

EUROPEAN PARLIAMENT



*Directorate-General for Research*

WORKING DOCUMENT

ENERGY COOPERATION IN THE BALTIC  
SEA REGION

INCLUDING  
SUMMARY: ENGLISH, GERMAN AND FRENCH

*Energy and Research Series*

W28

EXTERNAL STUDY

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# EUROPEAN PARLIAMENT



*Directorate-General for Research*

WORKING DOCUMENT

## **ENERGY COOPERATION IN THE BALTIC SEA REGION**

*Energy and Research Series*

W28  
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## FOREWORD

*The European Parliament, and its Committee on Research, Technological Development and Energy in particular, have always taken a great interest in the process of economic restructuring and cooperation in the Baltic region (embracing all the countries bordering the Baltic).*

*The Baltic region has always been a focus of attention, experiencing as it does the problems peculiar to the former meeting point of East and West,*

*The energy sector is of the greatest importance for the future development of the Baltic region, setting as it does the limits of future economic growth and decisively influencing the restructuring and development of the region's entire economy,*

*The Directorate-General for Research, at the request of the Committee on Research, Technological Development and Energy, has commissioned an external study as a basis for the development of a strategy on the contribution that energy cooperation could make to the development of the Baltic region (economic, technical and scientific restructuring of the region, options for cross-border cooperation, assistance with improving its environmental situation). The task of the external study is to gather background material for the European Parliament's initiative of developing an action plan in this policy area.*

\*\*\*\*\*

## VORWORT

*Das Europäische Parlament - und insbesondere der Ausschuß für Forschung, technologische Entwicklung und Energie - hat stets großes Interesse an Themen bekundet, die den Prozeß der wirtschaftlichen Umstrukturierung und Kooperation im Ostseeraum (alle Ostsee-Anliegerstaaten) betreffen.*

*Der Ostseeraum zog stets besondere Aufmerksamkeit auf sich, da sich hier an der einstigen Ost-West-Schnittstelle ganz besondere Probleme zeigen.*

*Für den Ostseeraum ist der Energiesektor von eminenter Wichtigkeit für die zukünftige Entwicklung, da von diesem Energiesektor die Grenzen für das zukünftige Wirtschaftswachstum abgesteckt werden und die Restrukturierung und die Entwicklung der gesamten Wirtschaft in dieser Region entscheidend mitbestimmt wird.*

*Die Generaldirektion Wissenschaft hat - auf Anforderung des Ausschusses für Forschung, technologische Entwicklung und Energie - eine externe Studie in Auftrag gegeben, um eine Strategie zu entwickeln, inwiefern die Energiekooperation einen Beitrag zur Entwicklung der Ostseeregion leisten konnte (wirtschaftliche, technische und wissenschaftliche Umstrukturierung im Ostseeraum, Optionen für grenzüberschreitende Zusammenarbeit, Beitrag zur umweltpolitischen Entlastung der Region). Die Zielvorgabe der externen Studie ist, Hintergrundmaterial für diese Initiative des Europäischen Parlaments zusammenzustellen, nämlich für die Entwicklung eines Aktionsplans in diesem Politikbereich.*

\*\*\*\*\*

## AVANT-PROPOS

*Le Parlement européen, et notamment sa commission de la recherche, du développement technologique et de l'énergie, ont toujours manifesté un grand intérêt pour les questions liées au processus de restructuration économique et à la coopération dans la région de la mer Baltique (regroupant tous les Etats riverains de la mer Baltique).*

*La région de la mer Baltique a toujours attiré l'attention dans la mesure où cette ancienne zone d'interface entre l'Est et l'Ouest est le siège de problèmes très particuliers.*

*Le secteur de l'énergie revêt une importance cruciale pour le développement ultérieur de la région de la mer Baltique car c'est ce secteur qui détermine la croissance économique future et contribue, de façon décisive, à la restructuration et au développement de l'ensemble de l'économie dans la région.*

*A la demande de la commission de la recherche, du développement technologique et de l'énergie, la Direction générale des Études a fait réaliser une étude externe visant à définir une stratégie démontrant jusqu'à quel point la coopération dans le domaine de l'énergie peut contribuer au développement de la région de la mer Baltique (restructuration économique, technique et scientifique dans la région de la mer Baltique, options pour une coopération transfrontalière, contribution à l'assainissement de l'environnement dans la région). L'objectif de cette étude est de rassembler la documentation sur laquelle s'appuiera l'initiative du Parlement, à savoir le développement d'un plan d'action dans ce domaine.*

**DIRECTORATE-GENERAL FOR RESEARCH**

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*Luxembourg, August 1997*

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## Executive Summary

### The countries of the Baltic Sea Region (BSR): Basic economic indicators

The study focuses on the energy situation in the countries of the Baltic Sea Region (BSR). These countries consist of the European Union Member states (EU-MS) Denmark, Germany, Finland, Sweden and the Non-EU Member states (Non-EU-MS) Poland, Lithuania, Latvia, Estonia, Russia (including the Kaliningrad area).

The whole Baltic Sea Region gains a growing importance and is expected to become a new economic and technological centre, because of

- the recent North expansion of the EU by the Scandinavian countries (Finland, Sweden),
- the German Reunification (Ex-GDR as an important part of the BSR)
- the entrance of Poland and of the other BSR-countries of the former East Bloc (Latvia, Lithuania, Estonia, Russia) for market economies
- the planned expansion of the EU by former East European countries of the BSR

The energy sector in the BSR requires special attention, because

- efficient energy markets and security of energy supply is of vital importance for the successful transformation process of the economies in transition
- integration of the energy markets between the Western and Eastern countries of the BSR plays a key role in the whole integration process of Europe.
- the security of energy supply of Western Europe depends heavily on transnational transit energy supply networks through the BSR, especially from Russia towards Germany.
- all energy markets of the countries in the BSR undergo a structural transformation process towards more deregulation.

The importance of the countries of the BSR is revealed by some basic geographical and demographic figures: all BSR countries cover an area of about 18.5 million qkm, the total population size of all BSR countries comprises about 300 million. Regarding only those country parts of Germany, Poland and in particular of Russia which belong to the narrower (coast) region of the Baltic Sea, to the so called Baltic Rim, this region still amounts to an area of about 1,133,000 qkm and to a population size of about 50 million.

The region under consideration cannot be regarded as an homogenous entity. There exist huge differences concerning the economic strength between the Non-EU-MS and the EU-MS. The Gross Domestic Product (GDP) per capita in the EU-MS of the BSR is about eight to ten times higher than the highest value in the Non-EU-MS of the BSR: about 3,000 US\$ per capita in Poland versus 25,000 US\$ per capita in Finland and 30,000 US\$ per capita in Germany (1995).

### Energy situation in the BSR region: key indicators

As regards the energy sector one country in the region, and also in Europe as a whole, represents a special case. This is Russia - with its large indigenous resources one of the world leading countries concerning reserves, energy production, consumption and energy exports. **Russia is the only net exporter of energy** among the countries of the BSR. **All other countries under consideration are poor of indigenous resources** compared with their energy requirements - only Poland and Germany have considerable coal resources, but their coal production is declining and not competitive.

The BSR key indicators relating to energy production, consumption and trade are as follows:

- **Energy production and consumption**  
The total primary production and consumption in the BSR countries is expected to remain almost constant in the period between 1994 and 2000: production about 1,300 Mtoe, consumption about 1240 Mtoe. Russia is the leading energy producer (1003 Mtoe), followed with large distance by Germany (143 Mtoe) and Poland (89 Mtoe), values referred to 1994. The

rank of countries ordered by their size of energy consumption is similar (1994): Russia (694 Mtoe), Germany (337 Mtoe), Poland (91Mtoe).

Due to the collapse of the Former Soviet Union (FSU) there was a sharp decline in the energy consumption of the Non-EU-MS in the beginning of the nineties, in particular in the three Baltic States (BS).

The **share of gas** in total energy consumption is expected to increase substantially, in particular in the BS, in Poland, Russia and in Denmark. In the three BS oil is expected to lose significant shares in favour of gas in the period 1994 to 2010. The gas share is expected to double in the BS in this period (Lithuania up to 70%, Latvia up to 34%, Estonia up to 45%) and in Denmark the gas share is expected to double in the period 1994 to 2005 (up to 27%).

One reason for the expected **increase of gas** will be the construction of a **new gas pipeline** from the Siberian peninsula Yamal via Belarus and Poland to Germany.

The utilisation of biomass for energy is **still** low, but is expected to increase, in particular in the three BS.

In opposite to most of the Non-EU-MS in the **EU-MS oil and coal are expected to dominate** further the energy sector with a total share of more than 50% of consumption - with the exception of Sweden with a high share of nuclear power of more than 30%. In all EU-MS of the BSR the gas share is expected to remain lower than 30% up to 2005.

#### - **Energy import dependence and energy trade**

All countries of the BSR with the exception of Russia are **heavily dependent on energy imports**. Only Russia is self sufficient with a self sufficiency ratio of about 145%. Although Poland has the second largest self sufficiency of about 97% it is heavily import dependent on oil and gas due to a share of these energy sources of about 25% of its consumption.

In four of the remaining seven states the self sufficiency lies below 50% (1996), in the rest of the countries the import-dependency is between 30% and 40%. In all BSR countries with the exception of Russia the import dependence is expected to increase substantially from 1996 up to 2010.

**The most energy import dependent states are Lithuania (nearly 100%) and Latvia** (about 70%). Due to natural resources of oil shale the situation in Estonia is a little bit better: Estonia can provide approx. 69% (1996) of its energy demand by indigenous resources, but on the consequences of environmental pollution. All BSR countries (except. Russia) including Poland are in particular heavily import **dependent on oil and gas**.

Poland and in particular the three BS were and partially they always still remain **heavily dependent on Russia and the FSU** as supply countries for their energy imports. The collapse of the FSR led to a sudden cut of these energy supplies from Russia, which dropped its energy supplies and adjusted its prices to world market levels. As a consequence of both effects - cutting supply quantities and sharp price increase - energy imports shrank dramatically. The economies in Poland and the Baltic States bottomed out at the beginning of the 90s.

Due to their higher dependency on Russia the Baltic States were much more affected than Poland; for example: the share of crude oil, oil products and natural gas of primary energy consumption was in the Baltic States (**BS**) between 40% and 80% in 1990, in Poland only about 25 %. The collapse of the FSR resulted in a dramatic decline in the BS consumption of these energy sources by a half or more up to two third (2/3). The oil and gas imports of the BS dropped in the three years between 1991 and 1994 significantly by almost 54 %.

#### - **Energy inefficiency**

All Non-EU-MS are characterised by an extremely high energy inefficiency correlated with a high energy intensity.

Compared with the EU-average of about 296 toe/1985 MECU the energy intensity in Poland is about three times higher (909 toe/1985 MECU), in Estonia about five times higher (1582 toe/1985 MECU), in Latvia also nearly about three times higher (856 toe/1985 MECU) and in Lithuania even more than five times higher (1587 toe/1985 MECU).

The emphasis on heavy industry, the poor state of the energy infrastructure including district heating systems (DHS), the low price of energy and production inefficiencies under central planning were among the principle causes of the high rate of energy intensity in all Non-EU-Member States of the BSR.

A common characteristic feature in the energy infrastructure of the Non-EU-MS of the BSR is the great importance of DHS. More than half of residential buildings in Poland and in the three BS are connected to DHS, in Russia DHS is used to a large extent in most Russian cities. In itself, heating presents an overwhelming problem not only because of high prices and the poor state of the DHS, but also because consumers are not aware of how much they are consuming. There is no effective metering for measuring the supply to apartments and houses and no valves on the radiators by which to control the quantity of heat used. The problem is worsened by the fact that in most houses wall and window insulation is inadequate compared with western standards. It is estimated that heat consumption per square metre is more than double than in Scandinavian countries. In summary DHS is a main source of energy inefficiency.

## Environment and renewable energy sources

The high energy intensity in the Non-EU-MS **exacerbates the environmental problems** created by energy production, transformation and use. Power plants and district heating plants have no or only insufficient facilities for removing SO<sub>x</sub>, NO<sub>x</sub> and dust.

Due to the high coal production and consumption the energy related environmental impacts in Poland are one of the most severest among the BSR countries. **Poland is the fourth largest emitter of SO<sub>x</sub> in Europe.** In Estonia a major environmental problem is the use of oil shale. In 1990 Estonia had the highest per capita SO<sub>2</sub> emissions in Europe, with corresponding negative effects also on neighbouring countries, such as Finland and Sweden.

It is supposed that renewable energy sources (RES) could contribute substantially to an environmental friendly energy supply. **The potential of RES in the BSR is expected to be high, but till yet mostly unexploited.** Only in the Scandinavian countries the RES have a significant share of total primary energy supply: Denmark 6%, Sweden 13%, Finland 15%, (1994 values). In the other countries, in particular in the three BS, large efforts are taken to increase the share of RES. Biomass, fire wood, wind and energy from waste are the most prospective kinds of RES.

A special problem is the **nuclear safety**. The Tschernobyl-type reactors (RBMK-reactor) of the nuclear power plants Ignalina in Lithuania and in St. Petersburg are considered unsafe compared with Western standards.

## Deregulation of energy markets

The Eastern European countries of the BSR face the challenge to adjust the whole framework of their energy systems to the requirements of a market economy. The achievement of competitive energy prices which reflect economic cost **is** a main goal of this restructuring process towards efficient energy markets.

Recent developments in EU-Energy-Legislation will accelerate the ongoing deregulation process in the EU-MS of the BSR. Two directives are of central importance for the further development of the European energy markets. The Directive on electricity, which entered into force on February 19th 1997, and the proposed Gas Directive establish common rules for the European Union's internal energy market. Both Directives will set the standards for a new legislative framework on energy within all Member States of the European Union.

## Network integration and the Baltic Ring

The ongoing deregulation of the energy markets is closely related to current efforts of further integration of the energy infrastructure in the BSR.

Today the BSR lies in the intersection of four mainly separated grid systems:

Former Soviet Northwest *Interconnected Power System (IPS)*

The IPS is the power network system of the Former Soviet Union and the present power system of the CIS countries.

- *UCPTE* network (Union of Companies for the Production and Transmission of Electricity)  
This is a Western European organisation of interconnected electricity systems.
- *NORDEL* network  
This network consists of the Nordic countries (Finland, Sweden, Norway, Denmark).
- *CENTREL*  
The members of this newly established power union CENTREL are: Poland, Czechia, Slovakia, Hungary.

A main development of all-European plans of economic integration is a gradual creation of a unified energy market covering all Europe. Substantial efforts towards this long term aim of a pan-European unified energy market are already ongoing under the project name “**Baltic Ring**”.

The European Commission admitted the Baltic Ring Project to the infrastructure programme “Trans-European Networks”. The aim of this project is to provide the technical prerequisites for an efficient electric power exchange between the Scandinavian countries Denmark, Norway, Sweden and Finland, the Baltic States, Germany and Poland including Russia and Belarus.

The network integration and the Baltic Ring project require a strengthening of **intra-Baltic-energy cooperation**. A number of multilateral structures have been created in recent years to promote regional cooperation. These bodies tend to involve states in contiguous areas, with traditional ties. They include for example the **Council of Baltic Sea States**: Denmark, Norway, Sweden, Finland, the Russian Federation, Estonia, Latvia, Lithuania, Poland and Germany. But in the three Baltic States the **tendency exists to maintain an independent energy policy** and rather to compete among each other than to cooperate. The border disputes among the BS about the continental shelf region (where oil and gas fields are supposed to be) are symptoms for a weak willingness to cooperate in vital Intra-Baltic energy questions.

## EU - and international cooperation, recommendations for EU-policy options

Due to the strategic situation of the BSR and since Baltic States and Poland expressed their willingness to become EU-Member States, large scale EU and international cooperation in the region appears as a priority. The EU supports the potential membership candidates by its pre-accession strategy. This strategy is embedded into the main EU-programmes for Eastern Europe:

- **Phare**, which provides technical assistance in CEEC through financial support within the frame of multi-country energy programmes, country operational programmes, and cross-border programmes  
  
**The 4<sup>th</sup> Framework programme for R&D** promoting cooperation in the field of energy technology through demonstration projects and dissemination activities within the INCO-COPERNICUS, JOULE-THERMIE specific programmes;
- **Synergy**, addressing cooperation activities in the field of energy policy.

In addition European and international financing institutions such as EIB, EBRD and World Bank are playing a crucial part regarding the financial requirements of the energy sector restructuring in the BSR.

Policy options for further EU-cooperation should focus to the following objectives:

strengthen the security of energy supply for Europe:

The Baltic region plays a key role in its function as a transient energy supplier and distributor for energy supplies from Russia towards Western Europe. The European Union with its high energy import dependence has a vital interest in stabilising and expanding this energy supply structure across the Baltic region.

- Protection of the environment:

A lack of environmental standards has led to a degradation of the environment in the Non-EU-Member States of the BSR. Environmental standards must be integrated in national and international frameworks. Nuclear safety precautions for the nuclear plant in Lithuania and in St. Petersburg are of special importance.

Integration of the energy markets

Large investments are required to overcome the technical problems of network integration and to build up the necessary hardware structure (power connection lines, dispatch stations etc.).

But there is not only a lack of technical integration. The energy markets, in particular the electricity markets, differ significantly in their framework and conceptual design, not only between the Western and Eastern countries of the Baltic Sea Region, but also within these country groups.

To meet these overall objectives main efforts should be aimed at the following priority areas:

- **Rational use of energy (RUE) (energy efficiency)**

The EU-Member States of the BSR are strong in well proven energy saving technologies. They could be transferred to the Eastern European countries.

#### **Clean technologies**

Technology transfer and installation of clean technologies are required to realise and enforce environmental standards and aims such as emission reduction.

- **Modern gas technologies**

Gas is becoming of increasing importance in the region, in particular in the Eastern European countries of the BSR. Support should be given in the introduction of modern high efficient gas technologies such as combined cycle technologies as CGT (Gas combined Cycle Turbines).

#### **Strengthening the role of RES (Renewable energy sources)**

A future energy policy should aim at the development of the great potential of regenerative energies in the Baltic Sea region. Utilisation of fuel wood and cogeneration plants based on biomass (biogas) are prospective.

In general, support should be given to the **improvement of the framework conditions**: an adequate legislative, institutional and pricing structure of the energy market is a prerequisite to mobilising private capital and to implementing energy saving programmes. The reduction of emissions does not only depend on technological measures, but also on reducing barriers to the diffusion and transfer of technology and on the institutional implementation of changes in behaviour.

To ensure quick short-term results it is recommended that international programmes aim rather to concrete investment projects (e.g. energy efficiency) than to general studies and evaluations.

The BSR countries: main energy indicators - a short overview							
	Self-sufficiency (%)		Energy Consumption			Energy Production	
	1994	2000	total Mtoe		per capita toe (1994)	total Mtoe	
			1994	2000		1994	2000
<b>Germany</b>	42	39	336,5	358,2	4,1	142,6	139,3
<b>Denmark</b>	72	80	20,7	20,16	3,9	14,9	16,2
<b>Sweden</b>	62	61	50,3	50,9	5,9	31,3	31,1
<b>Finland</b>	42	57	30,5	24,5	6	12,7	13,9
<b>Estonia</b>	67	67	5,5	6,3	3,8	3,7	4,2
<b>Latvia</b>	23	30	4,4	4,4	1,8	1	1,3
<b>Lithuania</b> (regarding import nuclear fuel)	29 (nearly 0%)	25	8,4	9,6	2,1	2,4	2,4
<b>Poland</b>	97	86	91	101,5	2,5	88,5	87,6
<b>Russia</b>	145	153	694	671		1003	1027
<b>Total</b>			<b>1.241</b>	<b>1.247</b>		<b>1.300</b>	<b>1.323</b>

## Ausführliche Zusammenfassung

### Die Länder der Ostseeregion (OSR) :Grundlegende Wirtschaftsindikatoren

Die Studie behandelt im wesentlichen die Energielage in den Ländern der Ostseeregion (OSR). Zu diesen Ländern zählen die Mitgliedstaaten der Europäischen Union Danemark, Deutschland, Finnland und Schweden sowie die Nichtmitgliedstaaten Polen, Litauen, Lettland, Estland und Rußland (einschließlich des Gebietes um Kaliningrad/Königsberg).

Die gesamte Ostseeregion gewinnt zunehmend an Bedeutung und wird sich **aller** Voraussicht nach aus folgenden Gründen zu einem neuen wirtschaftlichen und technologischen Zentrum entwickeln:

- die vor kurzem erfolgte Norderweiterung der EU um die skandinavischen Länder (Finnland, Schweden)
- die deutsche Wiedervereinigung (die ehemalige DDR als bedeutender Teil der OSR)
- der Übergang Polens und der übrigen ehemals dem Ostblock angehörenden OSR-Länder (Lettland, Litauen, Estland, Runland) zur Marktwirtschaft
- die geplante Erweiterung der EU um die ehemaligen osteuropäischen Länder der OSR

Aus folgenden Gründen verdient der Energiesektor in der OSR besondere Beachtung:

- Effiziente Energiemärkte und eine sichere Energieversorgung sind für den erfolgreichen Abschluß des Umwandlungsprozesses in den im Übergang befindlichen Volkswirtschaften von grundlegender Bedeutung.
- Die Integration der Energiemärkte der westlichen und östlichen Ländern der OSR spielt für den europäischen Integrationsprozeß insgesamt eine Schlüsselrolle.
- Die sichere Energieversorgung Westeuropas hängt sehr stark von grenzüberschreitenden Transitenergienetzen durch die OSR ab, vor allem von Rußland nach Deutschland.
- Alle Energiemärkte der OSR-Länder durchlaufen einen strukturellen Umformungsprozeß in Richtung verstärkte Deregulierung.

Die Bedeutung der OSR-Länder zeigt sich in einigen grundlegenden geographischen und demographischen Zahlen: Die Fläche der OSR-Länder umfaßt rund 18,5 Millionen km<sup>2</sup>, und die Gesamtbevölkerung aller OSR-Länder beträgt etwa 300 Millionen. Betrachtet man nur jene Landteile von Deutschland, Polen und insbesondere Runland, die die schmalere (Kusten-)Region der Ostsee ausmachen, den sogenannten baltischen Rand, so umfaßt diese Region immer noch ein Gebiet von etwa 1,133 Mio. km<sup>2</sup> und eine Bevölkerung von ungefähr 50 Millionen.

Die zu untersuchende Region läßt sich nicht als homogenes Ganzes betrachten. Es gibt enorme Unterschiede zwischen der Wirtschaftskraft der Nichtmitgliedstaaten und der Mitgliedstaaten der EU. Das Bruttoinlandsprodukt (BIP) pro Kopf in den Mitgliedstaaten der EU der Ostseeregion ist etwa acht- bis zehnmal so hoch wie der höchste Wert in den Nichtmitgliedstaaten der Ostseeregion: Etwa 3.000 US\$ pro Kopf in Polen stehen 25.000 US\$ pro Kopf in Finnland und 30.000 US\$ pro Kopf in Deutschland gegenüber (1995).

### Die Energielage in der Ostseeregion: Schlüsselindikatoren

Was den Energiesektor betrifft, stellt ein Land in dieser Region, und auch in Europa insgesamt, einen Sonderfall dar: Rußland, das durch seine riesigen Ressourcen eines der weltweit führenden Länder in Bezug auf Reserven, Energieerzeugung, Verbrauch und Energieausfuhren **ist**. Unter den OSR-Ländern ist **Rußland der einzige Nettoexporteur von Energie. Alle anderen in Betracht gezogenen Länder** verfügen, verglichen mit ihrem Energiebedarf, **kaum über Eigenressourcen** - nur Polen und Deutschland weisen beträchtliche Kohlevorkommen auf; ihre Kohleproduktion ist allerdings rückläufig und nicht wettbewerbsfähig.

Die Schlüsselindikatoren für Energieproduktion, -verbrauch und -handel für die OSR sind:

- **Energieproduktion und -verbrauch**  
Gesamtprimärproduktion und -verbrauch in den Ländern der Ostseeregion werden im Zeitraum 1994-2000 voraussichtlich mehr oder weniger konstant bleiben: Die Produktion wird etwa

1.300 ROE betragen, der Verbrauch etwa 1.240 ROE. Rußland ist der führende Energieerzeuger (1.003 ROE); mit großem Abstand folgen Deutschland (143 ROE) und Polen (89 ROE). (Bezugszeitraum: 1994.) Ähnlich ist auch die Reihenfolge der Länder nach Energieverbrauch (1994): Rußland (694 ROE), Deutschland (337 ROE) und Polen (91 ROE). Aufgrund des Zusammenbruchs der früheren Sowjetunion (FSU) ging der Energieverbrauch in den Nichtmitgliedstaaten der EU, insbesondere in den drei baltischen Staaten, zu Beginn der 90er Jahre stark zurück.

Der **Gasanteil** am Gesamtenergieverbrauch wird voraussichtlich beträchtlich steigen, insbesondere in den baltischen Staaten, in Polen, Rußland und Danemark. In den drei baltischen Staaten wird Erdöl im Zeitraum 1994 bis 2010 gegenüber Gas wahrscheinlich beträchtliche Anteile einbüßen. Man geht davon aus, daß sich der Gasanteil in den baltischen Staaten während dieses Zeitraums verdoppelt (Litauen bis zu 70%, Lettland bis zu 34%, Estland bis zu 45%); in Danemark wird er sich voraussichtlich während des Zeitraums 1994 bis 2005 verdoppeln (bis zu 27%).

Ein Grund für die erwartete **Zunahme von Gas** ist der Bau einer **neuen Gas-Pipeline** von der sibirischen Halbinsel Jamal über Weißrußland und Polen nach Deutschland.

Der Anteil der Energiegewinnung aus Biomasse ist nach wie vor gering, soll jedoch ebenfalls steigen, vor allem in den drei baltischen Staaten.

Gegenüber den meisten Nichtmitgliedstaaten werden in den **Mitgliedstaaten der EU Erdöl und Kohle weiterhin** den Energiesektor mit einem Gesamtverbrauchsanteil von über 50% **dominieren** - mit Ausnahme Schwedens, das einen hohen Anteil an Kernkraft (über 30%) aufweist. In allen EU-Ländern des Ostseeraumes wird der Gasanteil bis zum Jahr 2005 die 30%-Marke voraussichtlich nicht überschreiten.

#### - **Energieimportabhängigkeit und Energiehandel**

Alle Länder der Ostseeregion mit Ausnahme Rußlands sind **sehr von Energieimporten abhängig**. Nur Rußland ist mit einer Selbstversorgungsrate von etwa 145% autonom. Obwohl Polen mit rund 97% an zweiter Stelle der Unabhängigkeitsskala liegt, ist es bei Erdöl und Gas sehr stark einfuhrabhängig, weil der Anteil dieser Energiequellen an seinem Verbrauch bei etwa 25% liegt.

In vier der verbleibenden sieben Staaten liegt die Selbstversorgungsrate bei unter 50% (1996), in den übrigen Ländern beträgt die Importabhängigkeit zwischen 30 und 40%. Man geht davon aus, daß die Importabhängigkeit in allen OSR-Ländern mit Ausnahme Rußlands zwischen 1996 und 2010 beträchtlich steigen wird.

**Am stärksten von Energieeinfuhren abhängig sind Litauen** (fast 100%) **und Lettland** (etwa 70%). Dank natürlicher Ölschiefervorkommen ist die Lage in Estland etwas besser: Estland kann etwa 69% (1996) seines Energiebedarfs aus eigenen Vorkommen decken, allerdings auf Kosten der Umwelt. Alle OSR-Länder (ausgenommen Rußland) einschließlich Polen sind vor allem sehr stark von der Einfuhr von **Erdöl und Gas** abhängig.

Polen und vor allem die drei baltischen Staaten waren und sind zum Teil weiterhin **stark von Rußland und der früheren Sowjetunion abhängig**, aus denen sie ihre Energieeinfuhren beziehen. Der Zusammenbruch der FSU hatte einen plötzlichen Rückgang dieser Energieversorgung aus Rußland zur Folge, wodurch dessen Energielieferungen gesenkt und die Preise an das Weltmarktniveau angeglichen wurden. Diese beiden Ursachen - die Verringerung der Liefermengen und der deutliche Preisanstieg - hatten zur Folge, daß die Energieimporte beträchtlich zurückgingen. Anfang der 90er Jahre erreichte die Wirtschaft in Polen und den baltischen Staaten ihren Tiefpunkt.

Aufgrund ihrer größeren Abhängigkeit von Rußland waren die baltischen Staaten starker betroffen als etwa Polen: Der Anteil an Rohöl, Ölprodukten und Erdgas am Primärenergieverbrauch lag 1990 in den baltischen Staaten beispielsweise zwischen 40 und 80%, in Polen hingegen bei nur 25%. Der Zusammenbruch der FSU führte zu einem deutlichen Rückgang des Verbrauchs dieser Energieträger in den baltischen Staaten um 50-75%. Die Erdöl- und Gasimporte der baltischen Staaten fielen in den drei Jahren zwischen 1991 und 1994 um den beträchtlichen Wert von fast 54%.

#### - **Energieineffizienz**

Alle Nichtmitgliedstaaten der EU weisen eine extrem hohe Energieineffizienz, gekoppelt mit einer hohen Energieintensität auf.

In Polen beträgt die Energieintensität etwa das Dreifache (909 TRÖe/1985 MECU) des EU-Durchschnitts von etwa 296 TRÖe/1985 MECU, in Estland etwa das Fünffache (1582



TRÖe/1985 MECU), in Lettland ebenfalls etwa das Dreifache (856 TRÖe/1985 MECU) und in Litauen sogar mehr als das Fünffache (1587 TRÖe/1985 MECU).

Die überwiegende Schwerindustrie, der beklagenswerte Zustand der Energieinfrastruktureinrichtungen einschließlich Fernheizsystemen, die niedrigen Energiepreise und die Produktionsineffizienz in der zentralen Planwirtschaft zählen zu den Hauptgründen für das hohe Energieintensitätsniveau in allen Nichtmitgliedstaaten der EU im Ostseeraum.

Ein charakteristisches gemeinsames Merkmal der Energieinfrastruktur in allen Nichtmitgliedstaaten der EU im Ostseeraum ist die große Bedeutung der Fernheizung. Mehr als die Hälfte der Wohngebäude in Polen und in den drei baltischen Staaten sind an das Fernheiznetz angeschlossen; in Russland wird Fernwärme in den meisten Städten in großem Umfang eingesetzt. Das Heizen selbst stellt ein enormes Problem dar, nicht nur weil die Preise hoch und das Fernheiznetz in einem beklagenswerten Zustand ist, sondern auch weil den Konsumenten nicht bewußt ist, wieviel sie verbrauchen. Es gibt kein effizientes System um zu messen, wieviel Energie an Wohnungen und Häuser abgegeben wird, und keine Ventile an den Radiatoren, durch die sich die verwendete Warmemenge regeln läßt. Das Problem wird noch dadurch verschärft, daß in den meisten Häusern Mauer- und Fensterisolierungen verglichen mit westlichen Standards unzureichend sind. Man schätzt, daß der Wärmeverbrauch pro Quadratmeter mehr als doppelt so hoch ist wie in den skandinavischen Ländern. Kurz gesagt ist die Fernheizung eine Hauptursache für Energieineffizienz.

## Umwelt und erneuerbare Energiequellen

Die hohe Energieintensität in den Nichtmitgliedstaaten der EU verschärft die Umweltprobleme, die sich aus Energieproduktion, -umwandlung und -nutzung ergeben. Kraft- und Fernheizwerke verfügen über keine oder nur unzureichende Filtervorrichtungen für Schwefeloxyd, Stickoxyde und Staub.

Aufgrund der hohen Kohleproduktion und des hohen Kohleverbrauchs zählen die durch die Energiewirtschaft bedingten Umweltschaden in Polen zu den schwersten in den Ländern der Ostseeregion. **Polen ist innerhalb Europas der viertgrößte Schwefeldioxydemittent.** In Estland verursacht die Verwendung von Olschiefer beträchtliche Umweltprobleme. 1990 wies Estland die höchsten **Schwefeldioxydemissionen** pro Kopf in Europa auf, was sich auch entsprechend negativ auf die Nachbarländer, wie Finnland und Schweden, auswirkte.

Vermutlich würden sich erneuernde Energiequellen einen wesentlichen Beitrag zu einer umweltfreundlichen Energieversorgung leisten. **Man nimmt an, daß das Potential der regenerierbaren Energiequellen im Ostseeraum hoch ist, bisher wird es allerdings noch kaum genutzt.** Nur in den skandinavischen OSR-Ländern machen die sich erneuernden Energiequellen einen beträchtlichen Teil der Gesamtprimärenergieversorgung aus: Dänemark 6%, Schweden 13% und Finnland 15% (Stand 1994). In den übrigen Ländern, vor allem in den drei baltischen Staaten, werden große Anstrengungen unternommen, um den Anteil dieser Energiequellen zu steigern. Biomasse, Feuerholz, Wind und aus Abfall gewonnene Energie sind die vielversprechendsten Arten von regenerierbaren Energiequellen.

Ein besonderes Problem stellt die **nukleare Sicherheit** dar. Verglichen mit westlichen Standards gelten die Reaktoren vom Typ Tschernobyl (RBMK-Reaktoren) des Kernkraftwerks Ignalina in Litauen und des Kernkraftwerks in Sankt Petersburg als nicht sicher.

## Deregulierung der Energiemärkte

Die osteuropäischen Länder der Ostseeregion stehen vor der Herausforderung, den gesamten Rahmen ihrer Energiesysteme den Anforderungen der Marktwirtschaft anzupassen. Das Erreichen von konkurrenzfähigen Energiepreisen, die die Wirtschaftskosten widerspiegeln, ist eines der wichtigsten Ziele dieses Umstrukturierungsprozesses in Richtung effiziente Energiemärkte.

Die jüngsten Entwicklungen im Bereich der EU-Rechtsvorschriften für den Energiesektor werden den laufenden Deregulierungsprozeß in den Mitgliedsländern der EU in der Ostseeregion beschleunigen. Zwei Richtlinien sind für die Weiterentwicklung der europäischen Energiemärkte von zentraler Bedeutung: die Richtlinie über Elektrizität, die am 19. Februar 1997 in Kraft getreten ist, und der Richtlinienentwurf für Gas, die beide gemeinsame Bestimmungen für den Energiebinnenmarkt der

Europäischen Union erlassen. Beide Richtlinien werden die Normen für einen neuen Gesetzesrahmen für den Energiesektor in allen Mitgliedstaaten der Europäischen Union festlegen.

### Netzintegration und der Baltische Ring

Die derzeitige Deregulierung der Energiemärkte steht in engem Zusammenhang mit den Bemühungen, die Energieinfrastruktur in der Ostseeregion weiter zu integrieren.

Heute liegt die OSR im Schnittpunkt von vier im wesentlichen voneinander unabhängigen Verteilungsnetzen:

- das ehemalige sowjetische nordwestliche **Energieverbundsystem**  
Das Energieverbundsystem ist das Energienetz der früheren Sowjetunion und das derzeitige Energieversorgungssystem der GUS-Länder.
- **UCPTE-Netz** (Union von Gesellschaften für die Erzeugung und Übertragung von Elektrizität)  
Hierbei handelt es sich um eine westeuropäische Elektrizitätsverbundorganisation.
- **NORDEL-Netz**  
Dieses Netz besteht aus den nordischen Ländern (Finnland, Schweden, Norwegen und Dänemark).
- **CENTREL**  
Die Mitglieder dieses vor kurzem eingerichteten Elektrizitätsverbundes sind: Polen, Tschechien, Slowakei und Ungarn.

Einer der wichtigsten Entwicklungsschritte im Rahmen der gesamteuropäischen Pläne für die **Wirtschaftsintegration** ist die allmähliche Schaffung eines einheitlichen Energiemarktes, der sich auf ganz Europa erstreckt. Betrachtliche Anstrengungen in Richtung dieses langfristigen Ziels eines paneuropäischen vereinten Energiemarktes werden **bereits** unter dem Projektnamen "**Baltischer Ring**" unternommen.

Die Kommission hat das Projekt Baltischer Ring in das Infrastrukturprogramm "Transeuropäische Netze" aufgenommen. Ziel dieses Projektes ist es, die technischen Voraussetzungen für einen **effizienten** Austausch von elektrischer Energie zwischen den skandinavischen Ländern Dänemark, Norwegen, Schweden und Finnland, den baltischen Staaten, Deutschland und Polen einschließlich Rumänien und Weißrussland zu schaffen.

Die Netzintegration und das Projekt Baltischer Ring machen eine Stärkung der **energiepolitischen Zusammenarbeit innerhalb der Ostseeregion** erforderlich. In den vergangenen Jahren wurden eine Reihe von multilateralen Strukturen geschaffen, um die regionale Zusammenarbeit zu fördern. In der Regel sind an diesen Zusammenschlüssen benachbarte Staaten mit traditionellen Verbindungen beteiligt. Ein Beispiel hierfür ist etwa der **Rat der Ostseestaaten**, der Dänemark, Norwegen, Schweden, Finnland, die Russische Föderation, Estland, Lettland, Litauen, Polen und Deutschland umfasst. In den drei baltischen Staaten herrscht allerdings die Tendenz vor, die **Energiepolitik unabhängig zu gestalten** und eher untereinander zu konkurrieren als miteinander vorzugehen. Die Grenzstreitigkeiten der baltischen Staaten untereinander über die Region des Kontinentalschelfs (wo Erdöl- und Erdgasfelder vermutet werden) sind symptomatisch für die geringe Bereitschaft, bei zentralen Energiefragen innerhalb der Ostseeregion zusammenzuarbeiten.

### Gemeinschaftliche und internationale Zusammenarbeit, Empfehlungen für eine entsprechende EU-Politik

Aufgrund der strategischen Lage der Ostseeregion und des Wunsches der baltischen Staaten und Polen, der EU beizutreten, erscheint eine umfassende gemeinschaftliche und internationale Zusammenarbeit in der Region als Priorität. Die EU unterstützt die beitragswilligen Länder durch ihre Strategie für die Beitrittsvorbereitung. Diese Strategie ist in die wichtigsten EU-Programme für Osteuropa eingebettet:

- **PHARE**, ein technisches Hilfsprogramm für MOEL durch finanzielle Unterstützung im Rahmen von Energieprogrammen für mehrere Länder, auf jeweils ein Land beschränkte operationelle Programme und grenzüberschreitende Programme
- **Viertes Rahmenprogramm für F&E** zur Förderung der Zusammenarbeit im Bereich der Energietechnologie durch Demonstrationsprojekte und Tätigkeiten zur Informationsverbreitung innerhalb der spezifischen Programme INCO-COPERNICUS UND JOULE-THERMIE
- **Synergie**, das sich mit Kooperationstätigkeiten im Bereich der Energiepolitik befaßt

Außerdem spielen europäische und internationale Finanzinstitutionen, wie beispielsweise EIB, EBWE und Weltbank, eine zentrale Rolle in Bezug auf die finanziellen Anforderungen der Umstrukturierung des Energiesektors in der Ostseeregion.

Weiterführende Strategien zur Fortsetzung der europäischen Zusammenarbeit sollten sich auf folgende Zielsetzungen konzentrieren:

- **Stärkung der sicheren Energieversorgung Europas:**  
Die Ostseeregion hat durch ihre Funktion als Durchgangsgebiet für Energielieferungen und Verteiler von Energielieferungen von Rußland nach Westeuropa eine Schlüsselrolle inne. Die Europäische Union mit ihrer hohen Energieimportabhängigkeit hat ein lebhaftes Interesse daran, diese Energielieferstruktur innerhalb der Ostseeregion zu stabilisieren und auszuweiten.
- **Umweltschutz:**  
Der Mangel an Umweltstandards hat zu Umweltschaden in den Nichtmitgliedstaaten der EU in der Ostseeregion geführt. Derartige Umweltstandards müssen in nationale und internationale Rahmenbedingungen integriert werden. Von besonderer Bedeutung sind Sicherheitsmaßnahmen für die Kernkraftwerke in Litauen und Sankt Petersburg.
- **Integration der Energiemärkte:**  
Um die technischen Probleme der Netzintegration zu überwinden und die erforderlichen Anlagen zu errichten (Stromversorgungsleitungen, Leitstationen usw.), sind hohe Investitionen erforderlich.  
Es fehlt allerdings nicht nur an der technischen Integration. Die Energiemärkte, insbesondere die Elektrizitätsmärkte, weisen beträchtliche Unterschiede in Bezug auf Rahmen und Gestaltung auf, nicht nur zwischen den westlichen und östlichen Ländern der Ostseeregion, sondern auch innerhalb dieser Ländergruppen.

Um diese allgemeinen Zielsetzungen zu erreichen, sollten die wichtigsten Bemühungen vorrangig auf folgende Bereiche ausgerichtet sein:

- **Vernünftiger Umgang mit Energie (Energieeffizienz)**  
Die EU-Mitgliedstaaten der OSR gehen sehr erfolgreich mit bewährten Energiespartetechnologien um. Diese konnten auf die osteuropäischen Länder übertragen werden.
- **Saubere Technologien**  
Technologietransfer und die Einrichtung sauberer Technologien sind erforderlich, um Umweltstandards und Zielsetzungen wie die Verringerung von Emissionen zu verwirklichen und umzusetzen.
- **Moderne Gastechnologien**  
Erdgas gewinnt zunehmend an Bedeutung für die Region, vor allem in den osteuropäischen Ländern der OSR. Die Einführung von modernen, äußerst effizienten Gastechnologien, beispielsweise der Kombiprozeßtechnologie oder der Gasturbine im kombinierten Kreislauf, sollte unterstützt werden.
- **Stärkung der Rolle der regenerierbaren Energiequellen**  
Die zukünftige Energiepolitik sollte darauf abzielen, das große Potential der regenerierbaren Energien in der Ostseeregion zu erschließen. Die Verwendung von Brennholz und von auf Biomasse (Biogas) beruhenden Kraft-Wärme-Kopplungsanlagen ist vielversprechend.

Generell ist auf die **Verbesserung der Rahmenbedingungen** zu achten: eine entsprechende gesetzgebende, institutionelle und Preisstruktur des Energiemarktes ist eine Vorbedingung für die Verfügbarmachung von Privatkapital und für die Durchführung von Energiesparprogrammen. Die Verringerung von Emissionen erfolgt nicht nur mittels technologischer Maßnahmen, sondern bedingt auch den Abbau von Hemmnissen gegenüber der Verbreitung und Übertragung von Technologie sowie die institutionelle Verankerung von Verhaltensänderungen.

Im Interesse rascher, kurzfristiger Ergebnisse wird empfohlen, internationale Programme nicht so sehr auf allgemeine Untersuchungen und Bewertungen auszurichten, sondern auf konkrete Investitionsprojekte (z.B. Energieeffizienz).

Die Länder der Ostseeregion: die wichtigsten Energieindikatoren im Überblick							
	Selbstversorgung (%)		Energieverbrauch			Energieproduktion	
	1994	2000	Gesamt ROE		TRÖe pro Kopf (1994)	Gesamt ROE	
			1994	2000		1994	2000
<b>Deutschland</b>	42	39	336,5	358,2	4,1	142,6	139,3
<b>Danemark</b>	72	80	20,7	20,16	3,9	14,9	16,2
<b>Schweden</b>	62	61	50,3	50,9	5,9	31,3	31,1
<b>Finnland</b>	42	57	30,5	24,5	6	12,7	13,9
<b>Estland</b>	67	67	5,5	6,3	3,8	3,7	4,2
<b>Lettland</b>	23	30	4,4	4,4	1,8	1	1,3
<b>Litauen</b> (in bezug auf Import)	29 (fast 0)	25	8,4	9,6	2,1	2,4	2,4
<b>Polen</b>	97	86	91	101,5	2,5	88,5	87,6
<b>Rußland</b>	145	153	694	671		1003	1027
<b>Gesamt</b>			<b>1.241</b>	<b>1.247</b>		<b>1.300</b>	<b>1.323</b>

## Resume

Les pays de la region de la mer Baltique: Principaux indicateurs economiques

Cette etude porte sur la situation energetique dans les pays de la region de la mer Baltique. Ces pays regroupent des États membres de l'Union europeenne (EM-UE): Danemark, Allemagne, Finlande et Suede, et des États non membres de l'Union europeenne: Pologne, Lituanie, Lettonie, Estonie, Russie (y compris la region de Kaliningrad).

L'ensemble de la region de la mer Baltique gagne en importance et devrait s'affirmer comme un nouveau centre economique et technologique pour un certain nombre de raisons:

- la recente expansion vers le Nord de l'Union europeenne, avec l'adhesion de la Finlande et de la Suede
- la reunification allemande (l'ex-RDA represente une partie importante de la region)
- la transition operee vers une economie de marche par la Pologne et d'autres pays de la region, anciens membres de l'ex-bloc sovietique (Lituanie, Lettonie, Estonie et Russie)
- l'extension prevue de l'Union europeenne a d'anciens pays d'Europe de l'Est, situee dans la region de la mer Baltique.

Le secteur de l'énergie dans la région de la mer Baltique mérite une attention particulière pour les raisons suivantes:

- des marches de l'energie efficaces et la securite de l'approvisionnement en energie jouent un rôle crucial pour la réussite du processus de transformation de ces economies en transition;
- l'integration des marches de l'energie des pays d'Europe occidentale et orientale de la region de la mer Baltique est une composante essentielle de l'ensemble du processus d'integration europeen;
- la securite de l'approvisionnement en energie de l'Europe occidentale depend largement des reseaux transnationaux de transit des ressources energetiques a travers la region de la mer Baltique, notamment entre la Russie et l'Allemagne;
- tous les marches energetiques des pays de la region de la mer Baltique subissent un processus de transformation structurelle se traduisant par une dereglementation accrue;

Quelques indicateurs demographiques et geographiques rendent compte de l'importance des pays de la region de la mer Baltique: l'ensemble de la region represente une superficie d'environ 18,5 millions de kilometres carres pour une population totale d'environ 300 millions d'habitants. Si l'on considere uniquement les regions de l'Allemagne, de la Pologne et notamment de la Russie qui font partie de la bande (côtière) plus étroite qui borde la mer Baltique, le pourtour Baltique, il s'agit d'une region d'environ 1 113 000 km<sup>2</sup> comptant a peu pres 50 millions d'habitants.

Cette region ne peut cependant pas être consideree comme une entite homogene. Il existe d'énormes disparites entre les EM-UE et les pays non membres de l'UE en ce qui concerne la puissance economique. Le produit interieur brut (PIB) par habitant dans les EM-UE de la region represente huit a dix fois la valeur la plus elevee relevee dans les pays de la region qui ne sont pas membres de l'UE: environ 3000 dollars US par habitant en Pologne contre 25 000 dollars US par habitant en Finlande et 30 000 dollars US par habitant en Allemagne (1995).

Situation energetique dans la region de la mer Baltique: principaux indicateurs

En ce qui concerne l'energie, un des pays de la region, et de l'Europe dans son ensemble, constitue un cas particulier. Il s'agit de la Russie qui, avec ses ressources naturelles considerables, est l'un des premiers pays du monde pour ce qui des reserves, de la production, de la consommation et des exportations d'energie. La Russie est le seul exportateur net d'energie parmi les pays de la region de la mer Baltique. Tous les autres pays etudies disposent de ressources naturelles peu abondantes par rapport a leurs besoins energetiques - seules la Pologne et l'Allemagne disposent d'importantes reserves de charbon mais leur production charbonniere est en baisse et n'est pas competitive.

Les principaux indicateurs des pays de la region de la mer Baltique en matiere de production, de consommation et d'echanges energetiques sont les suivants:

- **Production et consommation d'energie**

La production et la consommation primaires totales dans les pays de la region de la mer Baltique devraient rester pratiquement stables au cours de la periode 1994-2000: la production est d'environ 1 300 Mtep, la consommation d'environ 1240 Mtep. La Russie est le premier producteur d'energie (1003 Mtep), suivie, de loin, par l'Allemagne (143 Mtep) et la Pologne (89 Mtep), l'annee de reference etant 1994. Le classement des pays en fonction de leur consommation d'energie est similaire (1994): Russie (694 Mtep), Allemagne (337 Mtep) et Pologne (91 Mtep).

En raison de l'effondrement de l'ex-Union sovietique, la consommation d'energie a fortement chute, au debut des annees quatre-vingt-dix, dans les pays qui ne sont pas membres de l'UE, notamment dans les trois Etats baltes.

La **part du gaz** dans la consommation totale devrait augmenter sensiblement, notamment dans les Etats baltes, en Pologne, en Russie et au Danemark. Dans les trois Etats baltes, le petrole devrait perdre du terrain face au gaz au cours de la periode 1994-2010. La part du gaz devrait doubler dans ces pays au cours de cette periode (proportion atteignant 70% en Lituanie, 34% en Lettonie et **45%** en Estonie) et au Danemark, la proportion devrait doubler entre 1994 et 2005 (pour atteindre 27%).

La construction d'un **nouveau gazoduc** entre la presqu'ile siberienne de l'Alaska et la Pologne et l'Allemagne via le Belarus constitue l'une des raisons de cette **augmentation attendue de la consommation de gaz**.

La production d'energie a partir de la biomasse est encore faible mais devrait augmenter, notamment dans les trois Etats baltes.

Contrairement a la situation observee dans la plupart des Etats de la region qui ne sont pas membres de l'UE, la **part du petrole et du charbon devrait continuer a dominer** le secteur energetique **dans les EM de l'UE**, avec plus 50% de la consommation d'energie, sauf en Suede ou plus de 30% de l'energie est d'origine nucleaire. Dans tous les Etats de la region de la mer Baltique qui sont membres de l'UE, la part du gaz devrait rester inferieure a 30% jusqu'en l'an 2005.

- **Dependance par rapport aux importations d'energie et echanges energetiques**

Tous les pays de la region de la mer Baltique, a l'exception de la Russie, sont **fortement tributaires de leurs importations d'energie**. Seule la Russie est en mesure de couvrir ses besoins energetiques avec un taux d'auto-suffisance d'environ 145%. Bien que la Pologne se place au deuxieme rang en matiere d'autoapprovisionnement avec un taux d'environ 97%, elle est largement tributaire de ses importations de petrole et de gaz, ces sources d'energie representant pres de 25% de sa consommation.

Dans quatre des sept autres pays, le taux d'autoapprovisionnement est inferieur a 50% (1996), dans les autres pays, la dependance par rapport aux importations se situe entre 30% et 40%. Dans tous les pays de la region de la mer Baltique, exception faite de la Russie, la dependance par rapport aux importations devrait augmenter sensiblement entre 1996 et 2010.

**Les pays les plus tributaires des importations d'energie sont la Lituanie (pres de 100%) et la Lettonie (pres de 70%).** En raison de ses ressources naturelles en schistes bitumineux, l'Estonie est en meilleure posture: elle est en mesure de satisfaire ses besoins energetiques a hauteur de 69% (1996) avec ses propres ressources, en depit des repercussions sur l'environnement. Tous les Etats de la region de la mer Baltique, a l'exception de la Russie, y compris la Pologne, sont **largement tributaires de leurs importations de petrole et de gaz**. La Pologne et, plus particulierement les trois Etats baltes, ont ete et restent, pour certains, **largement tributaires de la Russie et de l'ex-Union sovietique** en tant que pays fournisseurs de leurs importations energetiques. L'effondrement de l'ex-Union sovietique s'est traduit par un brusque tarissement de cette energie en provenance de Russie, cette derniere ayant reduit ses exportations d'energie et ajuste ses prix au niveau du marche mondial. A la suite de ces deux evenements - reduction des approvisionnements et forte augmentation des prix - les importations d'energie ont fortement diminue. Les economies de la Pologne et des Etats baltes ont atteint leur niveau le plus bas au debut des annees quatre-vingt-dix.

