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BALTIC SUSTAINABLE ENERGY STRATEGY

Stockholm Environment Institute Tallinn Centre

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This strategy is prepared during the project "Baltic-Nordic cooperation for sustainable energy" that is a joint cooperation project of environmental NGOs and experts from Baltic and Nordic countries, North-West Russia and Belarus. The project is financially supported by the Nordic Council of Ministers. Project was coordinated by the Latvian Green Movement (www.zalie.lv).

Strategy was prepared by Stockholm Environment Institute Tallinn Centre (www.seit.ee) and was discussed and amended by the participants of the international seminar "Sustainable energy policy for the Baltic Sea region: non-fossil and non-nuclear opportunities" that took place on February 26, 2008 in Riga, Latvia.

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List of abbreviations

BAU - Business as usual

BES - Baltic Energy Strategy

BSES – Baltic Sustainable Energy Strategy

CCGT – Combined Cycle Gas Turbine

CDM – Clean Development Mechanism

CFB – Circulating Fluidized Bed

CFSP – Common Foreign and Security Policy

CHP – Combined Heat and Power

DH – District Heating

EEA – European Environment Agency

EEK – Estonian Crown

EEP – External Energy Policy

EU – European Union

FEC – Final Energy Consumption

GDP – Gross Domestic Product

GHG – Greenhouse Gases

HPP – Hydro Power Plant

HVEN - High Voltage Electricity Network

IAEA – International Atomic Energy Agency

IEA – International Energy Agency

INFORSE – International Network for Sustainable Energy

ISD – Indicators of Sustainable Development

JI – Joint Implementation

LTL – Lithuanian Litas

MCA – Multi Criteria Analyze

NEA - Nuclear Energy Agency

NGO – Non-Government Organization

NPP – Nuclear Power Plant

OECD – Organization for Economic Cooperation and Development

PES – Primary Energy Supply

PP – Power Plant

RES-E – Electricity from Renewable Energy Source

UNDESA – United Nations Department of Economic and Social Affairs

UNECE – United Nations Economic Commission for Europe

1 Introduction

Baltic Sea Region faces at present significant challenges due to many political as well economic changes in energy sector. German Russian gas pipeline construction has strengthened the situation for all countries around the Baltic Sea because of the rise of potential risks to human environment. Another, much more serious potential human and environmental risk is connected with increasing the nuclear energy production in this region. The whole region experiences deficit of electricity already now, therefore the strategic planning of generating capacities up to 2020 and 2050 has been put in the agenda of the Baltic States governments.

Nuclear energy further development issue has risen in connection with the decommissioning of second unit of Lithuanian Ignalina nuclear power plant in 2009 according to EU Accession Treaty. Closing down the warn-out facility diminishes significantly the risks. In order to advocate for the need to develop non-nuclear energy strategies in the region, the analysis of current and future energy sources in Baltic region is needed to foresee the opportunities for a sustainable regional energy strategy.

Present study tries to give a short overview of current situation in energy sector in general and in particular, in electricity generation of Estonia, Latvia and Lithuania to assess possible alternative scenarios for the development of sustainable energy strategies without the use of nuclear energy and diminished use of fossil fuels. The obligations to reduce GHG emissions according to Kyoto Protocol taken by Member States will have great significance for countries around. Renewable energy sources wider deployment could be the major option for all Baltic States as all countries have rather significant potential. Despite the title of the study is Baltic sustainable energy strategy, the study is devoted to electricity sectors development in three Baltic countries.

Implementation of Kyoto Protocol has significant importance in designing Baltic Energy Strategy. In 01.01.2005 the EU Emission Trading Scheme (ETS) has been launched between 25 EU Member States for the period of 2005-2007. Next phase, worldwide trading with emission allowances for the period 2008-2012 has been launched since 01.01.2008. European Commission has taken serious cuts of the proposed by Member States the National Allocation Plans of GHG allowances in 2007. The cuts in three Baltic States were biggest and reached half of what was proposed to commission. This has put also, the Baltic States to totally new situation where missing allowances in energy sector must be bought on the market or obtained via developing Joint Implementation projects, majority of which are renewable energy projects, energy conservation and fuel switch to biomass projects. Much stronger development to decrease the fossil fuel based green house gases emissions are also emphasized in the January 2008 Renewable Energy package proposed by the EC. Present situation in electricity generation sector experiences the radically changed situation due to climate mitigation challenge already today.

The growth rate of electricity consumption has been rather high (around 6,5%) during recent years in all three countries. The rise is somehow slowed down now, however, in a longer perspective the further relatively high growth is projected. The electricity markets are fully opened for international competition in Latvia and Lithuania starting from 2008. Estonia will open its' market to 35% in 2009 and fully to 2013.

Lithuania, Latvia, Estonia and Poland have started the negotiations on the construction of new Ignalina nuclear power plant about three years ago. In October 2006 the public was informed about the results of the feasibility study on potential development of new nuclear reactors at the Ignalina site in Lithuania. Confidential feasibility allegedly claims that new nuclear power plant would be cost-effective. This was apparently the conclusion from a feasibility study made by *Lietuvos Energija* in cooperation with *Latvenergo* and *Eesti Energia*. However the calculations backing up this claim are not made public, neither in this study nor elsewhere. This indicates that the power utilities are apprehensive about public discussions. This means, no one, but relevant electricity utility companies and governments of Baltic States know the results of the study.

All three countries have demonstrated the wish for closer co-operation in the energy sector. In December 2006 the governments elaborated the first draft of the Baltic Energy Strategy (BES), which in fact, could be considered the first joint strategy document within energy sector. It aims to outline a framework for the energy sector development in long-term perspective – up to 2025. Unfortunately the draft Strategy is very general and doesn't refer to any calculations of currently available capacities for renewable energy sources and potential savings within energy efficiency measures. It also neglects the aspects of commitments that Baltic countries have made under Kyoto protocol and emission trading.

Present study is aiming to serve in capacity of a basis for further developing a joint Baltic NGOs position on sustainable energy strategies at the regional level. It is a part of wider project on Baltic sustainable energy supported by the Nordic Council. Stockholm Environment Institute (SEI) Tallinn Centre has been preparing the initial draft of the study, which thereafter has been discussed and amended during a number of workshops, conferences and seminars together with all project partners, environmental NGOs and other stakeholders around the Baltic Sea region. In some sense it could be considered as response to the governmental initiative to draft joint Baltic energy strategy including strong emphasis on nuclear. Present study is limited to electricity production sector only and does not include the development of heating and transport, also natural gas supply sectors.

Following this Introduction, Chapter 2 of the study reviews the current situation in three Baltic States' energy sectors. Chapter 3 deals with the analyzing of Baltic governments draft Energy Strategy paper dated back to Dec 2006. Chapter 4 gives overview of basic indicators and outlines goals for sustainable energy sector development as well lists major measures to achieve these goals

In Chapter 5 modeling and comparison of impacts of different scenarios is performed. Chapter 6 indicates the results of Euro-barometer, i.e. the public opinion towards the energy sector issues and in particular – nuclear energy. The policy oriented conclusions and recommendations are given in the final Chapter 7.

2 Baltic States' power sector developments and possible future scenarios

2.1 General characteristics

Three Baltic States, Estonia, Latvia and Lithuania performed the political transition in the same year – 1991. It was followed by fundamental transformations including principal structural changes in the economy from a centrally planned to a free market. This in it's' turn caused huge changes in energy sectors and also, in energy policy. The main structure of electricity supply, however, did not change drastically in Baltic States. Estonia still relies mostly on local low calorific and highly polluting oil shale. Latvia's major source of electricity generation is renewable energy source, hydropower. Lithuania relies mostly on nuclear power, what supply has decreased due to the closing of the first unit of Ignalina Nuclear Power Plant (NPP) since the end of 2004 according to EU Accession Treaty. Still, the nuclear power forms major (prevailing) share in country's electricity generation.

All three Baltic States Estonia, Latvia and Lithuania became the full members of the European Union (EU) on 1st May 2004. Membership opens the EU market for the Baltic States with considerable opportunities for economic development. It creates favorable conditions for real close co-operation in the energy sector. Baltic States national energy policies are harmonized with the EU policies, energy sector directives and standards. This forms good basis for further successful co-operation.

In connection with the EU membership in the longer prospective, however, big structural changes could be foreseen in each three states. Part of them are due to the requirements of EU energy sector directives, part are related to implementation of the climate change mitigation commitment, referring to EU common 8% GHG emissions reduction targets foreseen with the Kyoto Protocol first commitment period (2008-2012). And most recently the EU climate and renewable energy new proposal package issued in January 2008 will set stringent commitments to increase the share of renewable energy source based electricity generation (RES-E). The final commitments will be very probably forced to the beginning of 2009.

Three states have both common features and differences in their energy policies and regulations, which could create positively enriching diversity when working out common Baltic Energy Strategy. Latvia and Lithuania opened fully their electricity markets in 2008. Estonia will open its' market partly, up to 35% in 01.01.2009 and fully – in 01.01.2013 only. The latter date means Estonia could still gather experiences and reorganize its' energy sector for mostly 5 more years.

The Baltic States are following the EU renewable energy wider deployment directive 2001/77/EC, what foresees fixed shares of consumption of RES-E to year 2010. For Estonia the target is 5.1%, for Latvia – 49.3% and for Lithuania - 7%. The Directive foresees the step-wise phase-out of fossil fuels. The procedure of detailed reporting on the success in every five years period since the issuing of the Directive has been foreseen. New targets to year 2020 yet under discussion tend to be more demanding. In average 20% share in final energy consumption will be very probably settled.

Each out of three Baltic States have different options to follow the trends and targets taken by the European Commission, still the common feature is the countries are all relatively small economies, relying on import of natural gas, also liquid fuels from neighboring Russia. Three states have relatively weak connecting gridlines inside the Baltic's, interconnections outside the region are limited and oriented only towards Russia and Belarus. Baltic States have no major interconnections to EU, but the inaugurated in November 2006 330 MW direct current sea-cable ESTLINK I from Estonia to Finland. It is the first interconnection aimed towards EU, however, there are several more projects in pipe which are still in the feasibility study stage. Here the plans for sea-cables ESTLINK II between Estonia and Finland, sea-cables between Sweden and Estonia and also Latvia, interconnection between Poland and Lithuania, et al should be mentioned. The high dependence on natural gas supply from Russian *Gazprom* is one of the major concerns for the Baltic States. Further dependence of EU on Russia is constituently increasing, Baltic States will face the similar to EU security of supply risks in coming next decades.

In the following paragraphs all three countries will be presented by major energy sector indicators needed for characterization of power generation. Some comparison with the EU average energy sector indicators is presented including energy efficiency, energy intensity and per capita production and consumption will be referred. Major structural changes foreseen in ~15 years prospective up to 2025 will be described, also the trends and potential in RES-E wider deployment. The chapter refers to official statistics, overviews made by the relevant ministries of each country, IEA, OECD official publications, also research literature in the field.

2.2. Estonia[1]

2.2.1 Energy balance

A specific feature of the Estonian energy sector is production of electricity from domestic fuel – oil shale. Production of oil shale-based electricity covers Estonia's electricity consumption and also enables the export of electricity. As oil shale is the strategic energy source of Estonia, environmental, economic and social policy and security aspects must be considered when planning its further use in power generation and petrochemical industry. At the current volume of consumption the active supplies of the operating mines and quarries will last until 2025, what-after the new mines must be opened. At the current rate of consumption, the total active supplies of oil shale will last for 40-60 years calculated on the basis of the technical-economic conditions of power stations. The draft national program of usage the oil shale is publicly discussed. It will fix the marginal volumes of mining, what is in the range of 15 to 20 million tonnes per year. It also analyses the potential threats to environment caused by mining. The program will be finally adopted in 2008 by Parliament.

In heat production the share of oil shale while not dominant but is still remarkable – in 2005 nearly 21% of heat (produced in power plants and boiler houses) was produced from oil shale. The oil shale-based energy complex is concentrated into the North-East region of Estonia (*Ida-Viru* County) because of the location of oil shale deposits. Several oil-shale mines and quarries started working and two large oil-shale power plants *Balti PP* (1610 MW) and *Eesti PP* (1390 MW) were built, which enabled in the 1980s to extract 25-30 million tonnes of oil shale and produce electricity in the amount of 17-19 TWh, of which 50-60% was exported to other regions of the Soviet Union. *Iru PP* (190MW), combined heat and power station operates on natural gas. The rest of 15 power plants are relatively small ranging from 0.2 MW to 27 MW. Hydro PP total capacity is 4.4 MW. Currently annual gross electricity generation has stabilized at around 10 TWh with final inland consumption on the level of 6.5 – 7 TWh. However, oil shale remains dominant in electricity production, having dropped only from 95-97% in the 1990s to 91-94% in the 2000s.

During last years 12-14 million tons of oil shale was mined out annually of which 85 % was used for power production. In addition to combustion in power plants, oil shale is also used for the production of oil and in petrochemical industry, e.g. in 2005 about 2.8 million tons of oil shale was used in petrochemical industry.

The structure and dynamics of total primary energy supply (TPES) is presented for selected years over the period 1991-2006 in Table 2.1. The share of oil shale in TPES has not changed

[1] In this part the following major sources of information have been used: Eesti Energia AS. 2007. Annual Report 2006. Tallinn; Estonian Energy in Figures. 2007. The Ministry of Economic Affairs and Communication. Tallinn, 2008. (http://www.mkm.ee/index.php?id=1787), Laur, A., Tenno, K. Estonian energy sector developments over 1991-2005. Baltic Economic Trends, Ed. By A.Vanags. BICEPS, Riga, 2006, No 2. pp. 9-16; Statistics Estonia. 2007. Energy Balance 2006. Tallinn, National Electricity Sector Development Plan 2005-2015, https://www.riigiteataja.ee/ert/act.jsp?id=979263, Estonian Energy in Figures. 2007. The Ministry of Economic Affairs and Communication. Tallinn, 2008. (http://www.mkm.ee/index.php?id=1787). Long-Term National Development Plan for the Fuel and Energy Sector until 2015. Ministry of Economic Affairs and Communication, Tallinn 2004.

much being still around 60%. Nevertheless, the first Long-term National Development Plan for the Fuel and Energy Sector (adopted in 1998) stipulated a significant decline in the share of oil-shale to the level 47-50% by 2010. Also the new versions of the energy and electricity sector development plans still stipulate a decrease in the utilization of oil shale. For example, in the Long-Term National Development Plan for the Fuel and Energy Sector until 2015[2] (2004) oil-shale is expected to contribute to 68% only of electricity production in 2015.

Table 2.1. Dynamics of Total Primary Energy Supply

	1991		1995		2003		2004		2005		2006	
	TWh	%	TWh	%	TWh	%	TWh	%	TWh	%	TWh	%
Oil shale	61.1	56.3	39.1	62.6	37.9	63.6	37.9	61.9	36.4	60.7	34.6	59.9
Peat	2.1	1.9	1.9	3.0	0.7	1.2	0.6	1.0	0.6	0.9	0.6	1.0
Firewood*	2.1	1.9	5.1	8.1	6.6	11.1	6.9	11.3	6.7	11.2	5.6	9.7
Total domestic	**65.3**	**60.1**	**46.1**	**73.7**	**45.2**	**75.9**	**45.4**	**74.2**	**43.7**	**72.8**	**40.8**	**70.6**
Coal and coke	2.3	2.1	0.4	0.6	0.1	0.2	0.2	0.3	0.1	0.2	0.2	0.3
Liquid fuels**	31.1	28.7	9.9	15.9	8.4	14.1	8.3	13.5	8.3	13.8	8.0	13.9
Gas***	14.7	13.5	6.9	11.0	7.8	13.0	9.1	14.9	9.4	15.7	9.5	16.4
Total imported	**48.1**	**44.3**	**17.2**	**27.5**	**16.3**	**27.3**	**17.6**	**28.7**	**17.8**	**29.7**	**17.7**	**30.6**
Electricity****	-4.9	-4.4	-0.8	-1.2	-1.9	-3.2	-1.8	-2.9	-1.5	-2.5	-0.7	-1.2
Total	**108.5**	**100.0**	**62.5**	**100.0**	**59.6**	**100.0**	**61.2**	**100.0**	**60.0**	**100.0**	**57.8**	**100.0**

Notes: * Firewood, wood chips and wood waste

** Heavy fuel oil and light fuel oil, shale oil, motor gasoline, diesel and aviation gasoline

*** Natural, liquefied and biogas

**** The exports of electricity exceeds the imports

Sources: Sources: Statistics Estonia. 2007. Energy Balance 2006. Tallinn;

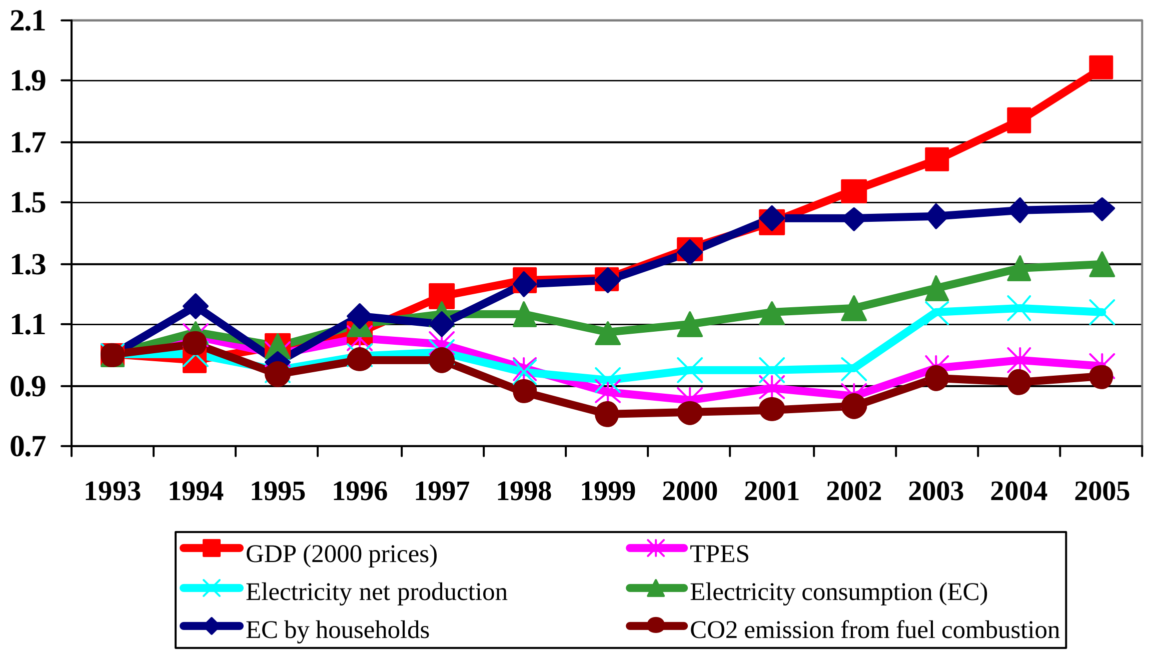
Statistical Office of Estonia. 1996. Energy Balance 1995. Tallinn.

[2] Long-Term National Development Plan for the Fuel and Energy Sector until 2015. Ministry of Economic Affairs and Communication, Tallinn 2004.

In Table 2.1. One can see that the share of majority of imported fuels – coal, liquid fuels has decreased (mainly in favor of wood fuels) to 14% in this period, which has raised the share of local fuels in the TPES to 73% in 2005.

The dynamics of TPES, electricity production and consumption and CO_2 emission from fuel combustion versus GDP growth in 1993-2005 is presented in Figure 2.1. One could observe a slight decline of TPES comparing the initial level of 1993 with the level of 2005. In intermediate years even lower level could be observed, the reason could be small exports of electricity and shale oil in these years.

Figure 2.1. Trends of the main Estonian energy sector indices compared with the GDP growth



Sources: Statistics Estonia. 2006. Statistical Yearbook of Estonia 2006. Tallinn;

Statistics Estonia. 2006. Energy Balance 2005. Tallinn;

(http://pub.stat.ee/px-web.2001/Database/Majandus/02Energeetika/02Energeetika.asp);

(http://pub.stat.ee/px-web.2001/Database/Keskkond/08Surve_keskkonnaseisundile/12Ehu_saastamine/12Ehu_saastamine.asp)

Significant growth of GDP has brought with the raising trend of electricity net production, but at the same time the CO_2 emission from fuel combustion diminishes. Consumption of electricity by households, however, increased until 2001 at the same rate as GDP, which could be a sign of rising living standard. Later the growth of electricity consumption by households has been clearly limited by electricity price rise – until 2001 the cost of electricity was relatively moderate, but thereafter several jumps in price levels occurred causing also a growth of the real price of electricity for households.

2.2.2 Power sector

Estonia's two main electricity producers – oil-shale power plants *Balti PP* and *Eesti PP* – are divisions of the power generation company *Narva Elektrijaamad AS* (*AS Narva PP*), which in turn is a constituent part of the vertically integrated infrastructure enterprise *Eesti Energia AS (Estonian Energy Ltd.)*. Pulverized fluidized bed combustion (PFBC) has been the main technology used since the beginning of power production. In 2001 *AS Narva PP* took for renovation of two 215 MW energy blocks, using a new, low temperature circulating fluidized bed combustion (CFBC) technology. The new technology is of significantly higher efficiency and has less negative impact on the environment compared with the PFBC technology used so far[3].

As a result of introducing the new technology, the emissions into air have considerably diminished, in particular the emissions of sulphur dioxide (SO_2), which has decreased 100 times and the emissions both of CO_2 and NO_x - approximately twice. The diminished level of SO_2 emissions should also enable Estonia to satisfy the requirement of the annual maximum amount of sulphur dioxide emission from oil shale-based power plants set in the EU Directive 2001/80/EC on the limitation of emissions of a number of pollutants into the air from large combustion plants. In 2003 the limitation of emissions according to the Directive was 76,000 tonnes of SO_2, and starting from 2012 the target is fixed on 25,000 tonnes. Actual emissions from *Eesti Energia AS* power plants were 81,600 tonnes in 2003 and 50,100 tonnes in 2006[4]. At present time the construction of two more CFBC blocs are intensively discussed. EU still, emphasizes on the issue of depositing of oil shale ash. It may even happen to be the most problematic task to be carried out in energy sector. The fulfillment of EU environmental (landfill) directive requirements, Directive1999/31/EC on the deposition of oil-shale ash puts big challenges to electricity generation sector in Estonia. According to the present plans of *Eesti Energia AS*, large-scale renovation of *AS Narva PP* will continue until 2018.

Installed electrical capacity of the Estonian power plants has decreased over the period 1990-2005 from 3425 to 2733 MW and thermal capacity from 3024 to 2593 MW). Electricity annual gross production has during last years stabilized around 10 TWh (10.8 TWh in 2007) and combined heat production around 11.5 PJ. In 2005 10.2% of electricity and 30.3% of heat was produced under cogeneration (CHP) regime.

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[3] Eesti Energia AS. 2006. Annual Report 2005. Tallinn.

[4] Eesti Energia AS. 2007. Annual Report 2006. Tallinn.

Estonian electricity balance is presented in Table 2.2. One could follow a sharp decline of domestic consumption of electricity in the initial years of transition. Consumption stabilized in 1995 and then turned to increase – in 2006 it was nearly 1.4 times bigger than in 1995. A positive phenomenon worth of mentioning is the remarkable reduction of the energy system losses, which by 1995 had increased significantly mainly due to the large overcapacity of the system. At present about 2% level of the decrease of system losses has been reached.

Table 2.2. Dynamics of the Electricity Balance, GWh

	1991	1995	2003	2004	2005	2006
Gross production*	**14627**	**8693**	**10159**	**10304**	**10205**	**9731**
Net production	13061	7607	9101	9232	9114	8728
Own use in power plants	1566	1086	1058	1072	1091	1003
Losses	1086	1773	1192	1112	1103	1077
Consumption in Estonia	**7204**	**5074**	**6013**	**6326**	**6403**	**6901**
incl. In: industry	3368	1943	2361	2460	2434	2640
construction	82	120	96	96	97	107
agriculture	2004	366	210	224	222	219
transport	172	191	98	101	103	83
commercial and publ. services	654	1387	1654	1827	1927	2177
households	924	1067	1594	1618	1620	1675
per capita (kWh)	592	743	1178	1199	1203	1247
Exports**	**4771**	**760**	**1896**	**1794**	**1608**	**750**

Notes: * Including own use by power plants

** Net exports (balance)

Sources: Statistics Estonia. 2007. Statistical Yearbook of Estonia 2006. Tallinn;

(http://pub.stat.ee/px-web.2001/Database/Majandus/02Energeetika/02Energeetika.asp)

Table 2.2. Illustrates well the dynamics in electricity sector. Electricity consumption has declined most dramatically in agriculture – this trend stopped only in 2003. The consumption by households underwent a considerable growth up till 2005 both in absolute terms and per capita). Considering that electricity consumption by households is regarded as an indicator of

the quality of life, such a development must be deemed positive – especially considering the low initial level in Estonia in 1991. Even so per capita consumption remains low by EU levels. For comparison: EU-15 average per capita consumption by households in 2000 was 1700 kWh and in Finland as much as 3600 kWh. With 1203 kWh per capita in 2005 Estonia is far below the rest of major EU member states.

Table 2.3. Represents data on the use of energy resources for electricity generation in 1997 and in the period 2001-2005. One can follow that the share of oil shale has stabilized at around 92% in recent years, the share of natural gas – at around 5% and the share of other fuels (biomass, peat, heavy fuel oil etc.) - at the level of 2.5%. In the context of energy sector sustainable development it is remarkable the growth of electricity production on the basis of hydro- and wind energy. In particular, the 7-fold growth of electricity production from wind energy in 2005 represents speedy development of this sector. The share of hydro- and wind energy in total electricity output remains still small, around 0.7% in 2005 due to the low starting position (0.05 GWh of wind and 2.95 GWh of hydro in 1997). As for the 2006, the wind based electricity production has reached 76.3 GWh and the landfill and biomass based production - 38 GWh. RES-based electricity productions reached 1.3% already. Peat based production forms only 0.2%

Table 2.3. Use of energy resources for electricity production

	1997	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Electricity gross production, GWh	9218	8483	8527	10159	10304	10205	9731
Share of oil shale -based electricity, %	**95.7**	**90.5**	**90.9**	**94.4**	**94.5**	**93.5**	**92.9**
incl. from oil shale	95.3	90.0	90.6	92.2	92.3	91.1	90.1
from shale oil	0.4	0.5	0.3	0.3	0.3	0.3	0.3
from shale gas	…	…	…	1.9	1.9	2.1	2.5
Natural gas consumption, 10^6 m^3	21	91	81	77	64	77	70
Share of natural gas in electricity production, %	**1.3**	**6.7**	**6.1**	**5.0**	**4.7**	**5.3**	**5.6**
Share of other fuels in electricity production, %	**3.0**	**2.7**	**2.9**	**0.4**	**0.5**	**0.5**	**0.6**
incl. RES (biomass and landfill gas)	…	…	…	0.2	0.3	0.3	0.4
peat	0.1	0.2	0.2	0.2	0.2	0.1	0.2

Electricity production from hydro- and wind energy, GWh	3	8	7	19	30	75.4	89.8
incl. hydro energy	2.95	7.72	6	13	22.4	21.5	13.5
wind energy	0.05	0.28	1	6	7.6	53.9	76.3
Share of hydro- and wind energy, %		**0.1**	**0.1**	**0.2**	**0.3**	**0.7**	**0.9**

Sources: Statistics Estonia. 2007. Energy Balance 2006. Tallinn;

Tenno, K., Laur, A. 2005. Main Features of Economic and Energy Sector Developments in 2004. - In: Estonian Energy 2004. Ministry of Economic Affairs and Communications, Tallinn, (http://www.mkm.ee/index.php?id=1787).

2.2.3 Renewable energy sources

The Directive 2001/77/EC has fixed the recommended targets to 2010 for RES based electricity production. The Accession Treaty poses the target for Estonia of 5.1% by 2010 for the electricity produced from RES in final electricity consumption[5]. Considering the negligible small share, 0.2% of the indicator in 2000, the RES-E target was challenging. Estonia has no significant hydro energy sources, hence the wind and biomass based production should be developed.

To year 2005 the situation has significantly improved, see Figure 1, which represents the Eurostat data for all European countries.

[5] Feasibility of the Directive 2001/77/EC in EU Accession Countries. Brussels, http://favores.die.unipd.it/monitor/MD-AccessionCountries.pdf 19 p.

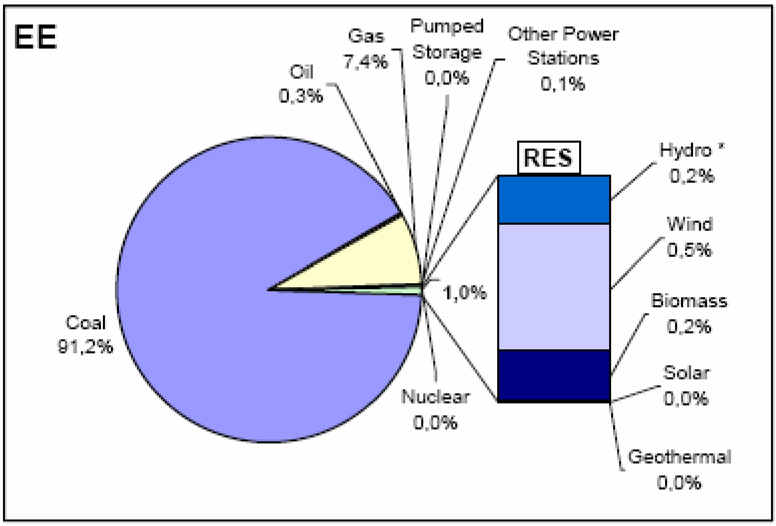

Figure 2.1. Gross electricity generation by fuel (2005).

* Not including generation from hydro pumped storage, but including electricity generation to pump water to storage. Municipal Solid Waste, Wood waste, Biogas included.

Source: Eurostat. Comment: By Coal is meant local fuel - oil shale.

Administrative feed-in tariff approach was used to stimulate RES wider deployment. After several attempts the stimulating amendment to electricity market act has been made and starting 01.01.2005 the feed –in tariff was set at the level of 81 cent/kWh (5.17€/100kWh). The stimulating impact caused the interest of investors and as a result the significant rise in wind based electricity production was launched. The production of electricity increased from 6.1 GWh in 2003 to 53.9 GWh in 2005, i.e. 8.8 times, and to 76.3 GWh in 2006, i.e. 12.5 times (see Table 2.4).

Table 2.4. Electricity production based on wind and hydro energy.

	2003	2004	2005	2006
Installed production capacities, MW_e				
Hydro energy plants	3.8	4.4	5.2	5.2
Wind parks	2.4	22.8	31.0	36,0
Electricity production, GWh				
Hydro energy plants	12.8	22.4	21.5	13.5
Wind parks	6.1	7.6	53.9	76.3

In 2001 the share of electricity production from renewable energy sources was 0.22% with 99.2% from biomass (mainly black liquor) and 0.8% from hydro energy.

RES wider up-take could be elaborated by the implementation of UN FCCC Kyoto Protocol flexible mechanisms, in particular, Joint Implementation (JI). Estonia has many projects registered under JI, however the much bigger number of potential projects is in pipe. The projects belong to wind sector, fuel switch from fossil to RES, energy conservation and biomass sector. For country JI is considered to be very efficient mechanism to leverage via selling of GHG emission reductions the high investment costs, e.g. in wind sector, also in all other project types. In fact, wind and biomass are the most promising sectors for RES wider deployment in Estonia.

2.2.4 Possible future development trends

Oil shale is a local most important and thus being the strategic energy source of Estonia. Economic, social and environmental policy and political security aspects must be considered when designing the overall development of the state. Therefore, the new *"National development plan of the use of oil shale 2008-2015"* has crucial importance for Estonia, and in particular for the power and petrochemical industry. Few basic conclusions on future development of oil shale based power generation considering the future mining volumes of remaining oil shale deposits could be drawn:

1. At the current volume of consumption (12-14 million t/y), the active supplies of the operating mines and quarries will last until 2025. If the volume of consumption will not decrease, in approximately 20 years new mines must be opened.
2. Total usable oil shale reserves will last for 40-60 years at the present volume of consumption, calculated on the basis of the technical-economic indicators of power stations. If the volume of consumption of oil shale will increase, new mines must be opened already earlier.
3. There exists heavy pressure towards increasing the production of shale oil. World market price for oil is strong incentive for petrochemical industry.
4. GHG EU Emission Trading Scheme (ETS) for the period 2008-2012 has set strong restrictions to oil shale based electricity production via limiting the total number of allowances to be allocated to Estonia. The main GHG emitter under the EU ETS is the power generation sector (~80%), thus the cuts made by the European Commission constrain electricity utility companies to buy the allowances with the market price already now. Quota trading during post-Kyoto period 2013 onwards will be the main factor influencing significant changes towards RES much wider up-take in Estonia.
5. The EC Climate and Renewable Energy package from January 2008 will have strong influence on whole electricity generation and thus elaborating to the energy sector sustainability concept[6].

In 2008 the Government of Estonia initiated two energy sector long term development strategies; *National Energy Sector Development Plan up to 2020* to be adopted by Parliament at the end of the year, and *National Electricity Sector Development Plan up to 2020.* These two strategic documents will establish the renewed energy sector development directions. Thus, the basic issues, step-wise phase-out of fossils, RES more faster development path, decision on participation in nuclear energy development in Lithuania and Finland the construction of new interconnections to European Union and in first order to Finland and Sweden, etc, will be adopted by the Government and Parliament.

[6] Renewable Energy and Climate Change Package. 23.01.2008. Brussels.

2.3. Latvia[7]

2.3.1 Energy balance

A specific feature of the Latvian energy sector is production of electricity from hydro energy. The main source of hydro energy in Latvia - the Daugava river – has been already used to a great extent with three cascades of the Daugava hydro power plants (HPP); Kegums HPP (264 MW), Plavinas HPP (870 MW) and Riga HPP (402 MW). Beside of hydro there are two large CHP PP are Riga TEC-1 (130 MW_{el}) and Riga TEC-2 (390 MW_{el}). Power is also generated in 149 small hydro power plants. Hydro energy resources of small rivers are within the range of 150-300 GWh of electrical power per year. The potential for actual use is considerably smaller, as the nature- and landscape protection requirements put restrictions on the use of hydro energy. There are restrictions on the construction of small hydro power plants on the rivers, which are important from the point of view fish migration. Electricity production could be increased also at the existing small hydro power plants if they were modernized. Electricity generation could be increased by 10-20%, considering the current financial and technical capacities of the existing hydro power plants in case of introducing new modern technologies[8].

In 2004 the consumption of primary energy sources in Latvia accounted for 193.6 PJ (Energy Balance 2004). This amount was supplied by local energy sources and the imported natural gas, oil and coal from Russia, Estonia, Latvia and CIS countries, see the Figure 2.3.

