DOI: 10.20472/EFC.2017.007.015

ASTA MIKALAUSKIENE
Vilnius University, Lithuania

DALIA STREIMIKIENE
Vilnius University, Lithuania

THE MAIN DRIVERS OF GHG EMISSION REDUCTION IN BALTIC STATES

Abstract:

Lithuania, Latvia and Estonia successfully implemented Kyoto protocol commitments in the period from 2008 to 2012. Moreover, targets of the Europe 2020 strategy, in which countries committed to reduce the greenhouse gas emissions of 1990 by 20% until 2020 are also achievable for Lithuania, Latvia and Estonia. It is forecasted that the reduction of GHG emissions in 2020 in the Baltic States will be much higher than EU average target.

Baltic States have achieved significant reduction of GHG emissions during 1990-2015, especially in energy sector which is the major sources of GHG emissions in Baltic States. During the period 1990–2013, Lithuania's gross domestic product (GDP) per capita increased by 56.8 per cent, while GHG emissions per GDP and GHG emissions per capita decreased by 66.7 and 47.8 per cent, respectively. The major reason for the decrease in per capita emissions are the structural changes in the energy sector. At the same period, Latvia's population decreased by 24.4 per cent, GDP per capita increased by 64.0 per cent, while GHG emissions per GDP and GHG emissions per capita decreased by 66.4 and 44.8 per cent, respectively. Latvia's economy grew rapidly in the period 2000–2007, with a GDP increase of 82.0 per cent. Economic growth rates and climatic conditions have been the most important drivers for GHG emissions trends in Latvia. Estonia's gross domestic product (GDP) per capita increased by 85.1 per cent, while GHG emissions per GDP and GHG emissions per capita decreased by 65.1 and 35.3 per cent, respectively. Such significant GHG emission reduction in Estonia was driven by restructuring of the economy and efficiency improvement in the energy industry and energy demand sectors. There is a significant decoupling of emissions from economic growth in all three countries however countries have very different energy supply balances and implemented various climate change mitigation policies.

Keywords:

GHG emissions, drivers, energy sector, Baltic States

Introduction

In 2007 the European Union stepped up its energy and climate change ambitions to a new level. Based on several communications by the European Commission on an Energy and Climate Policy for Europe, the EU Council agreed to:

– An independent greenhouse gas (GHG) emission reduction commitment of 20% by 2020 compared to 1990 levels and an objective for a 30% reduction by 2020 subject to the conclusion of a comprehensive international climate change agreement;

– A mandatory 20% share of Renewable Energy Sources (RES) in Gross Final Energy Demand by 2020 for the EU as a whole including a 10% share of renewables in transport for each Member State, and;

– An improvement of energy efficiency by 20% compared to baseline levels by 2020.

From the sole perspective of EU greenhouse gas emission reduction, such a policy instrument mix bears the risk of costly overlapping regulation. In a broader perspective, the policy mix may be justified by multiple targets as stated in the EU "20–20–20" Climate Action and Renewable Energy Package through which the EU pursues a 20% share of renewable energy sources in gross final energy consumption and an increase of energy efficiency of 20% by 2020 along with its greenhouse gas emission reduction target. However, while global warming provides a straightforward argument for the policy objective of curbing greenhouse gas emissions, the objectives behind renewable energy quotas and energy efficiency targets are less obvious. Therefore it is important to analyse interrelation of all these targets and to track the changes of GHG emissions in EU member states by relating them to the changes in energy intensity and increase in the share of renewables in final energy consumption.

Seeking to achieve this aim the main tasks are:

- to review climate change mitigation policies in Baltic States.
- to analyse and compare achievements of Baltic States in energy intensity, carbon intensity of energy and GHG emission reduction trends ;
- to develop policy recommendations based on the main findings of analysis conducted

The methods applied: comparative analysis, graphical analysis, systematization and generalization.

