PlasTEP

plasma for environment protection

Report on Air emissions Database in the Baltic Sea Region countries MS3-1.1

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PREPARED BY PLASTEP PARTNER #10 VILNIUS GEDIMINAS TECHNICAL UNIVERSITY

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List of Abbreviations

IPPC	– Integrated Pollution Prevention and Control
NO_x	– Nitrogen oxides
NMVOC	– Non methane volatile organic compounds
SO_2	– Sulphur oxides
UNECE	– The United Nations Economic Commission for Europe
VOC	– Volatile Organic Compounds

1 Introduction

The pollution control of the environment is a transnational request of all countries and a strategic aim of the European Union. This is also reflected in the increasing tightening of the exhaust emission standards particularly in the Baltic Sea Region (BSR) countries. Causes by the constantly rising of the industrialisation and environmental impact of exhaust air and gases. The intact nature represents an important commercial basis particularly in the BSR countries and therefore the industrialisation must be arranged environment-friendly. New possibilities for this will be opened by the innovative plasma-based filter.

The main point of the PlasTEP project is to clearly inform the decision makers from politics and economy about the practical possibilities of the low-temperature plasma technology for environmental purposes to establish a market driven transfer process and an increasing member of applications.

The analysis of main pollution source of NO_x/SO_2, NMVOC in the BSR should be the basic for the cost – benefit analysis and to define the main targets for plasma treatment.

The reduction of NO_x/SO_2, NMVOC, odours and particles in air has a very high potential in a lot of sensitive areas. For example the odours nuisances, which appear with the use of biological energy sources (fermentation gas, biomass, bio – ethanol) can be reduced. At the same time new application fields open up with the treatment of exhaust gas at decentralised power plants and in the transportation sector (ship diesel, vehicles).

Efficient NOx/SO_2 reducing procedures open up new possibilities for the optimisation of combustion processes (engines, power plants) and affect so indirectly the reduction of the CO_2 emission. At the same time energy can be saved by the substitution of conventional catalytic procedures and waste can be avoided (e.g. chemical industry, polymer processing).

To summarise the main task of our work is to perform the analysis of emission inventories for plasma technologies in the Baltic Sea Region. In order to obtain better analysis there was set the objective to make the data base of main producers of environmental pollutants that may be subjected to plasma treatment.

1.1 Data collection process

The Baltic Sea Region unites 8 European Union countries: Finland, Sweden, and Denmark, Northern part of Germany, Poland, Lithuania, Latvia and Estonia.

The population around Baltic Sea is approximately 15 million inhabits in 10 km band of the coast and 29 million – 50 km of the coast. Approximately 22 million live in population centres of over 250 thousd. and it covers 90% of the 10 km band around the coast. In the table 1 is shown the total population sizes in EU countries around the Baltic Sea.

In Europe, emissions of air pollutant are covered by several regulatory regimes, both under the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP) and directive of the European Commission. All member states of the European Union under the CLRTAP are subject to mandatory emission reporting (http://www.ceip.at/).

Country	Population, thou.
Finland	5351.4
Estonia	1340
Latvia	2248
Lithuania	3331.2
Poland	38100
N. Germany	1700
Denmark	5511.5
Sweden	9373.4

Table 1.1 Population in 8 Baltic Sea Region Countries (http://www.state.gov)

The present inventories data of air emission in BSR countries varied in a year periods. We were able to compare mostly data reported in 2008. However, the data from Northern Germany federal state Mecklenburg-Vorpommern was available only in 2004.

The general data of air emissions in different countries was collected from emissions inventory reports and from European Monitoring and Evaluation Programme (EMEP) Centre on Emission Inventories and Projections database (http://www.ceip.at/ceip/).

Data of air pollutant trends and emissions from different sectors in Finland and Estonia was available on Finish Environment Institute and Estonian Environment Information database (Air pollutant …2010; Environment information 2010).

The data of NO_x, SO_2 and NMVOC emissions in Latvia and Lithuania were collected from industrial sectors air emission reports and Environmental Agencies, also from performed emission measurements in the industrial plants.

Air emissions data in Poland, Denmark and Northern Germany was collected from Emissions inventory reports intended to the UNECE (Poland's… 2009; Danish… 2009; Denmark's… 2010; Emissionkataster… 2005).

The data of Sweden emissions collected from a database concerning emissions from the roughly 1000 largest companies in Sweden that are engaged in activities classified as 'environmentally hazardous' (Swedish Pollutant Release …2010).

1.2 Total Emissions in the Baltic Sea Region countries

Air emissions we compared separately and grouped in three Baltic States and Northern Germany and in other group of countries: Poland, Finland, Sweden and Denmark, according to the released emissions capacity.

In the first group of countries NO_x emissions varies from 6,190 to 67,739 t/year; SO_2 from 842 to 69,333 t/year and NMVOC varied from 3,007 to 71,465 t/year (Fig 1.1). While in the second group of countries NO_x emissions varied from 151,686 to over an 831,000 t/year; SO_2 approximately from 20,000 to 998,561 t/year and NMVOC from over an 106,000 to 582,623 t/year (Fig 1.2).

The highest NO_x emissions in Baltic States are released in Lithuania (67,739 t/year) as well as NMVOC emissions (71,465 t/year). However, the highest SO_2 emissions are reported in Estonia (69,333 t/year).

The highest emissions of all concerned air pollutants were reported in Poland (NO_x – 831,225 t/year; 998,561 t/year of SO_2 and NMVOC – 582,623 t/year). The NO_x emissions in Scandinavian countries are similar (151,686; 154,403 and 165,877 t/year). Meanwhile, the highest SO_2 emissions were reported in Finland (173,025 t/year) and the highest NMVOC emission in Sweden (70,119 t/year).

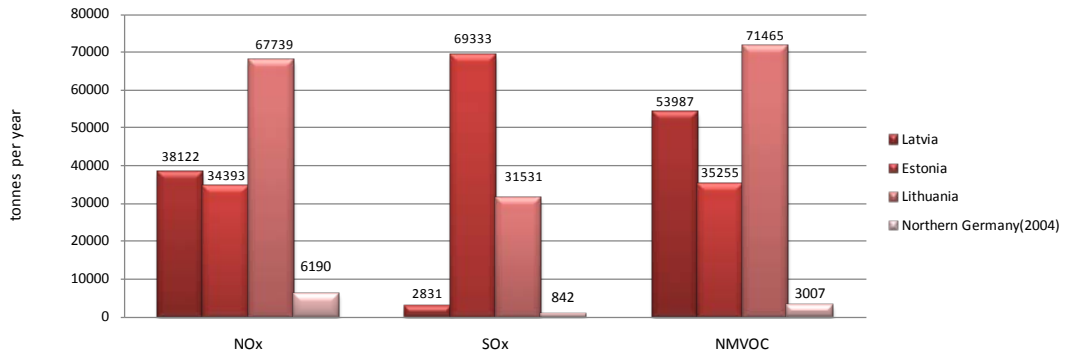


Fig 1.1 Total NO_x, SO_2 and NMVOC emissions in 1st group countries: Latvia, Estonia, Lithuania in 2008 and Northern Germany in 2004, t/year

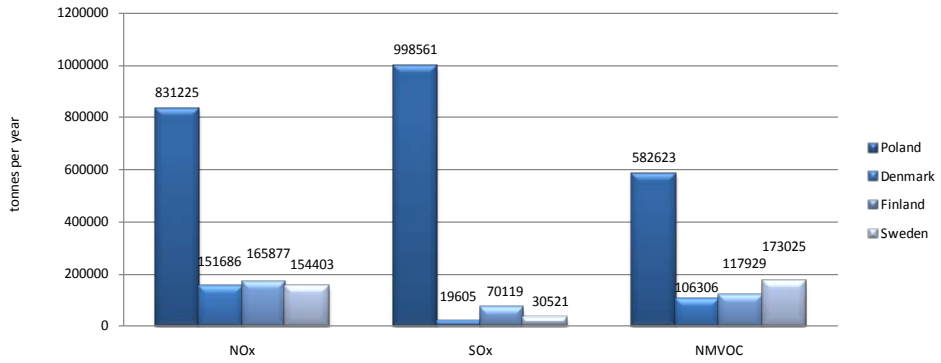


Fig 1.2 Total NO_x, SO_2 and NMVOC emissions in the 2nd group countries: Poland, Denmark, Finland and Sweden in 2008, t/year

1.3 Total Emissions per one person

The emissions of sulphur oxides (SO_2), nitrogen oxides (NO_x), non-volatile organic compounds (NMVOC) recalculated for one person are presented in Fig 1.3.

According to the annual NO_x emissions for one person three countries could be separated as releasing the highest amount: Finland, Denmark and Estonia (31, 28 and 26 kg/capita).

According to the highest annual SO_2 emissions for one person countries distributed following: Estonia (52 kg/capita), Poland (26 kg/capita) and Finland (13 kg/capita). The SO_2 emissions amount in the rest of the countries did not reach the 9 kg per capita.

NMVOC emissions distributed more or less evenly in all countries. However, in Latvia, Estonia and Denmark (24, 26 and 22 kg/capita) NMVOC emissions per capita were slightly higher comparing with the rest of BSR countries.

