

Keywords

Material Flow,
Domestic Material Consumption,
Direct Material Input,
Fossil Energy Materials,
Imports,
Exports,
Baltic Countries

Received: October 12, 2014

Revised: October 20, 2014

Accepted: October 21, 2014

Material flow analyses of Baltic countries

Toivo Tanning¹, Lembo Tanning²

¹Tallinn School of Economics, Tallinn, Estonia

²TTK University of Applied Sciences, Tallinn, Estonia

Email address

toivo.tanning@gmail.com (T. Tanning), lembo.tanning@gmail.com (L. Tanning)

Citation

Toivo Tanning, Lembo Tanning. Material Flow Analyses of Baltic Countries. *International Journal of Economic Theory and Application*. Vol. 1, No. 4, 2014, pp. 43-55.

Abstract

The purpose of this article is to analyse the material or resource flow of new European Union (EU) states, in Baltic countries; and to compare them on the EU level. Energy security is always one of the most important problems in the EU. The EU and including the Baltic countries are poor of material and energy region. With regard to acute political and economic situation in Eastern Europe is very topical, what is the position of resource in the former Soviet bloc countries. The analysis showed that the greater use of resources does not always lead to economic growth. Effective use of resources is different in Europe from country to country. How far is the use of these lands resource, including the 2009th economic crisis? What are the prospects for a partial boycott of resources? What are the lessons from the resource flow?

1. Introduction

Material flow in new EU states with the exception of Malta, Cyprus and CEE-8 countries in Baltic States (Estonia, Latvia, Lithuania) has been analysed.

The small Baltic States are part of the former Soviet Union a half century. After the collapse of the SU, they became fully independent again.

The situations before the crisis, during the crisis and after the crisis will be viewed.

A resource-efficient Europe is one of the main objectives of the Europe 2020 Strategy [1], which aims at guiding the effective use of resources to achieve sustainable economic growth. Natural resources underpin the functioning of the European economy and our quality of life. These resources include raw materials such as fuels, minerals and metals but also food, soil, water, air, biomass and ecosystems. The pressures on resources are increasing. Intensive use of the world's resources puts pressure on our planet and threatens the security of supply. Continuing our current patterns of resource use is not an option. In response to these changes, increasing resource efficiency will be key to securing growth and jobs for Europe. It will bring major economic opportunities, improve productivity, drive down costs and boost competitiveness. [1]

All economic systems utilize a variety of resources. The scarcity of resources forces countries, companies and people make a variety of choices. That's what we look at on the basis of the Baltic countries.

2. Methodology

The indicator DMC is defined as the total amount of material directly used in an economy. DMC equals *Direct Material Input* (DMI) minus *exports*. DMI measures the direct input of materials for the use in the economy. DMI equals *Domestic Extraction* (DE) plus *imports*. [2]

Domestic material consumption by material of Eurostat is in environmental accounts [3].

Economy-wide material flow accounts (EW-MFA) compile material flow inputs into national economies. EW-MFA cover all solid, gaseous, and liquid material inputs, except for water and air, measured in mass units per year. Like the system of national accounts, EW-MFA constitute a multi-purpose information system. The detailed material flows provide a rich empirical database for numerous analytical purposes. EW-MFA are used to derive various material flow indicators such as:

Domestic extraction (DEU): total amount of material extracted for further processing in the economy, by resident units from the natural environment;

Imports (IMP): imports of products in their simple mass weight;

Direct material input (DMI): measures the direct input of material into the economy; it includes all materials which are of economic value and which are available for use in production and consumption activities (=DEU+IMP);

Exports (EXP): exports of products in their simple mass weight;

Domestic material consumption (DMC): measures the total amount of material actually consumed domestically by resident units (=DEU+IMP-EXP). Note: IMP and EXP are distinguished into extra-EU-trade and total trade.

In order to compare the performance over time and across various countries the second resource productivity ratio employing GDP in chain-linked volumes has been *indexed to the year 2000*. This index allows a comparison of countries' resource productivity performance. [4]

This can be expressed in monetary terms, as monetary return per unit of resource. Here in million or thousand tonnes.

Material resources are divided: biomass (MF1), metal ores (gross ores) (MF2), non-metallic minerals (MF3), fossil energy materials/carriers (MF4), other products (MF5) and waste for final treatment and disposal (MF6). Here we look also subgroups of MF4: liquid and gaseous energy materials/carriers (MF42); crude oil, condensate and natural gas liquids (MF421) and natural gas (MF422).[5]

In summary, the main indicators are:

Domestic Extraction Used (DEU). Domestic Material Consumption (DMC). Exports (EXP). Imports (IMP). Direct Material Inputs (DMI).

$$DEU = DMC + (EXP - IMP) \quad (1)$$

$$DMI = DEU + IMP = DMC + EXP - IMP + IMP = DMC + EXP \quad (2)$$

National accounts (including GDP) was from Eurostat methodology. [6]

Econometrics is the application of mathematics, statistical methods, and, more recently, computer science, to economic data and is described as the branch of economics that aims to

give empirical content to economic relations. [7] The basic tool for econometrics is the linear regression model.

The processing of data is used to *regression analysis*. Regression analyzes are statistical analysis procedures that have the goal of relationships between a dependent and one or more independent variables to model. They are particularly used when relationships to describe quantitatively or values of the dependent variables are to predict. [8 - 9]

Mathematically, the relationship between the independent variable x and the dependent variable y are represented as:

$$y = f(x) + e, \text{ in the one-dimensional case, and} \quad (3)$$

$$y = f(x_1, x_2, \dots, x_n), \text{ in the n-dimensional case.} \quad (4)$$

We can model the expected value of y as an n th degree polynomial, yielding the general polynomial regression model:

$$y = a_0 + a_1x + a_2x^2 + a_3x^3 + \dots + a_nx^n + \varepsilon \quad (5)$$

Most authors using simple linear regression. It's convenient to use, but as a rule it is not well-characterized complex processes. We use *polynomial regression*, which gives a much more precise picture, which gives a much more precise picture. Numerical values of the parameters used to find the indirectly *least squares method* or *ordinary least squares*. We are a *non-linear correlation*. [8 - 9]

3. Analysis of Gross Domestic Product

The growth of the entire economy, measured using gross domestic product (GDP), will be viewed as background.

The trend line shows the cyclical development of the Estonian economy (GDP). In addition to the economic decline during the years 2008 – 2009, there was also a decline in 1999. If an annual real GDP increment of more than 10% can be considered excellent, then the result in 2009 (14.1%) was one of the largest in the world.

The development of the Estonian economy before and after the crisis was one of the fastest in the EC. Yet, the crisis led to a very deep recession, which was one of the greatest in the world, as well as in the EC, and lasted for nine quarters. Thus, the country covered two extremes. On the other hand, it also shows that the reforms carried out in the past were successful and established a base that enabled exiting the crisis successfully. In particular, this meant creating favourable conditions for business. Again, GDP growth in 2011 and also 2012 are highest in the EC. However, in 2013 only 0.8%.

GDP by quarter of Estonia is steadily declined since 2011Q2 and only in 2014Q2 was the decent GDP growth. Also GDP growth of Latvia and Lithuania is decreased in the past.