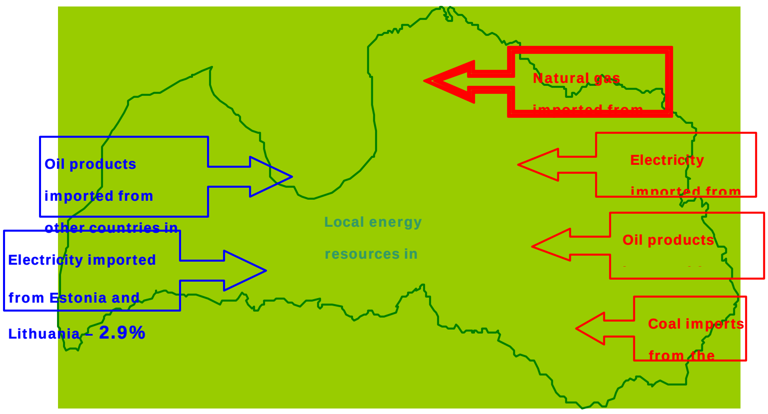

Figure 2.3. Breakdown of Primary Energy Resource Supplies in 2004[9]

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[7]In this part the following major sources of information have been used: Guidelines for Energy Sector Development 2007 – 2016. Project. Ministry of Economics of Latvia, Riga, 2007. 50 p, Annexes; Rekis, J., Freivalds, N. Energy in Latvia. Baltic Economic Trends, Ed. By A.Vanags. BICEPS, Riga, 2006, No 2. pp. 17- 23; Zero Emission fossil fuel Power plants. Country profile. Latvia, May 31, 2007. 6p. (http://www.zero-emissionplatform.eu/website/docs/GG/Country%20Profiles/LV%20Country%20Profile%20070531.doc).

[8] Guidelines for Energy Sector Development 2007 – 2016. Project. Ministry of Economics of Latvia, Riga, 2007. 50 p, Annexes.

[9] The breakdown of primary energy resource supplies by regions is based on the EUROSTAT (*External trade*) database.

The breakdown of the resource supplies reflects high dependence on imported fuels, 36% only of the total consumption is supplied by domestic resources.

Total primary energy consumption grew with an average annual rate of 3.2% in 2000-2005, while GDP grew annually in average 8.1%. This means, primary energy intensity diminished with an average annual rate of 4.5%, what is considered as a positive trend. Nevertheless, Latvia's energy intensity is higher compared to EU-15 indicators before Latvia joined EU in 2004. Total primary energy consumption increased by 17.1% over the period 2000-2005. Energy self-sufficiency increased slightly from 35.1% in 2000 to 36.5% in 2005. In general the changes in fuel mix of total primary energy consumption contributed to GHG emission reduction per unit of energy produced[10]. Reductions in energy intensity have been influenced both by structural changes of the economy and by improvements in the technical efficiency of appliances and processes, also due to better insulations in buildings.

As for the structure of primary energy consumption, the fossil fuels continuously dominate. The share of oil, coal, peat and natural gas form around 60% in 2000-2005. The share of imported coal is negligible small, but the rest have approximately equal shares; natural gas imported from Russia forms 28.8%, oil imported from CIS and other countries of the world – 29.3% and local biomass (wood, peat, straw) – 30.1% (see Figure 2.4). Major share (68.9%) of natural gas is used for production of heat and power. In the past Latvia depended rather heavily on imported primary energy

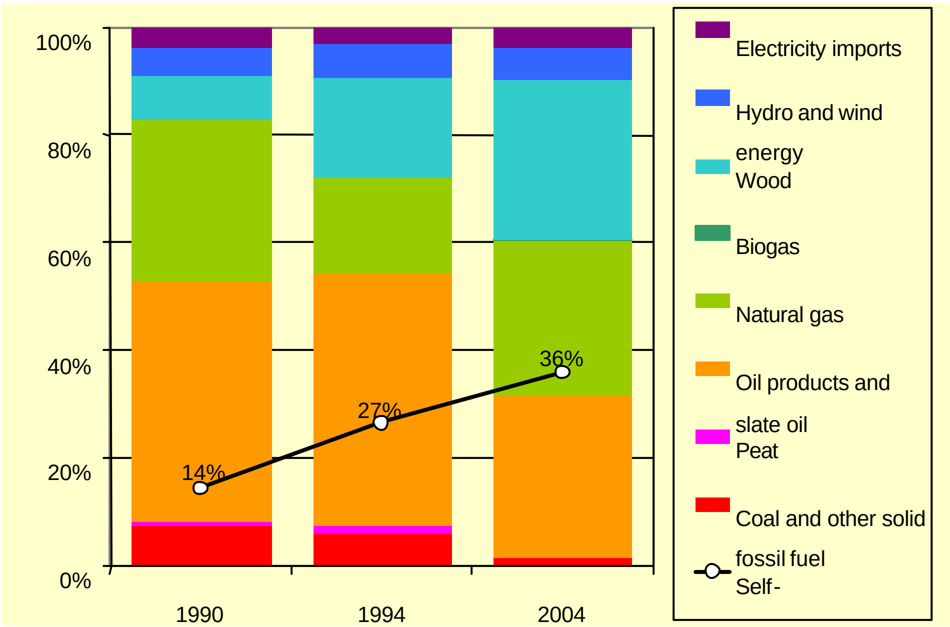


Figure 2.4. Dynamics and structure of primary energy sources consumption in 1990, 1994 and 2004[11].

[10] Rekis, J., Freivalds, N. Energy in Latvia. Baltic Economic Trends, Ed. By A.Vanags. BICEPS, Riga, 2006, No 2. pp. 17-23.

[11] Guidelines for Energy Sector Development 2007 – 2016. Project. Ministry of Economics of Latvia, Riga, 2007. 50 p, Annexes.

sources. However, during last 15 years the dependency on fuels import has decreased from 86% in 1990 to 64% in 2004 mainly due to the increased use of wood resources. Renewable energy uptake has been rather fast, yearly growth forms 2.6 percent points and reached to 36% by 2005. Hydro, wind and biomass are to be mentioned here. Fossil fuels use is the dominant source of impacting of energy sector on environment, in particular with nitrogen compounds and CO_2.

2.3.2 Power sector

The dominating company in the electricity generation and supply is Latvenergo, a state owned vertically integrated Joint Stock Company (JSC) that generates more than 90% of all electricity and ensures import of electricity, distribution and supply to consumers. Beside of it there exist around 180 small electricity producers and 15 certified electricity distribution and sale companies. Latvenergo has been nominated as a "public trader" under the Electricity Market Law, thus having the obligation to supply all customers. There is some trade in Baltic electricity market gathering volume at present, however, it takes place mostly between the former utilities only. By today big reforms have taken place and all functions of electricity distribution system operator have taken over

Only part of electricity is generated by Latvian hydropower plants (HPP) and CHPs, whereas the rest is imported from Russia and Estonia, also to some extent from Lithuania. In Latvia the gross electricity consumption increased by 19.1% in 2000-2005 and reached 7.05 TWh. The share of RES based electricity production accounted to 48% due to good water conditions in 2005. The average over the period equals to 44%. Electricity generation from small hydro, wind and biomass equaled to 2.1% in 2005. Volume of electricity generation directly depends on the water flow of Agave River. In 2005 the state JSC Latvenergo generated 64.5% of the required electricity, 30.5% was supplied from abovementioned neighboring countries, and 5% was purchased from small producers of electricity, see Table 2.6. Compared to 2004, the electricity consumption has increased by approximately 3.7%.

Table 2.6. Electricity Supply in Latvia, TWh

Components of electricity supply	2000	2001	2002	2003	2004	2005
Total electricity supply	**5.922**	**6.163**	**6.323**	**6.608**	**6.786**	**7.051**
Electricity generation – total	**4.136**	**4.280**	**3.975**	**3.975**	**4.689**	**4.903**
of which:						
HPP	2.799	2.801	2.433	2.216	3.044	3.267
CHP	1.163	1.246	1.238	1.363	1.225	1.278
other CHP	0.150	0.198	0.263	0.298	0.306	0.254
small HPS	0.020	0.032	0.030	0.050	0.065	0.058
wind generators	0.004	0.0034	0.011	0.048	0.049	0.046
Imports of electricity	**1.786**	**1.883**	**2.348**	**2.633**	**2.097**	**2.148**

Source: state JSC Latvenergo, Ministry of Economics, CSB

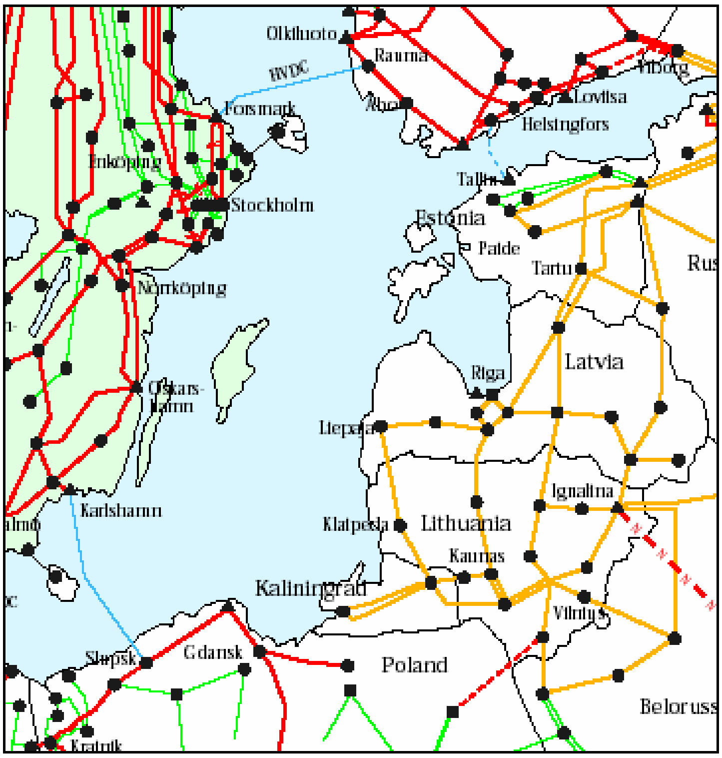
Daugava cascade and Aiviekste HPP (HPP of state JSC Latvenergo)

CHP of state JSC Latvenergo

Electricity imports and interconnections.

There is relatively high level of interconnections in all three Baltic States, however, Baltic electricity market lacks interconnection to rest of EU, but Finland. The import of electricity from Estonia, Lithuania and Russia and the physical access of consumers to these markets are provided by a mutually connected and jointly operating transmission system. Construction of an interconnection between Estonia and Finland has been accomplished to the end of 2006 and energy sales and exchange operations started in January 2007. However, Latvia, being the partner of sea-cable project will not have free access to electricity market at least until 2010.

The interconnection between Lithuania and Poland today is only at the conceptual level, as its costs are rather large and cannot be easily justified based on the demand for the development of a new transmission system to enhance the security of the electricity supply. The implementation of this project is related to Baltic-Poland common nuclear energy PP construction, what still is under the discussion in government. It is aggravated by the big costs related to the strengthening of the Polish transmission network and the increase of sales volumes to Germany. The sea-cable interconnection between Latvia and Sweden has been discussed for several times. A joint declaration of two national transmission network operators - JSC Augstsprieguma tikls and Svenska Kraftnät on system security and extension possibilities has to be agreed to start the implementation[12] (see Figure 2.5).



[12] Guidelines for Energy Sector Development 2007 – 2016. Project. Ministry of Economics of Latvia, Riga, 2007. 50 p, Annexes

Figure 2.5. Power grids around the Baltic Sea

The main generating capacities of HPP and thermal power stations (TPP) installed in Latvia are largely influenced by climate conditions – air temperature, precipitation and water flow in the Daugava river. From this point of view, the generation system in the country is especially sensitive and its projection is complicated. As in practice hydro energy based electricity is difficult (or if not even possible) to accumulate, the balance of electricity generation, supply and demand is an especially sensitive issue in any economy. Along with the required electrical networks and the infrastructure of the system control, the provision of energy generation capacity, primary energy supply and the related supply systems are of no minor significance. At certain moments of time, generators and primary engines (turbines, boilers) are not able to develop the capacities indicated at the places of their location. This can be caused by different reasons: the technical condition of the equipment, peculiarities of parameters or primary energy insufficiency.

The generating capacities of the energy system are characterized by the installed capacities, whereas in practice the so-called available capacity is the critical one, which can be used for balancing of the demand. At any time, the available capacity shall exceed the demand for capacity at least by the share of the mandatory reserves. Otherwise, the load should be limited which can lead to all the related consequences. As the analysis shows, even by renewing and expanding the capacities at the existing power plants, it is not possible to prevent considerable capacity shortage in winter when the consumption levels have reached their maximum, while the Daugava river inflow is minimal. The same situation can also be observed in summer.

2.3.3 Renewable energy sources

The Government will support the use of renewable energy resources to minimize the dependency on imported resources by means of taxation thus supporting a more extensive use of one or another primary resource, as well as by co-financing the projects focused on the improvement of supply security and the diversification of the energy resources[13]. In 2005 the situation in RES-E was much improved compared to 2000. Wind and biomass started to elaborate hydro energy based electricity generation, see Figure 2.6.

So far, wind generators, with a total capacity of 26.9 MW, are operating in Latvia. The distribution of wind energy resources in Latvia is very uneven. The Wind Energy Resource Atlas of Latvia shows areas with various average intervals for wind speed, starting from 3.5 m/s up to more than 5.0 m/s. The average theoretical potential per year ranges from 250 to

[13] Zero Emission fossil fuel Power plants. Country profile. Latvia, May 31, 2007. 6p. (http://www.zeroemissionplatform.eu/website/docs/GG/Country%20Profiles/LV%20Country%20Profile%20070531.doc).

1250 million kWh[14]. Wind farms with much higher capacity could be built into sea, however, the costs of offshore wind generators and cable connection is significantly higher compared to those of onshore. Compared to Estonia and Lithuania, the wind energy potential could be evaluated somewhat lower because of relatively modest average wind speed. Biomass has big potential as Latvia is relatively heavily wooded country with an average 1.23 ha of forests per capita. This is about 4.5 times more compared to average European indicator. The average volume of standing timber is 174 m^3/ha. The average annual increase in wood volume is estimated to be 16.5 million m^3 or 6.2 m^3/ha per year. Considerable part of the comprise shrubs and low-value forest, which has not been utilized yet, but could be used in energy sector. The share of wood in the balance of Latvia's primary energy resources constituted 30% of the total consumption of energy resources. Wood is used in district, local and individual heating. Biogas as a combustible gas produced by the fermentation of biomass has good potential. Currently the total installed capacity of biogas based power generation is 7.5 MW. Solar and geothermal energy have no considerable practical value.

Gross electricity generation in Latvia is dominated by renewable energy sources (70%) out of which hydro energy forms 68.8%. The rest of electricity is generated based on imported oil products, see Figure 2.6.

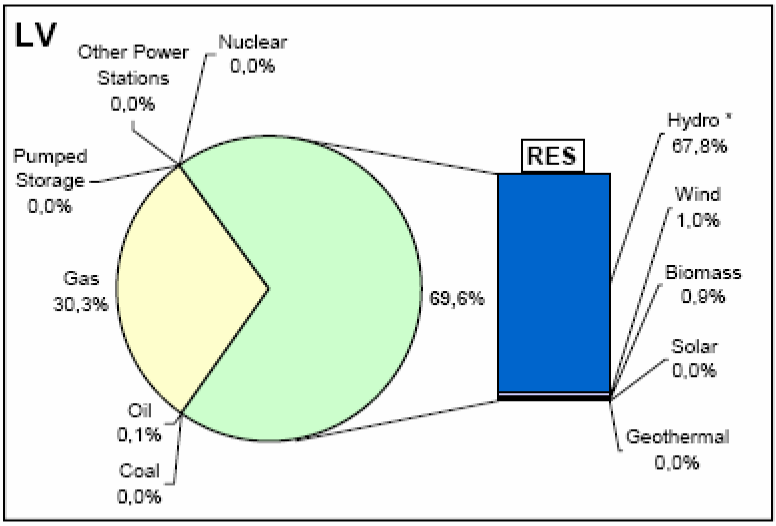


Figure 2.6. Gross electricity generation by fuel (2005).

* Not including generation from hydro pumped storage, but including electricity generation to pump water to storage. Municipal Solid Waste, Wood waste, Biogas included.

Source: Eurostat.

[14] - Renewable Energy Resources Programme, 2000. Prepared by COWI Engineers and Planners AS-Bkb EC DG1A on behalf of the Republic of Latvia Ministry of Economics and according to the Phare Energy Sector Agreement No.SFR96/04.

2.3.4 Possible future development trends

The government's abilities to directly influence and determine the preferable structure of the primary energy structure in the future are limited. Price signals and choices made by consumers are the main factors that will determine the structure of primary resources. The energy sector policy planning document, the Guidelines for Energy Sector Development 2007 – 2016 aim to develop a strategy for e secure, resource effective energy supply system, which ensures the effective use of energy, quality of life, economic growth and quality of environment. The Guidelines[15] and its' Summary[16] aim to:

- Facilitate the availability of resources required for economic growth and the quality of life and to ensure the security of the energy supplies by increasing self-sufficiency and promoting the diversification of supplies;

- Ensure the availability and sufficiency of energy to the population by improving the energy supply infrastructure and to extensively introduce energy efficiency measures in the consumer sector;

- Increase the effective use of renewable energy resources and energy generation in cogeneration plants;

- Ensure the maintenance of environmental quality by complying with the objectives regarding the reduction of greenhouse gas emissions as stated in the Kyoto Protocol of the United Nations Framework Convention on Climate Change, and the Latvian National Climate Change Programme for 2005 – 2010;

- Support further market liberalization and competition by ensuring the competitiveness of the economy, diversity of supplies and sustainable development. The market liberalization process shall be aligned to the application of flexible regulatory principles and the further development of the principles of commercial activities of energy companies;

- Promote conditions for further integration of the EU energy market;

- To ensure the diversification of fuel in electricity generation,

- Provide conditions for the increase of energy generation self-sufficiency.

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[15] Guidelines for Energy Sector Development 2007 – 2016. Project. Ministry of Economics of Latvia, Riga, 2007. 50 p, Annexes

[16] Summary of the Guidelines for Energy Sector Development 2007 – 2016. Cabinet Order No.571, dated 1 August 2006, 7 p.

2.4. Lithuania[17]

2.4.1 Energy balance

Lithuania is very dependent country in terms of energy resources. Only 13.8% of the primary energy requirement was covered by domestic resources in 2000. It includes the indigenous energy resources like wood, peat, hydro and oil. A rough estimate of the technically usable energy potential from indigenous and renewable resources is that a maximum of about 15% of the primary energy demand could be covered in the future by local resources. The remaining primary fuel requirement is imported mainly from neighboring Russia - all crude oil, natural gas and nuclear fuel. Lithuania is heavily dependant in the political and economic consequences of this dependence. However, due to that, there is good interconnection with neighboring countries for both electrical grid and gas pipelines. The supply of crude oil is also available via pipeline from Russia and two oil terminals from other countries, including orimulsion from Venezuela. Coal can be supplied by railway from both Russia and Poland. Natural gas is imported to Lithuania by pipeline from Belarus. It connects the Lithuanian gas network with Siberian gas fields. In the north the gas network is connected to the Latvian gas system, but the connection between two countries is closed at present time. The use of nuclear power is what differs Lithuanian energy sector from other Baltic States. Also, the use of the indigenous oil resources. They are not plentiful, however, domestic oil production at extraction level of 0.3-0.5 million tons can be continued for several decades[18].

Domestic local energy resources dynamics in 1990 – 2006 is given on following Figure 2.7, which also represents the dynamics of the share of local resources.

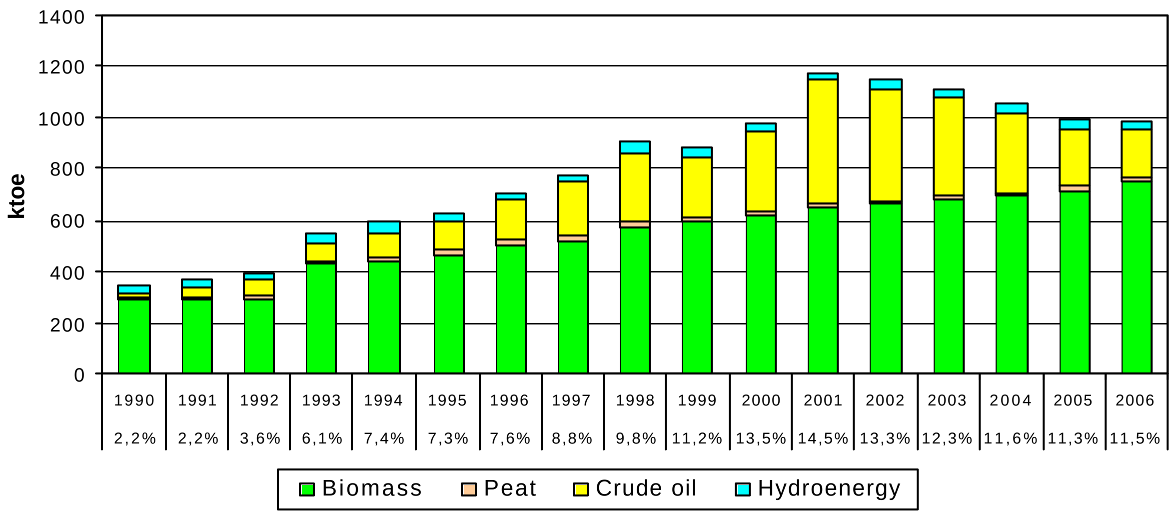

Figure 2.7. Local energy resources.

[17] In this part the following major sources of information have been used: Analyses of Energy Supply Options and Security of Energy Supply in the Baltic States. IAEA. February 2007, 323 p., National Energy Strategy. Approved by Resolution No X-1046 of the Seimas of the Republic of Lithuania of 18 January 2007. 29 p., Saulius Piksrys, Gunnar Boye Olesen. Vision for a Sustainable Energy Development for Lithuania. (www.videsprojekti.lv/faili/Sab.info/piksrys_vision_for_a_sustainable_energy_development_for_lithuania_en.doc)., Arvydas Galinis, Dalius Tarvydas. A new nuclear power plant in Lithuania in the light of power system development in the Baltic region. ENERGETIKA. 2006. Nr. 3. P. 102–109.

[18] Analyses of Energy Supply Options and Security of Energy Supply in the Baltic States. IAEA. February 2007, 323 p.

Source: S. Vrubliauskas, Lithuanian Energy Institute[19].

Consumption of final energy decreased more than twice since 1991 till 2005 and made up 4489 ktoe in 2005 (Figure 2.8). Structure of final energy consumption also has changed essentially. In 1990s industry was the largest consumer of energy. It consumed 3097 ktoe or 31% of all final energy. At present the largest consumers are transport (1550, 8 ktoe) and households (1429,3 ktoe). At present, industry is only the third largest consumer of energy (1002,7 ktoe). The most drastic changes occurred in agriculture where energy consumption decreased about seven times to 103 ktoe.

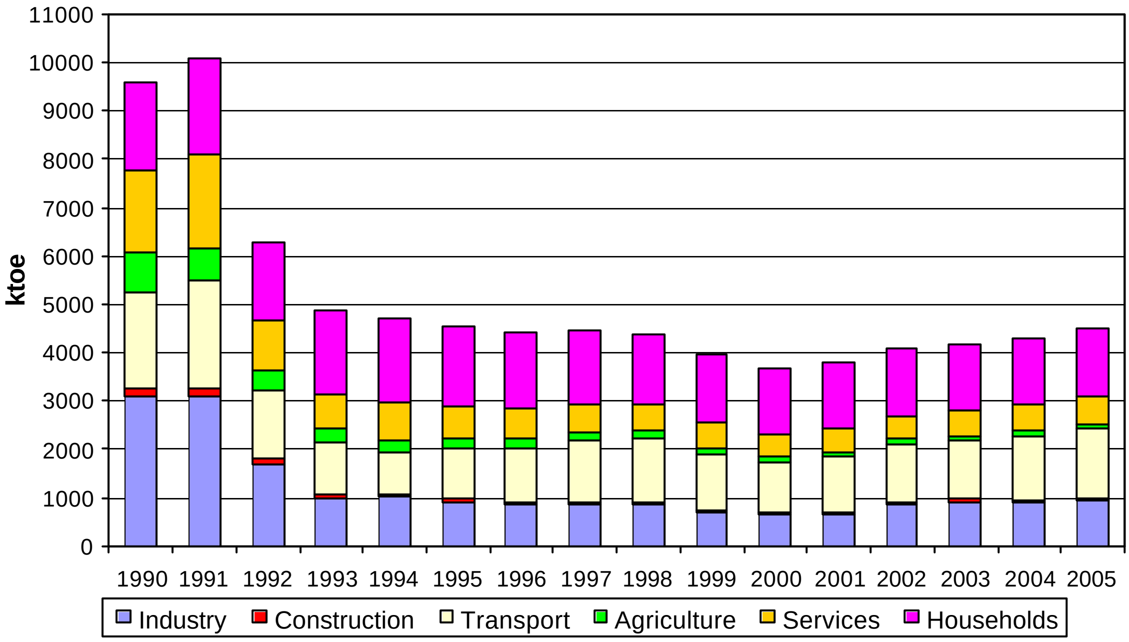

Figure 2.8. Dynamics of final energy consumption.

Source: S. Vrubliauskas, Lithuanian Energy Institute.2007

Primary energy consumption decreased by 52% during the period since 1991 and made up 8738 ktoe in 2005. Nowadays approximately equal parts of primary energy consumption, each about 30%, fall to oil products, natural gas and nuclear energy. Biomass, mainly wood, makes up 8,2% in the primary energy balance The structure of primary energy consumption represents rather good diversity of resources, see Figure 2.8. Share of RES has been growing constituently since the 1990s, but is still relatively modest.

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[19] Vrubliauskas S. Consumption of solid biofuel in Lithuania and perspectives // Rural Development 2007 : the third international scientific conference, Lithuanian University of Agriculture, Akademija, Kaunas region, Lithuania, 8-10th of November, 2007. Vol. 3, Book 2, p. 318-321.

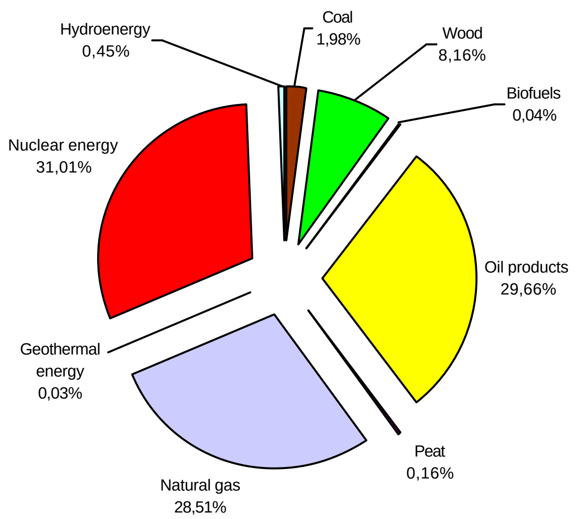

Figure 2.9. Structure of primary energy consumption in 2005.

Source: ibid.

2.4.2 Power sector

The total installed electricity-generating capacity (nuclear plus non-nuclear) amounts to nearly 5 000 MW and exceeds the present domestic needs of Lithuania by more than two times, see Table 2.7. The main source of electricity in the country is the Ignalina NPP, which generates cheaper electricity compared to thermal power plants running on fossil fuel. After the decommissioning of second unit of the Ignalina NPP at the end of 2009, the current generating capacities, including small capacity CHP plants that currently are planned to be constructed, will be sufficient to meet the national demand until 2013. The total capacity will remain 3666 MW.

Table 2.7. Development of the capacity of power plants in 1990 - 2005

Power plant	Installed capacity, MW			
	1990	1995	2000	2005
Ignalina NPP	3000	2600	2600	1300
Lithuanian PP	1800	1800	1800	1800
Vilniaus CHP	384	384	384	384
Kaunas CHP	170	170		170
Petrasiunai CHP	20,0	9,0	9,0	9,0
Mazeikiai CHP	210	194	194	160

Klaipeda CHP	10,8	10,8	10,8	10,8
Other CHP	61	61	76	102,3
Kruonis HPSP	-	600	800	900
Kaunas HPP	100,8	100,8	100,8	100,8
Small HPP	5,3	5,3	12,7	24,8
Biogas PP	-	-	1,06	3,6
Wind PP	-	-	-	1,1
Total	5761,9	5934,8	6158,4	4966,4

Source: S. Vrubliauskas, Lithuanian Energy Institute.2007

Lithuanian National Energy Strategy, passed by Seimas in January 2007, foresees the development of the electricity sector in the following way[20]. After the decommissioning of the second unit of the Ignalina NPP, the Lithuanian Power Plant will become the major source of electricity generation. The Lithuanian Power Plant and the existing CHP plants should be modernized to meet the more strict environmental requirements. Hence, it is required to carry out the necessary testing and adjustments of the power plant equipment and to ensure its reliable operation with a capacity of at least 1500 MW from the beginning of 2010. Still, the price of electricity generated by the existing generating units of the Lithuanian Power Plant using natural gas will not be competitive in the market. It will also be one of the factors determining the price of imported electricity. Therefore, it is necessary to accelerate the development of the capacities of more efficient CHP plants, to enhance the efficiency of the Lithuanian Power Plant and to reduce the price of electricity generated by the Lithuanian Power Plant. To this end, by 2010, the Lithuanian Power Plant should have a combined cycle gas turbine unit with a capacity of up to 400 MW (investment in this unit amounting to approximately LTL 720 million) installed, inefficient units of 150 MW capacity closed, as well as minimize the use of natural gas by substituting petroleum products for natural gas in other units.

At the same time, it is necessary to consider the possibility and economic feasibility of constructing a coal-burning power plant with a capacity of about 400 MW in the Baltic region. Having implemented the planned projects, the current electricity generating capacities will be sufficient to meet the demands of domestic consumers until a new nuclear power plant is put into operation; however, if economically feasible, a part of electricity could be imported. It is expedient to consider possibilities of electricity import from Ukraine via Belarus.

[20] National Energy Strategy. Approved by Resolution No X-1046 of the Seimas of the Republic of Lithuania of 18 January 2007. 29 p.

Strategy also, foresees the construction of new CHP plants in Klaipeda, Šiauliai, Panevežys, Alytus, Marijampole and other cities with well-developed district heating systems, as well as in industrial enterprises with high heat consumption, etc

Energy Strategy foresees that following the decommissioning of the Ignalina NPP, a new nuclear power plant should be constructed in Lithuania (investments totaling approximately LTL 10 billion) with a view to avoiding heavy dependence on imports of fossil fuel whose prices are difficult to forecast, reducing pollutant emissions into the atmosphere and mitigating related economic consequences. The issue of the management and final disposal of nuclear waste should be dealt with at the same time.

The further options on new generating capacities and the shares of the participating neighboring countries Poland, Latvia and Estonia, are still not finally fixed. The Lithuanian Parliament has passed the Law on the nuclear power plant. It foresees the construction of a new nuclear power plant in Lithuania. The national investor shall be the public company *Lietuvos Energija* which has shown a private initiative to invest in the project and fulfils the requirements laid down in this Law. The Republic of Lithuania shall own a block of more than 1/2 of shares in the national investor carrying more than 1/2 of votes at the general shareholders' meeting of the national investor. The Law foresees the establishment of Decommissioning Fund. Resources to guarantee the decommissioning of the new nuclear power plant shall be accumulated in the nuclear power plant decommissioning fund. The decommissioning works of the State Enterprise Ignalina Nuclear Power Plant shall be carried out separately and independently from the project. The State Enterprise Ignalina Nuclear Power Plant shall not participate in the nuclear power plant project[21].

As preparations by the 2007 show, the NPP will be most probably of 3400 MW capacity and new reactor will be built in co-operation with the strategic partners, Poland, Latvia and Estonia.

2.4.3 Renewable energy sources

Referring to National Energy Strategy, the share of indigenous and renewable energy resources, including the energy produced during chemical processes (hereinafter referred to as "indigenous energy resources"), (indigenous oil excluded), in the total primary energy balance amounted to approximately 10.8% (0.94 million toe) in 2005. A national target to be reached is approximately 2 million tons of oil equivalent of indigenous energy resources (out of this number, approximately 450 000 toe of biofuel) are used by 2025 and this would account for nearly 20% in the primary energy balance. The use of indigenous energy resources is foreseen to maximize and thus to reduce the import of fuel and the use of gas in generation of electricity and district heating, to create new jobs and reduce CO_2 emission.

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[21] Law on the nuclear power plant. Approved by Resolution Lithuanian Parliament No X-1231 of the Seimas of the Republic of Lithuania of 28th of June 2007. (http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=301266).

In the structure of RES in energy sector, wood dominates with 92.1%, the share of hydro is relatively small, 4.3%, see Figure 2.10. Electricity generation based on biomass is in the early stage at present. Only few enterprises produce electricity from biomass fuel. Four CHP plants are registered in the *Database guarantee of origin of electricity produced from RES*, see Table 2.8.

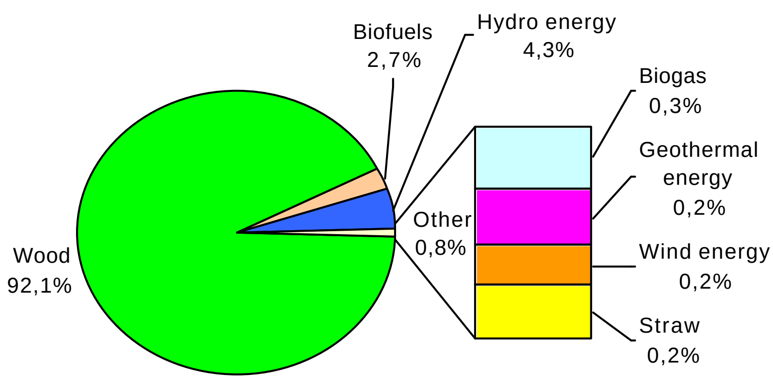


Figure 2.10. Structure of RES in 2006

Table 2.8. Biomass CHP plants

CHP plant	Capacity, MW_e	Potential electricity production, MWh
AB “Vilniaus energija”	12	90 000
Marijampoles siluma UAB “Litesko” filialas	2,5	16 000
UAB “Ukmerges energija”	1,5	7 500
UAB “Plunges bioenergija”	1,0	3 400
Total	17	116 900

Source: S. Vrubliauskas, Lithuanian Energy Institute.2007.

Assessing on the dynamics of RES deployment in electricity generation sector, wind energy most probably could be said has obtained the most speedy development path during recent years, see Table 2.9. To 2007 the total capacity installed in Lithuania reached 55MW and more wind parks are in the pipe at present.

Table2.9. Electricity production based on wind and hydro energy in Lithuania.

	2000	2004	2005	2006
Installed production capacities, MW_e				
Hydro energy plants				
large	100,8	100,8	100,8	100,8
small	12,7	22,0	24,8	27,0
Wind parks	0,0	0,845	1,1	49,0
Electricity production, GWh				
Hydro energy plants				
large	312,8	359,0	384,6	341,3
small	26,6	61,5	66,1	55,8
Wind parks	0,0	1,2	1,8	13,7

Still, in gross electricity generation the share of RES-E is 3.1% only, see Figure 2.11.