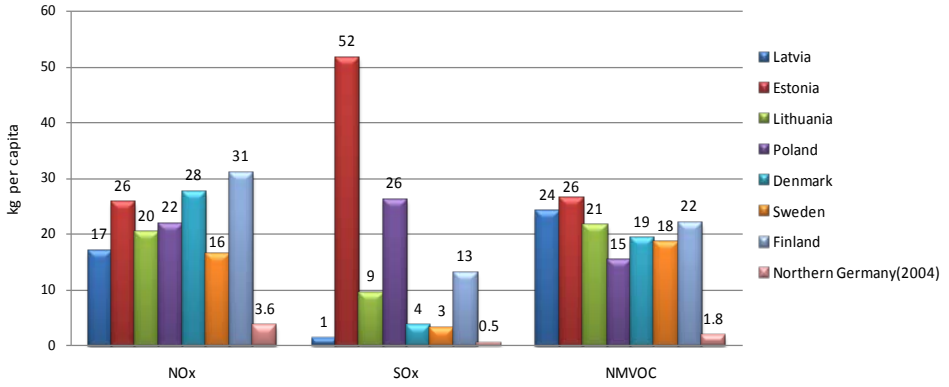


Fig 1.3 Amount of NOx, SO_2 and NMVOC emissions in the Baltic Sea Region Countries for one person in 2008, kg/capita

The clearly higher SO_2 emission in Estonia is related with the well established oil shale industry and high consumption rate as power fuel. The sulphur content in oil shale ranges 1.2 – 2.0 %, while, for example, in coal it is about 1% and in brown coal varies from 0.5 to 3% (Uus 2006).

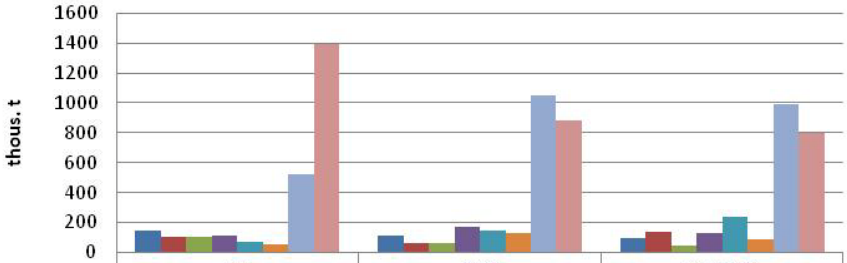
1.4 Limit values of NO_x, SO_2 and NMVOC emissions in the Baltic Sea Region countries

The most liberal limit values of all concerned air pollutants are determined in Poland (1,397,000 t/year for SO_2; 879,000 t/year for NO_x; 800,000 t/year for NMVOC) and Germany (520,000 t/year for SO_2; 1,051,000 t/year for NO_x; 995,000 t/year for NMVOC) (Fig 1.4).

The SO_2 emissions are the most strictly controlled in Sweden and Denmark, where the total sulphur oxide emissions cannot exceed 67,000 and 55,000 t/year, respectively. Meanwhile, in the rest BSR countries limit values of SO_2 are approximately similar and varies from 100,000 to 145,000 t/year.

Distinct from SO_2 emission limits, the NO_x emissions are mostly controlled in Latvia and Estonia (61,000 and 60,000 t/year). As well as, SO_2 in the rest of the BSR countries the NO_x limit values are defined approximately similar and varies from 110,000 to 170,000 t/year.

The most strictly NMVOC emissions are controlled in Estonia and cannot exceed 49,000 t per year. As well as in Estonia, in the Lithuania and Denmark (92,000 and 85,000 t/year) is allowed to emit quite small amounts of NMVOC. One of the highest NMVOC emissions limit value except Germany and Poland is defined in Sweden (241,000 t/year). In Latvia and Finland the limit values are defined similarly and are equal to 136,000 and 130,000 t/year, respectively.



	SOx	NOx	NMVOC
Lithuania	145	110	92
Latvia	101	61	136
Estonia	100	60	49
Finland	110	170	130
Sweden	67	148	241
Denmark	55	127	85
Germany	520	1051	995
Poland	1397	879	800

Fig 1.4 Limit values of SO_2, NO_x and NMVOC in the Baltic Sea countries in 2010, thous. t/year

1.5 Air emission charges in BSR countries

The development and implementation of air pollution charges varies throughout the region. Large point-source polluters (combustion plants, heavy industry) are the primary subjects of these instruments. The charges are intended to raise revenues and encourage cost-effective abatement below the permitted level (Laskowska and Scrimgeour 2001).

Only three Nordic countries (Denmark, Sweden and Norway) have sulphur taxes – Finland with the largest emission has not re-introduced this tax (National Statistical offices.. 2003). A sulphur tax was paid in Finland until 1993. At the moment, all diesel oil has sulphur content below 0.05 per cent. The Swedish tax on sulphur is estimated to be responsible for 30% of the total reduction in sulphur emissions from 1995 to 1998.

Country	SO_2	NO_x	NMVOC	Data year
Lithuania	~105 EUR	~197 EUR	~62 EUR	in 2010
Latvia	~85 EUR	~85 EUR	~85 EUR	in 2009
Estonia	~31 EUR	~70 EUR	~70 EUR	in 2009
Finland	No tax	No tax	n.d.	
Sweden	1600 EUR	4147 EUR	n.d	since 1992
Denmark	1340 EUR	~670 UR	n.d	(National Statistical offices.. 2003); NO_x – 2010 plan
Germany	n.d.	n.d.	n.d.	
Poland	~58 EUR	125 EUR	n.d	

Table 1.1 Environmental taxes applied for specific air pollutants in BSR Countries, EUR/t (n.d. – no data)

The Danish tax on the sulphur content of energy products, introduced in 1996 has had a rapid impact. The average sulphur content of fuel oil and coal (and thus SO_2 emissions) decreased significantly in the same year. In addition, the tax had a positive impact on the development of sulphur purification plants and technology (Danish

Ministry of Taxation 2011). It is planed that Denmark from sulphur tax will receive 75 mln. EUR and from nitrogen tax 225 mln. EUR in 2011 (introduced in 2010).

2 NO_x, SO_2 and NMVOC emissions in the Baltic Sea Region Countries

2.1 Sweden

- **SO_2 emissions**

Sulphur dioxide emissions come from the energy, transport and industry sectors and continued to decrease during the 1990s.

The highest SO_2 emissions are in Västerbottens County (Fig 2.2) (Swedish Pollutant Release … 2010). The main emitter is "Rönnskärsverken" facility; a leading European metals producing company (mining and smelting).

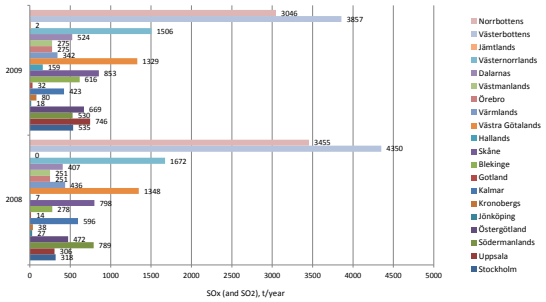


Fig 2.1 SO_2 emissions in Sweden Counties in 2008 – 2009, t/year

- **NOx emissions**

Nitrogen oxides are formed in all combustion in the energy and transport sectors, and the largest emission sources are road traffic, machinery, navigation and production of electricity and heating (National inventory report 2010).

The highest NO_x emissions are released in the Norrbotens County (Swedish Pollutant Release …2010) (Fig 2.1). Here the main emitters are one of the world's largest ore iron mining facilities "Malmbergsgruvan" and "Kirunagruvan".

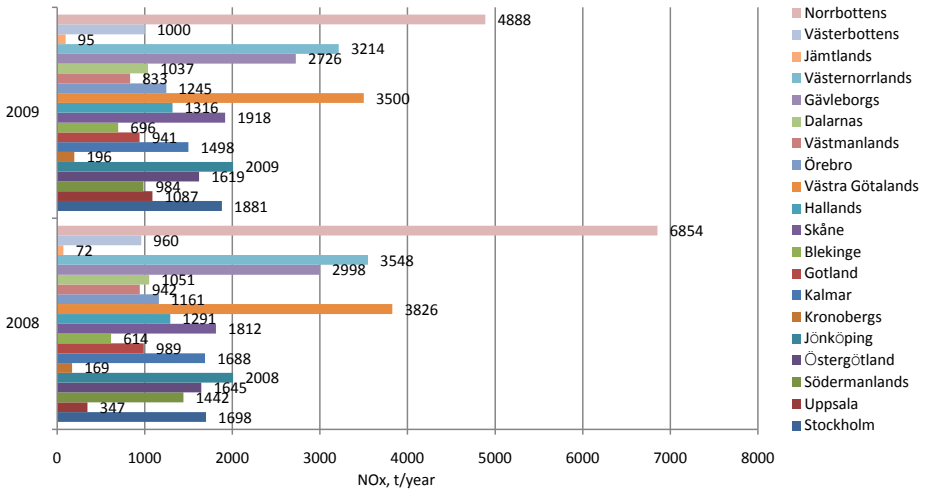


Fig 2.2 NO_x emissions in Sweden Counties in 2008 – 2009, t/year

- **NMVOC emissions**

Road traffic and combustion of wood in households dominate in NMVOC release in Sweden (National inventory report… 2010).

The highest NMVOC emissions appear in Västra Götalands County (Fig 2.3) (Swedish Pollutant Release … 2010). The main polluting facilities are mineral oil and gas refineries “VPreem AB (publ)” and “Preemraff Göteborg”.

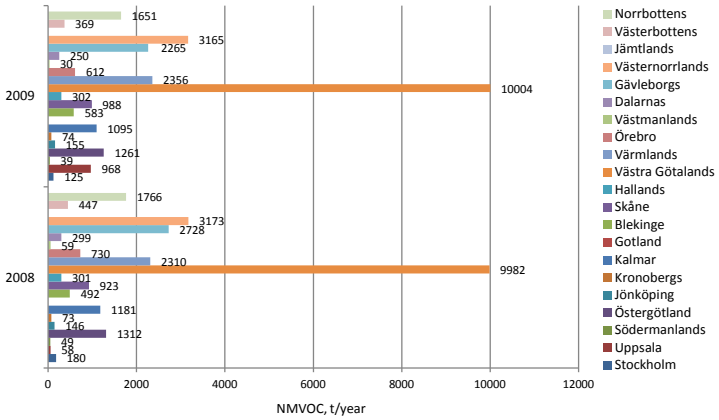


Fig 2.3 NMVOC emissions in Sweden Counties in 2008 – 2009, t/year

2.2 Denmark

- **SO_2 emissions**

SO_2 from stationary combustion plants accounts for 88 % of the national emission (Danish Emission Inventories... 2007). For example, power plants >300MWth are the main emission source, accounting for 79 % of the SO_2 emission.