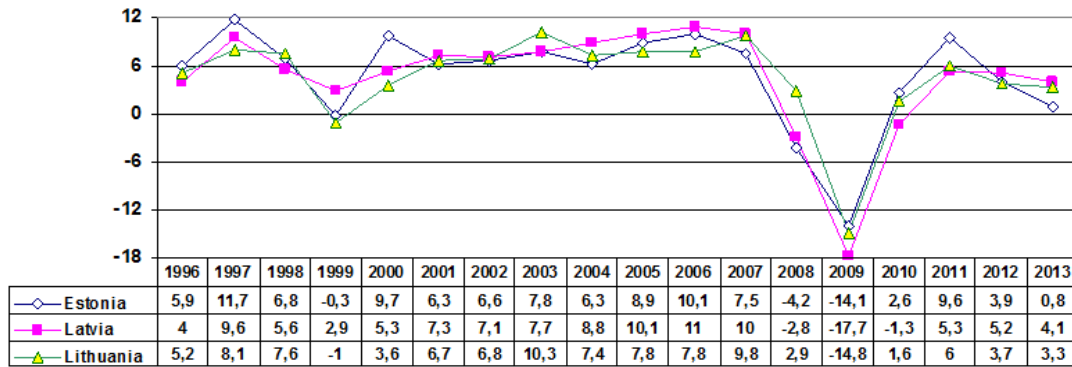


Figure 1. Real GDP growth rate – volume. Percentage change during the previous year. [10]

4. Analysis of Material Flow

Next we analyze material flow in EU-27 and Baltic countries of tonnes.

4.1. Material Flow Analyses by Total Domestic Material Consumption

Table 1. Total Domestic Material Consumption (DMC). Thousands tonnes [5]

	2000	2002	2004	2007	2008	2009	2010	2011	2012
Estonia	19,616	22,779	29,363	38,915	35,415	33,040	33,416	35,509	37,975
Latvia	34,666	35,789	38,301	49,252	41,469	32,074	37,029	40,932	37,452
Lithuania	29,173	31,553	39,520	48,735	51,779	34,905	38,462	41,721	38,283

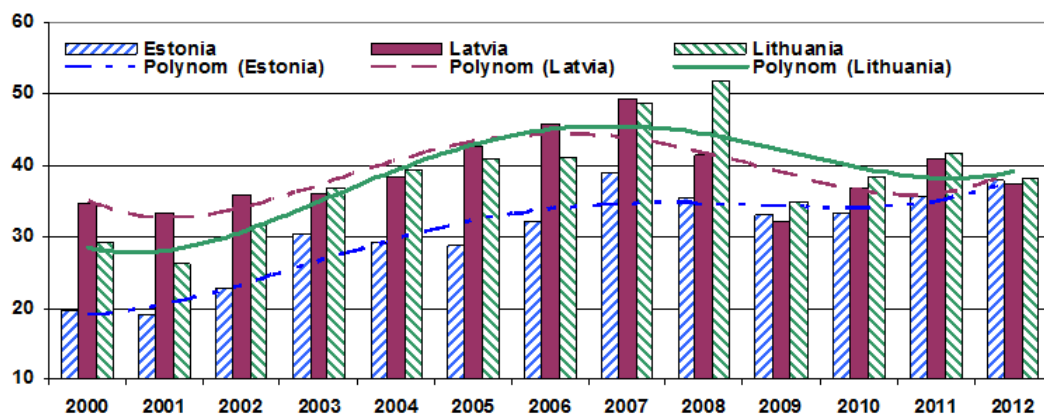


Figure 2. Total Domestic Material Consumption of Baltic States. Million tonnes [5]

Before the economic crisis, GDP growth rose by analogy with DMC. The peak was reached in 2007 - 2008. 2009. followed by a decline, especially large in Lithuania. In the following years the economy grew, and with it DMC or vice versa the better DMC used to cause growth. For more of the answer gives the material flow components detailed analysis.

DMC trend lines of Baltic States:

$$Estonia\ y = 0,0087x^4 - 0,2335x^3 + 1,8827x^2 - 2,7608x + 20,239; R^2 = 0,8944 \quad (6)$$

$$Latvia\ y = 0,0186x^4 - 0,5183x^3 + 4,5523x^2 - 12,762x + 43,922; R^2 = 0,602 \quad (7)$$

$$Lithuania\ y = 0,0154x^4 - 0,4422x^3 + 3,9078x^2 - 9,4493x + 34,592; R^2 = 0,736 \quad (8)$$

These theoretical trend lines (4-degree polynomial) is characterized by changes in the Baltic States DMC. Also, they are like the cyclical nature of the changes in GDP. However, these R² are smaller than the GDP R², thus a little weaker link.

This section is focused on the third (non-EU Member States) countries on imported fossil fuels, especially crude oil imports, and in particular for the purchase of natural gas from Russia.

Table 2. Components of DMC. Total imports resource, thousands tonnes [5]

	2000	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Estonia	5,591	7,549	9,733	9,416	11,991	12,140	9,837	8,979	9,550	10,767	9,108
Latvia	5,771	7,592	8,794	11,406	12,225	13,541	12,508	8,719	9,697	11,142	12,861
Lithuania	12,766	18,273	21,009	23,719	24,095	23,352	26,076	21,125	24,427	26,305	26,486

Table 3. Estonian imports mineral fuels, mineral oils and products of their distillation from Russian Federation, million of euro, 2004 – 2014 [11]

2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014-I
171	353	923	677	479	391	510	923	579	405	269

Estonian imports mineral fuels from Russia has changed by leaps and bounds. The top years were 2006 and 2011. In recent years, it has decreased two times.

Table 4. Estonian imports mineral fuels, mineral oils and products of their distillation from Russian Federation, thousands of euro, 2011 – 2014 [11]

Imp	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011	80 414	78 450	131 042	200 066	87 940	60 508	30 493	40 472	30 614	65 100	65 217	52 278
2012	34 617	62 212	67 089	45 963	93 483	44 411	49 932	44 330	23 193	23 895	33 821	55 781
2013	50 687	46 247	37 057	56 028	30 306	20 271	17 797	21 174	15 537	26 072	49 404	34 865
2014	33 182	49 522	49 150	43 686	49 889	43 298	24 846	22 753

Also, in previous years there have been major fluctuations in mineral fuels, but in 2014, imports are practically at the level of previous years.

