Climate change mitigation policies in energy sector of Baltic States

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1. Introduction

The Baltic States—Estonia, Latvia and Lithuania—each signed the UNFCCC in 1992 and ratified it in 1995. They also signed the Kyoto Protocol in 1998 and ratified it in 2002. In accordance with the Kyoto Protocol, signatories should, by 2008–2012, reduce the level of their aggregate anthropogenic GHG emissions to 8% below 1990 levels. Current GHG emissions in the Baltic States vary, but are all significantly below the Kyoto target. As the fuel combustion sector is responsible for 75 to 86% of total GHG emissions, a reduction of emissions in this sector will have the greatest impact on lowering emissions. This sector will also face the greatest challenges in terms of complying with the Kyoto commitments.

This article surveys GHG emissions from fuel combustion in the Baltic States. It compares various national climate change mitigation policies in the three countries, and reviews their impact on the reduction of GHG emissions.

2. Energy sectors in the Baltic States

The three Baltic States are of similar territorial and population size, and are also similar in terms of geographic and climatic conditions. In addition, they have undergone similar economic and political developments in the recent past. However, the three States differ in the structure of their economies and their energy sectors. These differences have an impact on the quantity and intensity of respective GHG emissions.

Despite the recent slowdown in the global economy, the three Baltic States posted an average yearly increase of 6.6% in their real gross domestic product (GDP) during the years 2001–2005. Being small States—their combined population is only 7.2 million people—Estonia, Latvia, and Lithuania have succeeded in increasing their presence in the international community by joining forces. They have made joint approaches in a number of political and economic arenas, including joining the North Atlantic Treaty Organization (NATO) as well as the European Union (EU) in 2004.

The Baltic States are net oil importers, and depend on Russia for close to 90% of their supply. Only Lithuania has an oil refinery, located at Mazeikiai in the north-west, which sells its products both within the country and to Latvia and Estonia. Estonia and Lithuania are net electricity exporters, selling their surplus to neighbouring Latvia and to northwest Russia. Latvia is the only net importer of electricity in the region, buying from the other Baltic States and from Russia. Main economic and population statistics, and data on primary and final energy and electricity consumption in the Baltic States (IEA, 2002, 2005a) are presented in Table 1.

Table 1. Main economic and energy consumption indicators in the Baltic States, 2003

Main data	Unit	Lithuania	Estonia	Latvia
Population size	Thousands	3454	1354	2320
GDP PPP	billion US$	33,50	13,95	20,18
GDP/capita	US$/cap	970	1030	870
Primary energy supply	Mtoe	8,985	5,161	4,623
Final energy consumption	Mtoe	4,951	2,790	3,858
Gross electricity consumption	TWh	11,958	8,263	6,608
Final electricity consumption	TWh	7,179	5,563	5,126
Primary energy per capita	toe/capita	2,60	3,81	1,99
Final energy per capita	toe/capita	1,43	2,06	1,66
Gross electricity consumption per capita	kWh/capita	3570	6103	2848
Final electricity consumption per capita	kWh/capita	2078	4109	2209
Primary energy per GDP unit	toe/thou US$ PPP	268	370	229
Final energy per GDP unit	toe/thou US$ PPP	148	200	191
Gross electricity consumption per GDP at PPP	kWh/thou US$	357	592	327
Final electricity consumption per GDP at PPP	kWh/thou US$	214	399	254
FEC/TPES	%	55,1	54,1	83,5
Net import share in balance	%	42,7	27,5	68,3

As seen in Table 1, Estonia shows higher values than the two other Baltic States in both energy consumption per capita and primary energy intensity. Latvia presents the highest energy supply efficiency—mainly the result of its large share of hydro in generating electricity. A related observation is that Latvia has the highest final energy consumption per GDP, and the lowest primary energy consumption per GDP, which is reflected in its high final energy to primary energy supply ratio.

All three Baltic States are highly dependent on energy imports. Estonia has the lowest share of imports due to its access to domestic oil shale resources. Summary information on the primary energy mix in the Baltic States (IEA, 2002, 2005a) is presented in Table 2.

Table 2. TPES structure in the Baltic States in 2003

TPES structure, %	Lithuania	Latvia	Estonia
Oil products	28.7	29.3	20.1
Natural gas	25.2	29.1	11.1
Coal	1.6	1.6	0.9
Peat	0.2	0.7	2.8
Oil-shale	-	1.1	54.49
Firewood	7.8	29	10.9
Hydro	0.3	4.8	0.01
Nuclear	42.8	-	-
Net import of electricity	-6.6	4.4	-0.3
TPES, ktoe	8621	4480	4630

GHG emission levels in the Baltic States are largely determined by their primary energy mix (TPES). As Table 2 illustrates, this mix differs significantly among the three States. In Lithuania, nuclear energy provides more than 40% of the country's primary supply; in Estonia, about 55% of primary energy supply stems from oil shale; and in Latvia, firewood constitutes about 30% of the total primary energy supply. For Latvia and Lithuania, shares of oil products and natural gas supply are similar, while Estonia shows lower shares of natural gas and oil products due to its oil shale resources.

The share of renewables in Latvia's TPES exceeds 33%, mainly due to the use of firewood, with hydro contributing only about 5%. Lithuania has the lowest share of renewables in TPES, around 8%, mainly from biomass (Statistics of Lithuania, 2005). The situation in Estonia is similar (Statistical Office of Estonia, 2005), with renewables—mainly firewood—making up some 11% of TPES .

3. GHG emissions in the Baltic States

3.1 Trends

Figure 1 presents the evolution of GHG emissions in the Baltic States and respective Kyoto targets (IEA, 2005b). GHG emissions in all three Baltic States in 2006 were far below Kyoto targets, and implementing the Kyoto Protocol will ensure that emissions remain low in the future.

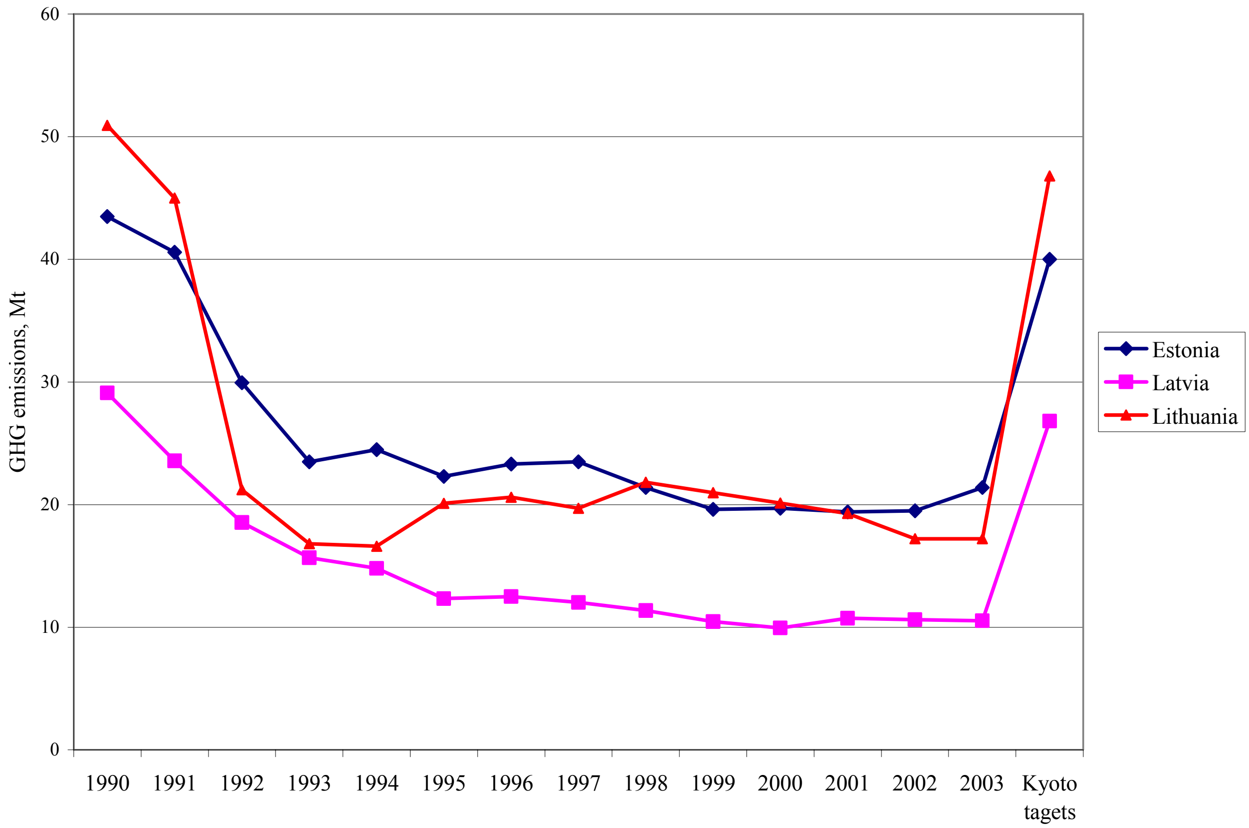

Figure 1. GHG emissions and Kyoto targets in the Baltic States

Since CO_2 is the main component of the greenhouse gases, it is a useful indicator to define the main trends in GHG emissions. CO_2 makes up about 88% of the total GHG emissions in Estonia?, more than 72% in Lithuania, and more than 77% in Latvia. GHG emissions, and CO_2, arise mainly from fuel combustion, which currently contributes between 75% and 86% of total emissions in the Baltic States.