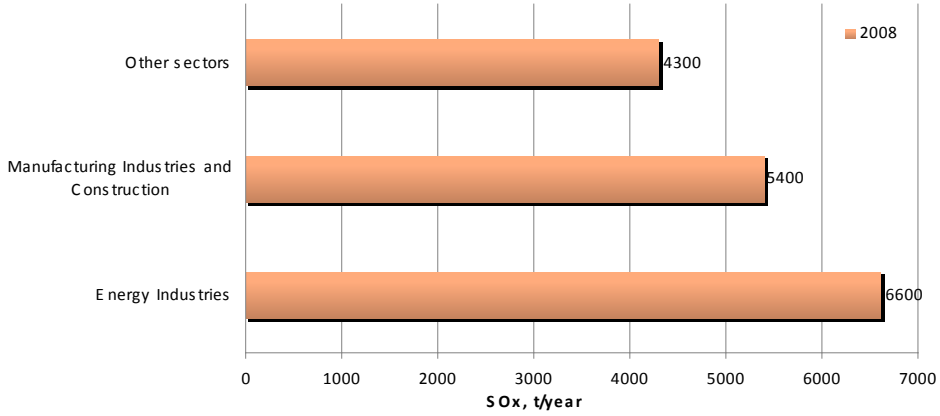


Fig 2.4 SO_2 emissions from stationary sources in Denmark, t/year

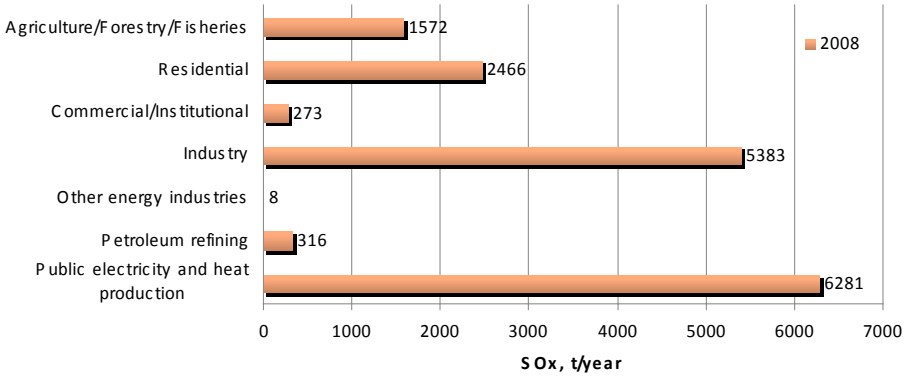


Fig 2.5 SO_2 emissions from stationary sources according to different sectors in Denmark, t/year

- **NO_x emissions**

NO_x from stationary combustion plants accounts for 37 % of national emissions (Danish Emission Inventories...2007).

The NO_x emissions in Denmark are mostly released from Energy producing enterprises *and* is the largest emission source accounting for 54 % of the emission from stationary combustion plants (Danish Emission Inventories...2007) (Fig 2.4). The emission from public power boilers > 300 MWth accounts for 61 % of the emission in this subcategory.

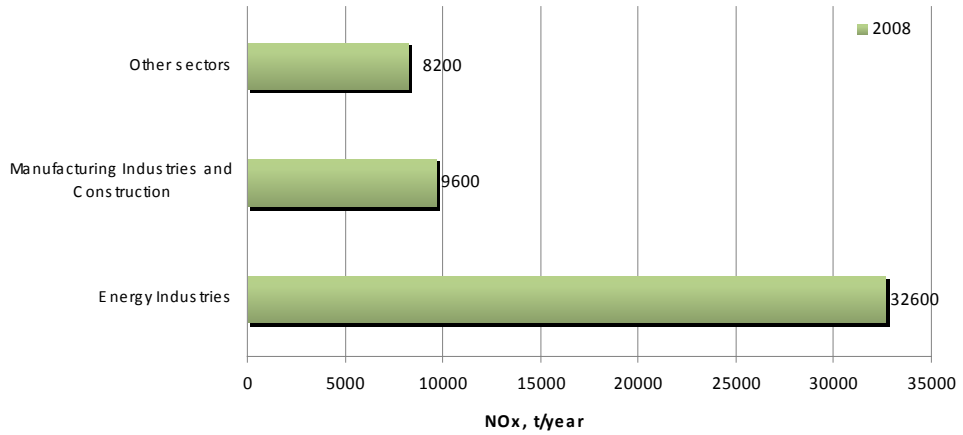


Fig 2.6 NO_x emissions from stationary sources in Denmark, t/year

Industrial combustion plants are also an important emission source accounting for 18 % of the emission. The main industrial emission source is cement production, which accounts for 64 % of the emission. Residential plants account for 11 % of the NOx emission. The fuel origin of this emission is mainly wood, gas oil and natural gas accounting for 65 %, 15 % and 15 % of the residential plant emission, respectively.

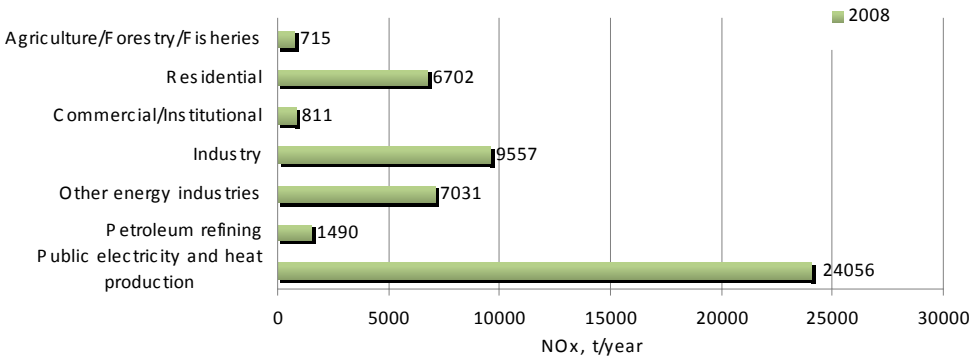


Fig 2.7 NO_x emissions from stationary sources according to different sectors in Denmark, t/year

- **NMVOC emissions**

NMVOC from stationary combustion plants accounts for 25% of the national emission. Residential plants are the largest emission source accounting for 79 % of the emission from stationary combustion plants. For residential plants NMVOC is mainly emitted from wood and straw combustion (Danish Emission Inventories... 2007).

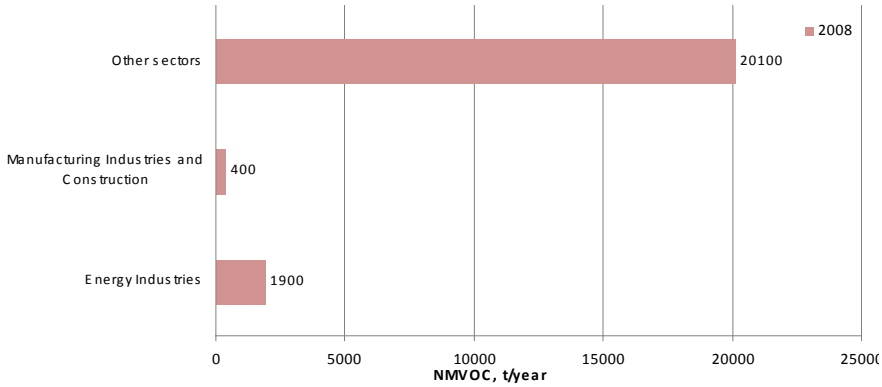


Fig 2.8 NMVOC emissions from stationary sources in Denmark, t/year

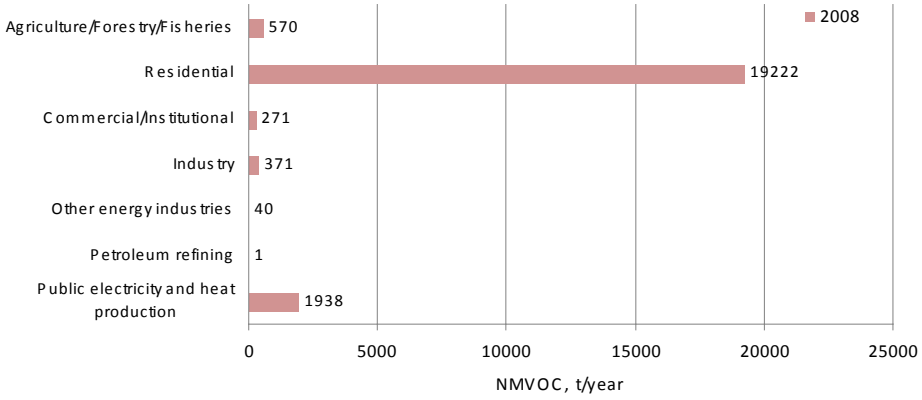


Fig 2.9 NMVOC emissions from stationary sources according to different sectors in Denmark, t/year

2.3 Poland

- **NOx emissions**

Emissions of NO_x in 2008 amounted 831.2 Gg and decreased by about 32% between 1980 and 2008, and 35% between 1990 and 2008. Similar to sulphur dioxide, most of the reductions were triggered by the decline of the heavy industry in the late 1980s and early 1990s and lower share of hard coal and lignite in 1990s (Poland's national inventory … 2010).