Etant fortement tributaires de la Russie, les Etats baltes ont ete beaucoup plus touches que la Pologne; a titre d'exemple, la part du petrole brut, des produits petroliers et du gaz naturel dans la consommation d'energie primaire etait comprise entre 40% et 80% dans les Etats baltes en 1990, alors qu'elle n'etait que de 25% en Pologne. L'effondrement de l'ex-Union sovietique a

entraîné une forte réduction (de plus de la moitié, voire des deux-tiers) de la consommation de ces types d'énergie dans les États baltes. Les importations de pétrole et de gaz des États baltes ont fortement chuté (de près de 54%) au cours de la période comprise entre 1991 et 1994.

#### - Faible rendement énergétique

L'une des caractéristiques communes de tous les États de la région qui ne sont pas membres de l'UE est un faible rendement énergétique lié à une intensité énergétique élevée.

L'intensité énergétique en Pologne (909 tep/1985 millions d'écus) est environ trois fois plus élevée que la moyenne de l'UE qui s'établit à environ 296 tep/1985 millions d'écus, elle est environ cinq fois plus élevée en Estonie (1582 tep/1985 millions d'écus), près de trois fois plus élevée en Lettonie (856 tep/1985 millions d'écus) et plus de cinq fois plus élevée en Lituanie (1587 tep/1985 millions d'écus).

La place prépondérante de l'industrie lourde, le mauvais état des infrastructures du secteur de l'énergie, y compris de réseaux de chauffage urbain, le prix peu élevé de l'énergie et les faibles rendements de la production dans le cadre de la planification centralisée sont les principales causes de la forte intensité énergétique constatée dans tous les États de la région de la mer Baltique, non membres de l'UE.

Les infrastructures énergétiques des États de la région de la mer Baltique, non membres de l'UE ont en commun la place importante tenue par les réseaux de chauffage urbain. Plus de la moitié des immeubles d'habitation en Pologne et dans les trois États baltes est reliée à un réseau de chauffage urbain; en Russie, le chauffage urbain est largement utilisé dans la plupart des villes. Ce système de chauffage présente un inconvénient énorme, non seulement en raison de son coût élevé et de la dégradation des réseaux mais également parce que les usagers n'ont pas connaissance de leur consommation. Il n'existe aucun système de compteur pour mesurer l'énergie délivrée aux appartements et aux maisons et aucun thermostat sur les radiateurs permettant de contrôler la quantité de chaleur utilisée. Le problème est aggravé par le fait que l'isolation des murs et des fenêtres de la plupart des logements est insuffisante, par rapport aux normes en vigueur à l'Ouest. La consommation de chaleur au mètre carré est estimée au double de celle constatée dans les pays scandinaves. En résumé, le chauffage urbain est une grande source de gaspillage énergétique.

### Environnement et sources d'énergie renouvelables (SER)

La très forte intensité énergétique dans les pays de la région qui ne sont pas membres de l'UE rend plus aigus les problèmes environnementaux liés à la production, à la transformation et à l'utilisation de l'énergie. Les centrales électriques et les usines de chauffage urbain ne disposent pas ou pas suffisamment d'installations d'élimination des oxydes de soufre, des oxydes d'azote et des poussières.

En raison de la forte production et consommation de charbon, les incidences sur l'environnement liées à l'énergie en Pologne comptent parmi les plus graves constatées dans les pays de la région de la mer Baltique. La Pologne est le quatrième producteur d'oxydes de soufre en Europe. En Estonie, l'utilisation des schistes bitumineux pose un problème écologique majeur. En 1990, l'Estonie détenait le record des plus fortes émissions de dioxyde de soufre en Europe, avec des répercussions négatives pour les pays voisins, comme la Finlande et la Suède.

Les sources d'énergie renouvelables (SER) devraient largement contribuer à fournir une énergie plus respectueuse de l'environnement. Le potentiel des SER dans la région de la mer Baltique devrait être considérable, mais il est encore très largement inexploité. La part des SER dans l'approvisionnement global en énergie primaire n'est significative que dans les pays scandinaves: 6% au Danemark, 13% en Suède et 15% en Finlande (chiffres de 1994). Dans les autres pays, notamment dans les trois États baltes, d'importants efforts sont faits pour accroître la part des SER. La biomasse, le bois de chauffage, l'énergie éolienne et l'énergie provenant des déchets sont les types de SER les plus prometteurs.

La sécurité nucléaire pose un problème particulier. En vertu des normes applicables à l'Ouest, les réacteurs de type Tchernobyl (réacteurs RBMK) des centrales nucléaires d'Ignalina en Lituanie et de St. Petersburg ne sont pas considérés comme sûrs.

## Dereglementation des marches de l'energie

Les pays d'Europe orientale de la region de la mer Baltique sont confrontes au defi que represente l'ajustement de l'ensemble des structures de leurs systemes energetiques aux exigences d'une economie de marche. Parvenir a des prix competitifs en matiere d'energie, qui reflecent le coût economique, constitue le principal objectif de ce processus de restructuration visant a creer des marches de l'energie efficaces.

L'evolution recente de la legislation de l'UE dans le domaine de l'energie va accelerer le processus de dereglementation en cours dans les Etats de la region de la mer Baltique, membres de l'UE. Deux directives ont une importance cruciale pour le developpement futur des marches europeens de l'energie. La directive sur l'électricité, entree en vigueur le 19 fevrier 1997 et la proposition de directive sur le gaz qui etablit des regles communes pour le marche interieur de l'UE dans le domaine de l'energie. Ces deux directives etablissent, les normes applicables au nouvel encadrement législatif du secteur de l'energie dans tous les Etats membres de l'Union europeenne.

## Integration des reseaux et le réseau Baltique

La dereglementation en cours des marches de l'energie est etroitement liee aux efforts deployes actuellement pour renforcer l'integration des infrastructures liees a l'energie dans la region de la mer Baltique.

Cette region se situe aujourd'hui a l'intersection de quatre grands reseaux en grande partie distincts:

- l'ancien reseau electrique interconnecte pour la region du Nord-Ouest (IPS)  
L'IPS est le reseau electrique de l'ex-Union sovietique et le reseau actuel des pays de la CEI.
- le reseau UCPTE (Union pour la coordination de la production et du transport d'electricite)  
il s'agit d'une organisation de reseaux electriques interconnectes d'Europe occidentale.
- le reseau NORDEL, reliant les pays nordiques (Finlande, Suede, Norvege et Danemark)
- CENTREL, union electrique recemment creee dont les membres sont la Pologne, la Republique tcheque, la Republique slovaque et la Hongrie.

L'un des principaux aspects des programmes paneuropeens d'integration economique est la creation progressive d'un marche unifie de l'energie couvrant toute l'Europe. D'importants efforts sont deja entrepris a cet effet dans le cadre d'un projet intitule "**Reseau Baltique**"

La Commission europeenne a fait figurer le projet de reseau baltique dans son programme infrastructure<sup>1</sup> de "Reseaux transeuropeens". Ce projet a pour but de reunir les conditions techniques indispensables aux echanges d'electricite entre les pays scandinaves (Danemark, Norvege, Suede et Finlande), les Etats baltes, l'Allemagne et la Pologne, ainsi que la Russie et la Bielorussie.

L'integration des reseaux et le projet du reseau Baltique necessitent un renforcement de la **cooperation intrabaltique dans le domaine de l'energie**. Un certain nombre de structures multilaterales ont ete creees au cours de ces dernieres annees pour promouvoir la cooperation regionale. Ces organismes tentent de faire participer les Etats voisins lies par des relations traditionnelles. Il s'agit par exemple du **Conseil des États de la mer Baltique** qui regroupe le Danemark, la Norvege, la Suede, la Finlande, la Federation de Russie, l'Estonie, la Lettonie, la Lituanie, la Pologne et l'Allemagne. Mais les trois Etats baltes tendent a **conserver une politique energetique independante** et a se concurrencer plutôt qu'a cooperer. Les conflits frontaliers entre les Etats baltes sur la region du plateau continental (ou sont supposes se situer les champs petroliferes et gisements de gaz) temoignent du manque de volonte de cooperer sur des questions vitales liees a l'energie dans la region de la mer baltique.



## Cooperation avec l'UE et cooperation internationale, recommandations concernant les choix politiques de l'UE

Compte tenu de la situation strategique de la region de la mer Baltique et dans la mesure ou les Etats baltes et la Pologne ont fait part de leur volonte de devenir membres de l'UE, la cooperation avec l'UE et la cooperation internationale dans la region semblent prioritaires. L'UE apporte son soutien aux candidats potentiels a l'adhesion par une strategie de pre-adhesion. Cette strategie est ancree dans les principaux programmes europeens destines a l'Europe orientale:

- **Phare**, qui apporte une aide technique aux PECO sous forme de soutien financier dans le cadre de programmes energetiques dans plusieurs pays, de programmes operationnels par pays et de programmes transfrontaliers;
- **le 4ème programme-cadre de R&D** qui encourage la cooperation dans le domaine des technologies liees a l'energie, par des projets pilotes et des activites de diffusion dans le cadre des programmes specifiques INCO-COPERNICUS, JOULE-THERMIE;
- **Synergy**, qui porte sur des activites de cooperation dans le domaine de la politique energetique.

De plus, des institutions financieres europeennes et internationales, telles que la BEI, la BERD et la Banque mondiale, jouent un rôle essentiel en ce qui concerne les besoins financiers lies a la restructuration du secteur de l'energie dans la region de la mer Baltique.

Les choix politiques concernant l'avenir de la cooperation avec l'UE devraient avoir pour objectifs:

- le renforcement de la securite de l'approvisionnement energetique pour l'Europe:  
La region de la mer Baltique joue un rôle cle en tant que zone de transit et de distribution de l'energie en provenance de Russie et a destination de l'Europe occidentale. Il est vital pour l'Union europeenne, fortement tributaire de ses importations en energie, qu'elle consolide et etende cette structure d'approvisionnement energetique a travers la region de la mer Baltique.
- la protection de l'environnement  
L'absence de normes environnementales a conduit a une degradation de l'environnement dans les pays de la region de la mer Baltique non membres de l'UE. Les normes environnementales doivent être integrees dans les structures nationales et internationales. Les mesures de securite pour les centrales nucleaires de Lituanie et de St. Petersbourg revêtent une importance cruciale.
- l'integration des marches de l'energie  
D'importants investissements sont necessaires pour surmonter les difficultes techniques liees a l'interconnexion des reseaux et pour developper les structures materielles necessaires (lignes electriques de raccordement, postes de distribution, etc.). Toutefois, l'absence d'integration technique n'est pas tout. Les marches de l'energie, notamment ceux de l'electricite, different tres largement dans leur structure et leur conception entre les pays de l'Est et de l'Ouest de la region mais egalement entre les pays d'un même groupe.

Pour atteindre ces objectifs globaux, d'importants efforts doivent être faits dans les domaines prioritaires suivants:

- **Utilisation rationnelle de l'energie (rendement energetique)**  
Les pays de la region de la mer Baltique, membres de l'Union europeenne maîtrisent les techniques éprouvées d'economie d'energie. Ces dernieres pourraient faire l'objet de transferts vers les pays d'Europe de l'Est.
- **Technologies propres**  
Les transferts de technologie et l'implantation de technologies propres sont necessaires pour réaliser et appliquer les normes et objectifs environnementaux, tels que la reduction des emissions.

- Technologies modernes liées au gaz  
L'importance du gaz croît dans la région, notamment dans les pays d'Europe de l'Est de la région de la mer Baltique. Il convient d'encourager l'introduction de technologies modernes et à fort rendement, liées au gaz telles que les technologies à cycles combinés (turbines à gaz à cycles combinés)
- Augmentation de la part des sources d'énergie renouvelables  
La politique énergétique de l'avenir doit tendre au développement du potentiel considérable que représentent les énergies renouvelables dans la région de la mer Baltique. L'utilisation du bois de chauffage et des centrales électrocalogènes utilisant la biomasse (biogaz) offrent d'intéressantes perspectives.

Il convient, en général, de soutenir l'amélioration des conditions d'encadrement: une structure législative, institutionnelle et une politique de prix adéquates pour le marché de l'énergie sont autant de conditions nécessaires à la mobilisation des capitaux privés et à la mise en œuvre de programmes d'économie d'énergie. La réduction des émissions n'est pas uniquement liée à des mesures technologiques, mais également à une réduction des obstacles à la diffusion et au transfert des technologies et à une volonté institutionnelle de changement des comportements.

Pour obtenir des résultats à court terme, les programmes internationaux doivent davantage porter sur des projets d'investissement concrets (rendement énergétique, par exemple) que sur des études et évaluations générales.

Les pays de la région de la mer Baltique: principaux indicateurs énergétiques - brève présentation							
	Autoapprovisionnement (0%)		Consommation d'énergie			Production d'énergie	
	1994	2000	Total Mtep		tep par hab. (1994)	total Mtep	
			1994	2000		1994	2000
<b>Allemagne</b>	42	39	336,5	358,2	4,1	142,6	139,3
<b>Danemark</b>	72	80	20,7	20,16	3,9	14,9	16,2
<b>Suède</b>	62	61	50,3	50,9	5,9	31,3	31,1
<b>Finlande</b>	42	57	30,5	24,5	6	12,7	13,9
<b>Estonie</b>	67	67	5,5	6,3	3,8	3,7	4,2
<b>Lettonie</b>	23	30	4,4	4,4	1,8	1	1,3
<b>Lituanie</b> (concernant import.)	29 (≈ 0)	25	8,4	9,6	2,1	2,4	2,4
<b>Pologne</b>	97	86	91	101,5	2,5	88,5	87,6
<b>Russie</b>	145	153	694	671		1 003	1 027
<b>Total</b>			<b>1 241</b>	<b>1 247</b>		<b>1 300</b>	<b>1 323</b>

## 1. Introduction

The Baltic Sea Region (BSR), consisting of the EU Member states (EU-MS) Denmark, Germany, Finland, Sweden and the Non-EU Member states (Non-EU-MS) Poland, Lithuania, Latvia, Estonia, Russia (including the Kaliningrad area) undertakes a long-term transitional process.

It gets a growing importance and is expected to become a new economic and technological centre, because of

- the recent North expansion of the EU by the Scandinavian countries (Finland, Sweden),
- the German Reunification (Ex-DDR as an important Baltic Sea country)
- the entrance of Poland and of the other BSR-countries of the former East Bloc (Latvia, Lithuania, Estonia, Russia) for market economies.

The planned East expansion of the EU by Poland and the three Baltic States (Latvia, Lithuania, Estonia) gives the Baltic Sea region the chance to belong to the important growth regions of Europe.

The former COMECON-states are in the transition phase to a market economy. They have a great need of information and support.

The establishment of an economic and technological network around the Baltic Sea region promotes the integration process of all Baltic Sea neighbours, in particular the integration process of the former East Bloc countries.

Recently in the past years there has already been a basic network of contact points as a start for a Baltic Sea union, for example there already exists a network of technology parks, energy cooperations and a net of chamber of commerce and industry among the Baltic Sea countries.

The European Union (EU) intensively supports this integration process. The Baltic Sea region is of growing importance for the enlargement strategy of the EU. The pre-accession strategy of the EU supports the EU-Membership candidates in their access preparations.

The recent summit meeting of the governments of the Baltic Sea countries in Visby (May 1996) and the recent conference of the ministers of foreign affairs in Kalmar (also 1996) are among the most important events of the integration efforts of the whole Baltic Sea region. In Visby and Kalmar the working programme for the next years were decided:

- Support of Estonia, Latvia, Lithuania and Poland in their preparations for their planned membership in the EU
- Expansion of the Intra-Baltic-infrastructure
- Improvement of the framework conditions especially for small and medium sized enterprises (SME).
- more environmental protection for the Baltic Sea region

The energy sector is of special importance for the realisation of this working-programme, in particular for the EU-integration process.

Energy plays a key role for the successful transformation process in the Baltic Sea Region. With the exception of Poland and Russia all countries in the region are poor of indigenous resources. Russia is the only net exporter of energy. Therefore energy conservation and energy savings are of vital importance for the economies in the BSR. But all Non-EU countries in that region are very inefficient consumers of energy. Restructuring of their economies towards higher energy efficiency is a central task and challenge for the economies in the whole region.

The energy markets undergo a structural transformation phase in the whole Baltic Sea Region, primarily in the East European, but also in the West European countries of the BSR. Transnational developments on deregulation and market liberalisation are ongoing. The establishment of an Intra-

Baltic electricity grid system as central part of a future European unified energy market belongs to the priorities of the "Transeuropean-networks" - Programme of the European Union.

Furthermore, the development of the energy sector in the Baltic Sea Region will have a crucial influence on future developments on East-West Co-operation, on international security of energy supply and, above all, on the global problems of energy-related pollution (CO<sub>2</sub>).

The study focuses on these challenging energy tasks. It analyses and describes the energy situation in the countries of the BSR. Policy options, strategies and recommendations for a closer cooperation are investigated.

Tables and Figures are attached as annex.

## 2. Basic features of the countries in the Baltic Sea Region (BSR)

As the Baltic Sea Region in the narrower sense only those country parts can be regarded which are located closely to the Baltic Sea coast. But Germany, Poland and in particular Russia contribute only to a smaller part to the Baltic Sea. Therefore it makes sense to distinguish the **narrower coast region** of the Baltic Sea from the **broader Baltic Sea Region** which includes the whole or the major parts of the respective countries. The narrower coast region of the Baltic Sea is defined as "**Baltic Rim**" and comprises mainly the following (coast) regions of the BSR (see the map in the appendix):

- Denmark; Sweden, Finland and the three BS
- the following Federal States of Germany: Mecklenburg-Vorpommern, Schleswig-Holstein
- the following administration regions of Poland: Szczecinskie, Koszalinskie, Slupskie, Gdanskie
- Kaliningrad, St. Petersburg and the St. Petersburg region.

In the annex the related tables (annex 1) and figures (annex 2) to chapter 2 summarise some key indicators describing the characteristic profiles and the general economic situation of each country in the Baltic Sea Region (BSR) and more specifically in the Baltic Rim: area, population size, Gross Domestic product (GDP), inflation and external trade.

The Baltic Rim has a total population of about 46 million and a total area of about 1.13 million km<sup>2</sup>. But there are large differences of population and area size among the BSR-countries. On the one side the larger countries such as Germany, Denmark, Sweden, Finland, Poland and Russia, on the other side the small three BS.

The great gap in the level of economic development between the EU-Member states (EU-MS) and the Non-EU-Member states (Non-EU-MS) of the BSR is seen by a comparison of GDP per capita. In the EU-MS the GDP per capita lies in the range between 33,400 US\$ per capita in Denmark and 24,800 US\$ per capita in Finland, but in the Non-EU-MS the range is much more lower: between 3000 US\$ per capita in Poland and 1500 US\$ per capita in Lithuania.

All Non-EU-Member States economies are in transition by transforming their countries to market economies. After the deepest break-down in 1992 (negative growth rates up to minus 30 % and more) the economies slightly recovered in recent years.

Mostly affected by the collapse of the FSU were the three BS. They have gained their independence at the beginning of the 90s. The drastic political transformation that the three BS underwent in recent years, the serious economic situation and the disruption of trade and economic relations with the main trading partners in the FSU aggravated the specific problems in the energy sector.

In all Non-EU-MS the energy use fell rapidly at the beginning of the 90s: in the BS and Poland up to minus 30 % and more, even in Russia despite its energy resources about minus 10 %, matching the decline in industrial production.

After a period of decline all Non-EU-MS with the exception of Russia have positive growth rates in the range of about 4% to 6% in 1996. Poland seems to have the strongest growth potential in the next years. In recent years Poland achieved the highest growth rates in Europe: 7 % in 1995 and further annual growth rates of about 5 % are forecasted. Russia lags behind with its economic development. But for 1997 positive GDP growth rates are estimated. Despite the economic recovery the BS and Russia are expected to reach their 1990 economic level not before the year 2000, Latvia and Lithuania probably not before 2010 due to estimation forecasts.

It should be regarded that almost all primary energy resources and the main part of the infrastructure facilities of Russia are located far away from the Baltic Sea. The access to the Baltic Sea is of strategic importance for Russia. Russia needs the peripheral export nodes at the Baltic Sea for its access to international (energy) markets, in particular to the Western European markets.

### **3. General overview of the energy situation in the BSR and comparison between EU and non-EU-Member States**

#### **3.1. Survey of the energy situation in the EU-Member States of the BSR**

The comparative analysis of energy policy and regulation in the EU-Member States of the BSR shows generally that the systems are in transition. These transitions currently take place in the electricity sector but it is to be expected that - for example - the gas sector will follow in the same direction. For many years it was commonly believed that a proper institutional setting for the electricity industry (and some other parts of the energy related industry) would be a vertically integrated monopoly subject to public regulation. However huge inefficiencies and consumers provided with unjustified privileges made this framework invalid. For example, one can observe independent power producers being denied access to the networks without economic or environment justification and further risk-averse and conservative behaviour of the big players towards the market potential of renewable energy sources. Therefore, the electricity industry has come under political pressure for opening the markets for electricity and energy. The economic and political debate shows that one can expect the opening of production and sales of electricity and the separation from the network services, transmission and distribution.

Up to now the Danish energy and *electricity* policy (see chapter 4.1) has been reluctant towards full competition in their electricity industry. The chain mode of power production in Denmark is combined heat and power (CHP). This technology will be competitive on an open European market, mainly the Northern European market. Here the marginal price-setting technology will be the more expensive German condensing plant. Therefore, the Danish producers can continue to exploit a favourable geographical position close to the large Norwegian and Swedish hydro power capacity. An open Nordic and Baltic market - as it is to be expected - will create more flexible opportunities for beneficial exchanges of power. However, the exploitation of these opportunities presupposes major changes of the present Danish regulatory regime. The price control system should allow generators to earn a profit and the many environmental regulations and agreements should be made compatible with market conditions.

In Germany (chapter 4.2) power is supplied by nine large interconnected utilities. The rest of the market is served by a large number of smaller regional and municipal utilities and independent producers. Currently the division of the markets is authorized by an exemption from the German Anti Cartel Law. However, this system has come under political and economic pressure. Currently the German government tries to open the markets in the direction of limited liberalisation according to the actual EU-guideline for creating an internal European market for energy. In Germany one has to expect a regime of negotiated TPA without creating an organized market for power.

The Swedish *electricity industry* (chapter 4.3) is much more concentrated than that of the other BSR-States. The two largest generators control more than 75 % of total capacity and output. Therefore, the highest danger of deregulating the Swedish market lies in a considerable degree of monopolistic pricing. However, this danger is limited because since 1996 Sweden is part of the integrated Nordic Market with Norway. Electricity is sold and bought on the Nordic Pool. This pool contains different markets like the spot market and the market dealing with fixed long term contracts (market for

futures). Currently Denmark, Finland, Russia and the other Baltic States are trying to integrate their systems step by step within this internal market. This development is the same in the field of further integrating the transmission networks and cables (like the Baltic ring).

The *Finnish* electricity industry (chapter 4.4) has never been subject to much regulation. There was still some competition in transmission in the past, as it was possible to construct competing transmission lines. However, this was an exception because the industry was monopolistic organised as in other countries. Both, Finland (in spring 1995) and Sweden (in January 1996) implemented electricity market reforms very much inspired by the Norwegian initiatives, but also modelled on the British and the liberal EU initiatives. As in Norway, the electricity market reforms in both countries replaced planned-economy systems with decentralised regional monopolies, supplemented by state-company engagement, especially on the production side.

### 3.2. Energy economic features and problems of the transformation process in the Non-EU-Member States of the BSR

The non-EU Member States of the Baltic Sea Region do not represent a homogenous set of countries. Regarding the energy sector one country in the region, and also in Europe as a whole, stands out as a special case. This is Russia with its large indigenous energy resources, which in the case of natural gas account for 35% of the world's proven gas reserves (IEA, 1995b, p. 50), and its dependence on the revenue from fossil fuel exports, which in 1994 accounted for 44% of earnings from exports to countries outside the former Soviet Union (IEA, 1995b, p. 24). In volume terms raw materials accounted for around two thirds of total exports (Konovalov, 1994, p. 35). It is therefore, obvious that the energy sector plays a different role in the transformation process in Russia than in the rest of the non-EU Baltic Sea Region, which is heavily dependent on energy imports.

Nevertheless, in spite of differences in the availability of indigenous resources and in the dependence on energy trade, the five countries under consideration have inherited a similar set of problems from the former planning system. This section provides an overview of these problems and challenges common to all or most non-EU countries of the region, serving **as** an introduction to the individual country chapters which present a more detailed picture of energy sector developments.

The energy features common to almost every country in the non-EU BSR include:

- inefficient use of energy;
- high environmental pollution;
- high investment requirements;
- low energy prices;
- payment problems of energy users and producers;
- energy import dependence (except in the case of Russia);
- revenue from the transit of Russian energy exports to third countries.

The free availability of energy under planning led to its very inefficient use by industry and households. Thus, the **energy intensity of production**, i.e. energy use relative to output produced, in the economies of the BSR was and still is very high compared to other European economies.

Compared with the EU-average of about 296 toe/1985 MECU the energy intensity in Poland is about three times higher (909 toe/1985 MECU), in Estonia about five times higher (1582 toe/1985 MECU), in Latvia also nearly about three times higher (856 toe/1985 MECU) and in Lithuania even more than five times higher (1587 toe/1985 MECU).

A cross-country comparison of energy intensity based on GDP figures is obviously problematic due to exchange rates and the different GDP presentation. Nevertheless, even the per capita figures point to high energy intensity in the BSR. But by 1994 these per capita figures were close to and for most of the countries even lower than those in the EU, reflecting the fall in total output and accompanying (though smaller) reduction in energy demand during the transition-induced recession.

The high energy intensity in these countries not only reflects the inefficient use by industry and private sector but also the industrial structure which is dominated by heavy industry, i.e. energy intensive activities such as chemical and machinery production and metallurgy. In the case of the

smaller Baltic states these industries were set up to serve the whole Baltic region within the former Soviet Union and the CMEA (IEA, 1994, p. 127). To the extent that the industries with a comparative disadvantage will reorganise, each economy will be undergoing structural change and move away from heavy to lighter industry and from industry to services. Thus, the demand for energy should rise less than GDP in the future. This assumes that existing opportunities for energy conservation are exploited and that the future increase in residential demand for energy will not make up for the change in industrial demand.

A common characteristic feature in the energy infrastructure in the **Non-EU-MS** is the great importance of DHS. More than half of residential buildings in Poland and in the three BS are connected to DHS. In Russia DHS is used to a large extent in most Russian cities. In itself, heating presents an overwhelming problem not only because of high cost and the poor state of the district heating systems, but also because consumers are not aware of how much they are consuming. There is no effective metering for measuring the supply to apartments and houses and no valves on the radiators by which to control the quantity of heat used. The problem is worsened by the fact that in most houses wall and window insulation is inadequate compared with western standards. It is estimated that heat consumption per square metre is more than double that in Scandinavian countries. In summary DHS is a main source of energy inefficiency.

Given the high energy intensity of production and the low priority given to the environmental impact of energy supply and consumption, all countries in the BSR suffer from **severe environmental pollution**. In 1990 Estonia had the highest per capita SO<sub>2</sub> emissions in Europe, with corresponding negative effects also on neighbouring countries, such as Finland and Sweden (IEA, 1994). But Poland, also plagued by heavy SO<sub>2</sub> emissions, introduced emissions regulations for power plants in 1990. All five countries signed the UN Framework Convention on Climate Change, committing themselves to limit greenhouse gas emissions, including CO<sub>2</sub> emissions, in the future.

However, if energy efficiency is to be increased and the negative environmental impact of energy production reduced substantial **investment in the energy sector** will have to be made. This includes, for example, investment in new technology in electricity generation and improved maintenance of gas and oil pipelines. The investment requirement in the region is further increased because of the age of energy equipment and hence the need for replacement investment, such as in the electricity sector in Estonia, Latvia, Poland and Russia (IEA, 1994). But, the recession during the early years of transition together with the developing financial sector impose quite stringent financial constraints on firms and governments in the BSR given the structural changes and investment requirements in the economy as a whole.

The issue of nuclear power is particularly difficult in this context. By preventing adequate investment in maintenance as well as the payment of employees' salaries, severe financial problems in the Russian nuclear industry, such as in 1994, is endangering the safety of nuclear power plants (IEA, 1995b, p. 224). Apart from one Russian nuclear power plant in the Baltic Sea Region, located near St. Petersburg, there is one other nuclear power station in the non-EU BSR, located in Lithuania, which uses RBMK reactors as in Chernobyl. Lithuania is in fact highly dependent on nuclear power: in 1989 57% of Lithuania's electricity production was nuclear, in 1992 it was 78% (IEA, 1994, p. 134). Disregarding the potential environmental cost in the case of an accident and the cost of nuclear waste disposal, nuclear power constitutes for Lithuania a cheap alternative to other power sources. This is due to low variable costs compared to thermal power plants using imported oil and gas from Russia (IEA, 1994, p. 129). This means that the more expensive fossil fuel imports are or the more strained the relations between Lithuania and Russia the lower is the incentive for Lithuania to reduce its reliance on nuclear power in the long term - though it would still need to import all its nuclear fuel from Russia.

The financial constraints faced by energy companies are exacerbated by **low energy prices** compared to Western European countries and relative to costs. In the case of most energy products prices continue to be state controlled. In all five countries energy prices have been increased substantially since the beginning of the transition, though in real terms much less **so** and, for example, in the electricity sector prices do not yet cover costs (IEA, 1994). Prices need to be raised further not only to make energy companies financially viable but also to encourage energy conservation. At the same time **as** energy prices have risen **a problem of non-payment by customers** has emerged **so** that a number of energy companies in the region, in particular in Russia, are facing severe financial problems (IEA, 1994 and 1995). To the extent that customers are refusing

to pay because energy is still perceived as a guaranteed public service to be available at little or no cost, the threat of disconnection needs to be enforced.

Four of the five non-EU Member States in the BSR are **net importers of energy**, with imports coming almost exclusively from Russia. Even Poland, which recorded a surplus in energy trade (in terms of volume) is also heavily dependent on gas and oil imports (from Russia). This implies a potential problem of security of supply. For example, Poland relies for 60% and more of its natural gas on imports, all of which come from Russia. In fact, Poland is the only transition economy in the Baltic Sea Region having succeeded in diversifying some of its energy imports, in this case crude oil. Before 1989 it imported crude oil almost exclusively from the Soviet Union, but by 1993 56% of imports came from the North Sea, Iran, and the Middle East (transported on tankers which are unloaded at Gdansk), with total imports accounting for 98% of Polish crude oil supplies (IEA, 1995a, p. 152). It will, nevertheless, be difficult for countries in the region to diversify energy imports in the near future, since:

- (i) Russian supplies are cheaper than alternatives, largely due to lower transportation costs;
- (ii) the energy infrastructure in the region, such as the network of gas pipelines, is centred on Russia.

Thus, import diversification is possible, especially in the case of oil given that all four countries have access to the Baltic Sea ports, but would require substantial investment.

The proximity to Russia does not only imply a high dependence on Russian energy imports raising concerns about security of supply. Proximity to Russia, together with access to the Baltic Sea, also offers the opportunity for earning **transit and port fees from Russian energy exports to third countries**. Both Latvia and Lithuania possess a port through which Russia exports crude oil and oil products. In 1994 20% of Russia's seaborne exports of crude oil (9% of total crude oil exports) were shipped through the Latvian port of Ventspils, which is free of ice in winter. (IEA, 1995, pp. 126-128). Shipments could be further expanded given that only 61% of the port's capacity was used in 1994, and the Lithuanian port of Klaipėda is also underutilized (IEA, 1995, p. 128). Thus, the continued expansion of Russian energy exports to western European countries could benefit the Baltic states substantially. Such an export expansion requires that transit relations in the region are subject to international contractual obligations and do not come under strain as in the Ukraine. Furthermore, investment in maintenance and possibly expansion of infrastructure (e.g. port facilities) may be required. There is a danger that competition between Baltic countries could drive transit and port fees down, especially if the respective negotiating partner on the Russian side has great market power. But there is also the danger that high transit and port fees encourage Russia to develop alternative export routes which only rely on pipelines, such as through Belarus. In conclusion, it may be in the interest of the Baltic countries to (i) cooperate in the negotiation over their own energy imports from Russia, (ii) cooperate in the negotiation over transit and port fees, and (iii) encourage the liberalisation of the energy sector in Russia.

But Russia is not the only non-EU country in the region exporting energy. Though they are energy importers in net terms, Estonia, Lithuania and Poland also **export energy products** (Estonia - electricity, Lithuania - electricity and re-exports of petroleum products, Poland - coal). Estonia and Lithuania are particularly dependent on the resulting foreign exchange earnings, though the countries' commodity concentration in exports has been falling between 1992 and 1994 (UNECE, 1996, p. 125). In 1992 electricity exports accounted for 15% of total export earnings in Lithuania (IIE, 1994). A Table of the volume of electricity trade in the region is shown in the annex 1. Given that electricity trade in the region has been falling since the beginning of the transition, largely due to a reduction in demand and payment problems, the gradual economic recovery of the Baltic states may offer opportunities for an expansion in electricity trade in the future.

This section concludes with a few words about the privatization and liberalisation reforms of the energy sector in the non-EU Member States of the BSR. Though Poland is clearly the most advanced country in terms of privatisation of energy companies and especially pro-competitive liberalisation plans (plans to support competition) for the electricity and gas sectors, the other four countries are also trying to privatise their energy companies. Thus, the government share in the Estonian gas import and distribution monopolist has already been reduced to a 39% stake, with the remainder being held by Gazprom, Ruhrgas and a local investment fund. Gazprom also holds a 16% share in the Latvian gas monopolist. However, the energy sectors largely still consist of monopolies



(state-owned monopolies in the case of Lithuania), though restructuring and liberalisation plans have been under discussion - in the Russian electricity sector for several years already (Economist, February 1st 1997).

### 3.3. Legal framework in the energy markets of the Non-EU-Member states in comparison to the EU-Member states in the BSR

#### Legal Framework in the Energy Markets of Non- EU- Member States in the BSR

##### *General Developments*

Until 1990 the traditional model for the energy markets in the countries of Eastern Europe was the vertically integrated State-owned monopoly reporting to the Ministry of Power or an equivalent. But since 1990 the legal framework in the energy markets of these countries is undergoing major changes. The period since 1990 was marked by reforms and restructuration in most of the Eastern European countries. As the energy sector is a key sector for every economy the reform process of this sector is since then regarded as being of high importance. The Eastern European countries in transition are at present aiming to insure attractive conditions for enterprises -domestic and especially foreign investors- to invest into the energy sector. Accordingly the legislative framework on energy in nearly all Eastern European countries in transition is being revised in terms of decentralisation, liberalisation, efficiency and privatisation. However, there appears to be a split between "fast" and "slow" reformers: the countries leading the wave are generally to be found in central Europe, whereas countries of the former Soviet Union generally belong to the group that is lagging behind. As a result of the legal uncertainty in the "slow" reforming states of Eastern Europe the investments from industrialised states which would be desperately needed in order to restructure the energy market as described are hardly being made. In contrast the "fast" reforming countries did not have just established the legislative framework for foreign investments but have also demonstrated their ability to adopt the changes that are necessary in order to become a member of the European Union.

##### *Specific Country Developments*

##### a) *Estonia*

Until today the energy sector of Estonia does still not have a legislative founding. The few existent standards -mainly on safety and construction- are partly dating back to Soviet time. Fortunately major changes are in sight. Currently a Draft Energy Law is discussed by the Estonian Parliament. This Draft Energy Law is expected to be adopted by the Estonian Parliament during spring 1997 and will then come to force soon after. The currently discussed Draft is designed to liberalise and demonopolise the Estonian energy sector while being compatible to current EU legislation. It seeks to ensure attractive conditions for enterprises to invest into the Estonian energy sector. It is therefore **based** upon the principles of free market economy and responds to the needs of the national economy, as well as to the requirements of international free trade, environmental protection and safety. It is intended to support the introduction of the Draft Energy Law by the implementation of all relevant secondary legislation (e.g. Law on Competition). The present Draft also takes into account the directives of the White Paper. After the enforcement of the Energy Law the transit of electricity and gas through the Estonian transmission grids will automatically be harmonised. If this Draft Energy Law should come to force as proposed it will guarantee a decentralised, deregulated and competitive Estonian energy market with legislative framework that is fully in compliance with current EU energy legislation.

##### b) *Latvia*

The situation of the Latvian energy sector is quite comparable to the energy sector in Estonia. Currently a Draft Energy Law is discussed. This Draft Energy Law is again intended to liberalise the energy sector and overcome the monopolistic structures. The current Draft Energy Law is aiming to ensure attractive conditions for enterprises to invest into the Latvian energy sector. It also intended to support the adoption of the Energy Law which is expected during 1997 by the implementation of all relevant secondary legislation. The current Draft Energy Law will - once in force- be fully in compliance with present EU legislation and provide Latvia with an energy legislative framework that meets the requirements of a free market economy.

#### Lithuania

Lithuania is certainly the country of the Baltic Sea Region where the legal framework of the energy market has changed most until today. An Energy Law has come to force already back in March 1995. This Energy Law liberalises the Lithuanian energy sector and is based upon the principles of free market economy. Again in order to support this reform process the implementation of the Energy Law was accompanied by the introduction of additional legislation relevant to the energy sector. (Law on Competition, Law on Foreign Capital Investment, Law on Joint Stock Corporations, Law on Enterprises) Although according to assessment reports several changes will still have to be made in order to provide Lithuania with a legal framework on energy that is compatible to current EU legislation.

#### d) Poland

After a process lasting four years a Draft Energy Law was proposed to the Polish Parliament in 1995. Poland seemed ready to pass a milestone on the road to a competitive energy market after the Polish Government had finally agreed on a proposal for a new legislative framework. However, contrary to this promising the Draft Energy Law which was intended to reorganise the Polish Energy market in terms of competition and decentralisation has still not been accepted by the Polish Parliament and therefore did not come to force yet. As a result of this legal uncertainty and unreliability foreign investors are still hesitating to get economically involved in the Polish energy market. The reform process of the energy sector in Poland is therefore developing comparatively slow. However -according to official reports- the Energy Law is likely to come to force by July 1997. If the current Draft is not subject to substantial changes the new Energy Law certainly will provide Poland with a competitive, monopolised energy legislative framework which is fully in compliance with current EU legislation.

### ***Legal framework of the Energy Markets of EU- Member States***

#### Developments in EU-Energy Legislation

In January 1997 the EU finally passed the long-time expected Directive (96/92/EC) on Electricity. The Directive which entered into force on February 19th 1997 establishes common rules for the European Union's internal electricity market. Adopted after years of discussion this Directive will open 32% of the EU electricity market to competition in three stages. In the first stage 22% of Europe's energy consumers will have access to the free market once the Directive is implemented in Member States in February 1999. The opening of the energy market then will increase in the next step up to 28% after further three years and finally up to over 30% of the market three more years later.

According to the Directive the Member States of the European Union have the opportunity to choose between two different mechanisms: the negotiated Third Party Access (Art. 17) or the Single Buyer (Art. 18).

This Directive definitely marks a major step on the way towards a competitive and deregulated internal energy market within the European Union and is going to have a heavy impact on the Member States electricity markets once it is implemented to national legislation by 1999.

While the Directive on Electricity has just been passed the next major step towards an internal energy market within the European Union is already in sight. Both the Dutch Council Presidency and the European Commission are hopeful that EU Energy Ministers will reach a common position on a Directive on Gas when they meet on May 26th 1997. Although there are still problems to be solved the Gas Directive is probable to be passed during the next twelve months.

Both Directives will set the standards for a new legislative framework and can be judged as major steps towards a competitive internal energy market within the EU.

Both Directives will set the standards for a new legislative framework on energy within all Member States of the European Union.

## Specific Country Developments

- a) **Germany**  
In Germany nine supra-regional companies still control 80% of generation and nearly all transmission. Competition at present is very much limited due to recourse to concessions and demarcation agreements. Until now the proposals of the government on a moderate liberalisation of the German energy sector were rejected from parties on both sides of the political spectrum due to different political reasons. However, since the EC Directive on Electricity has come to force energy consuming industries and the German government are increasing the pressure on gas and electricity companies to open for more competition. Currently a Draft Law for a revision of the national energy legislation is discussed in the German Parliament. The existing draft seeks to adopt the Electricity Directive of the EC through negotiated Third Party Access. However, no decision has been made yet and a **lot** of problems are still to be solved in order to implement the EC Directive on Electricity by 1999.
- b) **Sweden**  
The year 1996 marked a big change for the legal framework of the energy market of Sweden. A new legislation was introduced then in order to evolve a new, more competitive and more efficient electricity market. Under the new legislation local distribution networks and regional grids are open to all consumers. A competitive market for power is since then developing in Sweden. As the Swedish government has thereby introduced a legislation which guarantees Third Party Access already back in 1996 the country is well prepared to adopt the EC Directive on electricity by 1999. Still, taking into account that the electricity system is at 90% in hand of **8** power companies further steps may have to be taken in order to achieve a decentralised energy market.
- c) **Finland**  
In Finland the legal framework concerning the energy market was revised already back in 1995. Since the end of the transition period which lasted until January 1997 all consumers are free to choose their suppliers as the network operators at all levels (**national/regional/local**) have to ensure access to their networks for any customer. Again- like in Sweden- this guarantees Third Party Access and provides the energy sector of Finland with a legal framework that guarantees competition within energy market.
- d) **Denmark**  
The development of the energy sectors of Finland and Sweden have had spill-over effects on the Danish electricity sector. The Danish government fears that the effects of uncontrolled competition could undermine the national energy and environmental policy. In order to protect the Danish electricity market, the government has therefore proposed a legislation which submits large industrial users and distribution companies to negotiated Third Party Access.

## 4. The energy situation in the particular states of the Baltic Sea Region

### 4.1. Denmark

#### *The Danish energy sector*

The Danish primary energy supply is dominated by oil, coal and natural gas. The crude oil production matches domestic demand for oil products and Denmark is a net exporter of natural gas. Denmark has no nuclear energy and negligible hydro potential. Denmark plans to develop alternative energy including renewables, CHP and district heating.

The total primary energy supply remained approximately constant during the last years. At the same time the GDP grew 4.6 %. This led to a 3.4 % reduction in the TFC/GDP ratio. Transport energy consumption grew 4.2 %, but total energy related CO<sub>2</sub>-emissions fell by only 1.2 %. This was mainly because the coal electricity production was replaced by natural gas in small scale CHP for district heating and industry. Further information about danish Energy balances and key indicators can be found in table 4.1.

The Danish regulation praxis could be called "challenged negotiated regulation". The administration tries to find solutions in close negotiations with the old fossil fuel based supply companies. However, results of this process are persistently challenged by independent researchers, renewable energy interest groups and public debate. Denmark is an unitary country but with strong municipal authorities active in local energy supply. Together with the central government, the municipalities participate in key discussions about fuel choice, energy recovery from municipal waste and support of renewable energies.

### ***Basic data of the Danish energy system***

#### *Gas*

Gas reserves in and off-shore Denmark and their control are vested in the State. There are some licensing arrangements which are the same as for oil. To import, trade, transport and store gas one has to get an authorisation by the Minister of environment and energy. The DANGAS Company and its mother company, DONG, retain substantial monopolies over transportation and supply. The share of gas on total energy supply in Denmark has risen from nearly 10 % in 1990 to 13 % in 1994. It is expected that this share will rise up to 23 % until 2000.

#### *Coal*

Denmark relies fully on imported coal. The bulk of the imports needed for electricity generation is handled by ELSAM and ELKRAFT. Coal is also used to a minor extent in industrial plants. The share of coal on total energy supply in Denmark has risen from 33 % in 1990 to 38 % in 1994. However, it is expected to fall on a level of 25 % until the year 2000.

#### *Oil*

The oil reserves in and off-shore Denmark are vested in the State. Licences which give rights to explore in and produce from specified areas are issued by the ministry of environment and energy after approval by the parliament. All essential matters concerning operations are subject to official approval. Refining and distribution are in the hands of the private sector. One refinery is owned by STATOIL and another by KUWAIT Petroleum which have private company status. There is no special government control except in relation to an emergency. The share of oil on total energy supply in Denmark remains relative stable on a level of 44 %.

#### *Renewable energy sources*

In November 1995 the government launched a new package of initiatives to promote renewable energy. These measures respond to a recent review which stresses that more efforts towards renewable energy promotion will have to be done if Denmark is to achieve its target of 1500 MW of installed wind and biomass capacity by 2005. Negotiations between the government utilities and other parties concerning the next steps to achieve the target are under way. Among other things these negotiations will focus on a review of rules limiting private investment in wind turbines. As a result of these measures the minister of environment and energy and the utilities ELSAM and ELKRAFT reached an agreement to install an additional 200 MW of wind capacity over the next four years under conditions negotiated between the Danish Energy Agency and the utilities. Currently the share of renewable energy sources on total Danish energy supply is about 6 %. It is expected to rise on a level of 9 % in the year 2000.

### ***The institutional framework of the Danish energy system***

The Danish electricity supply industry consists of two vertically integrated regional systems. There are about 90 distributing utilities of widely different sizes which own eight generating companies that cooperate in two regional associations. These regional associations are responsible for fuel purchase, central dispatch and international trade. They have hitherto not being connected, but the cable has now being decided. All electric utilities except one are municipal enterprises or consumer owned cooperative societies.

Each generating company has its own area of supply. The distributing utilities in the area will buy all the power from this company, which they own. The distributing utilities are exclusively serving a franchise market. They are obliged to serve all demand (up to the capacity of the installations at the customers premises) and the customers can not make contracts with alternative suppliers.

The two regional systems are organised as tied pools with economic dispatch. This means that the power stations are being dispatched by the regional centre according to a merit order that reflects increasing variable energy costs. If the Danish system is almost exclusively fuel based, the energy efficiency of the power plant is a main determinant of variable costs. Electricity is being imported from the hydro power and nuclear power systems in Norway and Sweden, whenever available at a lower cost than self-generation.

Most power plants are located close to the consumption centres and the quality of transmission and distribution networks is high. Therefore transport costs are rather low and only exceptional circumstances will make network constraints be relevant.

The Danish power generation is nearly exclusively based on thermal capacity. Since the 70's, coal has been the dominating fuel. Because of environmental restrictions, gas and biomass are likely to substitute a part of the coal in the future, even though coal-generation has become very important during the recent decade. Since 1981 all large units have been situated near the large urban centres with a district heating route. After the *New Heat Act* of 1990 it was made obligatory for all district heating systems to substitute their heat boilers by back pressure units. This means that the future generating system will be dominated to an even larger degree than the present CHP-capacity. The production costs of electricity from CHP-units will depend on the cost sharing between heat and power. For rational factors the cost allocation rule can not result in costs that are higher than the stand-alone costs of each product.

### ***Regulation and legal foundations***

The Danish electric utilities are strongly regulated. New plant is subject to prior approval by ministry as well as by local authorities. The authorities don't limit their role to a discussion of the proposals made by the industry. Because of the ambitious energy and environmental policy of the last decade, the ministry of energy has tried on several occasions to enforce a specific capacity choice on the electric utilities. Examples are windturbines, small local CHP and the use of gas and biofuels instead of coal. Recently, it has been made obligatory for the electric utilities to prepare on demand side management and integrated resource planning.

A lot of aspects of regulations are specified in public laws. Other aspects of regulations are included in agreements between government and industry. The Danish regulation practice has a long tradition of such cooperative arrangements. Examples are agreements according to which the utilities accept to build a specified amount of wind turbines and a small local CHP-plant. The electric utilities are also subject to price control. Tariffs should be calculated according to a set of rules issued by the State authorities in cooperation with the association of electric utilities and preferred to the electricity price board. Surplus of utilities in one year will lead to price reductions in the following and deficits in one year will lead to price increases in the following year.

The composition of the price board reflects the cooperative administrative tradition in Denmark. The members are appointed by the minister, but most of them are representatives of the electric utilities and their customers. Decisions are usually based on consensus and implemented in cooperation with the association of electric utilities.

The Danish electric utilities have an international reputation of high quality and low costs which is reflected by low consumer prices compared to other European utilities. The relatively good performances indicates that other incentives of cost reduction and efficiency must be active. Such incentives are embodied in the Danish cooperative tradition of utility organisation and regulation. The low production costs in Denmark, cost based tariffs and the tradition for exploiting advantages of foreign trade all together indicate a Danish electricity industry with a strong initial position on a competitive European market.

### ***Deregulation and reorganisation of the Danish energy markets***

According to the actual EU-Guideline for an internal European Energy market the Danish system has to face the introduction of competition in the following areas: *The construction of new production and transmission capacity should be open* for competition among all European electric utilities and other power suppliers. Herefore, the member countries are able to choose between two different procedures: one where a new plant is authorised on application, the other where the estimated future demand of new capacities is allocated by tender. Moreover, *large customers, distributing utilities and industrial firms*, with an annual consumption of more than 100 GWh will have free choice of supplier,

On principal the Danish electricity supply industry can easily be adapted to the formal organisational requirements of the EU-guidelines. Adaptation will depend on the generators have separated their accounts for generation and transmission. The distributing utilities own the generators and are by tradition strongly integrated with them. This traditional integration and the lack of hard facilitating arrangements in the EU guideline don't make it likely that competition will be intensified in the near future. However, the ongoing reforms in the Nordic countries will have substantial impact on the Danish system. If Sweden, Norway and Finland have implemented the proposed reforms, the Danish utilities will come under heavy pressure in the strongly integrated Nordic system. Moreover, the new transmission lines between the Nordic countries and Germany, which are either under construction or are being discussed, will facilitate integration with this country as well and thereby create the framework for a competitive northern European electricity market.

The Danish politicians have passed different green plans and actual measures to strengthen their traditional energy policies. For example, they decided to introduce a system of energy levy including a CO<sub>2</sub>-levy. Moreover, they passed a CO<sub>2</sub> subsidy for electricity produced by co-generation plants powered by natural gas. In 1994, the Integrated resource planning statute was brought into operation. This statute requires the electricity system to prepare 20 year energy plans every second year. In December 1995 a law was passed by the parliament establishing a set of regulations regarding the sale of electricity for decentralised co-generation plants. This law states the right to sell electricity from decentralised co-generation plants to the public grid, at a price equivalent to the long term avoided costs in the electricity system. This means a payment including the capital costs per kWh of large coal fired power plants and transmission network.

The ministry of environment and energy has made a legal proposal regarding a certain liberalisation of the Danish electricity market in 1996. The main content of this law is the following: Electricity distribution companies and companies with consumption 100 GWh/yr and more are *allowed to buy electricity in the market place*, for instance from Norwegian or Swedish power companies. Moreover, *electricity from co-generation plants and renewable energy plants has priority in the market*. This means that any distribution company is obliged to buy a certain share of the total electricity production from these plants. The production from these plants will often be 80 - 90 % of the whole electricity market in Denmark, and this market share is increasing. If any cost are connected to the above mentioned obligation, these cost are equally distributed to the consumers of electricity. This law was introduced in order to protect the Danish environmental *public service* policy at the same time as the market was partially opened for the new market regime.

## **4.2. Germany**

### ***The German energy sector***

Germany is the largest consumer of Energy in Europe and the 3rd largest among the industrialised countries. It is a major producer of coal, a significant nuclear power producer and has some limited oil and gas resources. Due to imported oil and gas, the country depends on imports for about 55 % of its energy demand.

The energy and electricity related industry belongs to the most powerful companies in Germany. This position is based on the economic strength of this sector. The growing importance of electricity supply in Germany is reflected by 25 % increase in electricity demand in the period 1978 - 1989, while final energy use declined by 10 %. Public utilities have been the biggest investors, controlling the energy system from the open cast mining of lignite to the generation and distribution of electricity to the consumers.