There is a close statistical link between economic growth and rising CO_2 emissions. The relationship between GHG emissions and GDP for the three Baltic States is presented in Figure 2.

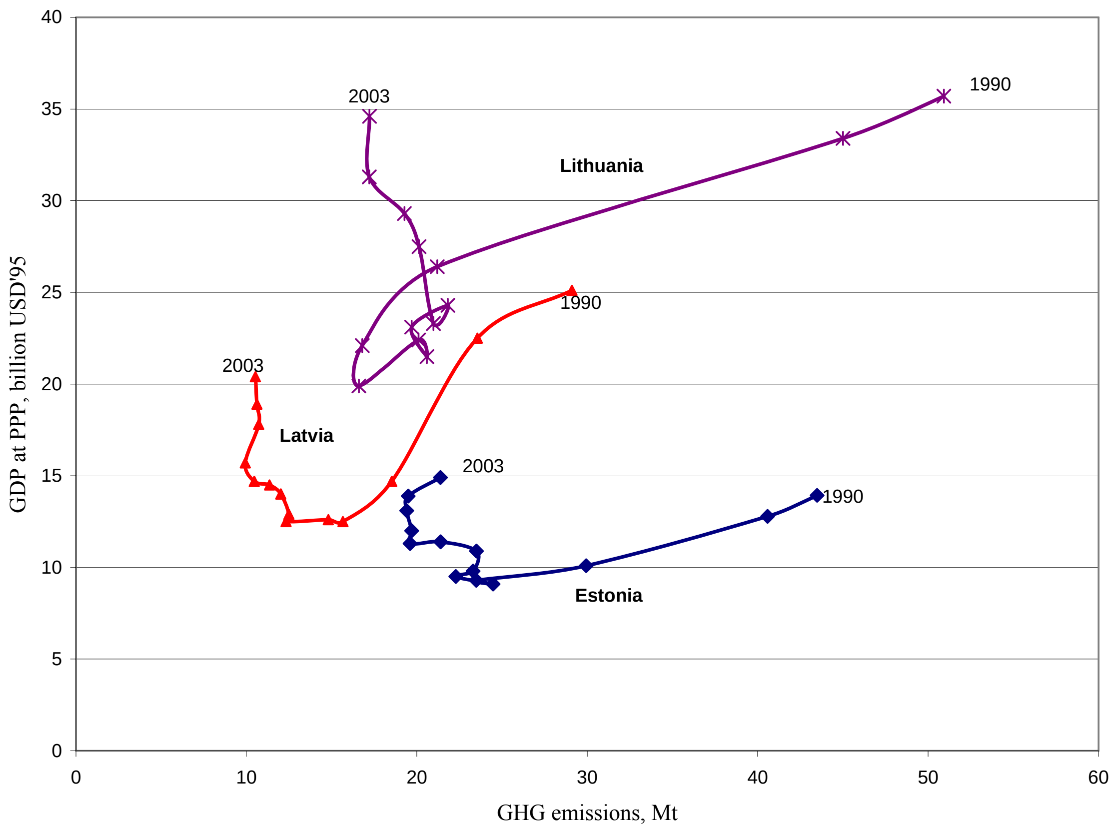

Figure 2. Relationship between GHG emissions and GDP at PPP in the Baltic States during 1990–2003

Energy prices also have a significant impact on CO_2 emission trends. Figure 3 shows the relationship between electricity prices for industrial consumers and GHG emissions from the electricity sector in the Baltic States during 1990–2003.

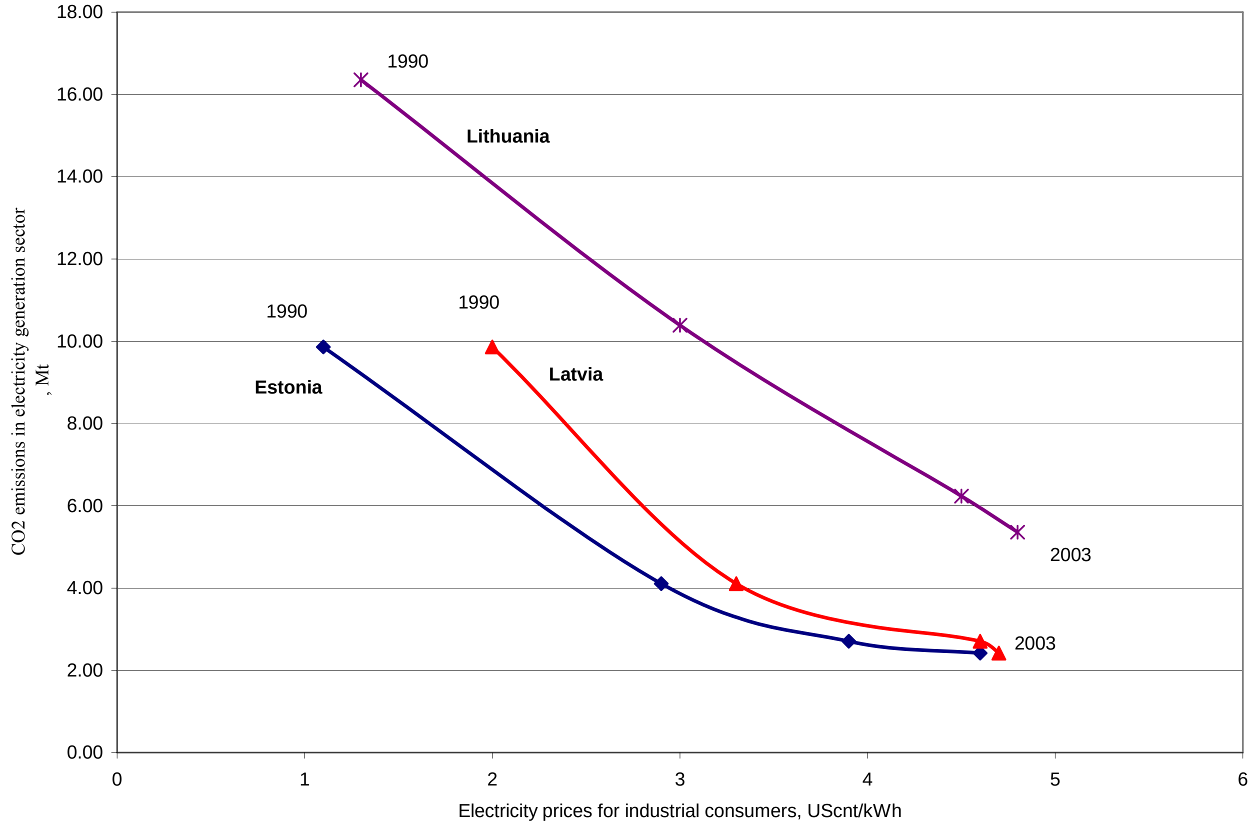

Figure 3. Relationship between electricity prices for industrial consumers and GHG emissions from electricity sector in the Baltic States during 1990-2005

As shown in Figure 3, electricity prices for industrial consumers rose following the price increase for primary energy sources. This price increase was followed by a decline in electricity production and consumption, and consequently by a decline in GHG emissions in the electricity generation sector.