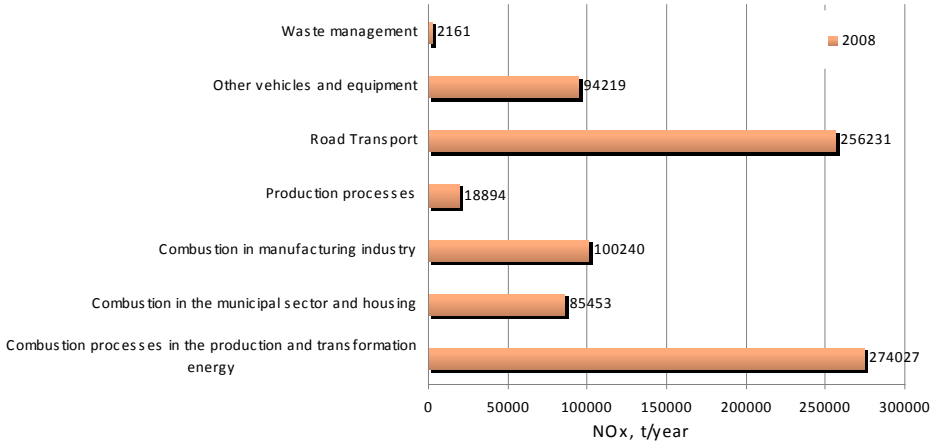


Fig 2.10 NO_x emissions in different sectors in 2008, Poland, t/year

- **SO_2 emissions**

The biggest drop characterizes emissions of SO_2, which amount 1131.0 Gg in 2007 and decreased by about 2% between 1980 and 2007, and 65% between 1990 and 2007. Most of the reductions were caused by the decline of heavy industry in the late 1980s and early 1990s. In late 1990s the emissions declined because of the diminished share of hard coal and lignite among fuels used for power and heat generation.

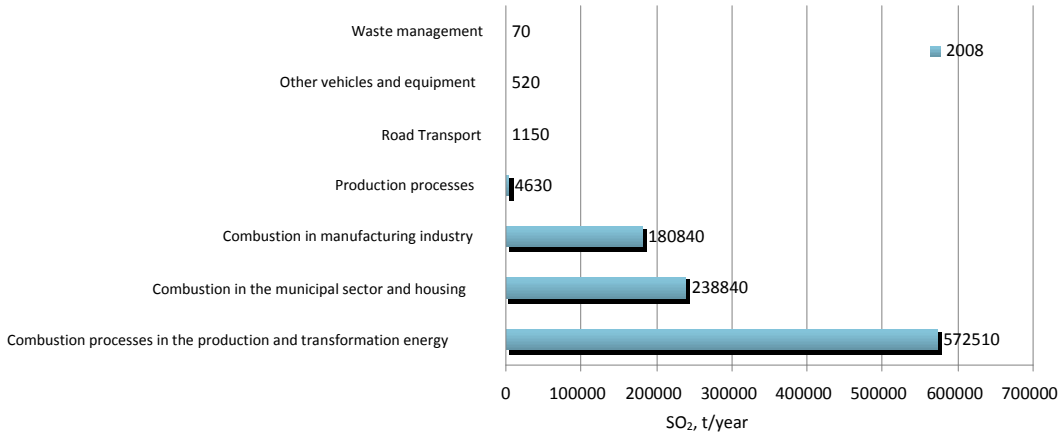


Fig 2.11 SO2 emissions in different sectors in 2008, Poland, t/year

- **NMVOC emissions**

Emissions of NMVOC decreased by 30% between 1990–2008 and was about 583 Gg in 2008

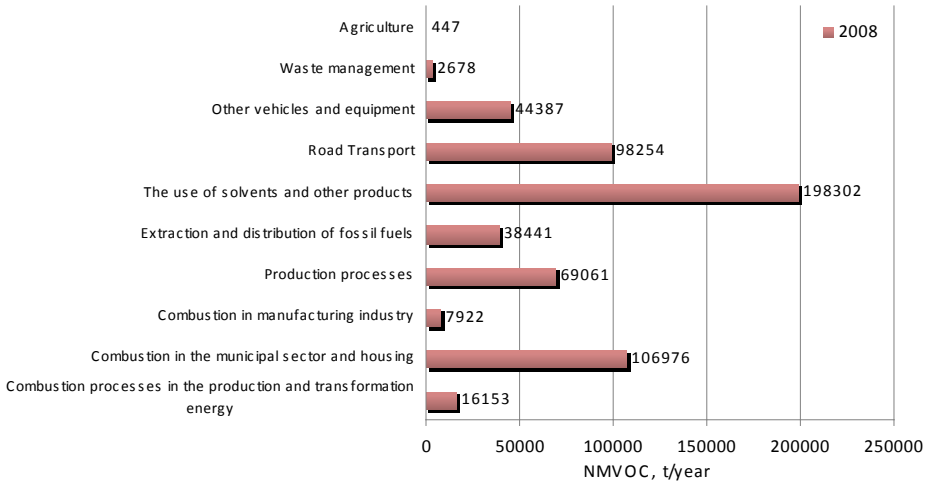


Fig 2.12 NMVOC emissions in different sectors in 2008, Poland, t/year

2.4 Lithuania

- **NO_x emissions**

The highest NOx emissions in Lithuania are recorded in Norther part of Lithuania (Siauliai Region) where the biggest industrial plants are placed. For example, SC“Akmenes cementas” (cement and concrete production)and SC“Orlen Lietuva” (oil refinery enterprise) (Fig 2.13).

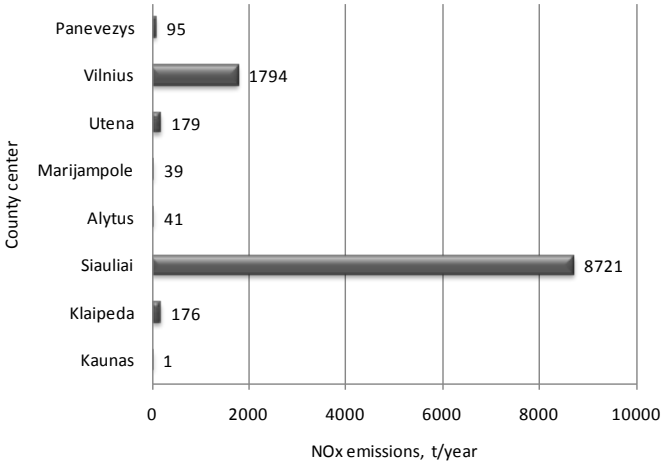


Fig 2.13 NOx emissions in different Lithuania Counties in 2009, t/year

The highest NOx emissions are released from cement and concrete production sector, fertilizers production, heat and power production and fuel/oil refinery plants (Fig 2.14).

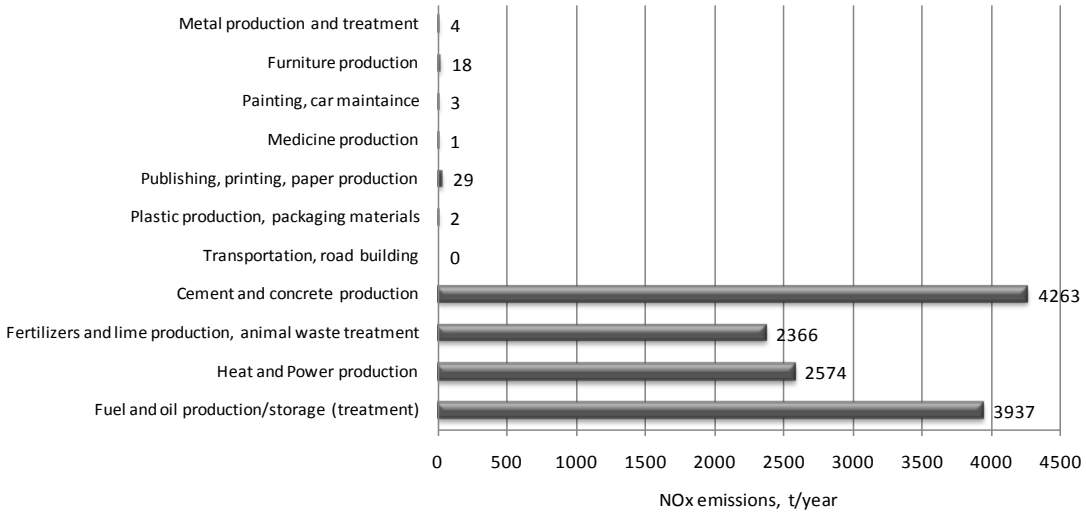


Fig 2.14 NO_x emissions according different industry sectors in 2009, t/year

- **SO_2 emissions**

SO_2 emissions are particularly the same in two Lithuanian Counties: Siauliai and Kaunas (Fig 2.15). The high SO_2 emissions could be derived from biggest in Baltic states fertilizers production company SC"Achema".

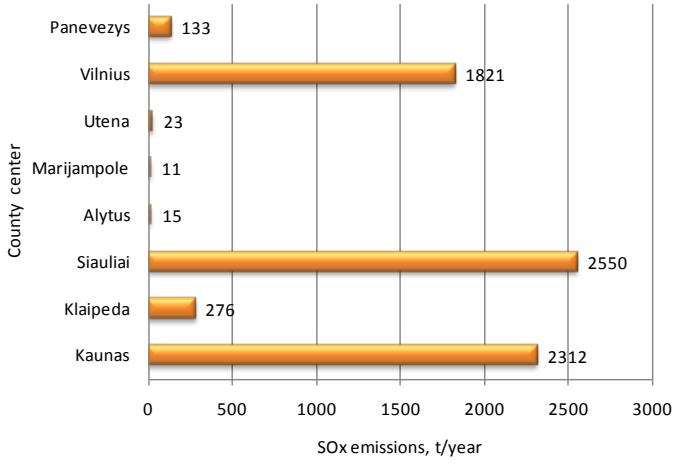


Fig 2.15 SO_2 emissions in different Lithuania Counties in 2009, t/year

In Lithuania the bigger part of SO_2 emissions are still derived from heat and energy sectors, the rest from fertilizers production sector, cement and concrete production (Fig 2.16).