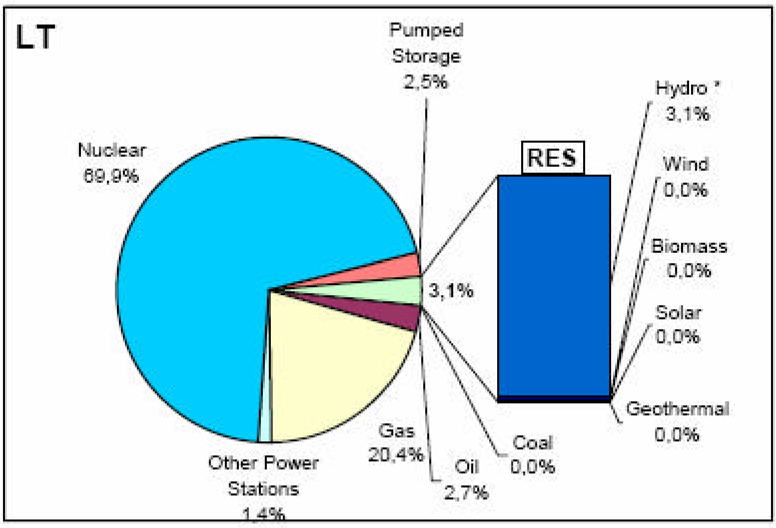


Figure 2.11. Gross electricity generation by fuel (2005).

* Not including generation from hydro pumped storage, but including electricity generation to pump water to storage. Municipal Solid Waste, Wood waste, Biogas included.

Source: Eurostat.

2.4.4 Possible future development trends

In the National Energy Strategy passed in Seimas in 2007, the Lithuania's interests and in the Baltic region are well formulated[22]. Lithuania's strategic interests in the region include development of co-operation and collaboration with Estonia, Latvia, Poland and Scandinavian countries and creation of a common electricity market of the Baltic countries. Also, drafting, in co-operation with Estonia and Latvia, of a coordinated strategy and action plans of the Baltic States for dealing with the following common energy tasks of importance to the region:

1) the interconnection of Baltic electricity transmission networks with the networks of Western European and Scandinavian countries by 2012; a more efficient use of generating capacities and the Kruonis HPSP for the needs of a wider EU region;

2) application of the Baltic States to the Western European Union for the Co-ordination of Transmission of Electricity (UCTE) for the issuance of technical specifications for synchronous interconnection of the Baltic power system with UCTE zone and creation of required technical, legal and organizational preconditions, while maintaining physical interconnections for energy exchanges with the Russian power system;

3) agreement of regulation of the Baltic States electricity market with regulation of the Scandinavian electricity market;

4) construction of a new nuclear power plant in Lithuania to satisfy the needs of the Baltic countries and the region and its inclusion in the electricity market of the region not later than by 2015;

5) development of the natural gas supply system and system interconnections with EU gas networks providing for consideration, in co-operation with Latvian, Polish and Estonian experts, of the expediency of construction of a regional liquefied natural gas import terminal and for preparation in 2007 of a feasibility study indicating therein the capacity of the terminal, construction site and time;

6) joint actions and mutual assistance in the event of energy emergencies.

2.5 Energy intensity of Baltic States

Sustainable development could be characterized with a number of energy sector indicators representing fuels used, electricity consumption, also the GHG emission, which are related to Gross Domestic Product (GDP).

[22] National Energy Strategy. Approved by Resolution No X-1046 of the Seimas of the Republic of Lithuania of 18 January 2007. 29 p.

Table 2.10 presents comparative data for some energy-related indicators of sustainable development: total primary energy supply (TPES), electricity consumption (EC) and CO_2 emissions from fossil fuel combustion per capita and also, per unit of GDP. The GDP (PPP[23]) energy intensity – TPES per unit of GDP, and also the GDP (PPP) electricity intensity (electricity consumption per unit of GDP) and GDP CO_2 intensity (CO_2 emissions per unit of GDP) for EU-15, EU-25 and the Nordic and Baltic States could be observed and compared to draw conclusions. The average levels of these energy-related indicators and also, the data of the International Energy Agency (IEA) have been used.

Table 2.10. Comparative data of the main energy-related indicators, 2004

Countries	**Per capita**			**Per GDP(PPP), USD'2000**		
	TPES, toe	**EC*, kWh**	**CO_2**, t**	**TPES, kg oe**	**EC, kWh**	**CO_2, kg**
EU-25 average	**3.82**	**6474**	**8.46**	**0.16**	**0.27**	**0.35**
EU-15 average	**4.01**	**6934**	**8.60**	**0.15**	**0.27**	**0.33**
Nordic Countries						
Denmark	3.72	6633	9.43	0.13	0.22	0.32
Finland	7.28	16774	13.17	0.26	0.60	0.47
Norway	6.03	24656	7.91	0.16	0.64	0.21
Sweden	6.00	15427	5.80	0.21	0.53	0.20
o **Baltic States**						
Latvia	1.99	2554	3.13	0.19	0.24	0.29
Lithuania	2.66	3142	3.69	0.22	0.26	0.31
Estonia	**3.83**	**5481**	**12.28**	**0.29**	**0.41**	**0.92**

Notes: * Gross production + imports - exports - transmission/distribution losses

** CO_2 emissions from fuel combustion only

Source: International Energy Agency. 2006. Key World Energy Statistics (http://www.iea.org);

[23] PPP (purchasing power parity) expresses the real purchasing power of national currency eliminating to some extent the differences of price levels between the countries

Laur, A., Tenno, K. Estonian energy sector developments over 1991-2005. Baltic Economic Trends, Ed. By A.Vanags. BICEPS, Riga, 2006, No 2. pp. 9-16.

Comparison of the total primary energy supply per capita indicates that differences are remarkable across and between the Nordic Countries and the Baltic States. In Estonia, primary energy consumption per capita is relatively high – mostly due to the largely prevailing oil shale-based electricity production. Electricity consumption per capita in Estonia is also bigger compared to Latvia and Lithuania. However, electricity consumption is still significantly smaller than in the EU-15 on average and in particular in the Nordic Countries, but Denmark, where the differences are in fact - huge.

CO_2 emission per capita in Estonia is one of the highest both among the Nordic Countries (except for Finland) and compared with the EU average. This is a consequence of high emissions from oil shale combustion and also, the small population number of Estonia. CO_2 emissions per capita have been significantly decreasing. In 1990, the relevant Estonian indicator was 2.6 times the EU-15 average, in 2004 it was only 1.4 times higher. From the point of view of sustainability this decrease is a positive trend.

The GDP (PPP) electricity intensity is also relatively high in Estonia as compared with EU-15 average level – in 2004 it was 52% higher. However, compared with the Nordic Countries, and especially with Norway, Estonia's GDP electricity intensity is much lower (see Table 2.4). AS for the GDP (PPP) CO_2 intensity indicator value, 0.92 in Estonia it was still 180% higher than the EU-15 average. However, a declining tendency can be observed also in the dynamics of this indicator in Estonia, which, on the one hand, is due to the reduction of CO_2 emissions in oil shale-based energy production, but, on the other hand, faster GDP growth rates than in EU-15 countries.

3 Goals for the energy sector in Baltic States

Baltic Energy Strategy (BES) has bee recently (2007) prepared by the Governments of the three Baltic States aiming to pave ways for cooperation of these countries on securing energy supply for coming decades and to define joint goals and actions (see Annex 3).

Three governments have come to conclusion that further strengthening of cooperation on energy field is required between Baltic States as well within European Union.

BES states that European energy security demands in the 21st century require the development of a European External Energy Policy (EEP) closely aligned to the further strengthening of the Common Foreign and Security Policy (CFSP). According to BES the means must be found to enhance the EU institutional framework for this purpose. It also suggests that EU-NATO cooperation covering energy security must be explored and supported.

According to the BES global environment for the energy sector development could be characterized by processes and events, which cause new challenges for the energy supply and national security of the Baltic States:

1) Rapid increase of hydrocarbons consumption in the world, which is growing faster than exploration and development of new deposits;
2) Large share of oil and gas deposits are concentrated in countries with unstable political regimes and centralized political control over energy export;
3) Complicated political relationships among Western countries and countries which have large share of energy resources;
4) Increasing geopolitical influence of certain energy exporting states over energy importing countries, including mechanisms to dictate conditions for this import;
5) Strengthening of the role of the main economics – USA, EU, China and India – in energy markets and their bilateral partnership with Russia;
6) Volatility of oil and gas prices and their dependence on political factors;
7) Increasing tensions regarding reduction of GHG emissions for national governments.

Taking into consideration requirements and provisions in the Treaty of Accession to the EU, Energy Charter Treaty, EU legislation and the Green Paper, the Baltic Energy Strategy has three main pillars:

1) Security of supply;
2) Sustainability;
3) Competitiveness.

Under these pillars, the following strategic objectives have been set by Baltic States:

1) To integrate power and gas supply systems into the energy systems and energy markets of the EU;
2) To diversify primary energy sources and supplies, and increase the contribution of renewable and local energy resource
3) To increase the energy efficiency at the demand side and in the energy transformation sector;
4) To develop the transit routes for energy products, including electricity;
5) To strengthen education, research and development in the energy sector;
6) To elaborate and implement a common policy on energy imports from non-EU countries.

BES stipulates also major joint tasks for the power sector of three Baltic. Recognizing the variety of different primary energy sources in use in electricity generation in the Baltic States: hydro, oil-shale, nuclear, natural gas, orimulsion, wind, landfill gas, biomass, fuel oil, etc., BES also looks for major expected changes in power production due to the commitments taken by countries before EU accession.

Some major commitments ahead are the Ignalina NPP decommissioning in 2009, what causes the situation where the major part of electricity will be generated by existing power plants. It assumes the modernization of Lithuanian Thermal Power Plant, renovation of the old units at Balti and Eesti power plants, construction of modern combined power and heat generation power plants and cogeneration plants for district heating purposes, also for and industrial enterprises. The existing available capacities in the Baltic power system will be sufficient to meet the regional demand until 2015 only. Thus, the construction of new generating capacities should be anyhow considered.

According to BES, in order to reduce the dependence on expensive fossil fuels and harmful impact of emissions, and to increase overall energy security in the Baltic States, the construction of a new nuclear power plant should be studied in Lithuania. The small size of the Baltic power market (in 2015, expected maximum load is about 6000 MW) creates additional issues with large-scale nuclear power plants e.g., concerning reserve capacities.

Integration of the Baltic power systems into Central European and Nordic energy systems and closer collaboration with these countries, as well as expected distribution of load and generating capacities, stipulates a necessity to prepare strategy for the development of transmission system, action plan for its implementation and appropriate financial sources. Electricity distribution grid and transformer substations also should be renovated with a view to complying with increasing requirements for the reliability and stability of electricity supply.

According to BES, in order to ensure the strategic reliability of electricity supply and integration into the EU internal market, the following measures must be taken:

1) To develop cooperation and collaboration of the Baltic States - to facilitate a competitive environment, to enhance transit and to promote common electricity market; to create a framework for green house gases (GHG) allocations;
2) To prepare an action plan regarding further integration of the Baltic power systems into markets of Central Europe and Nordic countries;
3) To renew and build transmission and distribution facilities;
4) To renew the large power production capacities;
5) To use possibilities and benefits from development of distributed electricity generation;
6) To increase the share of renewables in the electricity mix.

Unfortunately despite the fact that BES has been prepared using Governments resources and is expectedly based on best knowledge base of the countries, the Baltic Energy Strategy is very general and doesn't refer to any studies on availability of renewable resources nor potential for distributed generation or market uptake potential of energy efficient technologies or potential for energy savings within industry and household sectors. It also neglects the aspects of commitments that Baltic countries have made in order to implement Kyoto protocol and in order to achieve commitments taken in framework of EU climate and energy policy initiatives including EU emission trading. BES also doesn't foresee moving away from the use of nuclear energy and fossil fuels.

BES, prepared by Governments, is weak, mainly concentrated on stating of current situation of the energy sector and does not provide clear proposals for development of energy sector not in short-term, neither in long-term scale. Environmental NGO-s of Baltic States believe that proposal of possible new nuclear power plant in the Baltic's contradicts the strategic objectives of the same policy paper which in it's main statements emphasizes the need of diversification and increasing the use of local resources, because nuclear is neither renewable, nor a local energy source. Nuclear energy due to its centralized and market-dominating characteristics actually decreases the chances for local renewable source to penetrate the market. The strategy, which calls for construction of new nuclear power plant, contradicts to the goal to reduce emissions and harmful impact of emissions, because for example, nuclear power emits as much CO_2 as a modern gas-fired co-generation plant. When assessing the overall emissions, the whole life-cycle of a nuclear power production need to be part of the impact evaluation, including fossil fuels burnt during uranium mining, processing and transportation, building the nuclear power station and decommissioning as well as long-term nuclear waste storage and treatment.

NGOs highlight that the proposed strategy fails to consider different development scenarios for the power sector, particularly those that aim distributed power generation and would not include large centralized units such as a new Ignalina nuclear power plant or fossil-fuel based large condensing plants, where primary energy use efficiency is far below acceptable. Though the governments drafted strategy doesn‘t explicitly support construction of a new nuclear power plant at Ignalina, it is widely known that energy monopolists of three Baltic States and specially Lithuania put lots of emphasis on this plan neglecting possible alternative scenarios, despite the apparent huge problems that are attached to the use of nuclear power like the problems related to storage of nuclear waste, nuclear safety, risks related to possible terrorist attacks and depletion of uranium resources and rising global prices of construction and fuel costs world-wide.

Inclusion of a new nuclear power station in a future energy strategy for Baltic States also would decrease the flexibility of the electricity grid needed for inclusion more renewable energy sources and intelligent demand management. Uptake of several non-nuclear scenarios is therefore of uttermost importance to enable our countries to take a balanced and optimal decision on its energy future.

NGOs welcomes the fact that the BES mentions among strategic objectives the need to “increase the contribution of renewable and local energy resources” and “to increase the energy efficiency at the demand side and in the energy transformation sector”. High energy intensity of the economy and low energy efficiency offers the Baltic States a unique opportunity to make huge savings and via energy efficiency measures increase its global competiveness of economies. Increase of the use of renewable and local energy sources should be considered as a key response to the need to increase diversity and energy independence and security of supply. Increased use of renewable energy offers the only opportunity for truly sustainable, secure and accessible energy options for current and future generations and must be given priority above all other energy options for research and development, access to the grids and funding. Therefore we consider that a far more detailed strategy on the available capacities and assessments of potentials should be developed by three Baltic States.

Governments Energy Strategy has “all correct key-words”, however, as there is no measurable targets set taking into account energy indicators for sustainable energy and no externalities of power production are not counted while setting goals aiming increase of one or other energy mode in energy-mix, therefore the justification of these choices are missing. As n the paper there is o measures relevant to targets foreseen, nor implementation framework set, one may conclude that BES is just a paper for calming down the wider public in Baltic’s, showing likely active approaches of the governments towards meeting peoples expectations towards more sustainable energy future, but as such, strategy is not intended to be implemented.

Besides overwhelming critical view towards government's energy strategy document, NGOs of Baltic Countries are positive about the fact that the integration of the Baltic energy system into the energy systems and energy markets of the European Union is put forward as one of the strategic objectives. Building interlinkages with Nordic countries and Baltic countries would increase the opportunities for diversifying supply and through increased competition also promote supply from independent small and medium size suppliers.

Taking into account above key weaknesses, environmental NGOs propose following addition and adjustments to the government's joint energy strategy:

- exclude nuclear option from the trends of energy sector development;
- focus within sustainable development scenarios on energy efficiency, usage of local and renewable energy sources and decentralized power generation systems;
- apply deeper analysis for forecast of future energy demand and determine share of this demand, which can be covered by implementing energy efficiency and savings measures;
- goals towards wider use of renewable energy sources and energy efficiency measures should be similar or more ambitious to those, proposed in the EU Energy Package;
- goals should be aiming inclusion of energy externalities
- ensure that goals are measurable and there are implementing agencies for measures;
- propose tangible actions relevant to goals set;
- monitoring of the progress should be related to energy indicators of sustainable development;
- Build implementation framework and ensure monitoring of progress.

Without these elements proposed, BES remains empty paper gathering dust and reflecting government inability to meet global and national challenges related to energy and environment sectors.

4 Sustainable Energy Strategy for Baltic States

Energy is an essential input for social development and economic growth. It provides basic needs and services such as heating, cooling, cooking, lighting, and transportation and is a critical production factor in virtually all sectors of industry. There are large disparities in the level of energy use and quality of available energy services, not only among different countries, but also among the rich and poor in the same country. Nearly 1.6 billion people still have no access to electricity or other forms of commercial energy. At the same time, the production and use of energy can cause environmental degradation at all levels - local, regional and global. For example, combustion of fossil fuels and fuel wood leads to indoor and outdoor air pollution by particulates and oxides of sulphur and nitrogen; hydropower often causes environmental damage due to the submergence of large areas of land; and global climate change associated with the increasing concentration of greenhouse gases in the atmosphere has become a world-wide concern today. Natural resource depletion, accumulation of wastes, deforestation, water pollution and land disturbance are further examples of energy-related environmental concerns.

Because the objectives of sustainable development are very broad, governments and policy makers need a set of quantifiable parameters (indicators) to measure and monitor important changes and significant progress towards the achievement of these objectives. This was recognized by Agenda 21, which specifically (Chapter 40) asks countries and international governmental and non-governmental organizations to develop the concept of Indicators of Sustainable Development (ISD).

Agenda 21 covers all issues that have significant bearing on one or more of the three key dimensions of sustainability, namely social, economic and environmental. One of these significant issues is energy. The provision of adequate and affordable energy services, in a secure and environmentally benign manner, and in conformity with social and economic developmental needs, is an essential element of sustainable development. This was recognized by Agenda 21. In this connection, Chapter 9 of the Agenda clearly states:

"Energy is essential to economic and social development and improved quality of life. Much of the world's energy, however, is currently produced and consumed in ways that could not be sustained if technology were to remain constant and if overall quantities were to increase substantially."

At EU summits in March 2007 and 2008, once again all EU Member Countries recommitted themselves to make radical shift in energy and climate policy of EU. The package proposed by the EU Commission and agreed by Heads of States (including Prime Ministers of three Baltic States) seeks to provide solutions to these challenges based on three central pillars:

A true Internal Energy Market aiming to give real choice for EU energy users, whether citizens or businesses, and to trigger the huge investments needed in energy. The single market is good not just for competitiveness, but also sustainability and security.

Commission calls for stronger independent regulatory control, taking into account the European market, as well as national measures to deliver on the European Union's target of 10% minimum interconnection levels, by identifying key bottlenecks and appointing coordinators.

Accelerating the shift to low carbon energy. For this the Commission proposes to maintain the EU's position as a world leader in renewable energy, by setting a binding target of 20% of its overall energy mix will be sourced from renewable energy by 2020. This will require a massive growth in all three renewable energy sectors: electricity, biofuel and heating and cooling. This renewables target will be supplemented by a minimum target for biofuel of 10%. In addition, a 2007 renewables legislative package will include specific measures to facilitate the market penetration of both biofuel and heating and cooling.
Commission will propose a strategic European Energy Technology Plan. The European Union will also increase by at least 50% its annual spending on energy research for the next seven years.

Increasing Energy efficiency. The Commission reiterates the objective of saving 20% of total primary energy consumption by 2020. If successful, this would mean that by 2020 the EU would use approximately 13% less energy than today, saving 100 billion euro and around 780 tonnes of CO2 each year. The Commission proposed that the use of fuel efficient vehicles for transport is accelerated; tougher standards and better labeling on appliances; improved energy performance of the EU's existing buildings and improved efficiency of heat and electricity generation, transmission and distribution. The Commission also proposes a new international agreement on energy efficiency.

On basis of these firm commitments, it is clear, that tangible measures are needed to shift also Baltic Energy market in line of these principles.

4.1. Sustainable energy indicators

In order to achieve sustainable energy future, all the goals planned and measures foreseen or taken have to be measured against sustainable energy indicators. Same indicators have to be applied within planning national or regional energy policies and also other policies related to energy consumption.

In 2005 report "Energy Indicators for Sustainable Development: Guidelines and Methodologies." was published by the IAEA jointly with UNDESA, IEA, Eurostat and EEA. The report identifies and describes the most important ISD-s necessary to assess all issues and parameters relevant to energy sustainability. The indicators are classified according to themes and sub-themes within the main dimensions of sustainable development. Detailed methodologies are provided for each of the 30 energy indicators and guidelines are described to assist users in the development and implementation of these indicators. Any regional or national energy strategy should take those indicators as measuring tools for progress in implementing the goals emphasized.

Environment-related sustainable energy indicators are as described in table 4.1.

Environmental Dimension

ENV1:	Greenhouse gas (GHG) emissions from energy production and use, per capita and per unit of GDP
ENV2:	Ambient concentrations of air pollutants in urban areas
ENV3:	Air pollutant emissions from energy systems
ENV4-1:	Contaminant discharges in liquid effluents from energy systems
ENV4-2:	Oil discharges into coastal waters
ENV5:	Soil area where acidification exceeds critical load
ENV6:	Rate of deforestation attributed to energy use
ENV7:	Ratio of solid waste generation to units of energy produced
ENV8:	Ratio of solid waste properly disposed of to total generated solid waste
ENV9:	Ratio of solid radioactive waste to units of energy produced
ENV10:	Ratio of solid radioactive waste awaiting disposal to total generated solid radioactive waste

Table 4.1. Environment related sustainable energy indicators

As for the Baltic States poverty eradication is not the issue, Sustainable energy goals are related to security of supply and foremost to the reduction of negative impacts of power production to the environment and human health as well increase of efficiency of energy use.

Following the Sustainable energy principles in energy sector planning, means that the goals of the nation's energy policy should be to:

- promote energy-saving technologies in all sectors of the economy - including energy-efficient buildings, appliances, lighting, vehicles, and industrial processes as well as cogeneration, district energy, and distributed generation using micro turbines and fuel cells;

- promote environmentally-responsible applications of the cross-section of renewable energy technologies including biofuels, biomass, geothermal, hydropower, ocean waves, solar and wind and renewably-based hydrogen;

- reduce greenhouse gas emissions to a level consistent with a world-wide goal of global climate;

- eliminate energy imports (i.e., oil and natural gas, while reducing overall use of fossil fuels: oil, coal and natural gas;

- phase out the current generation of nuclear power and not construct new reactors in their place.

Similarly to IEA indicators for sustainable energy a European set of indicators for energy sector, applied and studied by European Energy Agency composes from 35 different indicators as listed below:

EN01 - EU-25 Energy and non-energy GHGs
EN02 - EU-25 Energy related GHGs
EN05 - EU-25 Ozone precursors
EN06 - EU-25 Acidifying substances
EN07 - EU-25 Particle emissions
EN08 - EU-25 Emissions intensity
EN09 - EU-25 Policy effectiveness
EN13 - EU-25 Nuclear Waste
EN14 - EU-25 Discharge of oil
EN15 - EU-25 Accidental oil spills
EN16 - EU-25 Final energy consumption
EN17 - EU-25 Total energy intensity
EN18 - EU-25 Electricity consumption
EN19 - EU-25 Efficiency of electricity production
EN20 - EU-25 Combined Heat and Power
EN21 - EU-25 Final energy intensity
EN26 - EU-25 Total energy consumption
EN27 - EU-25 Electricity production by fuel
EN29 - EU-25 Renewable energy
EN30 - EU-25 Renewable electricity
EN31 - EU-25 Energy prices
EN32 - EU-25-Energy taxes
EN34 - EU-25 Energy subsidies
EN35 - EU-25 External costs

Among those, most relevant to measure progress of Baltic States towards sustainable energy goals are share of renewables in energy-mix and total energy intensity of economy. As later indicator is aggregating many features of energy sector, both from production and demand side, it is very relevant and will be used to measure sustainability of measures taken in energy sector of Baltic States.

The electricity directive (2001/77/EC) defines renewable electricity targets as the share of electricity produced from renewable energy sources in gross electricity consumption. The latter includes imports and exports of electricity. The electricity generated from pumping in hydropower plants is included in gross electricity consumption but it is not included as a renewable source of energy. Large hydropower plants have a declared net capacity of more than 10 MW.

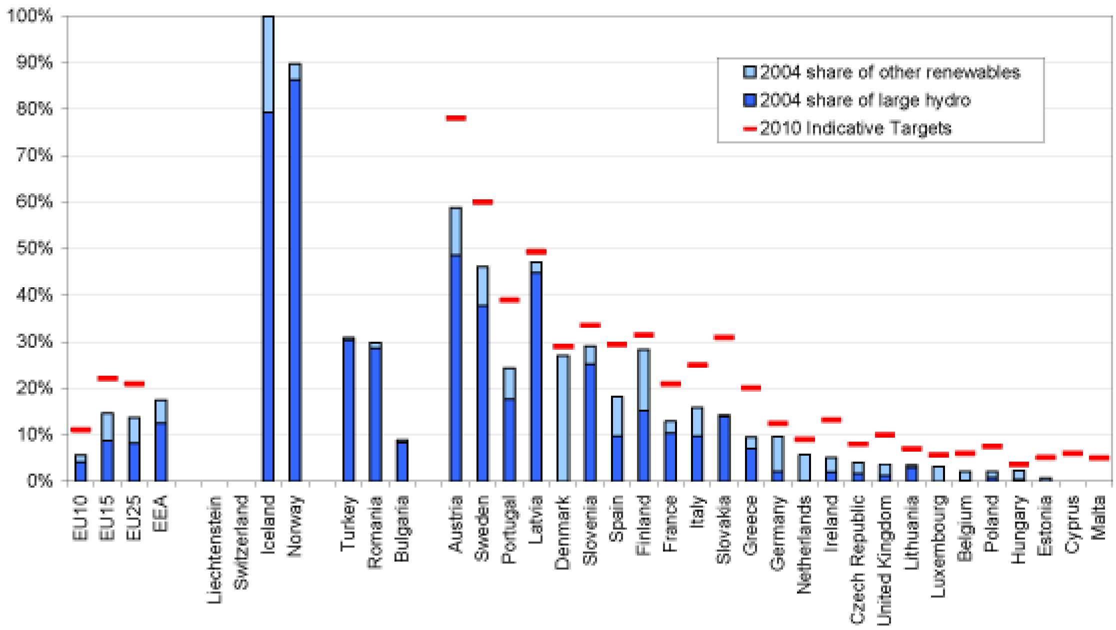


Chart 4.1. RES share and committed targets of EU Member States

According to EEA data, Latvia is well positioned among the EU member countries, with the share of renewable electricity of 48%, but Lithuania and Estonia are amongst the worst in EU – from Estonia' s electricity consumption, renewables covered

Total energy intensity characterizes energy use efficiency of economy, by comparing how much energy is consumed for production of national wealth.

Total energy intensity 1995-2004 (1995=100) and total energy intensity in 2004 relative to EU-25 (EU-25=100)								
	1995	2000	2001	2002	2003	2004	Annual average change 1995-2004	Energy intensity in 2004 (TOE per million GDP in PPS relative to EU-25)
EEA	100.0	90.8	90.9	89.6	90.9	89.7	-1.2%	102
EU-25	100.0	91.0	91.5	90.1	91.3	90.2	-1.1%	100
EU-15	100.0	92.7	93.2	91.8	93.0	92.1	-0.9%	96
EU-10	100.0	76.1	75.9	74.2	73.8	70.3	-3.8%	137
Belgium	100.0	99.3	95.7	89.0	93.7	89.7	-1.2%	117
Czech Republic	100.0	92.4	91.9	91.1	92.8	88.7	-1.3%	160
Denmark	100.0	84.3	85.9	83.9	86.7	82.7	-2.1%	80
Germany	100.0	91.1	93.2	91.2	91.9	90.6	-1.1%	102
Estonia	100.0	66.1	69.2	62.9	64.2	62.1	-5.2%	214
Greece	100.0	98.2	96.3	95.3	92.3	89.5	-1.2%	89
Spain	100.0	98.2	97.6	97.7	98.1	99.4	-0.1%	89
France	100.0	93.8	94.9	93.9	94.4	93.4	-0.8%	105
Ireland	100.0	81.5	80.1	77.2	72.6	73.4	-3.4%	74
Italy	100.0	97.4	95.9	95.8	101.0	101.0	0.1%	79
Cyprus	100.0	100.5	97.6	96.2	102.5	93.2	-0.8%	107
Latvia	100.0	62.4	62.2	57.9	56.7	54.4	-6.5%	122
Lithuania	100.0	68.0	70.6	71.5	67.4	64.0	-4.8%	147
Luxembourg	100.0	80.8	81.8	83.4	86.2	92.1	-0.9%	114
Hungary	100.0	78.8	76.9	75.2	74.7	70.0	-3.9%	113
Malta	100.0	76.2	72.1	85.6	87.9	89.6	-1.2%	83
Netherlands	100.0	84.6	85.1	85.7	88.3	88.8	-1.3%	107
Austria	100.0	92.2	97.8	96.6	102.2	100.2	0.0%	86
Poland	100.0	69.8	69.0	67.0	66.3	63.4	-4.9%	131
Portugal	100.0	100.6	101.3	105.4	104.2	106.2	0.7%	91
Slovenia	100.0	85.2	87.1	86.0	84.2	83.2	-2.0%	119
Slovakia	100.0	81.8	85.0	82.1	78.4	72.1	-3.6%	168
Finland	100.0	89.8	91.1	94.2	97.3	95.0	-0.6%	169
Sweden	100.0	81.1	86.3	84.5	82.5	82.6	-2.1%	133
United Kingdom	100.0	90.1	88.7	84.9	84.3	82.4	-2.1%	88
Bulgaria	100.0	83.0	83.0	77.6	76.1	70.0	-3.9%	209
Romania	100.0	83.8	78.7	76.3	77.9	70.6	-3.8%	149
Turkey	100.0	102.8	102.5	100.2	99.7	94.5	-0.6%	105
Iceland	100.0	119.5	119.4	121.8	117.9	112.5	1.3%	247
Norway	100.0	92.2	92.6	82.7	91.6	90.3	-1.1%	103

Table 4.2. Total energy intensity of EU Member States, 2001-2004

Despite the fact that over last years total energy intensity of economies of the three Baltic States has decreased somewhat quicker than average within EU member countries, absolute figures of this indicator show that energy intensity of Baltic States is many times lower than EU average.

	Gyventojai, mln. Population, mln.	Plotas, tūkst. km² Territory, thous. km²	BVP (VK)[2], mlrd. JAV dol.(2000) GDP (ER)[2], bn. USD(2000)	BVP (PGP)[3], mlrd. JAV dol. (2000) GDP (PPP)[3], bn. USD(2000)	BVP (VK), 10³ JAV dol./gyv. GDP (ER), 10³ USD/cap	BVP (PGP), 10³ JAV dol./gyv. GDP (PPP), 10³ USD/cap.	Pirminė energija (PE), Mtne Primary Energy (TPES), Mtoe	Galutinė energija (GE), Mtne Final Energy (TFC), Mtoe	Pirminė energija, tne/gyv. TPES, toe/cap.	Galutinė energija, tne/gyv. TFC, toe/cap.	PE/BVP, tne/10³ JAV dol. TPES/GDP, toe/10³USD	GE/BVP, tne/10³ JAV dol. TFC/GDP, toe/10³USD	
ES-12	**103.6**	**1087.0**	**459.2**	**1021.4**	**4.4**	**9.9**	**269.1**	**168.1**	**2.6**	**1.6**	**0.26**	**0.16**	**EU-12**
Bulgarija	7.8	110.9	15.2	57.6	1.9	7.4	18.9	9.4	2.4	1.2	0.33	0.16	BGR
Čekija	10.2	78.9	62.7	168.3	6.1	16.5	45.5	27.6	4.5	2.7	0.27	0.16	CZE
Estija	1.3	45.2	7.2	18.0	5.5	13.9	5.2	2.5	4.0	1.9	0.29	0.14	EST
Kipras	0.8	9.2	10.3	17.3	12.9	21.6	2.6	2.0	3.3	2.5	0.15	0.12	CYP
Latvija	2.3	64.6	10.3	24.8	4.5	10.8	4.6	2.9	2.0	1.3	0.18	0.12	LVA
Lenkija	38.2	312.7	186.6	445.2	4.9	11.7	91.7	60.9	2.4	1.6	0.21	0.14	POL
Lietuva	3.4	65.3	15.1	41.4	4.4	12.2	9.2	4.5	2.7	1.3	0.22	0.11	LTU
Malta	0.4	0.3	3.8	7.0	9.5	17.5	0.9	0.5	2.3	1.2	0.13	0.07	MLT
Rumunija	21.7	237.5	46.9	169.0	2.2	7.8	38.6	22.6	1.8	1.0	0.23	0.13	ROM
Slovakija	5.4	49.0	24.3	69.5	4.5	12.9	18.3	11.4	3.4	2.1	0.26	0.16	SVK
Slovėnija	2.0	20.3	21.7	38.4	10.9	19.2	7.2	4.7	3.6	2.3	0.19	0.12	SVN
Vengrija	10.1	93.0	55.1	144.8	5.4	14.3	26.4	19.1	2.6	1.9	0.18	0.13	HUN
ES-15	**385.9**	**3239.2**	**8523.5**	**10073.5**	**22.1**	**26.1**	**1545.7**	**1105.8**	**4.0**	**2.9**	**0.15**	**0.11**	**EU-15**
Airija	4.1	70.3	118.2	134.5	29.1	33.1	15.2	12.0	3.7	2.9	0.13	0.09	IRL
Austrija	8.2	83.9	205.0	243.2	25.1	29.7	33.2	27.6	4.1	3.4	0.14	0.11	AUT
Belgija	10.4	30.5	246.3	290.1	23.6	27.8	57.7	41.3	5.5	4.0	0.20	0.14	BEL
Danija	5.4	43.1	166.4	159.8	30.8	29.6	20.1	15.6	3.7	2.9	0.13	0.10	DNK
D. Britanija	59.8	244.8	1591.1	1661.3	26.6	27.8	233.7	163.6	3.9	2.7	0.14	0.09	UK
Graikija	11.1	132.0	135.0	211.3	12.2	19.1	30.5	21.4	2.7	1.9	0.14	0.10	GRC
Ispanija	42.7	504.8	655.6	958.0	15.3	22.4	142.2	103.5	3.3	2.4	0.15	0.11	ESP
Italija	58.1	301.2	1114.2	1495.8	19.2	25.7	184.5	144.8	3.2	2.5	0.12	0.10	ITA
Liuksemburgas	0.4	2.6	21.9	24.1	48.7	53.5	4.7	4.5	10.6	10.0	0.20	0.19	LUX
Olandija	16.3	41.5	398.5	467.4	24.5	28.7	82.1	63.3	5.0	3.9	0.18	0.13	NLD
Portugalija	10.5	92.3	108.5	180.9	10.3	17.2	26.5	21.3	2.5	2.0	0.15	0.12	PRT
Prancūzija	62.2	547.0	1414.8	1678.3	22.7	27.0	275.2	172.3	4.4	2.8	0.16	0.10	FRA
Suomija	5.2	338.1	132.1	146.5	25.3	28.0	38.1	27.2	7.3	5.2	0.26	0.18	FIN
Švedija	9.0	450.0	263.2	262.2	29.3	29.2	53.9	35.7	6.0	4.0	0.21	0.14	SWE
Vokietija	82.5	357.0	1952.7	2160.0	23.7	26.2	348.0	251.7	4.2	3.0	0.16	0.12	DEU
ES-27	***489.5***	***4326.1***	***8982.7***	***11094.9***	***18.3***	***22.7***	***1814.8***	***1274.0***	***3.7***	***2.6***	***0.16***	***0.11***	***EU-27***
G-8	***860.1***	***38502.8***	***22824.7***	***23387.0***	***26.5***	***27.2***	***4811.0***	***3311.8***	***5.6***	***3.8***	***0.21***	***0.14***	***G-8***
ES-4[4]	262.6	1450.1	6072.8	6995.4	23.1	26.6	1041.4	7324.5	4.0	2.8	0.15	0.10	EU-4[4]
JAV	294.0	9629.1	10703.9	10703.9	36.4	36.4	2325.9	1600.8	7.9	5.4	0.22	0.15	USA
Japonija	127.7	377.8	4932.5	3431.6	38.6	26.9	533.2	354.3	4.2	2.8	0.15	0.10	JPN
Kanada	32.0	9970.6	786.7	946.9	24.6	29.6	269.0	201.7	8.4	6.3	0.28	0.21	CAN
Rusija	143.9	17075.2	328.8	1309.1	2.3	9.1	641.5	422.5	4.5	2.9	0.49	0.32	RUS
Š-4	***2586.8***	***28944.4***	***3596.1***	***12317.4***	***1.4***	***4.8***	***2519.9***	***1219.6***	***1.0***	***0.5***	***0.20***	***0.10***	***C-4***
Kinija	1303.0	9597.0	1903.9	7218.7	1.5	5.5	1626.5	830.6	1.2	0.6	0.22	0.11	CHN
Indija	1079.7	3148.6	581.2	3115.3	0.5	2.9	572.8	190.0	0.5	0.2	0.18	0.06	IND
Brazilija	183.9	8512.0	655.4	1385.1	3.6	7.5	204.8	125.2	1.1	0.7	0.15	0.09	BRA
Australija	20.2	7686.5	455.6	598.3	22.5	29.6	115.8	73.9	5.8	3.7	0.19	0.12	AUS
Pasaulis	**6352.4**	**118124.0[5]**	**35024.8**	**52289.2**	**5.5**	**8.2**	**11059.4**	**6597.0**	**1.7**	**1.0**	**0.21**	**0.13**	**World**
Š-35	3673.8	70323.2	29330.7	39803.8	8.0	10.8	8104.4	5073.0	2.2	1.4	0.20	0.13	C-35
Š-350	***2678.6***	***47800.7***	***5694.1***	***12485.4***	***2.1***	***4.7***	***2955.1***	***1524.0***	***1.1***	***0.6***	***0.24***	***0.12***	***C-350***

1) – Pagal Tarptautinės energetikos agentūros duomenis (2006 m. leidiniai);
2) – BVP apskaičiuotas pagal valiutų keitimo kursą;
3) – BVP apskaičiuotas pagal perkamosios galios paritetą;
4) – D.Britanija, Italija, Prancūzija ir Vokietija;
5) – Nevertinant Antarktidos ir Grenlandijos.

