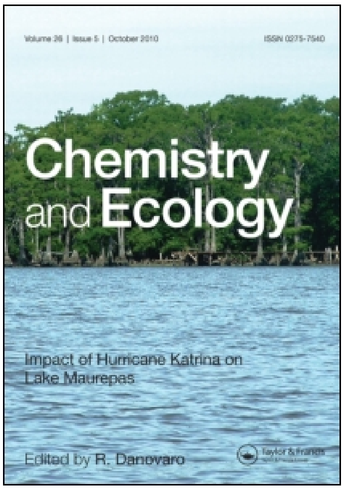

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Report of A Survey of the State of the Environment in the Estonia, Latvia and Lithuania

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REPORT OF A SURVEY OF THE STATE OF THE ENVIRONMENT IN THE ESTONIA, LATVIA AND LITHUANIA

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In connection with the change in economic principles and disintegration of big industrial enterprises, the environmental pollution in Baltic States decreased considerably in 1991–1996. Although there are still many things waiting to be done, the improvement of the Baltic environmental situation during the years of independence gives us a cause to be optimistic.

Keywords: Air pollution; monitoring; forest; Estonia; Latvia; Lithuania

INTRODUCTION

Signatories to the Long-range Transboundary Air Pollution (LRTAP) Convention have agreed to cooperate on research into the effects of sulphur compounds and other major air pollutants. The Working Group on Effects was established to consider the effects of major air pollutants on the environment and human health as well as to initiate and coordinate effect-oriented activities within the framework of the Convention. The objectives of its work include:

- assessing the present status and long-term trends in relation to the degree and geographical extent of damage caused by long-range transboundary air pollution;

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- deriving cause-effect relationships for major air pollutants;
- determining critical loads/levels with the use of harmonised methods;
- compiling maps of critical loads/levels and their exceedances.

The results of these activities, which are based upon the best available scientific information, will assist in the identification of the most endangered areas, ecosystems and/or receptors, as a basis for setting priorities in the further development of air pollution abatement strategies.

The Executive Body of the Convention notes the importance of air pollution effects on agriculture, forestry, materials, aquatic and other natural ecosystems and visibility as well as the effects on human health. For these topics special International Cooperative Programmes (ICPs) have been established under the Working Group on Effects to look at the relevant issues. Each ICP is on the responsibility of a lead country which provides a Task Force chairmen. The Task Force consists of representatives of countries that are signatories of the Convention. Coordination or data centres, often set up by leading countries, collate and interpret the results of each programme. National Focal Centres in collaborating countries are responsible for national contributions to the international programmes. The Working Group on Effects is responsible for the effective implementation of all the cooperative programmes. It reports to the Executive Body of the Convention an all matters related to the effects of air pollution and on the activities of the ICPs (Joint ICP/CCE Data Catalogue, 1994; WGE Handbook, 1997).

Currently there are five ICPs for the assessment and monitoring of air pollution effects:

- ICP for Assessment and Monitoring of Air Pollution Effects on Forests (established in 1985); thirty four countries are now participating in the activities of the Programme;
- ICP for Assessment and Monitoring of Acidification of Rivers and Lakes (established in 1985) (more than 200 catchments in 17 countries in Europe and North America);
- ICP on Effects of Air Pollution on Materials, including Historic and Cultural Monuments (established in 1985) (a network of 39 exposure sites);

- ICP on Effects of Air Pollution and other Stresses on Crops and Non-wood Plants (established in 1987) (includes 16 other Parties to the Convention);
- ICP on Integrated Monitoring of Air Pollution Effects on Ecosystems (established in 1987 as a pilot programme) (Joint ICP/CCE Data Catalogue, 1994; WGE Handbook, 1997); twenty two countries are now participating in the Programme.

The list of National Contacts for each Programme can be found (Joint ICP/CCE Data Catalogue, 1994; WGE Handbook, 1997).

In the near future a sixth programme will be added to the above-mentioned list of five UN/ECE programmes. The programme will deal with the distribution of heavy metals and persistent organic pollutants in Europe. Preliminary work on starting the programme has already been commenced.

DISCUSSION

The national monitoring programmes of the three Baltic States are quite different. Therefore, in order to make a comparison, we must identify those programmes which include all three Baltic countries together with other European/Baltic Sea countries. First there is the European programme "ICP Forest", which started in 1986. In phase one, the main interest was connected with defoliation and discoloration of leaves and needles. The review of the 10-year results was published in 1994 (Forest Conditions in Europe, 1998). The Integrated Monitoring programme developed in Scandinavian countries is directed to matter cycling in the watersheds including forest vegetation. Each of the Baltic States have two (except Lithuania – 3 sites) permanent IM study sites. The third forest monitoring programme – the Forest Ecological Monitoring Program (FEM) was initiated as an international part of the US EMAP Forest Health Monitoring programme.