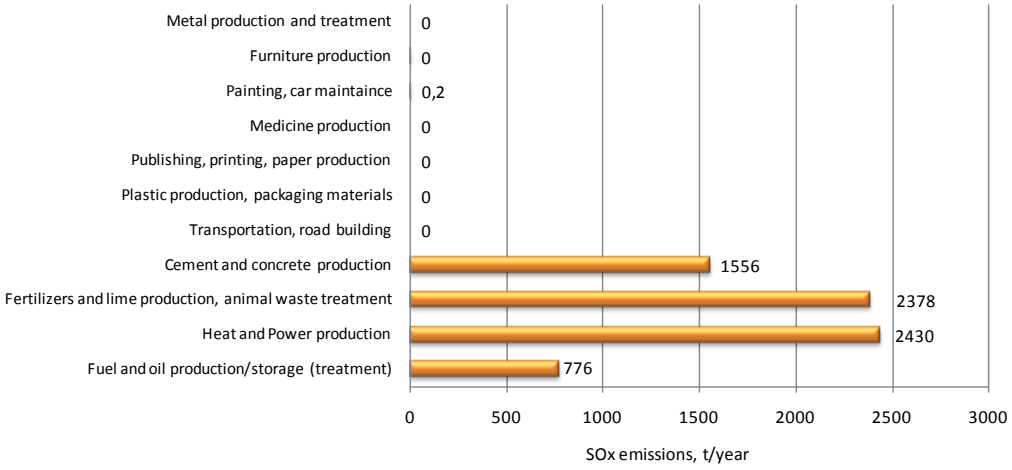


Fig 2.16 SO2 emissions according different industry sectors in 2009, t/year

- **NMVOC emissions**

The highest NMVOC emissions are defined in Siauliai region (Fig 2.17). In this region is located the biggest oil refinery enterprise SC ”Orlen Lietuva”.