Climate change mitigation policies in Baltic States

The most important EU policy document – strategy Europe 2020 also emphasizes security of energy supply because energy is crucial for economic growth. Europe 2020 is the EU's growth strategy for the coming decade. In a changing world, EU seeks to become a smart, sustainable and inclusive economy. These three mutually reinforcing priorities should help the EU and the Member States deliver high levels of employment, productivity and social cohesion (Janicke, 2011; Reilly, 2012;

Schmalensee, 2012). Concretely, the Union has set five ambitious objectives - on employment, innovation, education, social inclusion and climate/energy - to be reached by 2020. Each Member State has adopted its own national targets in each of these areas (Hallegatte et al, 2011). Concrete actions at EU and national levels underpin the strategy. The 2015 European Semester kicked off in 2014 November with the Annual Growth Survey, which outlined the new Commission's three-pillar jobs and growth strategy: boosting investment, accelerating structural reforms and pursuing responsible, growth-friendly fiscal consolidation. In February, the European Commission published a series of country reports in February, analysing Member States' economic policies. In May 2015, the Commission has published the country-specific recommendations for each Member State, along with an overarching Communication on how to strengthen and sustain the recovery, and how the streamlined European Semester is implemented (Heal, 2012). All Member States have committed to the Europe 2020 strategy. In addition to indicators of security of energy supply there are other indicators addressing energy dependency issues. Three broad dimensions are identified as relevant: (1) security of supply, defined as the uninterrupted availability of energy sources at an affordable price; (2) energy and carbon intensity as their improvement contributes to reducing energy dependence while bringing additional economic and environmental benefits; (3) the contribution of energy products to trade given its potential impact on the current account deficit (European Commission, 2014).

However, each country has different economic circumstances and translates the overall EU objectives into national targets in its National Reform Programme – a document which presents the country's policies and measures to sustain growth and jobs and to reach the Europe 2020 targets. The National Reform Programme were presented by EU member states in parallel with its Stability/Convergence Programme, which sets out the country's budgetary plans for the coming three or four years All indicators presented in Table 1 were assessed by EU member States in their National Reform programmes. In the next section of paper the dynamics of the main indicators having impact on GHG emission trends in of in Baltic States will be analysed by applying graphical analysis in order to define the best performing country.

Baltic States have implemented ambitious policies aiming to reduce GHG emissions, increase of use of renewables and energy efficiency. The Baltic States economy largely depends on fossil fuels, especially for electricity generation, industry and transport. It may therefore be expected that a decrease in economic activities – as measured by gross domestic product (GDP) – would lead to a decrease in overall GHG emissions. Over the period 2000-2009 the Baltic States economy experienced mostly growth, with the exception of the last year where due to the economic crisis GDP fell sharply. The emissions showed a similar trend of sudden decline in 2009. If less energy is used for each 1 000 euro of GDP then the intensity is lower which indicates gains in productivity and improved energy efficiency. EU energy intensity decreased by nearly 12 % in 2000-2009 which means that for each 1000 euro of GDP the EU used 12 % less energy by the end of the studied decade. There are two

possible reasons for this: first, energy may have been used more efficiently; and second, the overall economic structure of the EU may have shifted to less energy intensive economic activities. In the same way that overall energy consumption may be examined in its relation to GDP, total GHG emissions may also be considered in terms of the greenhouse gas intensity of the economy.

The Renewable Energy Directive (2009/28/EC) presents Member States with a huge implementation challenge that cannot simply be met by an extension of existing promotional policies for renewables. The Directive required each Member States submit a National Renewable Energy Action Plan (NREAP) by 30 June 2010, setting out how it plans to achieve its 2020 target. In Table 1 RES targets for Baltic States and achieved progress in implementing RES target is presented.

Table 1: National binding renewable energy targets for Baltic States in 2020

EU Member State	RES in 2005	RES in 2012	2020 RES Target
Estonia	18.0%	25.8	25%
Latvia	32.6%	35.8	40%
Lithuania	15.0%	21.7	23%
EU -28	8.5%	14.1	20%

SOURCE (European Commission, 2015 a, b, c)

As one can see from information provided in Table 1 Latvia and Estonia have implemented RES target set for year 2020 in 2012. Lithuania also has shoved good progress in implementing RES target since 2005 however in 2012 the share of RES in final energy consumption was slightly lower than target set for 2020.

Energy efficiency is the main target of sustainable development policy in EU. Energy efficiency improvement allows saving means, to reduce energy consumption, energy import dependency and GHG emissions. The EU is aiming for a 20% cut in Europe's annual primary energy consumption by 2020. On 8 March 2011, the EC adopted the Communication "Energy Efficiency Plan 2011" for saving more energy through concrete measures. The set of measures proposed aims at creating substantial benefits for households, businesses and public authorities. In Table 2 the development of final energy consumption in Baltic States and target set for 2020 are presented. The Baltic States have established target - keeping the end consumption of energy at the level of 2010 in 2020. In Table 2 the results of implementing energy efficiency targets in Baltic States is presented.