1) – Data of International Energy Agency (Editions 2006);
2) – GDP using exchange rates;
3) – GDP using Purchasing Power Parities;
4) – UK, Italy, France and Germany;
5) – Excluding Antarctica and Greenland.

Table 4.3. Energy sector indicators of selected countries.

4.2. External costs of energy production.

Fuel cycle externalities are the costs imposed on society and the environment that are not accounted for by the producers and consumers of energy, i.e. that are not included in the market price. They include damage to the natural and built environment, such as effects of air pollution on health, buildings, crops, forests and global warming; occupational disease and accidents; and reduced amenity from visual intrusion of plant or emissions of noise. For example, damage to human health is caused by emissions of particulate matter (including both primary particles and secondary aerosols). SO2, NOX and VOC emissions also lead to human health impacts (which are considered to be the largest externality) through the formation of secondary pollutants. NOX and VOC emissions have health impacts through the formation of ozone. SO2 and NOx emissions form secondary particles in the atmosphere (which have similar effects to primary PM). There are also costs associated with non-health impacts. SO2 is the main pollutant of concern for building-related damage, though ozone also does affect certain materials. The secondary pollutants formed from SO2, NOX and VOC also impact on crops and terrestrial and aquatic ecosystems.

Damages from climate change, associated with the high emissions of greenhouse gases from fossil fuel based power production, also have considerable costs.

Traditional economic assessment of fuel cycles has tended to ignore these effects. While planning sustainable energy strategies, there is inevitable need to adopt more sophisticated approach involving the quantification of these environmental and health impacts of energy use and their related external costs. There has been carried out extensive study of EU 15 member states power production externalities within the EU EXTERNE project[24], which results are presented in table below.

EXTERNAL COST FIGURES FOR ELECTRICITY PRODUCTION IN THE EU FOR EXISTING TECHNOLOGIES[1] (IN € CENT PER KWH*)

Country	Coal & lignite	Peat	Oil	Gas	Nuclear	Biomass	Hydro	PV	Wind
AT				1-3		2-3	0.1		
BE	4-15			1-2	0.5				
DE	3-6		5-8	1-2	0.2	3		0.6	0.05
DK	4-7			2-3		1			0.1
ES	5-8			1-2		3-5**			0.2
FI	2-4	2-5				1			
FR	7-10		8-11	2-4	0.3	1	1		
GR	5-8		3-5	1		0-0.8	1		0.25
IE	6-8	3-4							
IT			3-6	2-3			0.3		
NL	3-4			1-2	0.7	0.5			
NO				1-2		0.2	0.2		0-0.25
PT	4-7			1-2		1-2	0.03		
SE	2-4					0.3	0-0.7		
UK	4-7		3-5	1-2	0.25	1			0.15

* sub-total of quantifiable externalities (such as global warming, public health, occupational health, material damage)
** biomass co-fired with lignites

Table 4.4 Average external costs of electricity production from different fuels

[24] See http://externe.jrc.es/

EEA has gone further and has determined external costs by EU 25 member states. The external costs used to calculate this indicator are based upon the sum of three components: climate change damage costs associated with emissions of CO2; damage costs (such as impacts on health, crops etc) associated with other air pollutants (NOx, SO2, NMVOCs, PM10, NH3), and other non-environmental social costs for non-fossil electricity-generating technologies. Study shows that the external costs of electricity production have fallen considerably between 1990 and 2004 in almost all Member States, despite rising electricity production. However, the average external costs still represented between 1.8-6.0 Eurocent/kWh in the EU in 2004. These costs are very significant and reflect the dominance of fossil fuels in the generation mix.

However, given the long-time scales involved, and the lack of consensus on future impacts of climate change itself, there is considerable uncertainty attached to the damage costs of climate change. The external costs of CO2 emissions must thus be interpreted with care. The authors of a recent study on the impacts and costs of climate change (Watkiss et al., 2005) stress that there is no single value and that the range of uncertainty around any value depends on ethical as well as economic assumptions. The study concludes that the 'lower indicative estimate for the marginal damage costs for the full risk matrix might result in a minimum value of 15 EUR/t CO2, a central illustrative estimate of some 25 EUR/t CO2, and an upper indicative estimate of at least 80 EUR/ t CO2 and possibly much higher (for year 2000 emissions).' The damage factors for CO2 used in EEA Study range from 19 EUR/t CO2 (low estimate, based on ExternE-Pol) and 80 EUR/t CO2 (high estimate, based on Watkiss et al., 2005). These two values are common to all countries.

The overall level of these externalities will depend upon a number of factors including: the fuel mix for electricity generation (e.g. the use of coal releases far more CO2 and air pollutants than gas); the efficiency of electricity production (as the higher this is the less input fuel, and hence output emissions, are required to produce each unit of electricity); the use of pollution abatement technology, and the location of the plant itself. Environmental and social externalities are highly site specific and so results will vary widely even within a given country according to the geographic location. Results from the CAFE (Clean Air for Europe Programme) have highlighted that the highest damages are found from emissions in the central parts of Europe and the lowest from countries around the borders of Europe. This reflects variation in exposure of people and crops to the pollutants of interest - emissions at the borders of Europe will affect fewer people than emissions at the centre of Europe, due to the degree of urbanization and population density, and because the analysis did not account for non-European bordering countries.

Traditional fossil systems (coal, oil and to a lesser extent natural gas) exhibit the highest external costs for electricity generating technologies, in the range of 1.1 c EUR/kWh (for advanced gas technologies using the lower bound estimate of damage costs cEUR/kWh) to 24.1 cEUR/kWh (for traditional coal plants using the higher bound estimate of damage costs). These fuels accounted for about 54 % of all electricity production in 2004 in EU. The majority of these external costs occur during the production of the electricity itself (i.e. from the burning of coal and release of specific pollutants to air, etc), although there is a small component associated with other parts of the fuel cycle (e.g. due to the mining and transport of the fuel). The introduction of advanced technologies (such as combined cycle (CC) and pressurized fluidized bed combustion (PFBC)) can substantially reduce the external costs of fossil systems. This also applies to cogeneration, for which gas technology generates external costs one third lower than diesel technology. Renewable energy shows the lowest damages per unit of electricity.

Nuclear external costs are in the range 0.2-0.4 cEUR/kW. However, these external costs factors have to be treated with caution, as they reflect to a large extent the small amount of emissions of CO2 and air pollutants, and the low risk of accidents. The methodology to evaluate the impacts due to accidents is risk-based. Risk can be broadly defined as the probability of accident multiplied by its consequences. A low probability of an accident would therefore result in a low external cost. However, it would seem that in cases where risks have a very high damage but a low probability, the risk assessment of the public is not proportional to the risk. ExternE concludes that quantification of this risk has not been successful but that research is clearly needed to estimate the external-cost factors from nuclear energy production.

The fall in external costs observed over the period 1990 to 2004 was primarily due to a combination of fuel switching away from coal to natural gas (and a smaller component from the increased use of renewable energy, which in general leads to far lower external costs than fossil fuels); the ongoing improvement in generation efficiency (in part due to the use of higher efficiency gas plant), and the use of pollution abatement technology, such as Flue Gas Desulphurization in coal plants.

In some EU countries, the decline in the external costs per unit of electricity produced was mainly the result of the closure of old and inefficient coal-fired plants and their replacement with either newer, more efficient coal-fired plants or new gas-fired plants and the implementation of emission abatement measures. In Eastern Europe this was triggered primarily by economic restructuring and a decline in heavy industry (in Germany this occurred in the early part of the 1990s due to reunification) whereas in the United Kingdom it was due primarily to economic factors whereby gas became the fuel of choice for new plant, which also led to higher overall generating efficiencies from the use of combined cycle gas turbines (CCGT).

Many of the new 10 Member States still have some of the highest external costs on a per kWh basis. The externalities also vary between the EU Member States, as a result both of the fuel mix and location. Higher damages typically occur from emissions in countries in Western Europe because of the large population affected. Countries with lower mean externalities are Austria, Finland and Sweden, reflecting their low population density (in the two latter) and greater use of nuclear and renewable energy and, in particular, hydropower.

At present, energy prices and taxation often do not reflect the full extent of external costs. However, progress is being made; with the absolute level of taxation increasing and the introduction of the EU emissions trading scheme putting a price on carbon dioxide emissions. Full cost pricing (incorporating all environmental costs) is a long-term goal, but there are difficulties, notably the lack of consensus about the acceptability and validity of damage cost values. It should also be highlighted that taxes or other economic instruments are not the only way to internalize external costs; regulation are a way of internalizing the costs as they may have a feedback on production costs.

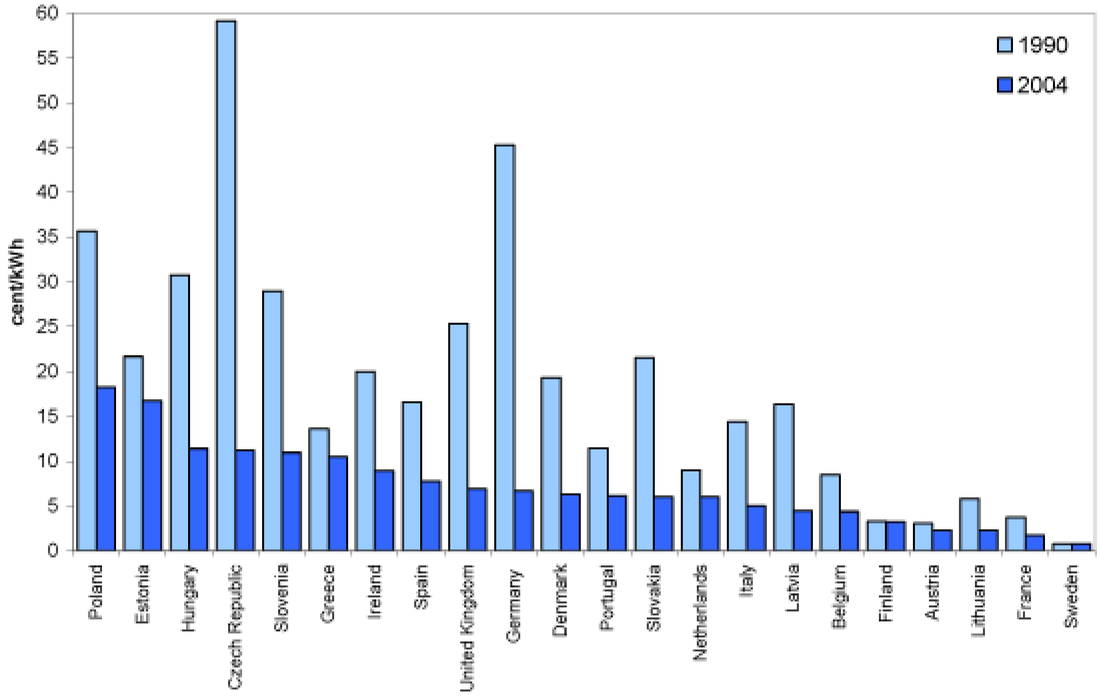


Chart 4.2. External costs of power production in EU Member States, *Source: EEA*

As seen from the table above, Estonian electricity production externalities are amongst the highest in Europe, achieving 18 eurocents per kWh, when Latvian and Lithuanian power production externalities are due to low share of fossil based power in their countries power production portfolios, are smallest ones (respectively 4 and 3 eurocents per kWh).

For preparing the Baltic Sustainable Energy Strategy and for comparison of different scenarios those basic indicators are used as well the extensive work carried out by Latvian and Lithuanian NGOs together with Danish based International Network for Sustainable Energy – INFORSE[25], on defining sustainable energy goals and options, has been used.

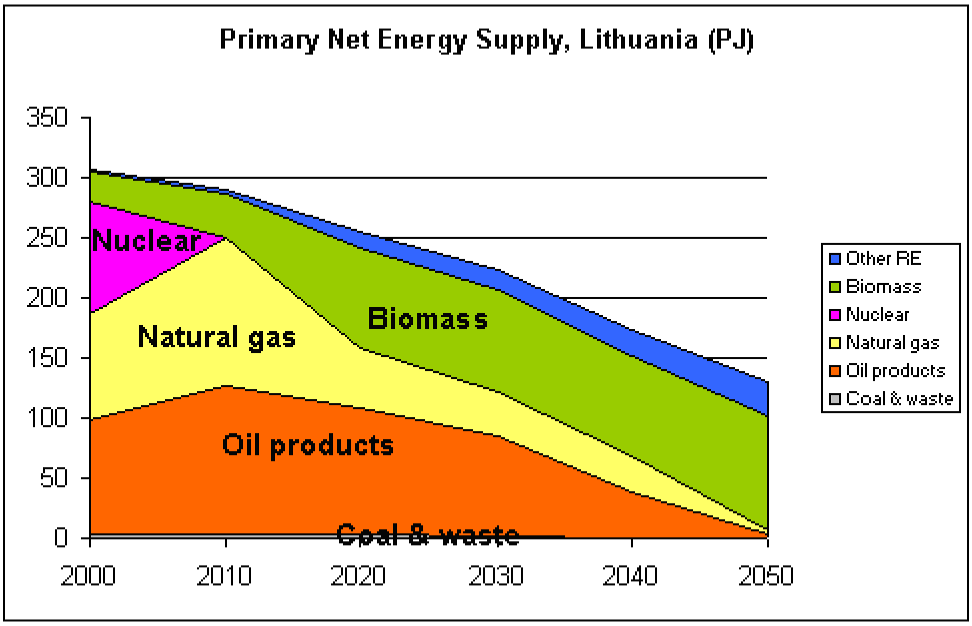
For **Estonia** no comprehensive sustainable energy strategy has been prepared nor by Government nor by NGOs. National Sustainable Development Strategy for Estonia - Agenda 21 (Säästev Eesti 21), adopted by the Parliament on 2007, does not elaborate detailed agenda for energy sector. Despite the national Long-term fuels and energy sector development plan 2015 as well National electricity sector development plan 2006-2015 emphasize implementation of the principles of sustainable development as well stipulate relevant goals, the implementation is lacking and thus goals are not achieved.

For **Latvia** There has bee prepared Sustainable Energy Vision for 2050 by Latvian Green Movement and INFORSE (see document in Annex 2)

For **Lithuania** there have been developed comprehensive Sustainable energy Strategy by NGO Atgaja – Vision 2050 for Lithuania, where main emphasis has been put to demand side management – to raise energy efficiency. Most energy consuming equipments will be

[25] http://www.inforse.dk/

changed several times until 2050, and if new generations of equipment are made with optimal energy performance, and markets are made to promote the most efficient technology, it will not be a problem to reach today's best available technology, even though the efficiency gains required are very large, - in the order of 4 times, similar to an annual increase of efficiency of over 2% per year from 2010. This will not happen by itself, given that the "natural" technological development in EU has been about 1% per year. It will require concerted actions from stakeholders involved, but if it is done on EU-scale and the market therefore is large for each new generation of efficient equipment, the changes will be cost-effective. The extra equipment costs will be off-set by energy savings. To realize this, it is, however, necessary to go beyond the conservatism of many market players in this field, and develop a truly enabling market for energy efficiency throughout the society.



Graph: Change of Energy Supply, following Vision2050

Sustainable Energy Strategy for three Baltic States is largely based on these two national sustainable energy strategies and assumptions on sustainable energy potential of Estonia.

4.3. Goals of Baltic Sustainable Energy Strategy

Taking into account the EU wide energy and environment policy goals, availability of renewable resources and energy efficiency potential of the three Baltic States, a Baltic Sustainable Energy Strategy (BSES) sets following goals:

1) Promotion of energy-saving technologies in all sectors of the economy – including energy-efficient buildings, appliances, lighting, vehicles, and industrial processes with a target to reduce primary energy use by 20% from 2005 levels and achieving EU

average energy intensity (toe/GDP) by 2020 as agreed by European Council in March 2007

2) Increase of energy efficiency of three Baltic States to EU average of 0,16 toe/1000USD
3) Via utilization of the energy saving and efficiency increase potential, decoupling energy consumption and economic growth to the extent that primary energy consumption will remain by 2020 at the level of 2005.
4) Promotion of and development of cogeneration, district energy, and distributed generation using micro turbines and fuel cells with target to increase distributed generation share to 30% of total electricity supply by 2020.
5) Promotion and development of environmentally-responsible applications of renewable energy technologies including biofuels, biomass, geothermal, hydropower, solar and wind and renewably-based hydrogen with target to have share of the renewables in electricity supply mix more than 50% by 2020
6) Reduction of greenhouse gas emissions by at least 50% from 1990 levels during the period 2012-2020
7) Phase out the current generation of nuclear power and ban construction of new reactors.

4.4. Measures to achieve BSES Goals

For achieving those goals, multiple actions relevant to the goals should be launched including strengthening of regulations and establishment of efficiency benchmarks for production and consumption, strengthening of existing fiscal instruments and creating new ones, providing information and support for efficient technology takeover both on supply and demand side.

List (not comprehensive) of actions to achieve sustainable energy future for Baltic States is as follows:

1) Internalization of external costs via implementing ecological tax reforms with special focus on charging (introducing and strengthening carbon-based fuel and electricity excise taxes and resource use fees) fossil fuels according to their carbon content and negative environmental impact as well energy and resource intensive technologies and products. Exemption from fuel and electricity excise renewable fuels and electricity produced using renewable sources and fuels.

2) Developing relevant spatial planning and tax regulation for promotion of district heating and use of energy efficient heating technologies;

Among other measures:

- developing and adopting national, regional and local theme planning for development of wind energy, biomass energy and micro energy;

- determine district-heating regions for major cities and setting condition for development like obligatory switch to heat supply grid which is supplied by efficient co-generation plant, ban of construction of fossil fuelled CHP or heat-only-boilers for heat supply of new housing areas;

- implementation of tax exemptions to or tax deductions of costs for purchase of soil-water based heat-pumps;

3) Launching national support schemes for promoting of distributed generation technologies and energy efficiency technologies development and market penetration;

Among other measures:

- provide investment support from national budget and EU structural funds (up to 50% of project costs) to renewable energy suppliers and micro energy producers;

- provide credit lines with beneficial terms to renewable and micro energy production developers;

- provide institutional support to establish cooperatives for renewable and micro energy producers, involving population;

4) Adopting regulation to promote renewable energy production and decentralized power production - setting obligation that large energy consumers (above 40 MWh/y) should purchase certain portion (national target should cover at least 50% of total annual production) of electricity to cover their annual electricity consumption from renewable producers;

5) Launching national support schemes for promoting energy saving measures and technologies;

7) Launching national support schemes for and establishes relevant information service for promoting of energy saving measures and technologies.

Among other measures:

- creating and supporting energy efficiency knowledge centers, dissemination of energy saving know-how via internet based services, arrange stakeholder specific information campaigns of energy efficiency;

- providing investment support using national and EU Structural Funds and launching credit schemes for housing cooperatives and individuals for investment on energy efficiency;

8) Adopting legislation creating strict energy efficiency benchmarks for housing, transport, energy producers and certain energy using equipment.

Among other measures:

- setting requirements to pass energy audits and provision of energy efficiency data during sales of houses;

- setting energy use standard for (design and construction of) new houses energy use at level of 75 $kWh/m^2/y$;

- applying energy use efficiency requirements at public procurement of goods, services (equipment, transport, construction etc) by public institutions;

- putting in practice that public sector applies passive-house technologies for design and construction of public buildings.

9) For quicker shift towards use of energy efficient solutions, adopting legislation to ban sales of decandecent pulbs, starting from 2010.

10) For energy saving purposes adopting legislation to ban import and production of equipment with “stand by” feature, starting from 2012.

Specific additional measures for Estonia:

- increasing the resource fee for use of oil-shale – major fossil fuel for power production, three times compared to current level (from 0,77EUR/t to 2,3 EUR/t)
- Estonia may increase the stability of gas supply if country increases it’s participation in the development and use of the underground storage facilities of Latvia, establishes stocks into the facilities and starts it’s own gas production using biomass and oil-shale.
- Adopt national legislation for use of sea bottom for construction of off-shore windparks

Specific additional measures for Latvia:

- National Wind Development Plan has to be prepared, considering opportunities to develop wind parks also in protected coastal areas, where wind energy does not contradict to conservation objectives of the area;
- Procedures and conditions for grid connection of independent energy producers has to be simplified;
- Adopt national legislation for use of sea bottom for construction of off-shore windparks

5 Comparison of different energy strategies

Within current study two different sets of assumptions for future power production strategies in three Baltic States for targeting 2020 are made: BAU – Business as usual Scenario and BSES – Baltic Sustainable Energy Strategy. Both Strategies are described and compared via energy balance (production, import-export and consumption of electricity) in order to reflect understandable way what necessary changes in power consumption and power saving have to be taken in order to achieve sustainable goals for Baltic States energy sectors. BES – Baltic Energy Strategy, developed as joint effort of the governments of three Baltic States is not considered as possible strategy, because document does not stipulate measurable goals nor tangible action plan, thus possible impact of BES to energy sector and particularly to power production developments cannot be measured nor compared.

Multi Criteria Analyze (MCA) has been used as basic methodology for determine Sustainable Energy Strategy and comparing it with government's strategy. MCA is a method for evaluating alternative options against several criteria, and combining the separate evaluations into an overall evaluation. It can be used to identify a single most preferred option, to rank options, to short-list a limited number of options for subsequent detailed appraisal, or simply to distinguish acceptable and unacceptable options. MCA helps to manage that complexity by converting the evaluation to a numerical score. All MCA approaches incorporate judgments that are expressed in weights of criteria and in performance evaluations. Usual steps in a multi-criteria analysis are as follow:

1. Identify assessment criteria. They can measure key consequences of proposed alternative options based on the relevant objectives or on their likely impacts. Carefully examine the proposed set of criteria to ensure that:

The set of criteria is complete (no significant criteria is missing)

There are no redundant criteria (these may include insignificant criteria or criteria where all options perform equally)

Criteria are measurable (it must be possible to assess - at least qualitatively - how well each option performs in relation to the criterion)

Criteria are mutually independent (there is no double counting)

2. Analyze relative importance of criteria (weighting). Most MCA techniques enable to determine relative weights of each criteria in the decision -making. Methods of weighting vary from simple techniques (e.g. comparing criteria against each other to determine their relative weight) to complex methods (e.g. sociological surveys to determine importance of each criterion in the affected community).

3. Analyze performance (scoring). Before scoring the performance, determination of what constitutes the best and the worst performance in a given context is required. Scoring performance may be done through three basic means:

Direct rating through expert judgments by assigning a score to each option

Determining performance against criterion-specific function that defines gradual progression from the worst to the best performance

Judging performance of options against each other. Methods vary – through simple ranking of options to determine the order of their performance (e.g. on criterion 1 the option A scores best, C second and B third) to complex calculations (based on fuzzy sets)
4. Multiply weights and scores for each of the options and derivation of their overall scores. Each option's performance on a criterion is multiplied by the weight of the respective criterion – this done for all the criteria. The sum yields the overall relative score for the given option. The results for all options are compared and discussed.
5. Analyze sensitivity to changes in scores or weights. Sensitivity shows how changes in the scores or weight affect the results of MCA. Such analysis may be essential if:
There are serious uncertainties about performance of some options against selected criteria, or
If decision-makers or stakeholders argue about the relative weights of criteria used in MCA.
MCA takes into account different criteria at the same time, which is impossible with the usual decision-making process based on a single criterion; MCA may be used to bring together the view of the different stakeholders in the evaluation; MCA is transparent and explicit (the scores and weights are recorded), easy to audit; MCA may facilitate communication with decision maker and sometimes with the wider community

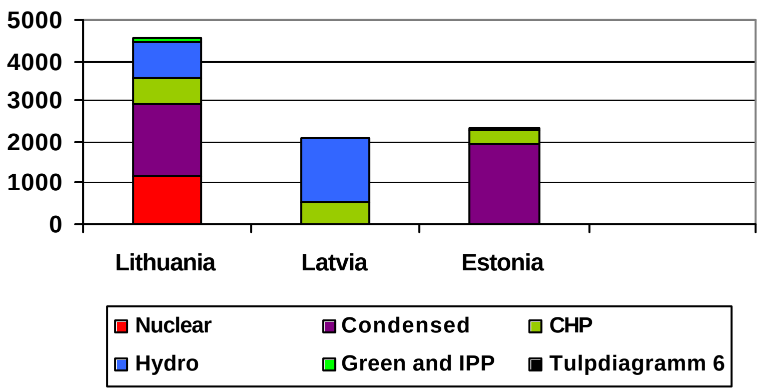
5.1. Business as usual scenario

Business as usual (BAU) scenario foresees that current development trends in three Baltic States continue. This means that concentrated power production remains largely prevailing and no significant changes in power supply mix in these countries occur besides those already agreed within EU Accession process (closure of Ignalina NPP and Phase out of Narva PP old oil-shale power units), where phased out power capacities will be replaced by cheapest and conventional technologies/fuels. For the baseline for projections data from National energy reports of 2005 have been used. For the projections of energy sector developments different studies, available from public sources, addressing availability of resources etc. have been used

Estonian energy sector development goals and measures as well as assumptions of possible power production investment projects of major market players have been taken from National electricity sector development plan 2005-2015. On Latvia a recently adopted Guidelines for Energy Sector Development 2007-2016 has been basis for projections within Business as usual Strategy.

On Lithuanian energy sector development, projections are based on National Energy Strategy, adopted by the Lithuanian Parliament on 18.01.2007.

Chart 5.1. Installed power production capacities 2005, MW



Actual electricity balance data from 2005 has be taken from relevant reports of National Statistical Offices. Savings are assumed to be on o level as no extra measures have been introduced and no significant saving results been reported by the countries.

Table 5.1. Electricity balance 2005, actual

	EST		**LAT**		**LIT**		**Total Baltic States**	
	GWh	%	**GWh**	%	**GWh**	%	**GWh**	%
Gross production	**10205**	100	**4905**	100	**14784**	100	**29894**	100
Fossil fuel	**10130**	99,3	**1533**	31,2	**3425**	23,2	**12483**	41,8
Hydro	**20**	0,2	**3325**	67,8	**820**	5,5	**4165**	13,9
Nuclear	**0**	0	**0**	0	**10338**	69,9	**10338**	34,6
Wind	**55**	0,5	**47**	1,0	**0**	0	**102**	0,3
Biomass	**0**	0	**0**	0	**0**	0	**0**	0
Other	**0**	0	**0**	0	**200**	1,4	**200**	0,7
Imp/Exp	**-1608**	15,8	**2148**	43,8	**-2966**	20,1	**-2426**	8,1
CHP share	**1041**	10,2	**1533**	31,2	**2352**	15,9	**4926**	16,5
Gross domestic consumption	**8597**	84,2	**7053**	143,9	**11818**	79,9	**27468**	91,9
Energy product.	**1531**	15,0	**488**	9,9	**2621**	17,7	**4640**	15,5
Transmission losses	**1103**	10,8	**836**	17,0	**1220**	8,3	**3159**	10,6
Final Consumption without saving	**5963**	58,4	**5729**	116,8	**7977**	54,0	**19669**	65,8
Savings	**0**	0	**0**	0	**0**	0	**0**	0
Final Consumption	**5963**	58,4	**5729**	116,8	**7977**	54,0	**19669**	65,8

At BAU scenario energy consumption growth scenarios data of official national strategies of three Baltic States have been used to determine consumption level for 2020. Investment plans from these strategies of possible new capacities have been taken in order to forecast share of different production sources and production volumes by 2020.

In Estonia part of the oil-shale based power production capacities will be phased out and part repowered (about 750 MWel), oil-shale use will be limited also by the high cost of CO2 quota at carbon market. Wind development will be modest due to continuous uncertainty within state incentive policy and protectionist measures applied to keep best development areas for domestic investors. Biomass based small size CHP- will take near maximum from the supply market, which is restricted to small heat capacity of District heating systems. No significant measures are planned to increase energy efficiency and to promote energy saving, thus energy saving measures in certain extent will occur due to rising energy costs. Shortage in power supply from domestic suppliers is foreseen due to phase out of old capacities and lack of new capacities, due to national policies to distort the energy market protect oil-shale power production via indirect subsidies (lower emission and resource use fees). Shortage is covered with the import from Lithuania and other nearby markets.

In Latvia, investments to new gas and coal based production capacities are by 2020 implemented and together with development of carbon emissions market, interest to utilize high biomass potential in the country will grow significantly and thus biomass use share increases significantly compared to 2005. No big changes occur for wider use of hydropower, but its share stays high due to exchange trade in order to compensate wind power deviations in Estonia. Due to participation in Ignalina new NPP project, part of domestic demand is covered with import from Lithuania as well in smaller extent with import from Russia and Nordpool. Energy saving is not promoted (supported) by the government seriously thus efficiency measures are applied by consumers only due to increased energy prices.

In Lithuania, by 2020 new nuclear capacity of 3400 MW has been built and domestic demand largely covered by nuclear power. There is gas as fuel dominating in small CHP sector adjacent to bigger cities as well as partly gas is used to run reserve plants due to NPP breaks and overhauls time. Hydro and wind share will remain marginal as all government resources go to cover construction costs of new reactor, thus there is no state means allocated to support renewables development. Same applies to government's incentives to promote energy efficiency and saving.

Table 5.2. Electricity balance 2020, Current Trends Scenario (BAU)

	EST		LAT		LIT		Total Baltic States	
	GWh	%	GWh	%	GWh	%	GWh	%
Gross production	**10408**	100	**8338**	100	**28640**	100	**47386**	100
Fossil fuel	**9784**	94	**4169**	50	**3000**	10	**16953**	36
Hydro	**0**	0	**3585**	43	**1025**	4	**4610**	10
Nuclear	**0**	0	**0**	0	**24000**	84	**24000**	51
Wind	**520**	5	**167**	2	**205**	1	**892**	2
Biomass	**104**	1	**417**	5	**410**	1	**931**	2
Imp/Exp	**1041**	10	**834**	10	**-8203**	29	**-6382**	-14
CHP share	**2082**	20	**1751**	21	**3410**	12	**7243**	15
Gross domestic consumption	**11449**	110	**9172**	110	**20437**	71	**41058**	87
Energy sector	**1374**	12	**917**	10	**3437**	12	**5728**	12
Transmission losses	**1145**	10	**1737**	15	**2291**	8	**5173**	11
Final Consumption without saving	**8930**	86	**7338**	88	**14709**	58	**30977**	65
Savings	**425**	5	**349**	5	**735**	5	**1509**	5
Final Consumption	**8505**	82	**6989**	84	**13974**	56	**29468**	62
Growth compared to 2005	**2542**	43	**1260**	22	**5997**	75	**9799**	50

Because of the lack of tangible measures taken by the governments in order to promote and implement energy saving measures, increase of consumption is high. As investments into new capacities are costly, thus there will be lack of new capacities to cover demand. Lack of investments into grid development together with lack of new capacities as well concentration of production results that security of supply by 2020 is weekend in all three Baltic States compared to 2005. Energy costs of inefficient public sector services will remain high, environmental costs from emissions and damage of energy production is large and creates big burden to the State Budgets.

5.2. Baltic Sustainable Energy Strategy

For BSES scenario electricity demand level for 2020 is calculated first by reducing it with assumed energy saving. Energy saving potential assumptions is based on official national strategies of three Baltic States. In order to achieve the then calculated demand more sustainable energy production fuel-mix is predicted, taking into account of available technologies and most of all there is assumed that renewables potential of all three Baltic States can be fully utilized with available technologies via implementation of proper incentives and lifting of market restrictions (existing 2005-2008) by governments. Decentralization of power production has reduced large extent self consumption of power production and energy losses from power grids.

In Estonia big part of the oil-shale based power production capacities will be phased out and only small part repowered (about 400 MWel), part of old capacities are renovated to meet environmental standards and used to cover peak demand. Oil-shale use will be limited also by the high cost of CO2 quota at carbon market. Wind development will be active, there will be installed about 2000 MW wind turbines from which larger part offshore. Biomass based small size CHP will supply power utilizing maximum district heating demand and new large consumer self-supply CHP-s will be constructed. Estonia will become net exporter of RES electricity due large-scale wind development and due to new connections to Nordpool. In order to compensate wind deviations, new connections to larger markets and cooperation with Swedish and other countries hydro reserves play important role. Because of large share of wind capacities also gas turbines are built by state and natural gas share remains noteworthy despite part of gas is originated from biomass and oil-shale.