TPES (total primary energy supply) declined 0.3 % in 1994 to 336.5 MTOE and energy production dropped 4.7 % to 142.6 Mtoe, mainly due to the fall of coal production. Both energy supply and production have decreased since 1988, mainly as a consequences of the restructuring of the new Lander. Further information can be found in Table 4.2. of the annex 1. State owned energy companies were privatised and the economic, energy and environmental legislation of old Lander was extended to the new ones. Moreover, increasing energy efficiency, decreasing lignite production and consumption and fuel switching in the new Lander led to substantial and rapid changes in German energy balances.

Germany has a federal system of Government in which responsibilities, including those for energy policy, are shared between the federal government and 16 Lander of which 5 are new Lander. Energy industries are mostly in the private sector. Local communities and Lander are involved in electricity production, transport and distribution, coal production and gas distribution. Within the federal Government lead responsibility for energy policy rests with the ministry of economic affairs. Responsibility for nuclear safety rests with the ministry for environment, nature conservation and nuclear safety and for energy research and development with the ministry of science and technology.

### ***Basic data of the German energy system: Energy production and supply***

#### **Gas**

Gas production, transmission and distribution are carried out by the private sector, although the latter is also done by public companies. There are more than 600 public owned distribution companies (Stadtwerke) created by acts of the local communities and normally controlled by the town councils. These distribution companies can also distribute electricity, district heating, water and run public transport.

Gas supply grew 2.4 % to 61.2 Mtoe in 1994 and continued to increase its share on total supply. In late 1994, the gas pipeline from Salzwedel near Berlin to the North Coast was completed. Ruhrgas and VNG contracted new gas deliveries with the Norwegian producers. Total gas volumes from

Norway are expected to grow to above 30 btm per year in 2005 in comparison with 12 btm in 1995. Companies must submit proposals for the construction of pipelines to governments which may rise objections based on public interests. The route and dimensions of the pipeline maybe check to enable the Lander governments to coordinate investment in transport installations. There is no legal right for the third party access, though it may be arranged by private contract. Action might be taken by the federal cartel office if refusal of access constituted and abused of the monopoly position of the transmission company. The federal cartel court and the government are currently examining the legality of demarcation agreements with the aim of increasing competition.

Competition on the wholesale level is increasing. WWGAS, jointly owned by Wintershall (65 %) and GAZPROM (35 %), are started operation in October 1994 and the gas trading company Wintershall Erdgas Handelshaus (WIEH) has reinforced its presence in the German gas market.

#### **Coal**

The coal industry in the old Lander is mainly in the private sector. Only one company is State owned (SaarBergwerke). Lignite production in the new Lander was privatised (the new Lander are not hard coal producers) in 1994. Two public companies from the new Lander MIBRAG and LAUBAG were sold to an Anglo-American consortium and to a consortium led by Rheinbraun respectively. Hard coal production in the old Lander is not competitive against imported coal. The federal government and the Lander are discussing of how to secure outlets for domestic coal.

Until 1995 the hard coal sector in the old Lander depended on a complex system of price subsidies via electricity market. There was a levy (the Kohle-Pfennig) and a long term exclusive contract between the coal producers and the electricity producers (the "Jahrhundert-Vertrag"). After the federal constitutional court questioned the method by which coal subsidies are funded, the federal government decided to maintain the subsidies to the coal producers and to finance them out of the annual budget.

During the first weeks of March 1997 the German government decided to reduce these subsidies. Hitherto, coal for the steel industry was subsidised directly from the federal budget and two Lander (Nordrhein-Westfalen and Saarland) through the "Hutten-Contract" paid to the two coal producers Saarbergwerke and Ruhrkohle. Coal production fell 7.8 % to 81 Mtoe in 1994, in line with past trends. Coal supply fell 2.3 % to 96 Mtoe and continued to loose share and total energy supply.

### *Nuclear power*

Nuclear power has a stable share of 12 % of the total energy supply. Its share in electricity generation is about 29 %. The nuclear industry which is in the private sector is controlled by the federal government. Under the atomic energy act the construction and operation of nuclear plants requires a licence and adherence to rules on safe waste disposal. These licences are granted by the Lander governments but the federal government has the overriding right of instruction in this area.

### *Oil*

The relative share of oil in total energy supply fell from 48 % in 1973 to 40 % in 1994. It is expected to fall on a level of 36 % until 2010. The exploration and production of crude oil are carried out by private companies which must obtain licences for exploration and authorisations for production from the Land government concerned. Licences and authorisations confer exclusive rights. There is no state participation. Oil refining and distribution are in the hands of the private sector. They are not subject to administrative controls. The privatisation of the refining and distribution sector in the new Lander was completed in 1992. Projects for the construction, renewal, extension or decommissioning of pipelines must be notified to the Land authorities which may object, seek modifications or issue declaration of none objection.

### *Renewable and non-conventional energy sources*

Currently the share of combined renewables and wastes is about 1.3 % of the whole electricity generation. The share of hydro energy is about 3.5 %. The 1994 Federal Government Programme of DM 10 Million for renewables was extended for 1995 to 1998 with the total funding of DM 100 Million. The programme aims at providing direct investment grants for the installation of solar collectors, heat pumps, hydro electric plants, wind power plants, photovoltaic plants, biomass and biogas facilities. The act that obliges utilities to take electricity from renewables at a premium has boosted electricity production from renewables. Utilities have contested the constitutionality of this law, arguing that subsidies for renewables must be financed out of the budget, like coal. However, the federal constitutional court rejected this argument in January 1996 claiming that the objection had been inadequately prepared by the utilities. As a result of this policy the production of renewables is increasing quickly. Germany is now the world's second largest wind electricity producer.

### ***The German energy sector and its institutional framework***

The German energy sector consists of a three layer system with nine interconnected utilities, 46 regional and about 800 local utilities. The nine *interconnected* utilities operate the grid (380/220 kV) in their respective delivery areas. This group of utilities accounts for about 2/3 of electricity generation by public utilities and for about 1/3 of the total electricity sales to final consumers in West Germany. The East German VEAG still accounts for more than 90 % of total electricity generation in East Germany. However, its share will decrease in the near future as more decentralised CHP capacity will be built. The delivery areas of the interconnected utilities are protected from competition by horizontal demarcation contracts between neighbouring utilities, their franchise areas are secured by concession contracts with the local political entities which accord them the exclusive right of use of public area for wires and cables. At the *regional level* electricity supply is carried out by 56 regional companies. Their size, measured by total sales to final customers and distributors, ranges from 11 TWh/yr to less than 500 GWh/yr. Together they account for 37 % of total electricity sales to final customer but they supply 71 % of the German territory. Their delivery areas are protected by vertical and horizontal demarcation contracts too. On the *local level*, municipal utilities (Stadtwerke) account for less than 1/3 of electricity sales to final customers, they buy most of the electricity from interconnected or regional utilities. Their own generation accounts for less than 1/10 of total electricity generation by public utilities.



Another important sector in the electricity market is that of the industrial producers. In 1994 they are representing a share of 6.9 % of electricity generation in Germany. Another special role in the German electricity market is played by the coal mining companies. They sell most of their electricity output to interconnected utilities under long term contracts. These big non-utility generators account for approximately 1/10 of total electricity generation. Another small group of players comprises non utility generation on the basis of renewable energy, mainly small hydro and wind energy.

### *Legal foundations of the energy sector*

The legal framework of the German electricity sector consists of a mixture of public and private laws. The legal basis is the law for the promotion of energy of 1935 (*Energiewirtschaftsgesetz*) which should have been amended during the present legislative period. According to this law the supply of energy should be as economical and save as possible. Preservation of resources and environmental protection are to be included as aims of equal importance. The public utilities are granted to act in a monopoly market. Other utilities or companies are only allowed to operate after positive decisions by the regulatory authorities and after they have informed the public utilities. On this basis, a system was developed which is organised through demarcation treaties between suppliers, and concession treaties between suppliers and local authorities. Through contracts of demarcation, public utilities secure their territory on a private law basis avoiding competition of supply. Through contracts of concession, utilities are granted the exclusive right of way by the local authorities. In return they pay concession tariffs to the municipality.

The law against limitation of competition (*Gesetz gegen Wettbewerbsbeschränkungen*) extends contracts of demarcation from the general prohibition of cartels. Of fundamental importance for the German electricity system is the difference between tariff customers and special contractors (*Sondervertragskunden*). Special contractors receive electricity on special conditions. Tariffs are regulated through the federal tariff order for electricity (*Bundestarifverordnung Elektrizität*). Only electricity tariffs are subject to legal control. With respect to the electricity sector environmental laws are of growing importance. For example, the law against the pollution of air (*Bundesemissionsschutzgesetz*) was enacted in 1974. This law sets strict limitations for all emissions components. A special act (*Stromeinspeisegesetz*) fundamentally improved the economics of renewable energy sources. For electricity from renewable sources supplied to the public grid, a minimum tariff is guaranteed. The amount is far above the amount agreed upon between public utilities and industrial electricity generators in the so called "Verbandvereinbarung" for the supply of electricity into the public grid.

The so called "Jahrhundertvertrag" (Contract of the century) was in operation until 1995 to support the utilisation of domestic coal in the electricity sector. The mining companies supplied the utilities until this time with 40.9 million tons of coal annually. All customers had to finance this levy, the so called "Kohlepfennig" which was collected by the Federal Government.

### *Deregulation and reorganisation of the German electricity sector*

According to the actual EU guideline the Federal Ministry of Economic affairs has drawn up several drafts of the new energy law which would abolish some of the existing institutional barriers to entry in particular demarcation contracts, the exclusivity of concession contracts and vertical price agreements concerning sales for resale. This proposal aims at a regime of negotiated TPA without creating a market for electricity. This draft includes for example that only new energy suppliers of tariff customers would require a licence. Moreover, the legal supervision of investment in power stations and transmission cables would be abolished. The price supervisory offices of the state would be maintained to protect tariff customers who have no choice of suppliers. Contracts on vertical pricing arrangements between utilities and distributors would no longer be allowed. No unfair refusal of TPA would be allowed, only three grounds for refusal would be considered: If the owner of the grid has insufficient capacity, if the transport levy is unreasonable and if it becomes impossible to supply other existing customers under reasonable conditions.

The Federal Ministry of the Environment seems to prefer a more fundamental reform with an independent grid company and the introduction of a pool system for electricity trading. The different associations of interconnected regional and local companies preferred to discuss their own drafts and conceptions of this reform. Up to now, the result of this discussion seems to be open.

### 4.3. Finland

#### *The Finnish energy sector*

The Energy Department of the Ministry of Trade and Industry MTI is responsible for energy policy planning and implementation. The framework of energy policy has to be approved by Parliament. Environmental issues connected with energy policy are checked by the Ministry of Environment. To understand the link between energy use and its impact on the environment, a close cooperation between MTI and the Ministry of Environment has been established. For research and development activities a Technology Development Centre is installed.

The Finnish energy policy aims at achieving three main objectives: security of supplies, an economic and efficient energy system, environmental acceptability and safety.

Construction of a new nuclear power plant requires a decision by the Council of State that it is in the interest of society, before it is submitted to a decision by Parliament. Nuclear waste producer are responsible for their own management, financing and disposal operations.

The energy supply is ensured by a mix of state-owned and private companies. Since the adoption of the Electricity Market Act in 1995 the Finnish energy market has become more open: unnecessary regulations in the competitive elements of the market were eliminated, the import and export licensing system was abolished and the monopolies in retail sales were cut. Today, distribution companies have no longer exclusive franchise supply areas.

#### *Finnish energy production and supply*

In 1994, Finland's total energy supply requirements were about 30.5 Mtoe. The biggest share of 32 % had oil, followed by coal at a 22 % stake and nuclear with a 17 %. Gas had a share of 9.3 % and hydro of 3.3 %. The two largest state-owned energy companies are Neste Oy for gas and oil and Imatran Voima Oy IVO for electricity.

As Finland does not have indigenous oil reserves, the sole refiner Neste Oy imports nearly all crude oil for its two refineries close to Helsinki. Neste Oy provides over 80 % of the oil products and it holds a 75 % share in Gasum Oy which is the main natural gas provider: Gasum Oy imports, transports and distributes the gas directly to large users, municipal energy plants and the 19 local distribution companies. A 25 % share in Gasum Oy is held by Russia's Gazprom.

Finland has an indigenous production of peat, Vapo Oy is the most important producer. All other coal requirements are imported. District heat is provided by 200 utilities which are municipally owned and operated commercially.

The electricity is generated by 370 power stations which are operated by 130 companies and municipalities. The four largest power stations generate about 70 % of total domestic electricity demand. Regarding the high electricity intensity of paper and pulp industry, the Finnish production of electricity by industrial producer accounts for 40 % of total supply, which represents a rather independent generation for their own use. A 20 % share is generated by municipal utilities. The state owned IVO has a 39 % share of total supply and controls one of the two interconnected transmission grids- more precisely about 68 % of the existing grid and most of the high voltage lines. The remaining transmission grid is controlled by the Industrial Power Transmission Company *N S*. Both IVO and *N S* sell electricity to distribution utilities and industrial clients. All major cross border transmission lines are owned by IVO which handles all major imports from Norway, Sweden and especially Russia. Finland's nuclear power plants are owned and operated by IVO and Teollisuuden Voima Oy TVO which is a company founded by 22 industrial companies.

At present there are no uranium mines in Finland. The uranium used by IVO is imported from Russia and TVO buys from Russia, Canada, Australia and China.

For further figures and forecasts see Table 4.4 in the annex 1.

## **Energy policy**

Energy markets are relatively efficient and energy use is balanced and diversified in end use and electricity production. The energy policy objectives are clear and there is an open debate on energy matters. In September 1993 the Parliament decided against enlarging the country's nuclear power capacity.

Oil products are subject to VAT at the general rate of 22 %. Enterprises which are VAT-registered can apply for refund on commercial purchase. Gasoline, automotive diesel oil, light fuel oil and heavy fuel oil are subject to an excise tax: from Mk 2.31- 2.81 per litre. Further an environment tax is based on the carbon and energy content of fuels: about Mk 38.30 per tonne carbon dioxide and MK 3.50 per MWh for the energy component. The tax is structured in such manner that 60 % of the revenue is based on the carbon component and 40 % on the energy component.

Further three fees are levied: pollution damage compensation fee of about Mk 0.0016 per litre for gasoline, Mk 0.0019 for diesel oil and light fuel oil and Mk 0.0022 per kg of heavy fuel oil. In case the vessel is single bottomed, the fee is doubled. Additionally a harbour fee is imposed as well as a precautionary stocks fee.

An environmental tax is also imposed on coal, peat and natural gas used in power generation, whereas electricity is exempt from the basic excise tax. A lower rate of environmental tax is imposed on gas until the end of 1997. Coal and peat are subject to the environmental tax, the latter at a lower rate as well.

Nuclear power, hydropower and imports of power are subject to the environmental tax. Only wood generated electricity continues to be exempt from energy and environmental taxes. The producer of nuclear waste must calculate and update the cost for future waste management activities. Fees have to be paid yearly to the State Nuclear Waste Management Fund. The share of waste management cost are about 10 % of nuclear electricity production costs.

The Governments energy conservation programme aims for an energy intensity reduction in the main end use sectors. By the year 2005 the primary fossil energy demand should be reduced by 3 Mtoe and electricity demand by 5 TWh.

## **4.4. Sweden**

### ***The Swedish energy sector institutional framework***

To maintain the influence on the main lines of development by the government, the Swedish energy sector is characterised by partnership arrangements between central and local governments, publicly-owned energy enterprises and the private sector. Vattenfall, for example, is the biggest state owned limited liability company which generates up to 50 % of Sweden's electricity demand.

In 1991, policy implementation was transferred to the National Board for Industrial and Technical Development NUTEK, a separated agency vesting energy matters (Narings och Teknikutvecklingsverket). As Sweden imports most of its energy resources, the department of Strategic Energy Supply of NUTEK gets the core of the National Emergency Sharing Organisation (NESO): in case of a crises NUTEK will be authorized to implement the actions decided by the Government.

NUTEK administers the low voltage grid below 130 kV and allocates grid licenses to local and regional companies. Joint Implementation programmes according to the FCCC framework convention are monitored. NUTEK's Innovative Technology Programme includes a market "push" for energy efficient products e.g. starters for fluorescent tubes and super-insulated windows.

The Swedish Energy Bill from 1991 states that short and long term supply of energy should be secured on internationally competitive terms, based on environmental sustainability and promoting social and economic development. The energy system should be based on lasting, indigenous and renewable resources and energy efficiency. The position stated in 1980 that nuclear power should be phased out by 2010 was not revised.

In 1994, a Parliamentary Energy Commission verified the sufficiency of the current energy policy programmes. According to the concluded framework, an exact time limit when the last nuclear power plant has to be phased out should be abandoned and instead the first nuclear power plants should be switched off already in 1998 taking into account the results of energy efficiency improvements and the supply of renewable energy so that the energy household remains balanced.

Recommendations for the new Parliamentary Bill include: combined heat and power plants *CHP* on a fossil-fuel basis should be converted to biofuels, the heating sector should be moved away from electric resistance heating to water-based distribution, the capacity of transport and distribution of natural gas should be enlarged.

It can be summarised that the government has a strong central role in energy matters which stresses on energy efficiency, the development and use of indigenous renewable energy resources, and the promotion of CHP and district heating. Notable policy developments since 1991 include

- Restructuring and liberalisation of the electricity sector
- Increased use of economic instruments to work towards energy, economic and policy goals
- Monitoring and evaluation of the energy efficiency and renewables programmes as to measure their progress
- Elaborating of a national strategy to address climate change commitments, e.g. The Swedish Programme for an Environmentally Adapted Energy System in the Baltic region and Eastern Europe (EAES) administered by NUTEK.

### ***Basic data of the Swedish energy system: Energy production and supply***

Sweden favours an energy mix based mainly on hydro power, nuclear power, oil and biofuel. The total final consumption *TFC* of energy during the year 1994 was about 35.3 millions Mtoe and will increase up to 36.1 Mtoe by the end of the year 2000.

Nuclear and hydropower have a share of 95 % in 1996 electricity supply which represents about 30 % of final energy consumption and represents a rather high electricity intensity. Figures of 1994 show that 51.3 % of electricity were generated by nuclear power and about 41.4 % were supplied by hydropower.

Oil has a share of 41 % in final energy consumption and is primarily used for transport. In 1994 its energy input in district heating systems was about 14 % which indicates that most of the 190 district heating plants are presently driven by biofuel.

Coal plays a minor role as energy resource: its share in final energy consumption is about 4 % and only 2.3 % of all electricity generation were due to coal in 1994.

As energy-, sulphur- and CO<sub>2</sub>-taxes make coal to have the highest level of tax per energy unit, this figure is likely to fall.

Meanwhile hydro and biofuel represent indigenous resources, uranium, coal, oil and gas have to be imported. Coal provides 4 % of final energy consumption and is purchased on the world market. It is mainly used in combined heat and power production CHP and some district heating plants. Light and low-sulphur oil is preferred by the three Swedish refineries and therefore 60 % of the supply comes from the North Sea.

Sweden has a limited natural gas grid which runs from Malmö to Gothenbourg. All natural gas is imported from Denmark. Vattenfall Naturgas AB, a 100 % daughter of the state owned Vattenfall, owns the trunk network and supplies five distributors as Sydgas, municipalities and local authorities.

Four electrical suppliers generate 90 % of Sweden's electricity demand. Sweden does have 12 nuclear power plants which are owned and operated by Vattenfall, Sydkraft and two other utilities. Vattenfall generates up to 50 % of Sweden's electricity, followed by the privately owned Sydkraft and the municipal Stockholm Energi.

An overview of the complete figures is attached in Table 4.3.

## ***Energy policy and legal framework***

To pursue energy and environmental policy goals, Sweden has gone further than many countries in its use of economic instruments. It has to be considered that all fuels are subject to a 25 % VAT.

In 1993 an energy tax (excise duty) was introduced which was about 9.5 ore per kWh in 1996 and can vary according to geographic location. A sulphur tax introduced in 1991 which was designed to encourage the use of cleaner fuels and to reduce the emissions from combustion processes has resulted in a 40 % decrease of sulphur content in oils in the Swedish market. On the other hand tax refunds are available in proportion of the reduced emissions.

For diesel-fuels, three classes have been introduced according to their emissions. Lower taxes for cleaner fuels used in vehicles (class 1 fuel) in combination with a rebate of collected tax for companies with increased production cost led to an increase of the market share: 15 % of the 1990 figures of sold diesel are now first class environmental diesel, about 60 % class 2 diesel.

Considering Sweden's climate change mitigation strategy, carbon dioxide tax plays a central role. It is considered to stimulate the transition to renewable energy sources and is levied as specific tax on oil, coal, natural gas, LPG, diesel and gasoline as well as on domestic air transport. Even though a differentiation on a sectoral basis with lower rates for manufacturing industries and horticulture has to be taken into account, the tax revenues amounted at 2.5 % of the total Government revenues (SKr 10.3 billion).

No rule without exception: with regard of international competitiveness of Swedish industry the carbon dioxide tax is levied at a 25 % rate applicable to other users. No energy tax is applied.

As a consequence two effects can be summarised: demand and supply are influenced according to the "Polluter Pays Principle" and the environmental policy measures can be financed. All energy conservation and efficiency programmes are administered by NUTEK, evaluated annually and the results submitted to the Parliament.

## **4.5. Poland**

### ***Basic energy data***

The tables 4-5 to 4-7 and the related figures 4-1 to 4-5 give an overview of the country specific energy features of Poland:

#### **a) primary energy production**

Coal dominates Poland's primary energy production.

Poland has rich reserves of hard coal, approx. 66 Mrd. t, and lignite, approx. 13 Mrd. t. The coal production is concentrated in Upper Silesia. Nearly 90 % of the hard coal reserves are located in this region. Coal has a share of about 95 % of Poland's primary production.

But coal production is becoming more and more difficult and economically inefficient. Main reasons are: increasing mining depth, unfavourable geological conditions, the technical equipment of most of the coal mines are out of date, foreign investors are reserved and reluctant to engage in investments due to the uncertain energy price policy and to the lack of a legal framework for the energy market. Polish coal will not be able to compete with other fuels without subsidies. Due to the ongoing exhaustion of the coal reserves many mining companies have already closed or are threatened to be closed. Forecasts estimate that coal production will decline by about 4 % up to year 2000 compared with output in 1996.

All other energy sources of primary production besides coal are nearly negligible: up to the year 2000 they are less than 1.5 Mtoe, only natural gas production is greater: 3 Mtoe in 1996 and 7 Mtoe are expected in 2020. Oil production is not significant, its production meets less than 1 % of domestic consumption.

Poland has significant resources of natural gas, the reserves are estimated at about 166 Mrd. m<sup>3</sup>. Till yet only a small part of them have been exploited. Recently joint efforts have been started to explore gas and oil fields. Several foreign investors have been awarded by the Polish government with exploring licences. Therefore gas production is expected to increase over the forecast period up to 2020.

Poland has only a small production of primary electricity which is based on hydroelectric power.

It has no nuclear fuel. 1990 was a turning-point of the Polish energy policy concerning nuclear energy. The construction of the planned nuclear power plant Zarnowiec near Gdansk was abandoned. Currently the construction of a gas power plant on this area is planned.

#### b) primary energy consumption

Between 1989 and 1992 the energy consumption fell considerably (about 20 %) as a result of the economic decline. The declining period stopped in 1995 when there was again a small positive growth rate of about 0.7 %. But the GDP grew in the same year (1995) much faster by the high rate of about 7 %. This can be considered as a sign that the impact of relative high energy prices and the changing structure of Poland's economy resulted both in a strong impact on the improvement of energy intensity in that period.

It is expected that the decoupling trend between GDP growth and energy consumption will continue which means that GDP will grow faster than energy consumption. The estimated energy consumption will moderately increase by annual rates of about 1 % to 2 % up to the year 2000, thereafter annual growth rates are expected to decline down to 1 % in 2010 and 0.7 % in 2020.

Coal has also the main share of primary energy consumption, approx. 72 % in 1995 and 1996, but its share of consumption is expected to decline to only 58 % by 2020. The shares of oil and gas will increase from about 25 % at present up to about 41 % in 2020.

#### c) electricity production and consumption

The electricity generation was approx. 114 TWh in 1994. Coal is almost the only fuel input for electricity generation. Domestically produced coal provided about 95 per cent of the energy used to generate electricity and heat.

Public electricity plants have 29.4 GW of installed capacity, including 9 GW provided by lignite-fired plants. Many large industrial enterprises generate their own electricity, accounting for about 3.3 GW of capacity.

#### d) energy trade

In 1996 about 22 % of the coal production was exported. Coal exports reached in this year again nearly the level of 1990 after a period of previous decline. According to the crisis in the coal mining sector and to the weak competitiveness of Polish coal on international markets coal exports are expected to decline further.

Declining coal exports and increasing oil and gas imports will rise total net energy imports up to a level approx. 4 times higher at the end of this decade compared with 1996. Oil and gas imports are expected to rise more rapidly after the year 2000. This results in a dramatic shift of Poland's net energy trade position: its import dependency is expected to increase from about 3 % in 1996 up to 30 % in 2020.

Concerning the supply countries the Polish oil imports shifted from CIS and from Russia to new supply countries such as UK, Norway and Iran.

Natural gas is further exclusively imported from Russia.

In addition to the exploitation of indigenous gas resources one reason for the above mentioned sharp increase of gas after the year 2000 will be the construction of a new gas pipeline.

In February 1995 an agreement in Warsaw was signed concerning the construction of a natural gas pipeline from the Siberian peninsula Yamal via Belarus and Poland to Germany. Poland and Russia agreed upon the financing of the Polish pipeline section (650 km) as follows: the Polish government contributes 15 % to the total cost of 2.5 Mrd. US\$, the rest of 85 % is financed by private companies of the Russian Federation. After the completion of the pipeline an annual total supply of 60 billion. m<sup>3</sup> natural gas through the pipeline for Poland and Germany is planned. Poland will probably consume a share of 14 billion m<sup>3</sup>.

### **Framework of the Energy market**

Until 1989 the organisation of the Polish electricity and gas industries was based upon public ownership, central planning and high degrees of both horizontal and vertical integration. As far as **the electricity supply industry** is concerned, when the communist era came to an end, Poland inherited a very centralised structure responsible for production and transmission of electricity, called *Wspólnota Energetyki i W\_gla Brunatnego* (WEWB). Changes in the degree of vertical and horizontal integration seemed to be necessary and, last but not least, environmental policy was to be harmonised with (or even become a part of) the energy policy.

There is a variety of distinct enterprises operating in the industry, including:

- 28 enterprises responsible for the various forms of electricity generation
- 33 electricity distribution enterprises (also responsible for some smaller generating units embedded in their networks);
- 6 enterprises responsible for manufacturing equipment for power stations;
- 6 enterprises responsible for power station maintenance; and
- 12 enterprises responsible for the maintenance of transmission and distribution systems.

Almost immediately after the Mazowiecki government was formed, i.e. in the Autumn of 1989, a team composed of parliamentary, government, and trade union representatives started to work on how to reform the energy sector, and in June 1991 the Council of Ministers approved the principles of the reforms, which later on were expressed in the so-called Letter of Intent addressed to the World Bank.

Already in February 1990 the Polish Parliament decided that on 30 September of that year WEWB would cease to exist as an organisational structure. In effect the PSE (*Polskie Sieci Elektrowni i W\_gla Brunatnego S.A.*), the Polish national power grid company, was created, and after having taken over the whole of the high voltage grid and the dispatch system as well as the pump and storage power stations<sup>1</sup> it became a monopsony buyer of almost all electricity produced and a monopoly seller to *Zak\_ady Energetyczne*, 33 regional distribution companies. At the same time all power and larger CHP stations connected to the national grid gained full autonomy.

Simultaneously the process of liberalisation of coal prices progressed step by step, although not without difficulties, but prices of electricity for final users are still decided by the Ministry of Finance. When PSE buys electricity from power stations, each of them has its own price formula, decided by the Ministry of Industry and Trade. All trade is now done on the basis of bilateral contract. Longer-term contracts, linked with some investment plans, are being implemented. A plan of future investments has been prepared, and the World Bank called in to help to finance them. In October 1995 Poland got successfully connected with the UCPTE system.

A competitive electricity market is envisaged. According to the plans presented in the 1996 *White Paper on De-monopolisation and Privatisation of the Polish Power Sector* the reforms are based on the following principles:

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<sup>1</sup> Later on PSE S.A. together with these power stations (Ł\_arnowiec, Por\_ bka- ar, Solina-Myczkowiec and Dychow) created a company called Elektrownie Szcz\_utowo-Pompowe (ESP) S.A., in which PSE holds 75 per cent of shares.

- decisions concerning sector transformations and electricity supply must be driven by the customers' needs;
- competition is the most effective guarantee of securing the interests of customers;
- independent sector regulation and the legislation implemented should enhance competition, ensure price control and protect the interests of customers wherever it is not possible to eliminate natural monopolies;
- the electricity supply security of the State, the safety of electricity utilisation and environmental protection must be maintained in line with the applicable regulations;
- the customers should be granted rights instead of the privileges currently protecting them, particularly given the fact that until recently electricity was not viewed as a commodity, but as a benefit that had to be provided by the State;
- all the employees of the sector should be afforded an opportunity to decide directly upon their future, their new career opportunities and the possibility to manage the commercial activities of companies without excessive Government intervention.

In practice it means that between 80 and 85 per cent of electricity will be supplied on the basis of medium-term contracts (3 to 6 years long). The remaining amount will be purchased either on the basis of very short-term contracts (70 to 90 per cent) or on the spot market. Later on the proportions will change in favour of the spot market. There will be also competition for the market, where investors will bid for the right to build new capacity or modernise the existing one in return for long-term contracts. **PSE** will prepare the necessary plans - they are by and large finished - and be responsible for their implementation. As long as prices do not reach their economic level, it will be also PSE that will sign the contracts with the generators. Later (according to the official plans, in the year 2008) the role of PSE as a monopsony buyer will be taken over by distributors and major energy users, which may result in an effectively competitive market.

The changes described above are sometimes presented under the heading of creating the electricity market. There are however limits to what can be done under the current legislation (the Energy Management Act of 6 April 1984), and therefore preparing and passing a new Energy Law had long become one of the most urgent tasks.

Needed was indeed a fundamental overhaul of the governance structure of the sector, which meant, among other things, establishing completely new principles governing relationships among government institutions, energy enterprises and customers. This was to be done by implementing the following two guiding rules:

- that the level of government involvement in the day-to-day management, planning, and staffing decisions of the energy enterprises should be reduced, and in this way the autonomy and accountability of energy enterprises increased; and
- that the institutional reforms should establish clearly defined, stable, consistent, and transparent sets of rules and procedures, which were to be followed by all economic agents and government institutions involved.

In practice the task consisted in separating the different roles that the government was until then playing in the energy industry: policy maker, owner and regulator. It was argued that the advantage of giving the different roles to separate Government departments is that each would have clear responsibilities and accountability. The concept of separation of Government's roles was accepted by the Polish Government, and they agreed that the most important part of the whole concept is to establish a separate, independent regulatory agency responsible for economic regulation of the energy sector.

According to the Letter of Intent, mentioned above, such a special agency was to be created before the end of 1992, but the birth process is still going on, and the frequent changes of government after the elections of 19 September 1993 were certainly not helping to accelerate it. The delays meant that the opportunities offered by the turbulent character of the first phase of the process of systemic



transformation were wasted, and at the same time uncertainty in the industry was unnecessarily prolonged and increased. The new Act is supposed to have its final reading in the Sejm in April 1997.

The Energy Regulatory Agency (*Urząd Regulacji Energetyki*, URE) is to be a central state administration organ, appropriate in the matter of energy and fuel economy regulation, reporting to the Council of Ministers. The most likely tasks of the URE include:

- issue, amendment and withdrawal of licences;
- approval and control of tariffs of energy and fuel;
- approval and control of quality customer service standards;
- hearing of complaints and resolving of disputes within the scope of the Act;
- determination of terms of use and of third party access to the grid, in case where it is impossible to reach an agreement for parties concerned;
- imposition of fines upon principles in the Act;
- cooperation with the relevant organs in counteracting the abuse by energy enterprises of a monopolistic or dominant position;
- publishing of information with a view to improving the efficiency of energy and fuels consumption;
- gathering and processing of information relating to energy management.

As one can see the prerogatives of the URE with respect to the very important issue of energy prices will be rather limited, and the degree of the regulator(s)'s independence should not be expected to go too far.

Before 1982 in the Polish **gas industry** there existed various local and regional (state-owned) enterprises. In that year the industry was re-organised by establishing the Polish Oil and Gas Company (*Polskie Górnictwo Naftowe i Gazownictwo*, PGNiG) as a single legal entity responsible to the Ministry of Industry. At present the gas sector is monopolised by PGNiG which has been operating in its present form since 1 September 1982. It is divided into many subsidiaries and organised vertically in a way corresponding to the technological process. There are altogether 23 such subsidiaries:

- PGNiG Head Quarters in Warsaw with corporate status and Geonafra consulting engineering company for geological projects for all kind of customers in Poland;
- 2 geophysics research institutes;
- 4 exploration companies (oil and gas);
- 3 oil and gas production companies;
- 6 natural gas regional distribution companies.

The rest constitute ancillary companies.

PGNiG operates the whole territory of Poland, and it encompasses all activities in the natural gas industry from wellhead to burner tip, including exploration, equipment manufacturing, installation, repairs and pipeline construction. According to the Antimonopoly Office's calculations, PGNiG's market share in exploration, transmission and distribution of natural gas was 100 per cent, and in its production 90 per cent. In these markets it does not in practice face any competition.

PGNiG has the status of a public utility, *i.e.* it has to supply gas to industrial and domestic consumers regardless of profitability of this activity. (Final prices are still decided by the Ministry of Finance, and their current level, *i.e.* the difference between what is paid to Gazprom and what is paid by the consumers, is considered to be too low to covers costs of storage, transmission, distribution, and marketing, not to mention investments.) In 1993 PGNiG distributed 10.6bn cubic meters of gas, *i.e.* about 108bn kWh to 6.3m domestic consumers. Natural gas is available in 2,800 localities, 500 of which are towns. There are 67,981 km of pipelines. The company employs 44,000 people, who, together with 21,000 workers retired from the company, are entitled to between 3000 and 3360 cubic meters of gas free of charge.

It is agreed that the present state of affairs has to be changed. The whole sector has to be restructured, so that competition is introduced where it is viable, and regulation where it is necessary. The structural break-up of PGNiG is supposed to be the most important element of this restructuring. It would be best if the restructuring were done by the owner (the state), first by issuing new laws (commercialisation), and then by using the means available on the basis of the Commercial Code. A reduction of the degree of concentration as well as de-monopolisation could be, however, also achieved on the basis of Article 12 of the Antimonopoly Act (see below).

Although one can say that there exists some kind of consensus about the direction of restructuring (vertical de-integration), the first version of detailed provisions, prepared by the Ministry of Trade and Industry and PGNiG and consulted with the Antimonopoly Office, met with total rejection by PGNiG's workforce. The main controversy is a consequence of the fact that the Privatisation Act of 31 July 1990 promises employees of enterprises privatised by the so-called capital privatisation the possibility of buying up to 20 per cent of shares at a 50 per cent discount. What it means in practice for individual employees depends on whether the company is broken up before or after commercialisation. Quite obviously, different units of PGNiG have different value, and therefore the expected value of discounted shares could be substantially reduced for those employed in less profitable units if they were to get shares only in their units and not in the whole company. And the first restructuring plan foresaw precisely spinning off the subsidiaries and their commercialisation (transformation in a public limited company in which all shares belong to the Treasury) before commercialisation of the parent company.

The new plan, presented in June 1994, reverses the sequence of events: commercialisation of PGNiG is to precede it breaking up. Thus the following units are to gain independence: Gazobudowa Zabrze, Gazomonta\_Wo\_omin, Naftomonta\_Krosno, Naftomet Krosno, Gazomet Rawicz, Zak\_ad Naprawczy Taboru Samochodowego i Sprz\_tu in Brzesko, Gazoprojekt Wroc\_aw, research units Geofizyka in Krakow and Toru\_, Zak\_ady Poszukiwania Nafty i Gazu in Jas\_o, Krakow, Wo\_omin and Pi-a and Zielonogorski Zak\_ad Gornictwa Nafty i Gazu. The Antimonopoly Office insisted that outside investors should take more than 50 per cent of shares in these companies.

In Stage II of the restructuring process, the rest of PGNiG will be divided into Polskie Gornictwo Naftowe S.A. and Polskie Gazownictwo S.A., the latter being responsible for exploitation of natural gas resources. Their actions will be coordinated by a special unit, and no decision has yet been taken with respect to the public/private ownership mix.

The main provisions of the draft Energy Law were presented in Section 1.1, above, and will not be repeated here, the more so as the draft law usually talks about energy, without distinguishing between electricity and gas. As far as natural gas is concerned the most important and, simultaneously, the most controversial provisions of the new act will be the so-called third party access and licensing procedures, import licences included. There are fears that Gazprom may try to market its gas directly to large consumers, leaving PGNiG with domestic users, supplying whom is usually much less profitable, which development could be further complicated by "take or pay" contracts signed in preparation for the construction of the Jamal pipeline. That is why the changes introduced by the Energy Law Select Committee go in the direction of restricting the use of the third party access clause to domestically produced energy. In this way, e.g. Ruhrgas becomes a victim of the Gazprom-phobia, and the restriction itself will certainly have to go in the moment of Poland's accession to the European Union.

### ***Rational use of energy (RUE) and Renewable energies sources (RES)***

Poland's high energy inefficiency (three times higher than EU-average, see chapter 3.2 and the related tables) and the correlated high energy intensity has several reasons.

Poland has a high concentration of energy-intensive industries. In addition the energy intensity of many branches is much higher than their counterparts in OECD countries; e.g. the energy consumption required for the iron production in 1989 was estimated of about 50 % higher in Poland than in the United States. Main reasons for the low energy efficiency in industry are: ageing capital stock resulting in a lack of up to date, more efficient production technologies.

The residential and service sectors are another source of the high energy inefficiency. These sectors have a share of about 48 % of total final energy consumption compared with an average of about

only 37% in OECD Europe. They belong to the largest consumers of energy. The consumption pattern of this sector is characterised by

- an extensive use of coal for heating: coal-based heat accounts for about 20 % of domestic coal consumption
- a broad use of district heating: 70 % of urban households are connected to district heating and 50 % to district hot water-

Due to the lack of meterings households are still charged by apartment area rather than amount of heat used. Therefore the installation of metering devices is a necessary prerequisite that the consumer can control and influence its energy consumption.

Modernisation projects of DHS are financed by the World Bank and the EBRD (e.g. DHS rehabilitation project in Krakov, which began 1992). Main aims are: improvement of heat pipe insulation and better control mechanisms. It is estimated that system energy efficiency of DHS can be improved by more than 50 % with better insulation, heat pipes and other modern control equipment.

The Polish development and Environmental Protection Bank give financial support for small projects to improve thermal efficiency and boilers of residential buildings. Small investments and low cost maintenance improvements can already contribute substantially to energy savings in many industrial processes..

Renewable energy sources which could contribute to energy saving and energy conservation are not significant in Poland. Their share in total primary production is about 1 % to 2%, of which most **is** constituted by the use of water resources in hydro power stations. Recently the utilisation of geothermal energy has been supported. **As** a first power station based on geothermal energy the heating plant Bialy Dunajec near Zakopane began its operational performance in the winter 1994/1995.

## **Environment**

Polish emissions per unit of GDP are nearly three times as high **as** those of the largest polluting country in OECD Europe. The combustion of coal for electricity and heat is the main cause of air pollution in Poland. The Tables in the annex 1 summarise the quantitative emission charges of the pollutants.

Poland is the sixth largest emitter of CO<sub>2</sub> in Europe. On a per capita basis, CO<sub>2</sub> emissions are slightly above the average for OECD Europe while in terms of emissions per unit of GDP, Poland produces twice as much CO<sub>2</sub> as the worst emitter in the OECD.

A major environmental concern is the widespread use of coal, often of low quality, in decentralised sites such as household stoves and small boilers. "These small sources are one of the main causes of *poor local air quality*, which is a serious **human health threat**. The emissions from these "low stack" sources are particularly dangerous because they remain concentrated in local areas, while those from "high stacks" of power plants and large industrial plants are diffused over large areas and contribute to considerable transboundary fluxes" (*OECD 95, S.111*). The liberalisation of energy prices encouraged low income families to use cheaper, lower quality coal.

Not only the combustion of coal, but also the operation of the underground hard coal mines produce severe environmental problems (see table):

- the water, pumped out of the mines, contains a high concentration of saline minerals
- large amounts of solid waste due to general mining operations (52 Mt in 1992)
- widespread land subsidence in forests, farmland and inhabited areas

The coal production **is** concentrated in Upper Silesia. Therefore the environmental problems are most serious in this region, the centre of underground mining. Although Upper Silesia is approx. 400-500 km distance away from the Baltic Sea coast, some of the mentioned environmental impacts are directly related to the Baltic Sea. For example three quarters of the saline water is discharged into the Vistula River and one-quarter to the Odra River. Both rivers flow into the Baltic Sea and transport

their environmental charges up to there. The resulting salinity in the rivers severely harms river life. The high salinity charges increase the cost of drinking water treatment downstream.

Also other environmental risks are related directly to the Baltic Sea. Oil consumption is expected to double over the next 25 years (from about 15 Mtoe in 1996 up to 27 Mtoe in 2020). There is concern that this will increase the risks of oil spills and oil pollutions.

In addition to emission sources within the national borders there is a larger share of transfrontier air pollution. Poland is a net importer of SO<sub>x</sub> from Germany and the Czech Republic and a net exporter to the former Soviet Union. In an overall consideration exports and imports of SO<sub>x</sub> are balanced.

Already in 1990 the Polish Ministry of Environmental Protection, National Resources and Forestry sets emission limits of SO<sub>2</sub>, NO<sub>x</sub> and particulates for combustion in large power plants. "To meet these emission regulations, the power sector will need to make much larger investments in pollution control: nearly every existing coal-fired plant will have to install flue gas desulphurisation equipment. Cost for meeting the 1998 requirements range from US\$3 billion to US\$6 billion" (*OECD 95*, S.11). This gives an estimated size about the dimension of required financial means. The Polish government estimates the required financial investments even much more higher. The achievement of the long-term goals of Poland's environmental protection will cost about US\$ 260 billion.

The improvement of the environment is not only a technical and financial, but also a political challenge. The adequate political instruments must be developed to tackle the huge environmental problems within the framework of a market economy.

Together with emission limits for regulated air pollutants emission charges are the main instruments of environmental policy.

- emission trading:  
One option f.e. functions as follows: large power plants trade among themselves to seek the least cost method for reaching overall reductions.
- bubble concept:  
power plants can choose if they would concentrate their reduction efforts to their own pollutions or "to support reductions from nearby smaller sources, such as district heating plants, as a substitute for their own emission reductions" (*OECD 95* S.118).

### **Results and country specific recommendations**

If we agree that a sound regulatory system consists in protection against monopoly abuse, encouragement of efficiency and innovation, low burden of regulation in terms of information costs, degree of discretion and implementation, promotion of competition, and regulatory simplicity and predictability, it will **soon** become obvious that the proposed structures and division of tasks does not fully correspond to this ideal. Does this, however, mean that it is unable to deliver what it was created for? **Is** better to have a regulator like this rather than none? Apart from the unforgivable delay, the problem that one has with the regulatory developments in Poland, is that so much is left to be decided by secondary legislation and implementing acts. Anything may, therefore, and politics may get an upper hand again. If this happens no regulatory assessment will be possible without using words like "short-termism", "expediency" or even "opportunism".

This embarrassingly slow progress in setting up a new legal and regulatory framework stands in sharp contrast with the progress achieved in procompetitive restructuring. It is true that the Polish Power Grid Company (PSE S.A.) is at present a monopsony buyer and a monopoly seller of almost all electricity, but the structure of the Polish electricity supply industry is such that once the Pool becomes fully operational - it is already tried -, the third party access introduced (and distribution separated from supply), and some progress with privatisation achieved, Poland could easily have one of the most competitive electricity in Europe apart from the UK and some Scandinavian countries. What is still missing is an independent regulator, but then what is the use of having an independent regulator, if, as it happened in Hungary earlier this year, the government is able - and did - overrule the agreed price increases?

The situation in the gas industry is a bit more complicated, mostly because Poland depends so much on its imports of natural gas from Russia. The main problem to be solved is that of how to increase pressure to improve efficiency in the situation where competition between alternative suppliers seems almost impossible, at least in the short to medium term. These problems must not, however, be perceived as an excuse not to do anything. PGNiG has been restructured and split with the aim of introducing a more commercial thinking into this company. At the national level efforts to diversify supplies have to be intensified.

## 4.6. Lithuania

### **Basic energy data**

The tables 4-8 to 4-10 and the related figures give an overview of the country specific energy features of Lithuania.

The main characteristics of the energy situation are described as follows:

#### *a) primary production and resources*

Lithuania is poor of indigenous energy resources, approx. 95% of its primary energy must be imported, mainly from Russia.

The main part of Lithuania's primary production consists of primary electricity and in addition small amounts of crude oil. Other primary sources such as peat or firewood are not significant. The primary electricity is produced by the nuclear power plant Ignalina, the only one in the Baltic States, but the nuclear fuel for the power plant must also be imported. Ignalina is expected to be finally closed at the beginning of 2005. Thereafter primary electricity production will fall to a low level.

Total primary production is expected to decline from 3.9 Mtoe in 1993 down to 2.4 Mtoe in 2000 and further down to only 0.7 Mtoe at the end of the forecast period in 2020.

Recently there are some new developments in the prospects of indigenous oil and gas resources. For example Lithuania has become an oil producing country with the development of the Genciai field by Svenska Petroleum, plus a few other fields. It is planned to develop onshore oil reserves under licence. The development of these reserves will not be sufficient enough to meet Lithuania's energy needs, but they can provide a significant contribution to the country's demand.

#### *b) energy consumption*

In contrast to the declining primary production the energy consumption is expected to rise from about 8.3 Mtoe in 1996 up to 13.1 Mtoe in 2020. This level is still lower than the consumption in 1990 (13.8 Mtoe) before the economy bottomed out due to the collapse of the FSU.

A break down of consumption by energy sources leads to the following shares in 1996:

- Oil / petroleum products:	40 %
- Primary nuclear electricity:	28 %
- Gas:	27 %

The share of natural gas is expected to increase from 25 % in 1995 up to 51 % in 2000. The increase of gas will displace oil which is expected to fall in the same period from 38 % to 28 %. One reason for this large shift from oil towards gas is the planned conversion of heavy fuel boilers to gas fired boilers.

#### *c) energy import dependence*

The report about the National Energy Strategy of the Republic of Lithuania (/C Consult 93) emphasises that there is great concern about the political and economic consequences of the total energy dependence. After the collapse of the FSU energy production, consumption and trade shrank sharply from 1991 to 1994: net energy trade by 60 %, gross inland consumption by almost 50 %,

electricity generation by 66 %, total final energy demand by nearly 50 %. Till today Lithuania has not recovered from this stroke.

The energy imports are also a main financial burden. In 1994 Lithuania had the highest amount of debts for deliveries of energy sources ( 307.7 billions of rubels). Only recently in February 1996 the Russian Gazprom cut the gas supplies to Lithuania substantially due to payment difficulties of the Lithuanian energy companies.

#### d) electricity production and consumption

After a continuous decline in production in recent years the electricity production increased again in 1995. Compared with the previous year an amount of about 13.9 TWh was produced: 11.7 were generated by the nuclear power plant Ignalina, 1.3 TWh by thermal plants and the rest by hydropower.

Lithuania itself consumed only a share of about 6.5 TWh of the generated electricity (1995).

Despite the almost total dependence on imported fuels the available capacities in the electricity sector exceeds by a large amount the domestic energy requirements. This imbalance of energy transformation supply capacity and domestic energy demand could arise because previously the energy sector was not planned for the present territory and energy needs of Lithuania, but in a major framework and in a wider context of the FSU North-Western region.

Lithuania has an installed power generation capacity of about 5.7 GWe. Only half of the capacity is needed to meet domestic demands. Although the nuclear generating capacity is even a little bit smaller than the thermal based capacity (2.5 versus 2.7) the related proportions in the *production* of electricity are total contrary: the main part of the electricity is produced by the nuclear power, 84 % in 1995. The opposite relations between nuclear and thermal capacities on the one side and production quantities on the other side are a consequence of the supply cuts of oil and gas from Russia and the payment difficulties of Lithuania. Therefore the output of the thermal units was reduced sharply and reliance shifted mainly to Ignalina. Currently no other power plant can compete with the low production costs of Ignalina. Therefore the reactor is indispensable for Lithuania's energy requirements. But due to the expected closure of the Ignalina nuclear station in the year 2005 there will be a shift backwards towards thermal power.

The high nuclear share is the most highest in the whole world. The nuclear plant is one of the largest in the FSU. It consists of two Tschernobyl-type reactors (RBMK-reactor). The two units have together a total supply capacity of 2,500 MW.

#### e) energy trade

Petroleum products contributed the major share of about 70 % to Lithuania's net imports in 1995. **But** this share will decline in the next years in favour of gas. **As** Lithuania's consumption moves towards natural gas this energy source is expected to account for about 70 % of total imports in the year 2000. Lithuania is a net exporter of electricity (see above) exporting to Belarus, Latvia and Russia.

### **Framework and energy market**

Till mid 1995 the whole energy sector was still state owned. The main operating organisations were: Lithuanian State Power System (LSPS), Ignalina nuclear power plant, Lithuanian gas, Lithuanian fuel, Mazeikiai Oil Refinery, Klaipeda Oil Export company. LSPS played a central role in the whole energy sector: it controlled the electricity transmission grid, all non-nuclear electricity generation and all of Lithuania's district heating companies were under LSPS control.

Since mid 1995 all state owned energy companies were transformed in joint-stock companies with the exception of the nuclear power plant Ignalina. According to a decision of the Lithuanian parliament the nuclear plant should not be privatised before the year 2000. A characteristic feature of the first privatisation phase is that the majority of the energy companies (mostly 90 %) remains to the state and by this the control over the energy sector. At the beginning only employees of the

respective company acquired the right to become a shareholder, but in the meantime further shares were offered for private persons.

It is planned that the centrally organised DHS-companies will be transferred into the decentralised ownership and responsibility of the municipalities or consumer cooperatives. This has the advantage that the DH-companies can operate closely as possible to consumers with all positive effects concerning service and efficiency. The financing of this project is still uncertain.

The introduction of competitive energy markets and competitive energy prices which cover costs is largely limited by the inefficient energy infrastructure which Lithuania has inherited. For example the introduction of a competitive electricity generation market makes no sense as long as the Ignalina nuclear plant operates at exclusive low generating costs; another example: district heating tariffs at cost recovery levels would lead to extreme price distortions and to unrealistically high financial burdens on consumers.

In recent years energy prices increased and the introduction of the cost recover principle have been introduced step by step. Energy prices were repeatedly increased substantially. An Energy Pricing Council (EPC), consisting of representatives of the government, energy enterprises and social organisations, is responsible for all subjects concerning the introduction of market economy conditions in the energy sector, in particular of energy price adjustments. Based on production, fuel, transmission, distribution and other cost the EPC works out price recommendations. But the government makes the final decision about the energy consumer prices. The price policy takes into account the avoidance of price distortions and regards social burdens which could result from too high energy consumer prices.

The prices for fuel and heat are shortly described in some more detail:

#### a) *fuel prices*

The Table "Fuel prices in the Baltic States" (see annex 1) shows the fuel prices of heavy fuel oil, natural gas, oil shale (only Estonia) and coal (only Latvia) in the BS. The average price for heavy fuel oil within the three BS is 100 US\$/t. They differ in the three BS in the range of 10 to 20 % with the highest price in Lithuania (110 US\$/t).