Table 2: Energy consumption targets in 2020

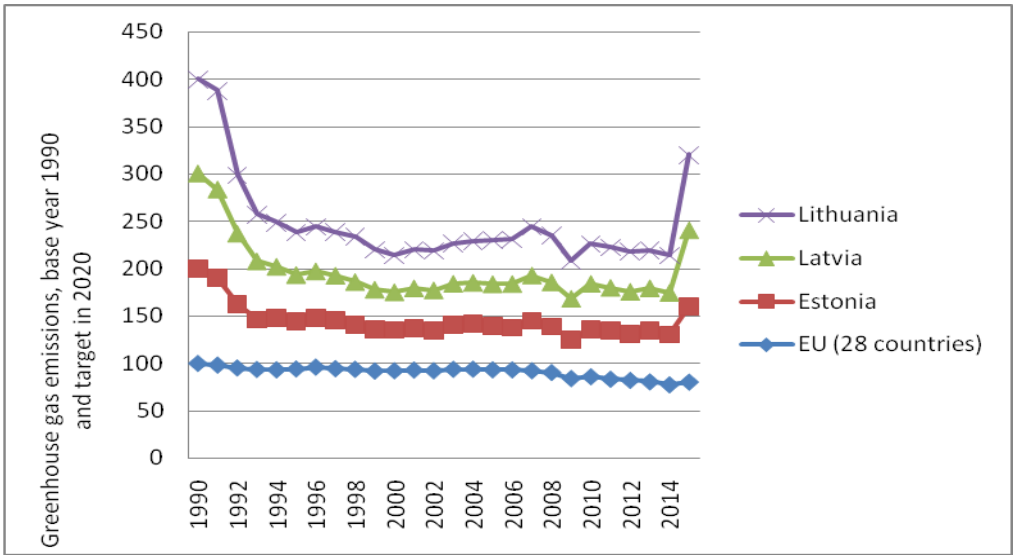
Country	Final energy consumption level in 2010, Mtoe	2012 level, Mtoe	Final energy consumption target in
Estonia	2.9	*2.9*	*2.9*
Latvia	4.1	4.0	4.1
Lithuania	4.8	4.8	4.8
EU-28	1186	1102	1086

SOURCE (European Commission, 2015 a, b, c)

As one can see from information presented in Table 2 Baltic States are on track in implementing energy efficiency targets. The best results in 2012 were achieved by Latvia.

Estonia, Latvia and Lithuania are among the 12 member states with an allowed increase of GHG emissions by 2020. In Figure 1 the trends of GHG emissions and target for 2020 are presented for Baltic States and EU-28.

Figure 1: Trends of GHG emissions and target for 2020 for Baltic States and EU-28.



Source: (EUROSTAT, 2016).

The decision provides that a member state with a positive limit (i.e. an increase of GHG emissions allowed) shall ensure that its GHG emissions in 2013 do not exceed a level defined by a linear trajectory, starting in 2009, on its average annual GHG emissions during 2008, 2009 and 2010. The increase of 15% comparing with 2005 level was allowed for Baltic States. The target for 2020 was recalculated to the year 1990 level for Baltic States. In Table 3 the GHG emissions in Baltic States and targets set in 2020 are presented.

Table 3: National GHG emission targets for Baltic States in 2020

EU MS	GHG in 2005, comparing with year 1990, %	GHG in 2012 comparing with year 1990, %	2020 GHG Target comparing with 1990 year level, %
Estonia	45.6	47.4	52.4
Latvia	42.51	42.92	48.9
Lithuania	47.75	44.41	54.3
EU -28	93.23	82.14	80

SOURCE (European Commission, 2015a,b,c)

As one can see form Table 3 the Baltic States are on track implementing GHG emission reduction target and have enough reserve in meeting target set for 2020. Table 3 indicates that according to the progress achieved in 2012 Baltic States will not

have problems in implementing 2020 target. The Lithuania is in the best position among Baltic States in terms of implementing GHG emission reduction target.

In the following chapter the main drivers of GHG emission reduction and implementation of EU 20-20-20 targets in Baltic States.