In Latvia, investments to new gas and clean-coal based production capacities are by 2020 implemented and together with development of carbon emissions market, interest to utilize high biomass potential in the country has been significant compared to 2005. No big changes occur for wider use of hydropower, but its share stays high due to exchange trade in order to compensate wind power deviations in Estonia and in Latvia. Energy saving is promoted (supported) by the government seriously thus efficiency measures are applied by consumers demand increase therefore is under control.

In Lithuania, by 2020 no new nuclear capacities will be built and domestic demand largely covered by gas based power of existing reserve capacities whish are renovated to meet environmental standards. Hydro and wind share will increase as all government resources are used to support carbon-free technologies deployment. Boost is taking place in biomass use sector and new small-scale producers occur everywhere in countryside utilizing agriwastes and energy culture industrial production. Government has allocated significantly incentives to promote energy efficiency and saving, thus shortage of supply after phase out of nuclear power is not as big as expected.

Table 5.3. Electricity Balance 2020, Sustainable Energy Scenario (BSES)

	EST		LAT		LIT		Total Baltic States	
	GWh	%	GWh	%	GWh	%	GWh	%
Gross production	12611	100	6747	100	9334	100	28692	100
Fossil fuel	4900	39	1012	15	4534	48	10446	36
Hydro	0	0	3400	50	900	10	4300	15
Nuclear	0	0	0	0	0	0	0	0
Wind	6500	51	675	10	940	10	8115	28
Biomass	1211	10	1660	25	2960	32	5831	20
Imp/Exp	-4400	-35	0	0	2400	20	-2000	-7
CHP share	2100	26	2361	35	4142	35	8603	30
Gross domestic consumption	8211	65	6747	100	11734	102	26692	93
Energy sector	410	5	337	5	592	5	1339	5
Transmission losses	657	8	540	8	947	8	2144	8
Final Consumption with saving	7144	57	5870	87	10296	110	23310	81
Savings	1786	25	1468	20	4413	30	7667	24
Final Consumption without saving	8930		7338		14709		30977	
Growth compared to 2005	1181	20	141	2	2319	29	3641	18

5.3. Results of impact assessment

Comparing the impacts of electricity production with two basic scenarios, calculation of total annual emission of major greenhouse gas CO2 (million tonnes), calculation of energy savings (GWh) on demand side and total external costs (EUR) of energy production have been used in a robust manner.

For fossil fuels CO2 emission calculations, different emission values according to prevailing fuel type (Estonia – oil-shale, Latvia and Lithuania – natural gas) have been used. For CO2 emissions for Natural Gas 490 tCO2 GWh, for Oil-Shale 1100tCO2 GWH, for Biomass, Hydro and Wind power 0 tCO2 GWh specific emission values have been used.

For calculating external costs for electricity produced from different fuels and sources, Oil-shale cost of 0, 18 EUR/kWh, Natural Gas cost of 0, 04 EUR/kWh, Nuclear power cost 0,005 EUR/kWh, Hydropower cost of 0,001 EUR/kWh, Biomass 0, 03 EUR/kWh and Wind power cost of 0, 0005 EUR/kWh has been used, similarly the average costs calculated within EU EXTERNE project.

	BAU	**BSES**	**Differences of BAU to BSES**	
CO2 Emissions, Mt	**14,3**	**8,1**	**6,2**	**177%**
Rank	**2.**	**1.**		
Demand side savings, GWh	**1509**	**7667**	**6158**	**505%**
Rank	**2.**	**1.**		
Externalities, Billion EUR	**2201**	**1287**	**914**	**171%**
Rank	**2.**	**1.**		
Total Rank	**2.**	**1.**		

Table 5.4. Ranking of impact of different scenarios

As can be seen from these robust calculations using most important indicators of sustainable energy, a strategy for energy future of three Baltic States, proposed by NGOs is much more beneficial in all areas. Phasing out nuclear power, decentralization of power production, implementing energy saving measures, shifting from fossil fuel use to renewables use, cooperation between the EU countries in order to benefit renewables potential of Baltic States, these are key tasks for governments to achieve sustainable energy and competitiveness of the countries.

6 Public opinion in Baltic States on energy issues

Main arguments of many politicians and representatives of power producers in Baltic States who promote construction of new nuclear reactors in Ignalina NPP are that nuclear power is safe, carbon free and cheap but shift to distributed generation and wider deployment of renewables based and more efficient power production technologies are much more costly, thus customers and public would not accept rapid shift to sustainable energy paths and for coming decades only option for Baltic States is to cooperate on this very project.

As no studies are carried out related to Ignalina NPP new reactors project, taking into account long-term feasibility and comparing different technological options including utilization of countries energy efficiency and savings potential or discussed with the stakeholders, nor public opinion polls are recently carried out by the governments, these statements are not based on true knowledge but just repetition of false myths. But truth is there and available also for policy makers.

Current study screens and makes reference to some of the recent public opinion polls made by EU EUROBAROMETER services, particularly Eurobarometer polls on Energy Issues, November 2006; Energy Technologies:Knowledge, Preception, Measures, January 2007;

Europeans and Nuclear safety, February 2007.

Full reports of the polls are available at web link http://ec.europa.eu/public_opinion/archives/eb_special_en.htm

Readiness of the European people (about 450 million energy consumers) to meet environmental and long-term security demands can be characterized by the willingness to change consumer habits i.e. save energy and via this reduce energy demand as well willingness to go ”green” to less polluting fuels and energy technologies also willingness to pay more for cleaner energy. In order to make right choices, opportunities to choose have to be in place as well more information is needed e.g. on energy saving technologies.

Europeans are very much looking for changes towards more sustainable energy supply and do expect from authorities quick and relevant action.

As indicated by the polls, there is emphasized, rather highly, the need to develop tax incentives to promote efficient use of energy. Therefore arguments widely used in Baltic States, that people are not willing to pay for cleaner energy, are baseless.

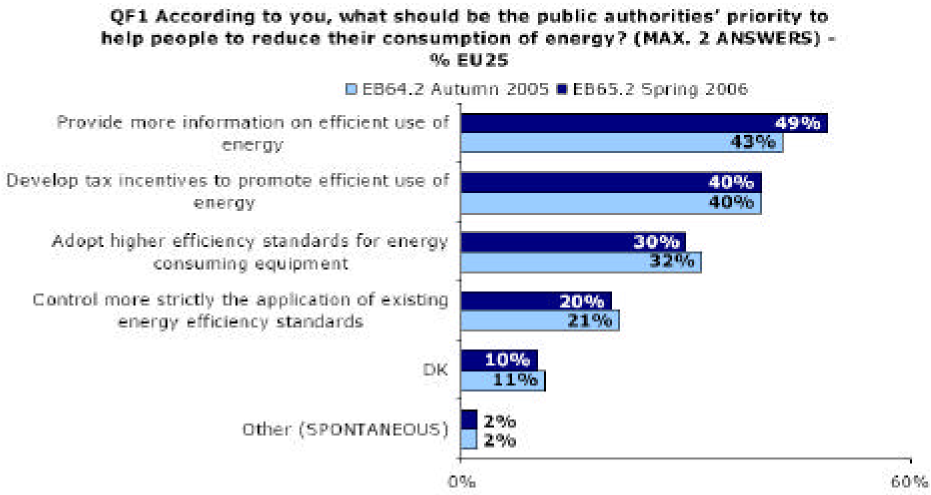


Chart 6.1. Priorities for authorities to facilitate energy savings

According to the Eurobarometer, Europeans are clearly supporting the use of renewable energy sources and technologies against fossil fuel based energy modes and lessest support is to nuclear energy. Only 20 % of Europeans support use of nuclear energy against more than 55% support towards different renewables based energy production.

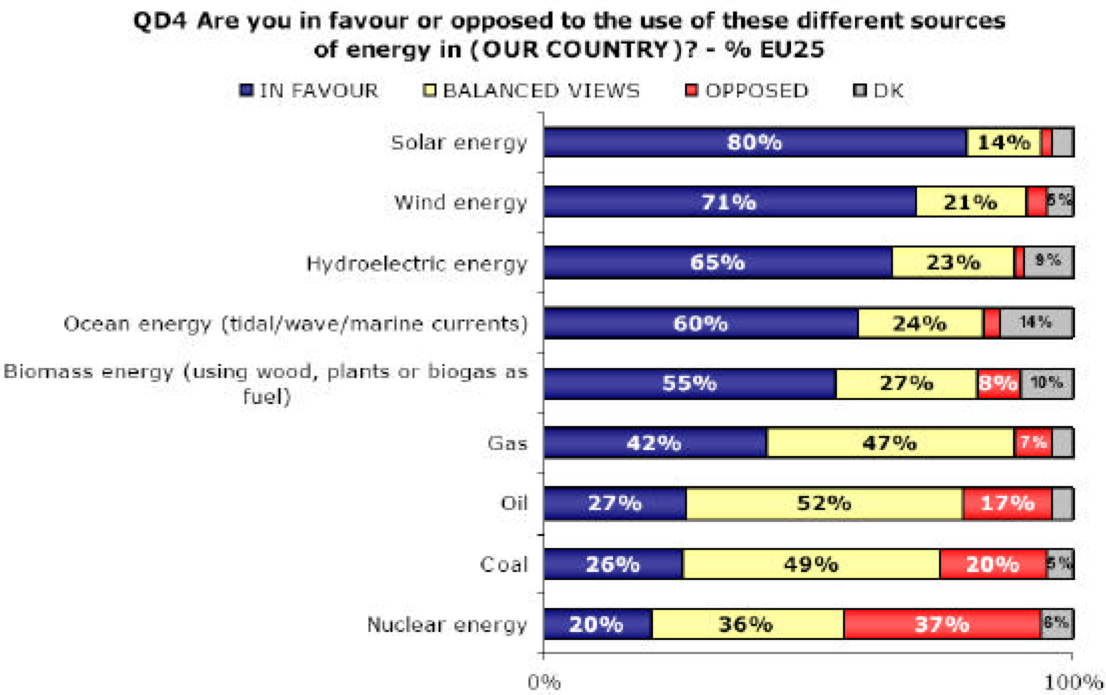


Chart 6.2. Preferred power production technologies

This indicates clearly, that arguments used today while debating Baltic energy future, that there is nuclear renaissance in Europe, are not based.

One of the myths which are widely used by those who argue against need to shift towards wider renewables use in Baltic States is specifically directed against deployment of wind energy. Namely, there is often used argument that people do not like wind energy, they do not accept wind turbines as these disturb people and pose visual pollution. This false myth is busted again by the Eurobarometer polls: Fact is that 79% of Estonians, 78% of Latvians and 73% of Lithuanians are in favor of wind power development compared to support of 71 % of Europeans as average.

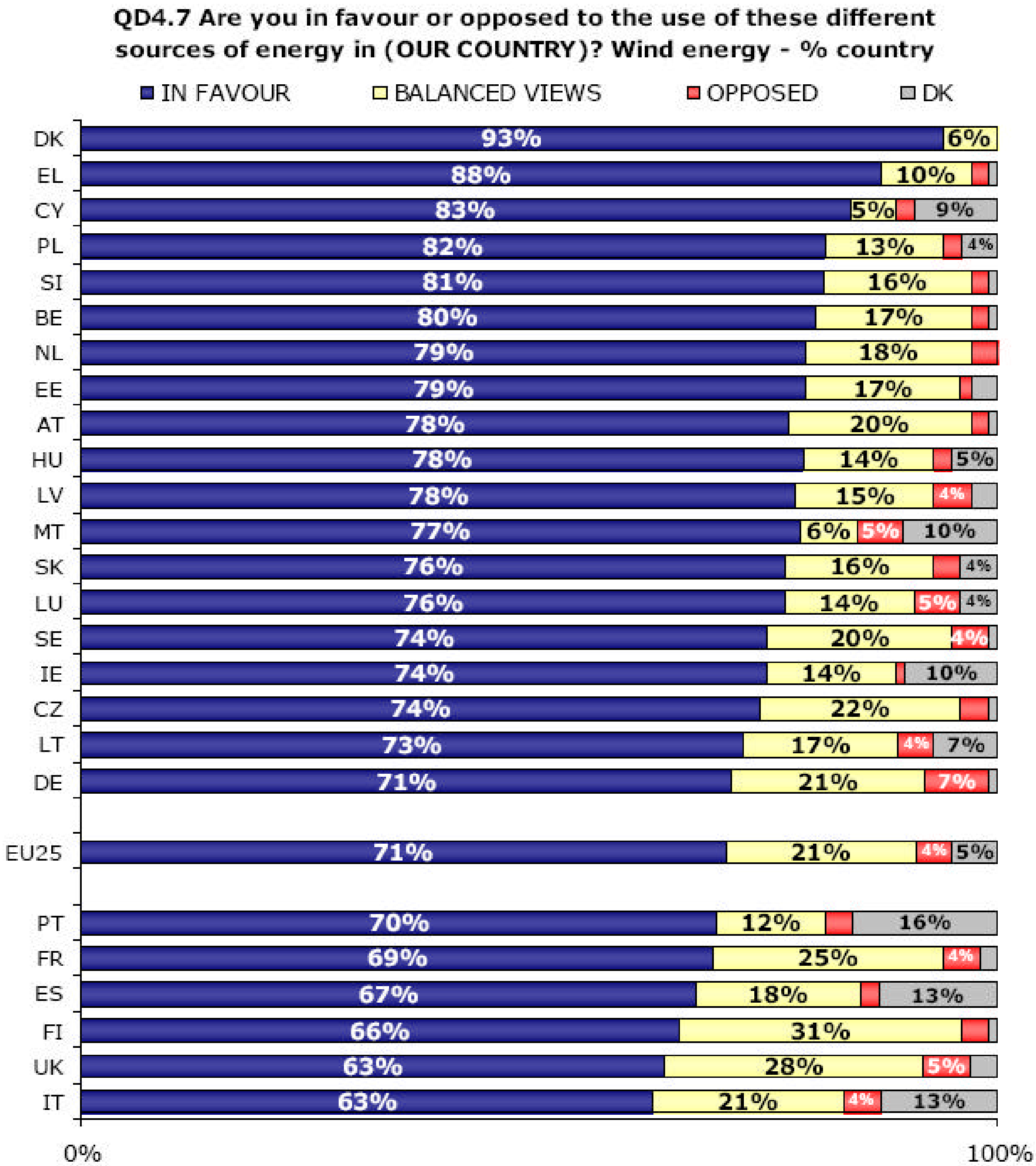


Chart 6.3. Support to wind energy

Most opposed by Europeans, as was already mentioned, is Nuclear Energy. Obviously, Lithuanians, where nuclear energy is used already decades, were among the three countries whose citizens where most supportive (together with Sweden and Slovakia), but still from them there was 37 % of supporters and only 20% of opposers of nuclear power use. Latvians and Estonians were rather evenly on other side of the axe: only 11% of Latvians and 12 % of

Estonians were supporting and releva ntly 57% and 55% were opposing use of nuclear energy compared to EU average of 20 % of support and 37 % of citizens opposing.

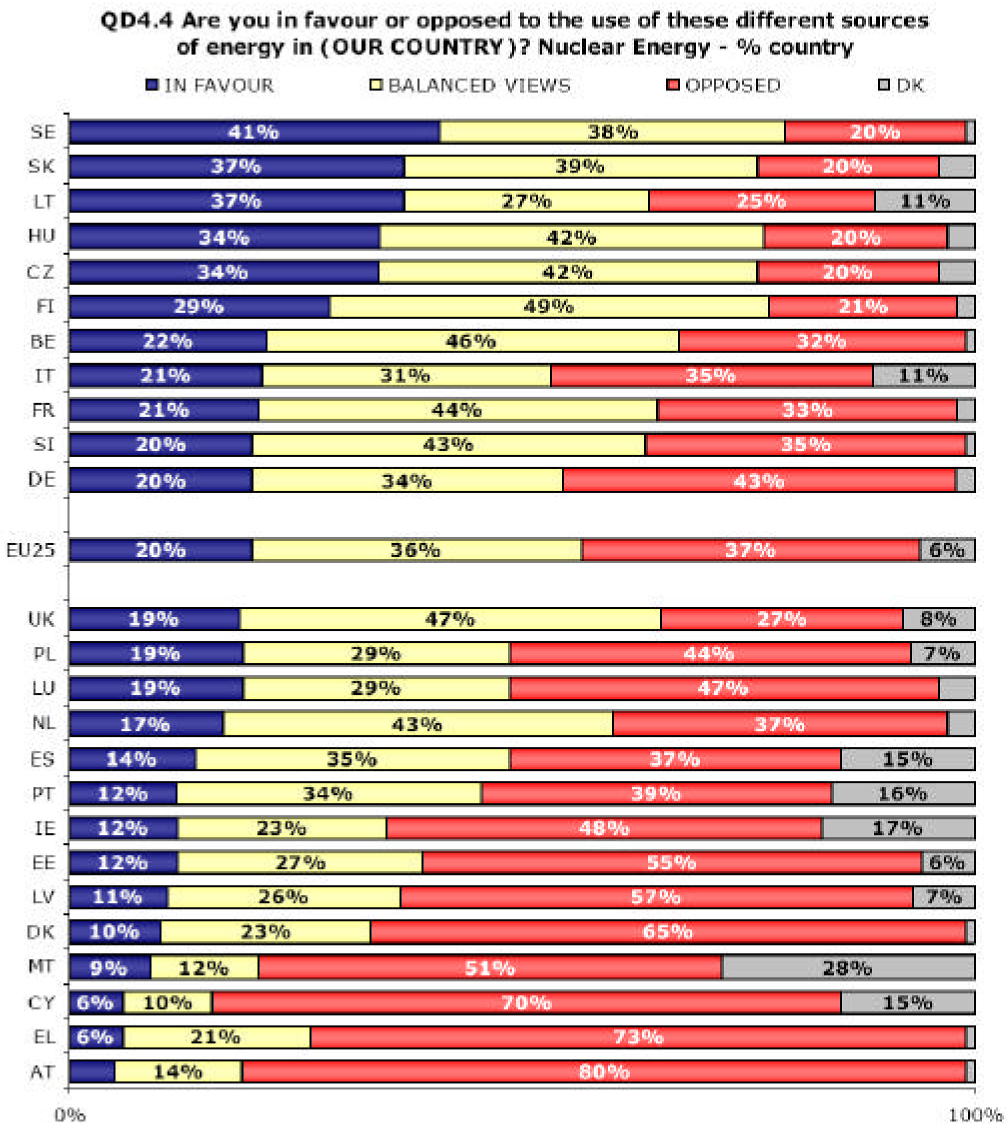


Chart 6.4. Opposition to nuclear energy

While asked about possibilities of replacing the nuclear power by the renewables and energy efficiency measures, Europeans remain differentiated by the support and between the countries, then opinions are rather even in finding that share of nuclear energy cannot be increased. 61 % of Estonians, 74% of Latvians and 67 % of Lithuanians (as average 71 % Europeans) think that share of nuclear energy should remain the same or has to be reduced.

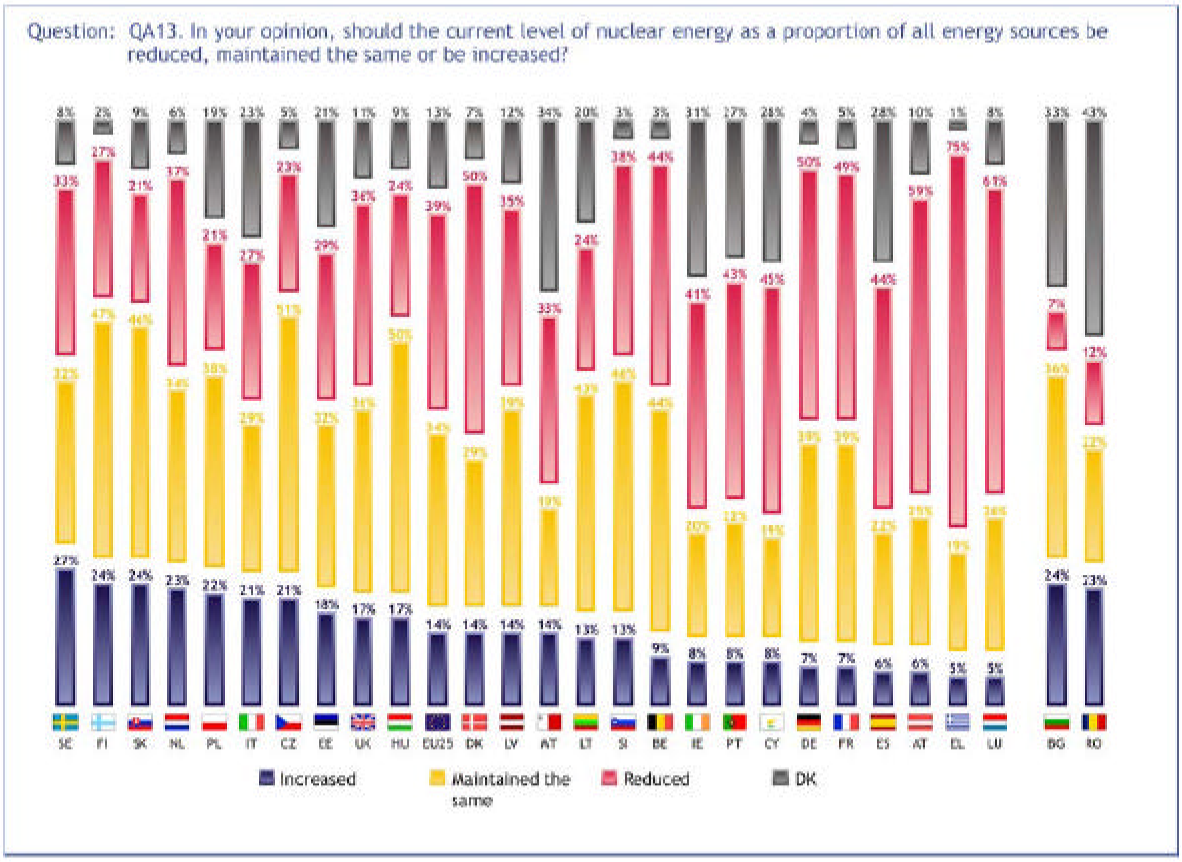


Chart 6.5. Estimation of risks related to power production

Nuclear energy is clearly identified more as risk than an advantage by Europeans.

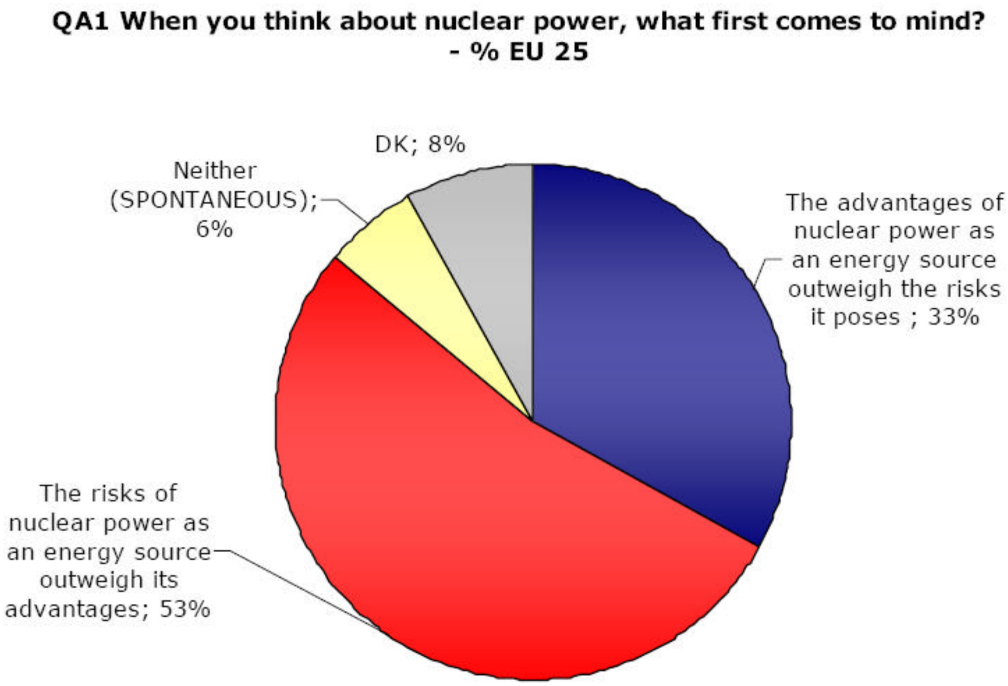


Chart 6.6. Thoughts about nuclear energy

One of the arguments used in Baltic States is that people do not know enough about safety of nuclear energy, therefore opposers of the nuclear energy make up their opinion based on emotions and wrong assumptions. Same argument is supported by the fact that among the three Baltic States Lithuanians are more in favor of nuclear energy, because they have more knowledge related to nuclear power. Surprisingly this turned out to be false myth again, and "higher knowledge" turned to be perhaps reflection of stronger government's and nuclear lobby initiated brainwash on safe nuclear energy than real knowledge as show the results of Eurobarometer. Answers to the specific questions showed out, that from Lithuanians 51% were responding correctly to these, Latvians and Estonians gave 54% of correct answers about nuclear energy.

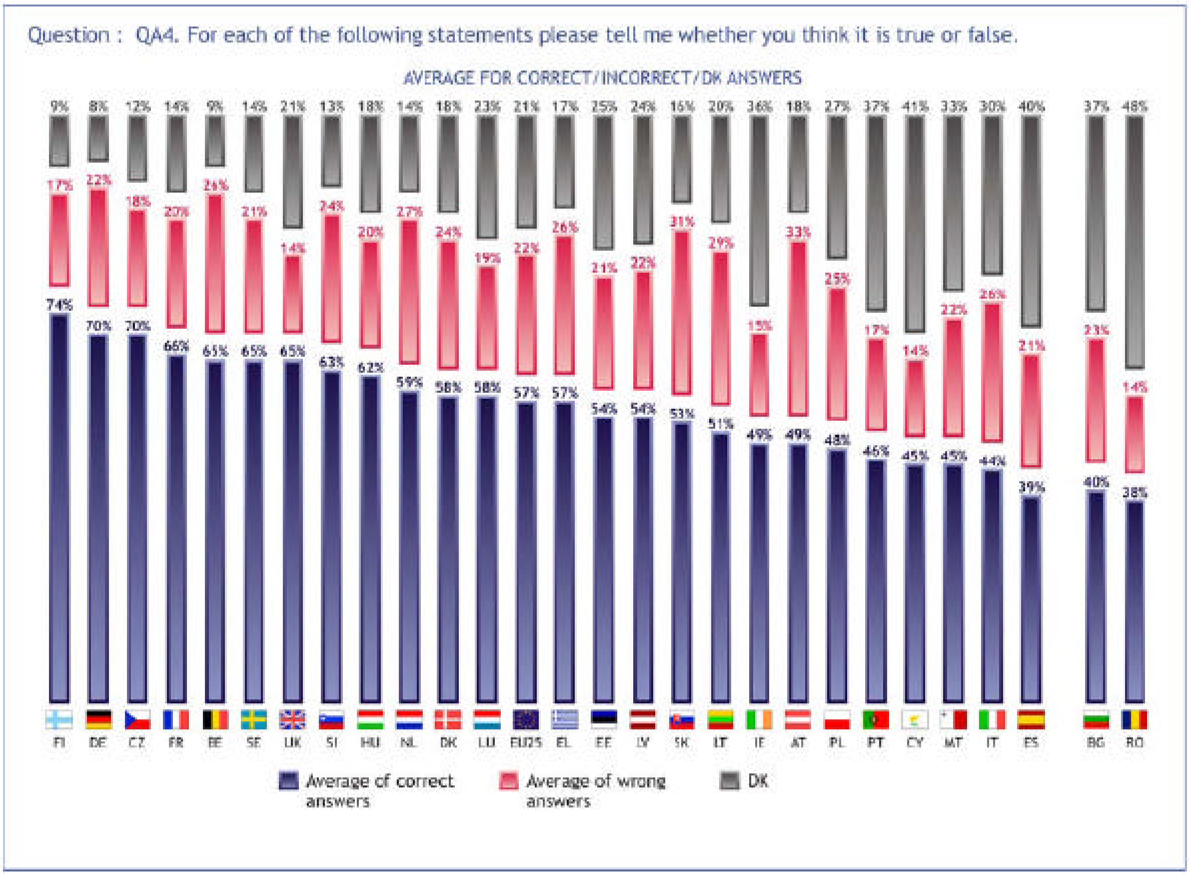


Chart 6.7. Knowledge on nuclear energy issues.

QF1 Against the background of high energy prices, some are proposing to take new measures that will help people to reduce their consumption of energy. According to you, what should be the public authorities' priority to help people to reduce their consumption of energy? (MAX. 2 ANSWERS)

	Provide more information on efficient use of energy	Diff. Aut.2005-Sp. 2006	Develop tax incentives to promote efficient use of energy	Diff. Aut.2005-Sp. 2006	Adopt higher efficiency standards for energy consuming equipment	Diff. Aut.2005-Sp. 2006	Control more strictly the application of existing energy efficiency standards	Diff. Aut.200 Sp. 200
EU25	**49%**	**+6**	**40%**	**0**	**30%**	**-2**	**20%**	**-1**
DK	63%	+4	44%	0	45%	-4	15%	-1
MT	63%	+6	21%	0	23%	-13	25%	0
PT	62%	**+11**	22%	-11	36%	-6	13%	-5
FI	60%	+9	45%	+4	40%	+8	14%	-5
LU	57%	+8	48%	+6	27%	+2	26%	-7
UK	57%	**+11**	34%	+1	37%	0	22%	-2
EE	56%	**+12**	40%	-5	25%	-1	22%	+2
CY	56%	-4	26%	-1	28%	-13	24%	-6
SE	56%	+4	65%	+3	20%	-6	18%	-4
SK	55%	**+10**	40%	-7	42%	+2	24%	-1
EL	54%	-1	35%	+8	41%	0	23%	-15
ES	54%	+3	24%	-1	15%	+2	18%	+8
IE	54%	+3	40%	0	32%	+2	28%	+1
BE	53%	+6	60%	+6	30%	+1	24%	-6
SI	50%	0	55%	+2	35%	-1	23%	-6
HU	49%	**+13**	41%	+1	17%	-1	16%	-4
DE	47%	+7	45%	-1	40%	-3	18%	-3
AT	47%	0	45%	-1	30%	+4	24%	0
NL	46%	0	56%	+2	42%	-3	13%	0
PL	46%	**+11**	42%	+1	19%	-1	13%	-5
FR	45%	+1	35%	+4	31%	-1	29%	-1
CZ	44%	+8	56%	-3	26%	-1	17%	-6
LV	43%	+3	31%	-3	29%	+1	26%	-2
IT	42%	+9	40%	-5	25%	-2	19%	+4
LT	36%	+3	29%	-1	24%	+3	29%	+3
HR	59%	+6	22%	-2	22%	-5	25%	-3
BG	39%	0	26%	-10	18%	-6	23%	-6
TR	38%	-6	19%	-2	13%	-12	25%	+7
RO	37%	-2	29%	-6	36%	+1	18%	-5
CY (tcc)	52%	+4	39%	+1	21%	+2	26%	+3

Chart 6.8. Priorities for measures to increase energy efficiency

Readiness to pay more for renewable electricity than fossil-based one was specifically asked and results of poll clearly indicates consumer's readiness, specifically by the people from member countries where environmental awareness is higher. When (as average) EU consumers were willing to pay up to 34 % more for clean energy and Danish, Luxembourg, UK and Finnish people more than 45%, then people of the three Baltic States were less committed: Estonians were ready to pay up to 32%, Latvians up to 19% more and Lithuanians up to 14% more for renewable energy than for the fossil based energy.

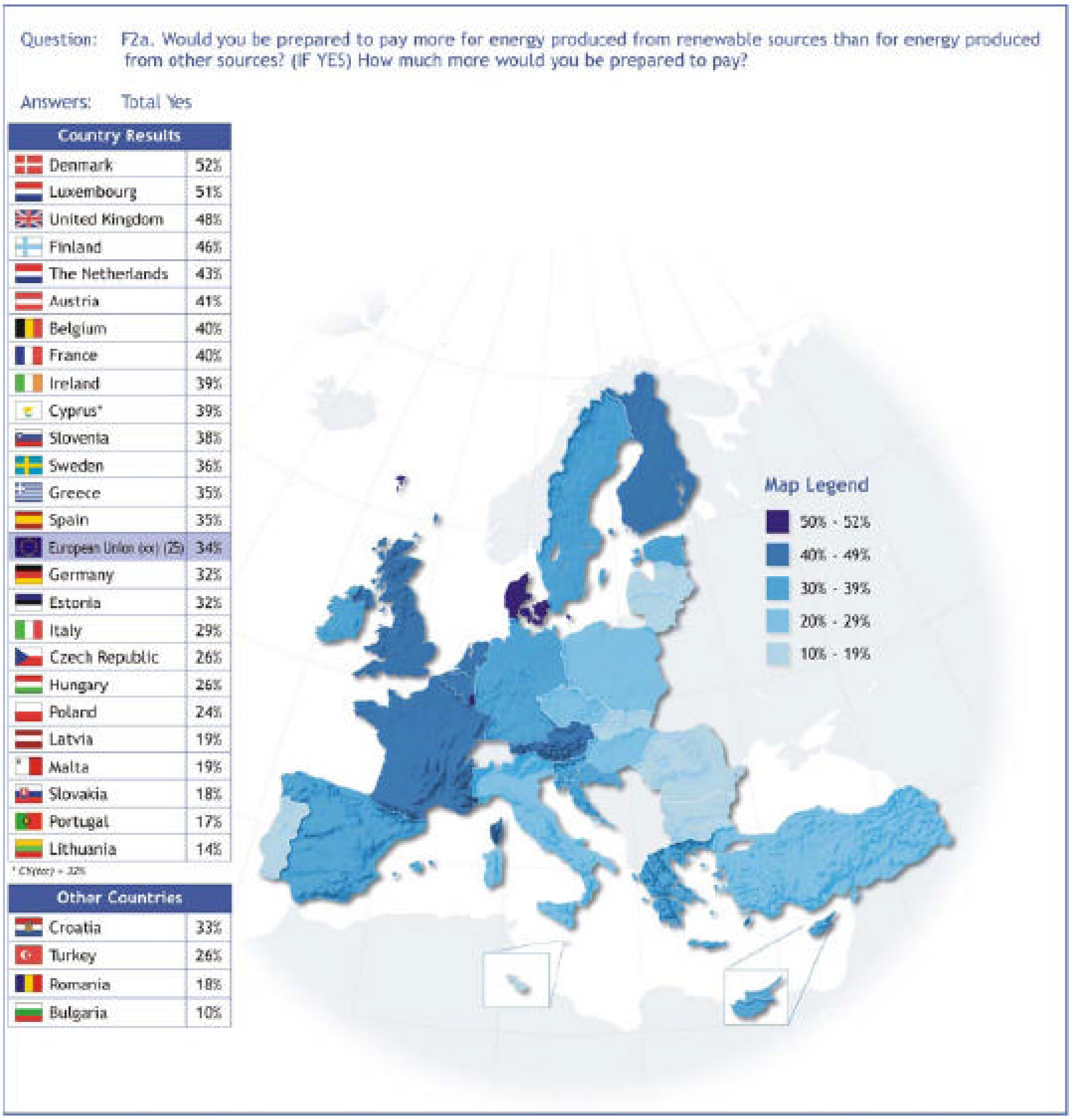


Chart 6.9. Willingness to pay

7 Conclusions

Energy is an essential input for social development and economic growth. It provides basic needs and services such as heating, cooling, cooking, lighting, and transportation and is a critical production factor in virtually all sectors of industry. There are large disparities in the level of energy use and quality of available energy services, not only among different countries, but also among the rich and poor in the same country. Nearly 1.6 billion people still have no access to electricity or other forms of commercial energy. At the same time, the production and use of energy can cause environmental degradation at all levels - local, regional and global. For example, combustion of fossil fuels and fuel wood leads to indoor and outdoor air pollution by particulates and oxides of sulphur and nitrogen; hydropower often causes environmental damage due to the submergence of large areas of land; and global climate change associated with the increasing concentration of greenhouse gases in the atmosphere has become a world-wide concern today. Natural resource depletion, accumulation of wastes, deforestation, water pollution and land disturbance are further examples of energy-related environmental concerns. In order to meet these challenges, strategies for sustainable energy are prepared on local, national and regional levels.