3.2 Analysis of CO_2 emission indicators in the Baltic States

As CO_2 emissions from fuel combustion make up more than 70% of total GHG emissions in the Baltic States, this indicator was used to define the main trends in GHG emissions. The main GHG emission indicators analysed in this article are:

- CO_2 emissions linked to total primary energy supply (TPES);
- CO_2 emissions linked to gross domestic product (GDP);
- CO_2 emissions per capita; and
- CO_2 emissions per kWh electric power produced.

These indicators were developed using data on CO_2 emissions originating from fuel combustion from the International Energy Agency (IEA, 2005 b) and the ISED methodology developed by the International Atomic Energy Agency (IAEA, 2004).[1]

3.2.1. CO_2 emissions linked to total primary energy supply (TPES)

Carbon intensity of TPES has a significant impact on the carbon intensity of a country's economy, and on its total GHG emissions. CO_2/TPES is expressed in tons of CO_2 per ton of oil equivalent (toe), and indicates the carbon intensity of the primary energy supply in a country. Figure 4 presents the evolution of carbon intensities in the three Baltic States and the EU-15 average (IEA, 2003, 2005b).

[1] The "indicators for sustainable energy development" (ISED) framework were applied for defining the priorities of Lithuania's energy sector. For a detailed description of the methodology, see Streimikiene (2005).

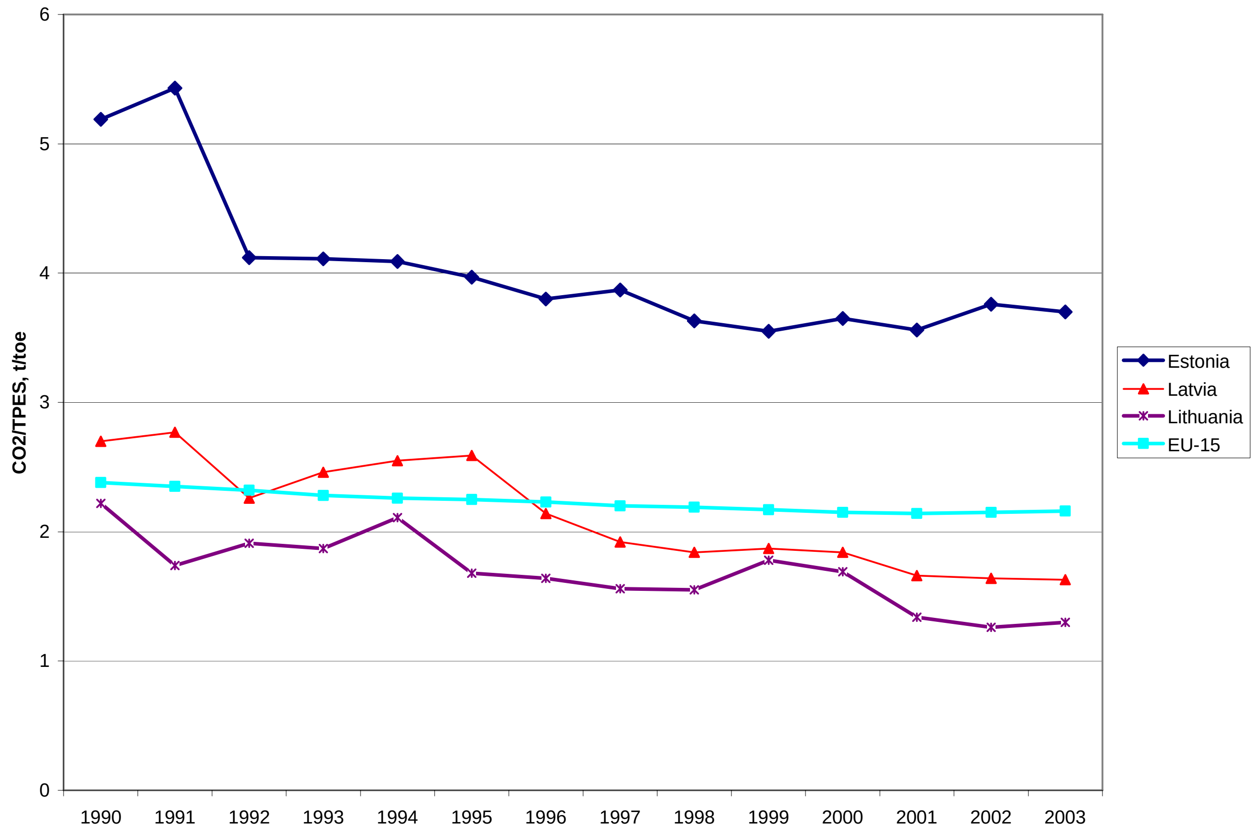

Figure 4. CO_2 per TPES in the Baltic States and EU-15

As shown in Figure 4, carbon intensity of TPES in EU-15 has been slowly decreasing, but is still higher than in Latvia and Lithuania, while significantly lower than in Estonia. Since 1999, carbon intensity of TPES has decreased in Latvia and Lithuania, whereas it has increased in Estonia, mainly from the country's increased use of its oil shale.

The low carbon intensity of TPES in Lithuania is due mainly to the country's heavy reliance on nuclear power for electricity generation. In Latvia, firewood and natural gas each account for 30% of the primary energy supply, together making up 60% of TPES, which has helped maintain a low carbon intensity.

3.2.2. CO_2 emissions linked to gross domestic product (GDP)

Figure 5 shows the relationship of CO_2 emissions to gross domestic product (GDP) in the three Baltic States and the EU-15 average (IEA, 2003, 2005b).

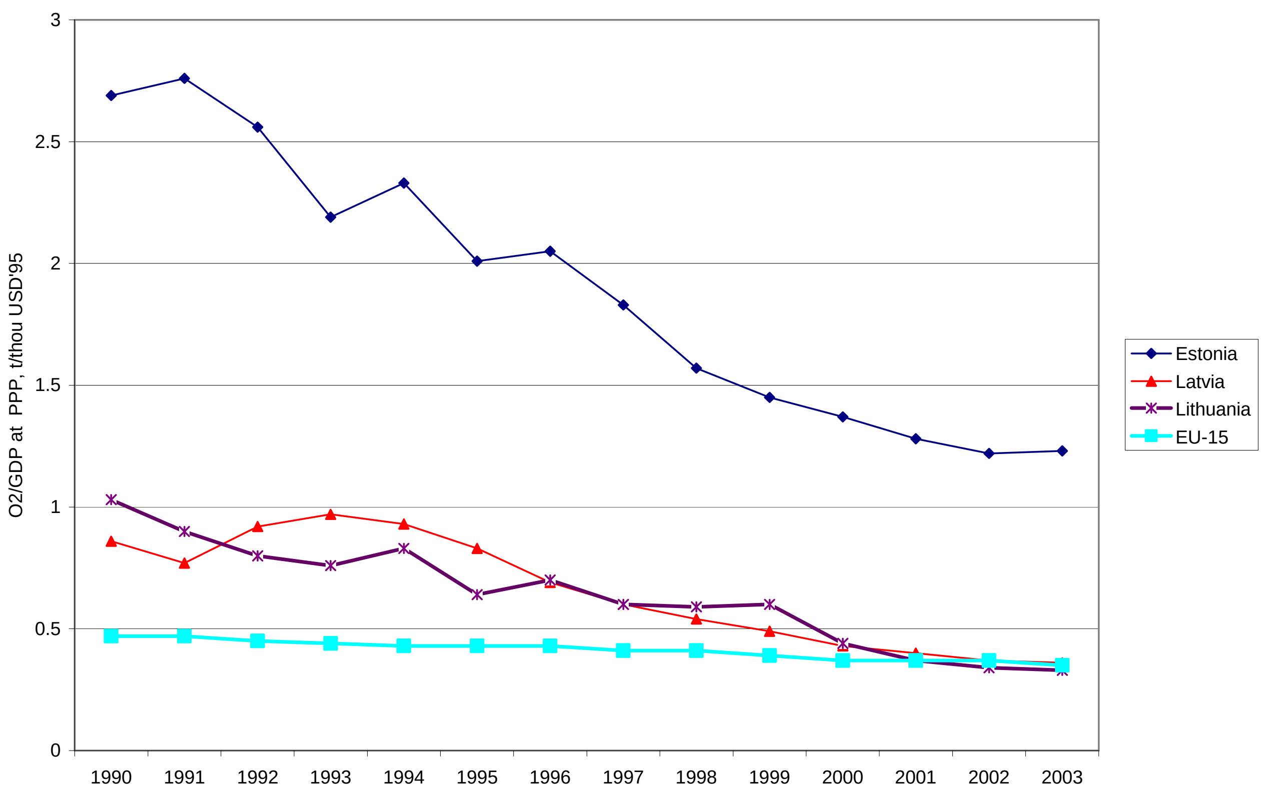

Figure 5. CO_2 per GDP at PPP in the Baltic States and EU-15

This indicator shows the amount of CO_2 emitted for each unit of GDP.[2] Figure 5 shows that the Estonian economy has had the highest carbon intensity. According to IEA data, Estonia ranks 15th among UNFCCC Parties in terms of high carbon intensity of GDP.

