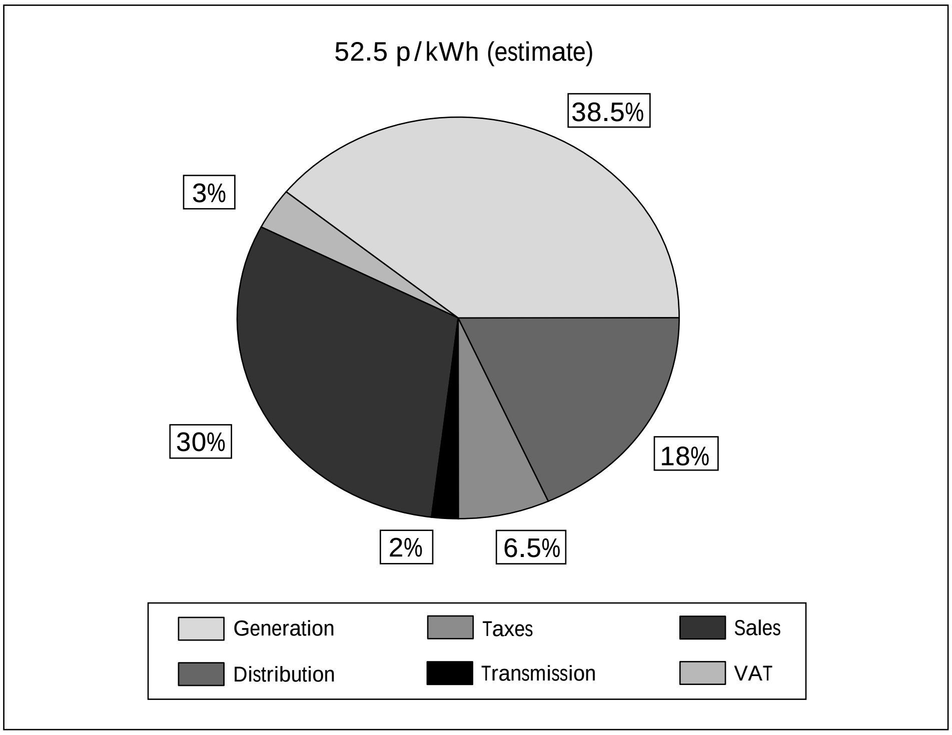
29 See section Reform Legislation.

Figure 37
Industrial and Residential Electricity Prices in Finland
(US $ per kWh)



Source: IEA/OECD: *Energy Prices and Taxes, Third Quarter 1998*. Paris, 1998.

Figure 38
Components of Residential Electricity Prices in Finland
(1 January 1998)



Source: Electricity Market Authority.

CRITIQUE

Market Design

Finland has accomplished a great achievement in designing and building up its competitive electricity market. The introduction of competition was made in a very innovative way, leading to an open market allowing both bilateral and multilateral trading[30]. A number of advanced features of the Finnish electricity market might be particularly prone to foster an open and competitive power market and warrant a closer look by the international community.

30 Bilateral trading occurs if only two market participants conclude a transaction with each other. One example is a bilateral contract which was not traded over EL-EX, and where consequently price and quantity information is not accessible to other market participants. Nor are other market participants implied in the transaction, as they might be, for example, for top-up deliveries.

The transition to competition was a relatively smooth one. This was partly due to certain favourable starting conditions, in particular a wide variety of existing players in the sector, and a decentralised way of doing business (e.g. no central dispatch), which the Government made good use of with a remarkable degree of flexibility. The Government first attempted to implement competition via grid access rules only, leaving transmission network ownership and operation with the vertically integrated power companies IVO and PVO. However, it became clear that this model would not be compatible with the rest of the Nordic power market. Integration with the power market in Sweden and Norway was an objective from the outset. Therefore the Government swiftly changed its strategy and managed to create the national grid company Fingrid rapidly and without major obstacles.

The Government must be commended for creating Fingrid as a unified high-voltage transmission company. In principle, and provided the company's decision-making cannot be captured by a particular interest in the market, creating a separate transmission company is the ideal way to remove both the incentive as well as the possibility to discriminate against any market participant. This is even more important in Fingrid's case, because the company is also the system operator (SO), and as such is responsible for all activities that are required for the efficient operation of the entire power system. Fingrid has more information on market conditions than any other entity in the market, and has tremendous power to interfere with the level playing field of competition. In order to make Fingrid function properly, its governance must be as unbiased as possible.

In practice, IVO and PVO remain major owners of the transmission grid through their share ownership in Fingrid. However, their share ownership and voting rights have been re-balanced against those of the Government and institutional investors in such a way that even together, IVO and PVO cannot overrule the interests of the smaller shareholders. This is a very important achievement and ensures a sufficiently level playing field in the foreseeable future. Eventually, however, e.g. in the case of new share issuance, the Government should seek to involve all interests in the market in Fingrid's ownership and governance, and should make sure that IVO and PVO do not expand their shareholding in Fingrid.

In pricing its transmission services, Fingrid has opted for a simple approach which yields easily predictable prices for its customers, but which nevertheless covers all important cost elements including congestion costs. These transmission prices do not reflect the cost conditions in the grid as correctly as nodal pricing does, but nodal pricing does have the drawback of being as complicated and unpredictable as the grid conditions themselves. The apparent price for this simplicity is that Fingrid charges an average rate for congestion that does not reflect the true cost of each transaction. There are, however, a number of alleviating circumstances.

First, the biggest damage from inaccurate congestion pricing does not occur in the short term but through distorted price signals for power plant siting. Since Fingrid has retained a decisive role in plant siting, the company can make sure that new plant will not come in on the most congested routes.

Second, congestion is a problem that occurs everywhere, but that is most pronounced in radial networks[31]. In fully meshed networks, electricity can (and does) flow along more alternative routes[32]; congestion will thus not block lines for other transactions as quickly. For example, Argentina, New Zealand, Norway and the south-east coast of Australia (New South Wales, Victoria and South Australia) have radial networks and use nodal pricing; the Finnish grid is comparatively meshed.

Third, and most important, the very innovative way in which Fingrid's Transmission System Operator role was designed also helps to rectify the situation. The most important task of the system operator is to reconcile the market's desired trading with available transmission capacity. In most existing competitive power markets the system operator does this by checking dispatch schedules and altering dispatch or disallowing transactions if the wires are congested. Since the Finnish power market was designed as a very open market allowing both bilateral and multilateral trading, and most importantly, without centralised dispatch, a solution had to be found to make the TSO's functioning compatible with this trading.

The solution applied in Finland – Fingrid's counter trading – fulfills all these requirements. Dispatch can remain completely decentralised, no dispatch schedules have to be submitted to Fingrid[33], no mandatory re-scheduling takes place, and no transaction is disallowed. Fingrid in its function as the SO operates in a way comparable to a central bank in a fixed exchange rate context: it acts like a market participant but is the only entity in the market that trades against its own economic interest, and thus quickly re-establishes equilibrium at the desired level, in this case at (or just below) transmission capacity.