These are some of the most important monitoring programmes which will help us to assess the current state of the environment in the Baltic countries.

As the condition of Baltic forests is strongly affected by the long-range transportation of air pollution from Central Europe (Roots, 1992; Roots *et al.*, 1992), it is also necessary to take a look at the forests in that region (Poland, Czech Republic, Germany, Hungary and Slovak Republic) in addition to borders of Estonia (Finland, Sweden and a part of Russia).

The decline in forest health began to attract more widespread interest during pollution in early 1980. Many countries started surveys to assess the condition of their forests. Closer attention was being paid to air pollution (Forest Conditions in Europe, 1998).

The main parameters assessed in the crown condition survey are defoliation and discoloration. Defoliation was assessed in 5% – steps and grouped into 5 defoliation classes of uneven width (Tab. I).

Condition of forests in twelve countries has served as a foundation of our comparison.

A first comparison of the observed 10-year average crown conditions and the calculated stress factors for air pollution shows a clear coincidence of high defoliation/discoloration and high exceedance of critical levels and deposition levels for sulphur and nitrogen compounds in Central Europe. The spatial distribution of the acid (S and N) deposition resembles largely the source area distribution. As with the concentration levels of sulphur dioxide, nitrogen dioxide and ammonia, highest deposition levels are observed in Central and Western Europe (Ten Years of Monitoring Forest Condition in Europe, 1997).

Calculated annual average sulphur dioxide concentrations for all the forest monitoring sites between 1986 and 1995 varied mainly between 2 and 50 $\mu g\, m^3$. The critical concentration of 20 $\mu g\, m^3$ was exceeded at 20% of the monitoring sites. Sites are concentrated in Central Europe, in such countries as Germany, Poland and Czech Republic. A clear reduction in exposure of sulphur dioxide concentration is shown between 1986 to 1995. During the last three years the concentration remained constant (Ten Years of Monitoring Forest Condition in Europe, 1997).

TABLE I Defoliation classes according to UN/ECE and EU classification

Defoliation class	*Needle/leaf loss*	*Degree of defoliation*
0	Up to 10%	None
1	> 10–25%	Slight (warning stage)
2	> 25–60%	Moderate
3	> 60– < 100%	Severe
4	100%	Dead

Ammonia concentrations show no clear trend during the ten years, whereas nitrogen dioxide concentrations decreased. Very little nitrogen dioxide and ammonia concentrations are highest in the Netherlands, Belgium and Western Germany (Ten Years of Monitoring Forest Condition in Europe, 1997).

Comparison of results (presented in Tabs. II–V) shows that the present condition of Baltic forests is relatively good, having improved since the restoration of independence in 1991 (Tab. IV).

The main sources of air pollution in the Baltic States are the energy sector, transport and industry. Total primary energy consumption decreased by about 40 to 50 per cent between 1990 and 1994 as a result of economic and social transition. Atmospheric emissions also decreased parallel to consumption (Figs. 1 and 2).

The main problems related to air pollution in Baltic States are emissions of sulphur dioxide (SO_2); nitrogen oxides (NO_x) and dust by local industry, *e.g.*, oil shale energy production in northern Estonia, the oil refinery in Mazeikiai, Lithuania, steel production in Liepaja, Latvia, and cement and fertiliser production in Baltic countries (Baltic State of the Environment Report, 1998).

From the three Baltic countries, Estonia has reduced more air pollution from its point sources during the last decade than Latvia and Lithuania (Tab. VI).

The three Baltic States put particular emphasis on air pollution on long-term environmental policy goals and targets. They have set goals relating to emissions of nitrogen oxides, sulphur dioxide and carbon dioxide which aim to reduce long-range transboundary pollution (Estonian National Environmental Strategy, 1997).

The following targets have been set in Estonia and Latvia:

- to stabilize nitrogen oxides emissions at the 1987 level, by 1995 in Latvia and by 2000 in Estonia;
- to reduce emissions of sulphur oxides to at least the 1980 level by the year 2000 in Latvia, and to 80 per cent of the 1980 level by 2005 in Estonia;
- to stabilize carbon dioxide emissions at the 1990 level by 2000;
- to reduce dust and ash emissions to 75 per cent of the 1995 level by 2005 in Estonia (Estonian National Environmental Strategy, 1997; Baltic State of the Environment Report, 1998).