The price differences for natural gas are larger within the BS. Gas users pay in Estonia and in Lithuania about 100 US\$/1000 m<sup>3</sup>, in Latvia about 30% more (about 130 US\$).

#### b) *heating costs*

The heating costs for residential buildings connected to DHS amounted to 2.4 Litass/m<sup>2</sup> (approx. 0.6 US\$) in the winter period 1995/96. Since July 1996 a new price increase of 25 % has come into force.

The price for centrally supplied hot water amounts to 6.22 Litass/cbm (about 1.6 US\$). During the heating period 1995/96 a share of 18% of the population got subsidies from the state for heating and hot water.

In the past the government influenced heating prices by cross subsidies due to a "price differentiation policy" by consumer groups and energy subsectors; e.g.: in March 1993 heating prices per 4,18 GJ (=1 Gcal) were three thousand times higher for industry than for residential customers. Due to massive problems with cross-subsidies the government recognises the need to phase out subsidies in the energy sector. Subsidies were reduced, only the DHS sector remained the most heavily subsidised energy sector (by a combination of cross subsidies from electricity and direct operating subsidies).

#### c) *wood chips*

The Table "Price for wood chips in the BS" (see annex 1) shows the prices at different trade places in the three BS. In Lithuania the prices are in the range of about 8.8 to 10 US\$/s.m<sup>3</sup> (December 96).

### ***Rational use of energy (RUE) and renewable energy sources (RES)***

Lithuania has the most highest energy intensity among the Baltic States: 1587 toe/1985 MECU.

Experts estimate that Lithuania consumes about 60 % too much energy (related to its total economic output).

A split of total final energy consumption by energy sources in the years 1991 and 1994 show that heat has a share in the range of 33 % to 40 %.

The share of heat is particularly high in Lithuania due to the important role of DHS. About 80 % of the households are connected to DHS. The specific heat consumption for the supply of housing areas is approx. 2,4 GJ per m<sup>2</sup> and per year. This is more than double of the specific consumption in Western Europe.

This high value combined with the poor maintenance of the district heating systems (DHS) is a main source for the energy inefficiency

The main defects of the DHS are:

- The main part of heat is produced in heat only boilers (HOB) based on high-grade energy sources such as natural gas or heavy fuel oil. Only 30 % of the annual heat production comes from low-grade-sources such as CHP plants.
- The systems run in "constant flow operation" resulting in the following disadvantages for the energy efficiency: no load dispatching is possible; no individual heat regulation by the consumers is possible, power consumption of pumps is extremely high.
- High heat and water losses: detailed information about heat losses is not available due to the lack of metering devices, but the potential of energy savings is estimated to about 20 % to 30%.

According to these lacks main sources of energy saving in the DHS and space heating sector are:

- CHP plants instead of Heat Only Boilers (HOB)  
An increased utilisation of waste heat from CHP should be aspired. It is estimated that the change from HOB to CHP can improve the efficiency by approx. the factor three.
- Rehabilitation and modernisation of the DHS-networks: new, better insulated pipes and a change from the current constant flow system to a variable flow system.  
A country-wide substitution of the existing one-pipe-system through independent two-pipe-systems is a prerequisite for the implementation of regulation valves at the heating units.
- Installation of metering devices so that customers can control their energy use
- Variable tariffs depending on variable consumption and consumer incentives
- Better thermal performance of buildings.

A major part of energy savings can already be realised by simple "better housekeeping"-methods with no or only small investment costs. Studies and experiences in other countries confirm that such low-cost/no-cost measures can already save approx. 20 % of the present energy consumption. But on the energy consumers side (residential as well as industrial) there exists a lack of information, of incentives and experience to invest in energy saving technologies.

Lithuania's energy efficiency improved in 1995 by about 9 %, a continuation of further improvements are expected. But they will not be sufficient enough to match the strong economic growth thus resulting in an increased energy consumption.

Utilisation of wood as renewable energy source may also contribute to energy savings and conservation. Conversion of existing boilers based on heavy fuel oil to use wood chips or the construction of new wood-chip-fired boilers was the subject of a recent feasibility study financed by



the EU-Phare programme. Due to the expected substantial economic benefits wood-chip-fired boilers are considered as prospective projects for financing by international funds organisations like the World Bank.

### ***Energy related environmental impacts***

Lithuania's thermal power plants are not equipped with modern emission control devices. Therefore the thermal power plants are a major reason for pollution. As a result of poor combustion the plants emit significant amounts of vanadium, nitrogen oxides, sulphur oxides and carbon monoxide into the air. Due to unfavourable wind conditions and an unfavourable location of some thermal plants a large part of the pollutants is blown into densely populated areas (e.g.: the maximum ground level concentration of pollutants related to the Elektrenai power station and the Vilnius CHP No.3 occurs about five kilometres east of the station in densely populated areas).

Concentrations in the neighbourhood of the largest power station at Elektrenai and Vilnius CHP No.3 frequently exceed Lithuania's national air quality standards. Emissions of nitrogen oxides are estimated to exceed Western standards.

There also exists a major number of smaller heavy-fuel-oil HOBs. The operating staff of these smaller boilers are less well trained, in addition these units are poorly equipped. Consequently they emit more pollutants per unit of heat than the larger plants.

There is scarcely prospect for improvement of emission reduction. A poor energy infrastructure, lack of sufficient energy sources, budget constraints and limited funds for investment make it unlikely that modern emission control equipment such as flue-gas desulfurization will be installed in the near future.

Planned rehabilitation of thermal units and of the DHS may give chances for low-cost emission reduction measures, e.g. by reconstruction and improvement of the boilers.

The recently exploited source of oil substrate is also a source of high emissions of sulphur and heavy metals.

A special environmental problem is the deposition of nuclear fuel waste of the Lithuanian nuclear plant Ignalina. The problems of nuclear safety are described in more details later on in this chapter.

### ***Special items of energy infrastructure facilities***

Two energy infrastructure facilities are of major importance in Lithuania, the oil refinery Mazeikiai and the Ignalina nuclear power plant:

#### ***Oil refinery Mazeikiai***

Lithuania's oil refinery Mazeikiai is the only one in the Baltic region. It is 15 years old and one of the modern units in Eastern European countries and Kaliningrad. But compared to modern standards the refinery is technically obsolete. The future commercial viability of the refinery depends on the success of an extensive refurbishment.

The Mazeikiai oil refinery is located just south of the Latvian border, approximately 100 km from the Baltic coast, a 720 mm pipeline with a designed capacity of 16,2 MTPa connects the refinery to the Birzai pumping station on the main arterial FSU double-pipeline link from the Western Urals oil field via Polotsk in Byelorussia.

The situation of the oil refinery is typical for the energy problems in the BS.

The capacity of the refinery amounts to approx. 12 Mt per annum. But 1993 only 5,1 Mt were refined, 1994 only 3,3 Mt and in 1996 approx. 3,7 Mt. The sharp decline of the oil refinery production is due to supply and payment difficulties with Russian supply firms as well as due to a reduced demand. After the price increases for Russian oil in 1992 Mazeikiai became uncompetitive against Russian refineries which received further low-priced oil.

In 1995 the crude oil is mainly processed to benzine (approx. 29%), Diesel (approx. 28%) and heavy fuel oil (approx. 25 %). Recently the joint-stock company "Mazeikiu nafta" founded together with the French oil company Elf a joint venture for the production of flight benzine which should meet Western quality standards.

An improvement of the oil supply infrastructure is necessary to diversify oil imports by supply countries. The extension of the oil terminal Klaipeda and the planned building of the Butinge Terminal shall provide the possibility to supply oil also from other states than Russia. The Klaipeda terminal has a capacity of 4,5 Mt per year, the Butinge terminal is planned for a capacity of about 12 Mt per year.

### **Nuclear safety**

An unsolved problem is the deposition of nuclear fuel waste of the nuclear plant. Until now the consumed nuclear fuel elements are being kept in a water basin. Special metall containers acquired from Germany should be applied for a long term intermediate storage. After Belarus refused to accept the nuclear fuel elements in its country for a finite storage several considerations have arisen how to solve the problem. One possible regarded solution taken into account is the finite deposition on the area of the nuclear plant. It is supposed that the consumed nuclear waste must be stored in the metall containers at least until the year 2004.

Since October 1991 a common Swedish-Lithuanian-Russian nuclear safety programme, the so called Barselina project, has been started and is now in performance. The nuclear plant Ignalina is mainly supported by the European Bank for Reconstruction and Development (EBRD). The nuclear power is regarded by the Lithuanian government still with high priority. Although it is considered to decide until 1998 about a closure of the nuclear plant at present the tendency prevails not to cut off the power plant from the grid. Financial means for improving the safety precautions should be acquired till 1998 with an amount to more than 250 Mio. US\$. It is assumed that this financial demand is mainly financed by credits of international organisations.

### **Results and country specific recommendations**

As a result of the described energy situation the main results and recommendations are:

- improvement of the high energy inefficiency
  - by adequate institutional and price reforms
  - by more supply side oriented measures such as: technical rehabilitation efforts into the energy infrastructure, in particular into the modernisation of the DHS.
  - high efficient gas applications.  
According to the expected rapid increase of the gas share of energy consumption (from 20 % in 1995 to 70 % in 2010) the application of modern gas turbines are very attractive: high thermal efficiency (more than 40 % for simple cycle, even more than 50 % for combined cycle units), low-cost environmental benefits by using the environmental friendly natural gas. Therefore the gas turbine option deserves main attention when considering any proposed repowering of power generating and CHP plants. The gas turbine option gains special advantage regarding that there exist many HOBs fired by heavy fuel oil.
  - by more demand side oriented measures such as: information programmes and incentives to promote energy savings and efficiency among customers. Basic technical prerequisites such as the installation of metering devices must be fulfilled to make individual energy consumption control only possible.
- increase energy security by source and by supply country
- in particular the nearly total import dependence from Russia is a cause of major concern: no harbours for alternative deliveries and only Russian controlled gas connections make possible supply disruptions (as happened in the past) very critical and makes Lithuania vulnerable.

- increase of indigenous resources such as **RES** and the exploration activities of recently supposed oil and gas fields in the Baltic sea.

#### 4.7. Latvia

##### **Basic energy data**

The tables 4-11 to 4-16 and the related figures give an overview of the country specific energy figures of Latvia. The main characteristic features of the energy situation are:

##### *a) primary production and indigenous resources*

Latvia has nearly no indigenous resources and must rely almost completely on imports to meet domestic demands. Consequently Latvia's primary energy production is extremely limited and the import dependency is very high about **84 %** (1996).

Primary production was in 1996 only about 640 ktoe, which is only about one third of the 1990 level.

Hydro power based primary electricity is the only significant part of indigenous production. It is almost exclusively generated by three power stations along the Daugava River.

Hydro power production depends on weather conditions. Deficit in rainfall results in a decline of electricity generation. Only in the year 2000 hydro power production will reach its 1990 level of about 1150 ktoe, further increase is limited because most of the Daugavas potential has already exploited.

Total primary production is expected to double in the period from 1996 to 2000, thereafter a slight increase is expected up to about 1400 ktoe in 2020.

Since 1992 the Government of Latvia has been negotiating with USA based AMOCO company on the eventual oil prospecting in the Baltic Sea in the vicinity of the Swedish and FSU borders. The data, obtained by Latvian geologists in cooperation with their Russian colleagues already by 1991, were bought by the Swedish company Oljeprospecting AB (OPAB). In the autumn of 1995 the Latvian Government signed an agreement with AMOCO and OPAB concerning oil prospecting in the Baltic sea continental shelf. The agreement was appealed against by Lithuania, which considered the territory, mentioned in the agreement, as disputable, belonging rather to Lithuania than to Latvia. Despite Lithuanian protests over the past year (1996), the Latvian parliament ratified the oil prospecting agreement on October 24, 1996.

The total cost of the project (the so called Dalders project) over the estimated 25 years of its duration could reach over 1000 million US\$. Drilling could start in 1997, but no drilling works will start unless there is a clearly marked border between Latvia and Lithuania. Under the agreement between Latvia and Amoco/OPAB Latvia will receive 10% of the profits without investing any of its resources in the exploration process. The foreign companies have agreed to cover all costs of the project.

##### *b) Energy consumption*

The rapid decline in the general economic situation after regaining independence was clearly reflected in the reduction of energy consumption. Energy consumption shrank down by about 50 % from 1990 to 1994 (from 9.2 Mtoe to 4.4 Mtoe). The decrease among the energy sources was different: oil reduces by about 40 %, but natural gas consumption was cut by about 67 %. The sharply decrease was accompanied by a shift in the structure (per cent shares) of energy consumption by sources: the share of oil increased from 36 % to **46 %**, gas fell down from 25 % to 18 %.

Total energy consumption is expected to grow from 4.4 Mtoe in 1996 up to 5,2 Mtoe in 2010, which **is** still behind the 1990 level of 9.2 Mtoe. The share of natural gas **is** estimated to rapidly increase from about 21 % in 1996 up to 34 % in 2010 and 38 % in 2020. At this time the gas share exceeds the oil share by about 3 %.

c) *electricity sector*

The share of hydro produced electricity amounts to 75 % of total electricity ( 3.3 TWh compared with a total electricity production of 4.4 TWh in 1994). The rest of electricity was imported from Lithuania, Estonia and Russia to meet the domestic electricity demand. In comparison to previous years energy purchase volumes from Estonia decreased, mainly due to a rise in the price of electricity.

Latvia's peak load consumption continued to decrease in 1995 in comparison to previous years. Despite the decline in the consumption of electrical energy the number of users of electrical power during the recent years has grown by more than 100 thousand.

Although Latvia is a net electricity importer there are also some electricity exports. According to the agreement between SJSC Latvenergo and the Central Dispatcher Department of EES Rossiji, Latvia supplied Russia with 418 million kWh in the period from February to May, whereas Russia supplied 1207 million kWh to Latvia in the other months. This arrangement was most beneficial to both countries, as it gave Latvia an opportunity to sell almost all its excess spring flood energy to Russia.

The three hydro power stations (HPS), located along the Daugava river, are: Plavinas HPS, Kegums HPS and Riga HPS.

Kegums HPS-1 has been in operation more than 50 years. Its basic and complementary equipment is physically worn out and the further operation is limited. Plavinas HPS equipment is in operation more than 25 years and several parts must be replaced. The technical status of Kegums HPS-2 hydro units is unsafe.

Faults have been detected also in the dam construction. There is no joint water optimum utilisation system for the Daugava Cascade HPS.

Recently the government has approved a loan to be received from the European Reconstruction and Development Bank to fund the project of reconstruction of power station cascade on the river Daugava.

After reconstruction the period of operation of power stations will be extended and their efficiency will be improved:

- additional electrical energy in the amount of 50.2 million kWh per year will be generated;
- losses of generation of electrical power in the amount of 38.7 million kWh per annum will be eliminated.

If such reconstruction was not started the generating capacity of the Daugava cascade would be gradually lost due to the age and wear of the equipment. This could lead to considerable increase of import of electric energy and result in corresponding increase of rates.

In addition to these large scale hydro power plants several projects with small-scale hydro power plants have been carried out fully on self-financing basis in recent years.

***Framework of the energy market: institutional and legal framework, energy policy***

Just recently 1996 the Latvian Government has announced the list of enterprises to be privatised, and the names of two big energy utilities are included there, i.e. SJSC Latvenergo, state power utility, and the company responsible for the oil terminal, **SJSC** Ventspils Nafta. The Government puts them on the **list**, without publishing plans of actions nor even formulating objectives, only to have a legal basis to start such preparations and see the reaction of the market. The privatisation in the gas sector is already ongoing.

The Latvian Privatisation Agency (LPA) is responsible for the performance of the privatisation.

The privatisation progress in the various energy subsectors is described more in detail as follows:

a) *Gas sector*

Privatisation process of the SJSC Latvijas Gāze, the gas utility, is in completion of the first phase. Two strategic investors have been selected by the Board of LPA in August 1996: GAZPROM from Russia and Ruhrgas in consortium with Preussen Elektra from Germany. Both, GAZPROM and the German consortium, acquire 16.25 % shares each.

b) *Electricity sector/ Latvenergo*

Preussen Elektra is also the first foreign company to have formally applied for the privatisation of Latvenergo.

Privatisation of Latvenergo is a process of high complexity due to the existing structure of the utility and an urgent need to solve liquidity problems. Neither in the nearest, nor in the foreseeable future there are any plans to reduce the share owned by the state under 51 %.

Recapitalisation projects have to be run to find out what the assets are, since at the moment assets are calculated on the basis of 1981 prices. The most difficult question to be resolved now is how, when and by whom process of restructuring of the utility will be undertaken and what configuration will have generation, transmission and distribution parts. Taking into account the trend towards deregulation and liberation of electricity markets around the Baltic Sea, economic and financial modelling of proposed future structures will be worked out, and market offers and demands projected. Then it will be possible to set the configuration of the utility and decide on the mode of privatisation.

Elaboration of a new Electricity Act, specifying relation between independent energy producers, distribution and transmission activities and clarifying issues of land acquisition, is a Government priority. Additional investigations, development of the concept of third party access, and data collection are to be done by privatisation developers. The bodies in charge are the LPA, Ministries of Economy and Transport and Communications. However, all the decisions will be made solely by the LPA.

The assessment of Latvenergo required for the estimation of share prices to potential investors is related to large problems. The value of Latvenergo consists only to a small portion of the value of power plants, dams, transmission lines and other objects. The main value are the expected profits. They depend mainly on two highly sensitive factors, the tariff level and the development of the economy.

Assessment of Latvenergo under these circumstances is difficult. To estimate possible profits of Latvenergo the valuers must assess the methods by which tariffs are being appointed and their objectivity. Macroeconomic data must be taken into account.

Since May 1, 1996 SJSC Latvenergo has passed its responsibilities in supplying heat and hot water to Riga inhabitants to the newly established organisation, JSC Rigas Siltums.

c) *Oil Harbor sector Ventspils Nafta*

The LPA representatives recently announced that SJSC Ventspils Nafta may be privatised by reorganising JSC LaSam, Latvian - Russian JV LatRosTrans and Ventspils Nafta. More details about the importance of the Ventspils harbour for the energy infrastructure in the BSR are given in chapter 5.2.

Concerning the general regulation of energy supply two new institutions were set up in 1996 for the implementation of the law "On Regulation of Entrepreneurship Activities in Energy Industries", adopted in September 1995:

- the Energy Supply Regulation Board (the Board):  
This is a state institution under supervision of the Ministry of Economy. The tasks of the Board are mainly licensing of energy supply enterprises; approving the tariffs calculated by energy supply enterprises; developing methodology for calculation of tariffs and setting the procedure for tariffs approval. In addition, the Board will review disputes between energy consumers and suppliers and make decisions that are binding on both parties and that can be appealed to the

Court in the procedure, set by the Law and to develop regulations on energy production and supply.

- the Energy Consumers' Committee:  
This is an advisory institution, represented in the Board by its two members. It has been established to protect the interests of energy consumers.

### **Prices and tariffs**

Energy resources tariffs and prices will be appointed on the basis of economic calculations, they will cover all costs, observing inflation indices, that is, lowering of tariffs as a consequence of inflation will not be allowed. The tariff and price structure will be improved also in the future by reflecting factual economic costs.

In accordance with regulations No. 185 of the Cabinet of Ministers (21.11.95) energy resource prices and tariffs are determined by the following institutions:

- electric power purchase and sales prices - by the Cabinet of Ministers;
- natural gas and liquefied gas prices - by the Ministry of Economy;
- thermal energy and hot water tariffs - by municipalities.

Other energy resources prices are determined by the market.  
The prices for fuel and heat are shortly described in some more detail:

#### **a) fuel prices**

According to the tables of fuel prices and wood chips in the BS (see annex I), already discussed in the chapter about Lithuania, Latvia has the highest prices for natural gas (100 US\$/1000 m<sup>3</sup> in 1996), but the lowest prices for wood chips compared with the other BS. The price for heavy fuel oil is about 100 US\$/t, higher than in Estonia, but lower than in Lithuania.

#### **b) electricity prices**

With the increase of price of electric energy purchased from other countries (on average from 0,0116 Ls/kWh in 1995 to 0,0131 Ls/kWh in March 1996), as well as with increased capital and production costs, electrical energy sales prices have also grown.

In conformity with Regulations No. 299 of the Cabinet of Ministers of the republic of Latvia from October 10, 1995 "On electrical energy sales prices" a levelling electrical power tariff has been approved of.

New electricity prices have come into force since July 1, 1996. The new tariff structure depends on the electricity supply voltage in the grid. Tariffs are divided into three voltage levels: 0.4 kV; 6 kV to 20 kV; 110 kV and higher. Electricity price in high voltage grids is lower as supply costs are cheaper. In addition, in various tariff variants electricity price depends on time zones (consuming at night or during day time). In dependence of these various price factors the average electricity prices are in the range (without VAT) at night about 0.015 Ls/kWh to 0.019 Ls/kWh and at day time about 0.025 Ls/kWh to 0.0336 Ls/kWh.

Remark concerning the exchange rates; in July 1996 the exchange relation is: 1 ECU = 0,687 Ls (Infor ECU 7/96).

#### **c) thermal energy tariffs**

In the heating season of 1995/1996 thermal energy tariffs fluctuated from Ls 4,24 to Ls 28,74 per 4.18 GJ (=1 Gcal) (including 18% VAT), and in the heating season of 1994/1995 tariffs ranged from 6,18 Ls to 18,73 Ls per 4.18 GJ.

The fluctuation of the tariff can be explained by the fact that in some regions municipalities have appointed thermal energy tariffs that were lower than calculated ones, covering the difference by other income resources.

Prices and tariffs must be seen in the context of purchase power and solvency of the customers.

Due to low solvency of inhabitants, big debtors' debts have appeared. Latvenergo debtors' debt on January 1, 1996 amounted to 48,5 million Ls, Latvijas Gaze at the same time debt was 59,4 million Ls. Regional district heating companies also have big debtors' debts, i.e. approximately 39 million Ls on May 1, 1996.

Latvenergo has cut out electricity supply to a number of industrial and individual customers who did not pay their electricity bill in due time. In 1995 electricity supply was interrupted in 41,900 cases. On April 1, 1996 the debt of state institutions to Latvenergo amounted to 1.2 million Ls.

With debtors' debts creditors' debts are also formed: on January 1, 1996 creditors' debts of SJSC Latvenergo were 44,9 million Ls, those of SJSC Latvijas Gaze were 51,5 million **Ls**. Regional district heating companies on May 1, 1996 had creditors' debt of about 46,5 million Ls.

The large debts (also including the foreign debts for unpaid bills for imported fuels) are a cause for major concern. The energy sector's age-old debts are affecting not only the power industry, but the general macroeconomic situation in Latvia. The solution of the debt's problem is necessary to receive loans from international funding institutions such as World Bank.

### *RUE and RES*

In principal the sources and causes for energy inefficiency are nearly the same as mentioned in Lithuania: poor state of infrastructure, lack of metering devices, ancient and obsolete equipment, lack of energy saving awareness and information.

The tables 4-12 to 4-15 in the annex 1 give an overview of projects (completed or ongoing) aiming at the improvement of the energy efficiency in Latvia. Besides general RUE projects the tables list special projects for special RUE sectors such as RUE in industry, **RUE** in buildings and RUE in transport. Some of the main projects are: rehabilitation of the energy infrastructure (e.g. Daugava hydro power station, DHS), installation of metering devices, conversion of industrial boilers to cogeneration, decreasing heat losses in DHS, energy audits, retrofitting of houses to decrease thermal losses.

Latvia has made improvements in energy efficiency which are expected to continue. But they **will** not be sufficient enough to match the strong economic growth.

An increased utilisation of renewable energy sources (RES) can contribute substantially to improve energy efficiency and to decrease the dependence on imported fuels. At present hydro power is the most important RES in Latvia. Much efforts are taken to increase the share of other kinds of RES such as wood, biomass other than wood, peat, wind.

The table 4-16 in the annex 1 shows a list of recent RES projects mainly supported by international funding organisations.

Due to large share of forest area a high potential of fuel wood exists. Wood can play an important role as fuel substitute concerning the conversion of boilers to indigenous resources. The success of conversion projects depends decisively on the price relation between the fuel to be substituted and the indigenous energy source.

An example for a concrete boiler conversion project is the Jurmala municipality. It decided in February 1995 to convert one of the gas/oil fired boilers in the Dubulti boiler house into domestic wood fuel firing. A cost calculation compared the heat production costs of wood with other fuels:

- Wood fuel: 3.5 Ls/MWh
- Fuel oil: 7.1 Ls/MWh
- Natural gas: 8.7 Ls/MWh

Other than fuel costs are relatively low and do not effect the economic analysis. The calculation reveals that wood fired boilers are economically viable and can save energy costs.

### ***Special items and energy infrastructure facilities***

Latvia has a well established energy infrastructure. It has the largest amount and the most highly developed oil facilities of the three **BS**: the modern oil harbour Ventspils, and nearly the whole amount of the (oil) pipeline segments of the BS are running through Latvia.

Due to excellent underground gas storages Latvia has the chance to become the biggest transit territory of gas repositories between the gas extracting regions and Western and Eastern Europe. The energy infrastructure will be described in more details in chapter 5.

### ***Results and recommendations***

Long term energy security (by source and by supply country) and improvement of energy efficiency are the main problems of Latvian's energy sector.

By order of the Energy department a consultant group worked out a study with the title "Energy Emergency Planning for Latvia", presented in June 1996. The study gives recommendations concerning the security of Latvia's energy supply. Preventive measures as well as measures for crisis management have been recommended.

According to the study the diversification in the sources of imported energy sources requires an improvement and extension of the mineral oil product terminal in Ventspils.

The study recommends institutional reforms including new energy laws to achieve substantial energy savings and a substantial contribution of domestic resources to energy supply:

- energy savings:  
establishment of a national standard, particularly in the space heating sector; the formulation of a "Law of Energy Saving Measures" is recommended for the introduction of such a standard.
- increase of domestic resources:  
The modernisation of existing hydroelectric power stations, the increased use of wind energy, of smaller hydro plants, the exploitation of the wood and peat resources and the use of cogeneration are recommended. The achievement of this goal should be reinforced by the introduction of a "Law on the Increased Usage of Domestic Energy Sources".

These measures should be accompanied by awareness campaigns to promote energy saving measures.

The rehabilitation of the energy infrastructure requires international financing support. In 1995, a US\$ 14 million World Bank loan was approved for a District Heating Rehabilitation Project to improve the DHS in the city of Jelgava.

A number of recommended investment projects have already been carried out in Latvia by the Swedish Government through NUTEK (Swedish National Board for Industrial and Technical Development), a Governmental Agency under the Ministry of Industry and Commerce. The available financial sources are used mainly for loans on favourable conditions to owners of energy plants, primarily heating plants, and for the conversion of boilers to use biofuels instead of oil or coal. In addition NUTEK supports the upgrading of DHS-systems and energy efficiency measures in residential areas; additional information about NUTEK is given in chapter 6.1.



## 4.8. Estonia

### **Basic energy data**

#### a) primary production and resources

In contrary to its Baltic neighbours Estonia has still the advantage of substantial indigenous resources. The self sufficient ratio of 68 % in 1996 is the highest in the BS, but it will get worse in the future,

The most important domestic energy sources are the oil shale reserves. The development of the energy industries in Estonia has primarily been connected with the availability of this local resource. Oil shale is of central importance for the electricity production. About 90 % of the oil shale production is used as fuel input for the power generation sector.

Other local available energy sources are the extensive resources of peat and fuel wood

Total primary production was in 1996 about 3.7 Mtoe compared with 5.3 Mtoe in 1990. It is expected that primary production will increase from about **3.7** Mtoe in 1996 up to 4.2 Mtoe in 2000. Thereafter primary production is expected to decline because oil shale resources will exhaust. Due to the depletion of oil shale the import dependence is expected to grow up to **80** % in 2010.

#### b) Energy consumption

Total energy consumption was **5.4** Mtoe in 1996 and is expected to increase further up to 8.4 Mtoe in the year 2020. This is the 1990 level. The growth of energy consumption is accompanied by structural shifts in the shares of energy sources. Due to the above mentioned depletion of oil shale the share of this energy source is expected to decline rapidly from 61 % in 1996 down to 21 % in 2020. Natural gas is expected to expand its share from 12 % in 1996 up to 61 % in 2020.

The cut of Russian energy supplies and the sharp increase of energy prices led to a drastic reduction of energy consumption in Estonia in 1992. The reduction in consumption of the energy sources was in 1992 compared with the previous year for petroleum products by about 50%, for natural gas by about 40%.

The reduction in the consumption of fuels has been especially drastic in construction, agriculture and industry. In these sectors the reduction is directly related to a decrease in production volumes.

The bulk of fuel used in Estonia is consumed by the energy industries. In 1993, energy industries devoured 67% of all fuel: 41% to produce electrical energy and 26% to produce thermal energy. Oil shale is mainly used for the generation of electrical energy while heat production relies almost entirely on imported fuels, mainly fuel oil and natural **gas**. **All** motor fuel is imported.

#### c) Energy *import* dependence

Despite the high self sufficiency Estonia was heavily affected by the collapse of the FSU. Until 1991 Estonia covered the remaining part of its energy requirements by imports from the FSU (coal, oil, gas) with cheap import prices wide below world market level. The cut of energy supplies from Russia and price increases to world market level led to a breakdown of Estonia's market for imported fuels and to an increase of the economic crisis. Estonia was dependent on foreign loans to maintain an energy emergency supply by imported fuels.

The lack of infrastructure, in particular of liquid fuel storage capacities, enlarged the energy dependence on Russia. In 1993 the establishment of two harbour terminals for oil and oil products in the harbour "Muuga" of Tallinn were finished. This gives Estonia the possibility to buy all required liquid fuels on the world market and to become independent from the oil pipeline supply system of the Russian Federation. Only for natural gas Estonia is still totally dependent on supply from Russia.

#### *d) electricity sector*

The electricity production reduced continuously in the last years. In 1990 power generation was about 17 TWh, in 1994 only about 9 TWh. Two reasons may be considered for the decrease of electricity production: first the decline of domestic electricity consumption, second lower electricity exports to the Russian Federation (St. Petersburg region and Pskov) and to Latvia as a result of the relatively expensive Estonian electricity.

The total installed power capacity is about 3.3 GW. The two biggest power plants with a common capacity of about 3 GW are located in Narwa and based on oil shale. The rehabilitation of these two ancient power plants is necessary to secure Estonia's electricity supply for the next 15 years.

The falling consumption of electrical energy is related to the slowdown of production in other sectors, mainly in industry. The fall has been especially noticeable for such energy-intensive products as mineral fertilisers, pulp and paper, and building materials. For example, over the period 1991-93 the production output of mineral fertilisers dropped 13 fold, that of electric motors 10 fold, reinforced concrete panels and wall materials respectively 7 and 8 fold. Moreover, such an important industry as pulp and paper manufacture has practically vanished from Estonia. The consumption of electrical energy has also decreased considerably in agriculture.

#### **Energy market, energy policy and recommendations**

The biggest enterprises in the field of energy are the state owned enterprises Eesti Energia (Estonian Power Company), Eesti Põlevkivi (Estonian Oil Shale Company), Jointstock company Eesti Gaas (Estonian Gas), state owned oil companies and district heating enterprises.

Privatisation in gas sector started with the Estonian Joint-stock company Eesti Gaas. Among the private shareholders are Russia's Gazprom (41%) and Germany's Ruhrgas (20%). Estonian individuals hold 6%, legal entities 23% and the remaining 10% is state-owned, out of which 17% are being offered to current investors and another 12% will be sold and freely traded on the stock market in 1997.

Recently the Estonian State oil shale company "Eesti Põlevkivi" has been transformed into a Joint stock company. It will become a state holding company, consisting of a number of independent state Joint stock companies, i.e. mines and open pits.

Electricity is still wholly state-owned. In December 1996, NR Generating International (NRG), a subsidiary of the American Northern States Power group, was authorised to take part in the privatisation of the Estonian state-run enterprise Eesti Energia (Estonenergo) by setting up a joint venture to restore two power plants, the Pribaltiiskaja and Estonian. This could be one of the largest foreign investments in Estonia to date.

Another private investment initiative concerns in the oil harbour sector. Coastal Corporation bought the Maardu fuel terminal near Tallinn with Baltica Finance (Netherlands/Sweden). The venture, which became Coastal Baltica Holdings, upgraded the facility and constructed a 7.5 km pipeline to Tallinn's Muuga port.

#### **Prices and tariffs**

When Estonia began to introduce reforms aimed at switching over to a normal market economy, it was inevitable that the prices of local fuels had to rise. At first the prices of major fuels were fixed by the government, later the State Price Department was responsible for them. The prices of the majority of imported fuels were liberated and they gradually rose to the world market level. It is noteworthy that the increase in the prices of domestic fuels and electrical energy has not lagged behind that of the imported fuels. The price indices of imported and domestic fuels were of the same order in the period 1990-93.

The underlying principle is that the price of oil shale and the price of electricity must guarantee a profit that will enable the industries to make the investments necessary for the normal continuation of production. It will, most likely, be necessary to use credits for major restructuring.

Heat prices vary depending on locations and fuel source, but are similar to world market prices. As the production costs of heat at the combined heat-and-power (CHP) plants operating on oil shale are much lower than in the cases of other fuels, the tariffs for heat are differentiated according to their actual production costs. By and large, the tariffs for heat for consumers in the oil-shale basin (the areas around the towns of Narva and Kohtla-Järve) are several times lower than in other areas. In 1991-93, heat tariffs rose 70 to 180 times.

At present (1997) electricity is still the only artificially controlled price, partly because the accounting systems in use do not adequately incorporate the cost of raw materials (i.e. oil shale) or environmental factors, and partly due to the social hardship which would arise from higher tariffs.

The total cost of the imported fuels consumed in Estonia in 1992 was EEK 2.7 billion (about USD 200 million) at the average prices that year. This makes up about 20% of Estonia's GDP in the same year. In Finland, the respective ratio was only 2%. At comparable prices, GDP decreased in 1993 as compared to 1992 by 7.8%. Thus we can say that imported fuels weigh heavily on the Estonian economy.

### ***RUE and RES***

Before Estonia regained her independence, the volume of electricity and heat consumed was relatively large. The main reason was the irrational use of energy both in production and in the home. As a consequence Estonia is among the three BS the country with the highest per capita consumption (3.8 toe in 1994); like Lithuania the Estonian economy is extremely energy intensive (1582 toe/1985 MECU).

The causes for the high energy inefficiency are similar to those in Lithuania and Latvia as mentioned before.

The building heating sector is one of the most important energy consumers. In 1991 and 1992 approx. 35% of Estonia's total consumption of fuel was used to heat buildings. In 1993 heating made up 39% of the total production of energy in Estonia. In Finland, Sweden and Denmark this indicator ranged from 8-12% in 1990. In 1991 approx. 75% of the imported fuels intended for producing energy was used to produce heat.

The main problems in the heating sector are excessive heat loss, the high price of heating and low individual incomes. The walls, roofs and ventilation openings of apartment buildings are responsible for 50% of all heat losses. The remaining part of the heat losses occur in boiler houses and poorly insulated heating mains. Up to a third of the heat energy produced is **lost** in transportation. In Estonia district heating is wide-spread; the total length of heating networks is 2200 km. In winter the grass above the heating pipelines in all new dwelling districts is green even in freezing weather, a sure sign of leaks.

Renewable energy sources (RES) may contribute to energy savings

At present, the importance of local fuels is smaller in Estonia than in the neighbouring countries. Wood and peat provide 3.5% of the total energy requirement. The respective indicator is around 7% in the Nordic countries and 12-13% in Finland. Research into the possibilities of using peat for the generation of energy shows that its importance by the year 2000 could be raised to 13% in Estonia. If necessary the volume of production and consumption of peat as a fuel can be increased considerably over a short period.

### ***Energy related environmental impacts***

Approx. 60 % of the emission of pollutants come from stationary sources of the power sector. Oil shale for power production is the main reason for this high share of the energy sector to total emissions. Oil shale contains a great share of ash and sulphur.

The regional centre of industrial air pollution is the North east region of Estonia where the oil shale production is concentrated. This region is one of the most heavily polluted areas in the whole region around the Baltic Sea. For decades Estonian electric and thermal power plants have emitted over 300 tonnes of volatile pollutants into the atmosphere every year.

However, atmospheric pollution has been decreasing in recent years, not thanks to more efficient environmental protection but due reduced production.

Air-borne pollutants from the oil-shale-fired power stations spread over vast areas, including the Gulf of Finland and mainland areas of southern Finland and Russia. Estonia has acceded to the 1985 Helsinki Protocol of the Geneva Convention on a 30% decrease in SO<sub>2</sub> emission by the end of 1993 and on a 50% decrease by 1995 as compared to 1980. To achieve this a pilot plant for removing SO<sub>2</sub> from flue gases has been put into operation at the Baltic Power Plant with help from Finland. As the amount of oil shale burned at the power plants has diminished, the requirements can now be met. The problem concerning nitrogen oxides (NO<sub>x</sub>) is much more complicated since nothing has been done so far to reduce their emission.

The relationship between the environment and production is extremely complicated in the mining of oil shale. The principles of environmentally friendly management have not been followed in oil-shale mining in Estonia. The mining losses of oil shale amount on average to 30%. Open-cast mining has damaged more than 9000 hectares of land. Recultivation of quarries will never restore their previous natural state. The groundwater in the oil-shale basin is also facing extremely serious problems. The level of groundwater has fallen and its quality has deteriorated.

### ***Results and recommendations***

The basis for the energy policy is a masterplan, which was already worked out in 1993. According to this masterplan the main causes for the difficult energy situation are the high inefficient energy production and the inefficient transport and utilisation of energy. Energy savings in production, transport and consumption are considered as priority aims in the national energy policy. According to estimations a share of 30 % of the electric energy and a share of 50 % of the heat energy can be saved. The following measures are recommended to improve energy efficiency:

- Modernisation of energy production plants to improve the efficiency degree of power generation
- Conversion of boiler for heat production based on heavy fuel oil to domestic fuels as peat and wood. Such conversion projects are financially supported by the European Bank for Reconstruction and Development (EBRD).
- Modernisation of DHS to minimise the high energy losses caused by poor isolation. In May 1994 a World Bank loan of US\$ 38.4 million for District Heating Rehabilitation project was approved.
- Installation of gas metering stations to control the actual volume of gas imports from the Russian Federation. It is supposed that Estonia pays too much for the gas supplies due to transport losses on the Russian territory.
- Production of high quality insulation materials

Emphasis should be laid on the demand side. In the past foreign credits have mainly been given to the energy producers. In the opinion of several critics this is a short-sighted policy. The state owns (or owned) the majority of energy-producing enterprises, and this is why it is interested above all in the development of energy production. From the consumer's point of view the credits are being used in the wrong order since 90% of the possibilities for saving energy rest with the consumer. The most effective results are to be achieved by weatherproofing windows and by the additional insulation of ceilings.

Lack of money has been the main hindrance to implementing the energy conservation programme, which was already approved by the government in 1992. According to preliminary estimates, comprehensive realisation of the programme would require nearly a billion USD.

Energy policy efforts aim at the minimisation of the energy dependence on Russia. The new establishment of two oil terminals at the Muuga port was an important prerequisite for this aim. The Muuga port plays also an important role as transit function in the energy trade between East and West. More details about this function are given in chapter 5.2.

An increased substitution of imported fuels by domestic energy sources is possible. But environmental impacts restrict such substitutions. An intensification of peat extraction as well as an extension of the oil shale production is related to serious environmental problems.

#### 4.9. Russia

The main part of Russia is not directly related to the Baltic Sea. These country regions can not be considered as parts of the Baltic Sea. Therefore it makes sense to distinguish between the Russian state as a whole and the *specific country parts directly related to the Baltic Sea*. These specific Baltic Sea country regions are Kaliningrad and the St. Petersburg region (city St. Petersburg and Leningrad oblast).

Due to this structure this chapter is subdivided into two parts: the first part gives a short overview of the general energy situation in Russia, the second part focuses more specifically to the Baltic Sea regions of Russia.

##### 4.9.1. Russia general

##### ***Basic data of the energy situation***

With about 13% of the world's primary energy production, Russia is the second largest producer in the world (after the USA 20%).

It is the world's largest producer of oil, exporting to Eastern Europe mainly through pipeline and to Western Europe via tankers. Resources are evaluated to about 6,700 Mtons, accounting for 5% of the world's reserves and are mainly located in Western Siberia.

Russia has 1/3 of the world's explored deposits of natural gas (estimated to 50.000 Billion M3 in 1995), which production is concentrated in Western Siberia. Russian production accounts for 85% of the CIS gas production.

There are massive coal reserves (13% of the world's known reserves), but coal sector has been in stagnation for the past years due to mines closing, transport difficulties, the low quality of coal from open mining, the decline in industrial power needs.

Renewable energy sources contribute marginally to Russian's energy production. However, Russia's potential of alternative RES is almost limitless because of the country's expansion, diversity of climate zones and landscape, long sea coast sides. Almost every kind of renewable energies potential could be used corresponding to local situations problems and needs.

During the 1993-94 period, nuclear generation represented 11% of total electricity generation. Thermal power and hydro power represented 60% and 29% of electricity generation respectively.

The huge transitional difficulties met by Russia is severely affecting the energy sector. The Russian energy production fell by nearly 25% since 1990 (except in the gas sector).

During the 1991-1995 period, the Russian primary energy consumption fell about 25% (660 MTOE in 1995/IEA); Forecasts for 2010 predict an increase of about 27% (840 MTOE) of the primary energy consumption due to economic growth and increased industrial activities. Data for 1995 indicate that the contribution of the different energy resources in the total primary energy demand are divided up as follows:

- natural gas: 52%
- crude oil: 21%
- coal: 18%
- nuclear energy: 6%
- others: 3%.

Energy exports, which account for nearly 45% of total exports of the Russian federation outside the CIS and for about 65% of exports to the EU, have decreased by 25,9% during the 1990-1994 period. However, it remains one of the biggest energy exporter.

The exports to New Independent States have been partially suspended as a number of countries were not able to pay the purchased gas.

The current Russian energy sector is characterised by a lack of efficient energy technology, a high degree of deterioration of the installations which require replacement or total refurbishment and a low technical level of the major production installations and equipment both on offer and demand sides. This is particularly obvious for the nuclear energy sector, in which a progressive decommissioning of obsolete and unsafe nuclear power plants is operated. The main pipelines of the existing energy transmission network are also greatly affected by deterioration (30 % of long-distance gas pipelines are 20 to 30 years old). Russia hosts a large refining utilities sector, which needs an in-depth renovation, as mostly produced heating products do not fit with the current world demand. On the demand side, most of urban district heating systems need a rehabilitation. There is a necessity for measuring and control equipment in the whole sector.

### ***Framework of the energy market (political, institute, legal)***

The energy sector was deeply affected by the disaggregation of Soviet Union and the economic crisis.

Some significant effort have already been made in reforming the energy sector. However, the legal framework specifically relating to it is still under-developed. To this respect an important issue further clearance of the relationship between federal and regional authorities for the ownership of natural resources and the definition of respective responsibilities appears as an important issue.

The Energy and Fuel Ministry decides and runs the energy policy. Other relevant ministries are the Electricity and Nuclear ones.

### ***The Programme of the Ministry of Fuel and Energy***

The Russian energy policy is based on the *Presidential decree No 472* of May 7 1995 'On the Main Trends in the Energy Policy and Structural Reconstruction of the Russian Fuel and Energy Complex for the period up to 2010'. This document rendered the following decision:

- To approve the main trends of the energy policy of the Russian Federation for the period up to 2010.
- Executive federal bodies and executive bodies of the federal subjects should be guided by the main trends of the energy policy of the Russian Federation for the period up to 2010 when developing and implementing state regulation measures including measures intended to form energy market and create competitiveness in the field of production and use of energy carriers, as well as elaborating investment, scientific and technical and other programmes to develop economy branches and regions.
- Based on the main trends in the energy policy of the Russian Federation for the period up to 2010, the Russian Government had to approve in 1995 the Russian Energy Strategy as well as the Federal target programme 'Fuel and Energy' aimed for the period from 1996 to 2000, with provisions related to the Fuel and Energy Complex (FEC) structural reconstruction aimed to provide reliable and effective energy supply for the whole country, to develop the raw material basis for the FEC of the Russian Federation, to implement energy saving policy, to ensure energy independence and safety of the Russian Federation and to support its energy export potential.

#### *Main Trends in the Energy Policy of the Russian Federation for the Period up to 2010*

When specifying conditions for constructive interactions between the federal executive bodies with enterprises and other organisations (including non-commercial) in the energy sector, the energy policy of the Russian Federation is based on the following **priorities**:

- security of energy supply of the country;
- improving energy efficiency and creating appropriate conditions for the transition of the country's economy to an energy efficient mode of production;
- creation of a reliable raw material basis and ensuring a stable development of the FEC under market conditions;
- reduce negative energy-related environmental impacts;
- support the FEC export potential and enhance its export activities;
- ensure energy independence and safety of the Russian Federation.

The **restructuring** of the FEC is the major target of the energy policy of the Russian Federation for the period up to 2010. It envisages:

- increase of the share of natural gas in total primary energy production and encourage its wider application in industrial centres with poor environmental characteristics as well as gas supply of rural areas;
- further electrification, including economically and environmentally justified use of nuclear and hydro-power plants and renewable energy sources;
- stabilisation of crude oil exploitation in Western Siberia and other regions, setting up conditions for developing new oil/gas producing regions;
- increasing production of high quality light oil products through increased efficiency of oil refining;
- ensuring the necessary scope of coal mining considering economic, social and environmental aspects, further development of coal preparation and comprehensive coal processing aimed at obtaining environmentally clean and competitive fuel, including high quality domestic fuel;
- wider utilisation of local fuel and energy resources, including renewable energy sources;
- realisation of energy saving potentials through the creation and utilisation of efficient fuel and energy consuming equipment, thermal insulating materials and building structures.

With regard to **scientific and engineering aspects** the energy policy of the Russian Federation is oriented on:

- developing technologies capable of ensuring fast re-equipment of operating power installations and creating of new ones;
- ensuring safe operation of nuclear power plants, developing a new generation of safe nuclear installations aimed at economically efficient development of nuclear power industry;
- developing and organising of an industrial production of small-scale power installations, including utilisation of hydro, solar, wind, geothermal energy and other non-conventional energy sources;
- increasing efficiency in exploration and exploitation of energy resources considering environmental requirements;
- in depth processing and complex utilisation of energy resources.

The energy policy of the Russian Federation as applied to **foreign trade** should encourage:

- mutually beneficial co-operation between the Russian Federation and the member states of the CIS;
- development of legal and economic framework in order to fulfil the obligations resulting from international agreements of the Russian Federation;
- broadening mutually beneficial co-operation between the Russian Federation and other foreign countries in order to efficiently exploit Russian energy resources and to promote Russian exports to new energy markets.

The energy policy of the Russian Federation is realised at the **federal and regional levels** based on the Russian Constitution and regulatory documents and envisages:

- legal regulation of the relations in the energy sector;
- assistance of the Federal executive bodies to the subjects of the Russian Federation in solving energy problems;
- combining the interests of energy surplus and energy deficit regions by preserving the unity and role of Federal utilities **as** one of the most important factors for strengthening the country's economic and political integration;
- participation of local administrations within their competence in ensuring reliable, safe and efficient energy supply to the local housing and industrial sector.

The energy policy of the Russian Federation is **implemented through:**

- energy price (tariff) regulation as specified by legislative and regulatory documents;
- creation of an energy market and development of competition in the field of energy supply and demand;
- improved tax policy;
- support to the construction of priority FEC projects and *to* the implementation of energy saving projects;
- development and implementation of measures related to seasonal fuel storage at power plants and by local consumers through pumping gas into underground storage facilities and supplying fuel to the northern regions of the country;
- selective support to coal mining industry, including social adaptation;
- support to low-income groups in order to soften burdens resulting from adjusting energy prices to real costs of energy.

While some efforts were made in the process of prices liberalisation, many major distortions still exist in energy prices. Pricing policy is torn by the discrepancy between the emerging pricing for energy products and the income level of most of the energy consumers.



Gas prices are still controlled, because of the monopolistic structure of supply, while crude oil and coal prices were liberalised. Prices have been increased but they do not comply yet with the real market values, as they do not reflect the cost for transport and distribution (especially for gas and electricity) or are subsidised (coal sector).

Regarding the market structure of the supply side, many monopolies (including privatised ones) are still existing, despite of the under way privatisation programme. This situation does not provide the energy market with favourable conditions for transparency and competition.

The law on natural monopolies, approved by the State Duma, aims to resolve some problems of state regulation and to limit monopolies in the electricity and oil sectors.

Gas sector: RAO GAZPROM is the company responsible for production, transport and distribution of natural gas, and keeps the monopoly over the state gas exports. It is a joint-stock company in which the state is the biggest shareholder.

Oil sector: The production associations-unions, which are stabilised at a regional level, as well as the refineries and the distributions companies have become joint-stock companies controlled by a State holding (called Rosneft for the production). Investments and production levels are decided by the unions, but Rosneft directly controls exports and transport. The remaining relevant companies are joint ventures, investment funds with exploitation licences and companies set up by local authorities.

Coal sector: the state financial holding Rosugol groups all exploitation in the country.

Electricity: The Unified Electrical System (production, transport, distribution) is managed by a holding RAO EES. It manages the most powerful hydro and thermal plants, the remaining ones by local companies.

Nuclear sector: the nuclear power industry is characterised by a high monopolistic and centralised structure, under the control of the Ministry of Nuclear Energy Industry, MINATOM. Production, distribution, and maintenance of equipment are managed by ROSENERGOATOM, which is 100 percent state-owned holding company.

The situation regarding financing issue is particularly worrying, mainly because of the overall non-payments for consumed energy products both on domestic markets and in the trade with other CIS countries. Furthermore the current taxation systems prevents energy companies from investing as royalties, export taxes (volume-based) excise taxes (income-based) in addition to other various taxes can amount to more of 100% of a company revenue at the margins in certain cases.

### **RUE and the role of RES**

Energy intensity remains three times higher than in Western European industrial countries. Potential for energy savings is evaluated to 1/3 of the primary energy demand.

Energy inefficiency is resulting from little energy consciousness, a lack of incentives to save energy (in particular due to low energy prices) and a poor maintenance of the equipment. The households sector provides with a good illustration of this situation. District heating is used to a large extent in most Russian cities. Private consumers pay a fix amount for heat and gas. Estimations indicate that energy efficiency is between 5% and 50% lower than in comparable Western cities. The estimated savings resulting from a basic package of low-cost energy conservation measures are of more than 50% per household.

The improvement of energy efficiency is a priority issue of the energy policy for the Russian Federation Government, as it is a fundamental factor for the energy security in Russia and in the CIS.

Energy efficiency policy and programmes are initiated at federal level by the Department for Energy Efficiency, under the authority of the Vice-Minister in charge of Energy policy, Energy Efficiency and Renewable Energies.

The “Law on Energy Efficiency in the Russian Federation” was adopted in Spring 1996 and includes provisions for the following issues:

- definition of responsibilities at federal and subjects level,
- standardisation, certification, and metrology in energy saving,
- state management in energy saving, economic and financial mechanisms for energy saving,
- international cooperation in the field of energy saving,
- education, training and information.

Various actions are undertaken at federal level. A Fund for Energy Efficiency has been set up (which remain at a very low level due to the non-payment crisis). NGO (such as the Moscow Energy Club and the Russian Union for Energy Efficiency) in relation with the Ministry of Energy and financing institutions are active for the promotion of energy efficiency projects, training and information.

Some initiatives such as local Energy efficiency programmes (Saint Petersburg, Samara, Novossibirsk, etc.) and installation of “demonstration zones” for energy efficiency projects are taken at regional and local authorities’ level.