The Estonian economy also shows the highest energy intensity among EU member States. The main reason for this is to be found in the country's primary energy mix, with oil shale currently contributing almost 60%, a fuel of low calorific value (8.4 MJ/kg) but high carbon and ash content. The bulk of Estonia's oil shale is used to fuel power plants with a low average efficiency (about 30%), with the remainder being processed into shale oil, of which about 50% is exported. Estonia also exports some 13% of its electricity. The colder climate of Estonia, the northernmost of the three Baltic States, also influences energy consumption. The economies of Lithuania and Latvia, in contrast, have carbon intensities very similar to that of EU-15.

CO_2 intensity of GDP reflects an economy's contribution to global warming. In 1990, CO_2 intensity of GDP in Estonia was 2.7 kg/US$; by 2003, it had come down to 1.23 kg/US$. The declining energy intensity of GDP in the Baltic States over the 1990s led to declining CO_2 emissions. In Latvia and Lithuania, the substitution to fuels with less carbon content also worked to decrease carbon intensity of GDP.

3.2.3. CO_2 emissions per capita

Figure 6 shows CO_2 per capita in the Baltic States and EU-15 (IEA, 2003, 2005b).

[2] Expressed as kg of CO_2 per unit of GDP, valued in terms of in 1995 US$ adjusted for purchase power parities (PPP).

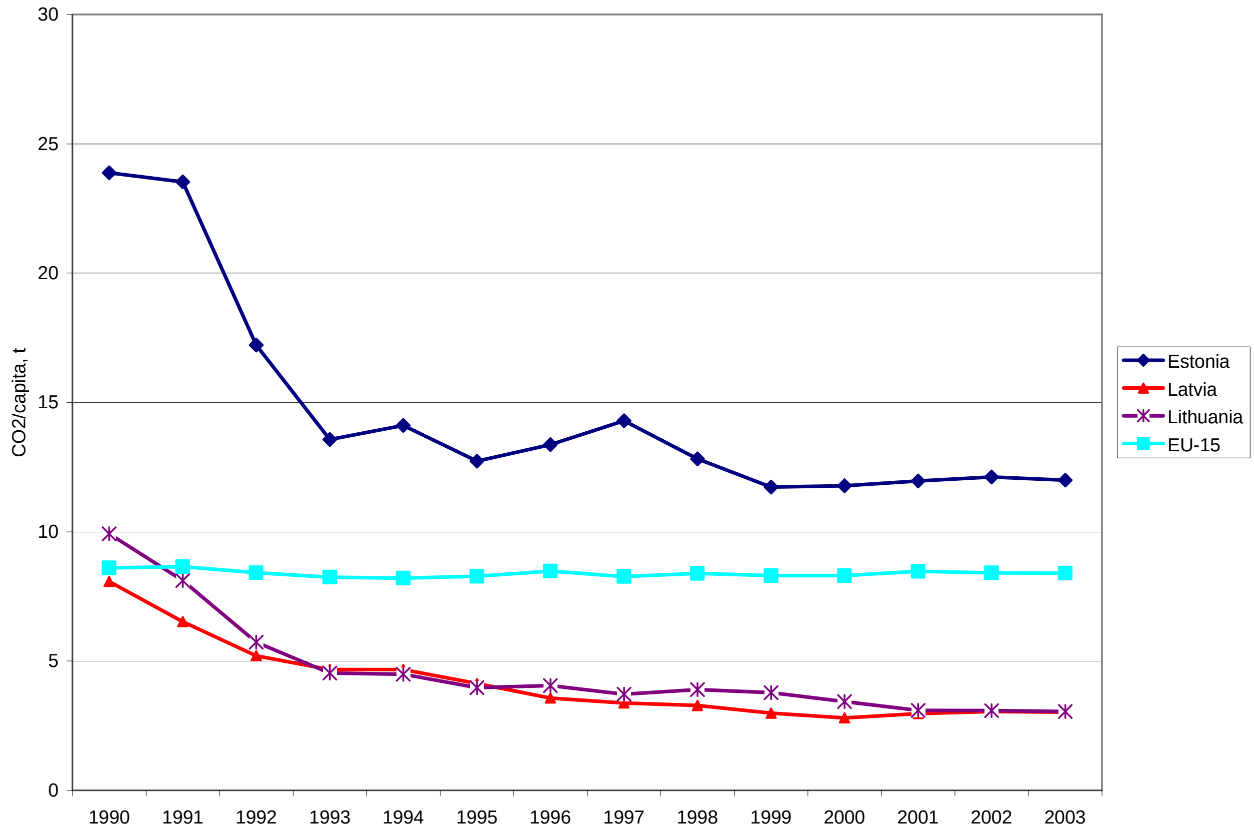

Figure 6. CO_2 per capita in the Baltic States and EU-15

In 1990, Estonia's CO_2 emissions per capita were about 24 tons, which declined to 12 tons by 2003. The 50% reduction was caused by a decrease in energy consumption in the country. Nevertheless, Estonia is currently the world's greatest emitter of CO_2 per capita . IEA statistics (2002) place the world average for CO_2 per capita at only 3.9 tons and the EU-15 average at 9 tons. The high value for EU stems mainly from the high energy intensity of its economy in general, and its high carbon intensity of TPES.

CO_2 emissions per capita were more than 3 t/year in Lithuania and Latvia in 2002. However, while per capita CO_2 emissions in EU-15 are almost stable indicate period, e.g. from 1990 they have been increasing since 2000 in the Baltic States.

3.2.4. CO_2 emissions per kWh electric power produced

In the Baltic States, 45–47% of CO_2 emissions from fuel combustion emanate from the power and heat sectors. Fluctuations over time in CO_2 emissions per kWh of electricity produced in the Baltic States and EU-15 is presented in Figure 7 (IEA, 2003, 2005b).