Baltic Energy Strategy (BES) developed by the Governments of three Baltic States has been prepared on 2007. Is not an only initiative of three countries to cooperate on energy field. First such joint strategy was developed on 1999, but newer implemented. Unfortunately despite the fact that BES has been prepared using Governments resources and supposedly based on best knowledge base of the countries, the Baltic Energy Strategy is very general and doesn't refer to any studies on availability of renewable resources nor potential for distributed generation or market uptake potential of energy efficient technologies or potential for energy savings within industry and household sectors. It also neglects the aspects of commitments that Baltic countries have made in order to implement Kyoto protocol and in order to achieve commitments taken in framework of EU climate and energy policy initiatives including EU emission trading. BES also doesn't foresee moving away from the use of nuclear energy and fossil fuels.

Baltic Energy Strategy, prepared by Governments is weak, mainly concentrated on stating of current situation of the energy sector and does not provide clear proposals for development of energy sector not in short-term, neither in long-term scale. Environmental NGOs of Baltic States believe that proposal of possible new nuclear power plant in the Baltic's contradicts the strategic objectives of the same policy paper which in it's main statements emphasizes the need of diversification and increasing the use of local resources, because nuclear is neither renewable, nor a local energy source. Nuclear energy due to its centralized and market-dominating characteristics actually decreases the chances for local renewable source to penetrate the market. The strategy, which calls for construction of new nuclear power plant, contradicts to the goal to reduce emissions and harmful impact of emissions, because for example, nuclear power emits as much CO_2 as a modern gas-fired co-generation plant. When assessing the overall emissions, the whole life-cycle of a nuclear power production need to be part of the impact evaluation, including fossil fuels burnt during uranium mining, processing and transportation, building the nuclear power station and decommissioning as well as long-term nuclear waste storage and treatment.

NGOs highlight that the proposed strategy fails to consider different development scenarios for the power sector, particularly those that aim distributed power generation and would not include large centralized units such as a new Ignalina nuclear power plant or fossil-fuel based large condensing plants, where primary energy use efficiency is far below acceptable. Though the governments drafted strategy doesn‘t explicitly support construction of a new nuclear power plant at Ignalina, it is widely known that energy monopolists of three Baltic States and specially Lithuania put lots of emphasis on this plan neglecting possible alternative scenarios, despite the apparent huge problems that are attached to the use of nuclear power like the problems related to storage of nuclear waste, nuclear safety, risks related to possible terrorist attacks and depletion of uranium resources and rising global prices of construction and fuel costs world-wide.

Inclusion of a new nuclear power station in a future energy strategy for Baltic States also would decrease the flexibility of the electricity grid needed for inclusion more renewable energy sources and intelligent demand management. Uptake of several non-nuclear scenarios is therefore of uttermost importance to enable our countries to take a balanced and optimal decision on its energy future.

NGOs welcomes the fact that the BES mentions among strategic objectives the need to “increase the contribution of renewable and local energy resources” and “to increase the energy efficiency at the demand side and in the energy transformation sector”. High energy intensity of the economy and low energy efficiency offers the Baltic States a unique opportunity to make huge savings and via energy efficiency measures increase its global competiveness of economies. Increase of the use of renewable and local energy sources should be considered as a key response to the need to increase diversity and energy independence and security of supply. Increased use of renewable energy offers the only opportunity for truly sustainable, secure and accessible energy options for current and future generations and must be given priority above all other energy options for research and development, access to the grids and funding. Therefore we consider that a far more detailed strategy on the available capacities and assessments of potentials should be developed by three Baltic States.

Governments Energy Strategy has “all correct key-words”, however, as there is no measurable targets set taking into account energy indicators for sustainable energy and no externalities of power production are not counted while setting goals aiming increase of one or other energy mode in energy-mix, therefore the justification of these choices are missing. As in the paper there is o measures relevant to targets foreseen, nor implementation framework set, one may conclude that BES is just a paper for calming down the wider public in Baltic’s, showing likely active approaches of the governments towards meeting peoples expectations towards more sustainable energy future, but as such, strategy is not intended to be implemented.

Besides overwhelming critical view towards Governments energy strategy document, NGOs of Baltic Countries are positive about the fact that the integration of the Baltic energy system into the energy systems and energy markets of the European Union is put forward as one of the strategic objectives. Building interlinkages with Nordic countries and Baltic countries would increase the opportunities for diversifying supply and through increased competition also promote supply from independent small and medium size suppliers.

Taking into account above key weaknesses, environmental NGOs propose following addition and adjustments to the Governments joint energy strategy:

- exclude nuclear option from the trends of energy sector development;
- focus within sustainable development scenarios on energy efficiency, usage of local and renewable energy sources and decentralized power generation systems;
- apply deeper analysis for forecast of future energy demand and determine share of this demand, which can be covered by implementing energy efficiency and savings measures;
- goals towards wider use of renewable energy sources and energy efficiency measures should be similar or more ambitious to those, proposed in the EU Energy Package;
- goals should be aiming inclusion of energy externalities
- ensure that goals are measurable and there are implementing agencies for measures;
- propose tangible actions relevant to goals set;
- monitoring of the progress should be related to energy indicators of sustainable development;
- build implementation framework and ensure monitoring of progress.

Without these elements proposed, BES remains empty paper gathering dust and reflecting government inability to meet global and national challenges related to energy and environment sectors.

Major issue for choosing the energy future –would it be sustainable or not, depends on question whether use or not to use nuclear energy. Current study shows clearly that from today's energy supply base there is possible and it will be much more beneficial (both in terms of environmental benefits and in terms of economic competitiveness) a energy future without nuclear power.

Main arguments of many politicians and representatives of power producers in Baltic States who promote construction of new nuclear reactors in Ignalina NPP are that nuclear power is safe, carbon free and cheap but shift to distributed generation and wider deployment of renewables based and more efficient power production technologies are much more costly, thus customers and public would not accept rapid shift to sustainable energy paths and for coming decades only option for Baltic States is to cooperate on this very project.

As no studies are carried out related to Ignalina NPP new reactors project, taking into account long-term feasibility and comparing different technological options including utilization of countries energy efficiency and savings potential or discussed with the stakeholders, nor public opinion polls are recently carried out by the governments, these statements are not based on true knowledge but just repetition of false myths. Opinion polls carried out by EUROBAROMETER clearly show, that besides many people see nuclear energy use as one of the options to tackle climate crisis, as nuclear power is claimed to be carbon neutral, still most of the people are against use of the nuclear power, clearly support wider use of the renewable energy as well are ready to pay more for clean and sustainable energy as consumers.

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Annexes

Annex 1.

Lithuanian Sustainable Energy Vision 2050

The *Lithuanian Vision2050* is similar to the vision for EU; but developed to fit the visions of the Lithuianian INFORSE member Atgaja. The proposed development follows in general the same path as in the European vision, but given the large biomass potential, the strong growth in construction and transport, and the need to replace nuclear power without increasing gas demand, the vision has a strong focus on actions that can be implemented cost-effectively until 2020, and include more growth than the vision for EU. . It includes a transition of the energy supply and demand with phase-out of fossil and nuclear energy over a 50-year period, starting with the closure of the Ignalina nuclear power plant in 2009.

This vision include a special strategy for immediate actions, for Lithuania until 2020.

The vision was developed in 2006, and the current version (December 2006) is still open for updates as more information becomes available. Comments are welcome.

Factor 4 for Energy Efficiency

In line with INFORSE's global vision for sustainable energy, the Lithuanian Vision is based on increase of energy efficiency to reach an average level in 2050 similar to best available technologies today. Most energy consuming equipments will be changed several times until 2050, and if new generations of equipment are made with optimal energy performance, and markets are made to promote the most efficient technology, it will not be a problem to reach today's best available technology, even though the efficiency gains required are very large, - in the order of 4 times, similar to an annual increase of efficiency of over 2% per year from 2010. This will not happen by itself, given that the "natural" technological development in EU has been about 1% per year. It will require concerted actions from stakeholders involved, but if it is done on EU-scale and the market therefore is large for each new generation of efficient equipment, the changes will be cost-effective. The extra equipment costs will be off-set by energy savings. To realise this, it is, however, necessary to go beyond the conservatism of many market players in this field, and develop a truly enabling market for energy efficiency throughout the society.

The Challenge of Reducing Heat Consumption

For buildings the situation is different from equipment because buildings often have lifetimes of 100 years or more. Most of the houses to be heated in 2050 are probably already built. For Lithuania, the proposed energy conservation plans for domestic and service sectors should be realised and the efforts should be continued in the following decades.

Efficient Transport

For transport is assumed that the conversion-efficiency from fuel to transport-work is increased 2.5 times (from current 15- 20% in combustion engine systems to 50% in fuel cell systems with break-energy recoverage; direct electrically driven vehicles have even higher efficiency), and that the vehicles will be equipped with recoverage of break-energy, so the "end-use" of energy in transport is limited to the unavoidable friction losses in transport (except for aviation). This increase is expected to happen until 2050. Most of the changes are only expected 2030-2050, and the efficiency increase 2000 – 2030 is only expected to be 22%. Faster improvements in transport efficiencies would be possible.

Growth Factors

The growth of energy services, i.e. heated floor space, transported goods and people, energy consuming production, is expected to continue for 2-3 decades and then level off for most sectors towards the end of the 50-year period of the vision. Assumed growth in activities for Lithuania:

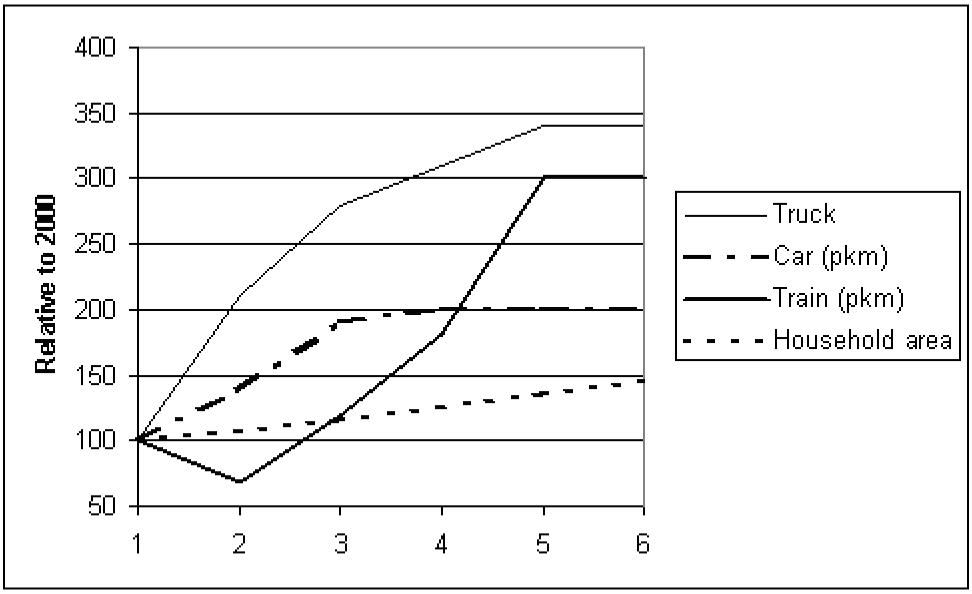
· Floor space, households: 1% annual increase from 2010 (6% in total 2000 – 2010)

· Floor space service sectors: 2% annual increase until 2020, then reduced to 1.5% 202-2030 and then to 1% per year in the following decades.

· Electric appliances in households and service: 1 – 1.5% higher annual growth than floor space. This will lead to a doubling in the service sectors in the period 2000 – 2050 and a 65% increase in household sector in the period.

· Industry: no growth in physical production volume, i.e. 0% in growth 2000 – 2050; but increase electrification

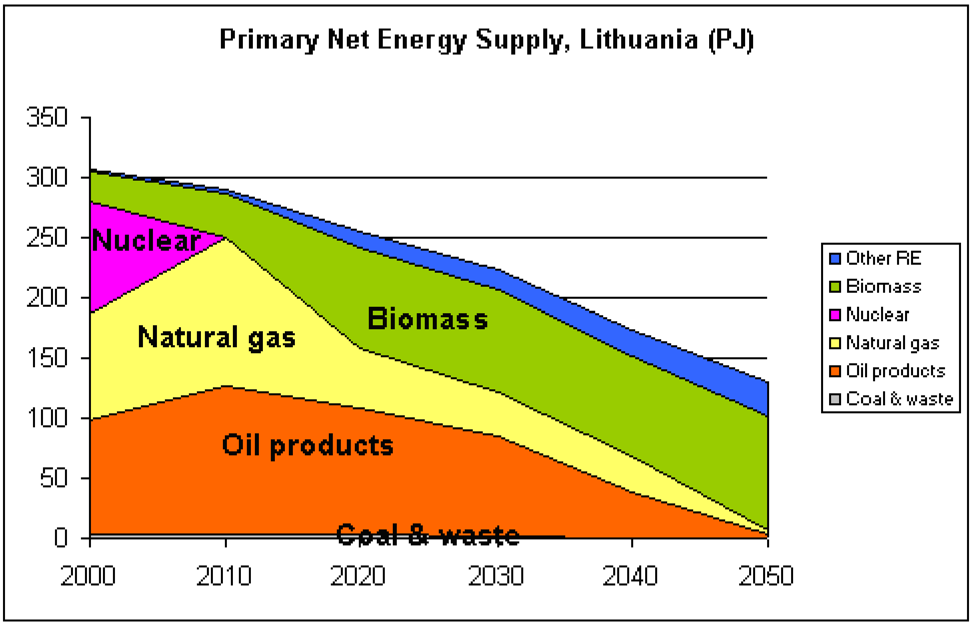
leading to 20% increase in the drivers for electricity for industrial production.
· Personal transport: the vision includes a doubling of private car use 2000 – 2030, following current high growth. Then we expect a stabilisation while rail use is expected to increase 3 times and bus use 3.2 times in the period.
· Freight transport: the vision includes a 3.4 times increase in the period for road, rail and water transports, based on current strong growth. Pipeline transport is expected to decrease 30% with decreased transport of fossil fuels and a small development of hydrogen pipelines.



Graph: Development of selected activities 2000 - 2050 for Lithuania

Renewable Energy

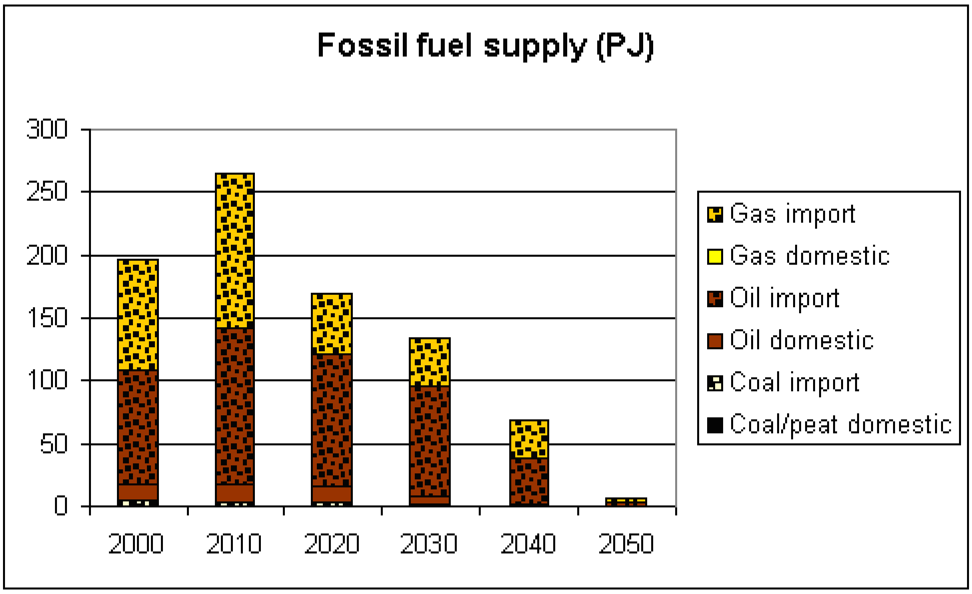
As a fraction of primary energy, renewable energy use is expected to reach almost 15% in 2010, 37% in 2020, 45% in 2030, 60% in 2040 and over 95% in 2050. For electricity the renewable share is below the share of primary energy 2000-2010, but the will change until 2020, where it will be higher.
The most important developments are in windpower and biomass including important use of agricultural land for biomass plantations, use of crops for biofuels and use of straw for heating and for combined heat and power (CHP) production. The use of agricultural land for energy plantations for solid biomass is expected to be 2200 km2 until 2020 (7% of agricultural land).
Also increase use of solar, geothermal and small hydro is included in the vision.



Graph: Change of Energy Supply, following Vision2050

Nuclear and Fossil Energy

Nuclear energy is expected to be phased out as the current nuclear reactor in Ignalina is stopped in 2009. Fossil fuel use is expected to grow until 2010 and then gradually be phased out until 2050.

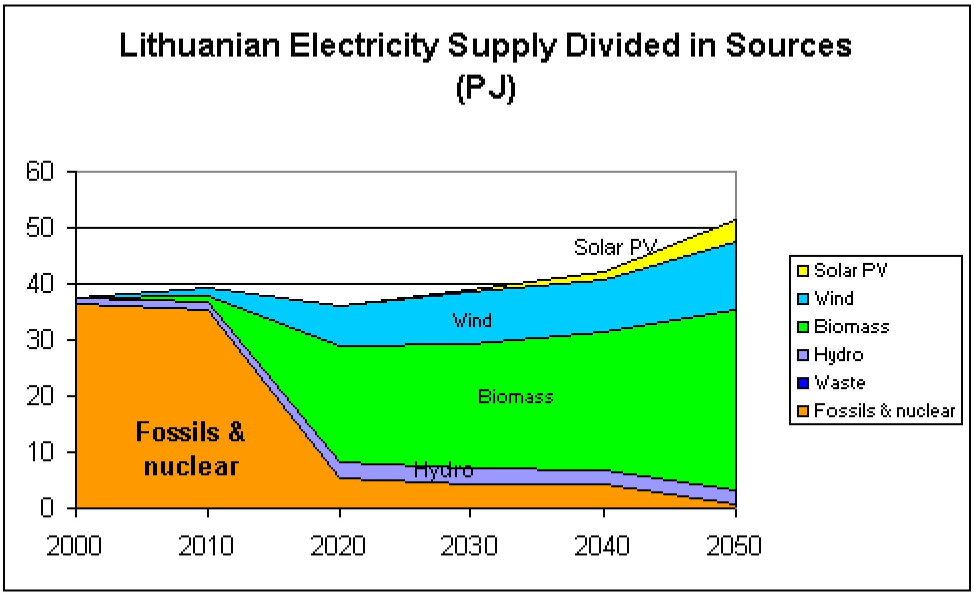


Graph: Fossil fuel development for Lithuania, according to Vision2050

Energy Conversion, Hydrogen& Heat Pumps

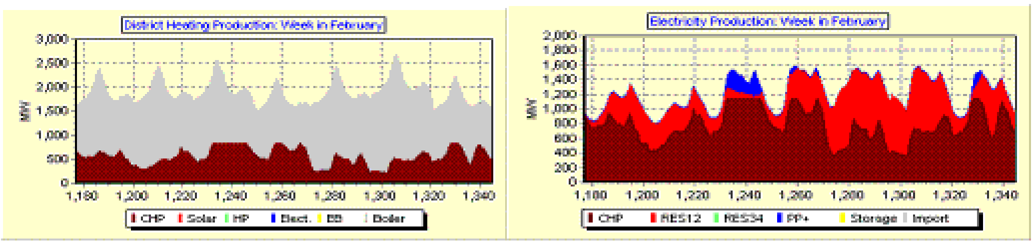
The energy conversion system will also have to be changed. The electric grid is likely to increase in importance, because electricity will also be used for transport, directly or via conversion to hydrogen. The increasing dependence on intermittent electricity supply makes it necessary to have energy storage in some forms and maybe flexible electricity consumption. Analysis shows that the current hydro pump storage will be sufficient until 2030, maybe longer.

Gas networks are expected to have decreasing importance. They might play a role for transportation of hydrogen or biogas, but probably not for long-distance transport.



Graph: Development of electricity production and sources, following Vision2050

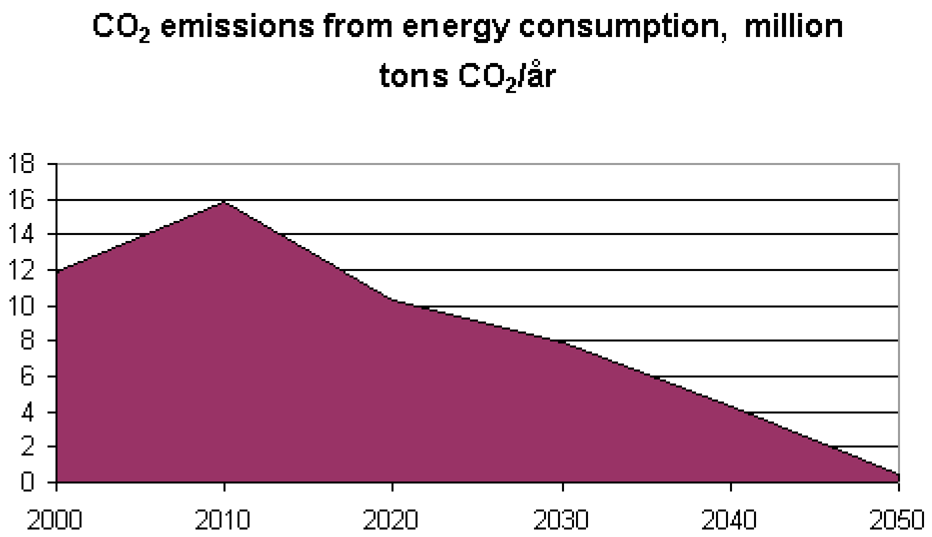
An evaluation of the hourly variation of electricity and heat loads and the windpower production was made on the EnergyPlan model for the year 2020, with input data for the vision's energy balance for 2020 and with variations from typical Danish conditions. The results were that CHP would cover 67% of electricity production, windpower 21%, hydro 7% and power-only plants 5%. Of the district heat load, CHP would cover 55% while the rest would be from heating plants. There would be no critical electricity excess or lack of electricity in any hours, but electricity export in some periods with high windpower. If the export is not possible widnpower or CHP production could be reduced in these hours. The results are consistent with the above results that is based on yearly energy balances.



Graphs: Detailed output (district heating and electricity) from the EnergyPlan model for winter weak with high windpower production
(Dark red is energy from CHP plants, grey is heat from boilers, clear red is windpower+hydro, blue is power-only plants)

Energy Trade

Energy trade is expected to be much less than today, only a moderate electricity exchange is expected. Electricity exchange with little net import or export is likely to continue, to exchange elelctricity from renewable sources such as hydropower (currently imported from Latvia on seasonal basis) and wind power.



Graph: Phase out of CO_2 emissions

The assumptions used in the vision are described in more details in the documents:

Background note for the vision, December 2006, INFORSE-Europe (pdf, 157 kB)

Actions for sustainable energy development for Lithuania until 2020
INFORSE-Europe & Atgaja, December 20, 2006 (pdf, 168 kB)

and

Vision for a sustainable energy development for EU – 25, 2000 – 2050

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Annex 2:

A vision for Latvia based on INFORSE's Vision2050

Background note, July 23, 2007, INFORSE-Europe.

1. Introduction

This background note gives an overview of the potentials for renewable energy and energy efficiency that is used in the sustainable energy vision developed by International Network for Sustainable Energy (INFORSE) – Europe and Latvian Green Movement and Green Liberty, Latvia. The vision includes growth in most sectors.

Comments are welcome (see last page)

For reference the note starts with a number of official forecasts for Latvia as well as statistical information (chapter 2).
Then the note gives an overview of renewable energy potentials and the potentials used in the vision2050 (chapter 3).
This is followed by a chapter on energy efficiency potentials, including the assumption of realised energy efficiency potentials with the vision2050 (chapter 4).
The next chapter gives an overview of growth in Latvia, including current trends and the assumptions of growth used in the vision 2050 (chapter 5).
Finally is a description of fuel shifts, including changes from imports to domestic production, e.g. of electricity, as well as energy storage demands (chapter 6)

Results of the sustainable energy visions and recommendations are included in two other documents, to be available from www.inforse.org/europe.

The current version of this paper will be improved if new and consolidated information becomes available. All comments are welcome.

National economic strategy in the period up to 2010 projects GDP increase by 8% annually, but in the long term (until 2030) 5% annually. In this note we do not use economic growth as a direct driver for energy consumption; but growth in energy services, such as area of heated floor space or transport work.

The Latvian Energy efficiency strategy[1] is out of date and does not go in details describing goals on energy efficiency for heating. However, the overall target of the strategy is to increase energy efficiency, to ensure that by year 2010 Latvia's primary energy consumption on unit of GDP is decreased by 25% from year 2004.

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1 MK 2004.gada 19.maija rīkojums Nr.321

2. Description of Latvian Electricity and Heat Supply and Existing Official Plans for Electricity Production

Total installed energy capacity in Latvia in year 2005 was 2184,6 MW (wind – 26,4; small TPP – 76,1; small hydro – 26,6; big TPP – 519,5; big hydro – 1536) and maximum demand was 1400 MW.

The state-owned Latvenergo is the main energy producer in Latvia, generating power at 3 Daugava hydro power plants (HPP) and 2 Riga thermal power plants (TPP), as well as by Aiviekste HPP with the capacity of 0,8 MW and Ainaži wind station (capacity of 1,2 MW). Riga TPP-2 also has 110 MW emergency turbogenerator and Riga HPP in the high water period (spring) has 200 MW of emergency capacities. Latvenergo's share of the regular capacity is 2054 MW.

Technical characteristics of the HPP:

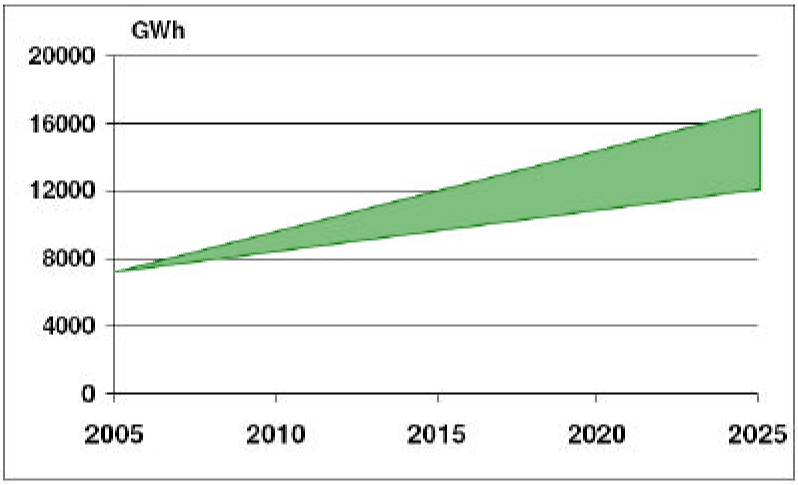
	Ķegums HPP1/HPP2	**Pļaviņas HPP**	**Riga HPP**
Installed capacity, MW	72/192	868,5	402
Number of hydro aggregates	4/3	10	6
Maximum head, m	14/14	40	18
Dam length, m	2161	4032	15400
Multiple annual average flow , m^3/s	615	610	640
Water reservoir capacity, million m^3	168,3	500,1	324,6
Estimated minimum energy storage capacity (GWh)[2]	4,9	40	12

Technical characteristics of the Riga TPP:

	Riga TPP-1	**Riga TPP-2**
Heat capacity (MW)	375	1279
2006/2007 heating seasons average and maximum heat load of the day (MW)	253 / 312	675 / 758
Electric capacity (MW)	142	390
Steam boilers	2	5
Turbo-aggregates	3	4
Water heating boilers	2	4
Fuel	Natural gas (diesel fuel as reserve fuel for boilers)	Natural gas (heavy fuel oil as reserve fuel)

[2] On the asumption that the average height of the storage is 75% of the head given in the table.

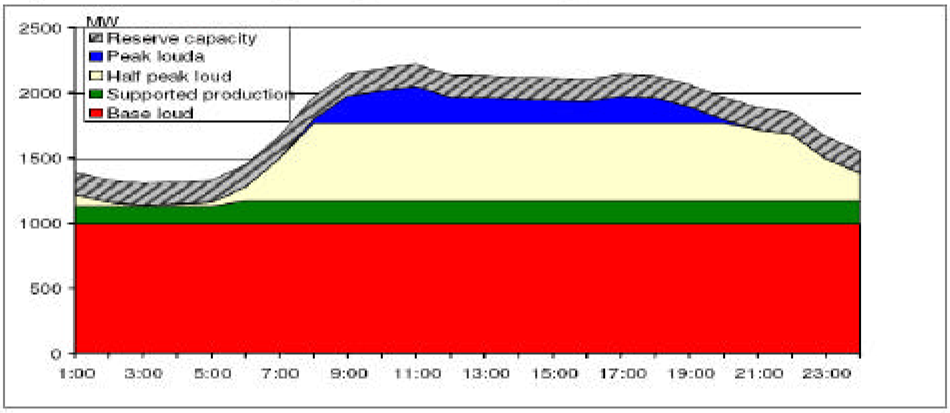
Scenario for electricity demand from Latvia's Investment and Development Agency's study on the base load, 2007:



Energy demand scenario developed by Transmission system operator, 26/9 2006:

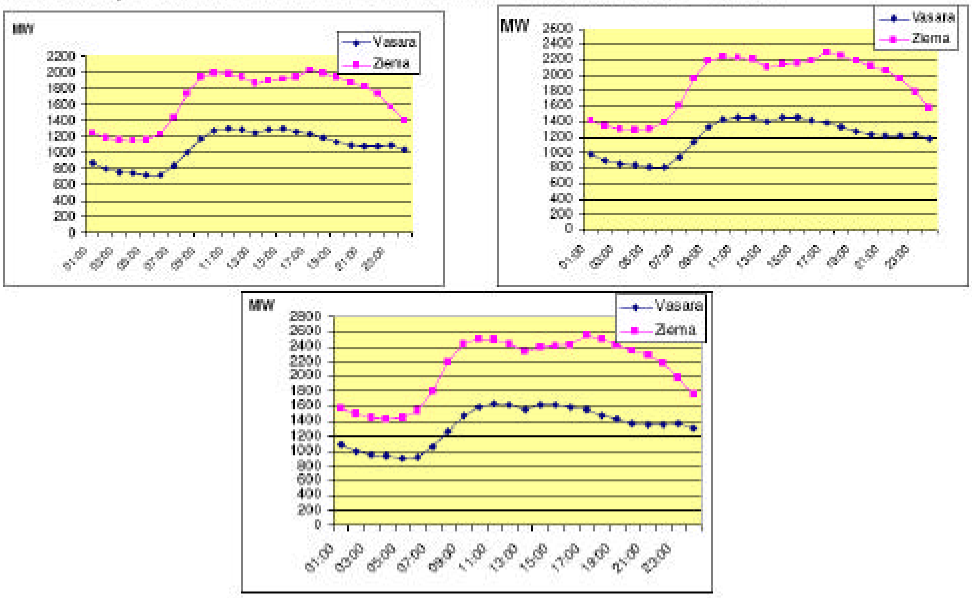
Year	Annual consumption (bruto)	Peak load
	GWh	MW
2005	7051	1272
2006	7482	1420
2007	7689	1474
2008	8068	1531
2009	8463	1589
2010	8610	1650
2011	9031	1715
2012	9342	1782
2013	9794	1852
2014	10264	1925
2015	10614	2000
2016	10779	2057

Report from Transmission system operator, scenario for year 2016:



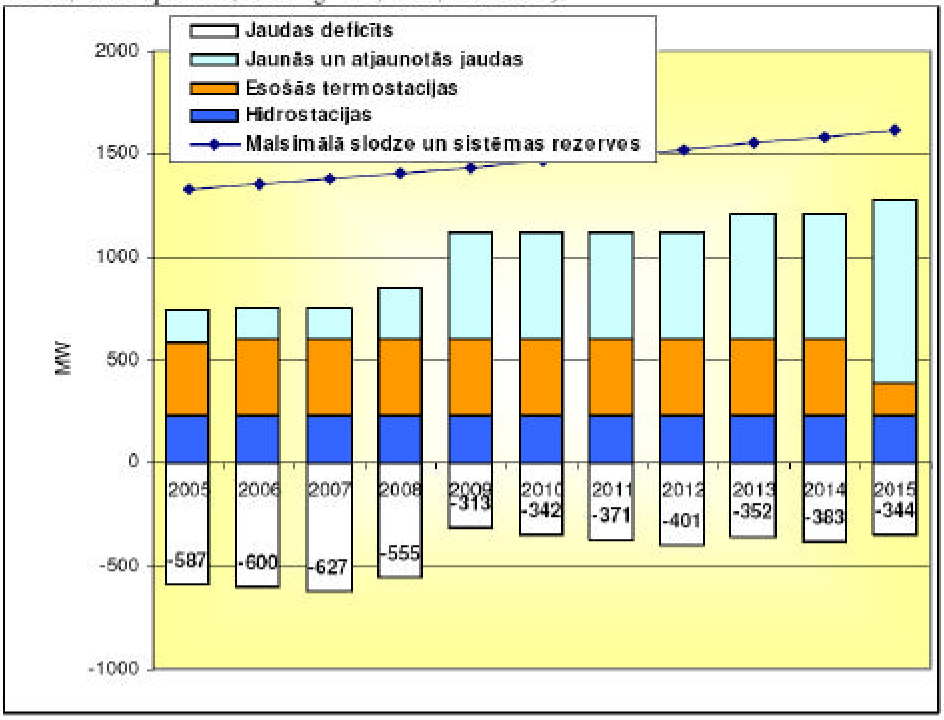
Type	Supported production	Base load	Half peak load	Peak load	Reserve capacity	Imported power
Power, MW	200	1000	600	300	150-250	+- 400
Use, hours a year	>6000	>6000	<3500	<1000	8760	

Max electricity demand (2015, 2020, 2025) (Vasara – summer; Ziema – winter)[3]



3 Latvian investment and development agency.

Possible electricity demand in the December when there is lack of hydro energy. (Legend: deficit, new capacities, existing TPP, HPP, Peak load).