Regarding the use of renewable energy sources, hydro power and fuel wood have traditionally contributed for a non negligible part to Russian energy production. According to the Ministry of Fuel and Energy, the technical potential for renewables is about 5 billion tonnes of coal equivalent per year and the economic potential near 274 million tonnes of coal equivalent per year. The federal power company RAO **EES** is interested in renewables, especially in large projects for hydro, wind and geothermal energy to generate power for the grid and intend to increase the share of renewable energy in the total electricity production up to 2-3% by 2010. There is also a large potential for off-grid market. Small-scale projects for heat and power supplies from local renewable energy sources appear of a great interest for remote areas.

However, important obstacles need to be overcome for developing the use of renewable energy sources in the Russian Federation. The huge existing reserves and the distorted low prices of conventional energy sources do not provide the renewable sources with fair competitive conditions.

Furthermore, funding resources have been decreased in this field during the past years, hampering technological development for renewables. In addition, while expressing its interest for such energy sources (regarding environmental benefits and exploitation of local resources), the government set down few incentives and support programmes to help in tackling the barriers to the development of renewable energy sources.

### ***Energy related environmental impacts***

The industrial and energy sectors are the main sources for environmental damages, mostly due to fast deteriorating and inefficient equipment. According to the Russian Ministry of Fuel and Energy, the energy industry contributes for nearly half of the harmful atmospheric emissions, for about one third of waste water and solid wastes in the Russian Federation. Major concerns are arising from the nuclear sector as a whole, the serious leakage from oil pipelines and the coal industry. Pollution from energy use and road transport is becoming a real threat for human health. At the beginning of the nineties, it was assessed that the most important Russian cities, among which Saint-Petersburg, had single concentrations of key atmospheric harmful emissions 10 or more times over the permissible levels.

While environmental protection is a prior concern, few efforts have been made in this way regarding the energy sector and these are challenged by high economic requirements.

There is no legislation into force yet, which may provide efficient measures to reduce environmental attempts. This is mainly due to the lack of coordination between the various concerned institutions (the Ministry of Fuel and Energy and the Ministry of Environmental protection and Natural Resources at federal level)) This sector is also suffering from a lack of financing. The federal budget dedicated to environmental protection is far from being able to fund the range of necessary measures (upgrading of energy equipment, monitoring, set up of pollution control equipment). The main financial resources are allocated by non budgetary fee funds, established in 1991 under the provision of the Law on Environmental Protection, which are mainly collecting payments for the use of natural resources and/or the production of pollutant emissions from companies.

Some economic incentives to address environmental issues exist, mostly encompassing fiscal instruments such as taxation privileges and low rate investment loans for clean technologies, taxes on harmful emissions. The Ministry of Environmental protection and Natural Resources has been working on a CO<sub>2</sub> tax proposal, to which the Ministry of Fuel and Energy is rather reluctant.

Up to now, the highest commitments of the Russian government remains at international level, as the Russian Federation is a signatory of most of international treaties and conventions on energy and environment. This international involvement may contribute to improve the national frame for a sustainable economic development of Russia.

### ***Results and country specific recommendations***

Russia plays an important role among the energy producers and consumers. The upgrade and the development of energy infrastructures for production, transport and distribution is crucial both for Russian economic restructuring and EU's security of supply, as well as for the global concern for environmental pollution. There are urgent requirements for technical assistance in deploying clean and efficient energy. Measures and investments to improve energy efficiency have thus the highest scope for economic viability. Russia represents a tremendous market for European energy technologies whose access can be facilitated by technological cooperation programmes such as TACIS, INCO-COPERNICUS, JOULE-THERMIE.

However, due to its present economic situation, Russia is unable to finance the energy sector's rehabilitation (the amount of investment needs is estimated to about 20 Billion US \$). Therefore, grants from foreign donors remains essential. Funding from European Union (mainly TACIS) in cooperation with international financing institutions (EBRD, World Bank) must be kept on a high level.

Progress in integrating its energy economy in the international environment has already been achieved by Russia in the process of reforming its energy sector. Further measures must however be adopted to improve the legal, fiscal and economic framework, in order to attract more foreign investment capital. International and EU cooperation instruments such as the European Energy Charter, the TACIS and SYNERGY programmes provide Russia with a helpful support regarding these issues.

#### **4.9.2. Russia specific: Kaliningrad and St. Petersburg region**

##### ***Part I: The Energy Sector in Kaliningrad Oblast and Perspectives of its Development***

Since 1990, total electricity consumption in Russia, including Kaliningrad Oblast, decreased substantially. Energy demand in the whole country diminished by 50 per cent in the period from 1990 to 1995. In Kaliningrad Oblast demand showed a lower decrease: 31 per cent from 1991 till 1994. At the same time, consumption of heat in Kaliningrad Oblast reduced by 18 per cent. A more intense fall of energy consumption could be observed in the industrial sector which was due to the general decrease in the production level in Russia.

As a result of this situation, in Kaliningrad region there was a 22 per cent lower electricity production level in 1995 than in 1994 and a 18 per cent lower central heat production level than in 1994.

The energy distribution in Kaliningrad Oblast is realised by JANTARENERGO which is subordinated to RAO EES Rossii. The Ministry of Fuel and Energy is holding the majority of shares. The major supplier of energy in Kaliningrad Oblast is the Joint Stock Company (JSC) Gasprom. That means that the energy sector in Kaliningrad Oblast is completely state-owned.

The establishment of a special economic zone in the form of a free trade zone in the Kaliningrad area will offer preferential conditions and special advantages for investments. It is expected that this development will also push the investment activities in the energy sector.

### **The Structure of Energy Supply**

The structure of energy supply in Kaliningrad Oblast is characterised by the following essential elements: natural gas, coal, oil products and nuclear power as an important part of imported electrical energy. Currently, Kaliningrad Oblast is producing not more than 20 per cent of consumed electric power (in 1995 only 11 per cent), the rest is imported through Lithuania. A general energy plan, 'The Complex Programme of Energy and Fuel Supply of Kaliningrad Oblast with Prospects up to 2010', was adopted at the beginning of 1994. According to this plan Kaliningrad Oblast will become self-sufficient in power supply and by 2004 the main primary energy supply will be natural gas and a feeder in Belarus will be connected to the Yamal-Europe pipeline.

### **Natural Gas**

Since 1990, the structure of energy supply developed towards an increasing share of natural gas in energy supply. Gas consumption, in 1991, was 160 million cu m -- in 1992, already 210 million cu m. In the following years, gas consumption rose to 240 million cu m which is equivalent to about 420 tsd. tons of coal equivalent (tce).

In the period from 1991 to 1994, the share of natural gas in the energy balance rose from 10 to 20 per cent. In accordance with the 'Programme of Economic Development of Kaliningrad Oblast' and the general energy plan the share of natural gas in the future will rise to 80-90 per cent.

The city of Kaliningrad is consuming substantial quantities of natural gas. In 1992/1993, the share of the city in gas consumption was around 80 per cent.

Since 1985, the oblast receives natural gas through the gas pipeline Vilnius-Kaunas-Kaliningrad. The supplier is the JSC Gasprom. Around 28 million cu m of natural gas is extracted in Kaliningrad Oblast itself.

### **Oil Products (fuel oil, gasoline, diesel oil)**

In 1994, consumption of oil products -- including fuel for transportation needs -- was 1,817.2 tsd. tce. This was more than 60 per cent of total fuel consumed in that year.

Average consumption of crude oil is equivalent to 2 million tons, 700,000 tons of which are extracted in Kaliningrad Oblast. Kaliningrad does not have its own oil treatment facilities. The extracted oil has to be transported to Russia. Afterwards, finished oil products are sent back to Kaliningrad either by ship or by train.

The main supplier of oil products is JSC Gazprom. The JSC Morneftegas, representing the interests of JSC Lukoil, is responsible for developing the local oil deposits.

### *Oil Deposit DF-6*

Potential oil reserves at this site are estimated at around 270 million tons. However, explored reserves are only 50 per cent onshore and around 17 per cent off shore. The JSC Morneftegas, Rosneft and German companies RVE DEA and Veba prepared suggestions for developing deposit DF-6 in the disputed territory between Kaliningrad Oblast and Lithuania. Since 1990, this disputed territory is the reason for political conflicts between Russia and Lithuania. Even if this did not influence the plans of Russian and German companies to mutually develop DF-6, this deposit can not be treated as a serious potential source for oil extraction for the time being. Considering the political changes in Lithuania -- the Landsbergis Party has the majority in the parliament -- it is not likely that negotiation between Lithuania and Russia concerning DF-6 will lead to any result.

### *Opportunities for Treatment of Crude Oil in the Kaliningrad Oblast*

According to experts of the administration of Kaliningrad Oblast, the construction of local treatment facilities in the oblast is not profitable. To be profitable the supply of a minimum of 2 million tons of crude oil would be necessary. The oblast, however, at best is able to provide only 500,000 tons of crude oil. It would be necessary to buy the remaining 1.5 million tons at world market prices so that the production would run at a loss. Furthermore, costs of constructing treatment facilities, of transportation of crude oil, etc. could not be covered over a longer period. Additionally, ecological damage of such a production site would also cause substantial losses and lead to social tensions in the region.

### *Perspectives*

In comparison to former years, a tendency towards reduced oil product consumption can be observed (excluding the use of fuel for transportation needs). In accordance with the 'Programme of Economic Development of the Kaliningrad Region', this decrease will continue in the future in favour of an increasing share of natural gas in energy consumption (which is also connected with the switch of energy intensive production from oil to gas).

## **Nuclear Energy**

In 1990, around 80 per cent and in 1994 around 87 per cent of electricity consumed, was imported from Lithuania. Lithuania is connected with the central dispatching units of Russia. A substantial amount of the imported energy is produced at the nuclear power station (NPS) Ignalina in Lithuania and at the NPS Sosnovy Bor in Russia. Taking into account that the Lithuanian Government announced to shut down NPS Ignalina up to the year 2005 and that the European Bank for Reconstruction and Development (EBRD) agreed to finance the decommissioning of this nuclear power plant, the development of the system of energy supply must be oriented at maximal independence from Lithuanian nuclear power and at exploitation of local energy resources. The NPS Sosnovy Bor near St. Petersburg is also bound to be closed in the near future. The life term of the RBMK reactors of first generation will end in 2005. However, it is questionable whether Russia in the current economic situation has the resources for closing and decommissioning the NPS, taking into account that in Russia there exist several NPS with the same type of reactor.

## **Coal**

Coal is completely supplied to Kaliningrad Oblast from Russian pits by railway. Both the oblast and the city of Kaliningrad in 1994 consumed around 400,000 to 500,000 tons so that overall coal consumption was around 1 million tons or 700,000 tce.

In the 'Programme of Economic Development of Kaliningrad Oblast' first priority is given to the use of natural gas so that the importance of coal in energy consumption will diminish.

## Electricity and Heat Consumption

Total electricity consumption in Kaliningrad between 1991 and 1994 decreased by 62.5 per cent -- in the industrial sector by 65 per cent. Heat consumption in the same period decreased by 60 per cent -- in the industrial sector by 65.5 per cent.

In 1990, electricity consumption in the social and housing sector was 37 per cent of the total consumption of Kaliningrad Oblast (around 1,090 million kWh). In the same year heat consumption was 28.5 per cent (2,215 tsd. Gcal) of the total. That means that the share of this sector in energy consumption of the oblast has been around 30 per cent (in 1996, according to expert estimates this number decreased to 13 per cent).

## Power and Heat Production Facilities

The main power and heat production facilities in the oblast and city of Kaliningrad belong to JSC JANTARENERGO which is subordinated to RAO EES Rossii. In power production installed capacity totalled 190.3 MW. However, in 1995 only 58 MW could be exploited due to financial shortages and out-dated equipment. So far 74 per cent of exploitable installed capacity is working on masut (fuel oil) and 26 per cent on coal.

The Kaliningrad Oblast will become self-sufficient. According to Russian sources, in the city of Kaliningrad a gas-fired power plant of 900 MW installed capacity is under construction. This \$1.5 billion project will be able to supply all Kaliningrad Oblast with electric power. Furthermore, old power plants will be refurbished and a 120 MW gas unit and several 25-30 MW gas turbines are planned.

Currently, the price of imported electricity (\$1 for 1 MWh) is substantially lower than that of locally produced electricity. This is due to the

- low energy efficiency in the local electricity sector;
- low price level for the local population;
- high losses of heat and power in the production and housing sectors as well as transmission losses;
- out-dated equipment in local electricity sector;
- unfavourable mixture of energy carriers in power production relying mainly on fuel oil -- a quite expansive input.

Consequently, serious measures have to be taken in order to achieve a more efficient power production. In this context, the development of an integrated approach of efficient and stable energy supply for the administration of Kaliningrad Oblast is the task of a project called 'Energy Supply Advice to Kaliningrad Oblast' which is financed under the **TACIS** facility and is currently in realisation. This project aims at providing reliable energy demand projections up to 2010 and at giving recommendations on how to meet this demand. That means that also detailed questions of major energy investments are subject to this EU engagement. Furthermore, a programme of energy saving and alternative energy sources has to be developed by considering construction of insulated houses, refurbishment of small hydro-electric plants, study and experimentation of wind energy units and development of the energy valorisation of waste.

## ***Part 2: The Energy Sector in St. Petersburg and Leningrad Oblast***

### **Legal Basis for Regulation**

The main legal basis for regulation is the federal law on "State Regulation of Tariffs for Electricity and Heat in the Russian Federation". This law transformed the existing federal Energy Commission into an independent regulatory body with its own budget and full-time staff. Regional governments have the possibility but not the obligation to create Regional Energy Commissions (REC). Originally a joint Commission was established for the city and oblast, but soon responsibility was split into two distinct RECs. Broadly, the REC is responsible for regulating the wholesale electricity market, for setting guidelines for the practice of the RECs and for arbitrating disputes.

### **Energy Supply and Energy Use**

Energy supply to St. Petersburg is estimated at 34 Mtce in 1994 including the nuclear component. Of the fossil fuels, gas has increasingly dominated the fuel mix in recent years. Over 95% of the supply come from outside the St. Petersburg region.

Energy consumption in St. Petersburg in 1994 is estimated to be 18 Mtce. Gas was the principal primary fuel, but the majority of energy is consumed in the form of heat (district heating and local boilers). The energy intensity of the economy in St. Petersburg has risen quite dramatically since 1990 and, while the intensity is still lower than in former Soviet Union as a whole, it is now 1,800 - 2,000 tce/MECU<sub>1985</sub> compared with around 1,400 tce/MECU<sub>1985</sub> in 1990. This is over four times the level in Western Europe.

The main actors in the electricity supply system in St. Petersburg are Lenenergo who own and operate over 50% of the generating capacity; RAO-EES who lease the mazut-fired Kirishi power station (1,800 MW) to Lenenergo; and the autonomous Leningrad Nuclear Power Plant in Sosnovy Bor (4,000 MW).

Main features of the energy supply system are:

- *Nuclear is base load; Kirishi meet peak demand.* Sosnovy Bor generated over 50% of the 39.9 TWh produced in the region in 1994 and supplies the base demand for power. Kirishi has a low load factor and meets peak-load requirements and serves functions.
- *CHP is 33% of electrical capacity.* The share of combined heat and power (CHP) stations - most of them operated by Lenenergo and the remainder by industrial enterprises - is one third of the installed capacity.
- *CHP plant operating in condensing mode.* As a large proportion of heat demand is met by heat-only boilers, there is not sufficient demand to allow the CHP plant to operate in cogeneration mode. For this reason, the electricity generation of Lenenergo CHP stations was produced in condensing mode rather than producing both heat and electricity. In addition, the CHP plant used to generate electricity are often the less efficiency facilities.
- *Natural gas main input fuel in City.* Natural gas accounts for about 80% of fuel burned in heat and power stations in the City. Switching is possible and mazut is used as the back-up fuel. Coal is mainly used in small-scale heat boilers in the suburbs of the City.
- *Mazut main fuel in Oblast.* 62% of fuel in the Oblast is mazut of which more than half is used at the Kirishi power station.
- *Age of electrical capacity relatively "young".* The electric capacity structure is rather "young", with two-thirds only up to twenty years. An age structure of the heat-only plants was not available but it is reported that their technical condition is rather old and of low quality.

- Key extensions. The construction of two very important electricity generating facilities is already underway:
  - TEZ 23 (CCGT) in the NW **St.** Petersburg (output - 1.6 GWe/1.4GWt);
  - 50 MWe topping gas turbine in one stream unit of TEZ 22 (could be extended further).

### Emissions from the Energy Sector

The main environmental issue associated with the energy sector is air pollution during combustion at the power station or boiler. The principal pollutants that contribute to air pollution are sulphur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>) and particulate matter (TSP). Using statistics from Lencomecology and additional calculations based on emission factors, estimates have been produced for the emissions of each pollutant. The key issues are summarised in the list of tables (annex 1).

## 5. Energy infrastructure in the BSR: networks, transportation, storage facilities, nuclear safety

### 5.1. Electric grid networks and the vision of a transnational “Baltic Ring” network

Today the BS lie in the intersection of four mainly separated grid systems:

- Former Soviet Northwest Interconnected Power System (IPS)  
The IPS is the power network system of the Former Soviet Union and the present power system of the CIS countries. The BS as former Soviet republics (FSR) are still closely integrated into the IPS and via IPS closely connected to the Northwest region of Russia (**St.** Petersburg region), Belarus and Kaliningrad. The IPS has a generating capacity of about 33,000 MW in the northwest region.  
The transnational electricity transmission within the IPS system is transferred via 330-kV lines. The present 330-kV Baltic transmission network consists of 14 interconnecting lines with Belarus and Russia, including three lines to Kaliningrad.
- UCPTE network  
UCPTE is the “Union of Companies for the Production and Transmission of Electricity”, a West European organisation of interconnected electricity systems.
- NORDEL network  
This network consists of the Nordic countries (Finland, Sweden, Norway, Denmark). Connections from the NORDEL network to other countries of the Baltic Sea Region already exist, a further integration is ongoing.  
Several cables have been laid down or are under planning: two 600 MW cables from Norway to Germany and two cables from Norway to Denmark with a capacity of 1040 MW. Sweden and Germany have a cable for 600 MW, Sweden and Denmark have cables of 670 and 1300 MW. As for Poland a 600 MW cable is planned from Sweden operating by early 1999. Germany and Sweden as well have a cable for about 600 MW. Considering Finland, a 900 MW cable is set up with Russia, a 300 MW cable is supposed to be operative soon.
- CENTREL  
The members of this newly established power union CENTREL are: Poland, Czechia, Slovakia, Hungary.

The BS have three main options for future synchronous interconnections among the BSR:

- The BS can remain connected with the northwest part of the IPS System;
- A connection to UCPTE is possible via Poland
- A connection to NORDEL will be possible via Finland.



In the short term run the BS will remain connected to the the IPS. Power exchange to the adjacent power networks is possible by the installation of high-voltage direct current (HVDC) connections.

In the long term the preferred option will be towards further integration with Western Europe, in particular with the European Union towards the long-term aim of an pan-European unified energy market.

But this idea can only be developed step-by-step beginning at the level of individual countries first and then on the level of Europe as a whole.

Main efforts towards this long term aim are already ongoing under the project name **“Baltic Ring”**. Because of its importance for the development of the countries in Central and Eastern Europe the European Commission admitted the Baltic Ring Project to the infrastructure programme “Trans-European Networks”. The aim of this project is to provide the technical prerequisites for an efficient electric power exchange between the Scandinavian countries Denmark, Norway, Sweden and Finland, the Baltic States, Germany and Poland including Russia and Belarus.

The Baltic Ring started already at the end of 1990 when an Estonian-Finnish working group was established to analyse the technical possibilities and economic reasons for transmitting electrical energy from Estonia to Finland. At the end of 1991 the Baltic States agreed to oblige Estonia to coordinate the direction of development of power engineering for the three countries. In the result of the co-ordinated actions the perspectives of including Poland and the Baltic States to the unified European system was formulated in 1993, at the Baltic Energy Conference in Gdansk. They realised that three fourths of the Baltic Ring already exists, to be represented by air transmission lines and sea cables in Finland, Sweden, Denmark, Germany and Poland. Only the connections between Poland - Lithuania and Estonia - Finland are missing.

The technical backbone of the Baltic Ring-scheme will be formed by a considerable number of high-voltage direct current (HVCD) links and alternating current grids. The total network will consist of a length of 7500 km **AC** grids in the countries concerned as well as DC links.

The links still missing are HVCD connections to the adjacent grids. The Polish connection to UCPTTE in combination with HVDC links between Poland and Lithuania and between Estonia and Finland will be major steps to complete the planned “Baltic Ring”.

Currently Poland extends its 400 kV transmission network from Warsaw to Bialystok near the Lithuanian border. A link to Lithuania would be of mutual interest, in particular for Lithuania: it would improve the energy trading possibilities with Poland and via Poland with other European countries, when Poland is connected to UCPTTE. Such a connection could reduce Lithuania's dependence on its energy trade with CIS countries.

The estimated investment costs of the transmission systems under consideration with regard to the idea of the Baltic Ring amounts to 2 billion USD. Three projects are included:

- Multiterminal HVDC double bipole line between Germany, Poland, the BS, Russia and Belarus (line to be split in Warsaw); capacity 4000 MW; length 1,800 km; investment approx. 1.5 bill. USD
- HVDC cable link between Finland and Estonia; capacity: 600 MW; length: 80 km; investment: approx. 0.2 bill. USD
- HVCD cable link between Sweden and Poland; capacity: 600 MW; length: 240 km; investment: approx. 0.3 bill. USD.

Despite the high amount of required investments the East-West High Power Transmission System (HPTS) are expected to have important economic, technical, environmental and last not least political benefits such as:

Reduction of installed power capacities by pooling of power plant reserve

It is estimated that by efficient power exchange management among the network partners future investment **costs** for reserve stations could be replaced, by which about 20 % - 30 % of the investment costs for the HPTS could be counterbalanced.

- Energy deliveries from Russia could cover peak load in Western countries resulting in a reduction of the required installed peak generating capacity. It is expected that this peak load delivery could pay for a substantial part of the investment.

Positive environmental effects

The optimisation of the generating capacity could lead to a substantial reduction of emissions of the thermal power plants. A more extensive exploitation of hydro power resources in Russia will be possible. This could at least partially substitute fossil primary energy sources.

- The Baltic Ring network can contribute substantially to the overall economic rapprochement between Eastern and Western Europe. The project will provide Russia with direct access to the Western European electricity market. This might be a step towards the aim of stabilising the political situation in Russia.

## 5.2. Energy infrastructure facilities among the Non-EU-Member States in the BSR

The existing energy infrastructure facilities in the Non-EU-Member States play an important role for their future energy development and for a larger integration into international energy markets.

Concerning Russia only those facilities are regarded which are located in the Baltic Rim.

The oil and gas facilities are most important for transnational energy networks besides the aforementioned electricity grids. They are described in further details.

### **Oil infrastructure network, oil pipelines and oil harbours:**

#### a) oil pipelines

The Non-EU-Member States of the BSR were highly integrated into the crude oil distribution of the FSU. This was a centrally directed system. The one-sided orientation to the FSU supply network is one reason for the heavy dependence of Poland and particularly of the **BS** on Russian energy imports.

The crude oil transportation in the FSU is dominated by pipeline.

The FSU crude pipeline network was developed basically in three directions from the Volga-Urals region: east to Siberia, northwest to the Moscow-St. Petersburg region and west to eastern Europe (the Druzhba Pipeline).

Important for the BSR and especially for Latvia are two pipelines with a small link to Lithuania:

- The Druzhba (friendship) pipeline:  
The Latvian segment of this pipeline has a length of 323 km.
- The oil product pipe line: Samara - Ventspils  
The Latvian segment is 329 km. This pipeline was built ten years later than the Latvian segment of the Druzhba pipeline.
- Refinery Mazeikiai in Lithuania: link to the Latvian segment  
The refinery is linked by pipeline to the main pipeline segment running through Latvia. By this way the refinery is connected by a 720 mm pipeline with a designed capacity of 16,2 MTpa (Mio. tons per annum) to the Birzai pumping station on the main arterial FSU double-pipeline link from the Western Urals oil field via Polotsk in Byelorussia.

Since the end of 1991 The "Druzhba" oil pipeline was automatically transferred into the ownership of the Latvian Government. The maintenance and servicing of the oil-product pipeline Samara-Ventspils from the Latvian part is performed by the Joint-stock company "LaSam" and from the Russian part by the Joint-stock company "Transnefteprodukt". The oil-product pipeline and the "Druzhba" pipeline part, which runs through the territory of Latvia, belongs to the Latvian - Russian Joint-venture "LatRosTrans" which provides about three fourth of the capacity of the Joint-stock company "Ventspils Nafta", the largest oil terminal in the Baltics. Its nominal capacity is 14 million tons of oil and 6 million tons of oil products per annum. The diameter of the pipeline is 720 mm, but that of the oil-product pipeline - 530 mm.

Besides the existing pipelines the construction of new pipelines is planned. These projects must be seen in the context of large efforts of each of the BS to enlarge their oil facilities, especially their oil terminal ports. The aspired increase of the harbours oil capacity implies and requires an extension of the current available pipeline capacity.

The following pipeline projects are discussed and/or planned:

Estonia: connection of port of Muuga with Kirishi (St. Petersburg)

Estonian companies, trading with Russian oil, are investigating possibilities to build an oil pipeline, that would connect the Baltic countries into one network on the one hand, and, on the other hand, would connect the port of Muuga with Joint-stock company Kirishi nefteorgsintez (Kirishi oil organic synthesis), a daughter company of SurgutNefteGas company. The town of Kirishi is situated 117 km to the east of Saint Petersburg. The capacity of the oil refinery is 20 million tons per year. Gazprom is also interested in that Baltic oil pipeline project, since that pipeline could concern the Russian gas supplier interests in the Baltic States. The 485 km long main could cost about 1 billion USD, and can be financed by foreign bank through Russia.

Latvia: alternatives to the old Druzhba and oil product pipelines

A reconstruction or as an alternative a new construction of the Latvian segment of the Druzhba and the oil product pipelines is planned.

According to one of the projects it is also planned to build a new pipeline which would run through the territory of Latvia without crossing Lithuania, as the old pipeline has been worn out, and, besides, Lithuania sets tariffs for pumping oil that are higher than those in Latvia. This project is supported by the Russian part of the Joint-stock company "LatRosTrans", since it would make it possible, by investing 400 million USD, to connect Ventspils with the rich oil deposits in the Battery Basin in Russia.

Lithuania: a new own indigenous pipeline for refinery Mazeikiai

The refinery Mazeikiai is joined to a pipeline supplying the refinery with imported Russian oil. The refinery is also supplied by indigenous oil. Due to a small amount this is presently shipped by railway or road to the refinery. If the refinery supply with indigenous oil should be increased then the indigenous oil production must also be increased and then a new pipeline would be necessary. But it is not sure at all if the refinery will still be maintained due to its bad situation (see also chapter 4.6).

Another pipeline project is discussed in context with the construction of an import/export oil terminal on the Baltic coast. The government of Lithuania in 1993 has taken the decision to build a 60 km crude oil pipeline and an import/export terminal on the Baltic coast in Butinge site, close to Latvian boarder.

## b) oil harbours

Estonian oil harbours

Estonia's central asset is the Port of Muuga. It is the deepest port in the Gulf of Finland (18.5 m deep). The port is capable of handling all vessels able to pass through the 16.5 metre-deep Danish straits. It is ice-free all year round. Two harbour terminals for oil and oil products were finished in 1993. Further expansion is planned with the financial aid of international fundings (i.e. loans from EBRD).

Estonia has advantages in offering East-West energy transit services, in particular transit services to St. Petersburg and North-West Russia. Considering an increasing amount of

East-West transit and supposing that most of this would go to Muuga Port the port's importance can be compared to that of Rotterdam to Western Europe.

#### - Latvian oil ports

Ventspils Nafta, the biggest oil terminal, connecting routes of crude oil and product pipelines and railways with sea tanker lines to Western Europe and North America, is playing an important role in securing supplies from oil deposits in the former Soviet Union. With a new Government transit has become a priority sector. The transit promotion working group is established under the auspices of the President of Ministers to work out a decree on national transit promotion board. The main task of the Board will be working out an implementation of transit encouragement strategy. Considering this, a need for expansion of capacity of terminal and oil pipelines is obvious.

Ventspils is the 13<sup>th</sup> largest port in Europe, and 27 % of the Russian oil transit shipped through ports passes through the Ventspils Port. The Ventspils Port is navigable all the year round without involving icebreakers as the port is ice-free. Oil, diesel fuel, fuel oil, petrol, fuel for jet engines and waste from oil processing that is brought to Ventspils by train or through the pipeline is exported through the port. Already since 1961 it has been a tradition for the CIS countries to use Ventspils as the shortest route to the profitable Western Market, besides Ventspils had the highest service level among the FSU oil ports. In the near future on the completion of the widening of the entrance canal for ships and pre-port and the deepening of the berth to 17,5 metres, it will be possible to service tankers with the carrying capacity up to 100 - 130 thousand tons. This means, that it will be possible to supply oil and oil products to the customers in the whole world without reloading. The development of the Ventspils Port has been included in Latvia's public investment programme which plans to increase oil transit through Latvia.

The other Latvian harbors such as Liepaja and Riga port are of minor importance for the international oil transit network.

#### Lithuanian oil ports Klaipeda

The Klaipeda state oil terminal consists of three oil loading berths. The terminal facilities are old and in many respects do not meet modern standards. There is no pipeline connection to the terminal, fuel oil is transported to the terminal by rail wagons. Due to the old age of the Klaipeda harbour a new company "Butinge Nafta" was founded for a construction of a new oil harbour terminal on the Baltic coast in Butinge site. The Klaipeda terminal has a capacity of 4,5 Mt per year, an extension of the Butinge terminal is planned for a capacity of about 12 Mt per year.

#### c) oil refineries

The Lithuanian oil refinery Mazeikiai is the only one in the BS. A description of this refinery has been given in chapter 4.6.

Other refineries in the Non-Member **States** of the **BSR** exist in Poland and in the St. Petersburg region.

#### Gas infrastructure: pipeline *network*, storage facilities

Natural gas from Russia constitutes a major part of the present fuel supply into the countries of the BSR. Some aspects of the regional parts of the gas pipeline networks have already shortly described in the chapter of particular states (see Poland and Lithuania).

The main infrastructure consists of the gas supply pipelines and storage facilities. Nearly all of the existing and potential gas storages lie in Latvia, only one in Lithuania. Latvia is highly favoured by nature having underground geologic formations providing excellent possibilities for an underground gas storage.

The gas in the gas storages belongs to Russia and not to Latvia. Latvia serves "only" as a storage function and has not the control and authority about the gas, at least not the exclusive one: disposition about the gas must be taken in agreement with Russia (see later in this chapter).

Underground geologic formations, providing possibilities to create natural gas storage, is a tremendous natural resource, that allows Latvia to participate in long-term projects on trans-national natural gas pipelines, as the potential capacity of the storage could theoretically cover load variations of the whole European gas market.

Due to unique possibilities to create underground gas storage, Latvia has a chance to become the biggest transit territory of gas repositories between the gas extracting regions in Russia and Nordic countries and Western and Eastern Europe.

The hardware system and operation of the gas networks are still far from state-of-the-art western technology. There is a serious lack of spare parts, present measuring instruments are inaccurate, and no systematic data collection system has been established. Modernisation projects should include upgrading management and information systems, and staff training as well as replacement of hardware using modern technologies.

The import and export LPG terminal in Riga port serves as a gateway connecting Russian suppliers of LPG with western markets. The terminal was constructed in 1967 and since that time has been the only one on the western coasts of the FSU.

The transnational gas network system gains growing importance by the construction of a natural gas pipeline from the Siberian peninsula Yamal via Belarus and Poland to Germany with an annual total supply of 60 billion m<sup>3</sup> (see also chapter about Poland).

### 5.3. Current status and outlook of a Trans-Baltic-Sea energy network system

Chapters 5.1 and 5.2 gave an overview of existing and planned energy infrastructure facilities in the BSR.

The long term aim is the integration of these facilities into an transnational Pan-European energy network and trade system.

The East-European countries of the BSR can play an important role in such a future network system. In particular the BS have special advantages for transit networks due to their natural and geopolitical situation. The BS are located **just** at the crossroads from the North to the South ("Via Baltica") and from the East to the West (Russia - Western Europe). Therefore, the biggest value, the BS have, are the ice-free oil terminals, crude oil and oil product transit pipelines, built already in the Soviet times. Wide entrance to the non-freezing Baltic sea guarantees transit servicing, which constitutes a substantial part of the national income.

Due to their strategic favourable highly advantageous geopolitical location Poland and the BS can play as an international or may be intercontinental turnover point for oil and gas transit transports between Russia/Asia and Europe.

These strategic advantages of the BS and also of Poland must be emphasised with regard to the difficulties of Russia and its strategic disadvantages in getting access to international markets. This is due to the fact that Russia is dependent on the access to the export and transit facilities via the BS and via Poland to other, in particular Western European markets. Russia (and other oil exporting states of the FSU) may need Poland and the BS as transit function for their export access to western, southern and northern (Finland, Sweden) Europe.

Besides the political obstacles there exist technical and financial problems on the way to an integrated transnational energy network.

Concerning the unification of the electricity grid the way to UCPTe via CENTREL will not be easy. Not only issues of capital intensive plants will have to be solved, but also fulfilment of connection conditions and much stricter criteria of co-ordinated operation will have to be ensured. Such stricter criteria are: frequency maintenance requirements  $< \pm 0,02 \text{ Hz}$  compared to  $< \pm 0,2 \text{ Hz}$  in the united power systems of CIS countries, the same has to be referred to maintenance of voltage, ensuring stability with sufficient reserve, operation of automatics, dispatch service. Each separate power

system of UCPTE must have capacity reserve that allows to increase the generating capacity by 1,25% within 5 seconds and by 2,5% within 30 seconds.

Obviously the integration process will develop by stages. The first stage for the BS could be f.e. a connection to CENTREL and NORDEL in asynchronous regime. The further development will show whether the Baltics will stay with this regime for a longer time or they will move on to synchronous mutual operation regime with the West at asynchronous or disconnected links with the united power system of **CIS** (FSU).

Connection of the **BS** with CENTREL and UCPTE unions must be carried out simultaneously by all the three Baltic power systems.

The financial resources needed for development of the networks are considerably larger than the BS can provide. By themselves it might only be possible to cover them with foreign assistance up to 60%.

Discussions on the 10th Multimodal Transport Corridor between the European Union and Russia, which could pass through Latvia (Moscow - Riga - Ventspils - Liepāja), and which could mainly be used for oil and gas transit, are ongoing. For Russia, after having lost the non-freezing Baltic Ports, it is the only direct and fast way to Europe.

Germany has also displayed interest in the issue.

## 6. International cooperation (including Intra-cooperation within the Baltic Sea Region)

### 6.1. Intra-Baltic energy cooperation

A number of multilateral structures have been created in recent years to promote regional cooperation. These bodies tend to involve states in contiguous areas, with traditional ties. They include for example the Council of Baltic Sea States: Denmark, Norway, Sweden, Finland, the Russian Federation, Estonia, Latvia, Lithuania, Poland and Germany.

Only some years ago the co-operation ship of the “Baltic Sea Chambers Organisation Association” (BCCA) was founded. 48 chambers of commerce and industry of all Baltic Sea countries have joined as a member the BCCA. The overall aim of the BCCA is the promotion of the economic development, commerce and trade and the economic co-operation in the Baltic Sea region.

Frequent interactions within the framework of these bodies improve relations between neighbouring states and encourage the development of regional economic cooperation in the BSR. Concerning the potential candidates for EU-Membership, in particular Poland, the European Union supports these initiatives as complementary developments to the pre-accession strategy.

The regional cooperation among the Nordel network in energy utilisation and environmental protection is already well established.

Inaugurated in 1993, the Nordel cooperation includes Denmark, Finland, Norway and Sweden. It was meant to exchange the marginal surplus in order to balance the independent national production systems. Today, the cooperation allows extensive electricity trade within the Nordic region. As consequence, Norway turns out to be a net exporter to Sweden and Denmark, whereas Sweden matches its sales to Denmark and Finland through import of norwegian power. Denmark and Finland appear as net importer of electricity.

Following the liberalisation of the Nordic electricity markets, a commercially based trade is developing between the Nordic peninsula and the non-liberal regimes in northern continental Europe. Background of this trade is the attractive complementarity between nordic hydro-power and continental heat-based power: hydro power can be used for top-load production whereas heat power can be used for base load and dry-seasons.

In the Eastern countries the energy cooperation is not so closely and so far developed as in the Nordel countries. The BS for example cooperate among each other in the subject of energy. But this energy cooperation is reserved and restricted. There is much competition among the BS. In all three BS there exists the tendency to maintain an independent energy policy. The mentioned border disputes, in particular between Latvia and Lithuania, are symptoms for a weak willingness to cooperate in vital intrabaltic energy questions. Regional Cooperation among the Baltic countries can contribute substantially to maximize the use of scarce resources and to strengthen the economic situation in the whole region.

Main efforts are ongoing to strengthen the intrabaltic cooperation among the Eastern and Western parts of the BSR. For example since 1993 there have been about 60 different international projects initiated and financed by the Swedish National Board for Industrial and Technical Development NUTEK: hereunder are about 40 minor projects which are cooperations in the three baltic countries and in Russia. Most of the projects focus on urban energy suppliers and include such matters as energy efficiency and district heating. A revolving financing secures future projects which means that the whole return on investments from current investments are reinvested. All projects belong to the Swedish programme for An Environmentally Adapted Energy System in the Baltic region and in Eastern Europe *EAES*.

The German Preussen Elektra has helped to install two windmill power plants in Latvia, which is going to be monitored by the German research association for environmentally sound energy conversion and use, ltd. Further the Wuppertal Institute for Climate, Environment and Energy carries out simulation studies with respect to four types of JI projects, e.g. solar energy plants.

Concerning Joint Implementation projects, Finland's state owned IVO is involved in cooperations with Russia.

The environment of the Baltic Sea is of special importance. Due to its slow water exchange the Baltic Sea reacts sensitive to contributions of pollutants and nutrient loads. In April 1992 the Baltic countries adopted the Baltic Sea Environmental Action Programme. The basic aim of this programme is the safeguard of the Baltic Sea, its ecological restoration and the preservation of its ecological balance.

## 6.2. EU- and international cooperation

Due to the strategic political and trading situation of the Baltic Sea Region and since Baltic States and Poland expressed their willingness to become EU's Member States, large scale EU and international cooperation in the region appears as a priority.

International and multi-country cooperation, as a means of promoting political stability and economic ties, is considered by the EU of particular importance for the success of the pre-accession strategy.

EU and international energy cooperation in the BSR is already significant. It is implemented in the frame of both agreements and support programmes. These instruments address issues relating to the integration of the region, and thus aim to overcome obstacles which impede further cooperation. The major energy-related instruments providing technical and financial support in the BSR are the following ones:

**Phare**, which provides technical assistance in CEEC through financial support within the frame of multi-country energy programmes, country operational programmes, and cross-border programme (financing of structural projects in border region of CEC sharing a common border with EU member States, in close cooperation with the EU regional programme INTERREG II), and **Tacis**, having similar activities in the NIS;

**The 4<sup>th</sup> Framework programme for R&D** promoting cooperation in the field of energy technology through demonstration project and dissemination activities within the INCO-COPERNICUS, JOULE-THERMIE specific programmes;

**Synergy**, addressing Cooperation activities in the field of energy policy

A list of projects implemented within EU-cooperation programmes is attached in annex 1 (table 6-1).

European and International financing institutions are playing a crucial part regarding the financial requirements of the energy sector restructuring in the BSR. The EIB grants loans for projects relating to infrastructures. The **EBRD** and the **World Bank** are both involved in energy investment financing (i.e. Baltic Investment Funds) and support for technical projects.

The European Energy Charter Treaty appears as a very important instrument as it provides an international legal framework aimed at securing energy cooperation in the fields of transit, trade, investments and environment.

Some cooperation is also initiated in the frame of international organisations such as **IEA**., **IAEA** and **UN Economic Committee for Europe** (Energy efficiency 2000 project)

Concerning international environmental commitments all countries of the BSR signed the UN Framework Convention on Climate Change, committing themselves to limit greenhouse gas emissions, including CO<sub>2</sub> emissions, in the future.

Denmark is part of the Nordic Council's Ad Hoc Group on climate strategies which carries out the Nordic Joint Implementation (JI) study which analyses five energy projects in Eastern Europe. Policy options and recommendations

## 7. Policy options and recommendations

Policy options for further EU-cooperation should focus to the following objectives:

- Support of the transformation process of the Non-EU-Member States of the BSR towards competitive market economies:  
As long as the fundamental transformation process of the economies in transition is not successfully completed there exists the risk that the process may erode with unforeseen negative political, economic and social consequences.  
Special importance should be given to the candidates for an EU-Membership (pre-accession strategy).
- Strengthen the security of energy supply for Europe:  
With the exception of Russia near all countries of the BSR are large net importer of energy. Poland's energy import dependence will grow due to its declining coal sector. The Baltic region plays a key role in its function as a transient energy supplier and distributor for energy supplies from Russia towards Western Europe. The European Union has a vital interest in stabilising and expanding this energy supply structure across the Baltic region.
- Protection of the environment:  
A lack of environmental standards has led to a degradation of the environment in the Non-EU-Member States of the BSR. Environmental standards must be integrated in national and international frameworks.
- integration of the energy markets  
There still exist several isolated power networks (see chapter 5.1). Large investments are required to overcome the technical problems of network integration and to build up the necessary hardware structure (power connection lines, dispatch stations etc.).  
But there is not only a lack of technical integration. The energy markets, in particular the electricity markets, differ significantly in their framework and conceptual design, not only between the Western and Eastern countries of the Baltic Sea Region, but also within these country groups.



To meet these overall objectives main efforts should be aimed at the following priority areas:

**Rational use of energy (RUE)**

Special attention and support should be paid to the reduction of the high energy inefficiency in the Non-EU-Member States of the BSR. The EU-Member States of the BSR are strong in well proven energy saving technologies. They could be transferred to the East European countries.

The following sectors are expected to have large energy saving potentials in the former centrally planned economies, therefore they are of special importance:

1. General energy infrastructure:  
The main part of the energy infrastructure facilities like power generation plants, district heating systems (DHS) are obsolete and in a poor state. Some facilities in some countries are already 50 years old and still in operation. A rehabilitation strategy for the facilities is needed to improve the energy efficiency and to secure future energy requirements: refurbishment, modernisation of the existing ones and the construction of new up to date facilities.
2. Residential sector including the DHS-supply for this sector is a source of high energy inefficiency. Energy savings opportunities include: installation of heat meters, installation of valves for controlling radiators.
3. RUE in industry: There is a large scope for energy saving. Saving opportunities include: automation of industrial processes, application of modern manufacturing technologies, combined cycle power generation, combined heat plants (CHP).

**Clean technologies**

Technology transfer and installation of clean technologies are required to realise and enforce environmental standards and aims such as emission reduction aims.

**Modern gas technologies**

Gas is becoming of increasing importance in the region, in particular in the East European countries of the BSR. Support should be given in the introduction of modern high efficient gas technologies such as combined cycle technologies as CCGT (Combined Cycle Gas Turbines).

**Strengthening the role of RES (Renewable energy sources)**

There is a substantial potential of regenerative energies in the total Baltic Sea region. The development of this potential is a challenge for the energy policy. It depends heavily on the international co-operation among the Baltic Sea countries.

Already today Denmark covers approx. 50 % of its power supply by renewable energy and by CHP, a further expansion is planned. The potential in the former East Bloc states is expected to be as big as in Denmark, but mainly undeveloped. A future energy policy should aim at the development of the great potential of renewables in the Baltic Sea region.

Besides these more technical subject areas the development and application of adequate political instruments is necessary.

The reduction of emissions, the enforcement of energy saving programmes and the development towards unified energy markets depend not only on technological measures, but also on reducing barriers to the diffusion and transfer of technology, on mobilising financial resources and on the implementation of changes in behaviour.

A large range of policy instruments are available to support the practical implementation of these aims.

On the supply side are:

- Establishment of appropriate institutional and structural frameworks
- Price reform and the removal of energy subsidies
- Restructuring of the energy supply sector

On the demand-side are:

- Utility demand side management programmes
- Least Cost Planning (LC) and the extended approach of Integrated Resources Planning methods
- Energy efficiency loan funds
- Environmental protection taxes and other market oriented instruments to influence environmental behaviour
- Product energy-efficiency labeling
- Renewable energy incentives
- Market pull and demonstration programmes that stimulate the development and application of advanced technologies
- Education and training; energy and environmental information, advisory measures

The successful enforcement of practical measures concerning the above mentioned issues depends on the way how the cooperation strategy is institutionalised in an effective manner. Existing intraregional network organisations such as the Baltic Energy Cooperation Council and the Baltic Chamber of Commerce can serve as institutional platforms for the practical enforcements for the cooperation strategy. It is important that the above mentioned issues are strongly embedded into the EU-programmes for the Baltic Region.

The ongoing transformation of the energy market towards deregulation in all countries of the BSR offers chances for a new ecological orientation. The conceptual design of a new intrabaltic infrastructure among the power suppliers of the BSR could regard an integrated utilisation concept of all renewable energy sources in a national as well as in an transnational (intrabaltic) relation.

A well functioned institutional framework is of central importance for the achievement of competitive efficient energy markets, in particular in the East European countries of the BSR.

Concerning institutional reforms a list of measures which should be supported by the EU and other international organisations can be summarised as follows:

### Adjustment of energy prices to reflect economic cost

Higher prices will lead to better utilisation of energy. Only relatively high energy prices ensure that it is attractive for the consumer to save energy. It must be regarded that there is a strong mutual interdependence between the macroeconomic framework conditions and the individual behaviour on the microeconomic level. The increase of energy prices makes only sense, when the market participants on the demand side can respond to price adjustments. This is not possible for instance when in the case of East European countries there is e.g. a lack of metering and heat regulation devices for individual consumption control. It is important to regard negative social consequences on low incomes which cannot afford high prices. Suitable social safety measures should be developed and financially supported to ensure social acceptability of real price increases to vulnerable users.

Reform of institutional framework conditions to attract investors to invest into the energy sector

### Provision of funds for investments to promote energy efficiency

Such funds can support cost-effective small investments in a wide range of mass applications which can provide a significant amount when they are bundled and managed by local financing intermediaries.

It is recommended that energy efficiency loans are accompanied by technical services such as: energy audits for industry and buildings, loan processing training for banking, industrial and utility organisations.

### Incentives for investments into renewable sources (RES)

Modern technologies for utilising biomass in an economic and environmentally viable way could be implemented to exploit the supposed high RES potential in the BSR. Cogeneration plants based on biomass (biogas) are most prospective.

To ensure quick short-term results it is recommended that international programmes aim rather to concrete investment projects (e.g. energy efficiency) than to general studies and evaluations.

The required financial means for restructuring the energy sector in the BSR can be granted by the following institutions:

- European Union

World Bank

Bilateral agreements between national donor countries and the supported country.

The financial funding available for the Baltic Sea region have increased substantially. The sum of all financial means available from the EU for this region in the period from 1995 to 1999 accounts for 950 Million ECU. Because these funding are enlarged by national means the total available financial volume reaches almost 5 billion ECU.

In addition to the financial transfer of these funding institutions private capital and investment transfer should be supported by incentives and favourable framework conditions.

Technology transfer on a private commercial basis from the higher developed Western countries into the Eastern countries of the BSR is essential for closer market integration and for restructuring of the economies in transition. This is a large market chance for companies from the EU-Member states.

The described energy developments within the basic transformation process of the BSR is a great challenge for all participating countries, but it also offers great chances. The Baltic Region can evolve to one of the leading economic regions in Europe. As a result of the recommended policy options and measures the vision of a unified high efficient transnational energy market may get a more concrete shape. This energy market will comprise the largest concentration of energy infrastructure facilities in whole Europe: electricity grids, oil harbours, gas and oil pipelines connecting East and West, South and North Europe about the crossroads of the Via Baltica.