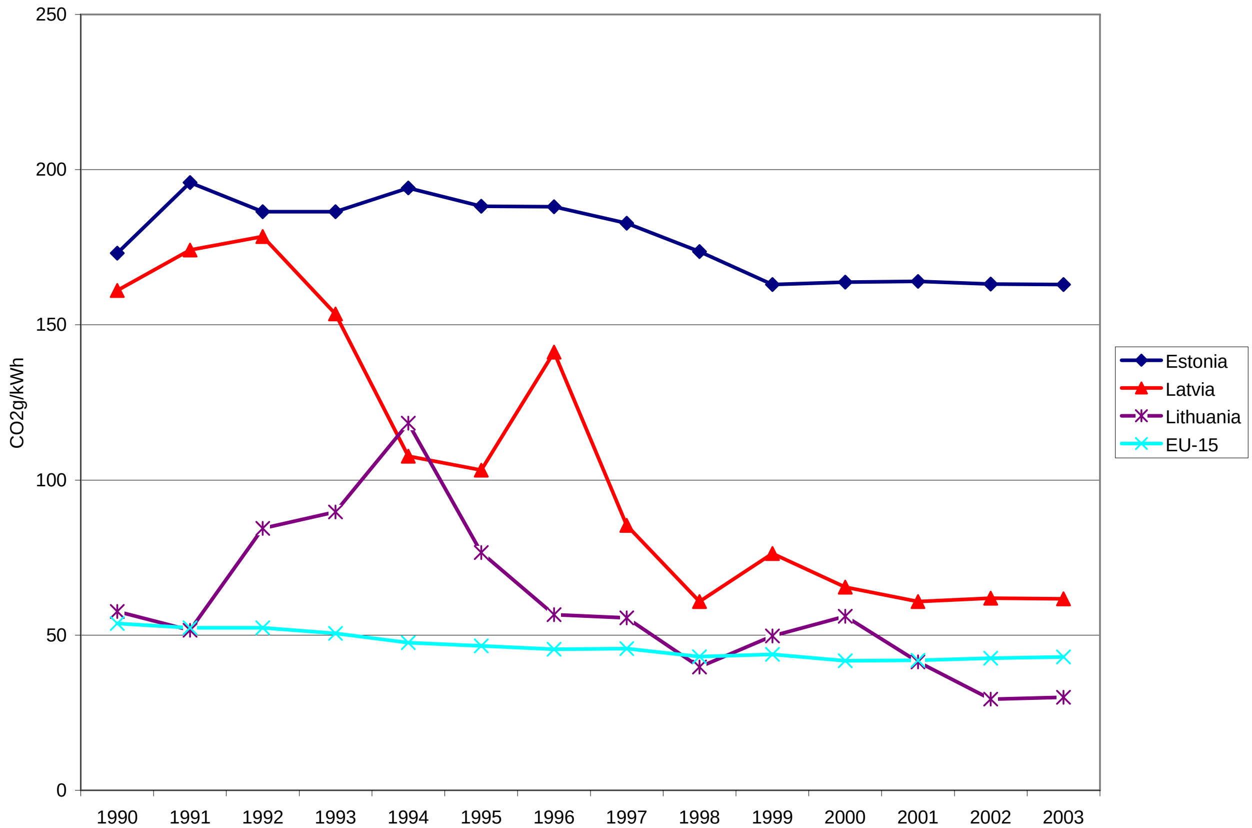

Figure 7. CO_2 per MWh of electricity and heat production in the Baltic States and EU-15

The ratio of CO_2 emissions/kWh is more than three times higher in Estonia than in the EU countries. The high value for Estonia stems mainly from the type of fuels currently used to generate electricity: about 99.98% fossil fuels, 93.5% of which is shale oil, and only 0.02% renewables. However, since 1995, CO_2 emissions/kWh have been decreasing in Estonia, Lithuania, and Latvia. Decrease in the latter is mainly due to the predominance of hydro in electricity production. Latvia's electricity generating capacity is dominated by the three hydropower plants on the Daugava River, with a combined share in electricity production ranging from 74% in 1998 to 62% in 2002. Thus, the country's power generation depends largely on the level of flows in the Daugava River. Why include the last sentence? Do the Daugava flows fluctuate?

Lithuania's CO_2 emissions per kWh of electricity produced are considerably lower than Estonia's, and also lower than Latvia's. This is mainly due to Lithuania's reliance on nuclear power, which produces 80% of its electricity since 1994. Please mention the fact that Ingalina is scheduled to close in 2009, only 2½ years from now. What are the plans for substitution? The opening of the nuclear plant had an immediate impact on lowering CO_2 emissions, which declined from 118 g/kWh to 76.6 g/kWh within one year of its operation. In 1995, the share of fossil fuels in electricity generation was 10% compared to 85% for nuclear power (Lithuanian Ministry of Economy, 2002).

For Estonia, Figure 7 indicates that, from 1999 onwards, there was an increase in CO_2/kWh The figure does not support this statement. It shows that CO_2/MWh went up from 1990 to 1991 then slowly down until 1999, and stayed approximately flat since then. Please explain/reword.. The same increasing emission trend can be observed in the CO_2 intensity of TPES (Figure 4). Again, the figure does not exactly support this statement. It shows a drastic decline from 1991 to 1992, followed by a basically descending trend. There is a slight increase in the average trend from 1999 to 2003, but the average from 1997 to 2003 is descending. Probably the imported oil price and increased use of shale had some effect, but there must have been other factors. This trend is caused by the increase of the share of oil shale in electricity production, which was resorted to in view of the increased prices of imported fossil fuels.

The four indicators described above—CO_2 emissions in relation to TPES, to GDP, per capita and per kWh of electricity produced—are linked through their common component: CO_2 emissions from fuel combustion. Carbon intensity of TPES is the driving force for all the indicators analysed in this article. The trends of these four indicators should be similar, although significant changes in GDP or population growth/decline, can have repercussions on carbon intensity of GDP and CO_2 emissions per capita.

4. Climate change mitigation policies in the Baltic States

The three Baltic States have very similar policies and use similar measures to regulate GHG emissions. These States have participated in the EU emission trading scheme (EU ETS) and hosted several events under the Activities Implemented Jointly programme (AIJ). GHG mitigation measures in the Baltic States were implemented mainly in an effort to gain EU accession. These fall mainly in the following categories:

- Pollution taxes and ecological tax reform
- Excise taxes
- Feed-in prices for electricity produced from renewable energy sources
- Feed-in prices for electricity produced by combined heat and power (CHP)
- Measures to increase energy efficiency
- Emissions trading scheme (EU ETS)
- Green tradable certificates (GTC)

4.1. Pollution taxes and ecological tax reform

The EU does not require pollution taxes in different States to be harmonized. Thus, pollution tax rates for stationary sources vary greatly between the three Baltic States. Lithuania grants exemptions for biofuels. These exemptions have had a positive impact on the penetration of renewables and, consequently, on the reduction of GHG emissions. Estonia implemented a CO_2 tax in 2005, which applies to installations under the EU emission trading scheme—combusting industries in the energy, iron and steel, mining and mineral processing, and paper and pulp sectors, as well as generating facilities exceeding 20 MW. Latvia also introduced a CO_2 tax in 2005, covering those combustion sources not covered by the EU scheme (Table 3) They could be listed.

In the spring of 2005, a broad-based working group was established in Estonia to identify principles for an ecological tax reform; these principles were subsequently presented to the Government. The draft reform was approved in principle by Estonian Government in July 2005. The reform calls for a partial re-orientation of taxes from focusing on income towards focusing instead on the use of natural resources and the pollution of nature. The broader goal of this tax reform is to reduce GHG emissions, to improve the competitiveness of Estonia, to support economic development and to reduce unemployment. The reform is based on the principle that the overall tax burden must remain the same. This means that the rise of environmental taxes and fees must be balanced by a decrease in income tax[3]. [Too much detail]

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[3]For articles analysing measures to increase the use of renewable sources of energy in the Baltic States, see Streimikienė and Bubelienė (2005) and Streimikiene (2004a). For an analysis of measures to improve energy efficiency in new EU member States, see Markandya *et al.* (2006). The direct climate change mitigation measures in Lithuania have been addressed in several articles, e.g. Streimikiene (2004b) and Streimikiene and Bubniene (2005).

In Estonia, the new Environmental Fees Act, which entered into force in January 2006, effectively contributes to environmental protection. CO_2 emissions charges are set to increase yearly until 2008; charges for discarding hazardous waste into the environment will rise until 2009; mineral extraction charges for oil shale will also rise until 2009. Water abstraction charges will rise on average 10% per year until 2013. Therefore total environmental taxes and fees, which were about 2.2% of GDP in 2005, are expected to increase significantly in the near future and should exceed 5% of GDP by 2009. In Lithuania, corresponding charges total some 2%, and 2.6% in Latvia, with over 80% coming from fuel excise duties.

Table 3. CO2 taxes in the Baltic States, EUR/t

Country	2005	2006	2007	2008
Estonia	0.72	1.0	1.5	2.00
Latvia	0.15	0.15	0.15	0.15
Lithuania	-	-	-	-

4.2. Excise taxes

The EU directive on the promotion of the use of biofuels and other renewables for transport[4] stipulates that member States were supposed to ensure that biofuels constituted a minimum of 2% of the fuel market by the end of 2005. Future targets were biofuel market shares of 5.75% by 2010, and 20% by 2020. The Baltic States have implemented this directive.