Future plans:

- New combined cycle energy block in Riga TPP 2 by 2008 with capacity 400 MW. After reconstruction it is planed that the energy production in TEC-2 will increase 4-fold - from 0,83 TWh to 3,35 TWh.
- Coal condensation electric station by year 2012 with capacity 400 MW in Kurzeme region (Western Latvia at the Baltic Coast).

Development of heat and primary energy demand for heat and processes (PJ, (TWh))[4]

	1995	2000	2001	2002	2003	2004
Final energy consumption, excluding transport sector and electricity		**(26,2)**	**(28,3)**	**(28,7)**	**(29,0)**	**(30,0)**
Centralized heat production	37,9 (10,5)	24,7 (6,9)	26,4 (7,3)	26,3 (7,3)	26,8 (7,5)	24,6 (6,8)
Local heat production *(industry, agriculture and services using primary energy resources)*	40,0 (11,1)	36,6 (10,2)	38,0 (10,6)	40,1 (11,1)	41,0 (11,4)	46,7 (13,0)
Individual heat production *(households using primary energy resources)*	38,0 (10,6)	33,0 (9,2)	37,6 (10,4)	37,0 (10,3)	36,7 (10,2)	36,8 (10,2)

[4] Statement on energy development 2007. – 2016

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Information from Energy balance 2005 (TJ):

	1990	1995	2000	2002	2003	2004	2005
Production of heat	99439	46112	31867	33048	33516	31093	31144
of which:							
public CHP	18280	13720	11250	14223	14465	14389	14238
public heat plants	43654	22258	16081	15322	15196	12917	13367
autoproducer CHP	4110	2070	684	515	659	428	439
autoproducer heat plants	31937	8064	3852	2988	3196	3359	3100
utilised heat	1458	-	-	-	-	-	-
Energy sector	**256**	**1800**	**1213**	**871**	**932**	**1195**	**1091**
Losses	**14915**	**6415**	**5947**	**5861**	**5739**	**5317**	**5033**
Final consumption	**84268**	**37897**	**24707**	**26316**	**26845**	**24581**	**25020**
of which:							
industry	**31928**	**1829**	**623**	**572**	**583**	**558**	**634**
other sectors	**52340**	**36068**	**24084**	**25744**	**26262**	**24023**	**24386**
agriculture, forestry, hunting, fishing	8006	360	50	65	87	119	155
construction	1001	140	36	58	43	50	50
households	25891	25175	18411	19508	19933	18119	18360
other consumers	17442	10393	5587	6113	6199	5735	5821

Heat production in Riga by "Rigas siltums":

Thermo stations	Riga TPP-1	Riga TPP-2	Vecmilgrā vis	Imanta	Ziepniekka lns	Daugavgrī va
Heat capacity (MW)	375	1279				
2006/2007 heating seasons average and maximum heat load of the day (MW)	253 / 312	675 / 758	40,7 / 45,5	231 / 271	55,9 / 60,9	16,1 / 17,8

6

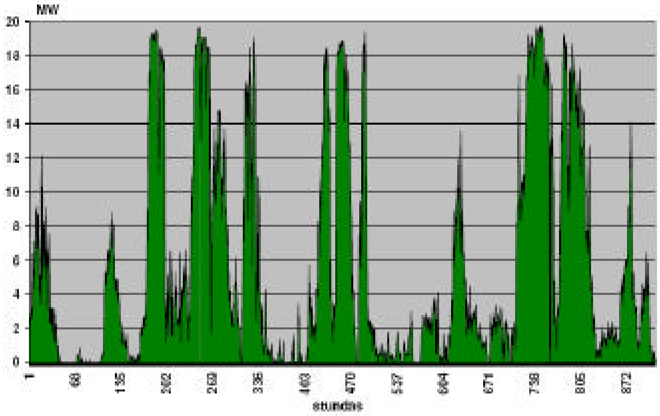
3. Renewable Energy Potentials

Windpower
Officially 298 MW of windpower (with capacity factor of 2300 full-load hours per year), are to be installed by 2010.

According to the assessment of Latvijas Wind Energy Association totally it is possible to install around 600MW of windpower.

According to the data from the EBRD Renewable Energy Program the practical windpower potential is estimated at 1,000 GWh/year and it represents about 2,000 MW of wind power capacity; but there are some uncertainties about this potential.[5]

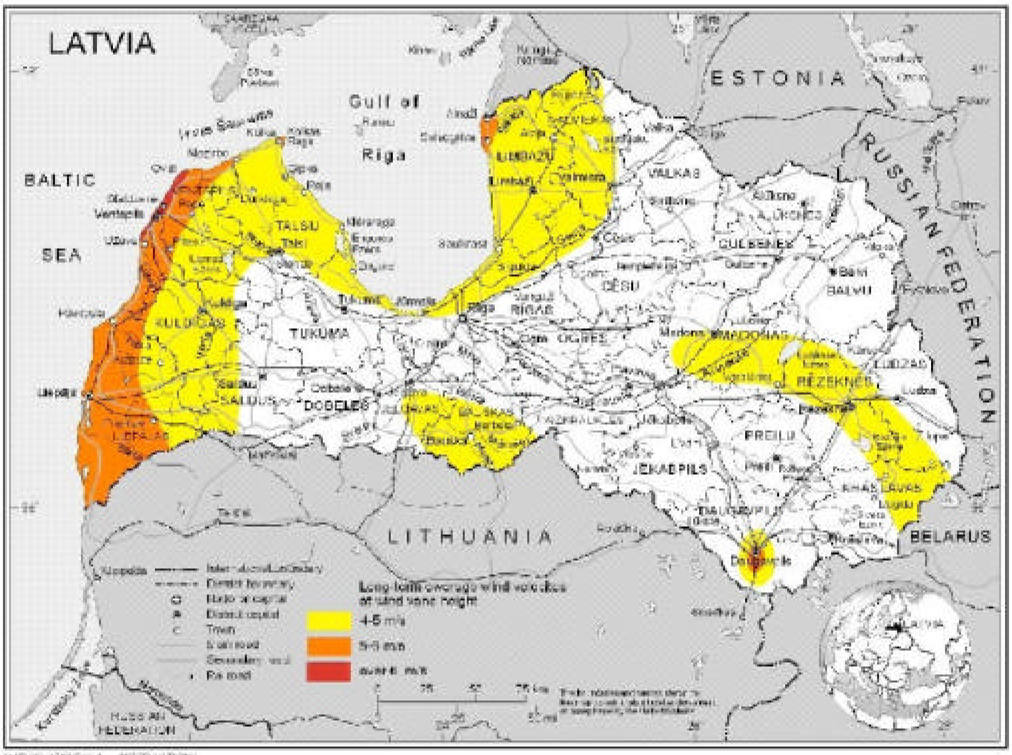
Variation in windpower production as measured in Latvia (stundas = hours), probably 2005.



The best sites for windpower on land are at and behind the Western Baltic Sea coast of Latvia (wind speed in 25m is 6,8-7,0 m/s, but in 50m it is 7,9-8,1 m/s). For environmental reasons sites should be south of the nature reserves around the Kolka horn. Smaller potentials are in other areas such as sites behind the eastern coast of the Bay of Riga.

The offshore potential is in the Baltic Sea west of Latvia while off-shore in the Riga Bay is not considered because of nature protection interests. In addition to this, there is potential for a larger windpower park further into the Baltic Sea.

5 http://ebrdrenewables.com/sites/renew/countries/Latvia/profile.aspx



Historical windpower production:

	2000	2001	2002	2003	2004	2005
Windpower (GWh)	4,4	3,4	11,2	48,5	49,1	47

Currently Latvia has 7 enterprises with 41 wind turbines installed with a combined capacity of 135 MW (2006).

For this study is used a potential of 600 MW with 2500 equivalent full-load hours. Presently the figure is about 2300 hours. The higher number of full-load hours is based on the assumption that the developments are partly offshore.

300 MW will be utilized by 2010 and the full potential of 600 MW by 2020.

Solar Energy
The energy in solar radiation in Latvia is an average 1109 kWh/m^2 on a horizontal surface according to Latvian Renewable Energy Statement 2006, Ministry of Environment. Most of the solar energy will come in the warm part of the year from April when solar intensity is 120 kWh/m^2 for the month on a horizontal surface till first part of September.

Solar energy is not used much in Latvia today. A largest existing solar heating project is at the Aizkraukla School[6] with a solar collector area of 208 m^2. There are also a number of smaller projects.

The maximal useful solar collector area is in this study limited to 10 m^2/capita, e.g. 23 mill. m^2.

For this study the area used for solar energy is divided between:

- Solar heating with collectors for hot water (directly used domestically for service sector, industrial heat demand or eventually district heating) with an annual yield of 440 kWh/year (about 40% efficiency) and a potential area of 11 mill. m^2 and
- Solar electric cells (PV-cells) with an annual yield of 110 kWh/year (about 10% efficiency) with a potential area of 11 mill. m^2.

The solar heating installations can be used for low to medium temperature heat demand (below 150'C) and district heating. Normal flat-plate solar collectors will be limited to supply heat below 90'C, while higher temperatures can be achieved with use of vacuum tube solar collectors.

In this study the use of solar energy is limited to the following maximal uses:
- 1/3 of buildings' demand for space and water heating (limited because of seasonal variation) for domestic and service sector heating
- 2/3 of low-temperature process heat (assuming equal demand throughout the year)
- 15% of medium-temperature heat

To cover 1/3 of buildings demand for space heating and hot water will require energy storages of 1-3 months. This is also necessary to cover 2/3 of low-temperature process heat. Because of the costs of such storages, they are only included after 2040. Until then we have limited solar heating installations to cover less than 60% of domestic hot water demand in houses outside district heating, equal to about 15% of domestic total heat demand outside district heating (assuming 25% of total heat demand is used for hot water and 75% for space heating) and 8% of service sector heat demand outside district heating areas. It is also expected that solar heating will cover industrial heat demand, up to 12% in 2050 in some sectors of industry, and 4% of district heating.

There is little market for solar energy installations in Latvia for the moment. This is not expected to change until 2010; but the development of solar heating is then expected to start and then follow a path like:
- 2010 – 2020: 10,000 m^2/year (total 110,000 m^2 installed in 2020)
- 2021 – 2030: 80,000 m^2/year (total 900,000 m^2 installed in 2030, covering 3% of domestic heat demand)
- after 2030: 200,000 m2/year, covering 9% of service sector heat demand and 12% of household heat demand by 2050. Solar also cover 9% of heat delivered from heat-only stations (CHP excluded)

With this development solar heating will cover about 5 mill. m^2 equal to 45% of the area of 11 mill. m^2 dicussed above.

The installed area for solar electric generation (PV) is expected to follow take off as solar thermal after 2020; but to expand stronger than solar thermal from after 2030, leading to 53% of the potential area used in 2050.

[6] www.gimnazija.aizkraukle.lv

With this development, 5 mill m^2 will be used for solar heating and 5.8 mill. m^2 will be used for solar electric generation, in total about 11 mill. m^2. This is equal to 5 m^2/person for solar energy use in 2050 in total. Most of this is expected to be on roofs. This area is of course not a maximum; it leaves room for additional solar installations after 2050.

Biomass

The potential for solid biomass for energy consists of wood and straw available for energy purposes. Bio-fuel for transportation, biogas and energy plantations are all treated separately below.

Wood is already used to a large extent today, mainly for heating in the domestic and service sectors and in district heating. It is predominantly waste from the timber production. It includes firewood, wood pellets, briquettes and wood chips. Production and consumption of wood for energy increased considerably in the last decade, national consumption (TPES) increased from 47 PJ to 59 PJ while production increased from 54 PJ to as much as 83 PJ because of increasing exports. Wood used in the energy transformation (mainly heat plants and CHP) increased from 8.3 PJ in 2000 to 12.9 PJ in 2005. The wood use in 2005 of 83 PJ including exports was higher than the potentials mentioned in the Statement on renewable energy production 2006-2010[7], of 44.5 – 82.5 PJ.

In 2005 Latvia exported total of 24.3 PJ[8] of wood for energy. Export of wood for energy in 2005 has a slight increase of 7.3% by volume and 21.3% by value. Thus it should be concluded that the increase of export volume was not caused by price increase, but by the increased share of the more expensive products – pellets and briquettes. In 2005 total of 2.311 million tons of wood for energy was exported, but in 2006 export reached 3.282 million tons, which is an increase of 42% compared to year 2005. Out of that 284 100 tons was firewood with annual increase by 9%; 2.48 million tons of woodchips with increase by 63.3%; but export of wood wastes was 514 200 tons, a slight decrease compared with 2005[9]. Over the same period also import of wood for energy increased – by 96% from 19500 tons to 38400 tons (firewood import decreased by 49.1%; woodchips increase by 88.4%; but import of wood wastes increased by 161.5%).

Export price for woodchips in year 2006 was in the range of 5-6 LVL/m^3. (7.3 – 8.7 LVL/MWh equal to 10-12 Eur/MWh with the assumptions of density 235 kg/m^3, energy content 2,92 MWh/ton, 1 Eur = 0.702 LVL). Price for sawdust brick fuel can reach (8.2-8.8 LVL/MWh)[10].

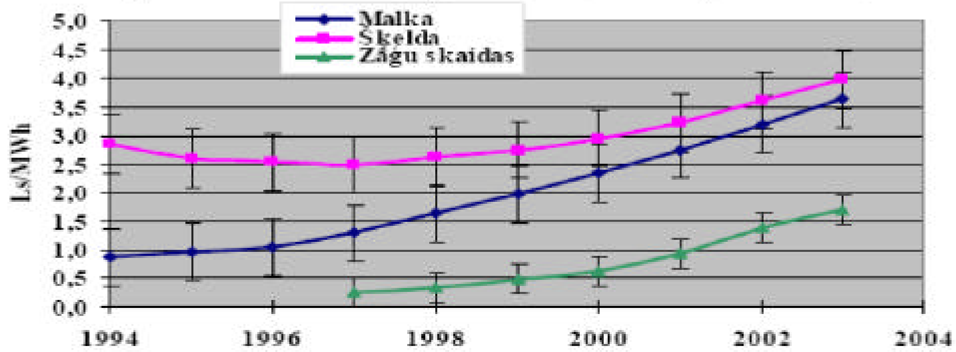
7 Atjaunojamo energoresursu izmantošanas pamatnostādnes 2006. – 2010. gadam

8 Central statistics office.

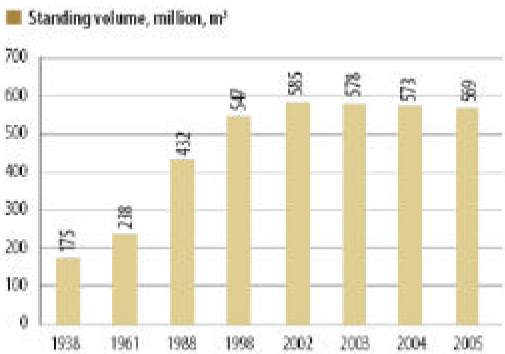
9 Ministry of Agriculture, http://www.zm.gov.lv/doc_upl/2005_2006.pdf

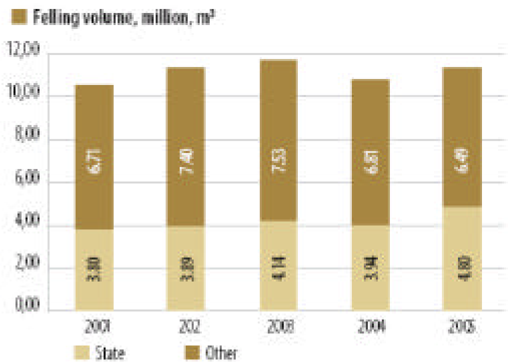
10 1 LVL = 0,702 EUR

Prices of energy wood in local marker (Legend: firewood, woodchips, wood waste):



Annually approximately 11 – 12 million cubic meters of wood are harvested. The annual increase of standing crop is 16.5 million cubic meters. At the beginning of 2004 total forest stock was 578 milj. m^3. During 2004 10.75 milj. m^3 were cut, which makes 66% of the growth[11]. Developing of forest felling and standing volume of forests is given in the graphs below. The decrease in standing forests since 2002 is partly a result of trees falling in storms. Use of wood from these trees is included in the statistics of wood use for energy.





However the data from forestry research institute Silava differs. According to their assessment baste on field trials there are 3313 thousand ha of forest with total standing volume of 629 mill. m^3. They estimate:

- the annual increase in the forest volume at 25,53 mill. m^3 annually,
- 60,42 mill. m^3 of dead wood and 52,04 mill. m^3 of damaged trees in the forest.

Till now, there has been a little use of wood residues in Latvia. Remains of forestry and forest harvesting amount to approximately 15 – 25% and constitute ~2.53 mill. m^3 of fuel (technical potential is around 4 mill. m^3). According to data from Latvia's environmental agency, currently around 2 mill. m^3 of wood residues are used annually. Potential for fuelwood is also in the wood processing industry, where from 1 m^3 of sawn timber it is estimated to remains around 1-1,5 m^3 loose wood residues. Analysis of Ministry of Agriculture on biomass resources available in Latvia shows that currently approximately 5 mill. m^3 of fuel wood are not used. From such an amount ~24 PJ of heat energy could be produced a year. Given the high increase in export of wood fuel from Latvia after the study was launched (export increased 950,000 tons from 2005 to

[11] State forest service.

2006, equivalent to about 1.2 mill. m^3), we only include 2 mill. m^3 of the above-mentioned 5 mill. m^3 as additional potential use of wood fuel for existing sources for energy in Latvia. This is equivalent to a potential increase of use of wood fuel form existing sources with 10 PJ.

For this study is used a future production of wood for energy of 94 PJ, equal to the production in 2005 + the above-mentioned additional potential of 10 PJ. Further increase in the use of wood for energy is expected to come from new plantations of trees, as described below under "energy plantation".

There is a potential for straw for energy use in Latvia. Straw from agricultural production is not calculated, so the potential use must be based on assumptions of assumptions of straw production and use in agriculture.

According to the PHARE project from 2000 "Renewable energy resource programme" excess straw production in Latvia which is not used in Agriculture is 150 - 570 thousand t. It has large regional variations with the highest potentials in Zemgale (Southern Latvia next to Lithuania).

If the average heating value of straw is 4.0 MWh/t then total energy value is 2,2 – 8,2 PJ.

For this study is used a potential of 5-6 PJ of straw from grain.

The increased production of rape-seed will lead to increased production of rape-seed straw. The production of one ton of rape-seed oil, roughly equivalent to one ton of biodiesel, will give 3.9 ton of rape-seed straw with an energy content of 14.5 GJ/ton[12]. The production of 168,000 ton of rape-seed oil (see below) will then lead to a straw production of 655,000 ton with energy content of 9.5 PJ. This potential will be available with the production of rape-seed oil (see below). Straw from rape-seed is less used internationally than straw from grain. Not all equipment for straw firing can be used for rape-seed straw, but technology for its use as fuel is available.
Also the press-cake from the rape-seed can be used for fuel with an energy potential of about 5 PJ for the 168,000 ton of rape-seed oil; but it is also valuable as fodder and is therefore not included as an energy source in this study.

According to report on energy from Physical energy institute[13] the potential from straw for grain and rapeseed for energy is about 330,000 tons (3.4 PJ) + 330,000 tons (3.4 PJ) of remaining from cleaning of seeds. This is calculated with 12.5% of the straw production used for energy. Based on Danish experience, the fraction of straw from grain for energy can be increased to 25%. The fraction of straw from rape-seed can be higher as there is no traditional use of rape-seed straw, e.g. for animal bedding. This is why we maintain a substantially higher potential of straw for energy in this report (we use 15 PJ compared with about 7 PJ in the report from Physical Energy Institute).

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12 Rape-seed oil for transport 1: Energy Balance and CO2 balance, Jacob Bugge 9/11-2000, available from www.folkecenter.net

13 Noslēguma pārskats par projektu «Lauksaimniecības atkritumu enerģētiskās vērtības un izmantošanas perspektīvu analīze un alternatīvo kurināmo izveide»

With this we use a total solid biomass potential is 109 PJ, combining the 94 PJ of wood and 15 PJ of straw including rape-seed straw. Of this 84 PJ is used today (2005), the remaining potential for wood is expected to be used in 2010 and the potential from straw is expected to be used in 2020 and later. The 2005 export of 24 PJ of biomass (wood) is used as future export volume of solid biomass.

Liquid Bio-fuel

To ensure the fulfilment of EU target of 5,75 % biofuel in the total fuel consumption, by year 2010 Latvia would need to consume 75,000 t of biofuels, for instance 32,000 t bioethanol (1.72 PJ) and 43,000 t of biodiesel (1.4 PJ)[14].

The maximum rape seed plantations are 180,000 ha according to Latvian Renewable Energy Statement[15]. This will provide 168,000 t of biodiesel, equal to 6 PJ, as well as straw and press-cake. The present area with rape-seed is 83,000 ha (2006) for all purposes.

The liquid biofuel potential is set to 5.5 PJ in this study, of which 3 PJ is expected to be used in 2010 and the full potential in 2020. This can be done with rape-seed, ethanol from grain, or other liquid biofuels. This is a bit below the EU-targets of 5.75% in 2010 and 10% in 2020 of biofuel use in transport fuels. No export or import of biofuels is included in the vision.

In this study is assumed that biofuel production will be used domestically. Current barriers to domestic biofuel use have resulted in the export of Latvia biofuel production to other EU countries.

Biogas

Potential streams of wet biomass for biogas were assessed like this in 2004:

- 5.8 mill. ton of manure.
- 0.4 mill ton on biodegradable household waste;
- 0.034 mill. ton of animal waste;
- 0.18 mill. ton of active sludge from waste water plants (36,000 ton of dry matter);
- Small amount from food production and processing.

In the biogas production and development programme are plans to construct 13 new biogas electricity generating stations before 2013. It is also assessed that in Latvia it is possible to produce:

- 95 mill. m^3 of biogas from manure;
- 23 mill. m^3 of biogas from biodegradable household waste;
- 23 mill. m^3 of biogas from food production and processing waste;
- 16.8 mill. m^3 of biogas from green mass (leaves etc.);
- 10.8 mill. m^3 of biogas from active sludge from waste water plants;
- 10.65 mill. m^3 of biogas from animal waste.

From this amount it is estimated that the production can be 290 mill. m³ biogas or 5 PJ energy and fertilizer for agriculture.[16] In the Biogas strategy[17] it is estimated to have 174 mill. m³ biogas annually or 3 PJ energy.

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14 Programma "Biodegvielas ražošana un lietošana Latvijā 2003-2010"

15 Atjaunojamo energoresursu izmantošanas pamatnostādnes 2006.– 2010. gadam

16 SIA Agito. Biogāzes ražošanas iespējas Latvijā. Rīga, 2005

17 Biogāzes ražošanas un izmantošanas attīstības programma 2007.-2011. gadam

In addition to this biogas potential, there is a potential of landfill gas which is not evaluated in this study.

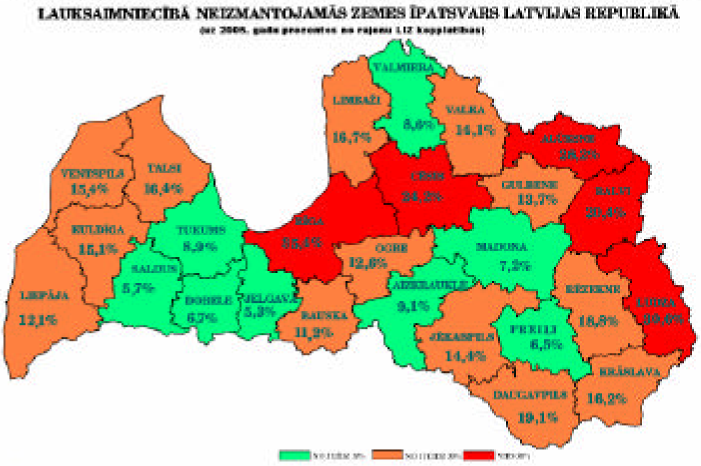
Currently total installed capacity of biogas in Latvia is 7.786 MWe which is producing electricity and heat from gas from landfills and sewage sludge.

We expect a large development of biogas, resulting in the full technical potential of 3 PJ utilised by 2020.

Energy Crops for Solid Biomass

Our proposal for energy crops for solid biomass is to use a fraction of the unused agricultural land. It is estimated that 14,9% of the agricultural land (363 505 ha (3635 km^2)) in year 2005 was not used for agricultural production[18]. This land is not cultivated for at least last two years but can be used for energy crops such as short rotation coppice with willows or poplar, elephant grass (*miscanthus*), or others. Of this land 51,000 ha is overgrown with bushes.

Unused agricultural land in proportion to agricultural land in Latvia's Regions:



In 2005 in Latvia there were 30-50 ha of willow (salix) plantations[19]. Most of them are eliminated by now, because there are no agricultural support (area payment) for this, but it is expected that such payments could be introduced starting from 2008, following EU rules for energy crops (payment 45 Eur/ha). However there are several field trials. One of them is in Olaine.

In Sweden the average yield for sallow (willow, salix) plantations is 6-8 t of dry matter/ha, with felling every third year of 18-24 t of dry matter/ha. Experience in Latvia shows that willow grown in fallow land on sandy soils the annual yield is a minimum of 5t/ha. In fertile, good cultivated soils the annual yield could reach 15-16 t of dry matter/ha.

In this study we assume an average yield of 7 t/ha and an available area of 340,000 ha, assuming that some of the unused agricultural land is not used because the owners plan to convert it to

18 Assessment done in 2005 by „ Latvian Rural Consulting and Education Centre".

19 http://www.zm.gov.lv/doc_upl/Iscirtmeta_energetiskas_koksnes_plantaciju..._Silava.pdf

urban developments within a few years. With an energy content of 4.9 MWh/ton[20] of dry matter, the corresponding energy potential is 34.3 MWh/ha or for the area of 340,000 ha 11.6 TWh = 42 PJ. Similar yields can be achieved with other fast-growing trees such as poplar and elephant grass (miscanthus).

We expect the development of energy plantation to take off after 2010 and that 64% of the area is utilised by 2020 and later.

Geothermal energy
The main geothermal resources are based in the Riga region and South-Western part of Latvia in the depth of 1300 – 1950 m. According to Latvian Renewable Energy Statement 2006 the temperature are in the range of only 25-30'C[21] and covering 12 000 km^2, but according to EBRD, the temperatures are in the range of 30-65'C. Because of the problems with extracting useful energy from such resources with low temperatures, use of geothermal energy is not included in this study.

Hydropower
Production of large hydropower was in 2790 GWh in 2005 and of small hydro-power 58 GWh (3100 h/ year). The potential for additional hydropower is not assumed to be acceptable for environmental reasons. Therefore we have not included expansion of the hydropower capacity.

4. Efficiency Potentials
For the vision is used that the efficiency can be increased a factor 4-10 with known technologies. This has been shown to be possible for Western European energy consuming sectors, see e.g. "Factor 10 Club" (www.factor10.de). Even though the increase of efficiency is cost effective when introduced gradually with exchange of equipment, it will not happen by itself, as the decision-makers, e.g. the designers and manufacturers of equipment are not dedicated to supply

[20] Biomass includes humidity and the calorific value depends on this. As an example coniferous wood with 40% humidity has a lower calorific value of 2.9 MWh/ton, but relative to the dry matter content (60%) the lower calorific value is 4.8 MWh/ton. For beech wood with 20% humidity the lower calorific value is 4.1 MWh/ton and relative to the dry matter the lower calorific value is 5.1 MWh/ton. For straw with 15% humidity the lower calorific value is 4.0-4.2 for different types of straw and relative to its dry matter content the lower calorific value is 4.7 – 4.9 MWh/ton. As an average the (lower) calorific value is set to 4.9 MWh (17.6 GJ) / tons of dry matter.

[21] EBRD, Country report 2005.

and install energy-efficient products for a number of reasons. The increase in efficiency can be measured as decrease in the specific amount of energy used to provide a certain energy service (heated floor space, transported persons or amount of goods, amount of industrial production, use of electric appliances etc.)

For transport, electric appliances, and industrial production, energy consuming vehicles and equipment will be changed several times during the more than 40 years that the vision covers. Thus, there are not technical limitations to raise the efficiency a factor of 4 or more. The following increase in efficiency is included in the vision for industrial appliances (heat, fuels and electricity), electricity and road transport to reach a factor 4 efficiency increase 2000 – 2050:

- 2000 – 2010 5% in total (10% for road freight, passenger cars, industrial energy consumption, and domestic and service electricity use)
- 2010-2020: 2%/year (1.5 % for road freight, industry, domestic and service electricity use)
- 2020-2030: 3%/year
- 2030-2040: 4%/year
- 2040-2050: 4.4%/year

The higher expected increases in efficiency 2000 – 2010 for road freight, domestic and service electricity use is because of ongoing rapid replacement of appliances and vehicles.

- In the transport sector the realisation of the efficiency will require a technological shift from present internal combustion engines with 15-20% efficiency to hydrogen fuel cells with >60% efficiency and electric vehicles with about 80% efficiency, including battery charging cycle losses. In addition is expected implementation of technologies to regain brake-energy from vehicles.

The expected increase in efficiencies will only happen with working energy efficiency policies in place from 2010.

For agriculture, construction, rail and water transport the following efficiency increases are included until 2050: 40% for agriculture and 50% for construction, 65% for rail transport (partly achieved with electrification), and 25% for navigation. Also for these sectors the start is expected to be slow: 5% increase 2000 – 2010 for agriculture and construction and no increase in efficiency in rail transport and navigation in this decade.

Manufacturing sector

Current industry in Latvia is not very energy intensive. In the vision is included a large growth in these sectors for 2000 - 2010 (see below chapter 5 in activities in society).

Official energy intensity estimates in Latvia (TOE/1000EUR(2000))[22]:

2004	2010	2013	2015	2020
0,41	0,35	0,31	0,28	0,22

According to the EU Action Plan for Energy Efficiency energy efficiency until the year 2020 will have to increase by 1.5% annually compared with value added to reach EU target of 20% saving in 2020[23]. In Latvia study on potential developments in manufacturing industry until 2020 was done by SIA Baltijas Konsultācijas in 2007. According to this study energy intensity in the

[22] Statement on energy development 2007. – 2016

[23] Communication From The Commission, Action Plan for Energy Efficiency: Realising the Potential, COM(2006)545

sector has decreased by 15% in the period 2000-2006 compared with value added (about 2.5%/year). Productivity in the sector historically increased from -33% to +10%, but on average +0.36% annually. Forecast is that the same trend will continue till 2020. No data is available on the relation between energy consumption and the volume of production, which is the energy service parameter used in this study; but we expect that improvements are lower than the 2.5% annual decrease in energy consumption relative to value added.

In the visions we will use the assumption that efficiency increased 1%/year 2000 – 2006 relative to volume of production and that this trend will continue until 2010. From 2010 is assumed that efficiency will speed up to 15%/year 2010-2020 and then increase further to reach a factor 4 increase 2000 – 2050. This is used for efficiency of both heat and electricity demand.

Efficiency of heating

In Latvia total heat consumption of dwellings was 55 PJ in 2000, including domestic use of fuels. Energy consumption in centralized heat production has decreased from 37.9 PJ (10527 MWh) in 1995 to 24.7 PJ in 2000 and has been stable since then. Local heat production in commercial sectors has increased substantially 2000 – 2004 from 36.6 PJ to 46.7 PJ, driving up total heat demand.

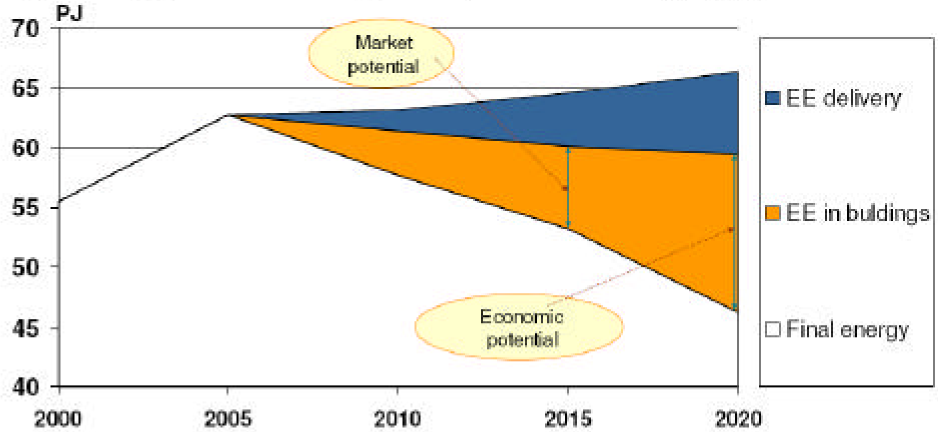
In Latvia there is very low energy efficiency in buildings. I Riga final energy demand for heating (including internal losses in buildings) is assessed to be on average 231 kWh/m^2/year, and in the rest of the country 220-250 kWh/m^2/year[24]. Also the heat losses in the district heating networks are high. The district heating losses have been reduced. But they are still around 5 PJ, equal to 20% of district heat consumption.

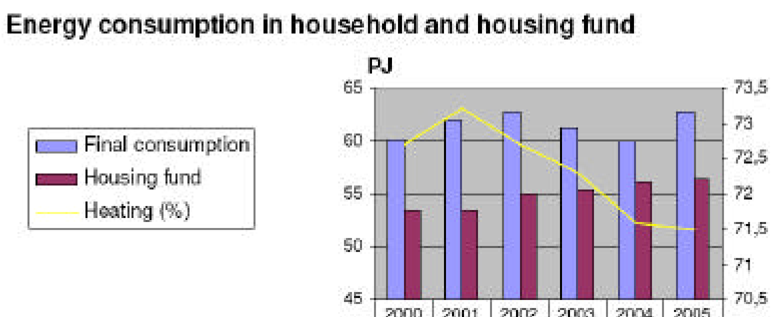
Statement on energy supply 2006-2016 sets the goal that until 2016 average final, specific energy demand for heating should be reduced from 220-250 kWh/m^2/year now to 195 kWh/m^2/year and until 2020 should reach the average of 150 kWh/m^2/year.

By realizing market potential and decreasing energy consumption to 195 kWh/m^2/year it is possible to save 7 PJ energy, but by realizing economic potential and decreasing energy consumption to 150 kWh/m^2/year it is possible to save 15 PJ energy, according to the study "Energy efficiency in buildings" done by Institute of Physical Energetics, Laboratory of Energy system analyses and optimisation.

[24] AS „Latvenergo" un AS Rīgas siltums publiskie gada pārskati.

Energy efficiency potential in buildings, following statement on energy supply:





	2000	2001	2002	2003	2004	2005
Final consumption	60,1	62,1	62,8	61,3	60	62,8
Housing fund	53,5	53,5	54,9	55,4	56,1	56,4
Heating (%)	72,7	73,2	72,7	72,3	71,6	71,5

Given the standstill in energy efficiency 2000-2005 (see below), is can be difficult to realise the above-mentioned targets for 2016 and 2020; but given the high volume of new construction, an increase of standards in new constructions could be a crucial factor to realise the target.
After 2020 we assume continued efforts for energy efficiency in line with further implementation of EU regulation and increasing energy prices, leading to an increase of building efficiency of 2%/year. This is similar to the assumptions for INFORSE-Europe sustainable energy visions for Western Europe.