Table 5. Components of DMC. Total exports resource, thousands tonnes [5]

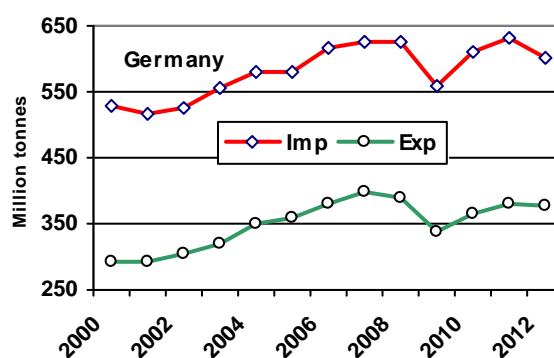
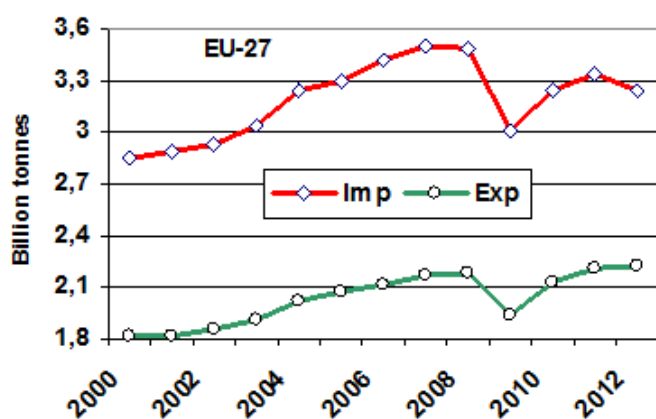
	2000	2003	2005	2006	2007	2008	2009	2010	2011	2012
Estonia	9,091	9,604	10,481	12,386	11,573	11,734	10,150	12,379	14,267	12,930
Latvia	9,255	11,056	13,112	13,585	13,595	14,103	13,569	17,478	18,298	19,610
Lithuania	9,569	14,514	18,943	18,425	18,198	21,376	19,251	21,135	23,540	25,055

Total exports resource of Baltic countries growth, in Lithuania and in Latvia over two times, but in Estonia 42%.

Next are the EU, the major countries and Baltic States import and export of materials.

Table 6. Material flow accounts, thousands tones, 2012 [5]

	IMP	IMP_XEU27	EXP	EXP_XEU27
European Union (27)	3 243 159	1 581 231	2 220 731	638 003
Germany	602 849	231 998	376 202	91 182
Netherlands	391 326	189 342	354 513	78 738
France	341 935	141 709	195 697	53 924
Italy	309 536	211 924	146 027	61 753
United Kingdom	286 829	182 743	156 973	46 524
Lithuania	26 486	17 671	25 055	7 046
Latvia	12 861	4 901	19 610	4 038
Estonia	9 108	3 213	12 930	3 772

**Figure 3.** Total import and export of the EU-27 and Germany [12]

Trend lines of import and export of the EU-27 and Germany run practical parallel. EU-27 difference was accordingly one billion and 430 million tonnes. EU 27 import was in 2000 1.6 and in 2012 1.5 times larger than exports. Germany difference was accordingly 1.8 and 1.6 times.

In 2012 was import 3243 million and export 2220 million tonnes of the EU-27; import of Germany was accordingly 602 million and export 376 million tonnes.

The EU-27 total imports of material in 2012. was 3,243 million tonnes and export 2,220 million tonnes. IMP_XEU27

was 1 581 and EXP_XEU27 638 million tonnes.

EU28 exports of primary goods (food & drink; raw materials; energy) was in Jan-Jun 2014 147 billion and imports 296 billion EUR. [13]

In contrast to the monetary value of trade EU's physical trade balance is asymmetric. The EU imports three times more goods by weight from the rest of the world than it exports. The amounts of physical imports into the EU are dominated by fossil fuels and other raw products which typically have significantly lower values per kilogram. [14]

Table 7. Domestic Extraction Used, thousands tonnes [5]

	2000	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Estonia	23,116	32,471	29,302	29,915	32,445	38,349	37,313	34,211	36,245	39,009	41,796
Latvia	38,149	39,561	41,117	44,448	47,108	49,306	43,065	36,924	44,810	48,087	44,201
Lithuania	25,976	33,231	35,043	36,123	35,515	43,580	47,079	33,031	35,171	38,956	36,851

Domestic Extraction Used (DEU) of Baltic countries in tones growth, in Estonia 1.8, in Latvia and in Lithuania 1.4 times.

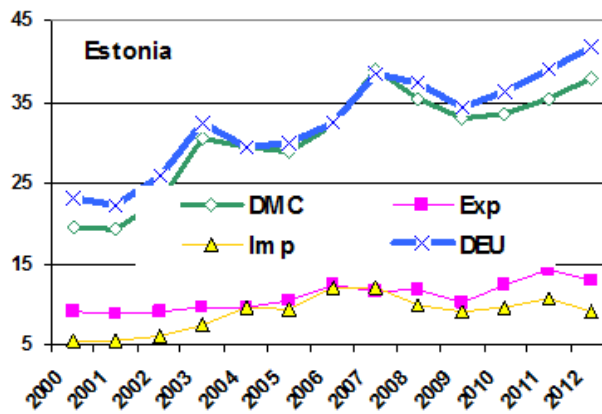


Figure 4. Total resource of Estonia, thousands tonnes [5]

Table 8. Total resource of Estonia, thousands tonnes [5]

Est	2000	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
DMC	19,616	30,416	29,363	28,850	32,050	38,915	35,415	33,040	33,416	35,509	37,975
Exp	9,091	9,604	9,672	10,481	12,386	11,573	11,734	10,150	12,379	14,267	12,930
Imp	5,591	7,549	9,733	9,416	11,991	12,140	9,837	8,979	9,550	10,767	9,108
DEU	23,116	32,471	29,302	29,915	32,445	38,349	37,313	34,211	36,245	39,009	41,796

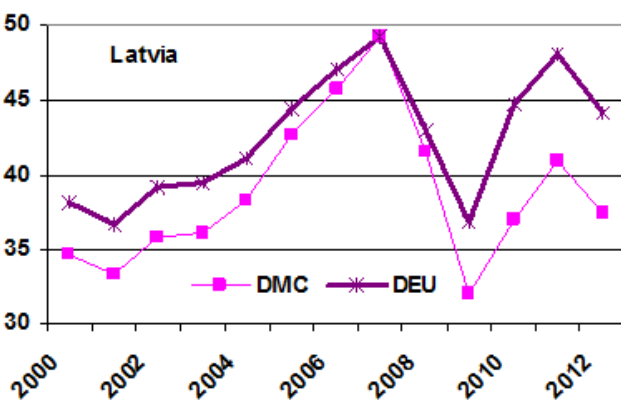


Figure 5. Total resource of Latvia, thousands tonnes [5]

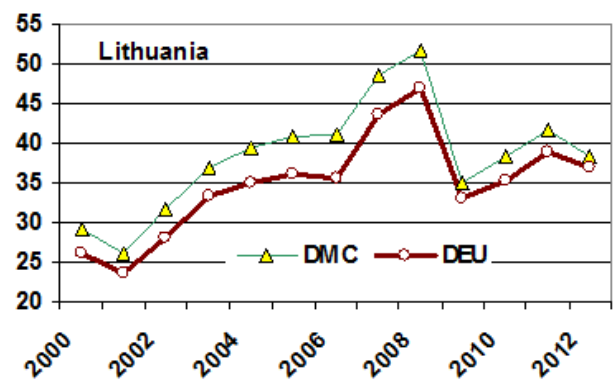


Figure 6. Total resource of Lithuania, thousands tonnes [5]

DMC of Estonia increased with the high growth GDP until

2007 80%, or 15,799 thousand tonnes and subsequent decreased a little. The 2012 level was nearly the same as in 2007. The increase occurred mainly at the expense of imports,

3517 thousand tonnes. From 2000 to 2012, imports increased by 63% and 81% DEU.