The main tool for the implementation of this directive is the increase of excise taxes on energy products. The EU directive for restructuring the community framework for the taxation of energy products and electricity[5] sets minimum levels of taxation for motor fuels; reduces taxes on fuels used for agriculture, horticulture and forestry, stationary motors, machinery used in construction, and vehicles used on public roadways; and minimises the taxes on heating fuels and electricity used in homes?. Implementation of the directive is expected to lead to reduced GHG emissions, while biofuels will become more competitive with fossil fuels in view of their tax exempt status. The Baltic States have been granted a transition period for the harmonization of their excise taxes.[6]

In general, excise taxes are very similar in the three Baltic States (Table 4), with Latvia having the lowest. The minimum EU tax rate for diesel will not be implemented in Latvia until 2013, as the country is enjoying one of the longest transition periods granted to new EU member States (Danish Energy Authority, 2003a). Estonia has been granted a transition period of six years, during which biofuels will be exempt from excise duty. [Too detailed]

The Baltic States currently do not tax natural gas. The EU energy taxation directive does not require them to do so, as the proportion of natural gas in their total energy consumption in 2001 was lower than 15%. However, there is no reason for natural gas to remain tax exempt, whether from an environmental point of view, or on the grounds of security of supply—all the gas is imported from Russia. Estonia has plans to tax natural gas together with shale oil from 2008 on, while Lithuania and Latvia have not yet made a decision in the matter.

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[4] Directive 2003/30/EC.
[5] Directive 2003/96/EC.
[6] According to EU Directive 2003/96/EC.

Estonia's Excise Duty Act currently exempts shale oil from excise duty if used for household or space heating purposes. However, from 1 January 2010 on, shale oil for space heating will also be taxed.

At present there are no excise duties on electricity consumption in the Baltic States. The proportion of all environmental fees and charges in the price of electricity to the end consumer is about 3%. This is about 3 times higher than the EU minimum excise tax rate on electricity. Since exported electricity cannot be taxed with excise, and imported electricity cannot be taxed with environmental charges, their combination in Estonia will be significant. The increase in revenue from excise taxes will bring about the shift from income taxes to environmental taxes foreseen in the 2005 tax reform, discussed above. This is expected to have positive impacts in terms of reducing energy intensity and GHG emissions.

Table 4. Excise taxes in the Baltic States in 2004 (in Euros)

Type of energy	Unit	Latvia	Estonia	Lithuania
Gasoline leaded	€/1000 litres	392	340	421.2
Gasoline unleaded	€/1000 litres	268	290	287.04
HFO	€ /t	14	10	15
Kerosene, diesel	€ /1000 litres	228	250	292
Heating oil	€ /1000 litres	20	26.84	21.02
Liquefied petroleum gas and gaseous hydrocarbons	€/t	117	100	126

4.3. Feed-in tariffs for electricity produced from renewable energy sources

The white paper entitled "Community strategy and action plan on renewable energy sources" urges member States to formulate indicative targets towards the ambitious target of doubling the overall share of renewables in the EU by 2010. The indicative target sets renewables at 12% of the total primary energy consumption within EU by 2010, and contains a strategy and an action plan to achieve this target. Lithuania has adopted the same target for renewables in TPES in its National energy strategy (Ministry of Economy of Republic of Lithuania, 2002). Estonia and Latvia established their indicative targets for renewables in TPES for 2010 at 15% and 50% respectively.

The EU directive on the promotion of electricity produced from renewable energy sources in the internal electricity market[7] is also being implemented in the Baltic States. Based on the requirements of this EU directive (Table 5) (Streimikiene, Punys, Burneikis, 2005), the Baltic States have set ambitious targets for an increased share of renewables in electricity production. This is expected to have a significant impact on the reduction of GHG emissions. The estimated impact can be calculated on the basis of the planned TPES and electricity generation structure in 2010.

Table 5. Targets of the Baltic States according the requirements of 2001/77/EC Directive

Country	Electricity production from renewables in 1999, TWh	The share of renewables-E in electricity consumption in 1999, %	In 2010 the share of renewables-E in electricity consumption of 2000 level, %
Estonia	0.02	0.2	5.1
Latvia	2.76	42.4	49.3
Lithuania	0.33	3.3	7.0

The main tool used in the Baltic States is the application of feed-in tariffs for electricity produced from renewables. In Latvia and Estonia such tariffs are based on the average price of electricity in previous years. The same coefficients are applied to the purchasing price increase for all types

[7] EU Directive 2001/77/EC.

of renewables, although Latvia applies a higher coefficient (2) than Estonia (1.8). It has to be noted that Latvia has stated the restrictions on power plant's capacity and it's commencing time to receive such support.

Latvia has established this doubled tariff on small scale hydro and wind plants (with capacity less than 2 MW) as long as the operation of the plants and their equipment commenced prior to 1st January 2003 for hydro plants or 1st June 2001 for wind plants. This support is available for eight years from the commencement of operation. After this period the Regulator shall determine the purchase price. The Regulator will also determine the purchase price from stations that started operations after those dates. For small-scale power plants with a capacity of less than 7 MW that use municipal waste or biogas as fuel and began operations before 1st January 2008, the purchase price corresponds to the average electricity tariff. For the remaining power plants using renewables the electricity tariff is determined by the Latvian Regulator.

Lithuania has fixed feed-in tariffs set for different types of renewables. The highest price is being applied to wind energy, with a lower tariff for small hydro and biomass (Danish Energy Authority, 2003b). A summary of feed-in tariffs for the Baltic States is presented in Table 6 (Streimikiene, Bubeliene, 2005). This table shows that the highest feed-in tariffs are applied in Latvia.

Table 6. Feed-in tariff in the Baltic States in 2004, €/kWh

RES Source	Latvia	Estonia	Lithuania
Hydro Power Plants	0.9316*	0.486	0.58
Wind Power Plants	0.9316**	0.486	0.64
Power Plants, using biofuel	1) 0.4658*** 2) determined by the Regulator	0.486	0.58

*for plants < 2MW, commenced before 01.01.2003
**for plants < 2MW, commenced before 01.06.2001
***for plants < 7MW using municipal waste or biogas commenced before 01.01.2008

4.4 Feed-in prices for electricity produced by combined heat and power (CHP)

The EU directive[8] on the promotion of cogeneration based on a useful heat demand in the internal energy market aims to increase energy efficiency and improve security of supply. This is to be achieved through creating a framework for high efficiency cogeneration of heat and power based on useful heat demand. The strategic goal of EU-15 is to double the share of electricity produced by combined heat and power (CHP) by 2010. Lithuania's National Energy Strategy, adopted in 2002, establishes a target of 35% of electricity to be produced from CHP by 2020. An increase in the use of CHP in electricity production will increase efficiency, and thus act to lower GHG emissions. The reduction can be projected on the basis of the forecast of electricity generation structure in 2010 and 2020.

Latvia also has the target to double the CHP share in electricity production by the year 2010. However, unlike Lithuania and Estonia, Latvia already has policies in place for this purpose.[9]

4.5 Measures to increase energy efficiency

The main EU directives targeting the improvements of energy efficiency are the following:

- The directive on energy end-use efficiency and energy services,[10] which targets the reduction in energy consumption at 9% by 2015.
- The directive on energy performance in buildings,[11] which targets savings in energy used for heating, air-conditioning, hot water and lighting at around 22% by 2010.

The buildings directive has been implemented in the Baltic States, and the impact of its implementation on the reduction of GHG emissions can be evaluated based on the targets for energy savings, forecasts for energy structure and carbon intensity of final energy consumption. The impact of the recently adopted "Directive on the improvements of the end-use energy efficiency" wasn't incorporated in the energy forecast and therefore wasn't assessed in terms of GHG emission reduction in the study (Nordic Council of Ministers, 2004).

4.6 Emissions trading scheme

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[8] EU Directive 2004/8/EC.

[9] The following feed-in tariffs for electricity produced by CHP are currently applied in Latvia. From co-generation plants with a capacity of less than 0.5 MW: for indigenous fuels, the average price (€0.4658/kWh) is multiplied by 1.12; for imported fossil fuels the average price is multiplied by 0.9. For plants with capacity from 0.5 - 4 MW, the average price of indigenous fuels is multiplied by 0.95, while for imported fossil fuels the multiplier is 0.75.

10 EU Directive 2006/32/EC.

[11] EU Directive 2002/91/EC.

EU Directive 2003/87/EC establishes a scheme for greenhouse gas emission allowance trading within the Community (EU ETS) commencing 1 January 2005 until 31 December 2007 for its first operating period. The scheme covers all plants in the energy sector, iron and steel, mining and mineral processing, and paper and pulp industries, as well as all generating facilities with a rated thermal input exceeding 20 MW. Member States are called upon to formulate national allowance plans (NAPs) outlining their major polluting installations, and corresponding pollution allowance allocations, to be approved and adopted by the Commission.