## Abbreviations

AC	Alternate current
barrel	barrel of oil = approx. 0.136 tonnes
Bcm	Billion cubic metres
Bn.	billion = $10^9$ = 1, 000, 000
BS	the three Baltic States: Lithuania, Latvia, Estonia
BSR	Baltic Sea region
CCGT	Combined Cycle Gas Turbines: combined gas and steam turbine to produce electricity; in this combined cycle the exhaust heat of the gas turbine is used to heat the steam in the following steam turbine.
CNG	compressed natural gas
COMECON	
DC	Direct current
DHS	District Heating Systems
DSM	Demand side management
EAES	a Swedish Programme for an "Environmentally Adapted Energy System in the Baltic region and Eastern Europe" administered by NUTEK
EBRD	European Bank for Reconstruction and Development
EU	European Union
EU-MS	European Union Member States
EU nn	e.g. EU 15 means: EU region of the 15 members; remark: the term "EU 15" is also used for the period <i>before</i> the membership of Austria, Finland, Sweden, when the figures are related to all <b>15</b> countries; analogous means EU 12: EU region of the 12 member countries
FCCC	UN Framework Convention on Climate Change
FEC	Fuel and Energy Complex (in Russia)
FSU	Former Soviet Union
G	prefix for $10^9$ = Giga
GDP	Gross Domestic Product
GHG	Green house gas (emissions)
GJ	Giga Joule
GW	Gigawatt
Gm3	Giga cubic meter
HOB	heat only boilers
HVCD	High Voltage Direct Current
I PP	Independent Power Producers
JI	Joint Implementation (in the framework of FCCC)
k	prefix for thousand = $10^3$ = kilo
ktoe	kilo tonnes of oil equivalent
kgoe	kg of oil equivalent
LCP	Least Cost Planning
LNG	Liquid natural gas
M	prefix for million = $10^6$ = Mega
Mega	prefix for million = $10^6$
MECU	$10^6$ ECU
Mt	million tonnes
Mtoe	million tonnes of oil equivalent
MW	Megawatt = million Watt
MWh	Megawatt hours
NGO	Non Government Organisation
Non-EU-MS	Non European Union Member States
NUTEK	National Board for Industrial and Technical Development (in Sweden)
OECD	Organisation of Economic Co-operation and Development
p.a.	per annum
RES	Renewable energy sources
R/P-ratio	Reserve/Production ratio: indigenous production in per cent of domestic energy consumption
tce	tons coal equivalent

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.
TJ	Terajoule ( $10^{12}$ joules).
toe	tonnes of oil equivalent; 1 toe = 42 GJ*
TPA	Third Party Access
TPES/GDP	a ratio of total primary energy (in Mtoe) to GDP (measured in billions of US dollars at 1990 prices and exchange rates); energy intensity.
TPES	total primary energy supply
TWh	Tera Watt hours

#### Conversion Factors and Energy Equivalents

1 toe	= 42 GJ*
1000 m <sup>3</sup> of natural gas	= 0.857 toe
1 tonne natural gas liquids	= 1.096 toe

#### Notes

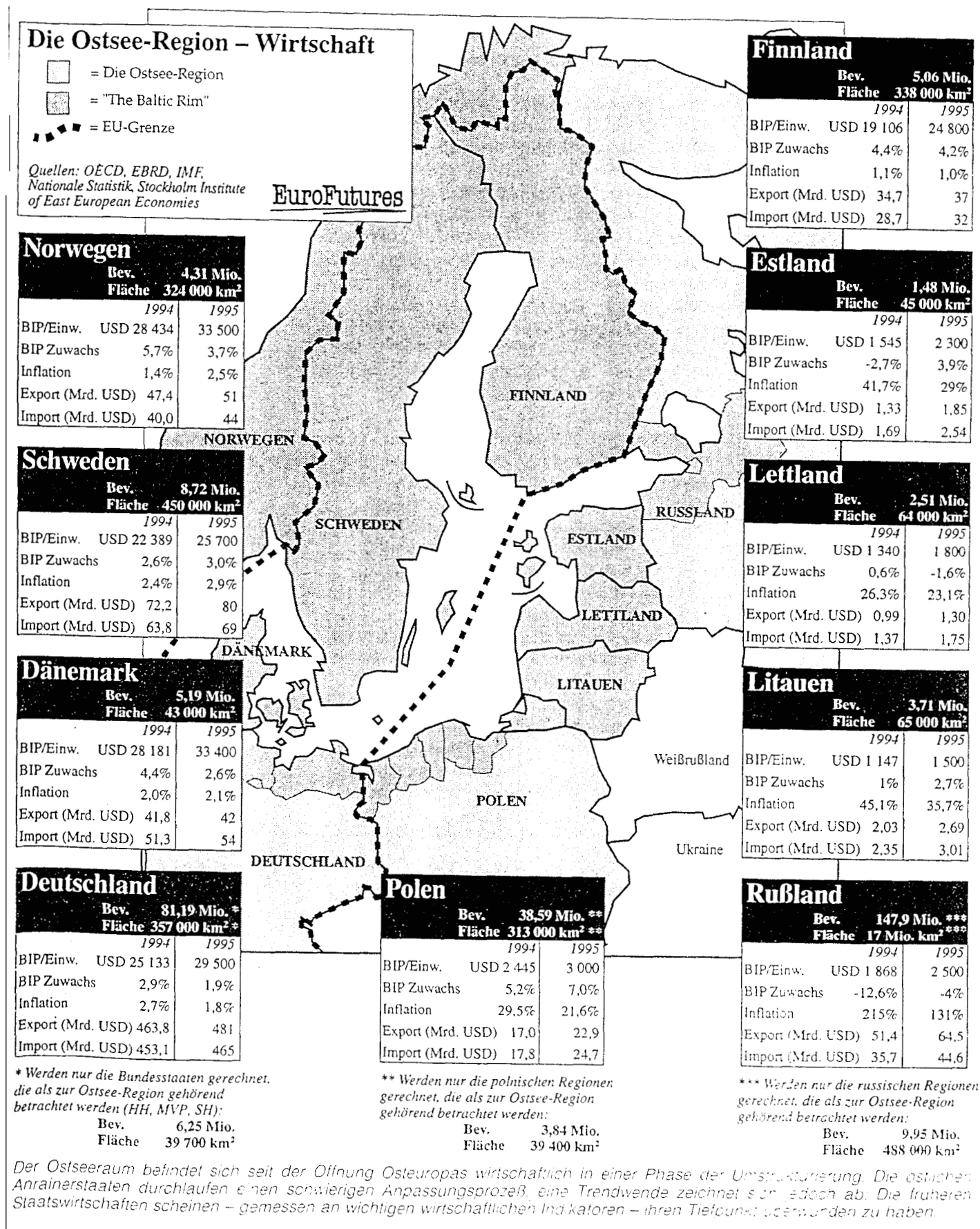
\* WEC standard conversion factors (from Standards Circular No. 1, 11/83), see WEC 95

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**Map of the Baltic Sea Countries** (source: Frankfurter Allgemeine Zeitung, 3. September 1996, Nr. 205, page B 3)

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## 2. Tables to chapter 2

Main country indicators of the Baltic Sea Region (1995, if not otherwise specified)										
Indicators	Germany	Denmark	Sweden	Finland	Poland	Estonia	Latvia	Lithuania	Russia	Total
<b>AREA</b> (qkm)										
a) total country	357,000	43,000	450,000	338,000	313,000	45,000	64,000	65,000	17,000,000	18,675,000
b) only Baltic Sea regions *	39,700	43,000	450,000	338,000	39,400	45,000	64,000	65,000	48,800	1,132,900
<b>POPULATION</b> (Mio.)										
a) total country	81.19	5.19	8.72	5.06	38.59	1.48	2.51	3.71	147.9	294.35
b) only Baltic Sea regions *	6.25	5.19	8.72	5.06	3.84	1.48	2.51	3.71	9.95	46.71
<b>GDP</b> (1995)										
Mrd. US\$						3.5	4.4	5.6		
per capita (US\$)	29,500	33,400	25,700	24,800	3,000	2,300	1,800	1,500	2,500	
real GDP growth rate (% pa)										
a) 1994	2.9	4.4	2.6	4.4	5.2	-2.7	0.6	1.0	-12.6	
b) 1995	1.9	2.6	3.0	4.2	7.0	3.9	-1.6	2.7	-4.4	
<b>Inflation</b> (%), 1995 (1996)	1.8	2.1	2.9	1.0	21.6	29 (14.8)	23.1 (13.5)	15.7 (13.1)	131.4	
<b>Export</b> (Mrd. USD)	481	42	80	37	22.9	1.85	1.3	2.69	64.5	
<b>Import</b> (Mrd. USD)	465	54	69	32	24.7	2.54	1.75	3.01	44.6	

Remark: \* For Germany, Poland and Russia only the country parts which belong to the "Baltic Rim" are regarded. These regions comprise:  
Germany: the federal states Hamburg, Mecklenburg-Vorpommern and Schleswig-Holstein  
Poland: the administration regions Szczecinskie, Koszalinские, Slupskie, Gdanskie  
Russia: mainly St. Petersburg region and Kaliningrad  
Concerning the exact geographical area of the "Baltic Rim" see attached map of the BSR; sources: OECD, EBRD, IMF, BFAI, national statistics, Stockholm Institute of East European Economies etc.

Table 2-1: Country overview Baltic Sea Region: Main country indicators

### 3. Tables to chapter 3

Summary Energy Balance of Poland and the Baltic States in 1996						
	Poland	Estonia	Latvia	Lithuania	Total Baltics	Total
<b>Primary Production (ktoe)</b>	<b>90,519</b>	<b>3,684</b>	<b>640</b>	<b>3,961</b>	<b>8,285</b>	<b>98,804</b>
Coal	85,837	0	0	0		
Oil	293	0	0	129		
Natural Gas	3,008	0	0	0		
Oil-Shale		3,276				
Primary Electricity	933	0	526	3,604		
Other	447	407	114	228		
<b>Net imports (ktoe)</b>	<b>3,187</b>	<b>1,718</b>	<b>3,261</b>	<b>4,329</b>	<b>9,308</b>	<b>12,494</b>
Coal	-18,372	50	129	139		
Oil and Petroleum products	15,398	1,028	1,340	3,232		
Natural Gas	6,716	621	829	2,234		
Oil-Shale		253				
Electricity	-556	-204	963	-1,276		
Other	0	-30		0		
<b>Consumption (ktoe)</b>	<b>93,705</b>	<b>5,381</b>	<b>3,902</b>	<b>8,290</b>	<b>17,572</b>	<b>111,278</b>
Coal	67,466	50	129	139		
Petroleum products	15,691	1,028	1,340	3,361		
Natural Gas	9,724	621	829	2,234		
Oil-Shale		3,306				
Primary Electricity	377		1,489	2,328		
Other	447	377	114	228		
<b>Shares in total consumption (%)</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>		
Coal	72.0	0.9	3.3	1.7		
Petroleum products	16.7	19.1	34.4	40.5		
Natural Gas	10.4	11.5	21.2	26.9		
Oil-Shale		61.4	0.0	0.0		
Primary Electricity	0.4	0.0	38.2	28.1		
Other	0.5	7.0	2.9	2.8		
<b>Electricity Generation (TWh) *</b>	<b>113.6</b>	<b>9.2</b>	<b>4.4</b>	<b>10.0</b>	<b>24</b>	<b>137</b>
Nuclear				7.7		
Hydro & Wind			3.3	0.7		
Thermal	113.6	9.2	1.1	1.6		
<b>Indicators</b>	<b>Poland</b>	<b>Estonia</b>	<b>Latvia</b>	<b>Lithuania</b>	<b>EU-average</b>	
Self Sufficiency ratio (%)	96.6	68.5	16.4	47.8		
Import dependency (%)	3	32	84	52	46.0	
Energy intensity (toe/1985 MECU)*	910	1,582	856	1,587	296	
Energy consumption per capita (toe)*	2.5	3.8	1.8	2.1	3.6	
CO2 Emissions/Capita (t of CO2/inhab.)*	8.9	11.7	4.3	4.3	8.4	
Electricity generated/capita (kWh/inhab.)*	3000	5983	1719	2713	6112	
Remark: * refers to 1994 values, partially estimated						
Source: PlanEcon 97 and EC 96 a						

Table 3-1: Non-EU-Member States (Poland, three BS): Summary Energy balance

All BSR countries: Shares of energy sources of energy consumption (%)															
	90			94			2000			2005			2010		
	Gas	Oil	Coal	Gas	Oil	Coal	Gas	Oil	Coal	Gas	Oil	Coal	Gas	Oil	Coal
Denmark	9,8	47,7	33,3	13,0	44,3	38,3	22,8	42,2	24,8	27,4	43,5	19,0			
Germany	15,5	35,7	36,2	18,2	40,2	28,5	20,0	38,0	29,2	21,3	37,3	28,0	22,3	36,2	27,6
Sweden	1,1	31,2	6,2	1,3	31,5	5,4	1,8	31,7	4,9	2,1	31,7	4,8			
Finland	7,9	34,8	18,6	9,3	32,1	21,9	11,0	29,2	23,2	11,1	27,4	25,9	10,5	25,7	26,6
Poland	9,2	16,2	73,6	9,3	15,2	74,3	10,3	17,7	71,0				14,0	20,6	64
Lithuania	37,3	43,6	7,0	20,4	44,9	3,3	51,4	28,0	2,0				70,2	24,7	1,5
Latvia	25,6	36,6	7,7	18,6	46,5	2,7	31,4	35,1	3,0				33,9	35,6	2,2
Estonia	14,3	36,1	2,6	9,2	22,7	1,3	15,3	17,2	0,8				45,7	16,7	0,7
Russia	42,3	30,1	20,8	51,4	22,2	18,4	55,9	19,2	16,2				59,2	20,6	12,6
Remarks:															
the figures relate to the particular country tables; for the EU-MS the share is related to TPES in the respective country tables; (for the Non-EU-MS the share is related to total consumption)															

Table 3-2: All BSR countries: shares of energy sources of energy consumption

	Share of net exports in total primary energy supply	Share of imports in total primary energy supply	Share of exports in total primary energy supply
Estonia	-39%	47%	8%
Latvia	-88%	91%	4%
Lithuania	-70%	107%	37%
Poland	-1%	23%	24%
Russia	50%	4%	54%

**Note:** A minus indicates that the country is a net importer of energy.

**Sources:** IEA (1996), *Energy Statistics and Balances of Non-OECD Countries: 1993-1994*, OECD, Paris, individual country tables.

**Table 3-3: Energy import dependence in non-EU Member States of the BSR in 1994**

	Electricity exports/total electricity production		Electricity net exports/total electricity consumption	
	1992	1994	1992	1994
Estonia	30%	24%	na	-16%
Latvia	0%	19%	-52%	-29%
Lithuania	57%	60%	40%	-10%
Poland	7%	5%	3%	2%
Russia	4%	5%	2%	2%

**Source:** UN (1996), *Energy Statistics Yearbook 1994*, New York, table 35 on 'Production, trade and consumption of electricity in million kWh'.

**Table 3-4: Electricity exports in non-EU Member States of the BSR, 1992 and 1994**

## 4. Tables to chapter 4

**Tab. 4.1: Denmark\***

### Energy Balances and Key Indicators

Unit: Mtoe

SUPPLY							
	1973	1990	1993	1994	2000	2005	2010
<b>TOTAL PRODUCTION</b>	<b>0.31</b>	<b>9.92</b>	<b>13.74</b>	<b>14.90</b>	<b>16.23</b>	<b>12.72</b>	--
Coal <sup>1</sup>	--	--	--	--	--	--	--
Oil	0.07	6.11	8.43	9.30	7.10	3.60	--
Gas	--	2.74	3.95	4.29	7.08	7.08	--
Comb. Renewables & Wastes <sup>2</sup>	0.24	1.02	1.26	1.20	1.89	1.84	--
Nuclear	--	--	--	--	--	--	--
Hydro	--	--	--	--	--	--	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other <sup>3</sup>	--	0.05	0.09	0.10	0.15	0.20	--
<b>TOTAL NET IMPORTS<sup>4</sup></b>	<b>19.85</b>	<b>8.16</b>	<b>4.83</b>	<b>5.07</b>	<b>3.92</b>	<b>7.56</b>	--
Coal <sup>1</sup> Exports	0.04	0.03	0.02	0.04	--	--	--
Imports	1.91	6.23	6.36	7.14	5.00	3.85	--
Net Imports	1.87	6.20	6.34	7.11	5.00	3.85	--
Oil Exports	2.89	5.52	9.32	10.17	8.94	5.14	--
Imports	21.58	8.76	10.49	11.54	11.40	11.52	--
Bunkers	0.69	0.96	1.35	1.49	1.04	1.15	--
Net Imports	18.00	2.28	-0.18	-0.12	1.41	5.23	--
Gas Exports	--	0.93	1.43	1.50	2.49	1.53	--
Imports	--	--	--	--	--	--	--
Net Imports	--	-0.93	-1.43	-1.50	-2.49	-1.53	--
Electricity Exports	0.11	0.42	0.44	0.57	--	--	--
Imports	0.09	1.03	0.54	0.15	--	--	--
Net Imports	-0.02	0.61	0.10	-0.42	--	--	--
<b>TOTAL STOCK CHANGES</b>	<b>-0.44</b>	<b>0.17</b>	<b>1.21</b>	<b>0.73</b>	<b>--</b>	<b>--</b>	<b>--</b>

<b>TOTAL SUPPLY (TPES)</b>	<b>19.72</b>	<b>18.25</b>	<b>19.78</b>	<b>20.70</b>	<b>20.16</b>	<b>20.28</b>	<b>--</b>
Coal <sup>1</sup>	1.93	6.07	7.22	7.94	5.00	3.85	--
Oil	17.57	8.71	8.69	9.18	8.51	8.83	--
Gas	--	1.79	2.41	2.69	4.59	5.55	--
Comb. Renewables & Wastes <sup>2</sup>	0.24	1.02	1.26	1.20	1.89	1.84	--
Nuclear	--	--	--	--	--	--	--
Hydro	--	--	--	--	--	--	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other <sup>3</sup>	--	0.05	0.09	0.10	0.15	0.20	--
Electricity Trade <sup>5</sup>	-0.02	0.61	0.10	-0.42	--	--	--
<b>Shares (%)</b>							--
Coal	9.8	33.3	36.5	38.3	24.8	19.0	--
Oil	89.1	47.7	43.9	44.3	42.2	43.5	--
Gas	--	9.8	12.2	13.0	22.8	27.4	--
Comb. Renewables & Waste	1.2	5.6	6.4	5.8	9.4	9.1	--
Nuclear	--	--	--	--	--	--	--
Hydro	--	--	--	--	--	--	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	0.3	0.5	0.5	0.8	1.0	--
Electricity Trade	-0.1	3.3	0.5	-2.0	--	--	--

\* Source: International Energy Agency (1996), "Energy Policies of IEA Countries, 1996 Review".

**Table 4-1: Denmark: Energy Balances and Key indicators (continuation next pages)**



<b>DEMAND</b>							
<b>FINAL CONSUMPTION BY SECTOR (combination of Table 4.1 Denmark)</b>							
	<b>1973</b>	<b>1990</b>	<b>1993</b>	<b>1994</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>
<b>TFC</b>	<b>16.32</b>	<b>14.30</b>	<b>15.03</b>	<b>15.16</b>	<b>14.83</b>	<b>15.03</b>	--
Coal <sup>1</sup>	0.34	0.39	0.38	0.41	0.43	0.42	--
Oil	14.26	8.03	7.90	7.98	7.75	8.02	--
Gas	0.12	1.13	1.48	1.54	1.07	0.92	--
Comb. Renewables & Wastes <sup>2</sup>	0.24	0.40	0.50	0.47	0.52	0.49	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	0.02	0.02	--
Electricity	1.37	2.52	2.63	2.67	2.74	2.79	--
Heat	--	1.84	2.13	2.09	2.30	2.37	--
<b>Shares (%)</b>	--	--	--	--	--	--	--
Coal	2.1	2.7	2.5	2.7	2.9	2.8	--
Oil	87.4	56.1	52.5	52.7	52.3	53.3	--
Gas	0.7	7.9	9.9	10.2	7.2	6.1	--
Comb. Renewables & Waste	1.5	2.8	3.3	3.1	3.5	3.3	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	0.1	0.2	--
Electricity	8.4	17.6	17.5	17.6	18.5	18.6	--
Heat	--	12.8	14.2	13.8	15.5	15.7	--
<b>TOTAL INDUSTRY<sup>6</sup></b>	<b>4.08</b>	<b>3.08</b>	<b>3.01</b>	<b>3.18</b>	<b>3.08</b>	<b>3.08</b>	--
Coal	0.21	0.31	0.30	0.34	0.39	0.39	--
Oil	3.41	1.31	1.22	1.23	1.39	1.45	--
Gas	0.02	0.53	0.56	0.61	0.21	0.05	--
Comb. Renewables & Waste	0.05	0.11	0.07	0.10	0.09	0.09	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	--	--	--
Electricity	0.40	0.75	0.78	0.82	0.93	1.03	--
Heat	--	0.07	0.08	0.08	0.08	0.08	--
<b>Shares (%)</b>	--	--	--	--	--	--	--
Coal	5.2	10.1	10.1	10.8	12.5	12.8	--
Oil	83.6	42.6	40.5	38.6	45.2	46.9	--
Gas	0.4	17.1	18.5	19.3	6.7	1.6	--
Comb. Renewables & Waste	1.1	3.5	2.5	3.2	3.0	3.0	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	--	--	--
Electricity	9.7	24.4	25.9	25.7	30.3	33.4	--
Heat	--	2.4	2.5	2.5	2.4	2.4	--
<b>TRANSPORT<sup>7</sup></b>	<b>3.52</b>	<b>4.58</b>	<b>4.49</b>	<b>4.68</b>	<b>4.39</b>	<b>4.73</b>	--
<b>TOTAL OTHER SECTORS<sup>8</sup></b>	<b>8.72</b>	<b>6.64</b>	<b>7.53</b>	<b>7.30</b>	<b>7.37</b>	<b>7.22</b>	--
Coal <sup>1</sup>	0.13	0.08	0.07	0.07	0.04	0.03	--
Oil	7.34	2.16	2.21	2.09	2.00	1.88	--
Gas	0.10	0.60	0.93	0.93	0.87	0.88	--
Comb. Renewables & Waste	0.20	0.29	0.43	0.37	0.43	0.40	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	0.02	0.02	--
Electricity	0.96	1.75	1.84	1.83	1.79	1.73	--
Heat	--	1.76	2.06	2.01	2.22	2.29	--
<b>Shares (%)</b>	--	--	--	--	--	--	--
Coal	1.4	1.2	1.0	1.0	0.6	0.4	--
Oil	84.1	32.5	29.3	28.7	27.1	26.0	--
Gas	1.2	9.1	12.3	12.7	11.8	12.1	--
Comb. Renewables & Waste	2.2	4.4	5.7	5.0	5.8	5.5	--

Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	0.1	0.1	0.3	0.3	--
<b>Electricity</b>	<b>11.0</b>	26.3	24.4	25.1	24.3	24.0	--
Heat	--	26.6	27.3	27.5	30.1	31.7	--

KEY INDICATORS (continuation of Table 4.1 Denmark)							
	1973	1990	1993	1994	2000	2005	2010
GDP (billion 1990 US\$)	94.80	129.10	133.90	139.80	155.50	168.76	--
Population (millions)	5.02	5.14	5.19	5.21	5.15	5.15	--
TPES/GDP <sup>10</sup>	0.21	0.14	0.15	0.15	0.13	0.12	--
Energy Production/TPES	0.02	0.54	0.69	0.72	0.81	0.63	--
Per Capita TPES <sup>11</sup>	3.93	3.55	3.81	3.98	3.91	3.94	--
Oil Supply/GDP <sup>10</sup>	0.19	0.07	0.06	0.07	0.05	0.05	--
TFC/GDP <sup>10</sup>	0.17	0.11	0.11	0.11	0.10	0.09	--
Per Capita TFC <sup>11</sup>	3.25	2.78	2.90	2.91	2.88	2.92	--
Energy-related CO <sub>2</sub> -emissions (MT CO <sub>2</sub> )	59.55	53.37	59.19	64.31	55.17	53.87	--
CO <sub>2</sub> -emissions from bunkers (MT CO <sub>2</sub> )	2.18	3.05	4.25	4.69	3.28	3.62	--

<b>GROWTH RATES (% per year)</b> (continuation of Table 4.1 Denmark)							
	<b>73-79</b>	<b>79-90</b>	<b>90-93</b>	<b>93-94</b>	<b>94-00</b>	<b>00-05</b>	<b>05-10</b>
TPES	1.1	-1.3	2.7	4.6	-0.4	0.1	--
Coal	14.4	3.1	5.9	9.9	-7.4	-5.1	--
Oil	-1.4	-5.5	-0.1	5.7	-1.2	0.7	--
Gas	--	--	10.6	11.5	9.3	3.9	--
Comb. Renewables& Waste	<b>6.0</b>	10.5	7.4	-5.0	7.9	-0.5	--
Nuclear	--	--	--	--	--	--	--
Hydro	--	--	--	50.0	-6.5	--	--
Geothermal	--	--	--	100.0	--	--	--
Solar/Wind/Other	--	--	20.9	10.9	7.1	5.5	--
TFC	0.4	-1.4	1.7	0.9	-0.4	0.3	--
Electricity Consumption	5.3	2.8	1.5	1.3	0.5	0.3	--
Energy Production	16.6	26.0	11.5	8.4	1.4	-4.8	--
Net Oil Imports	-2.6	-15.9	--	-30.6	--	<b>29.9</b>	--
GDP	1.9	1.8	1.2	4.4	1.8	1.7	--
Growth in the TPES/GDP Ratio	-0.7	-3.1	1.5	0.2	-2.2	-1.5	--
Growth in the TFC/GDP Ratio	-1.5	-3.2	0.4	-3.4	-2.1	-1.4	--

**Tab. 4.2: Germany\***

**Energy Balances and Key Indicators**

Unit: Mtoe

SUPPLY		1973	1990	1993	1994	2000	2005	2010
<b>TOTAL PRODUCTION</b>		<b>171.6</b>	<b>184.8</b>	<b>149.6</b>	<b>142.6</b>	<b>139.33</b>	<b>135.75</b>	<b>130.39</b>
Coal <sup>1</sup>		141.4	121.8	87.9	81.0	79.7	76.2	70.3
Oil		6.8	4.9	3.8	3.6	1.0	--	--
Gas		16.4	13.5	13.7	14.3	13.5	13.3	13.2
Comb. Renewables & Wastes <sup>2</sup>		2.5	3.4	2.6	2.6	4.5	5.2	5.8
Nuclear		3.2	39.7	40.0	39.4	38.7	38.9	39.0
Hydro		1.3	1.5	1.5	1.6	1.9	2.0	2.0
Geothermal		--	--	--	--	--	--	--
Solar/Wind/Other <sup>3</sup>		--	--	0.0	0.1	0.1	0.2	0.3
<b>TOTAL NET IMPORTS<sup>4</sup></b>		<b>167.6</b>	<b>165.5</b>	<b>188.3</b>	<b>192.1</b>	<b>218.9</b>	<b>222.2</b>	<b>225.8</b>
Coal <sup>1</sup>	Exports	18.3	8.2	1.7	2.2	--	--	--
	Imports	15.2	11.5	10.8	12.3	24.8	24.2	28.1
	Net Imports	-3.1	3.3	9.1	10.0	24.8	24.2	28.1
Oil	Exports	10.0	10.3	15.2	16.9	--	--	--
	Imports	171.5	133.2	149.1	151.3	138.4	136.5	132.0
	Bunkers	4.1	2.5	2.2	2.1	3.1	3.1	3.1
	Net Imports	157.4	120.4	131.8	132.3	135.3	133.4	128.9
Gas	Exports	0.1	0.9	1.3	1.4	--	--	--
	Imports	12.4	42.7	48.7	51.1	58.0	63.1	66.3
	Net Imports	12.3	41.7	47.4	49.6	58.0	63.1	66.3
Electricity	Exports	0.7	2.7	2.8	2.9	2.4	2.7	3.3
	Imports	1.7	2.7	2.9	3.1	3.2	4.4	5.8
	Net Imports	1.0	0.1	0.1	0.2	0.8	1.6	2.5
<b>TOTAL STOCK CHANGES</b>		<b>-1.1</b>	<b>4.7</b>	<b>-0.2</b>	<b>1.7</b>	<b>--</b>	<b>--</b>	<b>--</b>

<b>TOTAL SUPPLY (TPES)</b>	<b>338.2</b>	<b>355.1</b>	<b>337.7</b>	<b>336.5</b>	<b>358.2</b>	<b>358.0</b>	<b>356.1</b>
Coal <sup>1</sup>	139.4	128.5	98.2	96.0	104.5	100.4	98.4
Oil	162.2	126.9	135.5	135.4	136.3	133.4	128.9
Gas	28.7	55.0	59.7	61.2	71.5	76.4	79.5
Comb. Renewables & Wastes <sup>2</sup>	2.5	3.4	2.6	2.6	4.4	5.1	5.7
Nuclear	3.2	39.7	40.0	39.4	38.7	38.9	39.0
Hydro	1.3	1.5	1.5	1.6	1.9	2.0	2.0
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other <sup>3</sup>	--	--	0.0	0.1	0.1	0.2	0.3
Electricity Trade <sup>5</sup>	1.0	0.1	0.1	0.2	0.8	1.6	2.5
<b>Shares (%)</b>							
Coal	41.2	36.2	29.1	28.5	29.2	28.0	27.6
Oil	48.0	35.7	40.1	40.2	38.0	37.3	36.2
Gas	8.5	15.5	17.7	18.2	20.0	21.3	22.3
Comb. Renewables & Waste	0.7	1.0	0.8	0.8	1.2	1.4	1.6
Nuclear	0.9	11.2	11.8	11.7	10.8	10.9	10.9
Hydro	0.4	0.4	0.5	0.5	0.5	0.6	0.6
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	--	0.1	0.1
Electricity Trade	0.3	--	--	0.1	0.2	0.5	0.7

\* Source: International Energy Agency (1996), "Energy Policies of IEA Countries, 1996 Review".

**Table 4-2: Germany: Energy Balances and Key indicators** (continuation next pages)

DEMAND							
FINAL CONSUMPTION BY SECTOR (continuation Table 4.2 Germany)							
	1973	1990	1993	1994	2000	2005	2010
<b>TFC</b>	<b>250.5</b>	<b>251.2</b>	<b>242.8</b>	<b>242.3</b>	<b>254.7</b>	<b>253.5</b>	<b>251.1</b>
Coal <sup>1</sup>	59.6	42.9	20.9	19.7	26.4	21.7	18.0
Oil	139.4	118.6	128.8	127.5	125.6	123.0	119.0
Gas	20.7	41.0	46.0	47.3	49.4	52.6	55.2
Comb. Renewables& Wastes <sup>2</sup>	1.7	2.1	1.1	1.3	1.3	1.3	1.4
Geothermal	--	--	--	--	--	--	--
SolarNVindlOther	--	--	--	--	--	--	--
Electricity	26.9	39.1	38.4	38.1	42.7	45.4	47.7
Heat	2.2	7.4	7.6	8.3	9.3	9.5	9.8
<b>Shares (%)</b>	--	--	--	--	--	--	--
Coal	23.8	17.1	8.6	8.1	10.4	8.5	7.2
Oil	55.6	47.2	53.1	52.6	49.3	48.5	47.4
Gas	8.2	16.3	19.0	19.5	19.4	20.7	22.0
Comb. Renewables& Waste	0.7	0.8	0.4	0.5	0.5	0.5	0.5
Geothermal	--	--	--	--	--	--	--
SolarNVindlOther	--	--	--	--	--	--	--
Electricity	10.7	15.6	15.8	15.7	16.8	17.9	19.0
Heat	0.9	3.0	3.1	3.4	3.6	3.8	3.9
<b>TOTAL INDUSTRY</b>	<b>112.2</b>	<b>94.3</b>	<b>81.8</b>	<b>83.4</b>	<b>90.8</b>	<b>90.9</b>	<b>91.1</b>
Coal	35.2	26.3	15.1	15.3	17.6	16.0	14.4
Oil	48.2	28.1	28.9	30.0	30.0	28.0	26.4
Gas	12.8	19.7	18.8	19.3	21.7	23.5	25.2
Comb. Renewables& Waste	0.0	0.1	0.1	0.1	0.2	0.2	0.3
Geothermal	--	--	--	--	--	--	--
SolarNVindlOther	--	--	--	--	--	--	--
Electricity	15.3	18.6	17.4	17.3	19.7	21.4	22.8
Heat	0.7	1.5	1.5	1.5	1.6	1.8	2.0
<b>Shares (%)</b>	--	--	--	--	--	--	--
Coal	31.3	27.9	18.4	18.3	19.4	17.6	15.8
Oil	42.9	29.8	35.3	35.9	33.0	30.8	29.0
Gas	11.4	20.9	23.0	23.1	23.9	25.8	27.7
Comb. Renewables& Waste	--	0.1	0.1	0.1	0.2	0.3	0.3
Geothermal	--	--	--	--	--	--	--
SolarNVindlOther	--	--	--	--	--	--	--
Electricity	13.7	19.7	21.3	20.8	21.7	23.5	25.1
Heat	0.6	1.6	1.9	1.8	1.8	2.0	2.2
<b>TRANSPORT</b>	<b>39.7</b>	<b>60.0</b>	<b>63.8</b>	<b>63.3</b>	<b>61.6</b>	<b>61.7</b>	<b>60.6</b>
<b>TOTAL OTHER SECTORS</b>	<b>98.6</b>	<b>96.8</b>	<b>97.3</b>	<b>95.6</b>	<b>102.2</b>	<b>101.0</b>	<b>99.4</b>
Coal'	22.7	16.6	5.8	4.5	8.8	5.7	3.7
Oil	54.1	31.6	37.5	35.5	35.4	34.7	33.3
Gas	7.8	21.3	27.2	28.0	27.7	29.1	29.9
Comb. Renewables & Waste	1.7	2.0	1.0	1.2	1.0	1.1	1.1
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	--	--	--
Electricity	10.7	19.3	19.7	19.5	21.7	22.7	23.5
Heat	1.6	6.0	6.1	6.8	7.7	7.7	7.9
<b>Shares (%)</b>	--	--	--	--	--	--	--
Coal	23.0	17.1	6.0	4.7	8.6	5.6	3.7
Oil	54.8	32.6	38.5	37.2	34.6	34.4	33.5
Gas	7.9	22.0	28.0	29.3	27.1	28.8	30.1
Comb. Renewables & Waste	1.7	2.1	1.0	1.2	1.0	1.1	1.1
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	--	--	--

Electricity	10.9	20.0	20.2	20.4	21.2	22.4	23.6
Heat	1.6	6.2	6.3	7.1	7.5	7.7	7.9

<b>KEY INDICATORS</b> (continuation Table 4.2 Germany)							
	<b>1973</b>	<b>1990</b>	<b>1993</b>	<b>1994</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>
GDP (billion 1990 US\$)	1137	1640	1704	1753	2154	2485	2798
Population (millions)	79.0	79.4	81.2	81.4	79.1	79.7	78.6
TPES/GDP <sup>10</sup>	0.30	0.22	0.20	0.19	0.17	0.14	0.13
Energy Production/TPES	0.51	0.52	0.44	0.42	0.39	0.38	0.37
Per Capita TPES <sup>11</sup>	4.28	4.47	4.16	4.13	4.53	4.49	4.53
Oil Supply/GDP <sup>10</sup>	0.14	0.08	0.08	0.08	0.06	0.05	0.05
TFC/GDP <sup>10</sup>	0.22	0.15	0.14	0.14	0.12	0.10	0.09
Per Capita TFC <sup>11</sup>	3.17	3.16	2.99	2.98	3.22	3.18	3.19
Energy-related CO <sub>2</sub> -emissions (MT CO <sub>2</sub> )	1076.3	983.1	897.8	888.0	944.8	931.2	918.9
CO <sub>2</sub> -emissions from bunkers (MT CO <sub>2</sub> )	13.0	7.9	7.0	6.4	9.7	9.7	9.7



GROWTH RATES (% per year) (continued)							
	73-79	79-90	90-93	93-94	94-00	00-05	05-10
TPES	1.6	-0.4	-1.7	-0.3	1.0	-0.0	-0.1
Coal	-0.2	-0.6	-8.6	-2.3	1.4	-0.8	-0.4
Oil	0.3	-2.4	2.2	-0.1	0.1	-0.4	-0.7
Gas	10.2	0.6	2.8	2.4	2.6	1.3	0.8
Comb. Renewables & Waste	0.9	2.4	-8.4	1.2	8.9	3.2	2.1
Nuclear	27.5	10.3	0.2	-1.5	-0.3	0.1	0.0
Hydro	3.2	-0.5	0.6	4.7	3.3	0.3	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	-3.3	12.5	8.4
TFC	1.4	-0.7	-1.1	-0.2	0.8	-0.1	-0.2
Electricity Consumption	3.8	1.4	-0.7	-0.6	1.9	1.2	1.0
Energy Production	0.9	0.2	-6.8	-4.6	-0.4	-0.5	-0.8
Net Oil Imports	0.6	-2.7	3.1	0.4	0.4	-0.3	0.7
GDP	2.4	2.1	1.3	2.9	3.5	2.9	2.4
Growth in the TPES/GDP Ratio	-0.7	-2.5	-2.9	-3.1	-2.4	-2.8	-2.4
Growth in the TFC/GDP Ratio	-1.0	-2.7	-2.4	-3.0	-2.6	-2.9	-2.5

**Tab. 4.3: Sweden****Energy Balances and Key Indicators**

Unit: Mtoe

SUPPLY							
	1973	1990	1993	1994	2000	2005	2010
<b>TOTAL PRODUCTION</b>	<b>9.3</b>	<b>29.8</b>	<b>29.3</b>	<b>31.3</b>	<b>31.1</b>	<b>32.9</b>	<b>--</b>
Coal <sup>1</sup>	0.0	0.2	0.3	0.3	--	--	--
Oil	--	0.0	--	0.0	--	--	--
<b>Gas</b>	--	--	--	--	--	--	--
Comb. Renewables & Wastes <sup>2</sup>	3.5	5.5	6.2	6.6	7.2	7.7	--
Nuclear	0.6	17.8	16.0	19.1	18.0	19.6	--
Hydro	5.1	6.2	6.4	5.1	6.0	5.6	--
Geothermal	--	0.0	0.3	0.3	0.0	0.0	--
Solar/Wind/Other <sup>3</sup>	--	0.0	0.3	0.3	0.0	0.0	--
<b>TOTAL NET IMPORTS<sup>4</sup></b>	<b>29.6</b>	<b>17.8</b>	<b>17.7</b>	<b>19.5</b>	<b>19.8</b>	<b>21.4</b>	<b>--</b>
Coal <sup>1</sup> Exports	0.0	0.0	0.1	0.0	0.1	0.1	--
Imports	1.7	2.6	2.3	2.5	2.6	2.7	--
Net Imports	1.7	2.6	2.2	2.5	2.5	2.6	--
Oil Exports	1.4	8.7	10.2	9.3	10.8	11.4	--
Imports	30.4	24.2	25.9	26.7	28.0	29.6	--
Bunkers	1.1	0.7	0.9	1.1	1.0	1.1	--
Net Imports	27.8	14.9	14.8	16.4	16.1	17.2	--
Gas Exports	--	--	--	--	--	--	--
Imports	--	0.5	0.7	0.6	0.9	1.1	--
Net Imports	--	0.5	0.7	0.6	0.9	1.1	--
Electricity Exports	0.4	1.3	0.7	0.6	0.3	--	--
Imports	0.5	1.1	0.7	0.6	0.6	0.5	--
Net Imports	0.1	-0.2	-0.1	0.0	0.2	0.5	--
<b>TOTAL STOCK CHANGES</b>	<b>0.5</b>	<b>0.2</b>	<b>0.2</b>	<b>-0.6</b>	<b>--</b>	<b>--</b>	<b>--</b>

<b>TOTAL SUPPLY (TPES)</b>	<b>39.3</b>	<b>47.8</b>	<b>47.1</b>	<b>50.3</b>	<b>50.9</b>	<b>54.2</b>	<b>--</b>
Coal <sup>1</sup>	1.6	3.0	2.7	2.7	2.5	2.6	--
Oil	28.4	14.9	14.8	15.8	16.1	17.2	--
Gas	--	0.5	0.7	0.6	0.9	1.1	--
Comb. Renewables & Wastes <sup>2</sup>	3.5	5.5	6.2	6.6	7.2	7.7	--
Nuclear	0.6	17.8	16.0	19.1	18.0	19.6	--
Hydro	5.1	6.2	<b>6.4</b>	5.1	<b>6.0</b>	5.6	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other <sup>3</sup>	<b>--</b>	0.0	0.3	0.3	0.0	0.0	--
Electricity Trade <sup>5</sup>	0.0	-0.2	-0.1	0.0	0.2	0.5	--
<b>Shares (%)</b>							
Coal	4.1	6.2	5.8	5.4	4.9	<b>4.8</b>	--
Oil	72.2	31.2	31.4	31.5	31.7	31.7	--
Gas	--	1.1	1.5	1.3	<b>1.8</b>	2.1	<b>--</b>
Comb. Renewables & Waste	<b>9.0</b>	11.5	13.2	13.1	14.1	14.1	--
Nuclear	1.4	37.2	33.9	37.9	35.3	36.1	--
Hydro	13.1	13.1	13.6	10.1	11.7	10.4	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	0.7	0.6	--	--	--
Electricity Trade	0.2	-0.3	-0.1	--	0.5	0.9	--

\* Source: International Energy Agency (1996), "Energy Policies of IEA Countries, 1996 Review".

**Table 4-3: Sweden: Energy Balances and Key Indicators** (continuation next pages)

DEMAND							
FINAL CONSUMPTION BY SECTOR (continuation Table 4.3, Sweden)							
	1973	1990	1993	1994	2000	2005	2010
<b>TFC</b>	<b>35.8</b>	<b>32.6</b>	<b>34.2</b>	<b>35.3</b>	<b>36.1</b>	<b>37.6</b>	--
Coal <sup>1</sup>	1.5	1.5	1.3	1.3	1.5	1.5	--
Oil	24.8	14.0	13.7	14.5	14.3	14.8	--
Gas	0.1	0.4	0.4	0.4	0.5	0.5	--
Comb. Renewables & Wastes <sup>2</sup>	3.5	4.6	4.9	5.0	5.2	5.4	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	--	--	--
Electricity	6.0	10.4	10.4	10.5	11.5	12.4	--
Heat	--	1.7	3.5	3.5	3.2	3.0	--
<b>Shares (%)</b>	--	--	--	--	--	--	--
Coal	4.1	4.7	3.9	3.7	4.0	4.1	--
Oil	69.3	43.0	40.0	41.2	39.6	39.3	--
Gas	0.3	1.1	1.1	1.1	1.2	1.4	--
Comb. Renewables & Waste	9.6	14.2	14.3	14.2	14.4	14.4	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	--	--	--
Electricity	16.6	31.7	30.5	29.9	31.8	32.9	--
Heat	--	5.2	10.1	9.9	8.9	8.0	--
<b>TOTAL INDUSTRY<sup>6</sup></b>	<b>16.1</b>	<b>13.7</b>	<b>13.5</b>	<b>14.1</b>	<b>14.7</b>	<b>15.6</b>	--
Coal	1.4	1.5	1.3	1.3	1.4	1.5	--
Oil	8.3	3.5	3.4	3.8	3.6	3.7	--
Gas	0.0	0.3	0.3	0.3	0.3	0.4	--
Comb. Renewables & Waste	2.9	3.7	3.9	4.0	4.3	4.6	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	--	--	--
Electricity	3.4	4.6	4.3	4.3	4.7	5.0	--
Heat	--	0.2	0.3	0.3	0.3	0.4	0.4
<b>Shares (%)</b>	--	--	--	--	--	--	--
Coal	8.8	10.7	9.9	9.2	9.7	9.8	--
Oil	51.6	25.6	24.9	27.2	24.3	23.6	--
Gas	0.1	1.8	1.9	1.8	2.1	2.3	--
Comb. Renewables & Waste	18.3	26.8	29.0	28.6	29.5	29.7	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	--	--	--
Electricity	21.2	33.8	31.9	30.9	32.0	32.3	--
Heat	--	1.2	2.4	2.3	2.4	2.4	--
<b>TRANSPORT<sup>7</sup></b>	<b>5.5</b>	<b>7.4</b>	<b>7.5</b>	<b>7.7</b>	<b>8.4</b>	<b>9.1</b>	--
<b>TOTAL OTHER SECTORS<sup>8</sup></b>	<b>14.3</b>	<b>11.5</b>	<b>13.2</b>	<b>13.5</b>	<b>13.0</b>	<b>12.9</b>	--
Coal <sup>1</sup>	0.0	0.0	0.0	0.0	0.0	0.0	--
Oil	11.2	3.3	3.1	3.2	2.6	2.3	--
Gas	0.1	0.1	0.1	0.1	0.1	0.2	--
Comb. Renewables & Waste	0.5	1.0	1.0	1.0	0.9	0.8	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	--	--	--
Electricity	2.4	5.5	5.9	6.0	6.6	7.1	--
Heat	--	1.5	3.1	3.2	2.8	2.6	--
<b>Shares (%)</b>	--	--	--	--	--	--	--
Coal	0.3	0.4	0.1	0.1	0.2	0.1	--
Oil	78.7	28.9	23.2	23.8	19.8	17.5	--
Gas	0.7	1.0	1.0	1.0	1.1	1.2	--

Comb. Renewables& Waste	3.6	8.4	7.3	7.4	6.6	6.0	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	--	--	--
Electricity	16.6	47.9	44.7	44.4	50.5	54.9	--
Heat	--	13.4	23.7	23.4	21.8	20.3	--

<b>KEY INDICATORS</b> (continuation Table 4.3 Sweden)							
	<b>1973</b>	<b>1990</b>	<b>1993</b>	<b>1994</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>
GDP (billion 1990 US\$)	166.60	229.80	218.20	222.90	251.02	270.42	--
Population (millions)	8.14	8.57	8.72	8.78	8.96	9.14	--
TPES/GDP <sup>10</sup>	0.24	0.62	0.62	0.62	0.61	0.61	--
Energy Production/TPES	4.84	5.57	5.41	5.72	5.68	5.94	--
Per Capita TPES <sup>11</sup>	4.84	5.57	5.41	5.72	5.68	5.94	--
Oil Supply/GDP <sup>10</sup>	0.17	0.06	0.07	0.07	0.06	0.06	--
TFC/GDP <sup>10</sup>	0.21	0.14	0.16	0.16	0.14	0.14	--
Per Capita TFC <sup>11</sup>	4.40	3.81	3.92	4.02	4.03	4.11	--
Energy-related CO <sub>2</sub> -emissions (MT CO <sub>2</sub> )	89.0	52.8	52.7	55.2	55.3	58.8	--
CO <sub>2</sub> -emissions from bunkers (MT CO <sub>2</sub> )	3.5	2.1	2.9	3.4	3.2	3.5	--

GROWTH RATES (% per year) (continuation Table 1.3, Sweden)							
	73-79	79-90	90-93	93-94	94-00	00-05	05-10
TPES	1.9	0.8	-0.4	6.6	0.2	1.3	--
Coal	1.6	4.7	-2.7	0.2	-1.3	0.5	--
Oil	-0.6	-5.4	-0.3	6.9	0.3	1.3	--
Gas	--	--	9.9	-8.7	6.2	4.0	--
Comb. Renewables & Waste	1.8	3.1	4.2	5.8	1.4	1.4	--
Nuclear	46.7	11.3	-3.4	19.2	-1.0	1.7	--
Hydro	0.3	1.6	1.0	-20.9	2.7	-1.1	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	58.7	75.0	6.1	14.9	--
TFC	0.5	-1.1	1.6	3.1	0.4	0.8	--
Electricity Consumption	3.5	3.2	0.2	1.3	1.4	1.4	--
Energy Production	8.0	6.6	-0.5	7.1	-0.1	1.1	--
Net Oil Imports	0.4	-5.8	-0.2	10.9	-0.3	1.3	--
GDP	1.8	2.0	-1.7	2.2	2.0	1.5	--
Growth in the TPES/GDP Ratio	0.1	-1.2	1.3	4.4	-1.7	-0.2	--
Growth in the TFC/GDP Ratio	-1.3	-3.0	3.4	1.0	-1.6	-0.7	--

**Tab. 4.4: Finland\***

**Energy Balances and Key Indicators**

Unit: Mtoe

SUPPLY		1973	1990	1993	1994	2000	2005	2010
<b>TOTAL PRODUCTION</b>		<b>4.9</b>	<b>11.7</b>	<b>11.6</b>	<b>12.7</b>	<b>13.9</b>	<b>14.8</b>	<b>16.6</b>
Coal <sup>1</sup>		0.1	1.8	1.0	2.1	1.9	2.0	2.0
Oil		--	--	--	--	--	--	--
Gas		--	--	--	--	--	--	--
Comb. Renewables & Wastes <sup>2</sup>		3.9	4.0	4.2	4.5	5.4	6.2	8.1
Nuclear		--	50.	5.2	5.1	5.5	5.5	5.5
Hydro		0.9	0.9	1.2	1.0	1.1	1.1	1.1
Geothermal		--	--	--	--	--	--	--
Solar/Wind/Other <sup>3</sup>		--	--	--	--	--	0.0	0.0
<b>TOTAL NET IMPORTS<sup>4</sup></b>		<b>16.6</b>	<b>17.5</b>	<b>16.0</b>	<b>20.1</b>	<b>20.6</b>	<b>23.2</b>	<b>25.2</b>
Coal <sup>1</sup>	Exports	0.0	0.0	0.0	0.1	--	--	--
	Imports	2.4	4.4	4.0	5.4	6.1	7.8	9.2
	Net Imports	2.4	4.4	4.0	5.3	6.1	7.8	9.2
Oil	Exports	0.2	1.7	3.5	3.8	4.0	4.0	4.5
	Imports	14.0	12.2	12.8	15.6	14.8	15.1	16.0
	Bunkers	0.1	0.6	0.5	0.4	0.7	0.7	0.7
	Net Imports	13.8	10.0	8.7	11.4	10.1	10.4	10.8
Gas	Exports	--	--	--	--	--	--	--
	Imports	--	2.3	2.6	2.8	3.8	4.2	4.4
	Net Imports	--	2.3	2.6	2.8	3.8	4.2	4.4
Electricity	Exports	0.0	0.0	0.0	0.1	0.1	--	--
	Imports	0.4	0.9	0.7	0.6	0.7	0.8	0.9
	Net Imports	0.4	0.9	0.7	0.6	0.6	0.8	0.9
<b>TOTAL STOCK CHANGES</b>		<b>-0.1</b>	<b>-0.6</b>	<b>1.2</b>	<b>-2.3</b>	<b>--</b>	<b>--</b>	<b>--</b>



<b>TOTAL SUPPLY (TPES)</b>	<b>21.3</b>	<b>28.6</b>	<b>28.7</b>	<b>30.5</b>	<b>24.5</b>	<b>27.9</b>	<b>41.8</b>
Coal <sup>1</sup>	2.6	5.3	5.5	6.7	8.0	9.8	11.1
Oil	13.6	10.0	9.4	9.8	10.1	10.4	10.8
Gas	--	2.3	2.6	2.8	3.8	4.2	4.4
Comb. Renewables & Wastes <sup>2</sup>	3.9	4.2	4.2	4.6	5.4	6.2	8.1
Nuclear	--	5.0	5.2	5.1	5.5	5.5	5.5
Hydro	0.9	0.9	1.2	1.0	1.1	1.1	1.1
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other <sup>3</sup>	--	--	--	--	--	0.0	0.0
Electricity Trade <sup>5</sup>	0.4	0.9	0.7	0.6	0.6	0.8	0.9
<b>Shares (%)</b>							
Coal	12.0	18.6	19.2	21.9	23.2	25.9	26.6
Oil	63.6	34.8	32.7	32.1	29.2	27.4	25.7
Gas	--	7.9	9.0	9.3	11.0	11.1	10.5
Comb. Renewables & Waste	18.5	14.7	14.8	14.9	15.7	16.3	19.4
Nuclear	--	17.5	18.1	16.6	15.9	14.4	13.1
Hydro	4.2	3.3	4.0	3.3	3.1	2.8	2.6
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	--	--	--
Electricity Trade	1.7	3.2	2.3	1.8	1.9	2.0	2.1

\*Source: International Energy Agency (1996), "Energy Policies of IEA Countries, 1996 Review".