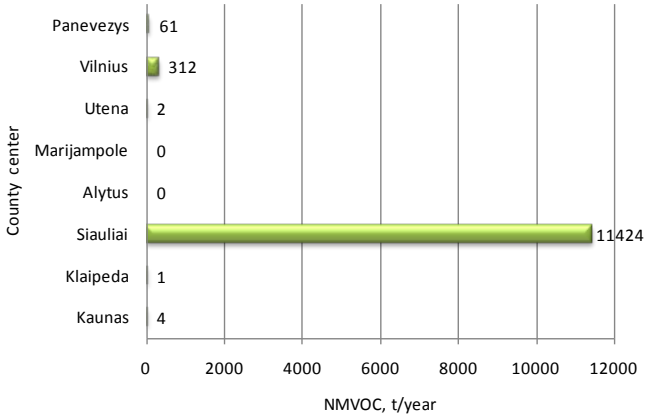


Fig 2.17 NMVOC emissions in different Lithuania Counties in 2009, t/year

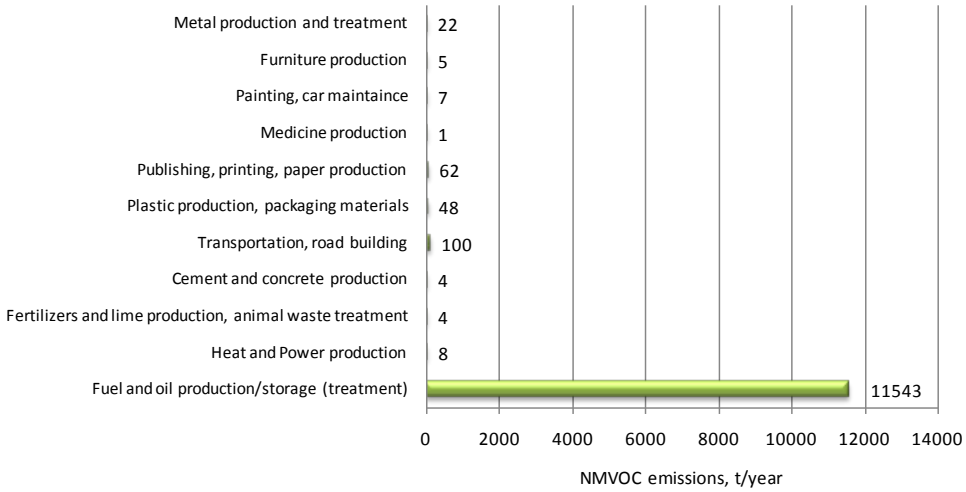


Fig 2.18 NMVOC emissions according different industry sectors in 2009, t/year

2.5 Germany (Mecklenburg-Vorpommern)

- **NOx emissions**

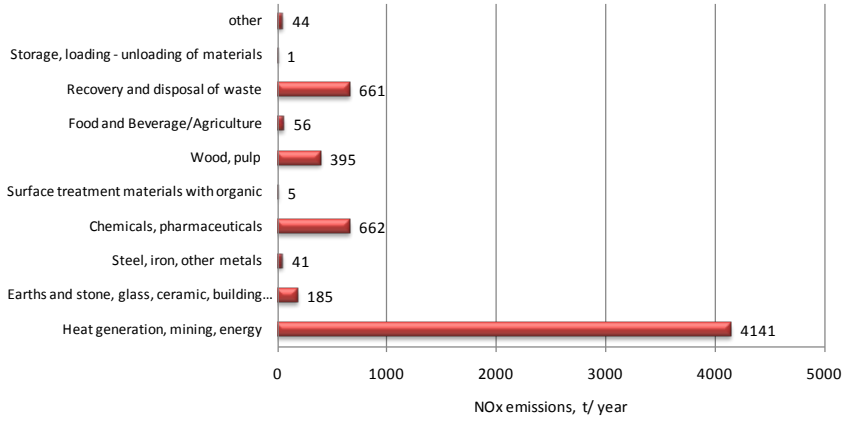


Fig 2.19 NO_x emissions in different industry sectors in 2004, t/year

- **SO_2 emissions**

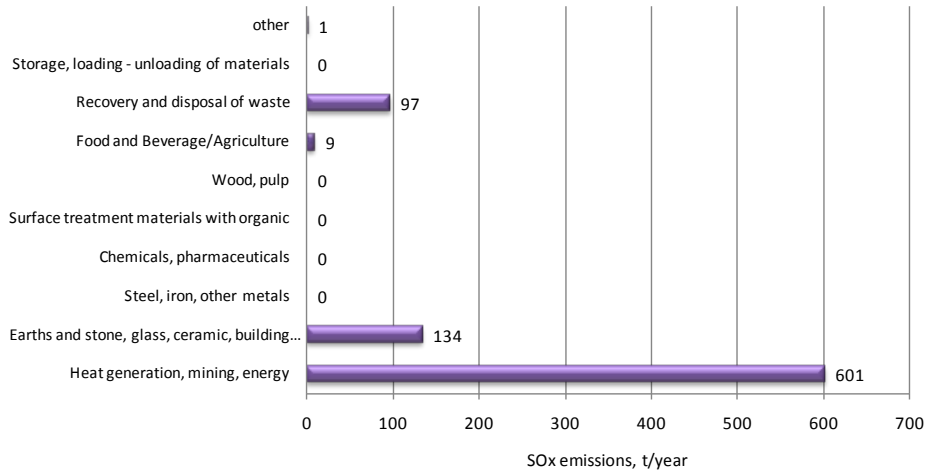


Fig 2.20 SO_2 emissions in different industry sectors in 2004, t/year

- **NMVOC emissions**

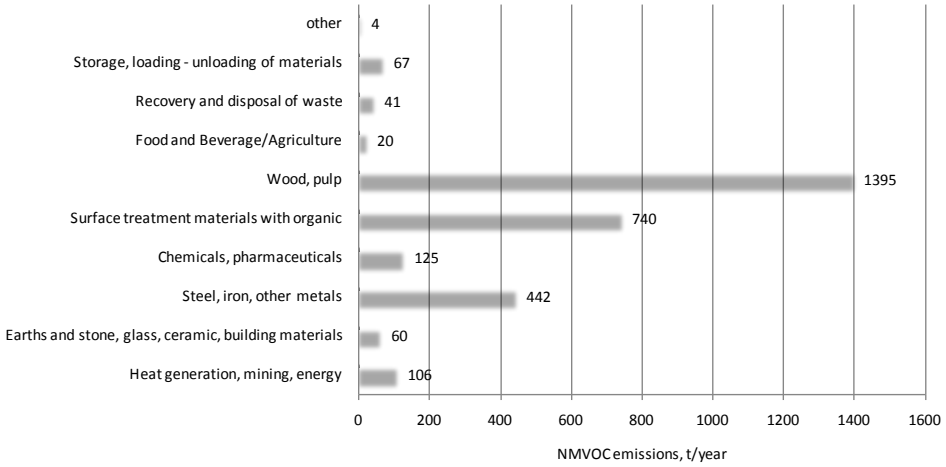


Fig 2.21 NMVOC emissions in different industry sectors in 2004, t/year

2.6 Latvia

- **NOx emissions**

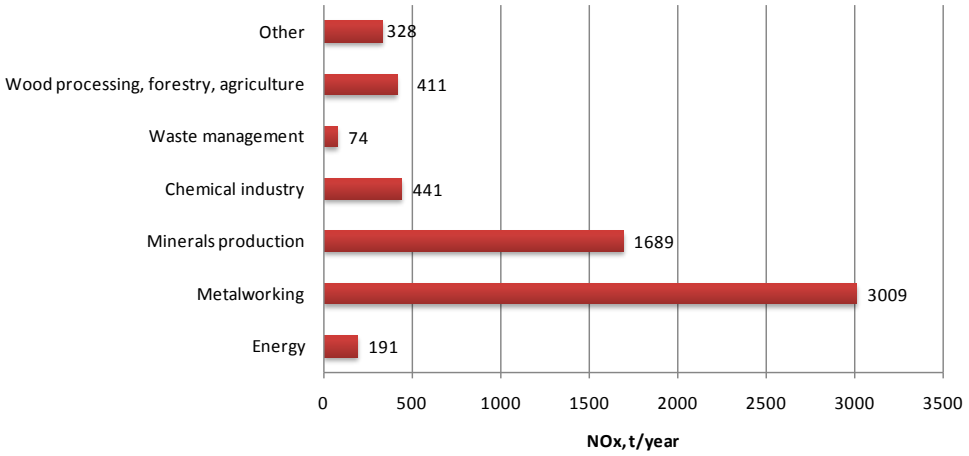


Fig 2.22 NOx emission from main sectors in 2009, t/year

The biggest emitter of NO_x in 2009 was the company JSC "Liepājas Metalurgs" which emitted 2819,19 t of NO_x per year.

- **SO_2 emissions**

In 2009 the main SO_2 emitters were JSC "Ventspils siltums" and manufacture of concrete products “Būvmateriāli AN“. These companies emitted 493,9 and 444,7 t of SO_2 per year, respectively.

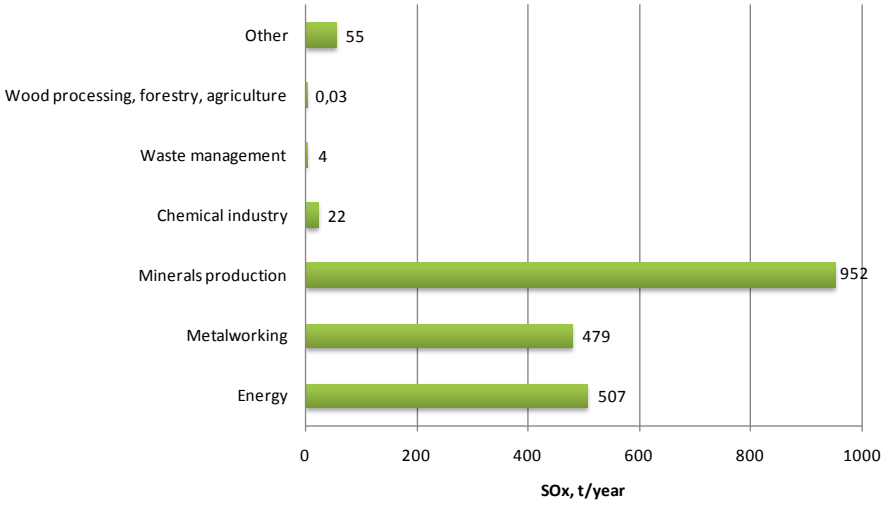


Fig 2.23 SO_2 emissions from main sectors in 2009, t/year

- **NMVOC emissions**

The biggest emitters of NMVOC in 2009 were two companies JSC "PEPIRER" (producing polyethylene foam products) and JSC "Tenapors" (manufacture of plastic plates, sheets, tubes and profiles). Companies emitted 158,4 and 311,3 t of NMVOC per year, respectively.

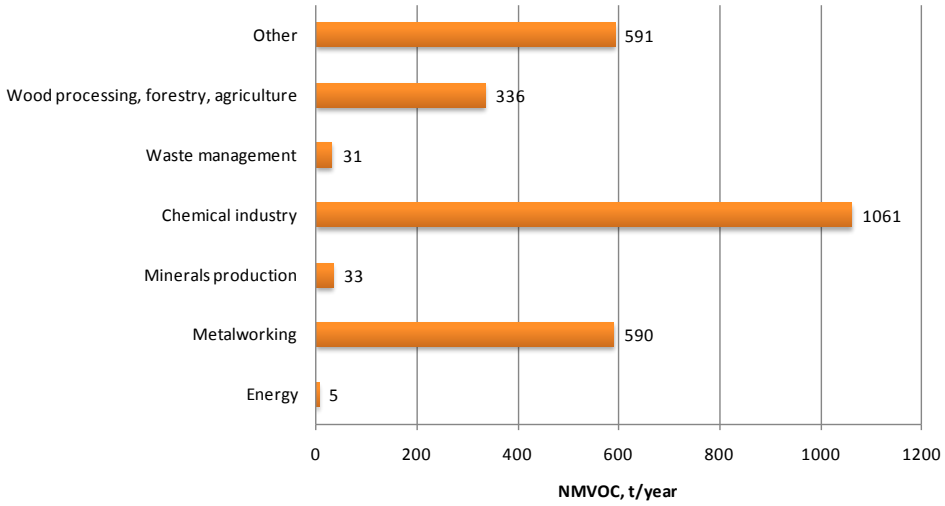


Fig 2.24 NMVOC emissions from main sectors in 2009, t/year

2.7 Estonia

- **NOx emissions**

The rest of the NOx emissions were discharged in the process of combustion of fuels in the energy and transformation industries and in the manufacturing industry. The primary polluters in the case of both sulphur dioxides and nitrogen oxides are power plants in Ida-Viru County.

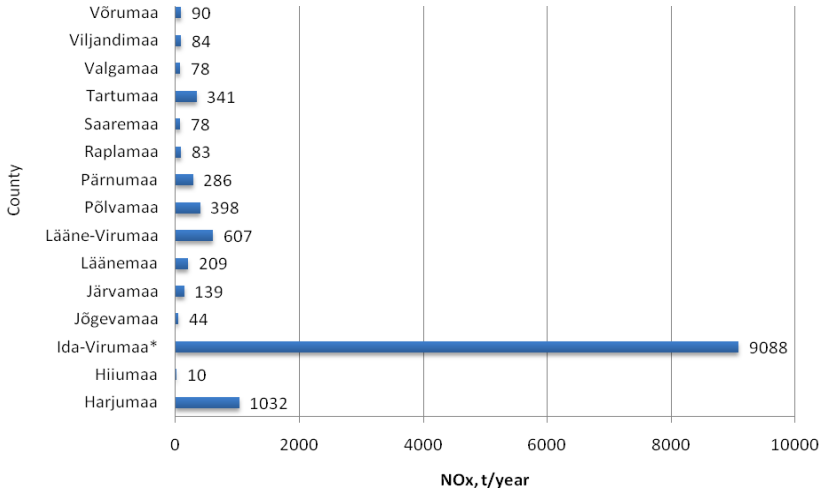


Fig 2.25 NO_x emissions in Estonian Counties 2009, t/year

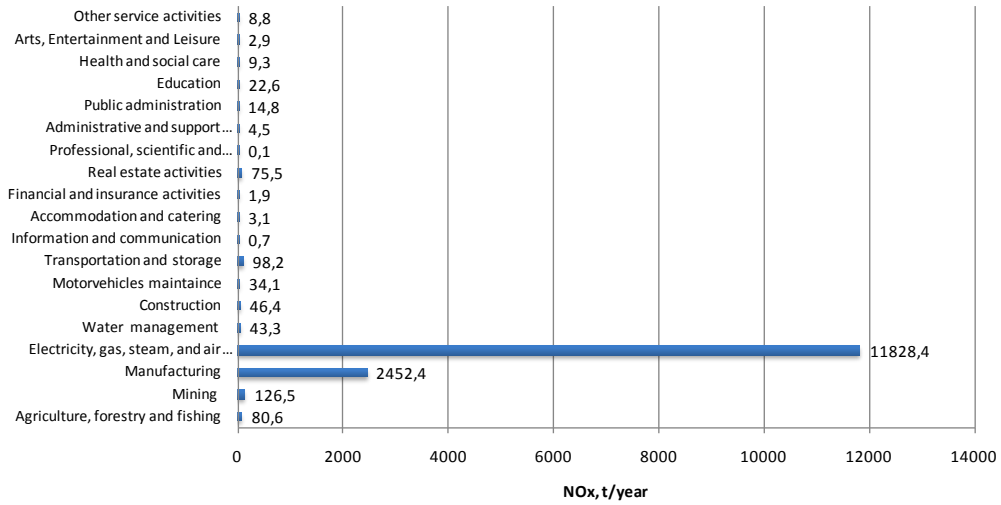


Fig 2.26 NOx emissions in different Estonian sectors 2008, t/year

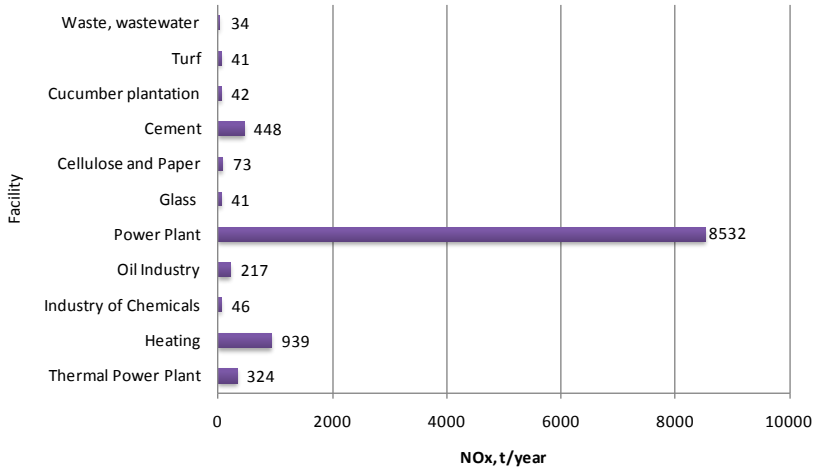


Fig 2.27 NOx total emissions in different Estonian facilities 2009, t/year

- **SO_2 emissions**

SO_2 primarily originates from oil-shale-fired power plants in Ida-Viru County. Thus reduction of sulphur dioxide emissions is in direct dependence on measures implemented at power plants (renovation of energy generation units). A small quantity of SO_2 emissions was given off from non-industrial fuel combustion and transport (use of motor fuels hat contain sulphur).