In the process, an economic signal to Fingrid in its function as the transmission company is generated: in order to prevent losses from counter trading, Fingrid has to invest in additional grid capacity. This investment signal is the exact reverse of the signal a market would give: markets trigger investment through high profits (and the expectation of future profits), drawing additional supply or suppliers into the market place. In the case of a regulated natural monopoly, reversing the incentive appears like an elegant way of solving several problems simultaneously. One of the damaging features of monopolies is their tendency to restrict supply in order to keep prices high[34], but Fingrid maximises its profit by expanding its grid capacity as soon as the losses from counter trading on a particular grid section are greater than the cost of new capacity or of a capacity upgrade.

31 Radial networks are grids that extend in one direction but not much in another. An electricity grid that has only one big power line in the north-south direction, and with merely a few smaller lines branching off in east-west direction, is an extreme example of a radial network.

32 The logical consequence of this is that there are more loop flows in meshed networks.

33 Bilateral transactions and transactions concluded in EL-EX have to be submitted to Fingrid. This is to ensure appropriate system balancing.

34 Monopolies engage in this behaviour if they are profit maximisers, particularly if they are privately owned.

In fact, the Finnish system is biased in favour of grid augmentation. In a situation of scarcity in a normal competitive market, the high prices do not only have the function to attract new supply but also to restrict demand to the available capacity. Every consumer suffers because he or she cannot buy all (or any) of the desired service as long as the bottleneck lasts. Fingrid's customers do not even grow aware of any bottleneck, and certainly do not reduce their trade volume across the congested interface, because their transmission prices do not change, and it is Fingrid which will at first suffer a loss. Eventually, consumers will pay for all of Fingrid's costs, including this loss, but there is a time lag between the moment when the loss occurs and the moment when it is paid for by customers, and this temporary loss can be expected to deliver a clear signal for investment.

This situation could theoretically lead to inefficiently high grid capacity. However, this is not the case in Finland, since interconnections are weaker than among most other European countries. The concern here is rather whether grid capacity, and especially cross-border links to Sweden and Norway, suffice to ensure adequate size of the electricity market, which is necessary to alleviate the relatively high concentration in power generation in Finland (see below). Importantly, countertrading is also done on the interconnectors, and it is therefore safe to assume that the necessary incentives for adequate investment in these vital facilities are in place.

A fourth, smaller point is that power lines, like most other investment in electricity supply, represent investment with an extremely high share of sunk costs[35], especially if the lines have to be buried. This is increasingly the case due to environmental considerations, especially in urban areas or areas of natural beauty. For the same reasons, siting power lines becomes increasingly difficult and costly. The higher the share of sunk costs, the higher is the investment risk for new market entrants. Power line construction by others than Fingrid, even though legally allowed, cannot be expected to occur very frequently, except if it is needed to carry out a very profitable electricity supply transaction. For this reason, high transmission prices and the profit expectations connected with them are unlikely anyway to draw many new companies into the transmission market; hence, profits would not be fully effective as an incentive for new line construction in any case, and using losses instead as the only economic signal for network users appears all the more reasonable.

The arrangements for balance power trading are as efficient as Fingrid's counter trading, and appear prone to foster security of supply by providing special remuneration for generators willing to set aside capacity for situations in which top-up is needed. The pyramid of open suppliers ensures back-up. Once again, the system was organised using market principles in Finland, and each operator only pays his fair share of back-up. The IEA appreciates this very market oriented method.

Freedom of choice for all consumers has been achieved in an effective and simple way. The abolition of the requirement for expensive metering equipment has made it easier for small consumers to exercise their freedom of choice of suppliers. The Government

35 Sunk costs are costs which are irrecuperable upon abandoning the business.

is already actively disseminating information about the functioning of the new market and assisting consumers, especially the smaller ones, in choosing suppliers. Information costs to small consumers, which can be substantial, could be further reduced through mandatory guidelines for billing and model power supply contracts.

International Co-operation

From the very beginning of its regulatory reform programme, Finland has co-operated closely with Sweden and Norway, and also seeks co-operation with Denmark. In fact, from the outset the intention was to integrate Finland in what would become a united Nordic power market. Therefore, Finland's legislation was flexibly adapted to that of its neighbours. The IEA commends this striving towards harmonisation beyond Finnish borders.

The Government's strategy reveals a clear recognition that the Finnish market on its own would take a long time to become sufficiently competitive, due to the dominant position held by IVO, together with its smaller private counterpart PVO. The strategy was maintained even in the light of massive inroads made by the Swedish power company Vattenfall, at the expense of Finnish power companies, almost immediately after the Finnish market was opened up in 1995; at some stage, Vattenfall attempted to attract supply contracts which would have amounted to 15% or more of total Finnish power supply. Integration with Sweden and Norway also occurred without any party having to resort to reciprocity requirements. In fact, Finland, Sweden and Norway made a smooth transition from the co-operative regime within their former electricity exchange organisation NORDEL towards a competitive regime in Nordpool/EL-EX.

In the event, the Nordic power market holds advantages for all countries. Finland benefits from cheap Norwegian and Swedish hydro power, whereas it can provide some "hydro-firming" fossil generation if needed. The wider Nordic market also helps to address problems of market power which prevail both in Finland as well as in Nordpool (see below).

Market Power and Its Control

There is ample evidence that there is excessive market power in the Finnish electricity market, nearly all of it inherited from the pre-competitive past. At the generation level, IVO's position alone, 40% on average of domestic supply, would give rise to concern, but the two largest producers, IVO and PVO, taken together, produce up to two thirds of domestic supply. In addition, the various sales agreements and partnerships concluded by IVO and PVO give rise to additional concern, and also indicate a tendency towards vertical integration with distributors/suppliers via contracts.

In view of this high degree of concentration, the Nordic market provides the guarantee that competition is viable. However, Figure 29 (Power Companies in the Nordic Market) in the section Regulatory and Antitrust Surveillance, shows that the

Nordic market itself is not free of concentration: it is effectively dominated by four very large players: the Norwegian power company Stattkraft, the Swedish utilities Vattenfall and Sydkraft, and IVO. Vattenfall has sales as high as IVO Group and Sydkraft taken together. PVO in comparison is small; it is even smaller than Birka Energi, one of IVO's Swedish acquisitions. The high concentration in the generation market and long-term contracts between generators and suppliers, which can interfere with utilisation of the spot market, may even be one of the reasons for the disappointing development of the trade volume in the Finnish electricity exchange EL-EX. The growth of electricity demand in the Nordic market is slow, as in most other IEA countries. It is thus unlikely that new entry will occur rapidly enough to quickly change the situation, unless if domestic electricity prices are high enough to justify displacement of existing generators by entrants supplying cheap power from CCGTs. This does not appear to be the case.

There are also concerns that there may be monopoly rents in electricity distribution, and that distribution pricing may contain elements of internal subsidisation, especially between the distributors' grid and retail activities. District heating prices cause concern and should be monitored.

During the IEA visit in September 1998, power prices in Nordpool were extremely low, due to an exceptionally rainy year and very full hydro reservoirs in Norway and Sweden. The interconnectors to Nordpool, however, were not even close to capacity. This is in spite of the fact that the amount of interconnection between Finland, Sweden and Norway is comparatively weak, amounting to only 17% of total available capacity. By contrast, interconnection of other European countries can amount to more than their peak capacity, e.g. in the Netherlands and Switzerland, and while this is not the case everywhere, most European countries are much more strongly interconnected than Finland.