There are not data on the division of heat losses in heating systems including boilers inside houses and heat consumption to hot water and space heating. In this study we assume that the looses in heating systems inside houses including losses in boilers is 25% in 2000 and that it will gradually decrease with 5%/decade until it reaches 90% in 2020. Then the increase will be only 1%/decade.
With this assumptions the improvements in the first decades will mainly be in the heating systems while the remaining efficiency gains resulting from building improvements.

This gives the following development in heat efficiency parameters, combining space heating and heating of hot water:

Specific heat demand in Latvian buildings	2000	2010	2016	2020	2030	2040	2050
Final spec. heat demand (kWh/m2)	230	210	195	150	123	101	83
Heating system efficiency in houses	75%	80%	81%	85%	90%	91%	92%
Net heat demand (kWh/m2)	173	168	158	128	111	92	76
Net heat demand relative to 2000	100%	97%	92%	74%	64%	53%	44%

It can be difficult to realise the sharp increase in efficiency 2016-2020; but the overall improvement decade by decade seems reasonable, on the assumption that special initiatives are carried out for the period 2010-2020, e.g. with EU support, building codes, loans for improvement of houses (mortgages), and not the least: rebuilding of a large part of the inefficient block houses from the Soviet era. For the vision is only included data set for the start of each decade, the data for 2016 in the table above are not used.

This development is used for space heating of buildings for dwellings as well as in the service sectors.

While the relative increase in efficiency from 2000 to 2050 is large, the target of 83 kWh/m2 is not ambitious compared with plans for Western Europe, e.g. For Denmark.

Efficiency in Energy Supply

For energy supply we expect an increase in the conversion efficiency in the electricity and heat sector, leading to a decrease in the average loss in power and CHP plants.

Statement on energy supply 2006-2016 sets targets for heating system efficiency and losses. Average efficiency for heat and CHP stations 2016 should be improved from current 68% to 80%-90%.

From the low efficiency in the CHP plants in 2000 are expected increases already in 2010 with the new gas-fired power plant in operation from 2008 in Riga[25].

We use the following efficiencies for thermal power plants in the vision:

Power plant efficiencies	2000	2010	2020	2030	2040 and later
Electric	20%	38%	45%	46%	47%/55%*
Heat	52%	40%	40%	39%	39%/0
Total	72%	78%	85%	85%	86%/55%

* For 2040 and later is included power production on power-only plants.

The electric efficiencies after 2010 are based on power plant efficiency data used for Danish energy planning for new plants (Danish Energy Authority, "Technology Data for Electricity and Heat Generating Plants" from www.ens.dk), phased in over the period. The Danish energy efficiencies data are:

25 The new combined-cycle 400 MW block is expected to have an electric efficiency of 50% in CHP mode and to produce 60% of CHP power production in Latvia in 2010.

Power plant efficiencies, new plants*		2010	2020 and later
Gas-fired combine-cycle, 100 – 400 MW	Electric (at 100% load)	58-62% (no heat prod.) 53-58% (full heat) 6% lower at 50% load	59-64% (no heat prod.) 54-60% (full heat) 6% lower at 50% load
	Total (at full heat)	90%	91%
Gas-fired combine-cycle, 10 – 100 MW	Electric (at full heat)	47-55% (100% load)	48-56% (100% load)
	Total (at full heat)	90%	91%
Gas engine 1-5 MW	Electric	41-44% (100% load)	as 2010
	Total	88-96%	as 2010
Large biomass-fired steam turbine plant, 400 MW	Electric	46.5% (100% load) 2.5% lower at 50%	48.5% (100% load) 2.5% lower at 50% load
	Total	90%	as 2010
Straw-fired steam turbine, 5-15 MW**	Electric	29-30%(>75%load)	as 2010
	Total	90%	as 2010
Wood gasification, 1-20 MW	Electric	35-40% 5% lower at 50% load	37-45% 0-5% lower at 50% load
	Total	103%***	103%***

*Net efficiencies, adjusted for own consumption
** Larger installations have larger electric efficiencies
*** With flue gas condensation

The electric efficiency of the plants in 2020 (45%) can be achieved with 20% of production on combined-cycle gas-fired power plants with 58% electric efficiency, 55% on large biomass plants with 48% efficiency and 25% on smaller biomass plants with 30% efficiency.

The heat efficiencies are below the plant characteristics as the plants will not run with full heat production during the whole year.

For heat producing plants, efficiencies are expected to increase 5%/decade from an average of 70% in 2000 to 80% in 2020 and 90% in 2040 and then remain stable.

According to the Statement on energy supply 2006-2016, the losses in heat transmission by 2016 should be reduced from 18% now (2005) to 14% of production. They were 19% of production (24% of consumption) in 2000. We expect these losses to be 18% of production in 2010 and to be reduced to 14% of production (17% of consumption) in 2020 and then remain stable.

Also the efficiency of the electricity network can be expected to increase. We expect that the grid losses are reduced from the very high figure of 19% of supply (22% of consumption, statistics for 2000) to 13% of production in 2010 (realised in 2005 according to statistics) and further to 9% of production in 2020 and then remain stable on that level.

5. Demand for energy services

In this model is not included an automatic link of economic development (GDP growth) and energy consumption. Instead is included expected growth of energy consuming factors, such as heated floor area, transport, production in volume, not in value. These drivers are refered to as energy service demands.

"Rigas siltums", the main heat service provider in Riga City, is forecasting heat demand increase in Riga over the next 5 years by 580-600 MW. This is, if all the new development projects in

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"Rigas siltums", the main heat service provider in Riga City, is forecasting heat demand increase in Riga over the next 5 years by 580-600 MW. This is, if all the new development projects in

Riga are realized. Rigas siltums over the next 5 years is planning to increase its capacity by 50-60 MW annually.

The demand for energy services (heated floorspace, transport etc.) is expected to increase as follows:

Heating (district heating + fuels):
Energy consumption for heating of dwellings has increased 6% in the period 2000 – 2005[26].

The development of housing and construction of dwellings is developing according to the statistics below:

Construction of dwelling-space in Latvia 1990. – 2004.g. (LR CSP data)

	1990	1995	2000	2001	2002	2003	2004	2005
Total housing fund mill.m^2	52,9	52,7	53,4	53,5	54,9	55,4	56,1	56,4
in cities	33,8	34,1	34,7	34,8	35,7	36,2	36,5	36,8
In countryside	19,1	18,6	18,7	18,7	19,2	19,2	19,6	19,6
Average for inhabitant, m^2	19,2	21,4	22,6	22,8	23,6	23,9	24,3	24,6

The development of dwelling area is an increase of 6% in the period 2000 – 2005 (3.0 mill. m^2 increase relative to 53.4 mill. m^2 in 2000), equal to 1.2%/year.
This increase in dwelling area follow the increase of consumption of heat and fuels in dwellings of 6% 2000 – 2005 (from 51.4 PJ to 54.3 PJ), and thus there is no effect to be seen of energy efficiency.

We expect that the increase in dwellings will be a bit faster than in the period 2000 – 2005, increase from 1.2%/year to 2%/year and continue this development until 2030, where it will level off to a net increase of 0.5%/year. In this way the area in 2050 will be 180% of the area in 2000, and the dwelling area per capita will then be 41 m^2.

Consumption of heat and fuels of service sector buildings has increased 24% 2000 – 2005[27]. With the assumption of no increase in efficiency in the same period as seen for dwellings, the area of service buildings has increased 24%, equivalent to about 4.8%/year. This increase is expected to continue until 2015 and then level off to 2%/year until 2030 and then 1%/year. In this way the area in 2040 will be 3 times the area in 2000.

Agriculture is expected to continue same level of activity that it had in 2000, measured in product volume that drives energy consumption.

Industry energy consumption increased 24% 2000 – 2005, driven by a 17% increase in electricity use, 41% increase in use of natural gas and a 2.4 times increase in biomass use. It is assumed that growth is 5% higher given the increase in efficiency discussed above. It is further assumed that this growth will continue until 2010 with the same rate: 49%/decade for production requiring electricity and 66%/decade for production requiring heat and fuels. The actual growth of energy demand will be lower because of efficiency as explained above. We assume that the growth of

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[26] From Latvian energy statistics for 2000 and 2005 respectively, both from the 2006-publication from Central Statistical Bureau of Latvia. The data is used with one change: in the statistics diesel oil consumption in households is gives as 0 in 2000 and 1105 TJ in the years 2001-2005. This seems to an error and therefore diesel consumption in households is set to 0 for 2005, to make the best comparison with 2000.

[27] From Latvian energy statistics for 2000 and 2005 respectively, both from the 2006-publication from Central Statistical Bureau of Latvia. Data for other sectors as there is no category for service sector.

production to stop in 2010, after which increased value in Latvian industry will come from improved quality instead of increased quantity, following Western Europe. Two changes of major industries are included:

-the new CEMEX cement kiln will increase industrial electricity consumption about 120 Gwh/year, this is less than the expected increase in electricity consumption of "other industries" 2000 – 2010. The increased fuel demand for the new kiln will mainly be from waste materials and will therefore not influence fossil or renewable energy demand, but is not included.

-the change of the steel smelter from gas to electric arc furnaces is included with a decrease of gas use of the "iron and steel" industries with 4.4 PJ and an increase of the sectors electricity use of 3.6 PJ. When the electricity increase is lower than the gas use decrease it is based on the assumption that electric arc furnaces are 20% more efficient that gas furnaces for steel smelters.

Construction has doubled in 2000 – 2005 according to statistics for construction of dwellings, so we assume that the sector's energy demand has doubled. It is expected to remain constant on the current higher level.

Electricity:
Household Sector: Household electricity demand increased 32% 2000 – 2005. Part of this is caused by a move to electric heating, including electric water heating, both in new houses outside areas supplied with gas and in areas supplied with district heating. There is no information about the size of this increase, and it cannot be seen in heat statistics as it is less than inter-annual variations in heating because of weather.

In this study we assume that policies are put in place to stop the expansion in electric heating, and that the electricity consumption will increase 15% 2005-2010 of the 2000 level, or 5% more than the expected increase in dwelling area, so the total increase 2000 – 2010 will be 47%. Then we assume that the increase in demand for electricity services will be 20%/decade above increase in living space until 2030, assuming that the trend towards electric heating will be stopped or reversed (increase of 47% 2010-2020 and 24% 2020-2030). After 2030 we expect the growth of electricity service demand will follow growth in household area. This will lead to an electric energy service level in 2050 of three times the 2000 level. We do not propose use of heat pumps for heating as they do not benefit the Latvian energy system; priorities are district heating and biomass.

Service sector: Service sector electricity demand increased 39% 2000 – 2005 or 15% higher than the increase in heating in the sector.

We assume that the high growth is partly caused by increased use of electric heating, and that the growth of electric heating is stopped. Then electricity service growth 2005-2010 is expected to be 5% higher than the growth in heated service area 2005-2010, which is expected to be 24%, so the total growth 2000 – 2010 will be 68%. We assume that there will be a growth of electric energy service demand equal to heated floorspace in the sector + 20%/decade in the period 2010-2020 (67%). Then we expect electricity service demand increase to follow increase in the area of heated floor space. This will lead to an energy service level for electricity using equipment in 2050 of 5 times the 2000 level.

Industry and farming: We assume increase of 35% per decade (3%/year) until 2020 (following trends 2000 – 2005, then stable.

Construction: We expect doubling 2000-2010 because of increased activity, then stable on new higher level.

Compared with the forecasts of Latvenergo, this forecast for power consumption for 2010 is equal to Latvenergo's figure (mentioned on page 2); but the forecast for 2020 is 7% lower than extrapolation of Latvenego's forecast for 2016 to 2020 (the forecast for 2020 is almost equal to Latvenergo's forecast for 2015). The main difference between the forecasts for the period after 2010 seems to be our assumption that growth of electric heating is halted.

Transport: Transport has increased in recent years and fuel use of road transport increased 40% 2000- 2005, with almost all of the increase in diesel oil use. The following statistical increases are all from Lavian ministry of transportation, statistics available online from ministerial website, Latvian version.

Bus passengers increased from 165.9 mill. in 2000 to 214,1 mill. in 2005 but decreased again to 208.8 mill. in 2006 (preliminary data). There is no data of distance travelled of bus passengers (in person-km), which is the information normally used for bus transport activity. Therefore number of passengers is used as a proxy for bus transport activity. There is no specific data on fuel consumption of buses, instead is used the estimate that 10% of diesel consumption for roads is used for buses. The increase 2000 – 2006 is 26%, if this trend continues until 2010 the increase is 43% in the decade 2000 - 2010. This trend is expected to continue until 2020 to reach 204% of the 2000-level. After 2020 the increase is assumed to be 10%/decade until 2040 and then stable on 2.5 times the 2000-level.

Use of passenger trains increased from 715 mill. passenger-km in 2000 to 892 mill. p-km in 2005 and 992 mill. p-km in 2006, an average increase of 5.6%/year, BUT 11% 2005-2006. In the 1990'ies use of passenger trains fell dramatically, to less than 1/3 of the previous level. The increase of 5.6%/year is expected to continue until 2030 and then level off to 1%/year. With this development, passengers train use in 2020 will be similar to the use in 1993 and in 2050 the use will be twice the 1993-level.

Passenger cars increased from 555,000 by 1/1-01 to 742,000 1/1-06 and 822,000 1/1-07. This is 7%/year in average during the period; but 11% during 2006. The increase of passenger cars is expected to continue with 7%/year until 2010 and then level off to 1%/year until 2020, when there will be 520 cars/1000 inhabitants equivalent to Western European (EU-15) average.

With these forecasts is expected that Latvia will follow a European path leading to a diverse transport sector with many types of transport, not a US-like path with mainly use of personal cars.

It is assumed that use of cars (in person-km of transport) per car is unchanged, so the number of personal cars can be used as a proxy for car use. The increase of petrol use was only 1% 2000 – 2005 while increase in number of cars was 35%. This is not caused just by increase in efficiency; but by a general shift from petrol to diesel vehicles. At the end of 2000 59% of buses and 57% of trucks operated on petrol, but these fractions have gradually decreased to respectively 38% and 36% in April 2007. In this study is expected that the low increase in petrol use is caused by 10% increase in car efficiency combined with a change from petrol to diesel vehicles

This gives the following development of personal transport relative to 2000:

Construction: We expect doubling 2000-2010 because of increased activity, then stable on new higher level.

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This gives the following development of personal transport relative to 2000:

Personal transport	1995	2000	2006	2010	2020	2030	2040	2050
Car	60	100	148	197	217	217	217	217
Bus	111	100	126	143	204	224	247	247
Rail	192	100	139	172	338	582	640	704

Air transport not included in this vision, but development of internal air transport in Latvia is not included as an option.

Rail freight increased steadily from 13291 mill ton-km in 2000 to 19779 mill tkm in 2005, but then decreased to 16831 mill tkm in 2006. The average increase 2000 – 2006 is 4%/year. We assume that the decline 2005 – 2006 is temporary and that the average growth of 4%/year will continue until 2020, after which we assume an increase of 2%/year until 2040 and then no further growth.

Road freight increased from 4789 mill ton-km in 2000 to 8547 mill. t-km in 2005 and 10936 mill. t-km in 2006. This is an increase of almost 15%/year; but the increase in 2006 was 28%. We expect the average rate of 15%/year increase to continue until 2010; but then decrease to 5%/year until 2020, as the large increase 2000 – 2006 is not sustainable and much above the economic growth of Latvia. After 2020 no further growth is expected in road freight.

Freight transport	1995	2000	2006	2010	2020	2030	2040	2050
Road	38	100	228	405	659	659	659	659
Rail	73	100	127	148	219	267	326	326

Pipeline use: Energy use for pipelines fell 24% 2000 to 2005. It is assumed that it will remain unchanged from 2005 until 2050.

6 Fuel shift

Fuel shift is in general limited to max 3%/year increase or decrease for a specific energy source in a specific sector, but the total can be more as more fuel shifts can happen simultaneously.

Average unused potential for centralized heating system in Latvia is 550 MW_{th}[28]:

- Cogeneration potential in Riga - 50 MW_{th}[29];
- In biggest Latvia's towns – 250 MW_{th} (Daugavpils – 100 MW_{th}, Liepaja – 80 MW_{th}, Ventspils – 40 MW_{th}, Rezekne – 30 MW_{th});
- Other towns with population more then 4000 inhabitants – 250 MW_{th}.

In heating is assumed that district heating is increasing after 2020 from currently 36% of household heat demand and 37% of service sector heat demand till respectively 48% and 46% of the demand of each of these sectors. District heating is expected to increasingly come from CHP instead of heat only plants, leading to 52% of district heating coming from CHP in 2020 and 85% in 2050 (current level is 37%).

28 Latvijas Siltumuzņēmumu asociācijas, AS „Rīgas siltums", AS „Latvenergo" informācija.

29 Šī potenciāla apgūšana neatstāj ietekmi uz esošo koģenerācijas staciju darbības režīmiem, jo to siltumapgādes zonas savā starpā nav savienotas.

Fuel shift in transport is starting with introduction of biofuels in transport, initially using the full potential for road transport in 2020 (5.5 PJ), covering 7% of road transport fuels.
In 2030 we expect that railways will be more electrified, covering 53%of rail transport (from 23% in 2020 and 13% in 2000) while we also expect that electricity will cover 20% of energy demand on roads, via the use of electric vehicles.
In 2040 we expect that the use of electricity in rail and road transport will increase to respectively 63% and 40%. We expect that hydrogen will cover 20% of road transport needs and 10% of railroad needs for energy.
In 2050 we expect that the railways will be 80% electrified with the remaining energy needs from hydrogen while road transport will be covered by 57% electricity, 34% hydrogen, and the rest mainly from biofuels.

Fossil Fuel Production

The small coal production of 0.7 PJ in 2000 was reduced to 0.12 PJ in 2005 and is not expected to continue until 2010. The use of peat in CHP stations is expected to be replaced by biomass use. There was no production of oil or gas in Latvia in 2000 and in this vision this is not expected to change.

International Energy Trade

The current export of biomass and import of fossil fuel is expected to continue. While the biomass export is assumed to be constant, fossil fuel imports are expected to grow 2000 – 2010 because of increased consumption and replacement of imported electricity with domestic electricity. After 2010 fossil fuel imports are expected to decline, in particular gas imports as gas is replaced by biomass.

Electricity import, currently 30% of electricity supply is expected to end by 2010 with power supply taken over by windpower that replaces about 40% of the import (import was 6.4 PJ in 2000, windpower is expected to produce 2.5 PJ in 2010) and increased use of power plants, in particular gas fired power plants. Before 2020 most of the power production is expected to come from biomass fired CHP and power plants. After 2040 electricity export could be an opportunity, if the efficiency potentials are realised.

Energy storages

High reliance on intermittent renewable energy – wind and solar- can require energy storages and flexible energy use. The total fraction of intermittent electricity production in 2020 is 15% raising to 16% in 2050. To cope with this, the regulation capacity of the hydro-power plants and thermal power plants can be used. The hydropower plants have a storage capacity of about 57 GWh, equal to about two days of average expected power demand in 2020[30]. There is no need for special storage of electricity in the system, given this low fraction of intermittent power (The Western Danish electricity system that is larger than the Latvian electricity system already has about 24% of electricity from windpower integrated in the power supply.)

In the electricity sector is also introduced some flexible consumptions:

- hydrogen production for transport.
- electric cars with batteries that can be charged at different times at night

For the CHP plants is recommended daily/weekly heat storages (water tanks) to de-couple electricity and heat deliveries on short-term basis.

[30] Expected power demand 10700 Gwh incl. Energy sector own consumption and grid loss in 2020, equal to 1.24 Gwh/hour in average. 57 Gwh of storage is then equal to 45 hours of average consumption.

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For solar heating there will be some need for seasonal storages from 2040 when solar thermal is expected to cover more than 10% of space heat demand outside district heating areas, and after 2040 also in service sector buildings.

About this note

This note was developed by Gunnar Boye Olesen, INFORSE-Europe in cooperation with Alda Ozola-Matule Latvian Green Movement and Janis Brizga from Green Liberty, Latvia, for the Vision2050 for Latvia. Read more about the vision for Latvia and for other countries at www.inforse.org/europe. Please send comments to ove@inforse.org.

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Annex 3:

Draft 2006-12-28

BALTIC ENERGY STRATEGY

I. INTRODUCTION

On 1st May 2004, Estonia, Latvia and Lithuania became full members of the European Union (EU). Membership opens the entire EU market for the Baltic economies with considerable opportunities for economic and cultural development. Common history, long-term cooperation and national policies harmonised with the EU policies, norms and standards create favourable conditions in the Baltic States for closer cooperation, and in particular in the energy sector.

Transition from a centrally planned to a free market economy in the Baltic States was accompanied by fundamental transformations: structural changes of the national economies, alteration of energy policies and gradual creation of market conditions. Over the last few years cooperation between the Baltic States has been directed towards preparation of common policy in the energy field, especially on creation of the sustainable, competitive and secure common energy market.

Currently the Baltic States altogether have a diverse energy mix, which is mainly based on contribution from oil shale in Estonia, hydro resources in Latvia and nuclear energy in Lithuania complemented with imported natural gas and oil products, and increasing share of local and renewable energy resources. Besides that, existence of the underground gas storage in Latvia and oil refinery in Mažeikiai is important facilities which contribute to energy security of the Baltic States.

However, the factors such as rapid economic growth in the Baltic States, significant increase of oil and natural gas prices, future decommissioning of Ignalina Nuclear Power Plant, the need for environmental upgrade of Narva Power Plants, dependency on gas supply from one supplier require an update of the common energy policy on future development of their energy sectors.

The Baltic States have comparatively well developed power, natural gas supply and district heating systems. The power and natural gas systems are well interconnected. However, interconnections outside the region are limited and oriented only towards Russia and Belarus. Up to now the Baltic States have no direct connection to the power systems of Central Europe. The dependence on gas supply from natural gas monopoly Gazprom is the major concern for the Baltic States, particularly taking into consideration the recent energy supply disruptions in Russia.

The Baltic Energy Strategy (hereinafter: Strategy) outlines a framework for the energy sector development in long-term perspective taking into consideration aspects of energy efficiency, energy security, sustainability and improved management. The Strategy focuses on strategic analysis of strengths and weaknesses in energy supply, threats for development of the energy sector and common activities directed to avoid feasible threats and to increase energy security in the Baltic States. The Strategy describes the most important measures which should be implemented seeking to ensure security of energy supply, to reduce negative impact from dominant dependency on energy import from one source and to improve the sustainability of the energy supply.

II. CURRENT SITUATION

The energy sector of the Baltic States has its strengths and weaknesses. It faces specific threats, however, has good opportunities for efficient and reliable operation. With more efficient use of the available opportunities and existing capacities, the energy sector of the Baltic States can enhance a more rapid economic development in the region, strengthening its competitiveness, reducing the possible threats and avoiding different unforeseen interruptions of energy supply.

Strengths

General

1) Diverse energy mix at primary energy supply;
2) Energy capacities are currently satisfactory to meet regional demands;
3) Relatively high level of qualified specialists in the energy sector.

Electricity

1) Strong interconnections between the Baltic States and with Russia and Belarus;
2) Diverse energy mix in electricity generation by technology and fuel;
3) Efficient co-operation between Baltic transmission system operators;
4) Current self-sufficiency in generation capacity.

Natural gas

1) Reasonably developed infrastructure;
2) Possibility to use alternative fuels by majority of largest customers;
3) Availability of gas storage facility.

Liquid fuels

1) Well-functioning markets;
2) Attractive transit route;
3) Availability of crude oil refinery;
4) Possibility to use non-conventional liquid fuels.

Weaknesses

General

1) Low energy efficiency in buildings, transport sector and district heating systems;
2) Different policy objectives among the Baltic States;
3) Small size of the energy markets;
4) Inadequate funding of education, research and development.

Electricity

1) Limited marketplace with small number of players on supply side;
2) Different policy objectives and legislation in the Baltic States;
3) Insufficient interconnection capacities with EU electricity markets;
4) Congestions in Russian transmission system may affect the electricity market functioning and operation of the power systems;
5) Insufficient technical quality of transmission and distribution systems;
6) Weak and non-transparent price signals for investments into new generation capacities;
7) Small size of the Baltic electricity market creates additional issues with large-scale nuclear power plants.

Natural gas

1) The Baltic States can currently buy natural gas only from Russia;
2) No state ownership in infrastructure companies;
3) Weak and non transparent natural gas supply contracts;
4) Inadequate regulation of the natural gas market;
5) Limited throughput of infrastructure.

Liquid fuels

1) Low current level of biofuels usage;
2) Still continued development of security stocks of liquid fuel creates vulnerability in cases of supply disruptions;
3) Influence of politics on transit/supply.

Opportunities

General

1) Clearer political signals about the priorities and objectives can create transparent regulatory framework for efficient long-term energy supply;
2) Utilization of available energy saving potential will reduce the growth rate of energy demand and generating capacities;

3) Economically justified larger contribution of available indigenous and renewable energy resources will reduce dependence on imported fuel;
4) Existing infrastructure and experience are supportive for construction of new nuclear power plant;
5) Universities and scientific institutions in the Baltic Sates are capable to prepare qualified specialists;
6) Modernization of the existing district heating systems will promote the development of combined heat and electricity production;
7) Timely introduction of new energy sources and technologies.

Electricity

1) Potential interest of market participants to develop and invest in the electricity market;
2) Construction of interconnections with power systems of Finland, Poland and Sweden would increase reliability of electricity supply;
3) Positive attitude of societies in the Baltic States towards the use of nuclear energy will support the construction of new nuclear power plant in Lithuania;
4) Existing potential to have modern power systems in relatively short period;
5) Potential for reasonable increase in the usage of renewable energy sources;
6) Application of UCTE conditions on security of electricity supply.

Natural gas

1) Development of existing and new natural gas storages;
2) Development of transit routes;
3) Potential construction of the liquefied gas import/export terminal;
4) Research and development of non-conventional gas;
5) Enlargement of gas usage.

Liquid fuels

1) Potential exploration of local crude oil;
2) Further development of the use of non-conventional fuels;
3) More efficient use of port facilities;
4) More efficient use of storage facilities.

Threats

General

1) Worsening of security of energy supply situation;
2) Creation of inadequate incentives by national legislations;
3) Absence of common energy policy;
4) Opposition from local public and local authorities (NIMBY effect);
5) Fragmentation of the EU energy markets;
6) Vulnerability from global trends;
7) Slow modernization of district heating systems;
8) Deficiency of qualified specialists.

Electricity

1) Potential lack of production capacities;
2) Potential dominance of power supplies with dumping elements from Russia;
3) Potential sharp increase of electricity prices;
4) Unwanted developments of energy-mix;
5) Possibility of major network outages and/or blackouts;
6) Uncertainty regarding long-term supply of fuel for power plants.

Natural gas

1) Unpredictability of supplies;
2) Higher dependence on natural gas supply after the closure of Ignalina NP.

Liquid fuels

1) Potential concentration of the market;
2) Potential crude oil and its products' supply interruptions;
3) Potential environmental impact of transit.

III. GOALS FOR THE ENERGY SECTOR IN THE BALTIC STATES

European energy security demands in the 21st century require the development of a European External Energy Policy (EEP) closely aligned to the further strengthening of the Common Foreign and Security Policy (CFSP). Means must be found to enhance the EU institutional framework for this purpose. EU-NATO cooperation covering energy security must be explored and supported.

Global environment for the energy sector development could be characterized by processes and events, which cause new challenges for the energy supply and national security of the Baltic States:

8) Rapid increase of hydrocarbons consumption in the world, which is growing faster than exploration and development of new deposits;
9) Large share of oil and gas deposits are concentrated in countries with unstable political regimes and centralised political control over energy export;
10) Complicated political relationships among Western countries and countries which have large share of energy resources;
11) Increasing geopolitical influence of certain energy exporting states over energy importing countries, including mechanisms to dictate conditions for this import;
12) Strengthening of the role of the main economics – USA, EU, China and India – in energy markets and their bilateral partnership with Russia;
13) Volatility of oil and gas prices and their dependence on political factors;
14) Increasing tensions regarding reduction of GHG emissions for national governments.

Taking into consideration requirements and provisions in the Treaty of Accession to the EU, Energy Charter Treaty, EU legislation and the Green Paper, the Strategy has three main pillars:

4) Security of supply;
5) Sustainability;
6) Competitiveness.

Under these pillars, the following strategic objectives have been set:

7) To integrate power and gas supply systems into the energy systems and energy markets of the EU;
8) To diversify primary energy sources and supplies, and increase the contribution of renewable and local energy resources;
9) To increase the energy efficiency at the demand side and in the energy transformation sector;
10) To develop the transit routes for energy products, including electricity;
11) To strengthen education, research and development in the energy sector;
12) To elaborate and implement a common policy on energy imports from non-EU countries.

IV. TASKS FOR THE POWER SECTOR

There are a number of different primary energy sources in use in electricity generation in the Baltic States: hydro, oil-shale, nuclear, natural gas, orimulsion, wind, landfill gas, biomass, fuel oil, etc.

In the case of Ignalina NPP decommissioning in 2009 the major part of electricity will be generated by existing power plants (modernisation of Lithuanian Thermal Power Plant, renovation of units at Balti and Eesti power plants, construction of modern combined power and heat generation power plants and power plants at district heating utilities and industrial enterprises) the existing available capacities in the Baltic power system will be sufficient to meet the regional demand until 2015. However, the construction of new power plants should be considered.

To reduce the dependence on expensive fossil fuels and harmful impact of emissions, and to increase overall energy security in the Baltic States, the construction of a new nuclear power plant should be studied in Lithuania. The small size of the Baltic power market (in 2015, expected maximum load is about 6000 MW) creates additional issues with large-scale nuclear power plants e.g., concerning reserve capacities.

Integration of the Baltic power systems into Central European and Nordic energy systems and closer collaboration with these countries, as well as expected distribution of load and generating capacities, stipulates a necessity to prepare strategy for the development of transmission system, action plan for its implementation and appropriate financial sources. Electricity distribution grid and transformer substations also should be renovated with a view to complying with increasing requirements for the reliability and stability of electricity supply.

In order to ensure the strategic reliability of electricity supply and integration into the EU internal market, the following measures must be taken:

7) To develop cooperation and collaboration of the Baltic States - to facilitate a competitive environment, to enhance transit and to promote common electricity market; to create a framework for green house gases (GHG) allocations;
8) To prepare an action plan regarding further integration of the Baltic power systems into markets of Central Europe and Nordic countries;
9) To renew and build transmission and distribution facilities;
10) To renew the large power production capacities;
11) To use possibilities and benefits from development of distributed electricity generation;
12) To increase the share of renewables in the electricity mix.

V. TASKS FOR THE NATURAL GAS SECTOR

The Baltic States have comparatively well developed technical systems of natural gas supply. Natural gas networks within the Baltic States are currently sufficient to cover the needs of the customers. The existence of gas storage in Incukalns with sufficient volume for the Baltic States and for North-West Russia provides reasonable security of gas supply in the region.

However, limited interconnection capacity between Latvia and Lithuania, limited output capacity of the storage in peak periods and limited interconnection capacity from Russia to the storage facility in Latvia are bottlenecks in the current natural gas networks in the Baltic States. Larger power stations and boiler houses have ability to use in the case of gas supply interruptions also light or heavy fuel oil or shale oil, decreasing so the vulnerability of the energy system from gas supplies.

Currently natural gas imports are handled by natural gas monopoly Gazprom and its subsidiaries. Domination of one natural gas supplier does not support liberalization of this market and dependence on supply from one source is the major concern. Furthermore, the governments of the Baltic States have no ownership in the transmission and storage of the gas companies in their territory. This fact makes it difficult to involve the projects of political interest in the investments strategies of the gas companies.

Taking into consideration the size and volumes of the Russian gas fields, the existing technical supply facilities and the more stringent environmental requirements, natural gas is one of the most attractive forms of fossil fuel in the Baltic States. In order to enhance reliability of the natural gas supply it is necessary:

1) To prepare feasibility study for construction of the regional liquefied gas import/export terminal and development of necessary infrastructure;
2) To prepare feasibility study for interconnection of Lithuanian and Polish natural gas systems;
3) To strive for financial support from the EU Structural Funds for construction of strategic pipelines connecting the Lithuanian and Estonian natural gas systems with gas networks in Poland and Finland.

VI. TASKS FOR THE LIQUID FUELS SECTOR

The share of petroleum products in the primary energy balance of the Baltic States currently constitutes about 26%. In 2005, total consumption of oil products amounted to almost 5 million tons. The retail market is well structured (several strong traders and suppliers) and the associated structures are operating properly. The ports of the Baltic States are well positioned for the large-scale liquid fuels transit from Russia to Europe and other countries as well as for their import from various countries. They have still a potential to be better exploited as liquid fuels transit hubs. There is one refinery with sufficient production volume (annual crude oil refining capacity is 10-11 million tons) within the Baltic States (in Mažeikiai) and several other refineries in reasonable range in the neighbouring countries.

In order to ensure reliable supply of the national economies with petroleum products, mandatory 90-day stocks will be accumulated gradually. All the Baltic States have a transition period for the creation of liquid fuels stocks. Currently only about half of these stocks are secured, which makes the Baltic States slightly more vulnerable to the potential risks of supply disruptions.

Indigenous oil resources are limited; however, extraction of local crude oil could be a competing source to imports of crude oil for several decades, maintaining the annual extraction level of about 0.2-0.4 million tons and reducing dependency on oil imports.

The share of petroleum products used for production of electricity and heat will decrease but fuel oil will remain a reserve fuel for thermal power plants and large district heating systems. The most noticeable increase in the consumption of light petroleum products is expected in the transport sector due to increasing international freight transportation and mobility of population.

An option for the future would be to produce transport fuels from oil-shale. The technologies for heavy fuel oil from oil-shale are today available in Estonia, and further development of oil-shale based diesel and gasoline is foreseen. The growing global interests for non-conventional liquid fuels will support the development of shale-oil production and would provide additional option for the increase the independence from imported energy resources.

There are several facilities in the Baltic States for production of biofuels and shale oil. Accumulated experience of biofuel production, existing and developing capacities of their production and expected international trends would support the implementation the EU objectives. Increasing consumption of biofuels will increase energy security of the Baltic States, and has also a potential to reduce harmful impact from transport on environment.

In order to enhance strategic reliability of the supply of the liquid fuels it is necessary:

1) To maintain the diverse structure of the liquid fuels market in the Baltic States;
2) To develop biofuels and non-conventional energy sources;
3) To build up efficiently the mandatory stocks of liquid fuels.

VII. CONCLUSIONS

Global environment for the energy sector development requires closer cooperation among the Baltic States, common energy policy and common decisions. Strategic analysis of strengths and weaknesses in energy supply, as well of potential threats will be useful for more efficient use of the available opportunities. Based on analysis performed in the Strategy appropriate measures (integration of power and natural gas systems into the EU energy systems, construction of new generation capacities, modernisation of energy systems, construction of a regional liquefied natural gas import terminal, faster utilization of justified local and renewable energy sources, increase of energy efficiency, etc.) directed to increase energy security in the Baltic States should be implemented. The Strategy could be supplemented by a corresponding Action Plan indicating the most important activities for the Baltic States.