**Table 4-4: Finland: Energy Balances and Key Indicators (continuation next pages)**

<b>DEMAND</b>							
<b>FINAL CONSUMPTION BY SECTOR</b> (continuation Table 4.4 Finland)							
	<b>1973</b>	<b>1990</b>	<b>1993</b>	<b>1994</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>
<b>TFC</b>	<b>19.2</b>	<b>23.0</b>	<b>22.8</b>	<b>23.8</b>	<b>25.1</b>	<b>27.6</b>	<b>30.7</b>
Coal <sup>1</sup>	1.3	1.9	1.6	1.7	1.5	2.0	2.0
Oil	11.5	9.7	9.0	9.4	8.8	8.9	9.3
Gas	0.0	1.3	1.3	1.5	1.7	2.0	2.0
Comb. Renewables& Wastes <sup>2</sup>	3.5	3.2	3.3	3.5	4.0	4.7	6.4
Geothermal	--	--	--	--	--	--	--
SolarNVindlOther	--	--	--	--	--	--	--
Electricity	2.3	5.1	5.4	5.6	6.8	7.6	8.3
Heat	0.6	1.9	2.1	2.2	2.4	2.6	2.6
<b>Shares (%)</b>	--	--	--	--	--	--	--
Coal	6.9	8.4	7.2	7.2	5.9	7.2	6.6
Oil	59.8	42.1	39.6	39.4	34.8	32.3	30.3
Gas	0.1	5.4	5.9	6.1	6.8	7.1	6.6
Comb. Renewables& Waste	18.1	13.7	14.5	14.6	15.9	16.8	20.9
Geothermal	--	--	--	--	--	--	--
SolarNVindlOther	--	--	--	--	--	--	--
Electricity	12.0	22.0	23.5	23.4	26.9	27.5	27.1
Heat	3.1	8.3	9.3	9.2	9.6	9.3	8.4
<b>TOTAL INDUSTRY<sup>6</sup></b>	<b>9.6</b>	<b>11.2</b>	<b>11.0</b>	<b>11.6</b>	<b>12.6</b>	<b>14.3</b>	<b>16.5</b>
Coal	1.2	1.9	1.6	1.7	1.5	2.0	2.0
Oil	5.0	2.6	2.6	2.7	2.5	2.4	2.4
Gas	0.0	1.2	1.3	1.4	1.7	1.9	2.0
Comb. Renewables& Waste	1.8	2.5	2.5	2.7	3.0	3.3	5.1
Geothermal	--	--	--	--	--	--	--
SolarNVindlOther	--	--	--	--	--	--	--
Electricity	1.6	2.8	2.9	3.0	3.8	4.5	4.8
Heat	0.1	0.2	0.2	0.2	0.2	0.2	0.2
<b>Shares (Yo)</b>							
Coal	12.5	17.1	14.7	14.3	11.5	13.9	12.3
Oil	52.3	23.4	23.3	22.9	19.9	16.8	14.5
Gas	0.1	10.8	11.6	12.0	13.5	13.3	11.9
Comb. Renewables& Waste	18.3	22.0	22.4	22.9	23.7	23.4	30.9
Geothermal	--	--	--	--	--	--	--
SolarNVindlOther	--	--	--	--	--	--	--
Electricity	16.1	25.1	26.2	26.1	29.8	31.2	29.1
Heat	<b>0.8</b>	1.6	1.8	1.8	1.6	1.4	1.2
<b>TRANSPORT</b>	<b>2.6</b>	<b>4.4</b>	<b>4.1</b>	<b>4.3</b>	<b>4.2</b>	<b>5.0</b>	<b>5.4</b>
<b>TOTAL OTHER SECTORS<sup>8</sup></b>	<b>7.0</b>	<b>7.5</b>	<b>7.6</b>	<b>7.9</b>	<b>8.4</b>	<b>8.4</b>	<b>8.8</b>
Coal <sup>1</sup>	0.1	0.0	0.0	0.0	0.0	--	--
Oil	3.9	2.7	2.4	2.5	2.1	2.1	2.1
Gas	0.0	0.0	0.1	0.1	0.0	0.1	0.1
Comb. Renewables& Waste	1.7	0.7	0.8	0.8	1.0	1.3	1.3
Geothermal	--	--	--	--	--	--	--
SolarNVindlOther	--	--	--	--	--	--	--
Electricity	0.8	2.2	2.4	2.5	3.0	2.5	2.9
Heat	0.5	1.7	1.9	2.0	2.2	2.4	2.4
<b>Shares (%)</b>							
Coal	1.5	0.3	0.2	0.5	0.4	--	--
Oil	55.6	36.7	31.4	31.8	25.1	25.1	24.0
Gas	0.1	0.6	0.7	0.7	0.2	0.6	0.7
Comb. Renewables & Waste	24.5	9.3	10.7	10.4	12.2	15.7	15.0
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	--	--	--

Electricity	10.8	29.8	31.8	31.6	35.5	30.3	33.3
Heat	7.5	23.2	25.1	25.0	26.6	28.3	27.1

KEY INDICATORS (continuation of table 4.4 Finland)							
	1973	1990	1993	1994	2000	2005	2010
GDP (billion 1990 US\$)	82.90	134.80	119.40	124.20	150.91	167.44	185.77
Population (millions)	4.67	4.99	5.07	5.09	5.17	5.21	5.23
TPES/GDP <sup>10</sup>	0.26	0.21	0.24	0.25	0.23	0.23	0.22
Energy Production/TPES	0.23	0.41	0.40	0.42	0.40	0.39	0.40
Per Capita TPES <sup>11</sup>	4.57	5.74	5.66	6.00	6.66	7.28	7.98
Oil Supply/GDP <sup>10</sup>	0.16	0.07	0.08	0.08	0.07	0.06	0.06
TFC/GDP <sup>10</sup>	0.23	0.17	0.19	0.19	0.17	0.17	0.17
Per Capita TFC <sup>11</sup>	4.12	4.61	4.49	4.67	4.86	5.31	5.86
Energy-related CO <sub>2</sub> -emissions (MT CO <sub>2</sub> )	49.4	53.8	54.3	61.2	69.1	78.1	84.7
CO <sub>2</sub> -emissions from bunkers (MT CO <sub>2</sub> )	0.3	1.8	1.7	1.3	2.2	2.2	2.2

GROWTH RATES (% per year) (continuation Table 4.4 Finland)							
	73-79	79-90	90-93	93-94	94-00	00-05	05-10
TPES	2.0	1.6	0.1	6.4	2.0	2.0	1.9
Coal	8.9	2.0	1.2	21.3	3.0	4.2	2.5
Oil	-1.0	-2.2	-2.0	4.6	0.4	0.6	0.7
Gas	--	9.8	4.4	10.6	5.0	2.0	0.9
Comb. Renewables & Waste	-2.4	1.9	0.3	7.4	2.9	2.8	5.5
Nuclear	--	10.0	1.2	-2.5	1.3	0.0	--
Hydro	0.6	-0.0	7.5	-12.5	1.1	--	--
Geothermal	--	--	--	--	--	--	--
Solar/Wind/Other	--	--	--	--	--	--	14.9
TFC	0.2	1.5	-0.4	4.4	0.9	1.9	2.1
Electricity Consumption	4.7	4.7	1.8	4.0	3.3	2.3	1.9
Energy Production	4.7	5.6	-0.5	10.3	1.4	1.3	2.4
Net Oil Imports	0.7	-3.2	-4.2	29.8	-2.0	-0.6	0.7
GDP	2.2	3.3	-4.0	4.0	3.3	2.1	2.1
Growth in the TPES/GDP Ratio	-0.2	-1.7	4.2	2.3	-1.2	-0.1	-0.1
Growth in the TFC/GDP Ratio	-1.9	-1.7	3.7	0.4	-2.3	-0.2	-0.0

Summary Energy Balance of Poland							
	1990	1992	1994	1996	2000	2010	2020
<b>Primary Production (ktoe)</b>	<b>96,222</b>	<b>86,761</b>	<b>88,478</b>	<b>90,519</b>	<b>87,659</b>	<b>88,116</b>	<b>87,078</b>
Coal	92,261	82,646	83,916	85,837	82,368	80,734	77,563
Oil	204	253	298	293	333	357	357
Natural Gas	2,422	2,517	2,904	3,008	3,465	5,302	7,302
Primary Electricity	804	864	908	933	1,047	1,276	1,410
Other	531	482	452	447	447	447	447
<b>Net imports (ktoe)</b>	<b>3,480</b>	<b>7,342</b>	<b>2,497</b>	<b>3,187</b>	<b>13,805</b>	<b>26,796</b>	<b>35,875</b>
Coal	-18,888	-11,884	-16,332	-18,372	-10,330	-7,188	-6,865
Oil	15,905	14,693	13,572	15,398	17,622	23,326	26,816
Natural Gas	6,716	5,515	5,530	6,716	6,955	10,787	15,984
Electricity	-253	-983	-273	-556	-442	-129	-60
Other	0	0	0	0	0	0	0
<b>Consumption (ktoe)</b>	<b>99,702</b>	<b>94,108</b>	<b>90,965</b>	<b>93,705</b>	<b>101,464</b>	<b>114,917</b>	<b>122,948</b>
Coal	73,373	70,762	67,580	67,466	72,038	73,547	70,697
Oil	16,113	14,947	13,864	15,691	17,950	23,683	27,173
Natural Gas	9,134	8,037	8,434	9,724	10,419	16,088	23,281
Primary Electricity	551	-119	635	377	611	1,152	1,350
Other	531	482	452	447	447	447	447
<b>Shares in total consumption (%)</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
Coal	73.6	75.2	74.3	72.0	71.0	64.0	57.5
Petroleum products	16.2	15.9	15.2	16.7	17.7	20.6	22.1
Natural Gas	9.2	8.5	9.3	10.4	10.3	14.0	18.9
Primary Electricity	0.6	-0.1	0.7	0.4	0.6	1.0	1.1
Other	0.5	0.5	0.5	0.5	0.4	0.4	0.4
<b>Indicators</b>							
Self Sufficiency ratio (%)	96.5	92.2	97.3	96.6	86.4	76.7	70.8
Import dependency (%)	3.5	7.8	2.7	3.4	13.6	23.3	29.2
Energy/GDP Ratio (1985 = 100)	84	83.1	73.6	66.8	59.6	49	43

Source: Plan Econ 97; original units have been transformed into toe for better comparison, see remarks in Annex to Tables

**Table 4-5: Poland: Summary Energy Balance(1990 up to 2020)**

Poland: energy related <b>environmental</b> Impacts (1992)	
Emissions by source	1992
	1000 t
<b>SO<sub>2</sub></b>	<b>2,470</b>
public power plants	1,300
power plants within enterprises	420
combustion of coal in building, household burners and district heating plants	750
transport sector	90
<b>NO<sub>x</sub></b>	<b>585</b>
public power plants	370
power plants within enterprises	115
combustion of coal in building, household burners and district heating plants	100
transport sector	<b>400</b>
Particulates	<b>1,055</b>
public power plants	420
power plants within enterprises	115
combustion of coal in building, household burners and district heating plants	520
<b>CO<sub>2</sub></b>	302,000
<b>Ash and other</b> solid waste due to coal combustion	15,800
Water pollution <b>by</b> saline materials due <b>to</b> extracting coal	5
Solid waste produced from mine operations (not combustion of coal)	<b>52,000</b>
total of accumulated mine wastes (up to 1992)	662,000
<b>Remark:</b>	
power plants within enterprises produce the equivalent of 6 % <b>of</b> the electricity generated in public power plants	
<b>Sources:</b>	
for SO <sub>2</sub> , NO <sub>x</sub> , Particulates, <del>waste</del> : OECD 95 (Poland, p. 112/113)	
for CO <sub>2</sub> : EC 96 a (Energy Europe Sept. 96, p.99)	

**Table 4-6: Poland: Energy related environmental impacts in 1992**

CATEGORY	SO <sub>2</sub>	NO <sub>2</sub>	PARTICLES
Total	2605	1105	1395
The electricity supply industry	1645	450	260
The share <b>of</b> the ESI	63.2	40.7	18.6'

1. Only system power stations.

Source: GUS, *Ochrona \_rodowiska* **7996**, Tabela **4** (126), p. 169.

**Table 4-7: Poland: Total emissions **of** SO<sub>2</sub>, NO<sub>2</sub> and particles in 1994**

Summary Energy Balance of Lithuania							
	1990	1992	1994	1996	2000	2010	2020
<b>Primary Production (ktoe)</b>	<b>4,631</b>	<b>4,095</b>	<b>2,437</b>	<b>3,961</b>	<b>2,393</b>	<b>720</b>	<b>680</b>
Coal	0	0	0	0	0	0	0
Crude oil	10	50	94	129	139	139	139
Natural Gas	0	0	0	0	0	0	0
Primary Electricity	4,368	3,792	2,090	3,604	2,105	496	496
Other	253	253	253	228	149	84	45
<b>Net imports (ktoe)</b>	<b>9,258</b>	<b>6,672</b>	<b>5,962</b>	<b>4,329</b>	<b>7,198</b>	<b>10,772</b>	<b>12,425</b>
Coal	973	625	278	139	194	174	129
Petroleum products	6,041	5,222	3,673	3,232	2,547	2,695	3,137
Natural Gas	5,182	2,859	1,718	2,234	4,934	8,062	9,159
Electricity	-2,939	-2,035	288	-1,276	-477	-159	0
Other	0	0	5	0	0	0	0
<b>Consumption (ktoe)</b>	<b>13,889</b>	<b>10,767</b>	<b>8,399</b>	<b>8,290</b>	<b>9,595</b>	<b>11,492</b>	<b>13,105</b>
Coal	973	625	278	139	194	174	129
Petroleum products	6,051	5,272	3,768	3,361	2,690	2,834	3,276
Natural Gas	5,182	2,859	1,718	2,234	4,934	8,062	9,159
Primary Electricity	1,430	1,757	2,378	2,328	1,628	338	496
Other	253	253	258	228	149	84	45
<b>Shares in total consumption (%)</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
Coal	7.0	5.8	3.3	1.7	2.0	1.5	1.0
Petroleum products	43.6	49.0	44.9	40.5	28.0	24.7	25.0
Natural Gas	37.3	26.6	20.4	26.9	51.4	70.2	69.9
Primary Electricity	10.3	16.3	28.3	28.1	17.0	2.9	3.8
Other	1.8	2.4	3.1	2.8	1.6	0.7	0.3
<b>Indicators</b>							
Self Sufficiency ratio (%)	33.3	38.0	29.0	47.8	24.9	6.3	5.2
Import dependency (%)	66.7	62.0	71.0	52.2	75.0	93.7	94.8
Energy/GDP Ratio (1990 = 100)	100	135.2	149.9	135.8	120.6	94	74.3

Source: Plan Econ 97; original units have been transformed into toe for better comparison, see remarks in Annex to Tables

**Table 4-8: Lithuania: Summary Energy Balance (1990 up to 2020)**

Fuel Prices in the Baltic states 1996				
Fuel	Unit	Estonia	Latvia	Lithuania
Heavy fuel oil	US\$/t	90	100	110
Natural gas	US\$/1000 m3	80 - 100	130	95 - 100
Oilshale oil	US\$/t	105		
Coal	US\$/t	63 - 69		

Source: LEN December 96

**Table 4-9: Lithuania, Estonia, Latvia: Fuel Prices**

Price of wood chips in the Baltic States 1996					
Estonia		Latvia		Lithuania	
Name of place	US\$/s.m3	Name of place	US\$/s.m3	Name of place	US\$/s.m3
Viru	10.7	Jurmala	11.6	Kazla ruda	8.8 - 10.1
Viljandi	11.3	Balvi	8.7	Ukmerge	10
Saaremaa	16.5	Ugale	5.5 - 7.2		
		Saldus	9.1 - 10.5		
		Aluksne	7.7		
		Talsi	9.1		
		Riga	7.5 - 9.6		

Source: LEN December 96

Table 4-10: Lithuania, Estonia, Latvia: Price of wood chips



Summary Energy Balance of Latvia							
	1990	1992	1994	1996	2000	2010	2020
<b>Primary Production (ktoe)</b>	<b>1,837</b>	<b>501</b>	<b>993</b>	<b>640</b>	<b>1,281</b>	<b>1,425</b>	<b>1,484</b>
Coal	0	0	0	0	0	0	0
Crude oil	0	0	0	0	0	0	0
Natural Gas	0	0	0	0	0	0	0
Primary Electricity	1,152	318	844	526	1,152	1,325	1,410
Other (peat)	685	184	149	114	129	99	74
<b>Net imports (ktoe)</b>	<b>7,337</b>	<b>5,029</b>	<b>3,455</b>	<b>3,261</b>	<b>3,182</b>	<b>3,748</b>	<b>4,378</b>
Coal	710	238	119	129	134	114	89
Petroleum products	3,356	2,447	2,050	1,340	1,569	1,842	2,050
Natural Gas	2,353	1,301	819	829	1,405	1,752	2,239
Electricity	918	1,042	467	963	74	40	0
<b>Consumption (ktoe)</b>	<b>9,173</b>	<b>5,530</b>	<b>4,413</b>	<b>3,902</b>	<b>4,468</b>	<b>5,168</b>	<b>5,862</b>
Coal	710	238	119	129	134	114	89
Petroleum products	3,356	2,447	2,050	1,340	1,569	1,842	2,050
Natural Gas	2,353	1,301	819	829	1,405	1,752	2,239
Primary Electricity	2,070	1,360	1,310	1,489	1,231	1,360	1,410
Other (peat)	685	184	114	114	129	99	74
<b>Shares in total consumption (%)</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
Coal	7.7	4.3	2.7	3.3	3.0	2.2	1.5
Petroleum products	36.6	44.3	46.5	34.4	35.1	35.6	35.0
Natural Gas	25.6	23.5	18.6	21.2	31.4	33.9	38.2
Primary Electricity	22.6	24.6	29.7	38.2	27.6	26.3	24.0
Other (peat)	7.5	3.3	2.6	2.9	2.9	1.9	1.3
<b>Indicators</b>							
Self Sufficiency ratio (%)	20.0	9.1	22.5	16.4	28.7	27.6	25.3
Import dependency (%)	80.0	90.9	78.3	83.6	71.2	72.5	74.7
Energy/GDP Ratio (1990 = 100)	100	103.4	96.4	82.9	74.3	58.7	46.7

Source: Plan Econ 97; original units have been transformed into toe for better comparison, see remarks in Annex to Tables

Table 4-11: Latvia: Summary Energy Balance of Latvia

Project	Financina body	Status of the project
Improving energy efficiency in Latvenergo and Latvijas Gāze	USAID	In progress, completion in July 1997
Latvenergo - Vermont Utility partnership programme	USAID	In progress, completion in September 1997
Baltic Power Pooling	USAID	In progress, completion in 1998
Energy Conservation Awareness Campaign	Technical assistance under EU PHARE / EBRD Agreement	Finalised, 1994
Electrical Distribution Co-operation for competence development	SIDA of the Swedish Government	Completed
Installation of individual gas meters Public	Investment Programme, foreign loans: 1,08 million Ls, other sources: 0, 46 million Ls	In progress
Rehabilitation of the Daugava Hydropower Schemes, feasibility study	Technical assistance under EU PHARE / EBRD Agreement	Finalised, 1995
Rehabilitation of the Daugava Hydropower Schemes	Public Investment Programme	To be started
Rehabilitation of CHP-2 in Riga	Public investment Programme	In progress

**Table 4-12: Latvia: Internationalfinanced projects focusing on rational use of energy**

<u>Financina body</u>	<u>Project</u>	<u>Status of the project</u>
USAID, through Latvian Pollution Prevention Centre	14 waste minimisation projects in Latvian industries. The projects included regulation of operation boiler houses	Completed: 1995
Public Investment Programme, foreign loans: 1,5 million Ls	installation of industrial gas meters	In progress
SENER of the Dutch Ministry of Economic Affairs	Energy Conservation and Clean production in Latvian Agrofood Industry, with focus on meat, dairy and fish production.	1995 - 1998
SJSC "Ventpils Nafta"	Conversion of the industrial boiler house into cogeneration	Completed
EU THERMIE	Agrofood and Brewing Industries Sector Study in the Baltics (Market study and Energy audits)	Completed: September, 1994.
EU THERMIE	Industrial Survey. Establishing of an Industrial database, and its continual updating. The sectors surveyed are: agrofood and brewing, building materials, metal processing and electrical machines construction sectors, wood processing industry (ongoing).	Completed: 1995
EU THERMIE	"Crash" programme: Energy Audits in Latvian industry	Completed: 1992

**Table 4-13: Latvia: Projects Rational Use of Energy (RUE) in industry**

<u>Financina Body</u>	<u>Project</u>	<u>Status</u>
EU THERMIE	Strategic Study "Urban Public Transport in Latvia"	Completed: 1993
The World Bank	A loan to the Riga municipality within the Municipal Services Development Project for rehabilitation of the Riga urban transport system.	in progress
Danish Government	A project on public transport systems in Riga	In progress

**Table 4-14: Latvia: Projects Rational Use of Energy in Transport**

<u>Financing Body</u>	<u>Project</u>	<u>Status</u>
NUTEK	Efficient use of energy in buildings, projects in Saldus, Jelgava and Riga	In progress
NUTEK	Decreasing heat losses in heat distribution systems, projects in Jelgava and Balvi	In progress
Government of Norway	Co-operation of the Academy of Sciences of Latvia with the Academy of Sciences of Norway:  Measures for improving energy efficiency in buildings of the Ministry of Education  Demonstration project in Ādapi - decreasing heat losses in District Heating systems	In progress
Danish Ministry of Housing	Energy Saving in Housing in Latvia, including energy audits, catalogue of energy saving measures, demonstration project in a residential building in Riga	In progress: 1993 - present
EU PHARE: Ecos/Ouverture	Rehabilitation project of the Heating network in Liepaja City for Saving Energy	In progress
Danish Government	Energy Saving, Consultancy and Training in Latvia: energy audits of 6 public buildings in Riga demonstration project in 3rd secondary school in Riga	Completed: 1995
EU THERMIE	A number of actions:  Market Study "Metering of Energy Consumption"  Analysis and Market Survey "Export Potential for European Building Technologies in the Baltic States", residential buildings  Thermography as a Tool to Determine Priorities for Retrofitting Measures in Buildings, residential buildings	December 1992  March, 1993  October 1995

**Table 4-15: Latvia: Projects of Rational Use of Energy in Buildings**

Financing Body	Project	Status
Latvian Government, Ministry of Transport and Communications	National programme on Production of Biofuels and their Utilisation in Latvia	In progress
NUTEK	Conversion of municipal boiler houses to firing biomass: projects in Ugāle, Slampe, Daugavgrīva, Jādmuiža, Alūksne, Balvi, Rauna	Most of the projects completed
German Federal Ministry for Research and Technology, Latvenergo, PreussenElektra	Wind energy farm demonstration project in Aināpi (1,2 MW)	Completed
Ministry of Environment of Denmark, Ministry of Environmental Protection and Regional Development of Latvia	Wind energy demonstration project in Liepāja (150 kW)	In progress
Latvenergo	Reconstruction of the Aiviekste Hydro Power Plant, and increasing its output	In progress
Private initiative	Abulas sHPP, installed capacity 130 kW Brutuīu sHPP, installed capacity 60 kW Trikātas sHPP, installed capacity 60 kW Viiani sHPP, installed capacity 260 kW Pakuīu sHPP	All completed
Norwegian Government	Sprukti sHPP	In progress
German Government (Geothermie Neubrandenburg GmbH), Dobeles City Council	A feasibility study on possibilities of building a geothermal plant in Dobeles.	1994 - beginning of 1995
Danish Government	A pilot project in a boiler house in Malpils	Completed

**Table 4-16: Latvia: Projects of renewable energy sources (RES)**

Summary Energy Balance of Estonia							
	1990	1992	1994	1996	2000	2010	2020
<b>Primary Production (ktoe)</b>	<b>5,302</b>	<b>4,373</b>	<b>3,688</b>	<b>3,684</b>	<b>4,205</b>	<b>2,652</b>	<b>1,684</b>
Coal	0	0	0	0	0	0	0
Crude oil	0	0	0	0	0	0	0
Natural Gas	0	0	0	0	0	0	0
Oil-shale	4,969	4,046	3,246	3,276	4,026	2,551	1,628
Primary Electricity	0	0	0	0	1	1	2
Other	333	328	442	407	179	99	55
<b>Net imports (ktoe)</b>	<b>3,157</b>	<b>1,598</b>	<b>1,817</b>	<b>1,718</b>	<b>2,040</b>	<b>4,711</b>	<b>6,726</b>
Coal (and coke)	223	149	69	50	50	50	50
Petroleum products	3,053	1,251	1,251	1,028	1,077	1,226	1,430
Natural Gas	1,211	710	506	621	953	3,361	5,123
Oil-Shale (and derivatives)	472	382	352	253	243	218	199
Electricity	-1,792	-894	-303	-204	-283	-144	-74
Other	-10	0	-60	-30	0	0	0
<b>Consumption (ktoe)</b>	<b>8,459</b>	<b>5,971</b>	<b>5,505</b>	<b>5,381</b>	<b>6,250</b>	<b>7,362</b>	<b>8,409</b>
Coal	223	149	69	50	50	50	50
Petroleum products	3,053	1,251	1,251	1,028	1,077	1,226	1,430
Natural Gas	1,211	710	506	621	953	3,361	5,123
Oil-Shale	3,649	3,534	3,296	3,306	3,991	2,626	1,753
Other	323	328	382	377	179	99	55
<b>Shares in total consumption (%)</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
Coal	2.6	2.5	1.3	0.9	0.8	0.7	0.6
Petroleum products	36.1	20.9	22.7	19.1	17.2	16.7	17.0
Natural Gas	14.3	11.9	9.2	11.5	15.3	45.7	60.9
Oil-Shale	43.1	59.2	59.9	61.4	63.9	35.7	20.8
Other	3.8	5.5	6.9	7.0	2.9	1.3	0.6
<b>Indicators</b>							
Self Sufficiency ratio (%)	62.7	73.2	67.0	68.5	67.3	36.0	20.0
Import dependency (%)	37.3	26.8	33.0	31.9	32.6	64.0	80.0
Energy/GDP Ratio (1990 = 100)	100	99.2	97.9	85.7	76.7	59.2	46.4

Source: Pian Econ 97; original units have been transformed into toe for better comparison, see remarks in Annex to Tables

**Table 4-17: Estonia: Summary Energy Balance of Estonia**

Mtoe	1990	1994	1995	2000	2010
<b>Oil:</b>					
Production	516	317	300	310	340
Consumption	270	154	137	129	172
Net exports	246	164	163	181	168
<b>Natural gas</b>					
Production	526	497	492	545	705
Consumption	379	357	344	375	495
Net exports	147	139	148	171	210
<b>Coal</b>					
Production	184	128	119	109	105
Consumption	186	128	119	109	105
Net exports	-2	0	0	0	0
<b>Primary electricity</b>					
Production	63	61	61	63	64
Consumption	62	55	55	58	64
Net exports	1	6	6	4	0
<b>Total primary energy</b>					
Production	1289	1003	972	1027	1214
Consumption	896	694	656	671	836
Net exports	393	308	316	356	378
<b>Total electricity (in TWh)</b>					
Production	1082	876	850	950	1200
Consumption	1078	851	825	930	1200
Net exports	4.6	25	25	20	0
<b>Total Heat (in Pcal)</b>					
consumption and production	1162	1086	1031	1087	1199
<b>Official GDP in (1990) billion roubles</b>	644	340	327	397	617
Index	100	53	51	62	96
Change p.a. in %	-13	-4	4	4	
Energy intensity in 1000 R/toe	1.39	2.04	2.01	1.69	1.35

sources: Goskomstat and IEA estimates

Table 4-18: Basic energy data for the Russian Federation

Population	110.0 million cu m
Power Production	100.3 million cu m
Heat Production	102.5 million cu m
Other Consumers	41.3 million cu m
Losses	8.5 million cu m

Table 4-19: Kaliningrad: Distribution of natural gas (1994)

Year	Coal consumption by the city of Kaliningrad	Share of Industry (in %)
1991	920,000 t	62
1992	840,000 t	76
1993	630,000 t	77
1994	470,000 t	61

Table 4-20: Kaliningrad: Coal Consumption of the city of Kaliningrad

Electric capacities and electric generation in St. Petersburg	Breakdown of Installed Electric Capacities in 1994 (9,931 MWe), %	Breakdown of Gross Electricity Generation in 1994 (39,9 kWhe), %
Hydropower Lenenergo	6,6	8,8
Cond. power Lenenergo	19,6	9,4
CHP Lenenergo, Cond	27,7	8,9
CHP Lenenerao. Coaen		18.2
CHP Industry, Cogen	5,8	3,7
Nuclear Power Plant	40,3	51,0

Table 4-21: Electric capacities and electric generation in St. Petersburg



<b>Energy Sector in St. Petersburg: Energy Infrastructure</b>	
Natural gas	<ul style="list-style-type: none"> <li>• RAO Gasprom and its subsidiary AO Lentransgas transport natural gas along the high pressure gas pipelines</li> <li>• Natural gas is distributed in the City by the rented enterprise Lengas and in the Oblast by Lenoblgas. They operate the low pressure gas pipelines and the gas equipment in dwellings</li> <li>• Gas is supplied to the high pressure ring of St.Petersburg and to the urban networks of the Leningrad Oblast towns from gas regulation stations (GRS)</li> </ul>
Oil Products	<ul style="list-style-type: none"> <li>• The oil industry of the NW Region is dominated by Surgutneftegas, which is one of five vertically integrated oil companies in Russia. It owns the oil storage depot in St.Petersburg, gasoline stations, and also distributes mazut</li> <li>• Surgutneftegas subsidiaries are: AO Kirishi Oil Refinery, AO Neftebasa Ruychi and AO Nefte Kombi. AO Neftebasa Ruychi operates the largest mazut and gasoline storage depot of St.Petersburg City</li> </ul>
Oil (cont.)	<ul style="list-style-type: none"> <li>• <i>Mazut.</i> There are two further organisations in St.Petersburg - AO "Nevskiy mazut" and AO "Krasniy Neftyanik". The facilities for mazut and the treatment plant of the AO "Nevskiy mazut" have to be renewed. The mazut facilities at AO "Krasniy Neftyanik" are in satisfactory technical condition, having been renovated in 1981 - 1982</li> <li>• <i>Gasoline &amp; Diesel.</i> These fuels are delivered to St.Petersburg and Leningrad Oblast mainly from AO Kirishi Oil Refinery. There are about 140 stationary filling stations in St.Petersburg and approximately 40 in Leningrad Oblast. The main organisations selling gasoline and diesel are AO limited "Petersburg fuel company", AO "Nevskaya fuel company", AO limited "Nefto Kombi", AO limited "Faeton" and the foreign company "Neste"</li> </ul>
Coal	<ul style="list-style-type: none"> <li>• Consumers without private railway sidings are supplied by coal with road trucks from the tanks of AO "GorTop St.Petersburg" which has two storage dumps. There are railways and elevated railways for coal unloading at these storage dumps</li> </ul>

**Table 4-22: Energy Infrastructure in St. Petersburg**

<b>Pollutant</b>	<b>Emission level'</b>	<b>Key Issues</b>
SO2	= 170 kt	<ul style="list-style-type: none"> <li>• &gt; 70% emission in oblast due to Kirishi power station,</li> <li>• &gt; 99% from stationary sources</li> </ul>
NOx	= 70 kt	<ul style="list-style-type: none"> <li>• 65% emission in city as gas emits significant NOx,</li> <li>• transport emission contribute &gt; 15%</li> </ul>
TSP	= 75 kt	<ul style="list-style-type: none"> <li>• emission also dominated by Kirishi in oblast (&gt; 80%),</li> <li>• &gt; 99% from stationary sources?</li> </ul>
cO2	= 50 Mt	<ul style="list-style-type: none"> <li>• 92% from stationary sources, 8% from transport</li> </ul>
<p>'Sum of emissions from Oblast and City</p> <p>Source: TACIS 92 Erb 001, ST.Petersburg Energy Policy</p>		

**Table 4-23: St. Petersburg: issues relating to the emission of energy sector pollutants**

Leningrad Oblast							
	1990	1991	1992	1993	1994	1995	1996
<b>Primary production</b>							
primary electricity (bn.kWh)	37.9	37.1	32.8	32.3	30.1	26.3	26.6
heat (bn. Mkal)	21.6	20.9	20.6	18.8	15.9	15.8	
<i>Selected oil products</i>							
primary refined (mln. tonns)	19.1	18.9	16.8	15.0	11.6	12.1	15.3
light oil products	7.2	7.1	6.4	5.8	4.3	4.5	
- petrol	2.0	1.9	1.7	1.6	1.2	1.3	1.6
peat and schist products	4.1	2.9	2.1	1.3	1.2	0.5	
<b>Imported</b>							
primary electricity (bn.kWh)	2.4	1.5	2.2	1.3	0.7	1.3	
<b>Exported</b>							
primary electricity (bn.kWh)	24.1	22.4	20.4	21.7	19.3	17.0	
<b>Consumption</b>							
primary electricity (bn.kWh)	10.0	9.8	9.0	7.9	6.3	5.8	
heat (bn. Mkal)							

Source: Industries of St. Petersburg, 1996, Petersburg Committee of Statistics, Social and Economic Development of St. Petersburg, 1995-96 (various issues)

Table 4-24: Energy production and consumption in Leningrad Oblast

St. Petersburg							
	1990	1991	1992	1993	1994	1995	1996
<b>Primary production</b>							
primary electricity (bn.kWh)	13.0	12.7	11.8	11.4	9.7	9.3	9.0
heat (bn. Mkal)	43.7	43.7	41.6	40.7	35.9	31.8	23.4
<b>Imported from the outside</b>							
coal*							
crude oil*							
natural gas*							
primary electricity (bn.kWh)	65.0	64.1	58.8	6.9	6.3	6.9	
<b>Consumption</b>							
coal*							
crude oil*							
natural gas*							
primary electricity (bn.kWh)	19.7	19.3	17.7	18.3	16.7	16.2	
heat (bn. Mkal)				28.7	25.1		
* either no official or reliable data source: the same as for Leningrad Oblast							

Table 4-25: Energy production and consumption in St. Petersburg

<b>Leningrad Oblast electricity production and consumption (GWh)</b>							
	<b>1990</b>	<b>1991</b>	<b>1992</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>
production	37911	37123	32847	32364	30187	26375	26600
import	2490	1596	2217	1369	767	1331	
export	24131	22438	20469	21769	19295	16979	
consumption	16271	16281	14595	11964	11659	10727	
- industry	10096	9860	9087	7890	6344	5810	
- construction	172	148	143	178	136	128	
- transport	692	653	615	... <sup>1</sup>	598	582	
- agriculture	1650	1725	1634	1456	1319	1285	
- municipal sector <sup>1</sup>	1027	1050	1052	1147	1125	1114	
- others	863	1060	515	400	730	733	
- losses	1771	1750	1546	862 <sup>2</sup>	1404	1074	
<sup>1</sup> includes households and public sector <sup>2</sup> weak confidence value							

**Table 4-26: Leningrad Oblast: electricity production and consumption**

<b>St. Petersburg electricity production and consumption (GWh)</b>							
	<b>1990</b>	<b>1991</b>	<b>1992</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>
production	13225	12758	11853	11372	9716	9321	9000
import	6508	6420	5889	6945	6325	6922	
export	0	0	0	0	0	0	
consumption	19732	19177	17743	18316	16040	16244	
- industry	8575	7763	6978	5856	4994	4677	
- construction	319	305	265	302	302	184	
- transport	11610	1458	1335	1888	1384	1254	
- agriculture	63	83	90	74	47	66	
- municipal sector <sup>1</sup>	4083	4497	4347	4629	4620	4467	
- others	3420	3588	2945	2963	2925	3184	
- losses	1662	1482	1784	2603	1767	2410	
<sup>1</sup> includes households and public sector							

**Table 4-27: St. Petersburg: electricity production and consumption**

<sup>1</sup> includes households and public sector

<sup>2</sup> weak confidence value

## 5. Tables to chapter 5

**Table 5-1: European Transport Corridors**

The first corridor ("Via Baltica"): Saint Petersburg - Tallinn - Riga - Kaunas - Warsaw, with a branch: Riga - Kaliningrad - Gdansk.

The second corridor: Berlin - Warsaw - Minsk - Moscow.

The third corridor: Berlin - Wroclaw - Katowice - Lviv - Kiev, with a branch: Dresden - Wroclaw.

The fourth corridor: Dresden - Prague - Bratislava - Gyor - Budapest - Sofia - Istanbul; with branches:

- Nuremberg - Prague;
- Vienna - Gyor;
- Arad - Bucharest - Constanta;
- Sofia - Salonika.

The fifth corridor: Trieste/Koper - Postoina - Ljubljana - Budapest - Uzhgorod - Lviv; with branches:

- Bratislava - Gilina - Kosice - Uzhgorod - Lviv;
- Rijeka - Postoina.

The sixth corridor: Gdansk - Katowice - Gilina, with a branch: Turin - Poznan.

The seventh corridor: The Danube with all its ports.

The eighth corridor: Durres - Tirana - Skopje - Sofia - Plovdiv - Burgos - Varna.

The ninth corridor: Plovdiv - Bucharest - Kishinev - Ljubasivka - Kiev - Vitebsk - Pskov - Saint Petersburg - Helsinki; with branches:

- Odessa - Ljubasivka;
- Kiev - Minsk - Kaunas - Klaipeda;
- Kiev - Moscow;
- Kaunas - Kaliningrad.

The tenth corridor: Moscow - Riga - Ventspils - Liepaja.

**Table 5-1: Multimodal European Transport Corridors**

## J. Tables to chapter 6

**Table 6-1: International energy cooperation in the Baltic Sea Region:  
Projects implemented within EU cooperation programmes**

Programme	Year	Target region	project title	financial support (ECU)
TACIS	1993	Russia/St-Petersburg	Improvement of the gas distribution network in the city of Saint-Petersburg	500,000
TACIS	1993	Russia/St-Petersburg	Expansion of modern combined cycle generating capacity	1,700,000
TACIS	1993	Russia/St-Petersburg	Establishment of gas and heat metering system for internal consumers	1,000,000
TACIS	1993	Russia/St-Petersburg	Electricity tariffs, commercial management system and economic information system	500,000
TACIS	1995	Russia/St-Petersburg	Fire alarm and suppression system for new safety-related Buildings at Leningrad nuclear power plant	1,000,000
TACIS (+World Bank)	1995	Russia, Finland	Feasibility study of 'Baltic oil pipeline' (Yaroslavl oleoduc)	3,000,000
TACIS	1996	Kaliningrad Oblast	Energy Supply Advice to Kaliningrad Oblast	1,000,000
Phare Multicountry energy programme	1993	Estonia, Lithuania, Poland +TACIS	Interface between the extended UCPTE networks and its Eastern neighbours (electricity interconnection)	500,000
Phare Multicountry energy programme	1994	Estonia, Latvia Lithuania	coordination of natural gas strategies in the Baltic Republics	1,000,000
Phare Multicountry energy programme	1995	Estonia, Latvia Lithuania	assistance to the Baltic's Council of Ministers	750,000
Phare country operational programme	1996	Estonia	Infrastructure development programme/energy: - legislation, institutional framework - energy planning - sectoral technical assistance	2,000,000
Phare country operational programme	1996	Latvia	Infrastructure development programme/energy: - legislation, institutional framework - energy planning - efficient energy use	900,000
Phare country operational programme	1996	Lithuania	Infrastructure development programme/energy: - Programme Management Unit - energy awareness campaign - use of local energy resources - feasibility studies for investment in energy sector rehabilitation - implementation of privatisation plan - long-term coordinator of technical and financial assistance - Ukmergė-Anykščiai-Utena gas pipeline - construction of heavy fuel storage - Klaipėda aeothermal plan	6,250,000

**Table 6-1: Baltic Sea: projects implemented within EU cooperation programmes**  
(continuation of the table next page)

Continuation of Table 6-1:

Programme	Year	Target region	project title	financial support (ECU)
Inco-Copernicus	1995/1996	Poland, Russia	accompanying measure on intelligent computation and stimulation in planning and operation of power systems taking into account energy storage	80,500
Inco-Copernicus	1995/1996	Poland	Demonstration project on catalytic VOC (H-VOC) combustion in gas stream from coal and waste combustors	270,000
Inco-Copernicus	1995/1996	Russia	Demonstration project on advanced pulverised coal burners with reduced NOx emissions	220,000
THERMIE (Type B actions) <sup>3</sup>	1995/1996	Baltic Sea Region	preparation of energy technology transfer and coordination of information dissemination	170,000
THERMIE (Type B actions)	1995/1996	Latvia	reduction of Latvian hospitals energy losses	80,000
THERMIE (Type B actions)	1995/1996	Latvia	Training course-solar water heating	70,000
THERMIE (Type B actions)	1995/1996	Poland	Energy management and promotion of wood fuel in Poland	84,000
THERMIE (Type B actions)	1995/1996	Poland	Promotion of the EU Energy Centre Katowice, regional centre for solid fuels clean technologies	152,000
SYNERGY	1995	Russia/St-Petersburg	Training programme in energy sector	84,150
SYNERGY	1995	Estonia	Legal energy adviser for power sector	289,075
SYNERGY	1995	Estonia	EC energy Centre Tallin	160,000
SYNERGY	1995	Poland	EC energy Centre Katowice	312,000
SYNERGY	1995	Poland	EC energy Centre Warsaw	254,980
SYNERGY	1995	Russia	EC energy Centre St-Petersburg	180,000
SYNERGY	1995	Lithuania	EC energy Centre Vilnius	142,000
SYNERGY	1995	Latvia	EC energy Centre Riga	145,970

Source: European Commission Services

<sup>3</sup> Include strategic, dissemination and support actions.

Year	Target region	project title	financial support (ECU)
1995	Estonia	Energy sector Emergency Loan: repairs to energy supply facilities, improvements of oil sector facilities	33,200,000
1994	Lithuania	Safety of the Ignalina Nuclear Power Plant upgrades	33,000,000
1995	Lithuania	Energy sector Emergency Loan: supply, energy efficiency, improvement of financial management in the sector	37,130,000
1995	Latvia	Energy sector Emergency Loan: upgrading of hydro power plants on the Daugava River	32,110,000
1996	Russia/St-Petersburg	Invitation for tenders for active fire protection measures at Leningrad nuclear power plant	Non available

Source: EBRD information Desk

**Table 6-2: EBRD activities in the Baltic Sea Region**

## Annex to Tables

### A) Tables 4-1 to 4-4 (Germany, Denmark, Sweden, Finland): Footnotes to country Energy Balances and Key indicators

- 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 Toe per thousand US dollars at 1990 prices and exchange rates.
- 11 Toe per person.

### B) Remarks to all Tables based on data of PlanEcon 97:

Specific Country Tables 4-5 (Poland), 4-8 (Lithuania), 4-11 (Latvia) and 4-12 (Estonia); parts of the aggregated tables Table 3-1 (Non-EU-MS) and Table 3-2 (all BSR countries, shares of energy sources) with respect to Poland and the three BS

The data of the original source PlanEcon 97 are based on the units "thousand barrels per day oil equivalent". For a better comparison with other energy data in the study the PlanEcon data have been transformed into the more conventional unit "toe per year". For simplification the following relations have been used for the transformation:

- 1 barrel of oil = appr. 0.136 tonnes (World Energy Council, WEC, standard conversion factor)
- 1 year = 365 days

Some small deviations to other data due to this transformation may be possible.

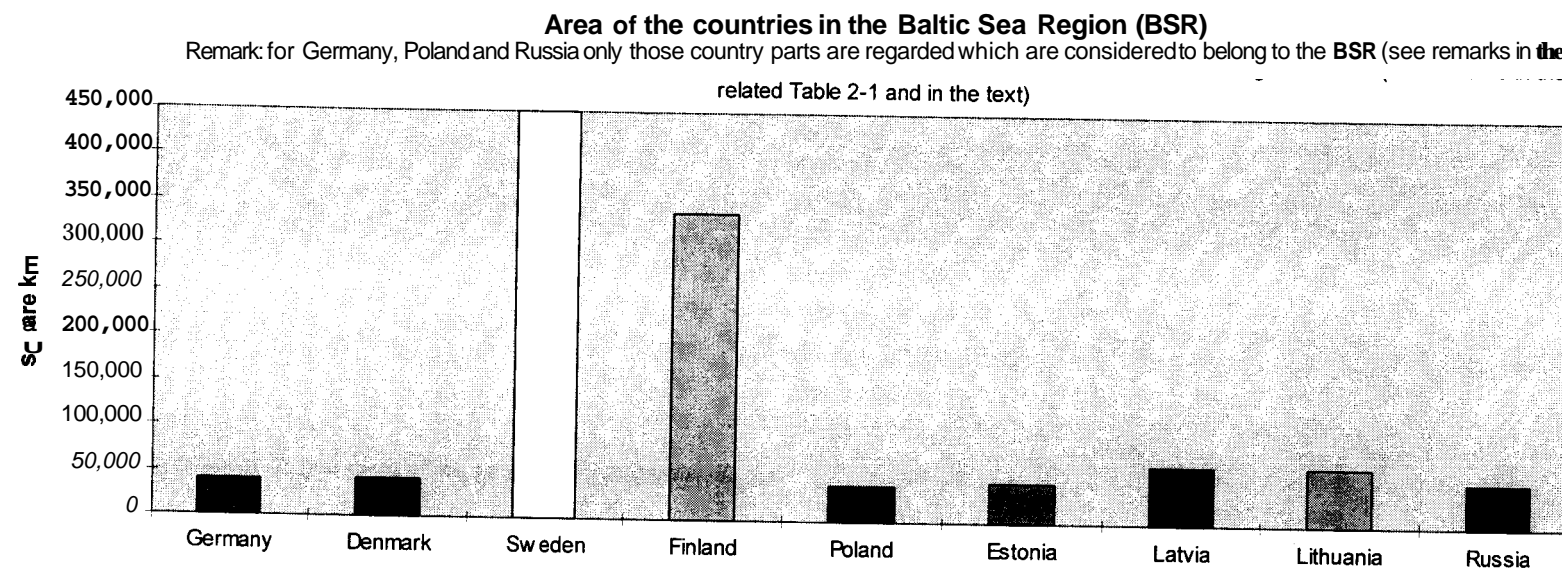
In general due to different statistical sources and calculations there exist differences between various sources. The following table compares the energy data of PlanEcon 97, transformed to toe per year, with the data of the source "Energy in Europe, issue Sept.96, European Commission" (EC 96 a in the references):

Source	Energy production (Mtoe)		Energy consumption (Mtoe)	
	PlanEcon 97*	Energy Europe, Sept.96*	PlanEcon 97*	Energy Europe, Sept.96*
	1994	1994	1994	1994
Poland	88,5	96,5	91	95,7
Lithuania	2,4	2,5	8,4	7,8
Latvia	1	1	4,4	4,5
Estonia	3,7	3,7	5,5	5,9
* original data transformed into toe per year; + estimated				



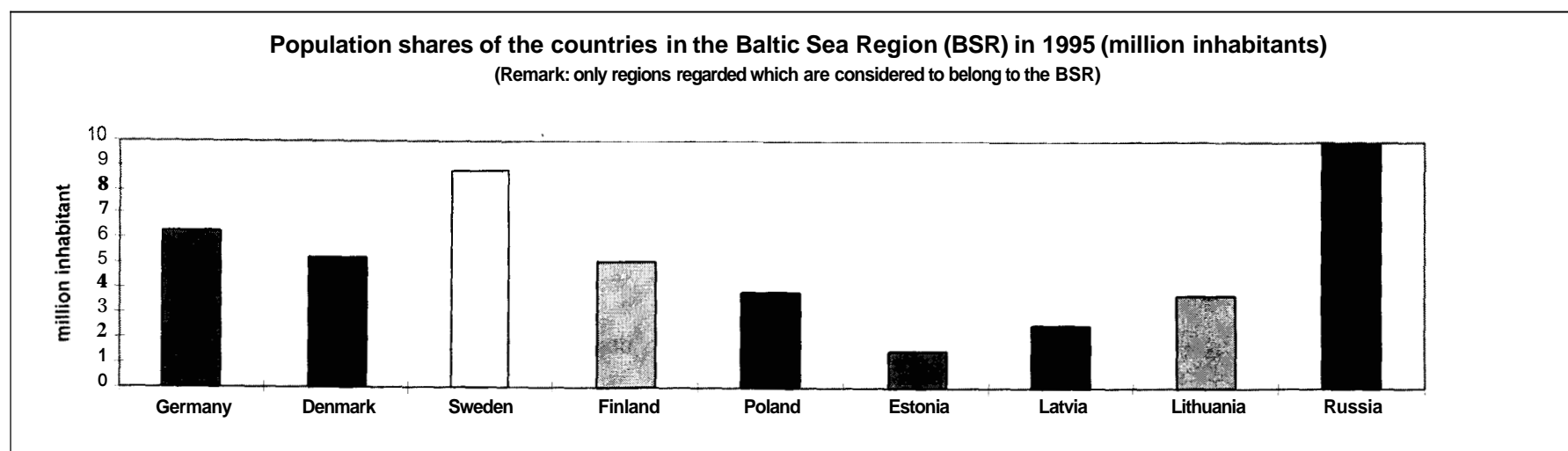
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## **2. Figures to chapter 2**



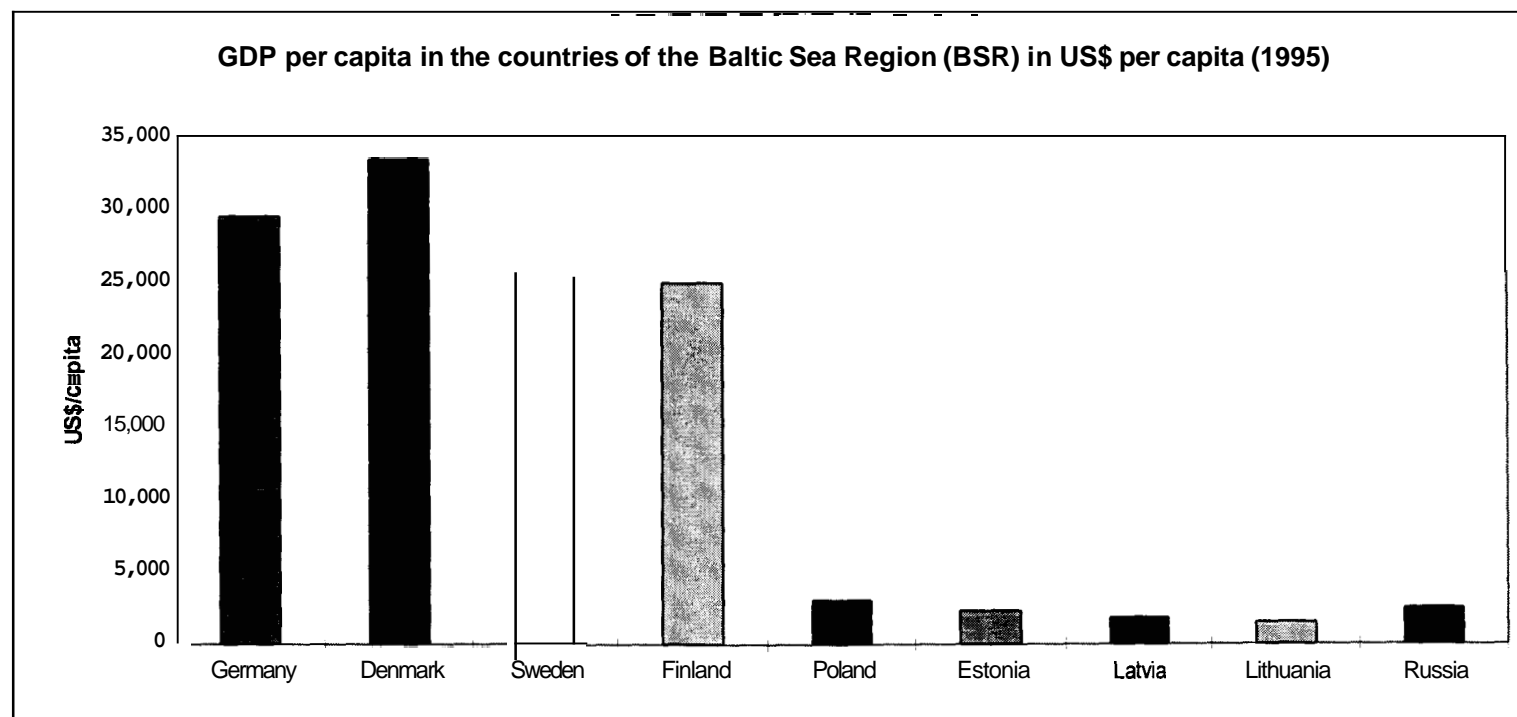
Source: see remarks to related Table 2-1

**Figure 2-1: Area of the countries in the Baltic Sea Region**



Source: see remarks to related Table 2-1

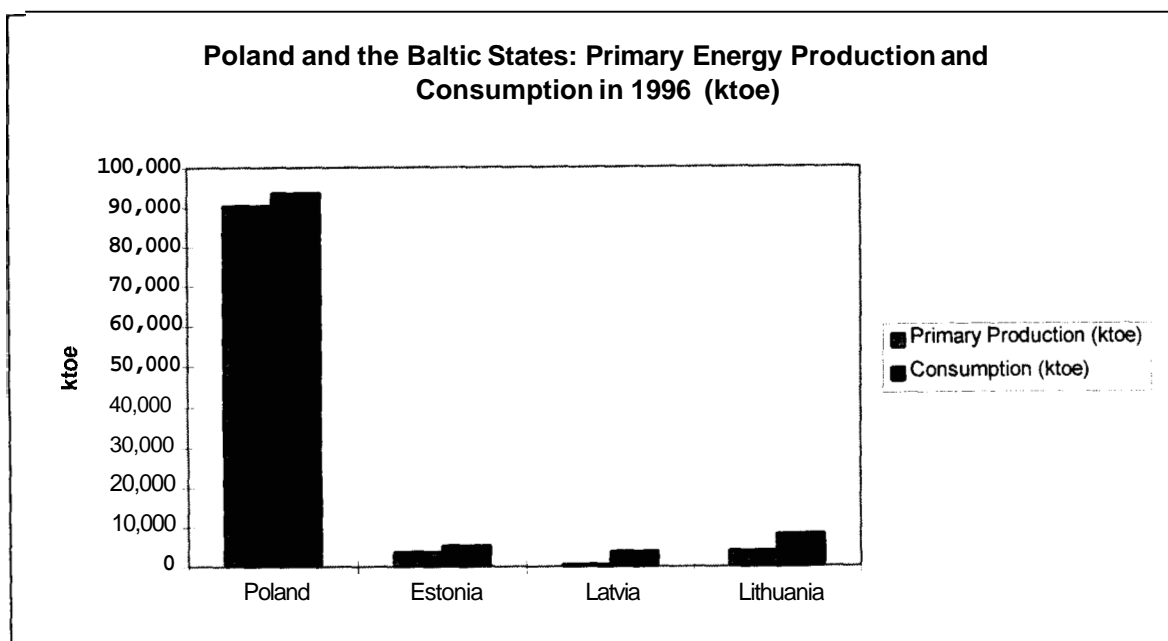
**Figure 2-2: Population of the countries in the Baltic Sea Region**