In fact, the business practice of recent years seems to indicate that the low level of interconnection to Nordpool is more than sufficient for the current trade volumes. This is surprising and suggests that there is not yet enough competition in supply to force suppliers to look for, buy and dispatch the cheapest electricity that is available. Only when this happens will the interconnectors be used more, will Fingrid have to counter-trade across borders, and will the transmission capacity be expanded.

This curiously low use of transmission capacity at a time when international trading should be most profitable might be due partly to the high share of CHP in Finland. Since operation of CHP plants is determined by the heat load, it is uneconomical to stop the plant even if spot prices are low (i.e. must run requirement). There might also be existing power supply contracts with high fixed and low variable costs. Still, despite its high share, CHP cannot fully account for the inertia in trade flows, and long-term contracts with high fixed payments may themselves be a sign that competitive trading has not yet reached its optimum.

The Finnish surveillance authorities are well aware of these facts, and investigative procedures into the market power of IVO and PVO, as well as into distribution and supply, have been set in motion. The approach to electricity regulation is light-handed, following Finland's tradition in industrial policy. This approach results in few people and small administrative costs in regulatory bodies – a positive result in principle. Licensing is used as an effective regulatory tool for natural monopoly areas. It is also commendable that no special licence is required for the retailing business.

It remains to be seen, however, whether the surveillance authorities are sufficiently well-equipped to effectively control abuses of such overwhelming market power. The specialised electricity regulator has a professional staff of only 10 and a mandate to regulate the wires business. It co-operates with the non-specialised competition authority OFC, which has a professional staff of 25, but OFC has the responsibility to supervise competition in the entire economy. The resources of the surveillance authorities clearly do not match those of the utilities. It was this kind of consideration that prompted the Finnish Government to expand the Electricity Market Authority's budget and staff (from 8 in 1998 to 10 in 1999) but concern still remains.

At the very least, it is vital that the co-operation and the division of labour between the Electricity Market Authority and the Office of Free Competition is as good as possible. Full competition in the Finnish electricity market is so recent that the co-operation between the Electricity Market Authority and the Office of Free Competition has not yet been tested.

In this respect, it also gives rise to concern that the Electricity Market Authority has not yet fully developed the proper methodology to track down cross-subsidies and monopoly pricing and to regulate price levels (if not price structures) effectively. The current approach probably allows deep insights into a company's costs and prices once an investigation is under way, but may be so resource-intensive that it can only be used in a few cases and does not allow wide-range monitoring of prices for captive consumers and grid services. It remains to be seen whether the light-handed approach is sufficient to protect consumers.

A practical suggestion regarding the supply market, in which new entry can be expected, is to establish an easily-accessible register for electricity retailers. This could be used to provide a basic check on retailers as to their good business practices and would provide security for Finnish power consumers, especially the smaller ones, who lack the time, resources or interest for the necessary research. Since the use of the Internet is very common in Finland, this register could be put on the Internet (as it is done in California). This would be an effective, low-cost way of reducing consumers' information cost and could reduce the threshold to participate in the competitive power market and possibly switch suppliers. The register might also be used to publish distribution tariffs and retail prices. The Electricity Market Authority actually keeps a list of distributors which is accessible via the Internet. This list also contains their distribution tariffs and retail prices. However, it does not contain companies who only market power but do not distribute it. An Internet website containing all electricity suppliers is kept by a commercial company. This website also contains a function to solicit bids. However, these lists do not include a regular check of good business practice.

At this stage, the only remaining concern is that of long-term security of supply/reliability. As the electricity market becomes a "normal" commodity market, one can expect the same kind of dynamic business cycles as in other commodities. In order to avoid capacity shortfalls, a bottom-up approach could be adopted. This would leave the security in the hands of each end-user who will accept to pay a premium against a certain chosen level of insurance that will be supplied (with an agreed financial penalty to be paid by the supplier in case of non-delivery). This approach is fully consistent with a competitive market; the government's role is then to ensure that end-users are well informed (contracts can be easily compared) and that suppliers' insurances are backed by the right level of financial guarantees (i.e. prudential rules of the same nature, as for the bank or the insurance industry). The Ministry of Trade and Industry has developed mandatory guidelines for power supply contracts which are observed by all power suppliers and thus fulfill these functions to a large degree.

To conclude, the introduction of competition into the Finnish power market can be considered a major success. Without competition, the existing utilities could have exploited their monopoly positions, which would have brought about a situation worse than the actual open but rather concentrated market. Consumers have also benefitted from price reductions, which in practice were most pronounced for small and intermediate industrial consumers. The institutions and rules that have been put in place look very promising. Once the regulatory and competition authorities become fully operational, the Finnish power market could become an example that other countries may wish to follow.

RECOMMENDATIONS

The Government should:

- ☐ Ensure that all aspects of the electricity market that need regulatory surveillance are adequately supervised and in particular:
  - ☐ Ensure that the Electricity Market Authority (EMA) has all of the powers and resources it needs to monitor the market. Make sure EMA, perhaps with support from other institutions, develops a transparent and effective methodology to assess the "reasonableness" of prices and to identify and eliminate monopoly rents and internal subsidisation.
  - ☐ Ensure that the Office of Free Competition (OFC) continues to monitor market power in the wholesale market and, where necessary, uses the new provisions in the Competition Act. Exert adequate antitrust scrutiny. Concentration in the electricity market, including cross-ownership, should be closely monitored.
  - ☐ Ensure co-operation and division of work between EMA and OFC, since both are comparatively small organisations.

- Continue to ensure that end users are fully informed of electricity prices. Consider the introduction of a register for all electricity retailers which can easily be accessed by consumers. It would provide information, including information on prices, and a basic examination for good business practice, in addition to the regular company register.

- Through EMA, monitor Fingrid's ownership and governance, making sure that the large shareowners do not significantly expand their ownership, and work toward broadening Fingrid's ownership base. Since Fingrid is at the core of the Finnish power market, all interests in the market should eventually be reflected in this company.

- Further strive to reduce information and transaction costs to small consumers through mandatory guidelines for billing and model power supply contracts.

- Consider involving EMA in the OFC's monitoring of district heating prices, especially cross-subsidies between heat and electricity supply.

7

NUCLEAR

NUCLEAR POWER PLANTS

Finland has two nuclear power plants. In 1997, they accounted for some 30.2% of the country's electricity output and had a joint net capacity of 2 700 MW. One is owned and run by IVO, the other one by TVO. Each of the plants has two blocks.

IVO's plant is located on the island of Hästholmen near the town of Loviisa, on the southern coast of Finland. The plant consists of two pressurised water reactors of the Russian VVER-440 type. The plant was adapted to Western safety requirements by adding several safety features, including a containment building of the ice condenser type around each of the generating units. The plant was constructed by Russian and Finnish subcontractors, also using technology from the US and Germany. The nuclear fuel for Loviisa is delivered from Russia under long-term contracts. The first unit came into commercial operation in 1977, the second one in 1981. The plant's capacity in 1999 was 1020 MW, divided equally between the two blocks; it was augmented from 2×445 MW in 1998.