The main drivers of GHG emissions in Baltic States

The main drivers of GHG emissions in energy sector are: energy efficiency improvements and reduction of carbon intensity of energy consumption. By multiplying these two main drivers one can get cabin intensity of economy. Carbon intensity of economy it is valuable indicator to track progress of GHG emissions in the country of economic growth on GHG emissions. The reduction of carbon intensity of economy indicates the second stage of decoupling then pollution decouples from energy consumption and energy consumption decouples from economic growth.

The two main drivers can be expressed by the following main indicators: energy intensity of economy and energy intensity of the main branches of economy and carbon intensity of the final energy consumption of economy or carbon intensity of final energy consumption in the main branches of economy. Achievements of Baltic States in reduction of energy intensity and carbon intensity in 2013 are summarized in are summarized in Table 4.

Table 4: Achievements in reduction of carbon and energy intensity by Baltic States in 2013

Green growth performance indicators	Units of measurement	Lithuania	Latvia	Estonia
Energy and carbon intensity of economy				
Energy intensity	kgoe/€	0,29	0,33	0,48
Carbon intensity	kg / €	0,89	0,79	1,50
Industry energy intensity	kgoe / €	0,18	0,39	0,23
Transport energy intensity	kgoe / €	0,57	0,95	0,96
Transport carbon intensity	kg / €	1,63	2,53	2,76
Energy intensity of households	kgoe/ €	0,106	0,167	0,156
Carbon intensity of households	kg/€	0,11	0,20	0,19
Share of energy intensive sectors in total GVA	%	-	-	12,6

Source: (European Commission, 2015a, b, c)

As one can see from information provided in Table 4 according macroeconomic indicators related to energy intensity and carbon intensity Latvia and Lithuania are best performing countries however according to industry energy intensity Latvia is the worst performing country having highest energy intensity of industry. The detail analysis and development of energy and carbon intensity indicators in Baltic States is given in Table 5.

Table 5: Development of energy and carbon intensity of economy in Baltic States

Energy and carbon intensity of the economy										
	Energy intensity of the economy (kgoe/1000 EUR)	Energy intensity of industry (kgoe/1000 EUR)	Energy intensity of transport (kgoe/1000 EUR)	Energy intensity of households (kgoe/1000 EUR)	CO2 intensity of the economy (ton CO2 eq./1000 EUR)	CO2 intensity of energy use (ton CO2 eq./toe)	Share of energy intensive sectors in total GVA (%)	CO2 intensity of transport sector (ton CO2 eq./1000 EUR)	CO2 intensity of households (ton CO2 eq./1000 EUR)	Weight of energy in HICP basket (%)
	2008-2012	**2008-2012**	**2008-2012**	**2008-2012**	**2007-2011**	**2007-2011**	**2008-2012**	**2007-2011**	**2009-2011**	**2008-2012**
EE	500	265	1035	155	1.6	2.9	12.2	2.9	0.19	13
LT	330	180	648	106	1.0	1.6		2.0	0.11	14
LV	342	382	1133	163	0.8	1.8		3.4	0.20	14
EU28	148	144	729	44	0.6	2.2	9.2	1.9	0.19	10

Source: (European Commission, 2014)

In some Member States, improvements in energy intensity have not been equally distributed over time. All Baltic States have recorded a decline in gross energy intensity since 2004, but some countries, such as Latvia and Estonia concentrated most of their efforts to the beginning of 2000s.

As one can see from Table 5 Lithuania have lowest energy and carbon intensity as well as the lowest carbon intensity in all sectors among Baltic States therefore Lithuania is the best performing country in terms of energy and carbon intensity indicators which contribute to reducing energy dependence while bringing additional economic and environmental benefits. Estonia has the highest energy and carbon intensity.

Baltic States have achieved significant reduction of GHG emissions during 1990-2015. During the period 1990–2013, Lithuania's gross domestic product (GDP) per capita increased by 56.8 per cent, while GHG emissions per GDP and GHG emissions per capita decreased by 66.7 and 47.8 per cent, respectively. The major reason for the decrease in per capita emissions are the structural changes in the energy sector.

In 1990-2013 Latvia's population decreased by 24.4 per cent, GDP per capita increased by 64.0 per cent, while GHG emissions per GDP and GHG emissions per capita decreased by 66.4 and 44.8 per cent, respectively. Latvia's economy grew rapidly in the period 2000–2007, with a GDP increase of 82.0 per cent. Economic growth rates and climatic conditions have been the most important drivers for GHG emissions trends in Latvia.