As the three Baltic States differ in their Kyoto targets, current emission levels and energy mix, their various allocations also vary significantly. Table 7 summarizes data in respective national allocation plans which were submitted to the European Commission in September 2004 and accepted after consultations.

Table 7. Data submitted by Baltic States" national allocation plans

Country	Emissions in 1990	Kyoto target	Emissions in 2001	CO_2 amount allocated for trading in 2005 – 2007 t/year
Latvia	29.1 Mt	26.8 Mt	11.18 Mt*	4 Mt
Lithuania	54.6 Mt	50 Mt	20.6 Mt**	12.2 Mt
Estonia	43.5 Mt	40 Mt	19.43 Mt***	21.6 Mt

*in emission trading sector – 3.7 Mt
**in emission trading sector –7.3 Mt
*** in emission trading sector – 14.6Mt

Among the three Baltic States, Estonia allocated the highest amount of tradable allowances: 56.86 Mt in the first period, 2005-2007, although Lithuania, allocating 36.8 Mt for the three year period, actually had higher total GHG emissions both in 1990 and in 2001. Latvia allocated 12 Mt for the first trading period. Estonia's high allocation is attributable to its highly polluting fuel combustion sector, especially its energy transformation sector, which accounted for 87% of total

GHG emissions in 2001, while comparative values for Lithuania and Latvia were 30% and 23% respectively.

4.7. Green tradable certificates (GTC)

Estonia is the only Baltic State that has implemented the green certificate trading (GTC) system, although its version of the scheme is slightly different from that in other EU member States being voluntary and having no legally binding obligations for consumers (Streimikiene and Bubeliene, 2005).

A Europe-wide GTC scheme might also become implemented in 2008 or 2010, following a report and a proposal from the European Commission in 2005. High efficiency cogeneration can also be enhanced via the scheme.

5. Estimated impacts of EU directives on the reduction of GHG emissions

Parties to the UN Framework Convention on Climate Change (UNFCCC) are required to report on their climate change mitigation policies in their national communications to the Convention secretariat and to present an evaluation of policy impacts. The evaluation of impacts presents many methodological difficulties, and various approaches are available for performing the task.

The national communications by the Baltic States on the impacts of climate change mitigation policies in their countries were incomplete, and more qualitative than quantitative.

As mentioned above, the key driver for the implementation of climate policies in the Baltic States was satisfying the requirements for EU accession. The following were the main efforts, and corresponding measures taken or EU directives/white papers implemented (Nordic Council of Ministers, 2004):

1. *Increasing the use of renewable energy sources.* EU white paper on renewable energy (1997); EU directives on renewable electricity and biofuels (2001/77/EC, 2003/30/EC);
2. *Increasing energy supply and transformation efficiency*. EU directive on the promotion of CHP (2004/8/EC), and rehabilitation of the centralized heating system; What is the centralized heating system SINGULAR? ;
3. *Increasing energy use efficiency.* EU directive on the energy performance of buildings (2002/91/EC); implementation of energy efficiency programmes;

4. *Promotion of low carbon intensive, cleaner fuels*. EU directive on GHG emission trading (2003/87/EC); implementation of directive on taxation of energy products (2003/96/EC).

As all three Baltic States have implemented the above EU directives, the same criteria were developed to evaluate their effect in lowering emissions, based on the study results (Nordic Council of Ministers, 2004). Forecasts were made of the future development of the energy sector in each of the three Baltic States using the scenario approach and various modelling tools. Based on current energy intensities and potential for energy savings, assumptions were made as to possible energy intensity decrease in each country. Requirements of all EU directives were included in the scenarios. Table 8 summarises the effects of the policies implemented in each country.

Table 8. Projected impact of climate change mitigation policies on the reduction of GHG emissions in the Baltic States (in Mt of CO_2)

Policies	**2005**	**2010**	**2015**	**2020**
Estonia				
Total in energy generation	0.66	1.074	1.209	1.39
Implementation of renewables-E directive 2001/77/EC by guaranteed purchase, feed-in prices, VAT exemptions on electricity from renewables, GCT, CO_2 taxes	0.052	0.368	0.500	0.680
Implementation of tax exemption for biofuels, Feed-in prices, CO_2 taxes,	0.0034	0.006	0.0087	0.01
Implementation of Directive 2001/80/EC on large-scale combustion by renovation of Narva power plants	0.600	0.700	0.700	0.700
Total in transport	0.02	0.065	0.071	0.077
Implementation of national development plan for the transport sector by increasing the share of public transport and new low-emission cars	0.0027	0.0061	0.009	0.012
Implementation of biofuels directive 2003/30/EC by excise exemptions for biofuels	0.017	0.059	0.062	0.065
Total in industry	0.0002	0.0008	0.0012	0.0014
Implementation of Energy conservation programme measures in cement and lime production	0.0002	0.0008	0.0012	0.0014
Total in households by implementing Energy conservation programme, Buildings directive (2002/91/EC)	0.0008	0.0012	0.0015	0.0019
Total impact	**0.676**	**1.141**	**1.147**	**1.471**

Lithuania				
Total in energy generation	3.306	3.846	4.279	4.734
Implementation of renewables-E directive 2001/77/EC by guaranteed purchase and feed-in prices	0.322	0.302	0.376	0.451
Implementation of the White paper on renewables strategy by VAT, Excise tax exemptions for biofuels, Feed-in prices	2.77	3.20	3.50	3.80
Implementation of CHP directive 2004/8/EC	0.304	0.344	0.403	0.483
Total in transport	0.52	0.697	0.723	0.8
Implementation of energy efficiency programme	0.442	0.442	0.41	0.41
Implementation of biofuels directive 2003/30/EC by VAT, excise and pollution tax exemptions for biofuels	0.078	0.255	0.313	0.39
Total in industry	0.51	0.48	0.44	0.42
Implementation of energy efficiency programme	0.51	0.48	0.44	0.42
Total in households	0.12	0.12	0.12	0.12
Implementation of energy efficiency programme, Buildings directive (2002/91/EC)	0.12	0.12	0.12	0.12
Total impact	**4.456**	**5.143**	**5.562**	**6.074**
Latvia				
Total in energy generation	0.266	0.572	0.806	1.017
Implementation of renewables-E directive 2001/77/EC by guaranteed purchase of electricity and feed-in prices	0.12	0.307	0.475	0.686
Implementation of CHP directive 2004/8/EC by guaranteed purchase of electricity, feed-in tariffs for small producers	0.146	0.265	0.331	0.331
Total in transport	0.143	0.367	0.469	0.675
Implementation of biofuels directive 2003/30/EC by excise tax exemptions for biofuels	0.073	0.273	0.313	0.338
Creation of optimal transport by implementing Riga city air quality improvement programme etc.	0.07	0.094	0.156	0.337
Decrease of energy intensity of economy by implementing National energy efficiency programme in all sectors of economy	1.091	2.838	4.966	7.661
Reduction of CO2 quotas for public utilities defined by NAP	0.027	0.126		

New building standards, financing schemes for multiflat dwellings renovation, implementation of Buildings directive (2002/91/EC).	0.36	0.36	0.36	0.36
Total in households	0.43	0.486	0.36	0.36
Total impact	**1.500**	**3.777**	**6.241**	**9.353**

As seen from Table 8, although the three countries implemented similar GHG emission reduction measures, the effects were very different. Of course, specific climate change mitigation measures were implemented in each country. Thus, Estonia's national development plan included plans for the renovation of the Narva power plant; and the implementation of air quality improvement programme for the city of Riga. However, these measures do not change Estonia's emissions significantly.

The differences in policy impact on lowering emissions are mainly related to the size of the country, to the primary energy supply, and to the final energy consumption. Other factors lowering GHG emissions are energy mix of TPES, the relative share of renewables foreseen in TPES and changes in electricity consumption from implementation of the EU white paper on renewables. A sensitive issue is the expected decrease in energy intensity of the three national economies. The assumptions in expected decreases, made for each country to model future energy sector development patterns, were crucial for the projections of GHG emissions and impacts on the introduced EU energy and environmental policies.

6. Flexible Kyoto mechanisms

There are 6 new market-based climate change mitigation tools under the Kyoto Protocol:

- The EU GHG emission trading scheme;
- Three flexible mechanisms under the Kyoto Protocol: Joint Implementation (JI), International Emission Trading and Clean Development Mechanism (CDM).
- Green Tradable Certificates (GTC); and
- White Tradable Certificates for energy savings (WTC) recently being tested in Italy.