TVO's Olkiluoto plant is located on the south-western coast near the town of Rauma. It comprises two boiling water reactors of Swedish design, in commercial operation since 1979 (Olkiluoto 1) and 1982 (Olkiluoto 2). The blocks were originally designed for commercial capacity of 660 MW each, but with minor technical changes, their individual capacity was raised to 710 MW in 1982/1983 and to 840 MW in 1998. The uranium for this plant comes from Canada, Australia, China and Russia. Most of the enrichment takes place in Russia, but some also in Western Europe.

Finland's nuclear power plants have achieved very high load factors; in 1997, these were above 94% for all four reactor blocks. These are the highest load factors that have so far been achieved consistently in any nuclear power plant in the world. Simultaneously, the occupational doses of radioactivity that nuclear power plant staff is exposed to lie significantly below the European average.

The plants are expected to have a technical and economic lifetime in excess of 40 years at increasing capacity. The plants' operating licences expired at the end of 1998. The Council of State extended the operating licence of the Loviisa blocks to the end of 2007 at raised core power of 109%. IVO plans to uprate the capacity of Loviisa by a total of 100 MW, TVO completed an upgrade of 250 MW. TVO's licence was extended until the end of 2018.

FUEL CYCLE AND WASTE MANAGEMENT

Under the Finnish Nuclear Energy Act (990/1987), the generators which own nuclear power plants are responsible for nuclear waste management, including the technology research and development that is required for it. The Council of State ensures that waste management is carried out in compliance with safety regulations and general law. Following recent amendments to the Nuclear Energy Act, shipments of spent fuel to Russia were terminated in 1996. According to the new amendments, Finnish spent fuel will be disposed of in Finnish bedrock. Before disposal, the spent fuel is stored in intermediate storage facilities at the power plant sites.

Posiva Oy, a company owned jointly by IVO and TVO, is responsible for preparing the construction of a final repository for spent fuel. The organisation submitted an environmental impact assessment (EIA) programme on four different possible sites to the Ministry of Trade and Industry in March 1998; the assessment was completed in March 1999. All four sites are classified suitable. A selection is to be made by 2000, and construction is to begin by 2010, to allow start-up of operation by 2020.

SAFETY AND LICENSING

The Finnish Nuclear Energy Act (990/1987) and Decree (161/1988) gave to the Parliament the final decision regarding the construction of any new major nuclear facility, including power plants and waste disposal facilities. Responsibility for licensing lies with the Council of State. The Radiation and Nuclear Safety Authority (STUK) has to deliver a preliminary safety assessment whenever a power company files an application for a new nuclear facility with the Ministry of Trade and Industry. After collecting the opinions of the Ministry of the Environment and other Ministries as well as the concerned municipalities, and after hearings held with the local population, the Council of State takes a decision, which then needs to be confirmed by the Parliament. The construction permit and operation licence are granted by the Council of State upon subsequent application submitted by the power company. The licensing procedure involves verification that the new facility is in compliance with the Nuclear Energy Act and the Radiation Act (592/1991).

OUTLOOK FOR NUCLEAR POWER

Both nuclear operators have begun environmental impact assessments on new nuclear power plants, to come into operation before 2010. TVO's EIA is farthest advanced; it focuses on a third reactor block of 1 000 to 1 400 MW at the Olkiluoto site, to come into operation in 2006-7. The Parliament is expected to take a general decision regarding the future use of nuclear power in the near future. In autumn 1993, the Parliament rejected by a narrow margin the Government's proposal to grant the nuclear operators a decision in principle to construct new nuclear plants. Even if the Parliament takes a decision in favour of new nuclear plants, the decision to go ahead with any nuclear power project lies solely with the utilities.

CRITIQUE

Finland's experience with nuclear power is exceptionally successful. The existing plants achieve very high load factors at high safety levels, leading to comparatively low cost. The process leading eventually to the construction of a waste repository has begun, and the public appears to accept at least existing nuclear power plants. There is thus little doubt that the existing nuclear power plants will continue generating until the end of their technical and economic life.

The question that does arise is whether there will be any additional nuclear plants. This depends upon what decision the Government elected in the 1999 general elections will make; especially in relation to Finland's CO_2 commitments. The public's attitudes appear to have recently shifted in favour of nuclear power.

Once a decision is made, the further question that arises is whether new nuclear will be built in a competitive power market. Finland would be the first country in the world where new nuclear capacity would be constructed in a competitive power market. In Finland, nuclear power may be competitive with natural gas, which is the cheapest base load generating option in many countries where it is available. Additional natural gas for power generation in Finland would require construction of additional gas pipelines, e.g. the interconnection to the EU gas grid which is already under consideration. The recent IEA/NEA generating cost study[36], however, indicates that it is not gas but coal that is nuclear's biggest competitor in Finland, and that coal is actually cheaper than nuclear in the time span under consideration – at least as long as Finland's carbon tax is not applied to input fuels to electricity generation[37]. Yet Finnish nuclear operators are optimistic that nuclear will be competitive in the market.

Eventually, the choice of power generation will depend on the Government's decision on the further development of its Energy Strategy. Whether new power plants are nuclear or fossil-fired might have a significant impact on future CO_2 emissions. If nuclear is seen as central to achieving Finland's CO_2 targets, and if the system of carbon and electricity taxation is adjusted accordingly, new nuclear power plants may well be built.

Therefore, the Government should carefully assess the role that nuclear power can play (i.e. through lifetime extension or nuclear capacity additions) in the reduction of CO_2 and air pollutant emissions, and in helping to ensure security of supply. The decision on new nuclear plants should be based on an economic assessment of all energy resources; including their environmental and security impacts.

It is important to determine a strategy regarding the future role of nuclear and the diversification of input fuels as soon as possible, because investors in the

36 See section Electricity Generation.

37 As explained in the section Energy Taxation, electricity is at present subject to a blanket output tax. This tax does not reflect the carbon emissions of input fuels.

electricity market must be provided with a stable and predictable framework for their investment decisions.

In Finland, nuclear waste management is based on the polluter pays principle, which means that the producers of radioactive waste are responsible for its disposal. This effectively internalises the cost of waste management which is then reflected in prices, and is to be commended.

RECOMMENDATIONS

The Government should:

- Consider past electricity demand and supply trends and assess the role that nuclear power can play (through lifetime extension or nuclear capacity additions) in reducing CO_2 and air pollutant emissions, in helping to ensure security of supply and in diversifying input fuels. Clarify the future role of nuclear based on the economic, environmental and security impacts of all energy resources.

- Continue to ensure progress in the design and development of a final repository site for the disposal of high-level radioactive waste.

8

TECHNOLOGY, RESEARCH AND DEVELOPMENT

OVERVIEW

Development of energy technology is one of the key activities in Finnish energy policy and also plays an important role in the Energy Strategy. Development and deployment of advanced energy technology is particularly important given the government's emphasis on energy efficiency and renewables in the strategy.