Table 9. Total resource of Latvia, thousands tonnes [5]

Lat	2000	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
DMC	34,666	36,097	38,301	42,742	45,747	49,252	41,469	32,074	37,029	40,932	37,452
Exp	9,255	11,056	11,610	13,112	13,585	13,595	14,103	13,569	17,478	18,298	19,610
Imp	5,771	7,592	8,794	11,406	12,225	13,541	12,508	8,719	9,697	11,142	12,861
DEU	38,149	39,561	41,117	44,448	47,108	49,306	43,065	36,924	44,810	48,087	44,201

Economic (GDP) growth until 2007 of Latvia was the EU's biggest. Her DMC grew in the same period 42% or 14,586 thousand tonnes and declined in subsequent years to levels of 2004. The increase occurred mainly at the expense of imports,

7,770 thousand tonnes. From 2000 to 2012 exports grew steadily, a total of 111% and imports of 123%. What was the whole, the growth of 29% until 2007. Total growth of DEU was until 2007 by 29%.

Table 10. Total resource of Lithuania, thousands tonnes [5]

Lit	2000	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
DMC	29,173	36,990	39,520	40,899	41,184	48,735	51,779	34,905	38,462	41,721	38,283
Exp	9,569	14,514	16,532	18,943	18,425	18,198	21,376	19,251	21,135	23,540	25,055
Imp	12,766	18,273	21,009	23,719	24,095	23,352	26,076	21,125	24,427	26,305	26,486
DEU	25,976	33,231	35,043	36,123	35,515	43,580	47,079	33,031	35,171	38,956	36,851

Also economic (GDP) growth of Lithuania was very high until 2008. Her DMC grew in the same period 77% or 22,606 thousand tonnes and declined in subsequent years to levels of 2004. Growth occurred both imports and exports at the expense of continuously, in period 2000 to 2012 by 104% and 123%.

In summary, total DMC and DEU of Estonia growth. Lithuania and Latvia were large abrupt changes, peak was before the crisis, and the biggest drop one year after the crisis.

Next we look material flow accounts in raw material equivalents (RME) of EU 27.

Table 11. Material flow accounts of EU 27, thousand tonnes [15]

	2000	2008	2009	2010	2011	2012
Domestic Extraction Used	6 508 005	6 877 813	6 162 608	5 957 662	6 224 943	5 812 166
Total Imports in RME	3 133 336	3 832 190	3 339 357	3 527 146	3 613 616	3 617 956
Total Exports in RME	1 728 340	2 160 365	1 804 819	2 038 078	2 182 022	2 315 427
Raw Material Consumption	7 913 001	8 549 637	7 697 146	7 446 731	7 656 537	7 114 695
Raw Material Input	9 641 340	10 710 002	9 501 965	9 484 809	9 838 559	9 430 122

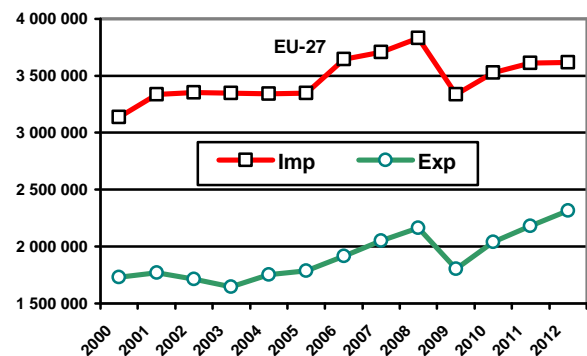
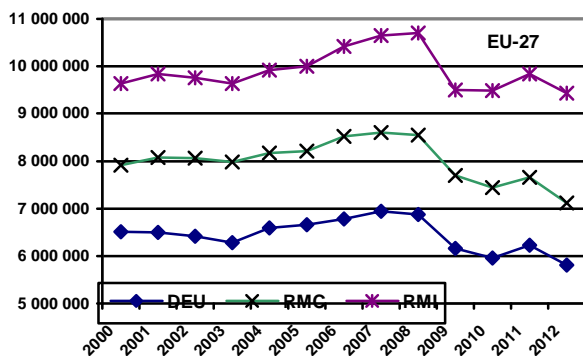


Figure 7. Material flow accounts of EU-27, thousand tonnes [15]

4.2. Material Flow Analyses by Key Components of DMC

Next we analyze the development of the key components of DMC during 2000 to 2012.

Table 12. Domestic material consumption by material - 1 000 tonnes. Biomass (MF1) [5]

	2000	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Est	2,869	3,291	4,396	3,986	4,045	5,768	4,973	5,035	5,167	5,160	5,743
Lat	26,540	22,372	22,667	23,986	23,461	23,326	16,360	18,905	20,027	21,319	18,332
Lit	14,772	16,953	16,941	15,697	13,991	16,833	15,824	16,196	14,820	16,085	17,313

Biomass (MF1) divided: Crops (excluding fodder crops) (MF11); Crop residues (used), fodder crops and grazed biomass (MF12); Wood (MF13); Wild fish catch, aquatic plants/animals, hunting and gathering (MF14); Live animals, and animal products (MF15) and Products mainly from biomass (MF16).

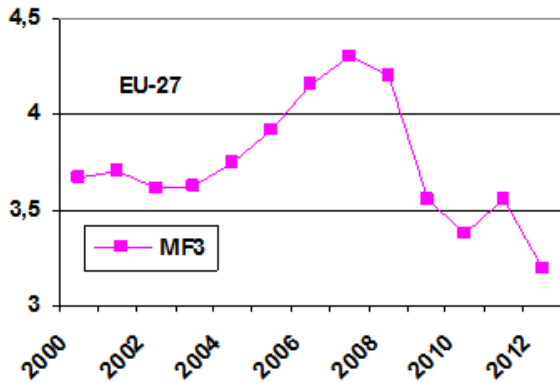


Figure 8. DMC by MF3 - billion tonnes [5]

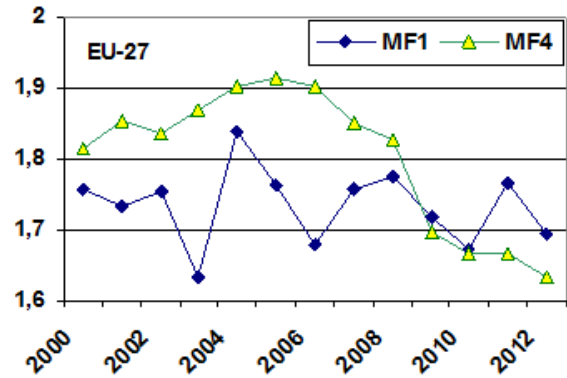


Figure 9. DMC by MF1 and MF3 - billion tonnes [5]

Biomass of the EU 27 and Latvia declined slightly over the analyzed period. Biomass of the EU 27 in 2012 was 1.693 million tonnes, over the 12 years it decreased by 3.7%. Lithuania had a small and Estonia double biomass consumption growth. However, Estonia consumed of biomass three times less than Latvia and Lithuania.