Estonia's gross domestic product (GDP) per capita increased by 85.1 per cent, while GHG emissions per GDP and GHG emissions per capita decreased by 65.1 and 35.3 per cent, respectively. Such significant GHG emission reduction in Estonia was driven

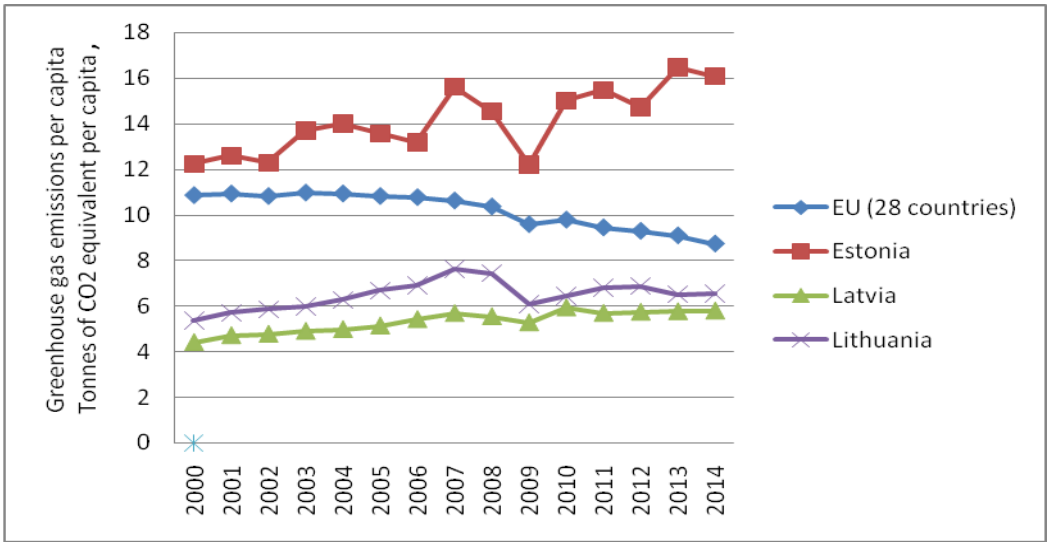
by restructuring of the economy and efficiency improvement in the energy industry and energy demand sectors.

Development of energy intensity and carbon intensity indicators in Baltic States

The most important indicators for analysis of the main drivers of GHG emission reduction in Baltic States from Table 2 to compare Baltic States towards their achievements in GHG emission reduction.

In Figure 2 GHG/emission per capita trends were compared among Baltic States.

Figure 2: GHG/emission per capita trends in Baltic States

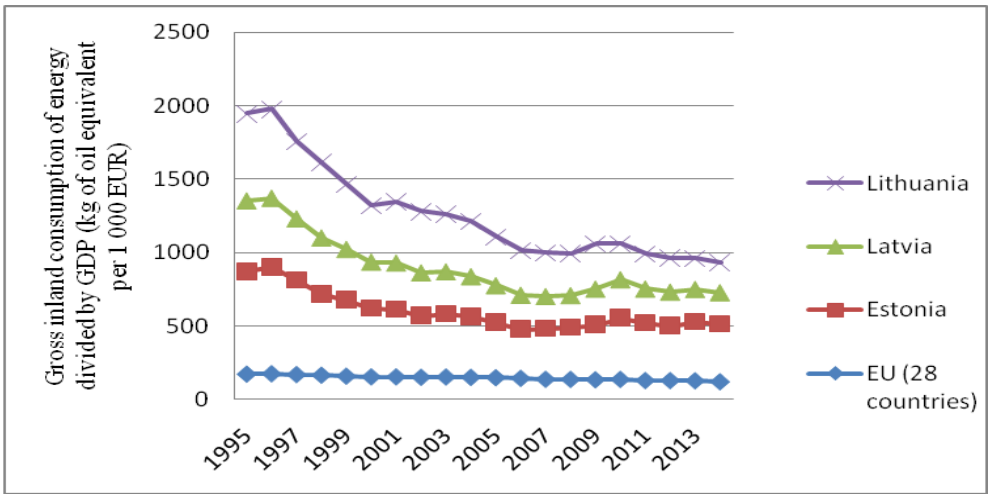


Source: (EUROSTAT, 2016).