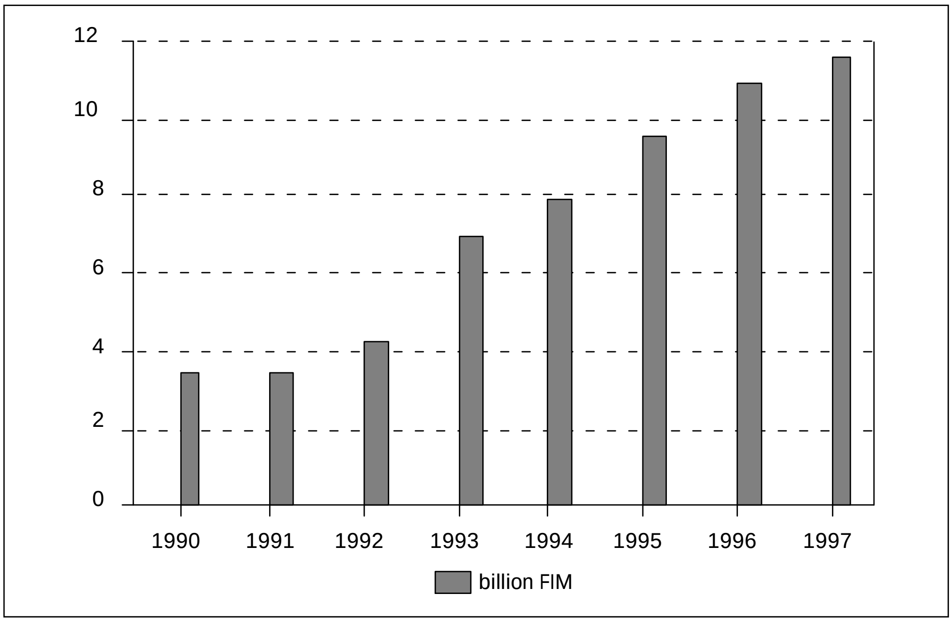
Another very important objective of government policy is to increase the export of energy technology. This objective is part of the country's general aim to diversify away from the export of primary products towards more high-tech, high-value added exports. The long-term trends in Finnish exports reflect this aim. While exports of wood products declined from 16% of all exports in 1970 to 7% in 1997, and the figure for paper products shrank from 40% to 24%, exports in the electronic and electrical industries rose from 2% in 1970 to 25% in 1997. The Government seeks to achieve a substantial increase in energy technology exports over the next ten years. At present, the value of energy technology exports amounts to some FM 12 billion, a figure which exceeds the value of energy imports. The rapid growth in technology exports began in the early 1990s. Figure 39 shows the growth in energy technology export earnings since 1990, and the principal export technologies.

The majority of Finnish research and development money comes from industry, amounting to some FM 11.6 billion in 1997. The Government provided an additional FM 5.3 billion for technology research, which yielded a total of FM 16.9 billion or 2.7% of GDP. The government's funds are channelled through the Technology Development Centre (Tekes), which operates under the Ministry of Trade and Industry, the Academy of Finland, which operates under the Ministry of Education, and the Sitra Fund (Finnish National Fund for Research and Development), whose operations are mainly financed through income from endowment investment and project finance. Figure 40 shows the organisation of technology R&D funding in Finland.

Tekes finances development of industrial products and production methods, applied technological research at research institutes and universities, and technology projects run jointly by companies and research institutes. In 1997, Tekes used two thirds of its budget of FM 2 billion for industrial R&D and one third for applied technological research. Tekes' 1998 budget was increased to FM 2.2 billion.

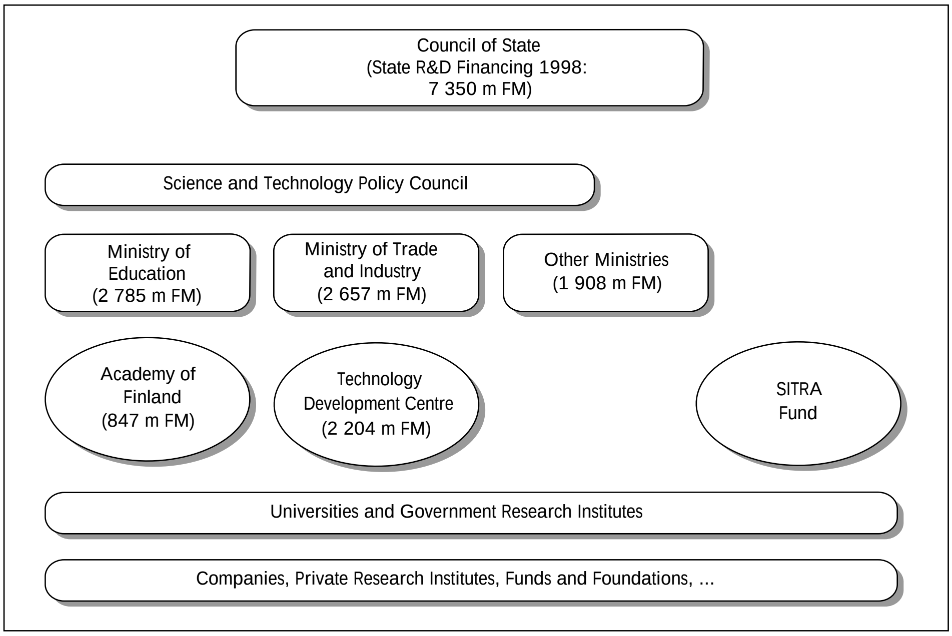
The Academy of Finland, with a 1998 budget of FM 847 million, finances basic research, and especially the training of researchers. The Academy's activities cover both natural and human sciences. The Sitra Fund allocates some 70% of its resources

Figure 39
Finnish Energy Technology Exports, 1990-1997



Source: Tekes.

Figure 40
R&D Funding in Finland



Source: Tekes.

to joint ventures, especially those promoting technology transfer. In particular, Sitra finances the start-up of technology companies that originate as a result of research projects.

Among the recipient institutions, the Technical Research Centre of Finland (VTT) is responsible for the implementation of national technology research programmes. VTT carries out its own research work, i.e. technological research and testing, as well as work commissioned by companies and the public sector.

These recipient institutions and private industry work together on a number of national research programmes, which aim to develop energy-efficient and environmentally sound technologies competitive in the international market place. Tekes' energy technology programmes in 1998 were:

- Liekki 2: combustion and gasification technology;
- Bioenergia: technologies for the use of biomass and peat;
- Sihti 2: environmental technology;
- Nemo 2: advanced energy systems and technology;
- Fusion: fusion energy;
- Mobile: energy use in transportation;
- Sustainable Paper: energy use in paper and board production;
- Sula 2: energy in steel and non-ferrous metal production;
- Raket: energy use in buildings;
- Tesla: electricity distribution and information technology;
- Termo: district heating and cooling; and
- CFD: computational fluid dynamics.

Nuclear fission research focuses on safe operational limits and accident and risk management (Retu programme, 1995-98), structural safety of nuclear power plants (Ratu 2 programme, 1995-98), and nuclear waste management.

CRITIQUE

Finland's energy R&D activities are remarkable. A comparatively high percentage of GDP is spent on research, and research budgets are increasing, in contrast to most IEA countries.