Table 13. Domestic material consumption by material, 1 000 tonnes. Metal ores [5]

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Estonia	111	39	191	449	756	39	-39	152	-199	-283	-341	-203	-120
Latvia	-33	47	145	270	181	-32	145	351	87	-318	-123	-47	12
Lithuania	-48	-71	99	148	384	328	560	535	268	-197	-239	-92	-86

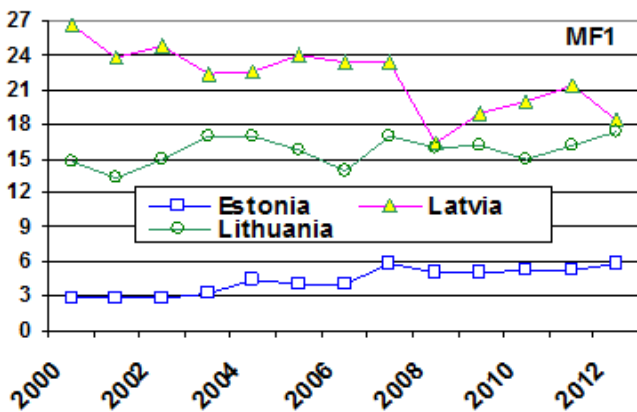


Figure 10. DMC by Biomass 1 000 tonnes. MF1 [5]

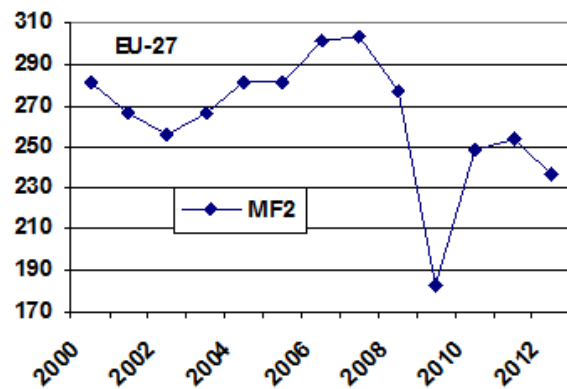


Figure 11. DMC by MF2 of EU-27, million tonnes. [5]

Metal ores (gross ores) (MF2) divided: iron (MF21); non-ferrous metal (MF22): copper (MF221), nickel (MF222),

lead (MF223), zinc (MF224), tin (MF225) and other; products mainly from metals (MF23).

EU-27 metal ores consumption in 2012 was 237 million

tonnes, over the 12 years it decreased by 15.7%. Consumption of metal ores in the Baltic countries was very small and with large fluctuations.

Table 14. Domestic material consumption by material - 1 000 tonnes. Non-metallic minerals [5]

	2000	2003	2005	2006	2007	2008	2009	2010	2011	2012
Est	4,902	12,040	11,027	14,053	16,671	15,398	14,069	12,325	13,864	16,033
Lat	5,868	10,700	15,892	18,903	22,886	22,200	11,089	15,099	17,493	16,864
Lit	9,949	14,788	18,476	20,996	25,707	29,583	14,309	18,787	20,684	16,264

Non-metallic minerals (MF3) divided: marble, granite, sandstone, porphyry, basalt, other ornamental or building stone (MF31); chalk and dolomite (MF32); slate (MF33); chemical and fertiliser minerals (MF34); salt (MF35); limestone and gypsum (MF36) and other.

EU-27 non-metallic minerals consumption in 2012 was 3,189 million tonnes, over the 12 years it decreased by 13.0%. Estonia, Latvia and Lithuania it decreased 3.3, 2.9 and 1.6 times.

Table 15. Domestic material consumption by material - 1 000 tonnes. Fossil energy materials/carriers [5]

	2000	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Est	11,841	14,722	14,035	13,960	14,130	16,297	15,406	14,285	16,357	16,852	16,465
Lat	2,197	2,677	2,552	2,946	3,312	2,709	2,972	2,584	2,316	2,612	2,409
Lit	4,269	4,910	4,737	6,190	5,477	5,879	6,256	4,705	5,330	5,528	5,462

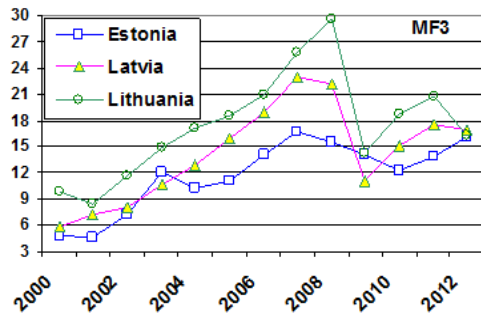


Figure 12. DMC by non-metallic minerals 1 000 tonnes. MF3 [5]

Fossil energy materials/carriers (MF4) divided: coal and other solid energy materials/ carriers (MF41); Liquid and gaseous energy materials/carriers (MF42): Crude oil, condensate and natural gas liquids (MF421), Natural gas (MF422), Fuels bunkered (MF423); Products mainly from fossil energy products (MF43).

EU-27 fossil energy materials/carriers consumption in 2012 was 1,632 million tonnes, over the 12 years it decreased by 10.1%. Grow in Estonia, Latvia and Lithuania it according to 39.0%, 9.6% and 27.9%.

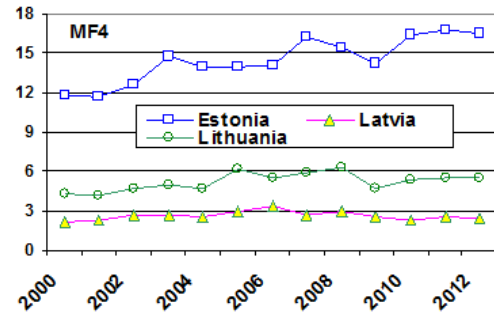


Figure 13. DMC by fossil energy materials/carriers 1 000 tonnes. MF4 [5]

EU-27 *other products* consumption in 2012 was 4,659 thousand tonnes, over the 12 years it decreased by 15.5%. Consumption of *other products* in the Baltic countries was very small and with large fluctuations.

EU-27 *waste for final treatment and disposal* consumption in 2012 was 218 thousand tonnes, over the 12 years it growth by 45.3%. In the Baltic countries was it also very small and with large fluctuations.

Table 16. DMC by main material category, thousand tonnes [5]

	Total		Biomass		Crop residues (used), fodder crops and grazed biomass	
	2000	2012	2000	2012	2000	2012
EU-27	7 526 545	6 757 464	1 758 066	1 693 745	740 863	757 637
Estonia	19 616	37 975	2 869	5 743	2 016	1 770
Latvia	34 666	37 452	26 540	18 332	1 979	2 425
Lithuania	29 173	38 283	14 772	17 313	6 360	8 867

	Metal ores (gross ores)		Non-metallic minerals		Sand and gravel		Fossil energy materials/carriers	
	2000	2012	2000	2012	2000	2012	2000	2012
EU-27	281 219	236 960	3 666 645	3 189 593	2 474 446	:	1 816 430	1 632 289
Estonia	111	-120	4 902	16 033	2 554	11 288	11 841	16 465
Latvia	-33	12	5 868	16 864	2 735	12 036	2 197	2 409
Lithuania	-48	-86	9 949	16 264	7 315	12 390	4 269	5 462

When EU-27 *metal ores (ores gross)* the percentage in total DMC was 3.5%, then Baltic countries practically 0. *Other products and waste for final treatment and disposal* as well as the percentage was practically to 0.