Compared to 1990, SO_2 emissions have dropped by 67.5%. The changes were occasioned by economic restructuring that took place at the beginning of the 1990s, as a result of which the amount of electricity consumed in industry dropped significantly. The extent of the use of other fuels also changed – a transition has occurred from use of heavy oil with high sulphur content to combustion of natural gas and wood. Use of lower-sulphur shale oil and light fuel oil has increased.

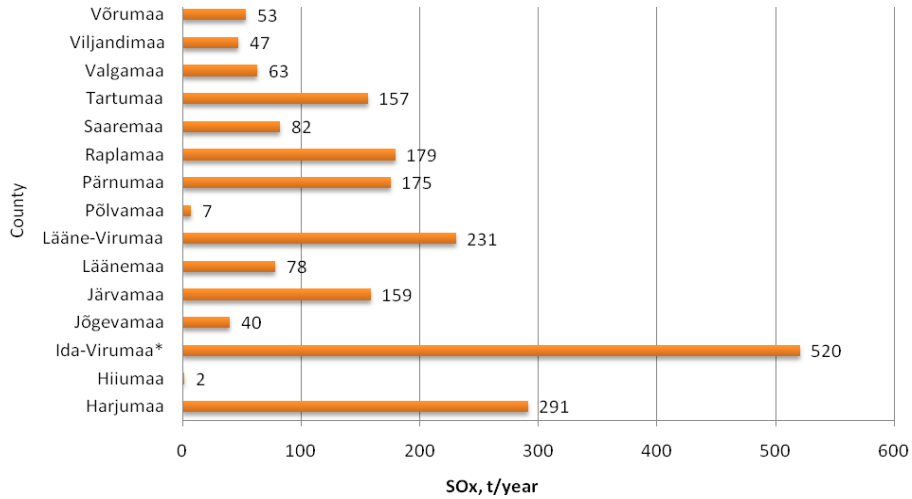


Fig 2.28 SO_2 emissions in Estonian Counties 2009, t/year

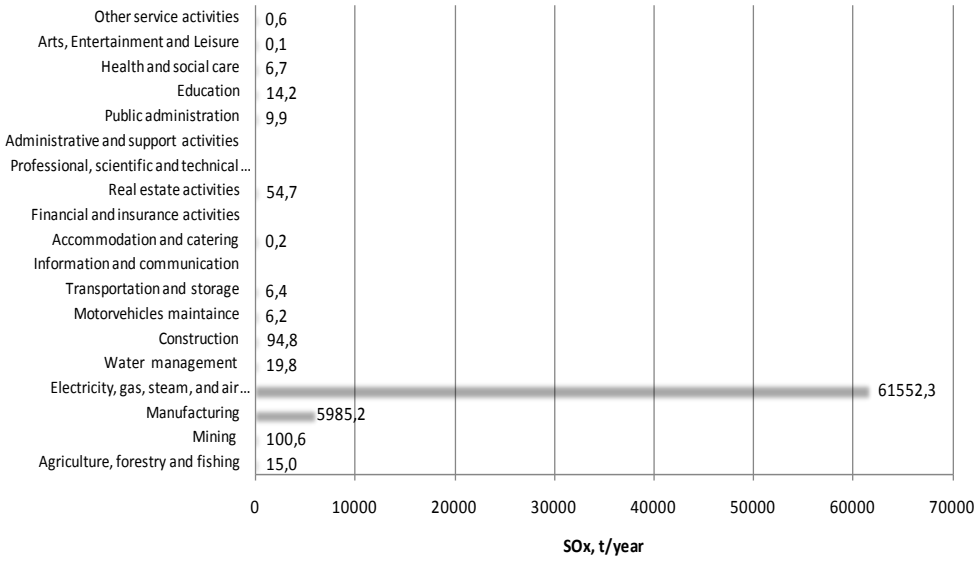


Fig 2.29 SO_2 emissions in different Estonian sectors in 2008, t/year

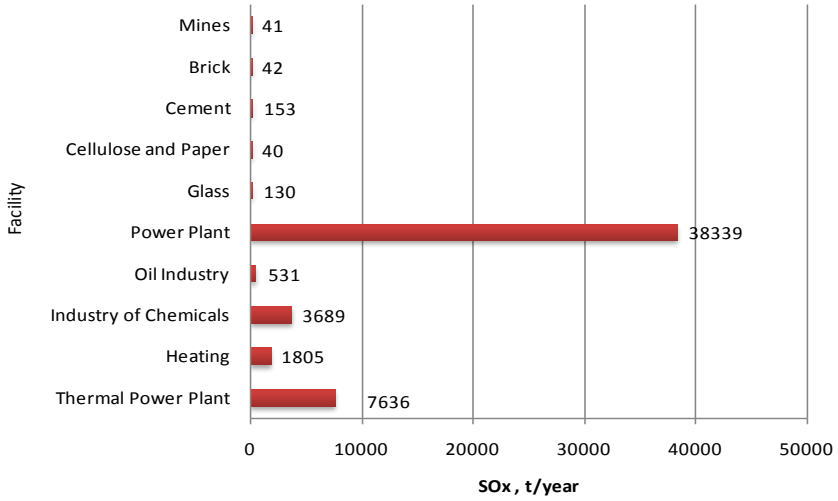


Fig 2.30 SO_2 emissions in different Estonian facilities in 2009, t/year

- **NMVOC Emissions**

Non-methane volatile organic compounds are discharged into the air from road transport, household wood heating, solvent use and fuel distribution (Estonian Environmental .. 2010).