As one can see from Figure 2 Estonia distinguishes with highest GHG emissions per capita among Baltic States. This is because of high share of shale oil in primary energy supply structure. Latvia distinguishes with the lowest GHG/capita indicator among Baltic States because of the high share of renewables (hydro) in fuel mix. In all Baltic States the growth of GHG/capita can be noticed since 2010 this is related with the fact that after economic crisis, the increase of GDP was followed by increase of GHG emissions.

In Figure 3- 5 the development of the main drivers GHG emission in Baltic States, are presented.

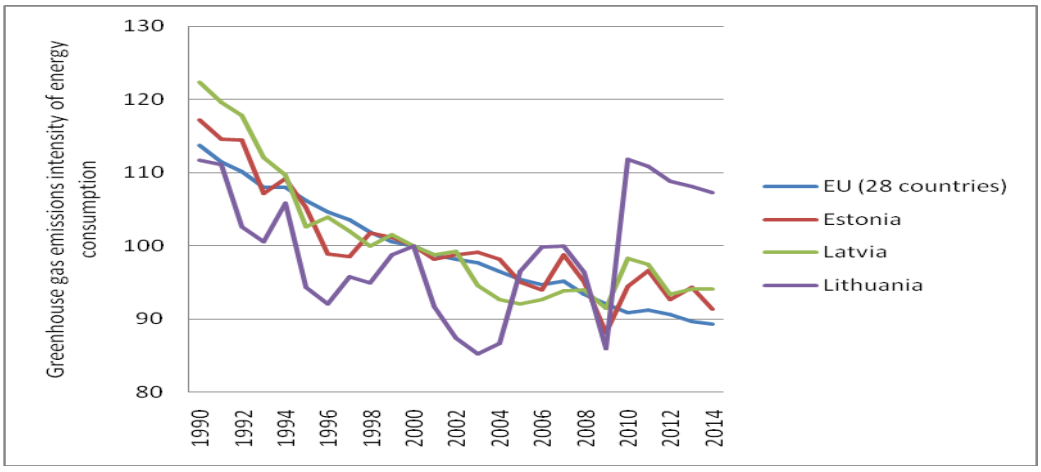
Figure 3: Energy intensity in Baltic States



Source: (EUROSTAT, 2016).

The most important of GHG emissions in energy sector is energy intensity of GDP as this indicator represents also competitiveness, environmental sustainability and energy security issues. Reduce of energy intensity in member states has direct impact on environmental and pollution reduction, climate change mitigation and on increase of competitiveness of economy and security of energy supply. In Figure 1 the trends of energy intensity of GDP is compared in Baltic States. As one can see from Figure 1 though all Baltic States have energy intensity well above EU-28 level the highest energy intensity is in Estonia and the lowest one in Lithuania. Comparing data of year 2004 with energy intensity in 2012 one can notice that energy intensity was decreasing since entering EU in all analysed countries however economic crisis had negative impact and energy intensity stared to increase however in Estonia energy intensity increase can be noticed since 2007 but in 2010 this trend has dramatically changed and energy intensity began to decrease. In other analysed countries the trend of energy intensity decrease can be noticed following the recovery from economic crisis in 2010.

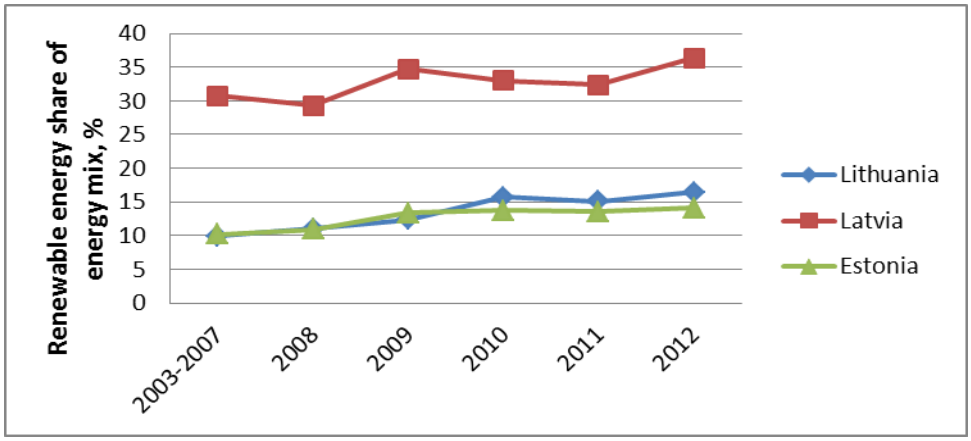
Figure 4: Carbon intensity of energy consumption in Baltic States



Source: (EUROSTAT, 2016).