Source: see remarks to related Table 2-1

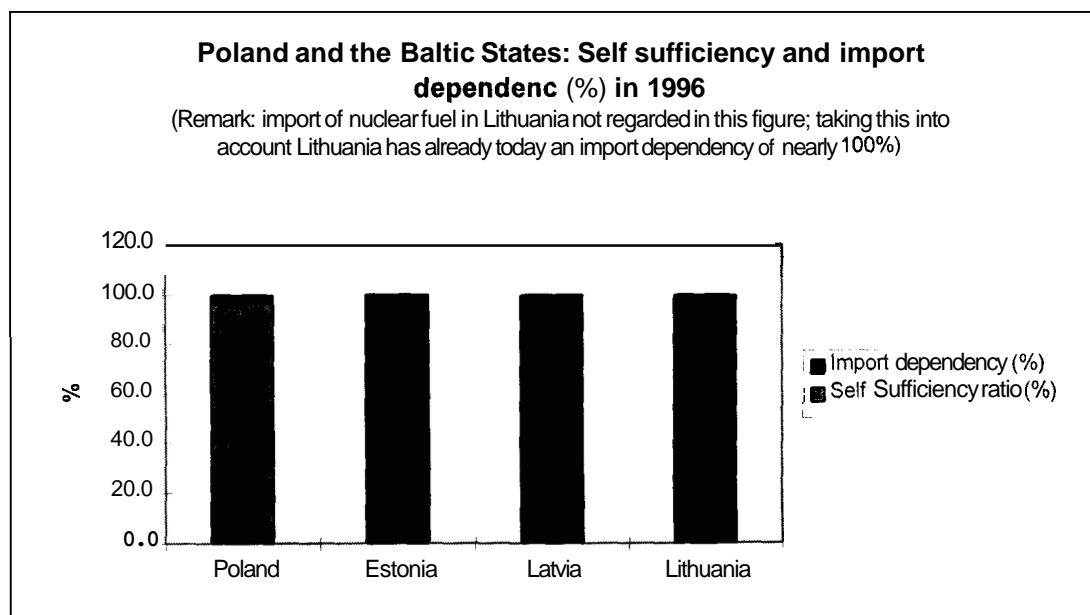
**Figure 2-3: GDP per capita of the countries in the Baltic Sea Region in US\$ per capita**

### 3. Figures to chapter 3



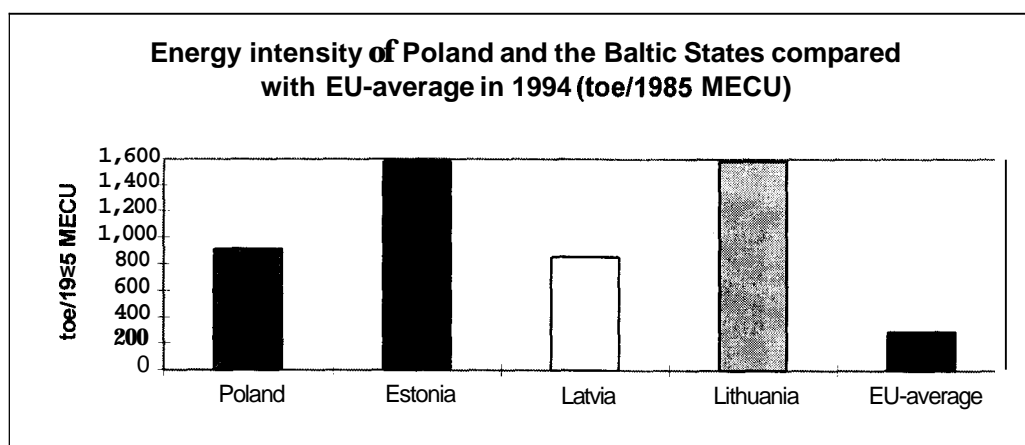
Source: see remarks to related Table 3-1

**Figure 3-1: Poland and the three BS: Primary Energy Production and Consumption**



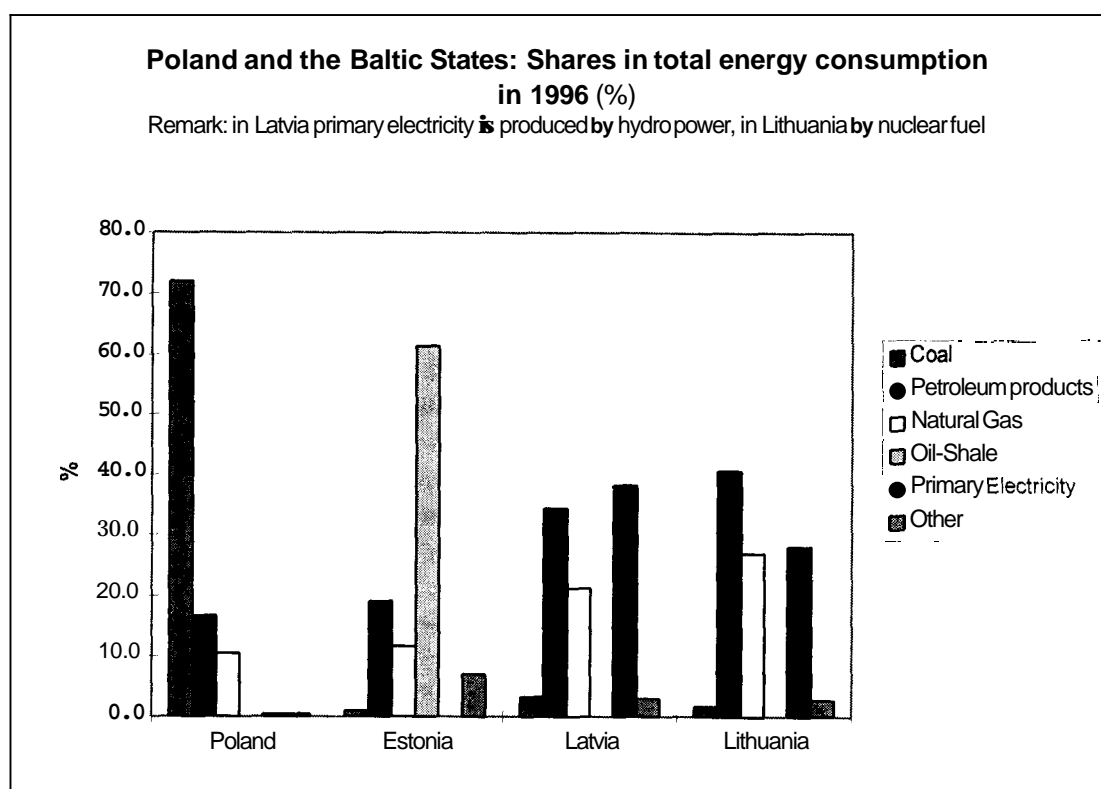
Source: see remarks to related Table 3-1

**Figure 3-2: Poland the Baltic States: Self Sufficiency and import dependence**



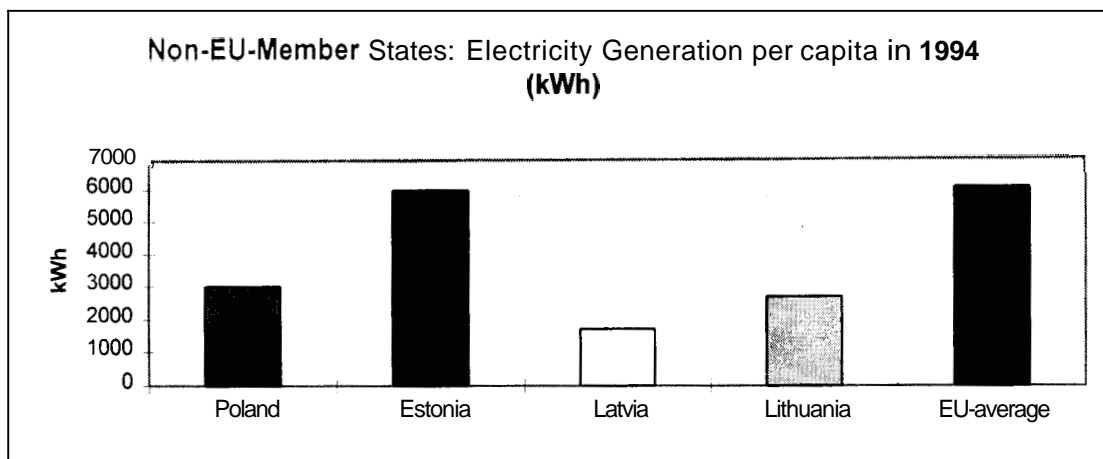
Source: see remarks to related Table 3-1

**Figure 3-3: Poland and the Baltic States: Energy intensity of compared with EU-average**



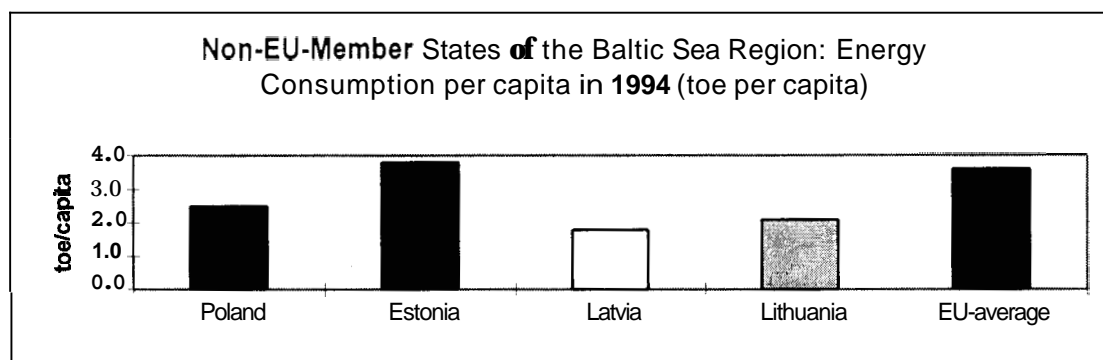
Source: see remarks to related Table 3-1

**Figure 3-4: Poland and the Baltic States: Shares in total energy consumption**



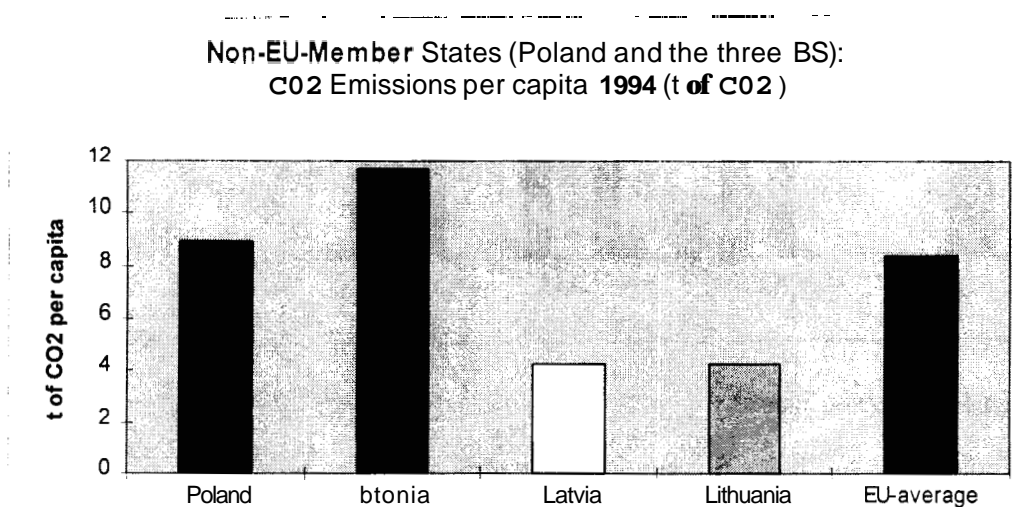
Source: EC 1996 a

Figure 3-5: Poland and the Baltic States: Electricity Generation **per capita**



Source: EC 1996 a

Figure 3-6: : Poland and the Baltic States: Energy Consumption per capita



Source: EC 1996 a

Figure 3-7: Poland and the Baltic States: CO<sub>2</sub> Emission per capita



## 4. Figures to Chapter 4

Sources for the following figures: see remarks to related tables to chapter 4

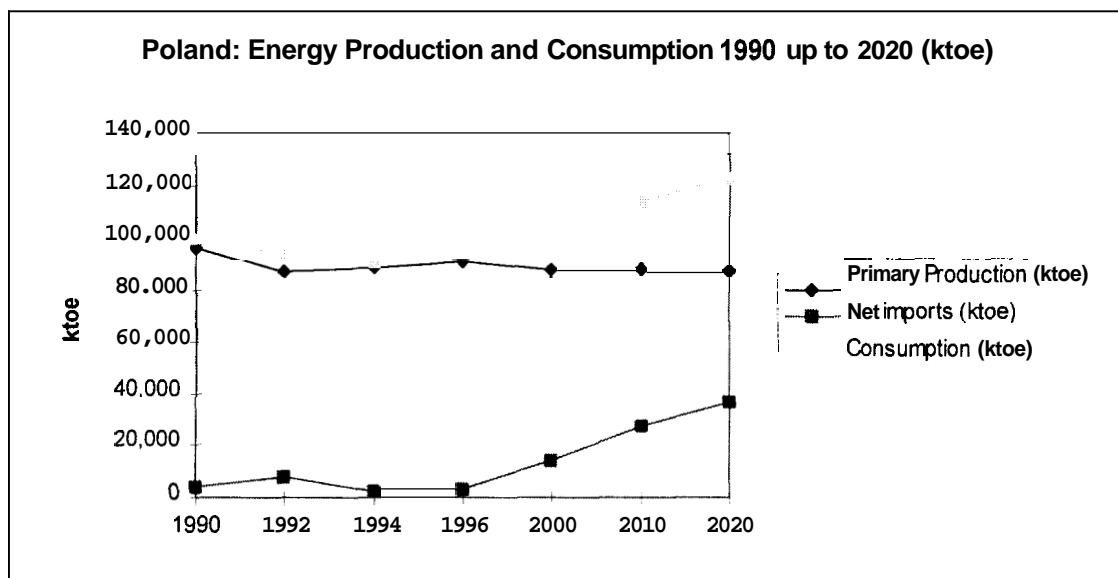


Figure 4-1: Poland: Energy Production and Consumption 1990 up to 2020

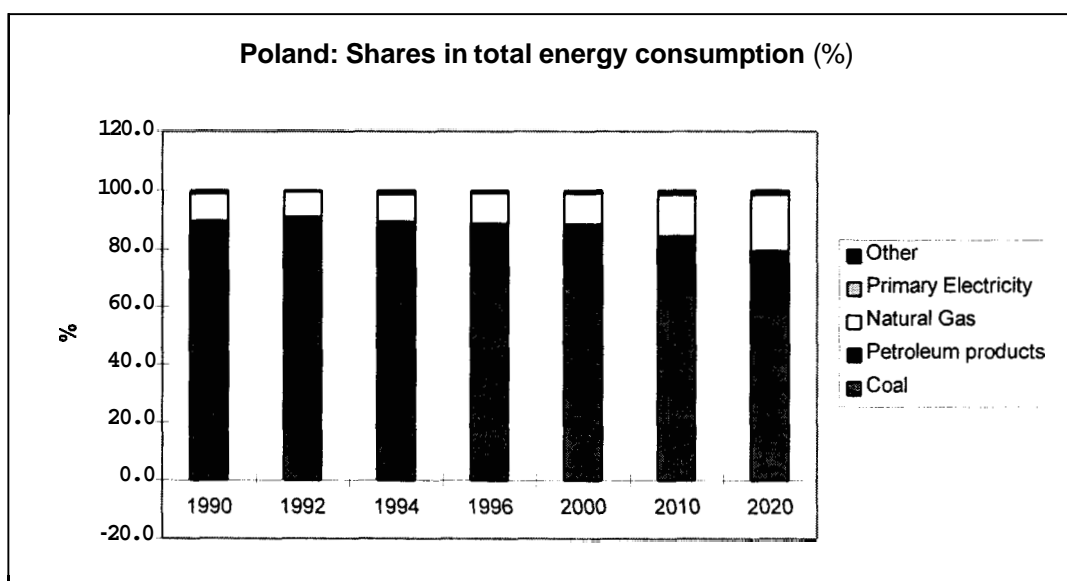
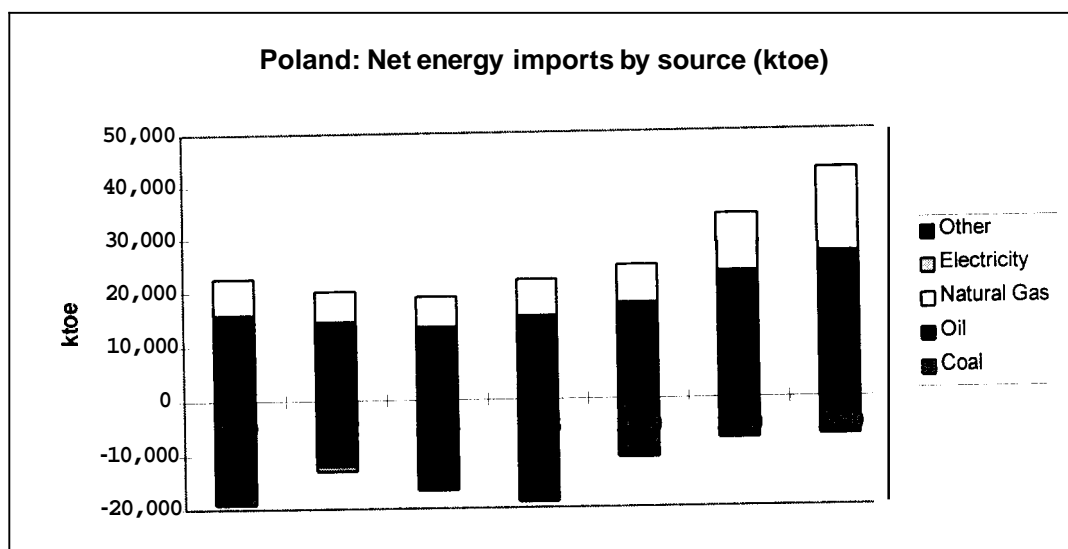
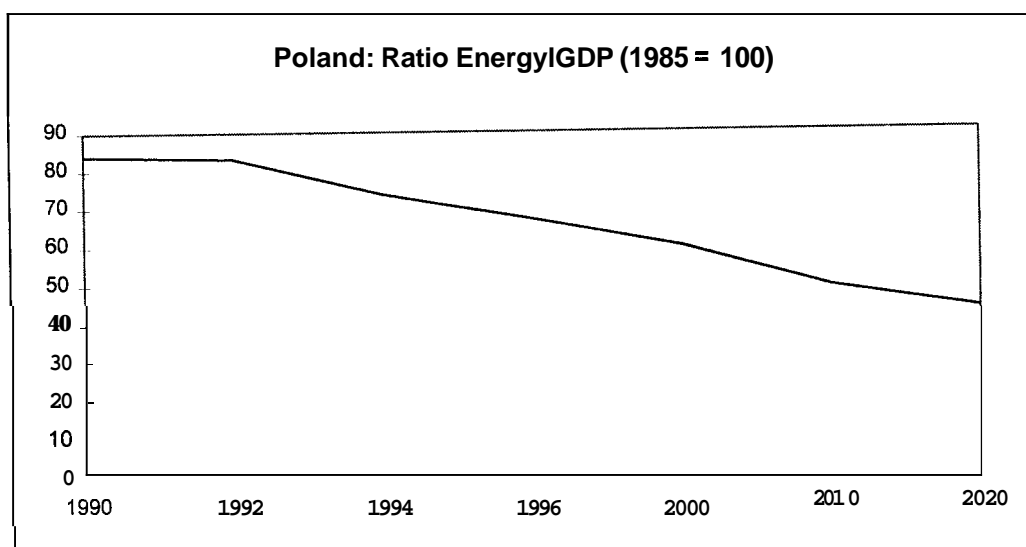


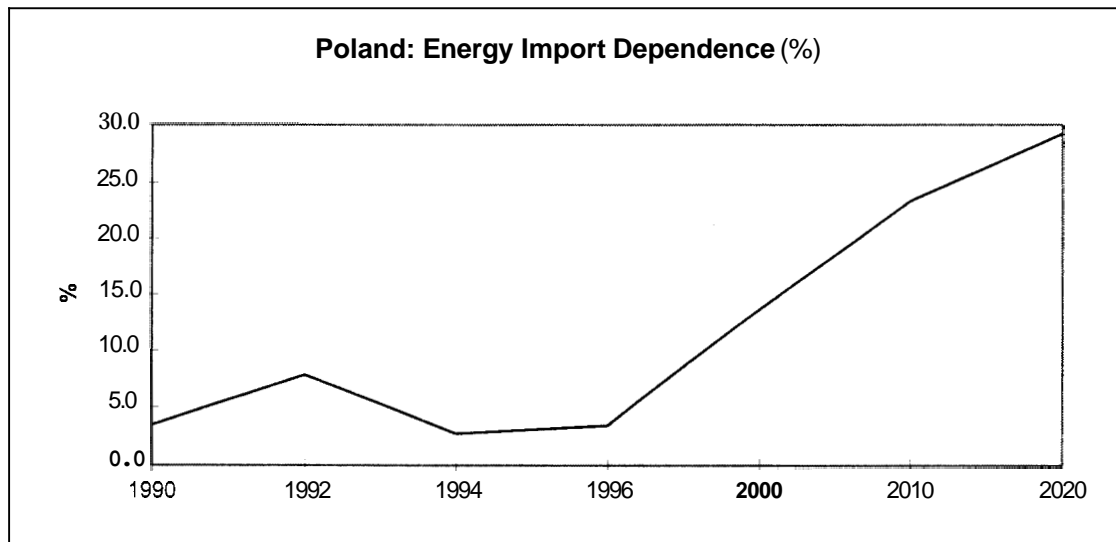
Figure 4-2: Poland: Shares in total energy consumption 1990 up to 2020



**Figure 4-3: Poland: Net energy imports by source 1990 up to 2020**



**Figure 4-4: Poland: Energy Intensity, Ratio Energy/GDP 1990 up to 2020**



**Figure 4-5: Poland: Energy and Import Dependence 1990 up to 2020**

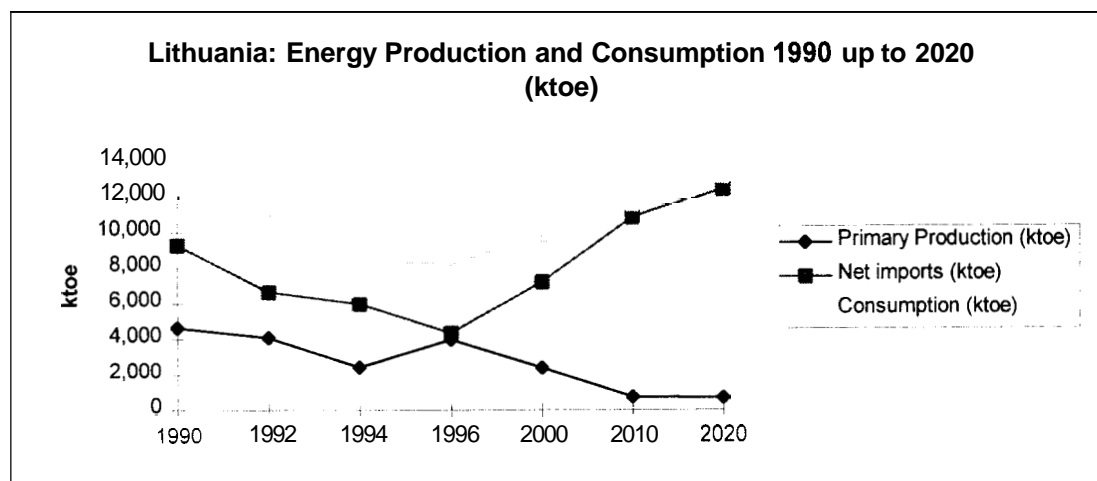


Figure 4-6: Lithuania: Energy Production and Consumption 1990 up to 2020

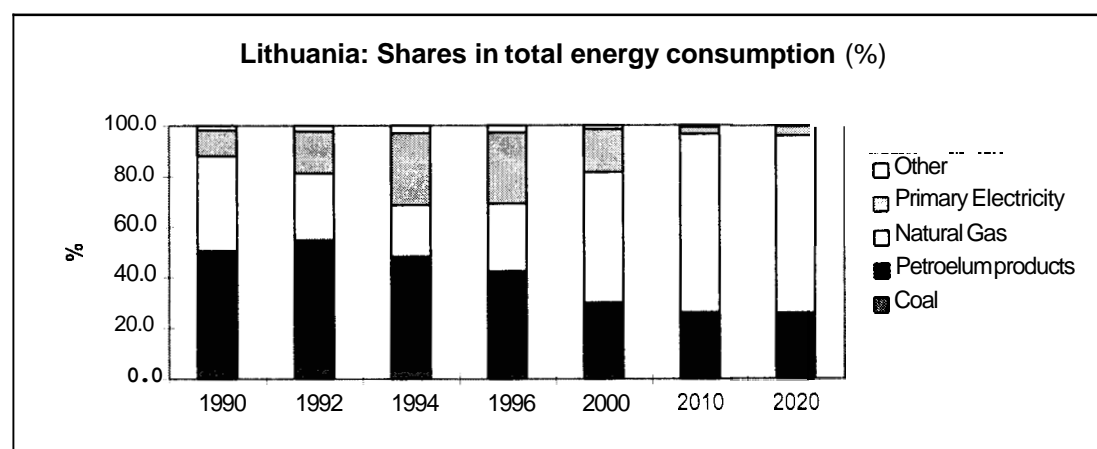


Figure 4-7: Lithuania: Shares in total energy consumption 1990 up to 2020

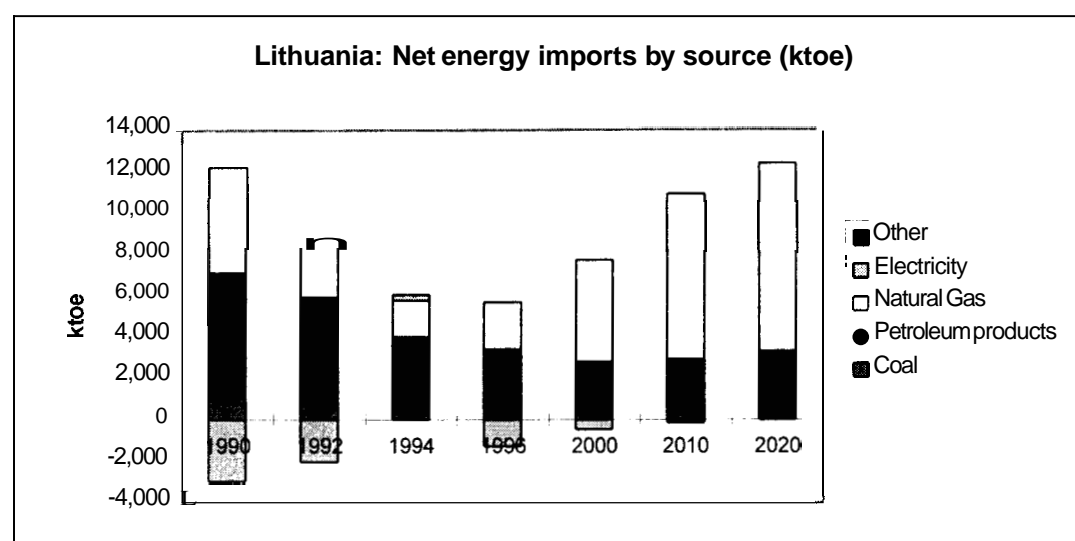
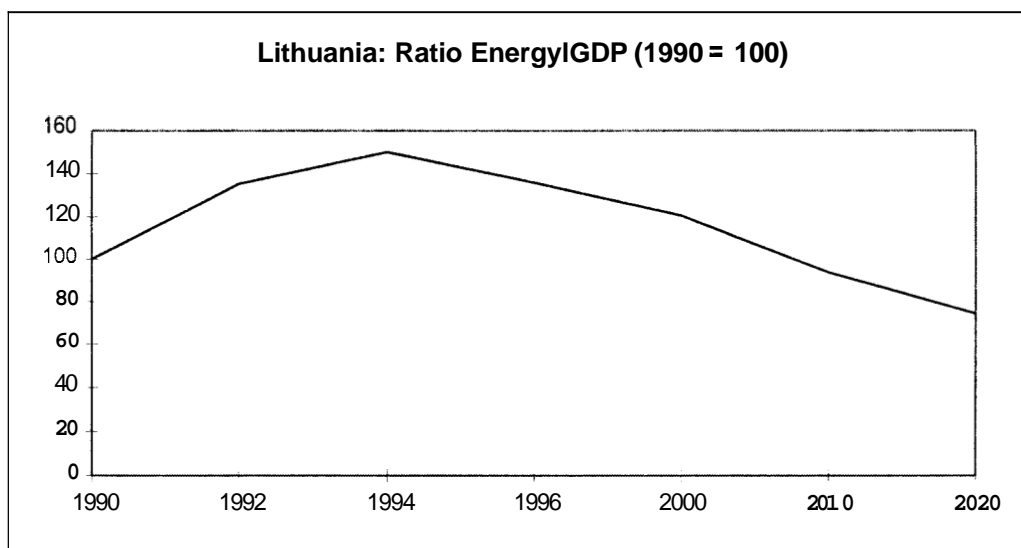
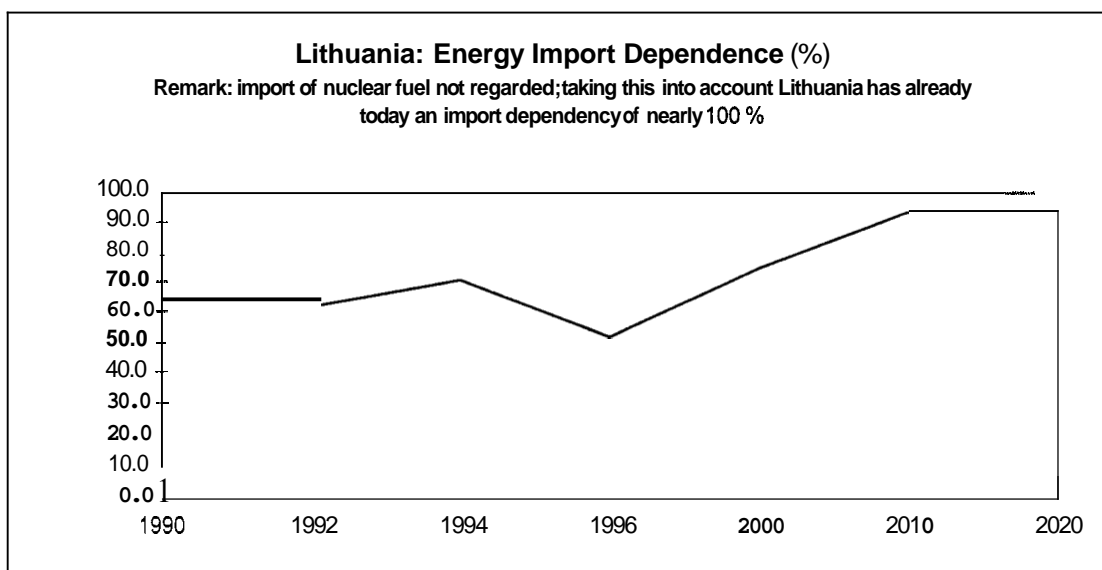


Figure 4-8: Lithuania: Net energy imports by source 1990 up to 2020



**Figure 4-9: Lithuania, Energy Intensity: Ratio Energy / GDP (1990 = 100)**



**Figure 4-10: Lithuania, Energy Import Dependence 1990 up to 2020**

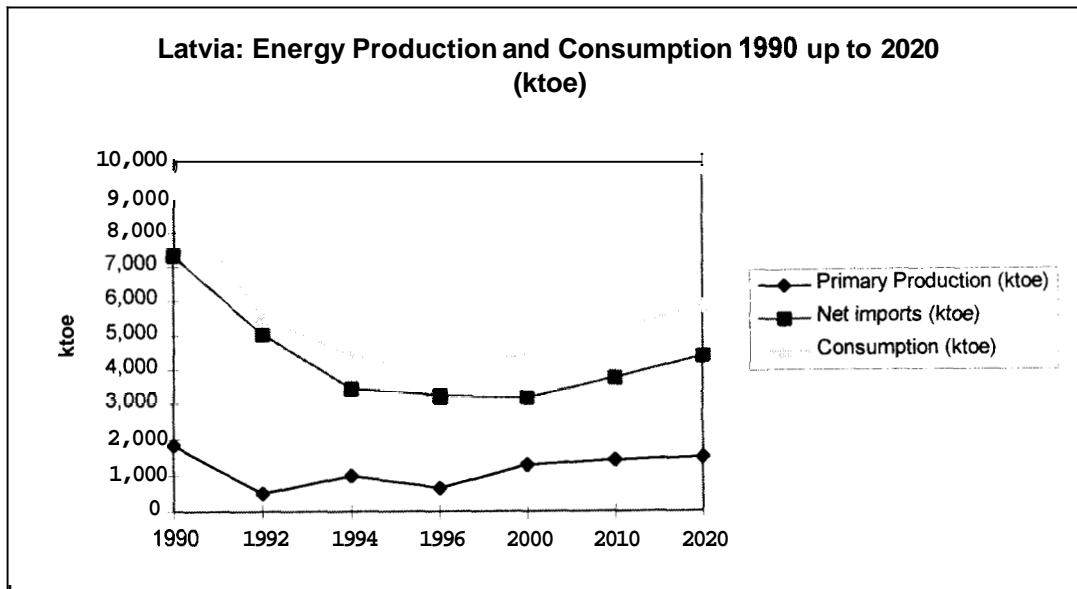


Figure 4-11: Latvia: Energy Production and Consumption 1990 up to 2020

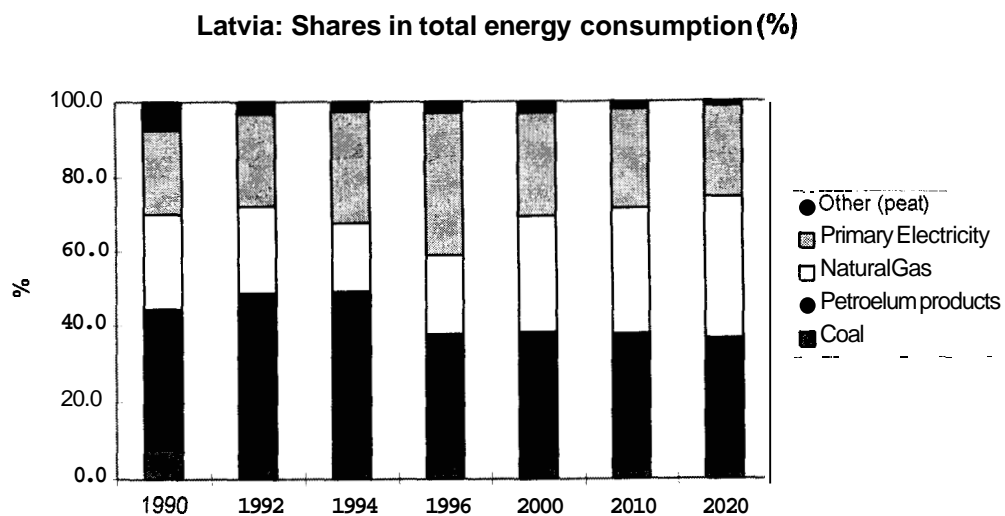
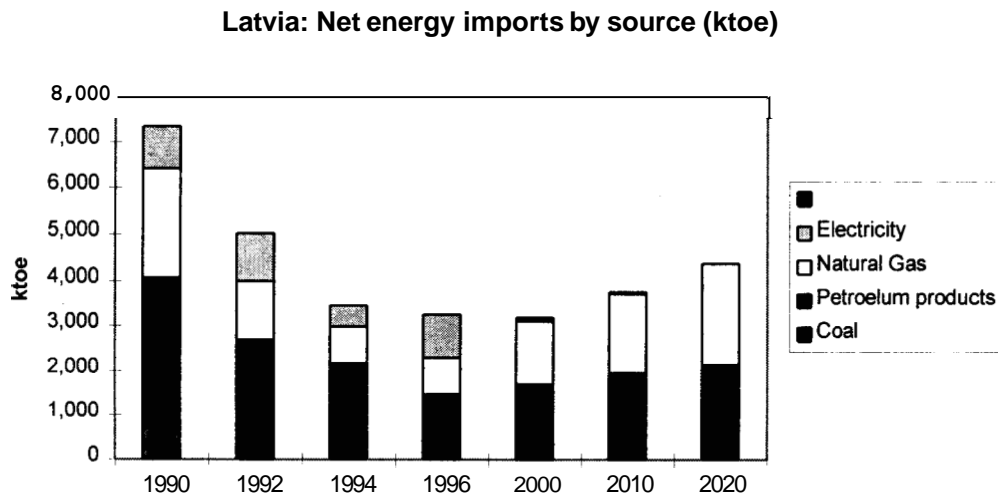
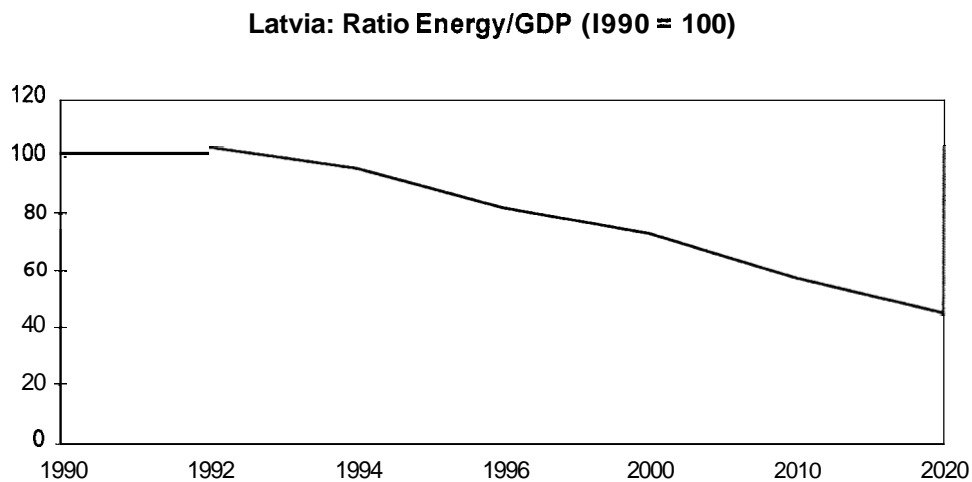


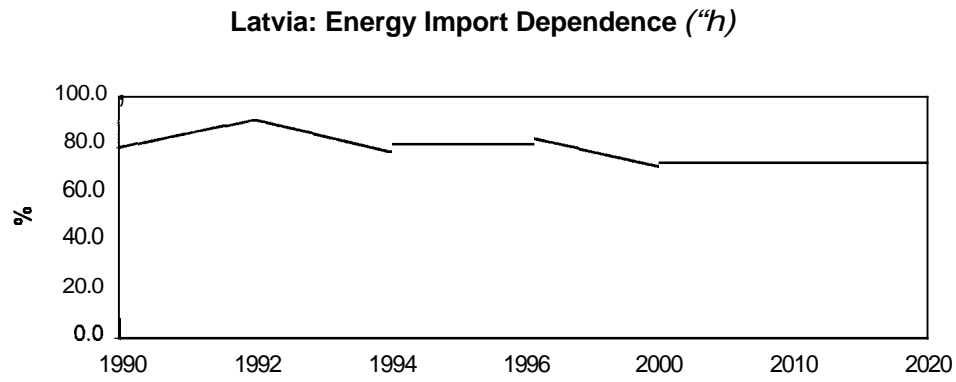
Figure 4-12: Latvia: Shares in total energy consumption 1990 up to 2020



**Figure 4-13: Latvia: Net energy imports by source 1990 up to 2020**



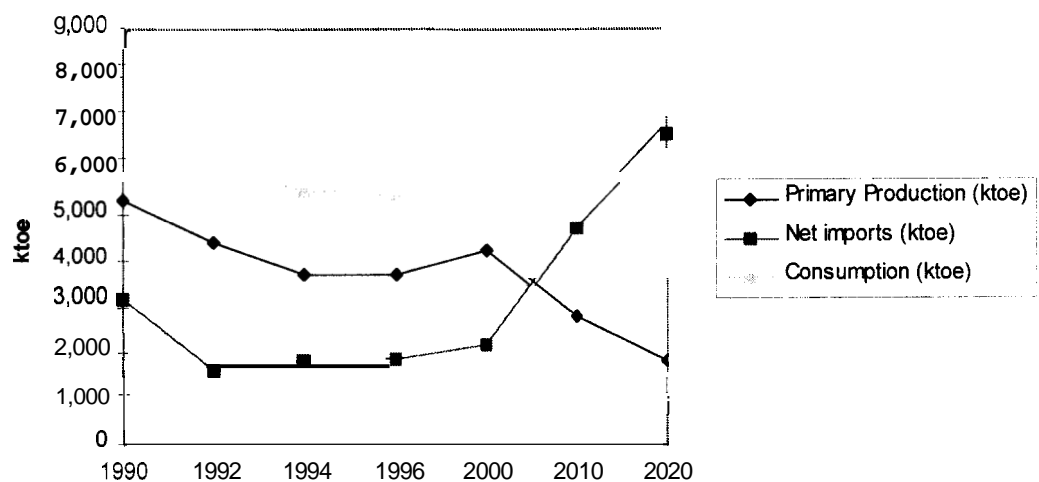
**Figure 4-14: Latvia: Ratio Energy ■ GDP; (Energy Intensity), 1990 up to 2020**



**Figure 4-15: Latvia: Energy ~~Import~~ Dependence 1990 up to 2020**

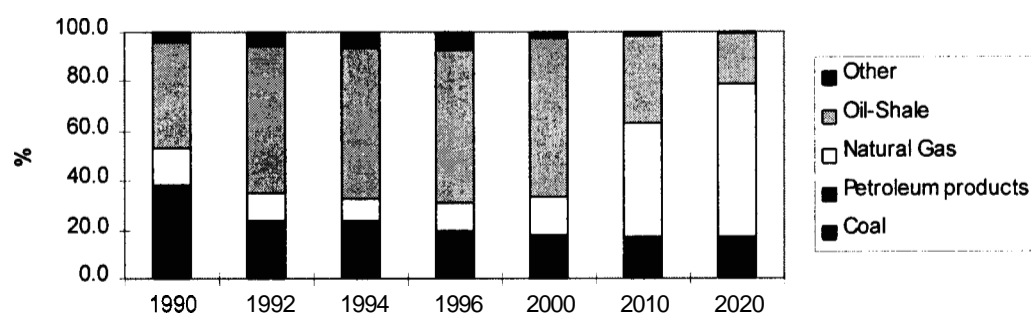


**Estonia: Energy Production and Consumption 1990 up to 2020  
(ktoe)**



**Figure 4-16: Estonia: Energy production and Consumption 1990 up to 2000**

**Estonia: Shares in total energy consumption (%)**



**Figure 4-17: Estonia: Shares and total energy consumption**

### Estonia: Net energy trade (Ktoe)

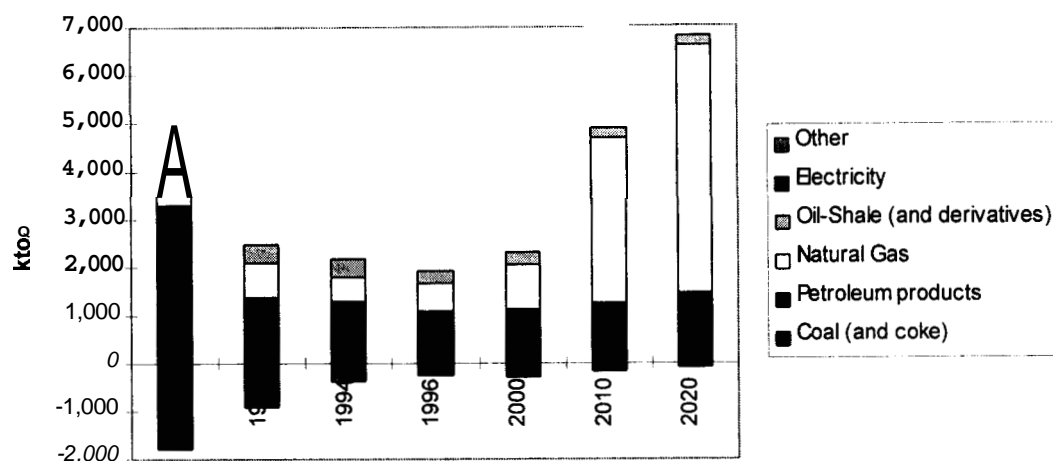


Figure 4-18: Estonia: Net energy trade 1990 up to 2020

### Estonia: Ratio Energy/GDP (1990 = 100)

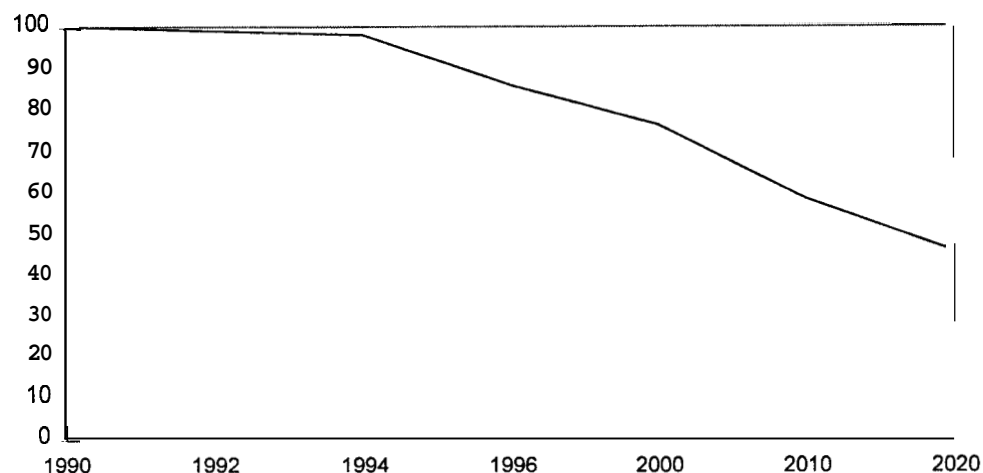


Figure 4-19: Estonia: Energy Intensity

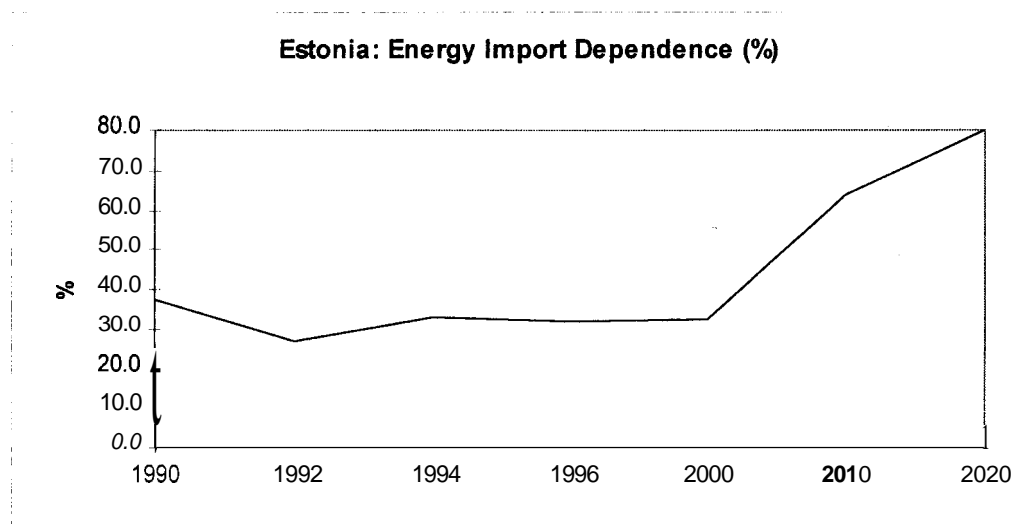


Figure 4-20: Estonia: Energy import Dependence

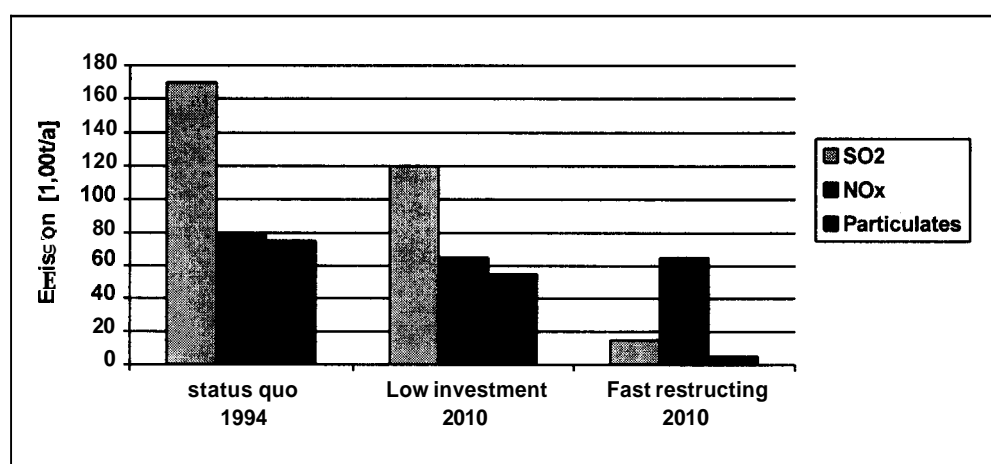


Figure 4-21: St. Petersburg: Emission inventory for SO<sub>2</sub>, NO<sub>x</sub> and particulates

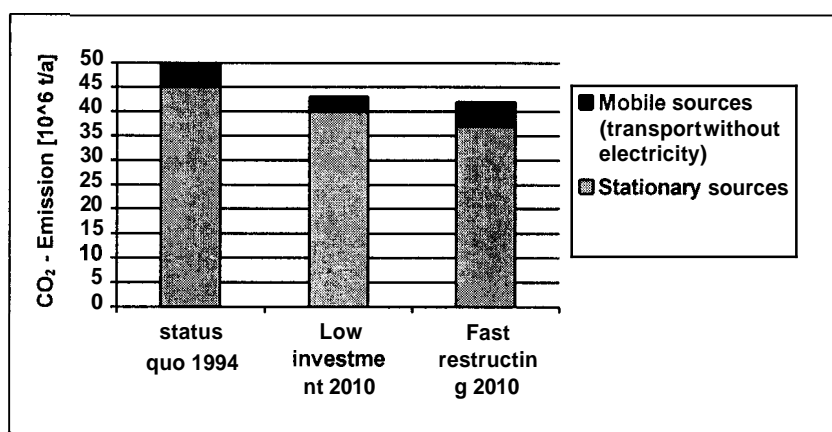


Figure 4-22: St. Petersburg: CO<sub>2</sub> emission inventory