Therefore, it is useful to analyze components of the DMC only for *biomass, non-metallic minerals* and *fossil energy materials/carriers*. In 2012, the total DMC of Estonia, Latvia and Lithuania almost equal.

Biomass consumed in Estonia was three times less than Latvia and Lithuania. Estonian biomass percentage was

15.1%, Latvia 48.9%, Lithuania 45.2% and EU-27 for comparison 25.1%.

Fossil energy materials/carriers trends were reversed: Estonia percentage was 43.4%, Latvia 6.4%, Lithuania 11.1% and for comparison EU 27 24.2%.

Non-metallic minerals trends were the same: Estonia percentage was 42.2%, Latvia 45.0%, Lithuania 42.5% and for comparison EU-27 47.2%.

Components of DMC and DEU of Estonia growth.

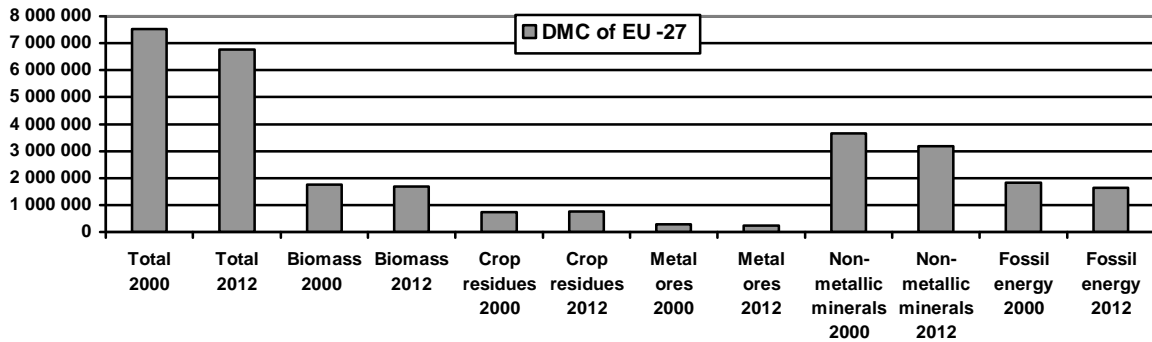


Figure 14. DMC of EU-27 by main material category, thousand tonnes [5]

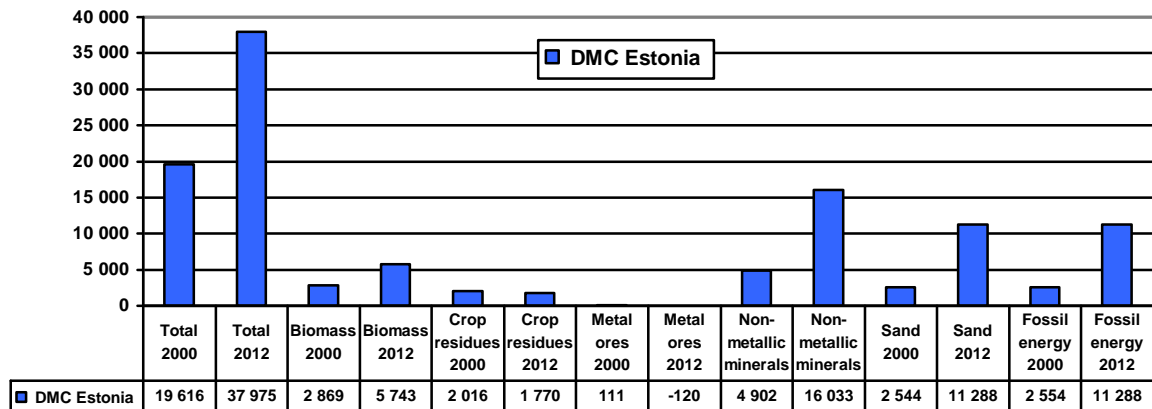


Figure 15. DMC of Estonia by main material category, thousand tonnes [5]

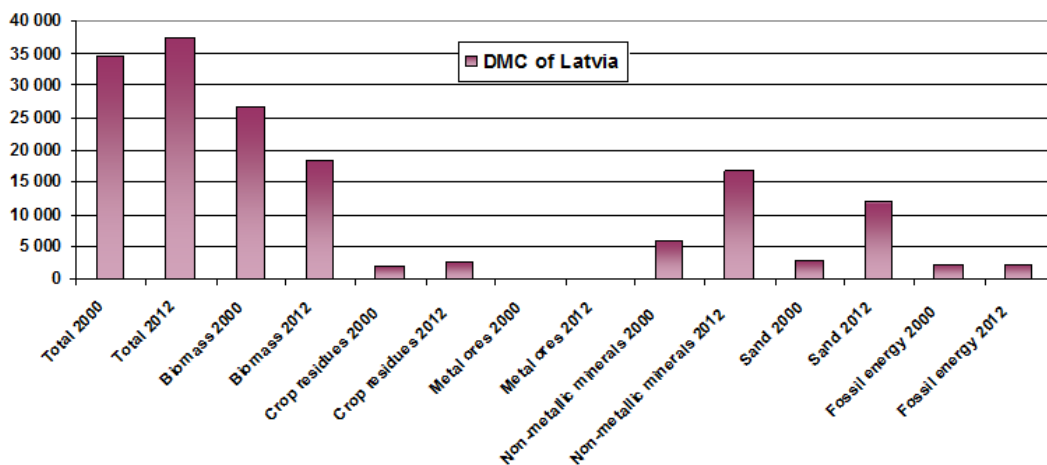


Figure 16. DMC of Latvia by main material category, thousand tonnes [5]