Carbon intensity of energy consumption is important driver of GHG emissions in energy sector as represents the development of energy mix in the country. Reduction of carbon intensive energy carries and increase of renewable energy are the major forces driving the reduction of carbon intensity of energy consumption in the country. As one can see from Figure 2 carbon intensity of energy consumption reduced in all Baltic States during investigated period except in Lithuania as in 2010 Lithuania finally closed nuclear power plant and carbon intensity of fuel consumption has increased in Lithuania.

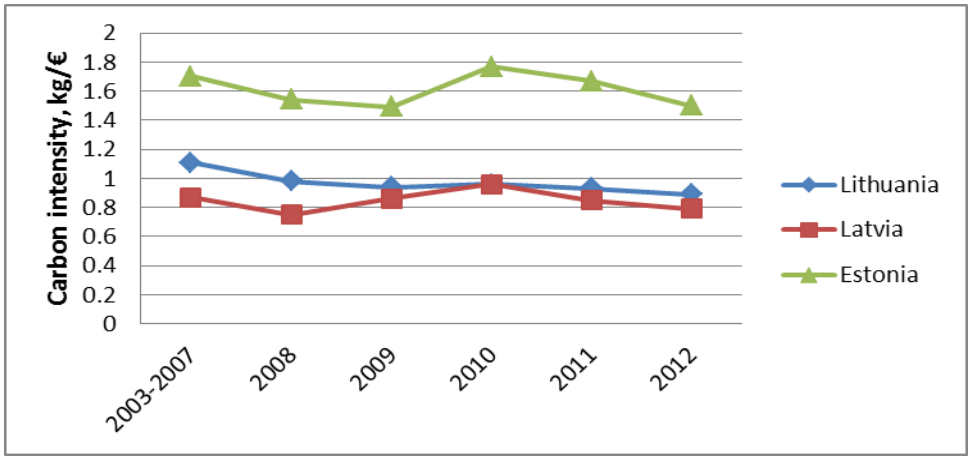
Figure 5: Renewable energy share of energy mix in Baltic States



Source: (EUROSTAT, 2016).

The share of renewable in final energy consumption is the major driving force of reduction in carbon intensity of fuel consumption. As one can see from Figure 3 Latvia distinguishes with very high share of renewables in final energy which is well above EU-28 level. In Estonia and Lithuania the share of renewables in final energy is also above EU-28 level and has increased significantly since 2004 (by almost 70%). The high share of renewables in Latvia is related with the natural conditions and high share of hydro in electricity generation. Comparing results achieved by new EU member states with target one can notice that Estonia achieved level above target set for 2020 in 2011.

Figure 6: Carbon intensity of economy in Baltic States



Source: (EUROSTAT, 2016).

The CO_2 intensity of the economy for the whole EU decreased substantially since 2001 by about 23%. It declined for all Member States. However, similarly to the energy intensity, a trend break occurred around 2008 for a group of countries when the carbon intensity of these economies started increasing. This is the case for Estonia and Latvia.

It is necessary to stress that there is close relationship between all analysed indicators as increase in the share of renewables and energy efficiency improvements have direct impact on reduction of energy and carbon intensity of economy and all sectors as well as on decrease of energy import dependency, energy balance of trade and diversification of energy mix.