The impact of these measures was not evaluated in the "with measures" scenario. They should be included in the "with additional measures" scenario.

Joint Implementation (JI) is a specific form of emission trading at project level. Annex I Parties to the Convention can undertake projects (e.g. fuel switching for a power station) with other Annex I Parties, which result in additional emission reductions in the country where the project is located. Those reductions can be used to increase the emission allowance of the Party financing the project, while the emission allowance of the Party where the project is carried out is correspondingly reduced.

Clean development mechanisms work in a similar way to JI. The difference is that under CDM non-Annex B Parties to the Convention can undertake projects with Annex B Parties, which results in additional emission reductions in the country where the project is located.

The EU emission trading scheme (EU ETS) is the first such venture on an international scale. The scheme will be implemented independently of the Kyoto Protocol, but will be linked to the international emission trading and other flexible Kyoto mechanisms. In order to ensure the coherence between international and EU emission trading related matters, a linking directive was adopted. The aim of this directive is to allow the emission reduction units gained from JI and CDM to be accepted as equivalent to European tradable emission permits. From 1 January 2005, European firms were able to use CDM credits (certified emission reduction units, CERs), from 2008 they will be able to use JI credits (emission reduction units, ERUs).

The core element of this directive is to extend recognition to JI and CDM credits as equivalent to EU tradable emission permits. Linking will increase the diversity of compliance options, thereby leading to a reduction of compliance costs for installations in the scheme. Linking will improve the liquidity of the European market of tradable GHG emission permits and lower their market price.

Although the EU GHG ETS was implemented in 2005 and the related linking directive allows GHG emission credits from CDM and JI to be transferred in tradable emission permits from 2005 or 2008 respectively, these 6 market-based mechanisms would not start to interact until 2008-2010. This is because the Europe-wide GTC scheme can only be implemented in 2008-2010, following a report and a proposal from the European Commission in 2005. The fate of the Europe-wide TWC scheme is unclear. However, there are many discussions about possible integration of these schemes and possible advantages of such combination on GHG emission reduction (Andersen, 2000; Malaman, Pavan, 2002).

The Baltic States have rather a lot of experience in the first stage of JI and AIJ. The main projects were developed by Sweden, Denmark and other Nordic countries. Latvia has signed a memorandum of understanding with Denmark and Austria. Estonia has signed memoranda of understanding with Finland, the Netherlands and Denmark.

Latvia has hosted 24 AIJ projects, (14 on biomass conversion and 10 on energy efficiency improvements in heat supply and buildings) supported by Sweden (Ministry of Environment of Republic of Latvia, 2002). It also hosted an ambitious wind park project implemented under the AIJ scheme supported by Germany and an additional 2 projects on biomass conversion and small scale CHP development supported by Denmark. The Solid Waste Management & Landfill Gas Recovery AIJ project in Latvia was funded by Denmark, the World Bank and the Global Environmental Facility (GEF).

In cooperation with the Netherlands, two documents of background analysis had been produced in Latvia – a Joint Implementation Action Plan for 2001-2004 and a Joint Implementation Policy. The objective of these documents is to support the Latvian Government in the development and implementation of a national policy for JI by providing the required background information for decision-making and by providing recommendations for policy measures and implementation actions. The JI policy background analysis document contains an overview of the existing climate change policy framework in Latvia, and a detailed analysis of past experience, risks and benefits of potential JI projects.

Estonia has hosted 21 AIJ projects on biomass conversion supported by Sweden, 4 JI projects on biomass conversion supported by Finland and 2 wind farm projects implemented with the support of Denmark and the Netherlands.

Although Lithuania hasn't signed a memorandum of understanding with any other country, there have been more than 30 projects implemented according to the AIJ scheme in Lithuania. Lithuania hosted 11 biomass conversion projects, implemented according to the AIJ scheme with

Swedish support; 15 biomass conversion projects were implemented with Danish support; and a Geothermal Demonstration Plant was implemented with support from Denmark, the World Bank and GEF. A package of 7 biomass conversion projects under the JI scheme was submitted by France. Lithuania has no JI strategy but it has introduced a legal act regulating implementation of JI and it has established the strategic directions for the implementation of JI. However, this document cannot be considered as JI implementation strategy because it lacks many important issues attributable to strategic documents such as background, analysis of situation, including GHG emission levels and trends, climate change mitigation policies in place, review and evaluation of the main findings from AIJ, etc.

Before entering the EU, the Baltic States were attractive host countries for AIJ. However, because the baseline has been lowered due to the need to comply with EU environmental directives, any JI projects are now in baseline in the Baltic States. The implementation of EU emission trading and linking directives will also have a negative impact on JI in the Baltic States (Morthorst, 2001). Even though the Baltic States are host countries for JI, developed countries will undertake JI and CDM projects in countries outside the EU zone because the price of generated ERUs and tradable emission permit will be the same in internal EU GHG markets. Therefore, the incentives of project developers to launch JI inside the EU have diminished. Welfare graphical analysis of interlinkages between 3 market-based GHG emission reduction tools (EU ETS, JI, and CDM) indicated that the implementation of linking directives may have a detrimental effect on the deployment of renewables in the Baltic States. The negative impact of the linking directive can be mitigated by the implementation of the European-wide GTC scheme, which will generate additional revenues to renewables-E producers in the EU and Baltic States (Nordic Council of Ministers, 2004).

7. Institutional framework for climate change mitigation

The institutional structure for climate change policy implementation in the Baltic States is similar though some differences exist. In all countries, the institution in charge is the Ministry of Environment. In Lithuania the main functions of implementation of climate change mitigation policy were assigned to the Lithuanian Environmental Investment Fund. The Environmental Investment Centre in Estonia, which performs similar functions to the Lithuanian Environmental Investment Fund, is not engaged to the same extent in climate change mitigation policy.

Estonia has only recently adopted a climate change mitigation policy document: Greenhouse Gas Emission Reduction Programme for 2001–2010 (Ministry of Environment, 2005). Lithuanian and Latvian climate change mitigation strategies are outdated; Lithuania's climate change mitigation strategy was adopted in 1996 (Ministry of Environment of the Republic of Lithuania, 1996) and Latvia's National Climate Change Mitigation Policy Plan was adopted in 1998. However, Latvia has included a chapter on climate change mitigation actions in the latest National Environmental Policy Plan (Ministry of Environment of the Republic of Latvia, 2004). It is anticipated that a new Latvia National Climate Change Policy was adopted in the 2005.

The recently completed "Poland and Hungary: Assistance for Restructuring their Economies" project (Phare), includes some important recommendations for the strengthening of Lithuanian institutional capacity in the area of climate change mitigation and proposes new insights into climate change mitigation policy development.

8. Conclusions

Although the Baltic States have implemented similar GHG emission reduction tools, mainly driven by the requirements of EU accession, the effect of these measures on GHG emission reductions is be very different. The impact of polices on the reduction of GHG emissions is related to the size of the country and especially primary energy supply and final energy consumption levels. The structure of TPES and the indicatives shares of renewables for the Baltic States foreseen in TPES and electricity consumption based on EU White paper on renewables and Directive 2001/77/EC have also had significant impact on the differences in policies" effect on the reduction of GHG emissions. The most sensitive issue in the assessment of impact on the reduction of GHG emissions is the expected decrease of energy intensity of national economies. The most significant impact of the implementation of GHG emission reduction of the EU requirements will be seen in Lithuania. The lowest impact will be seen in Estonia.

The most significant resources that can assist in the preparation of climate change mitigation policy in the Baltic States, are the National Communications to the UNFCCC. Estonia and

Latvia have submitted fourth National Communications to the UNFCCC. Lithuania has more problems with the preparation of GHG inventory reports and National Communications than the other Baltic States; so far it has only submitted two National Communications and all of them were identified by the UNFCCC secretariat as very weak. GHG emission projections were not presented according to the UNFCCC guidelines; the effects of policies and measures were not evaluated; and the "with measures" scenario, which is obligatory for National Communication, was not presented. The National Communications of the other Baltic States have also had methodological difficulties and uncertainties.

The authors of this paper believe this paper can also make a significant contribution to the development of climate change mitigation policy in the Baltic States" energy sectors and can serve as the background document for the preparation of amended climate change mitigation strategies and new National Communications to the UNFCCC.

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