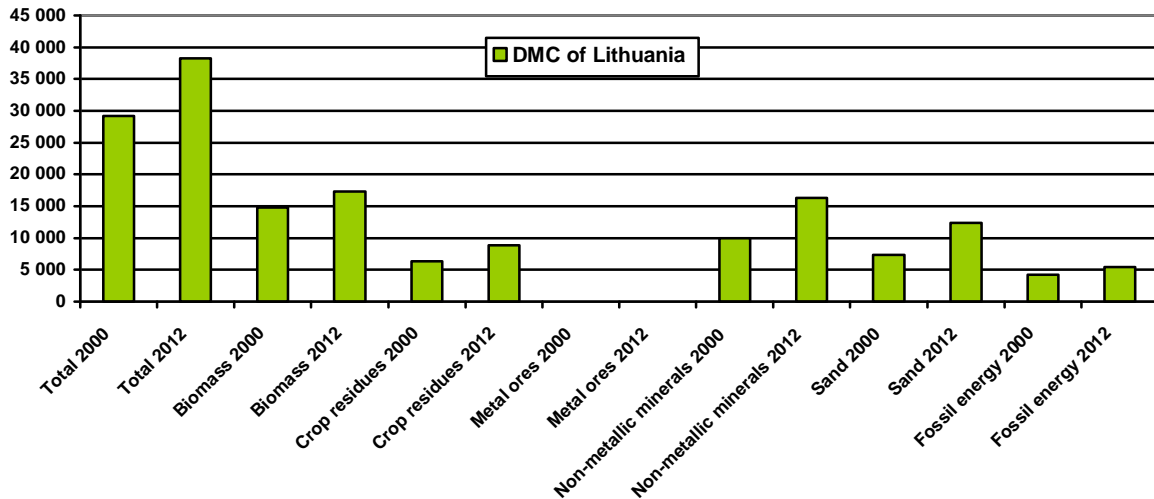
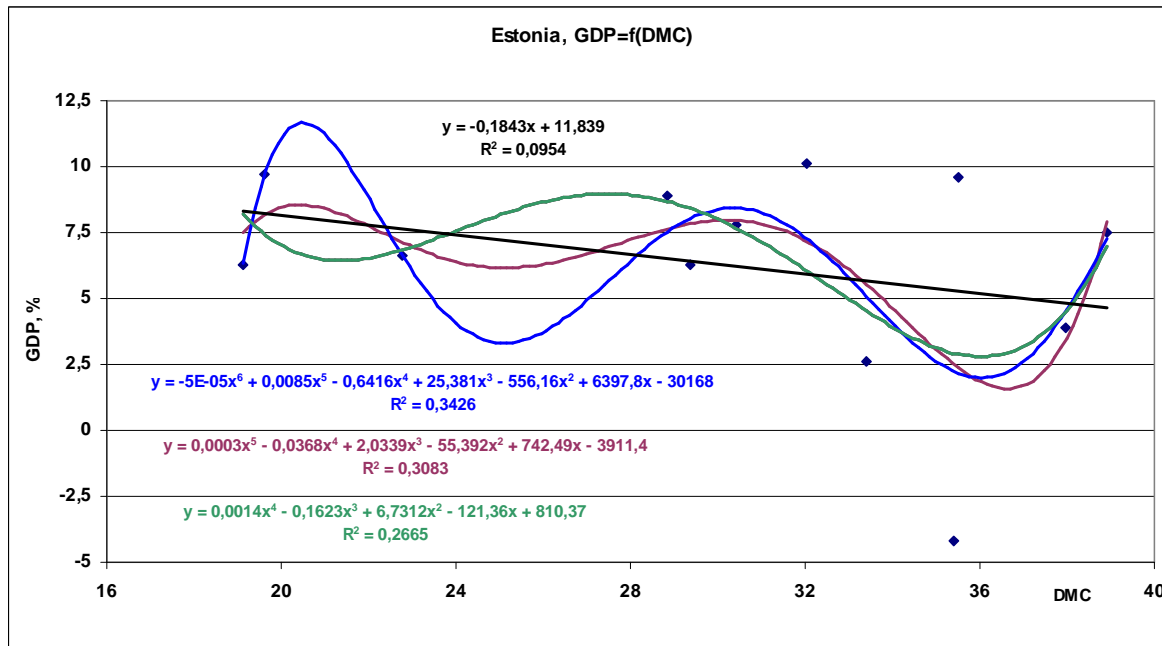


Figure 17. DMC of Lithuania by main material category, thousand tonnes [5]

Here is a consolidated table of the development and distribution of resources in the EU-15 and Baltic States.



Note: outliers (2009. year) excluded

Figure 18. GDP = f(DMC) of Estonia, 2000 – 2012

The processing of data is used to *regression analysis*. For this purpose we use the computer program. Microsoft Excel provides a set of data analysis tools— called the Analysis ToolPak— that you can use to save steps when you develop complex statistical or engineering analyses.

Summary Output

Regression Statistics

Multiple R	0,803515
R Square	0,645636
Adjusted R Square	-1,1

Standard Error	19,85095
Observations	1

ANOVA

	df	SS	MS	F
Regression	11	7179,604	652,6913	18,21955
Residual	10	3940,604	394,0604	
Total	21	11120,21		

Figure shows the example of Estonia relatively weak relationship between GDP and DMC, as R² is small. The figure shows that the DMC can increase GDP even decreased.

It shows that the optimum borders over the DMC large expenditures to exceed the income there from. Also, as higher fossil-on fuel consumption is harmful to the environment.

Therefore, we should analyze the *resource productivity* in depth below. This, however, is strongly correlated with labor productivity analysis [16+].

Taking into account this publication and the previous work of the authors [16 - 24] and other authors' works [14, 25 - 29] have made the following conclusions and suggestions.

5. Conclusions

- Development of the Baltic economies was before and after the economic crisis, the EU's largest.
- The Baltic countries GDP per capita is still lower than 2/3 of EU average and of better half.
- Resource productivity was not so large fluctuations when in the whole national economy (GDP).
- Before the economic crisis, GDP growth rose by analogy with DMC. The peak was reached in 2007 - 2008. 2009. followed by a decline, especially large in Lithuania. In the following years the economy grew, and with it DMC or vice versa the better DMC used to cause growth. For more of the answer gives the material flow components detailed analysis.
- Volume growth of material resources does not always result in economic growth. This leads inevitably to increased costs, which could exceed the income.
- Total exports resource of Baltic countries in tones growth, in Lithuania and in Latvia over two times, but in Estonia 42%.
- Domestic Extraction Used (DEU) of Baltic countries in tonnes growth, in Estonia 1.8, in Latvia and in Lithuania 1.4 times.
- Total DMC and DEU of Estonia growth. Lithuania and Latvia were great abrupt changes, in peak was before the crisis, and the largest decline year after the crisis.
- Resource productivity grew of EU (27) in 12 years was 29%. In a few years, however, was a step backwards. Almost as large was also growth in Lithuania. Latvia Resource Productivity grew strongly, then fell for two years and rose sharply again in 2012. It rose by 1.5 times. Estonia decreased steadily.
- Biomass decreased in the period analyzed EU (27) and Latvia scarce. Lithuania had a small and Estonia double biomass consumption grew. However, Estonia biomass consumed was three times less than in Latvia and Lithuania.
- EU (27) metal ores consumption in 2012 was 237 million tonnes, of 12 years it fell 15.7%. Consumption metal ores in the Baltic countries was very small and with large fluctuations.
- EU (27) non-metallic minerals consumption of 12 years fell 13.0%; Estonia, Latvia and Lithuania but 3.3, 2.9 and 1.6 times.
- EU (27) fossil energy materials/carriers consumption of 12 years fell 10.1%; Estonia, Latvia and Lithuania however, grew 39.0%, 9.6% and 27.9%.
- EU (27) other products consumption grew in 12 years was 15.5%. *Other products* consumption of the Baltic countries was very small and with large fluctuations.
- EU (27) waste for final treatment and disposal consumption in 12 years was 45.3%. In the Baltic countries was it very small and with large fluctuations.
- Extra EU27 imports liquid and gaseous energy materials/carriers and crude oil, condensate and natural gas liquids per capita: EU (27) – stable or small decrease, Latvia - small decrease, Lithuania – growth, Estonia - growth over 2 times.
- The EU has a poor energy region, it is unexpected decrease in mineral fuels (sanctions) is very sensitive.
- Total imports resource per capita grew in all Baltic countries.
- So far the mineral fuels imports from third countries progressed steadily.
- DMC per capita growth was in Estonia double, in Latvia 26% and in Lithuania 54%.
- Total extra EU27 imports resource per capita trend: Lithuania intermittent growing, Estonia decrease and Latvia was stable. Extra EU27 imports per capita of Estonia and Latvia was two times less when in Lithuania. This shows that Latvia and Estonia should be much better than to live economic blockade when the Lithuania.
- Extra EU27 imports natural gas per capita in Latvia and Lithuania are much greater than in Estonia.
- Total exports; direct material inputs and domestic extraction used resource per capita grew in all Baltic countries in 2003 – 2012.
- Of the Baltic countries are more dependent of the imported resources Lithuania.
- In summary, total DMC and DEU of Estonia growth. Lithuania and Latvia were large abrupt changes, peak was before the crisis, and the biggest drop one year after the crisis.
- Analysis of extra EU27 imports resource per capita shows that Latvia and Estonia should be much better than to live economic blockade of Lithuania as. The final for an assessment is need for more analysis of trade groups and countries.
- Of the Baltic countries are more advanced DMC in Estonia.
- The use of environmentally friendly materials has risen, and the use of sustainable materials is reduced.
- Material flow is generally decreased less so EU whole, but also in the Baltic states.
- Resource productivity is usually grown so EU whole, but also in the Baltic States.