Also remarkable is the export orientation of R&D policy, which appears to be well-embedded in the government's general economic policy and which seems to have met with great success especially since 1991/92. This export orientation is well in line with the opening of energy markets such as electricity and gas, which means that the country has to look beyond its boundaries for sales of energy technology. Only a small fraction, however, of actual energy technology exports as indicated in Figure 39 is energy efficient or renewable technology.

The research programmes are well-focused and concentrate on domestically-available energy resources. The same care needs to be taken in the future if energy technology R&D is to fulfill the high expectations that are placed on it by the Government's Energy Strategy and CO_2 commitments. In this sense, the Government may wish to develop concrete guidelines for Tekes' research activities.

At present, the Government focuses more on the funding the research organisations receive, and the objectives they are to fulfill, than on the actual outcomes of the research. Monitoring of R&D results, especially the number of patents developed from government-funded activities, and their uptake by the market, would be areas for improvement of an already successful R&D policy.

RECOMMENDATIONS

The government should:

- ☐ Take measures towards improving the use of R&D results.

A

ANNEX

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	1996	1997	2000	2005	2010
TOTAL PRODUCTION		**4.9**	**11.7**	**13.6**	**10.99**	**10.24**	**14.2**	**14.3**
Peat		0.1	1.8	2.2	2.6	2.2	2.2	2.2
Oil		–	–	0.0	0.1	–	–	–
Comb. Renewables & Wastes[2]		3.9	4.0	5.3	5.9	5.4	5.7	5.8
Nuclear		–	5.0	5.1	5.4	5.2	5.2	5.2
Hydro		0.9	0.9	1.0	1.1	1.1	1.1	1.1
Solar/Wind/Other[3]		–	–	0.0	0.0	0.0	0.0	0.0
TOTAL NET IMPORTS[4]		**16.6**	**17.7**	**17.5**	**18.5**	**18.6**	**20.5**	**20.9**
Coal[1]	Exports	0.0	0.0	–	–	0.0	0.0	0.0
	Imports	2.4	4.4	4.6	4.8	5.2	5.3	5.3
	Net Imports	2.4	4.4	4.6	4.8	5.2	5.3	5.3
Oil	Exports	0.2	1.7	5.0	4.3	4.5	4.5	4.5
	Imports	14.0	12.5	15.0	14.9	14.2	14.2	14.2
	Bunkers	0.1	0.6	0.4	0.4	0.4	0.4	0.4
	Net Imports	13.8	10.2	9.7	10.1	9.3	9.3	9.3
Gas	Imports	–	2.2	3.0	2.9	3.5	5.2	5.6
	Net Imports	–	2.2	3.0	2.9	3.5	5.2	5.6
Electricity	Exports	0.0	0.0	0.1	0.0	–	–	–
	Imports	0.4	0.9	0.5	0.7	0.7	0.7	0.7
	Net Imports	0.4	0.9	0.3	0.7	0.7	0.7	0.7
TOTAL STOCK CHANGES		**–0.1**	**–0.6**	**1.0**	**–0.5**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**21.3**	**28.8**	**32.0**	**33.1**	**32.5**	**34.7**	**35.2**
Coal[1]		2.5	4.1	5.1	4.8	5.2	5.3	5.3
Peat		0.0	1.2	2.3	2.1	2.2	2.2	2.2
Oil		13.6	10.3	9.9	10.3	9.3	9.3	9.3
Gas		–	2.2	3.0	2.9	3.5	5.2	5.6
Comb. Renewables & Wastes[2]		3.9	4.2	5.3	5.9	5.4	5.7	5.8
Nuclear		–	5.0	5.1	5.4	5.2	5.2	5.2
Hydro		0.9	0.9	1.0	1.1	1.1	1.1	1.1
Solar/Wind/Other[3]		–	–	0.0	0.0	0.0	0.0	0.0
Electricity Trade[5]		0.4	0.9	0.3	0.7	0.7	0.7	0.7
Shares (%)								
Coal		*11.8*	*14.2*	*16.1*	*14.5*	*15.8*	*15.3*	*15.1*
Peat		*0.2*	*4.2*	*7.3*	*6.2*	*6.8*	*6.3*	*6.3*
Oil		*63.6*	*35.6*	*31.0*	*31.1*	*28.5*	*26.8*	*26.4*
Gas		*–*	*7.6*	*9.3*	*8.8*	*10.8*	*15.0*	*15.9*
Comb. Renewables & Wastes		*18.5*	*14.6*	*16.4*	*17.7*	*16.6*	*16.4*	*16.5*
Nuclear		*–*	*17.4*	*15.8*	*16.5*	*16.0*	*15.0*	*14.8*
Hydro		*14.2*	*3.2*	*3.2*	*3.2*	*3.4*	*3.2*	*3.1*
Electricity Trade		*1.7*	*3.2*	*1.0*	*2.0*	*2.1*	*2.0*	*2.0*

0 is negligible. – is nil. .. is not available.