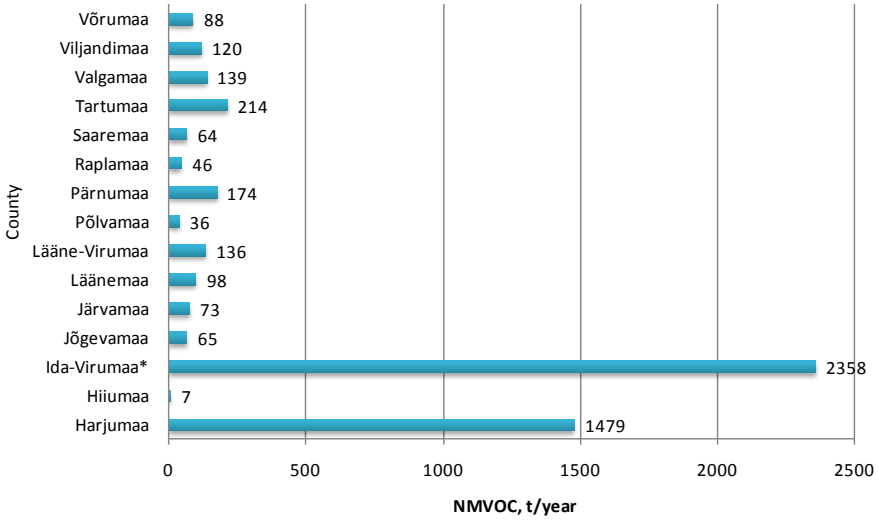


Fig 2.31 NMVOC emissions in Estonian Counties in 2009, t/year

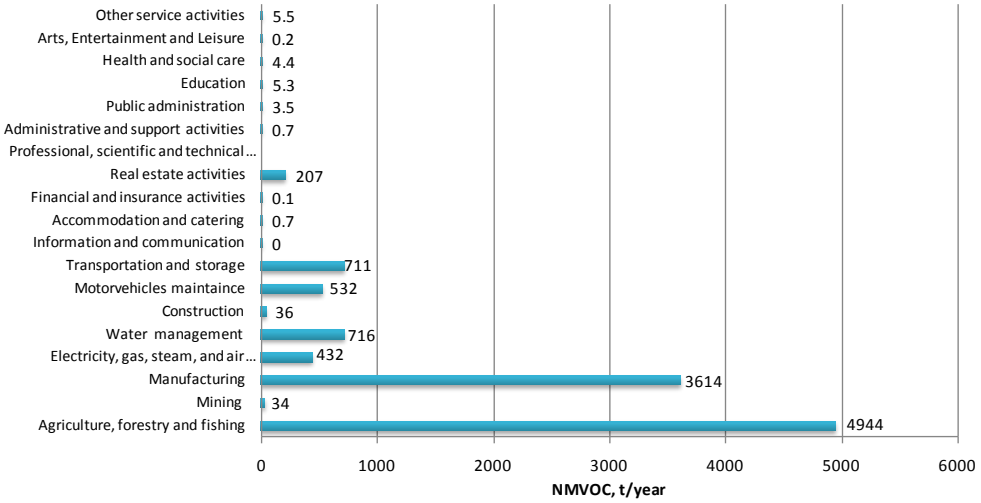


Fig 2.32 NMVOC emissions in different Estonian sectors 2008, t/year

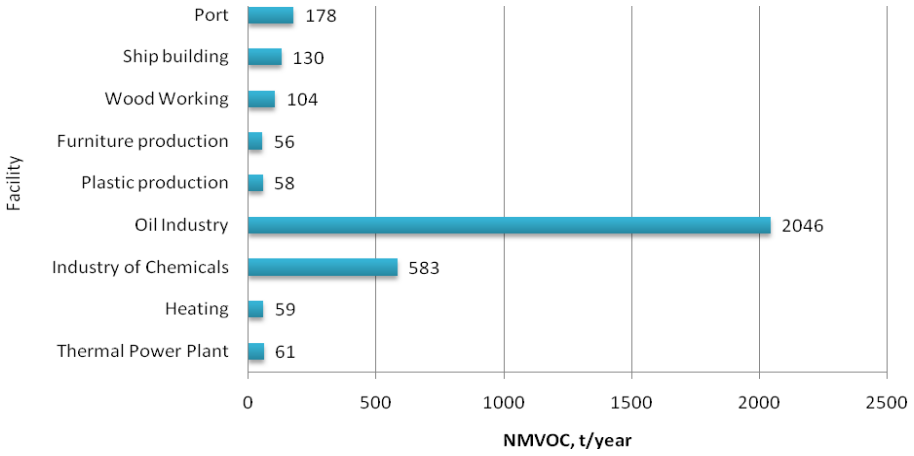


Fig 2.33 NMVOC emissions in different Estonian facilities 2009, t/year

2.8 Finland

- **NO_x emissions**

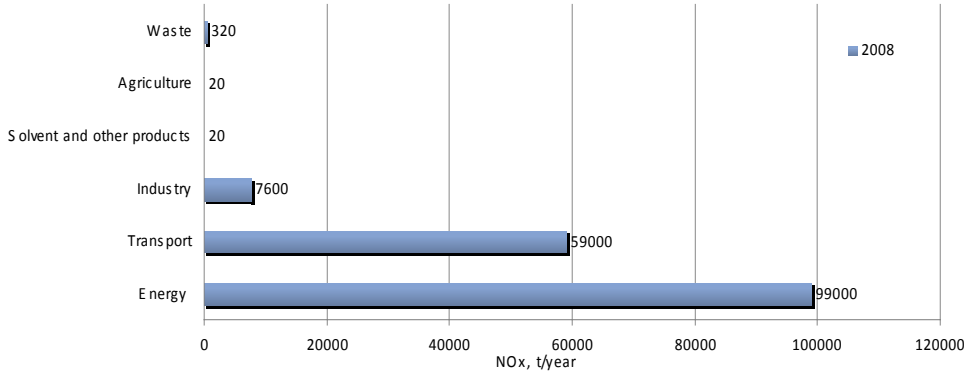


Fig 2.34 NOx emissions in different sectors, t/year

- **SO_2 emissions**

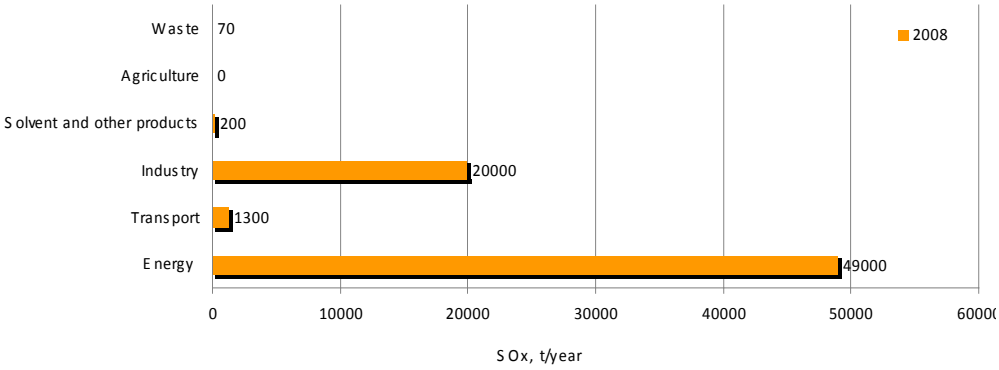


Fig 2.35 SO_2 emissions in different sectors, t/year

- **NMVOC emissions**

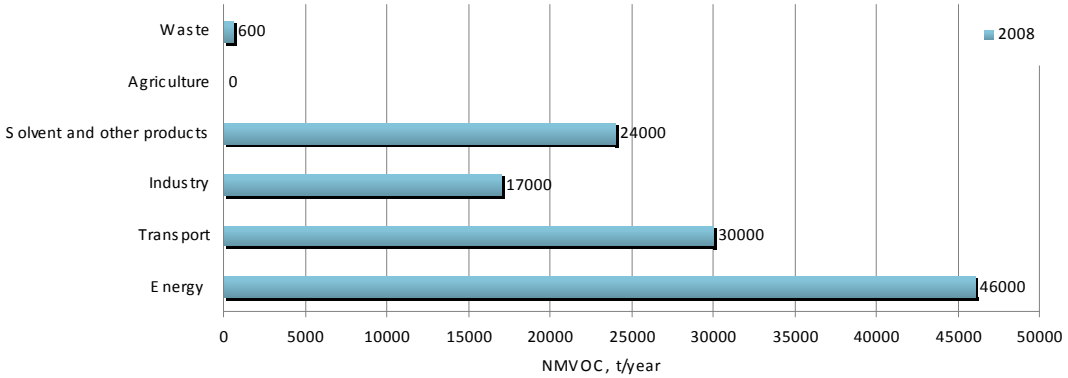


Fig 2.36 NMVOC emissions in different sectors, t/year

3 Conclusions

The data inventory of eight Baltic Sea Region Countries NO_x, SO_2 and NMVOC emissions highlighted the main tendencies:

- Poland is the main emitter of all considered air pollutants in BSR region and Finland could be considered as the second one;
- The remaining main air polluting sector is energy production and distribution:
- The NO_x emissions mostly emitted from energy sectors dominates in Poland, Denmark and Finland, Estonia and Northern Germany; and from industry sector in: Latvia, Lithuania and Sweden.
- Estonia should consider the high SO_2 emissions associated with oil shale use, now it is the second country after Poland according to these emissions in energy sector. SO_2 emissions in the rest countries except Latvia and Sweden are mostly derived from energy sector. In Latvia and Sweden the biggest percent is derived from industry.
- NMVOC was assumed mostly released from solvent and other product use sector. However, not in all countries in this category NMVOC emissions were the highest, but it was in: Latvia, Lithuania, Sweden and Poland. In Estonia and Northern Germany NMVOC emissions were mostly released from the agriculture sector. In Denmark the leading sector is transport, and in Finland – energy sector.

According to prepared data base we could highlight some tendencies and differences between BSR countries:

4 References

1. Air pollutant emissions in Finland. 2010 Available in internet [2010 11 16]: <http://www.ymparisto.fi/default.asp?contentid=179522&lan=en>
2. Danish emission inventories for stationary combustion plants. Inventories until 2007. 2009. Available in internet [2010 12 14]: <http://www2.dmu.dk/Pub/FR744.pdf>
3. Danish Ministry of Taxation 2011. Available in internet [2011 06 03]: <http://www.skm.dk/soegning/?id=Search&submit=S%C3%B8g&exclude=&words=svovl+Afgiftssatser+&restrict2=>
4. Denmark's National inventory report. Emission inventories (1990 - 2008). 2010. Available in internet [2010 12 14]: <http://www2.dmu.dk/Pub/FR784.pdf>
5. Environmental information (Estonia) 2010. Available information in internet [2010 11 17]: http://www.keskkonnainfo.ee/index.php?lan=EE&sid=120&tid=114&l1=29
6. Emissionskataster: Emittentengruppen genehmigungsbedürftiger Anlagen (*engl*. Emissions inventories: Pollutants group from industry plants). 2005.
7. EEA gap-filled LRTAP Convention data viewer based on 2010 officially reported national total and sectoral emissions to UNECE LRTAP Convention, the EU NEC Directive and EU-MM/UNFCCC. <http://dataservice.eea.europa.eu/PivotApp/pivot.aspx?pivotid=478>
8. Latvian emissions factsheets (2007, 2009) Available in internet [2010 11 15]: <http://www.eea.europa.eu/themes/air/air-pollutant-emissions-country-factsheets/latvia-air-pollutant-emissions-country-factsheet>
9. Latvia's National inventory report (1990 - 2007), 2009. Available in internet [2010 11 15]: <http://www.meteo.lv/upload_file/parskati/starpt_org/ANO/zinojums.pdf>
10. Laskowska, A. and Scrimgeour, F. 2001. Environmental taxation: The European experience. Available in internet [2011 03 21]: <wms-soros.mngt.waikato.ac.nz/NR/rdonlyres/.../EuropeET.doc>
11. National inventory report 2010 – Sweden. Swedish Environmental Protection agency. Available in internet [2010 12 15]: < http://www.naturvardsverket.se/upload/05_klimat_i_forandring/statistik/2008/National%20Inventroy%20Report%20%28NIR%20submission%202010_Text.pdf >
12. Poland's national inventory report 2010. Available in internet [2010 12 16]: <http://www.kashue.pl/materialy/Inwentaryzacje_krajowe/NIR_2009_Poland_05-09.pdf>
13. Swedish Pollutant Release and Transfer Register. Data available on internet [2010 11 25]: <http://utslappisiffror.naturvardsverket.se/en/Search/ >
14. Swedish Environmental Protection Agency. 2010. Official statistics: Emissions. Available on internet [2011 02 07]: < http://www.swedishepa.se/en/In-English/Menu/State-of-the-environment/Official-statistics/Statistics-classified-by-topic/Emissions/>

15. Uus, M. 2006. Estonian Oil Shale Utilisation Applications In Energy Production. WEC Executive Assembly -2006, CFFS Workshop AS. Available on internet [2010 12 10]: <http://www.usea.org/Programs/CFFS/CFFSTallinn/Mati%20Uus%20Presentation.pdf>.