References

- [1] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. 26.1.2011 COM (2011) 21. http://ec.europa.eu/resource-efficient-europe/pdf/resource_efficient_europe_en.pdf
- [2] Domestic material consumption by material. Code: tsdpc230 Eurostat Last update: 04.09.2014 <http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdpc230>
- [3] Domestic material consumption by material. Environmental accounts (t_env_acc) http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/data/main_tables
- [4] Material flow accounts. Code: env_ac_mfa. Explanatory texts (metadata). Eurostat. Last update: 01.09.2014 http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/EN/env_ac_mfa_esms.htm
- [5] Material flow accounts. Code: env_ac_mfa. Eurostat. Last update: 01.09.2014 http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_ac_mfa&lang=en
- [6] Methodology. Annual accounts. National accounts (including GDP). Eurostat http://epp.eurostat.ec.europa.eu/portal/page/portal/national_accounts/methodology/annual_accounts
- [7] Mohammad Hashem Pesaran. *Econometric Analysis of Heterogeneous Panels with Unobserved Common Effects*. University of Cambridge. <http://www.econ.cam.ac.uk/people/crsid.html?crsid=mhp1&group=emeritus>
- [8] Klaus Backhaus, Bernd Erichson, Wulff Plinke, Rolf Weiber. *Regressionsanalyse. Nichtlineare Regression. Multivariate Analysemethoden. Eine anwendungsorientierte Einführung*. Springer. Berlin. 2011. pp. 55 – 118, 509 – 518
- [9] Carl T. Kelley. *Iterative Methods for Optimization*, SIAM Frontiers in Applied Mathematics. North Carolina State University, No 18, 1999. http://www.siam.org/books/textbooks/fr18_book.pdf pp. 22 - 28
- [10] Real GDP growth rate – volume. Percentage change on previous year. Code: tec00115. Eurostat. 28.08.2014. <http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tec00115>
- [11] Code: FT2: exports and imports by commodity chapter and country. Statistics Estonia. Modified: 10.10.2014 http://pub.stat.ee/px-web.2001/Dialog/varval.asp?ma=FT2&ti=EXPORTS+AND+IMPORTS+BY+COMMODITY+CHAPTER+%28CN+2%2DDIGIT+CODE%29+AND+COUNTRY+%28MONTHS%29&path=../I_Databas/Economy/11Foreign_trade/03Foreign_trade_since_2004/&lang=1
- [12] DMC by country and main material category. Eurostat. http://epp.eurostat.ec.europa.eu/statistics_explained/images/ef/Material_flow_accounts_13Aug2014.xlsx
- [13] Eurostat newsrelease 137/2014 - 15. September 2014 http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/6-15092014-AP/DE/6-15092014-AP-DE.PDF
- [14] Stephan Moll, and Cristina Popescu (2012). In physical terms the EU-27 imports three times more than it exports - Statistics in Focus, Issue number 51/2012. Eurostat. http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/documents/KS-SF-12-051-EN.pdf
- [15] Components of domestic material consumption, Code: tsdpc220. Eurostat. Last update: 04.09.2014 <http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdpc220>
- [16] Toivo Tanning, Lembo Tanning. *Labour Productivity Trends Analyses in Baltic Countries to 2014*. International Journal of Economic Theory and Application. Vol. 1, No. 3, 2014, pp. 35-42.
- [17] Tanning, Lembo; Tanning, Toivo (2013). *Lessons From The Economic Crisis of Europe – the Baltic States Companies Working Efficiency before and After the Crisis*. PARIPEX – Indian Journal of Research, 2, 40 - 42.
- [18] Tanning, Lembo; Tanning, Toivo (2013). *Economic Lessons from the Crisis - The Professionals Saved the Estonian Economy*. American International Journal of Contemporary Research, Vol. 3(May), 52 - 61.
- [19] Tanning, Lembo; Tanning, Toivo (2013). *Companies working efficiency before and after the economic crisis of the Latvia example*. Global Advanced Research Journal of Management and Business Studies, 2(3), 126 - 136.
- [20] Tanning, Toivo; Tanning, Lembo (2013). *Why Eastern European wages are several times lower than in Western Europe?* Global Business and Economics Research Journal (Jakarta, Indonesia), 2 (1), 22 - 38.
- [21] Lembo Tanning, Toivo Tanning. (2009). *Rahvusvaheline majandus I*. (International Economy, Vol. 1). Tallinn University of Technology. Tallinn, p. 280.
- [22] Lembo Tanning. (2010). *Maaenergia ülevaade. I osa. Nafta ja gaas*. (World Energy Outlook. I part. Oil and Gas). Tallinn University of Technology. Tallinn, p. 240.
- [23] Lembo Tanning. (2010). *Maaenergia ülevaade. II osa. Tuumaenergia*. (World Energy Outlook. II part. Nuclear energy). Tallinn University of Technology. Tallinn, p. 140.
- [24] Lembo Tanning. (2010). *Maaenergia ülevaade. III osa. Alternatiivsed kütused*. (World Energy Outlook. III part. Alternative fuels). Tallinn University of Technology. Tallinn, p. 252.
- [25] Stephan Moll, Cristina Popescu, and Ramona Nickel (2012). *EU's Resource Productivity on the increase - Number 22/2012*. Eurostat. http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/documents/EU's_Resource_Productivity_on_the_increase.pdf
- [26] Julie Hass, and Cristina Popescu (2011). *Economy-wide material flows: European countries required more materials between 2000 and 2007 - Statistics in focus 9/2011*. Eurostat. http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-SF-11-009
- [27] Nancy Steinbach, Ute Luksch, and Julio Cabeça (2006). *Manufacturing industry 1995-2003 - Economic activities and their pressure on the environment - Statistics in focus 16/2006*. Eurostat. http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-NQ-06-016

- [28] Ute Luksch, Nancy Steinbach, and Katarina Markosova (2006). Economic activities and their pressure on the environment 1995-2001 - Statistics in focus 2/2006. Eurostat. [http://epp.eurostat.ec.europa.eu/portal/page/portal/product_det](http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-NQ-06-002)
- [29] Resource intensity and productivity (2012). EJOLT <http://www.ejolt.org/2012/12/resource-intensity-and-productivity/>