Conclusions

1. The increase in the share of renewables and energy efficiency improvements have direct impact on reduction of energy carbon intensity of economy and all sectors as well as on decrease of GHG emission in Baltic States.
2. Lithuania, Latvia and Estonia successfully implemented Kyoto protocol commitments in the period from 2008 to 2012. Moreover, targets of the Europe 2020 strategy, in which countries committed to reduce the greenhouse gas emissions of 1990 by 20% until 2020 are also achievable for Lithuania, Latvia and Estonia. It is forecasted that the reduction of GHG emissions in 2020 in the Baltic States will be much higher than EU average target.
3. Estonia distinguishes from other Baltic States with good results achieved in increase of the share of renewable in final energy consumption however country has very high energy and carbon intensity of economy and it's particular branches though significant decrease in energy intensity and carbon intensity of energy can be noticed during 2000-2013.
4. Latvia also distinguishes with very high shares of renewables in electricity generation and in final energy consumption however it is more related with favourable climate conditions and well developed hydro power plants.
5. Lithuania distinguishes with the best indicators of energy and carbon intensity of economy as well as energy and carbon intensity of specific branches of economy.
6. The performed analysis indicated that energy intensity and economic growth were the main factors driving the change in GHG emission per capita across Baltic States.
7. An exception is observed for Lithuania where changes in the GHG emission factor played an important role. The GHG emissions per capita have increased in Lithuania because of increase of carbon intensity of energy consumption in Lithuania. This is related with the closure of Ignalina NPP in 2009. The increase of the share of renewable in energy consumption was not able to overcome negative impact of carbon intensity increase because of the disappearance of nuclear in energy balance.

8. In other Baltic States analysed carbon intensity of energy consumption was almost stable during 2004-2012 periods. This indicates that increase of the share of renewable in final energy 'consumption though expensive policies were implemented didn't have impact on GHG emission reduction and was not important driver of implemented climate change mitigation policies.
9. The changes in energy intensity or productivity are related to changes in GDP structure and implemented energy efficiency improvement policies. The most significant decrease in energy intensity can be noticed in Lithuania.
10. Policies to increase energy efficiency are the most effective in terms of GHG emission reduction and driving to achievement of EU 20-20-20 target in Baltic States. Policies to promote use of RES didn't effected the changes in GHG emissions per capita in Baltic States therefore though the structure of energy consumption has changed in Baltic States and the share of RES increased this didn't effected too much the development of GHG emissions therefore more emphasis on energy efficiency policies is necessary in Baltic States and other EU member states for the achievement of GHG emission reduction targets.

Reference

CAPPELEN, A., F. CASTELLACCI, J. FAGERBERG, And VERSPAGEN, B. (2003). The impact of EU regional support on growth and convergence in the European Union," Journal of Common Market Studies, No. 41(4), p.p. 621-644. DOI: 10.1111/1468-5965.00438

DRESNER, S. (2008). *The Principles of Sustainability*. 2nd edn. London: Earthscan. ISBN 9781844074969.

EUROSTAT (2016). Europe 2020 indicators. Available from: (http://appsso.eurostat.ec.europa.eu/nui/print.do?print=true).

European Commission (2014). European Economy. Members States Energy Dependence: an Indicator-Based Assessment, Brusselss.

European Commission (2015a). Country Report Latvia 2015. COM (2005) 85 final). http://ec.europa.eu/europe2020/pdf/csr2015/cr2015_latvia_en.pdf

European Commission (2015b). Country Report Lithuania 2015. COM (2005) 85 final). http://ec.europa.eu/europe2020/pdf/csr2015/cr2015_lithuania_en.pdf

European Commission (2015c). Country Report Estonia 2015. COM (2005) 85 final). http://ec.europa.eu/europe2020/pdf/csr2015/cr2015_estonia_en.pdf

HALLEGATTE, S., HEAL, G., FAY, M., TREGUER, D. (2011). From Growth to Green Growth. The World Bank, Policy Research Working Paper, p. 5872. http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2011/12/07/000158349_20111207171314/Rendered/PDF/WPS5872.pdf

HEAL, G. (2012). Reflections—defining and measuring sustainability. Rev. Environ. Econ. Policy No. 6 (1), p.p. 147–163. Green Growth Knowledge Platform. (2013). Moving towards a Common Approach on Green Growth Indicators. A Green Growth Knowledge Platform Scoping Paper.

JÄNICKE, M. (2011). Ffu-Report 09-2011: "Green Growth": From a growing eco-industry to a sustainable economy. FFU-Report 09-2011, Forschungszentrum für Umweltpolitik, FU Berlin, 18 Seiten. www.gws-os.com/discussionpapers/gws-researchreport13-1.pdf

REILLY, J. (2012). Green Growth and the Efficient Use of Natural Resources. Energy Economics 34

(Suppl. 1), S85–S93.

SCHMALENSEE, R. (2012). From "Green Growth" to sound policies: An overview. Energy Economics 34, p.p. 52-56.