Please note: All forecast data are based on the 1997 submission. Forecast data for electricity and heat generation are IEA Secretariat estimates.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1996	1997	2000	2005	2010
TFC	**19.4**	**22.6**	**23.2**	**24.0**	**23.3**	**25.5**	**26.3**
Coal[1]	1.0	1.2	0.7	0.8	0.8	0.8	0.8
Peat	0.0	0.4	0.4	0.3	0.4	0.4	0.4
Oil	11.5	9.7	8.5	8.5	7.4	7.4	7.4
Gas	0.0	1.2	1.2	1.2	1.5	2.6	2.7
Comb. Renewables & Wastes[2]	3.9	3.2	4.0	4.4	4.0	4.2	4.3
Electricity	2.3	5.1	5.7	6.1	6.9	7.6	8.0
Heat	0.6	1.9	2.8	2.7	2.4	2.5	2.6
Shares (%)							
Coal	*5.3*	*5.2*	*3.0*	*3.4*	*3.2*	*3.1*	*3.0*
Peat	*0.1*	*1.8*	*1.6*	*1.3*	*1.7*	*1.6*	*1.5*
Oil	*59.2*	*42.8*	*36.4*	*35.4*	*31.7*	*29.1*	*28.3*
Gas	*0.1*	*5.4*	*5.3*	*4.9*	*6.4*	*10.2*	*10.3*
Comb. Renewables & Wastes	*20.3*	*14.0*	*17.3*	*18.4*	*17.1*	*16.3*	*16.2*
Electricity	*11.9*	*22.5*	*24.6*	*25.2*	*29.5*	*29.7*	*30.6*
Heat	*3.1*	*8.5*	*11.8*	*11.2*	*10.3*	*9.9*	*10.1*
TOTAL INDUSTRY[6]	**7.6**	**10.7**	**10.8**	**11.4**	**11.5**	**12.7**	**13.3**
Coal[1]	0.9	1.2	0.7	0.8	0.7	0.8	0.8
Peat	0.0	0.4	0.3	0.3	0.4	0.4	0.4
Oil	5.0	2.6	2.0	1.9	2.0	1.9	1.9
Gas	0.0	1.2	1.2	1.1	1.4	2.2	2.3
Comb. Renewables & Wastes[2]	–	2.5	2.9	3.3	2.9	3.1	3.2
Electricity	1.6	2.8	3.1	3.4	3.9	4.2	4.6
Heat	0.1	0.2	0.6	0.6	0.2	0.2	0.2
Shares (%)							
Coal	*12.1*	*10.8*	*6.4*	*7.2*	*6.4*	*6.2*	*5.9*
Peat	*0.2*	*3.6*	*2.9*	*2.5*	*3.4*	*3.0*	*2.9*
Oil	*66.2*	*24.2*	*18.1*	*16.7*	*17.4*	*15.1*	*14.4*
Gas	*0.1*	*10.9*	*10.8*	*9.5*	*12.0*	*16.9*	*16.9*
Comb. Renewables & Wastes	*–*	*22.9*	*27.2*	*28.9*	*25.2*	*24.0*	*23.6*
Electricity	*20.4*	*26.1*	*28.8*	*29.7*	*33.9*	*33.0*	*34.5*
Heat	*1.0*	*1.6*	*5.8*	*5.5*	*1.8*	*1.8*	*1.8*
TRANSPORT[7]	**2.6**	**4.4**	**4.1**	**4.4**	**4.1**	**4.2**	**4.2**
TOTAL OTHER SECTORS[8]	**9.3**	**7.5**	**8.3**	**8.2**	**7.8**	**8.5**	**8.7**
Coal[1]	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Peat	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Oil	3.9	2.7	2.4	2.3	1.4	1.4	1.4
Gas	0.0	0.0	0.1	0.1	0.1	0.4	0.4
Comb. Renewables & Wastes[2]	3.9	0.7	1.1	1.1	1.1	1.1	1.1
Electricity	0.8	2.2	2.6	2.6	2.9	3.3	3.4
Heat	0.5	1.7	2.1	2.1	2.2	2.3	2.4
Shares (%)							
Coal	*1.1*	*0.1*	*–*	*–*	*0.1*	*0.1*	*0.1*
Peat	*0.1*	*0.2*	*0.7*	*0.4*	*0.2*	*0.2*	*0.2*
Oil	*42.3*	*36.7*	*29.1*	*28.0*	*18.0*	*16.4*	*16.1*
Gas	*–*	*0.6*	*0.7*	*0.8*	*1.3*	*4.8*	*4.7*
Comb. Renewables & Wastes	*42.6*	*9.3*	*13.0*	*13.7*	*14.2*	*12.9*	*12.6*
Electricity	*8.2*	*29.9*	*30.9*	*31.8*	*37.8*	*38.7*	*38.8*
Heat	*5.7*	*23.2*	*25.5*	*25.3*	*28.4*	*26.9*	*27.6*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1996	1997	2000	2005	2010
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**3.5**	**11.9**	**15.4**	**15.4**	**15.6**	**16.4**	**16.7**
OUTPUT (Mtoe)	**2.2**	**4.7**	**6.0**	**5.9**	**6.5**	**7.2**	**7.7**
(TWh gross)	26.1	54.4	69.4	69.2	75.2	83.4	89.2
Output Shares (%)							
Coal	*18.7*	*18.5*	*22.4*	*19.0*	*25.5*	*29.1*	*32.2*
Peat	*9.4*	*14.6*	*9.4*	*9.3*	*8.9*	*8.0*	*7.5*
Oil	*31.6*	*3.1*	*1.9*	*2.0*	*1.7*	*1.6*	*1.5*
Gas	*–*	*8.6*	*12.3*	*10.0*	*11.0*	*12.8*	*13.5*
Comb. Renewables & Wastes	*–*	*–*	*8.9*	*11.8*	*9.2*	*9.2*	*8.6*
Nuclear	*–*	*35.3*	*28.1*	*30.2*	*26.5*	*23.9*	*22.4*
Hydro	*40.3*	*20.0*	*17.1*	*17.7*	*17.0*	*15.3*	*14.3*
Solar/Wind/Other	*–*	*–*	*0.0*	*0.0*	*0.0*	*0.2*	*0.1*
TOTAL LOSSES	**2.0**	**6.9**	**8.6**	**8.5**	**9.2**	**9.2**	**8.9**
of which:							
Electricity and Heat Generation[10]	0.6	5.1	6.4	6.5	6.5	6.5	6.2
Other Transformation	0.5	0.6	0.7	0.6	2.2	2.2	2.2
Own Use and Losses[11]	0.9	1.2	1.4	1.4	0.5	0.5	0.5
Statistical Differences	**–0.1**	**–0.7**	**0.2**	**0.6**	**–**	**–**	**–**

INDICATORS

	1973	1990	1996	1997	2000	2005	2010
GDP (billion 1990 US$)	82.91	134.81	135.82	143.99	157.34	178.88	199.45
Population (millions)	4.67	4.99	5.13	5.14	5.17	5.21	5.23
TPES/GDP[12]	0.26	0.21	0.24	0.23	0.21	0.19	0.18
Energy Production/TPES	0.23	0.41	0.42	0.46	0.43	0.41	0.41
Per Capita TPES[13]	4.57	5.78	6.25	6.43	6.29	6.66	6.73
Oil Supply/GDP[12]	0.16	0.08	0.07	0.07	0.06	0.05	0.05
TFC/GDP[12]	0.23	0.17	0.17	0.17	0.15	0.14	0.13
Per Capita TFC[13]	4.16	4.53	4.54	4.67	4.52	4.89	5.02
Energy-related CO_2 Emissions (Mt CO_2)[14]	49.3	54.4	65.8	64.1	64.4	69.0	70.0
CO_2 Emissions from Bunkers (Mt CO_2)	0.3	1.8	1.2	1.3	1.3	1.3	1.3

GROWTH RATES (% per year)

	73–79	79–90	90–96	96–97	97–00	00–05	05–10
TPES	2.3	1.5	1.8	3.2	–0.6	1.3	0.3
Coal	7.4	0.6	3.9	–6.6	2.4	0.6	–
Peat	48.1	10.6	11.4	–11.7	2.4	–	–
Oil	–0.5	–2.3	–0.5	3.5	–3.4	0.0	–
Gas	–	9.4	5.2	–2.0	6.4	8.2	1.5
Comb. Renewables & Wastes	–2.4	1.9	3.8	11.6	–2.7	1.1	0.3
Nuclear	–	10.0	0.2	7.3	–1.5	–	–
Hydro	0.6	–0.0	1.5	3.2	1.5	–	–
Solar/Wind/Other	–	–	–	–	44.2	_	10.8
TFC	0.4	1.2	0.5	3.2	–0.9	1.8	0.6
Electricity Consumption	4.7	4.7	2.0	5.8	4.4	1.9	1.2
Energy Production	4.7	5.6	2.5	10.9	–2.6	0.4	0.1
Net Oil Imports	1.1	–3.3	–0.9	5.0	–2.9	0.0	–
GDP	2.1	3.3	0.1	6.0	3.0	2.6	2.2
Growth in the TPES/GDP Ratio	0.1	–1.7	1.7	–2.6	–3.5	–1.3	–1.9
Growth in the TFC/GDP Ratio	–1.7	–2.1	0.4	–2.7	–3.8	–0.8	–1.6

Please note: Rounding may cause totals to differ from the sum of the elements.

Footnotes to Energy Balances and Key Statistical Data

1 Includes lignite and peat.

2 Comprises solid biomass and animal products, gas/liquids from biomass, industrial waste and municipal waste. Data are often based on partial surveys and may not be comparable between countries.

3 Other includes tide, wave and ambient heat used in heat pumps.

4 Total net imports include combustible renewables and waste.

5 Total supply of electricity represents net trade. A negative number indicates that exports are greater than imports.

6 Includes non-energy use.

7 Includes less than 1% non-oil fuels.

8 Includes residential, commercial, public service and agricultural sectors.

9 Inputs to electricity generation include inputs to electricity, CHP and heat plants. Output refers only to electricity generation.

10 Losses arising in the production of electricity and heat at public utilities and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of 33% for nuclear, 10% for geothermal and 100% for hydro.

11 Data on "losses" for forecast years often include large statistical differences covering differences between expected supply and demand and mostly do not reflect real expectations on transformation gains and losses.

12 Toe per thousand US dollars at 1990 prices and exchange rates.

13 Toe per person.

14 "Energy-related CO_2 emissions" specifically means CO_2 from the combustion of the fossil fuel components of TPES (i.e. coal and coal products, peat, crude oil and derived products and natural gas), while CO_2 emissions from the remaining components of TPES (i.e. electricity from hydro, other renewables and nuclear) are zero. Emissions from the combustion of biomass-derived fuels are not included, in accordance with the IPCC greenhouse gas inventory methodology. TPES, by definition, excludes international marine bunkers. INC-IX decided in February 1994 that emissions from international marine and aviation bunkers should not be included in national totals but should be reported separately, as far as possible. CO_2 emissions from bunkers are those quantities of fuels delivered for international *marine* bunkers and the emissions arising from their use. Data for deliveries of fuel to international *aviation* bunkers are not generally available to the IEA and, as a result, these emissions have not been deducted from the national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 1996 and applying this factor to forecast energy supply. Future coal emissions are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

B

ANNEX

INTERNATIONAL ENERGY AGENCY "SHARED GOALS"

The Member countries* of the International Energy Agency (IEA) seek to create the conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants.

In order to secure their objectives they therefore aim to create a policy framework consistent with the following goals:

1 Diversity, efficiency and flexibility within the energy sector are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2 Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

3 The environmentally sustainable provision and use of energy is central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should where practicable have regard to the Polluter Pays Principle.

4 More environmentally acceptable energy sources need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA Members wish to retain and improve the nuclear option for the

* Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5 Improved energy efficiency can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6 Continued **research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-Member countries, should be encouraged.

7 Undistorted energy prices enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8 Free and open trade and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9 Co-operation among all energy market participants helps to improve information and understanding, and encourage the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at their 4 June 1993 meeting in Paris.)

C

ANNEX

GLOSSARY AND LIST OF ABBREVIATIONS

In this report, abbreviations are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention and abbreviated subsequently, this glossary provides a quick and central reference for many of the abbreviations used.

AC	alternating current.
bcm	billion cubic metres.
b/d	barrels per day.
bioenergy	a Finnish term which comprises renewable biomass and peat.
cal	calorie.
CCGT	combined-cycle gas turbine.
CERT	Committee on Energy Research and Technology of the IEA.
CFCs	chlorofluorocarbons.
CHP	combined production of heat and power; sometimes, when referring to industrial CHP, the term "co-generation" is used.
CNG	compressed natural gas.
Council of State	the Finnish Government.
CO_2	carbon dioxide.
DC	direct current.
DH	district heating.
DSO	distribution system operator.
EFTA	Europe Free Trade Association: Iceland, Norway, Switzerland and Liechtenstein.
EIA	environmental impact assessment.
EL-EX	the Finnish Electricity Exchange.
EMA	Electricity Market Authority.
EMS	energy market scenario.
EPO1	energy policy scenario 1.
EPO2	energy policy scenario2.
EU	The European Union, whose members are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.
Euro	European currency (€).
FCCC	Framework Convention on Climate Change.
FM	Finnish Markka. One Finnish Markka corresponded to 0.188 US$ in 1998 and to 0.193 US$ in 1997. Its 1999 equivalent in Euro is 0.1682 (€).

FSU	the Former Soviet Union.
GDP	gross domestic product.
GJ	gigajoule, or 1 joule × 10^9.
GW	gigawatt, or 1 watt × 10^9.
IEA	International Energy Agency whose Members are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.
IEP	International Energy Programme, one of the founding Treaties of the IEA.
IPCC	International Panel on Climate Change.
ISO	independent system operator.
J	joule; a joule is the work done when the point of application of a force of one newton is displaced through a distance of one metre in the direction of the force (a newton is defined as the force needed to accelerate a kilogram by one metre per second). In electrical units, it is the energy dissipated by one watt in a second.
KTM	Kauppa- ja teollisuusministeriö, Finnish for Ministry of Trade and Industry.
kV	kilo-Volt, or one Volt × 10^3.
kWh	kilowatt-hour, or one kilowatt × one hour, or one watt × one hour × 10^3.
LDC	local distribution companies
LNG	liquefied natural gas.
LPG	liquefied petroleum gas; refers to propane, butane and their isomers, which are gases at atmospheric pressure and normal temperature.
mcm	million cubic metres.
Mt	million tonnes.
MTI	Ministry of Trade and Industry.
Mtoe	millions of tonnes of oil equivalent; see toe.
MW	megawatt of electricity, or 1 Watt × 10^6.
MWh	megawatt-hour = one megawatt × one hour, or one watt × one hour × 10^6.
NEA	the Nuclear Energy Agency of the OECD.
NESA	National Emergency Supply Agency.
NESO	National Emergency Sharing Organisation.
NGG	the Northern Gas Grid project.
NORDEL	the Association of Nordic Electricity Companies.
NO_x	nitrogen oxides.

OECD	Organisation for Economic Co-operation and Development.
OFC	Office of Free Competition.
OPBR	Organisation with Power Balance Responsibility.
PBD	power balance deviation.
ppm	parts per million.
PPP	Purchasing power parity: the rate of currency conversion that equalises the purchasing power of different currencies, i.e. estimates the differences in price levels between different countries.
R&D	research and development, especially in energy technology; may include the demonstration and dissemination phases as well.
SB	Single Buyer.
SEK	Swedish Crowns.
SLT	Standing Group on Long-Term Co-operation of the IEA.
SO	system operator.
SO_2	sulphur dioxide.
STUK	the Radiation and Nuclear Safety Authority.
TEKES	Finnish Technology Development Centre.
TFC	total final consumption of energy; the difference between TPES and TFC consists of net energy losses in the production of electricity and synthetic gas, refinery use and other energy sector uses and losses.
toe	tonne of oil equivalent, defined as 107 kcal.
TPA	third party access.
TPES	total primary energy supply.
TSO	transmission system operator.
TW	terawatt, or 1 watt $\times 10^{12}$.
TWh	terawatt $\times$ one hour, or one watt $\times$ one hour $\times 10^{12}$.
VAT	value-added tax.
VOCs	volatile organic compounds.
VTT	the Technical Research Centre of Finland.
VVER	Vodiano Vodianoi Energuyetitcheski Reaktor (Russia)