TABLE II Forests and surveys in European countries (1997) (Forest Condition in Europe, 1998)

Participating countries	*Total area* (1000 *ha*)	*Forest area* (1000 *ha*)	*Coniferous forest* (1000 *ha*)	*Broadleave forest* (1000 *ha*)	*Area surveyed* (1000 *ha*)	*Grid size* (*km* × *km*)	*No. of sample plots*	*No. of sample trees*
Czech Republic	7886	2630	2057	573	2630	8 × 8/16 × 16	196	11724
Denmark	4309	445	271	146	417	7 × 7/16 × 16	51	1224
Estonia	4510	2016	1122	724	1846	16 × 16	91	2184
Finland	30460	20032	18089	1663	15006	16 × 16/24 × 32	460	8788
Germany	35562	10264	6869	3395	10264	16 × 16/4 × 4	7558	211852
Hungary	9300	1738	261	1477	1738	4 × 4	1127	23994
Latvia	6459	2882	1816	1066	2882	8 × 8	379	9005
Lithuania	6520	1858	1144	714	1858	16 × 16/8 × 8	302	6970
Poland	31268	8756	6786	1970	6439	16 × 16	1180	23600
Russian Fed.	8391	6075				no survey in 1997		
Slovak Republic	4901	1961	815	1069	1961	16 × 16	110	4267
Sweden	41000	23500	2050	1300	2050	varying	3771	16316

TABLE III Defoliation of all species by classes and class aggregates (1997) (Forest Condition in Europe, 1998)

Participating countries	*Area surveyed* (1000 *ha*)	*No. of sample trees*	0 *None*	1 *Slight*	2 *Moderate*	3 + 4 *Severe and dead*	2 + 3 + 4
Czech Republic[a]	2630	11724	4.3	27.1	67.8	0.8	68.6
Denmark	417	1224	46.4	32.9	18.0	2.7	20.7
Estonia	1846	2184	48.9	39.9	9.9	1.3	11.2
Finland	15006	8788	60.4	27.4	11.2	1.0	12.2
Germany	10264	211852	41.5	38.7	18.4	1.4	19.8
Hungary	1738	23994	43.8	36.8	14.5	4.9	19.4
Latvia	2882	9005	26.9	53.9	18.2	1.0	19.2
Lithuania	1858	6970	15.8	69.7	12.6	1.9	14.5
Poland	6439	23600	10.9	52.5	35.1	1.5	36.6
Russian Fed.				no survey in 1997			
Slovak Republic	1961	4267	18.1	50.9	28.2	2.8	31.0
Sweden	2050	16316	55.2	29.9	13.0	1.9	14.9

[a] Mainly trees older than 60 years assessed.

TABLE IV Defoliation of all species (1988 – 1997) (Forest Condition in Europe, 1998)

Participating countries	1988	1989	1990	1991	*All species* *Defoliation classes* 2 – 4 1992	1993	1994	1995	1996	1997	*Change* *%-points* 1996/1997
Czech Republic[a]	only conifers assessed			45.3	56.1	51.8	57.7	58.5	71.9	68.6	– 3.3
Denmark	18.0	26.0	21.2	29.9	25.9	33.4	36.5	36.6	28.0	20.7	– 7.3
Estonia	only conifers assessed				28.5	20.3	15.7	13.6	14.2	11.2	– 3.0
Finland	16.1	18.0	17.3	16.0	14.5	15.2	13.0	13.3	13.2	12.2	– 1.0
Germany[b]	14.9	15.9	15.9	25.2	26.4	24.2	24.4	22.1	20.3	19.8	– 0.5
Hungary	7.5	12.7	21.7	19.6	21.5	21.0	21.7	20.0	19.2	19.4	0.2
Latvia			36.0		37.0	35.0	30.0	20.0	21.2	19.2	– 2.0
Lithuania	3.0	21.5	20.4	23.9	17.5	27.4	25.4	24.9	12.6	14.5	1.9
Poland	20.4	31.9	38.4	45.0	48.8	50.0	54.9	52.6	39.7	36.6	– 3.1
Russian Fed.[c]							10.7	12.5			
Slovak Republic	38.8	49.2	41.5	28.5	36.0	37.6	41.8	42.6	34.0	31.0	– 3.0
Sweden			only conifers assessed					14.2	17.4	14.9	– 2.5

[a] Mainly trees older than 60 years assessed.
[b] For 1988 – 1990, only data for former Federal Republic of Germany.
[c] Only Kaliningrad and Leningrad Regions.

TABLE V Defoliation of broadleaves (1988 – 1997) (Forest Condition in Europe, 1998)

Participating countries	1988	1989	1990	1991	*Broadleaves Defoliation classes 2–4* 1992	1993	1994	1995	1996	1997	*Change %-points* 1996/1997
Czech Republic[a]				37.6	29.2	54.4	48.0	30.6	34.0	26.5	– 7.5
Denmark	14.0	30.0	25.4	27.3	21.2	27.0	32.4	39.7	36.1	28.4	– 7.7
Estonia	only conifers assessed				0.0	1.1	2.0	1.1	5.3	7.4	2.1
Finland	7.9	12.6	11.6	7.7	10.1	12.8	12.0	11.0	10.3	8.4	– 1.9
Germany[b]	16.5	20.4	23.8	26.5	32.0	29.9	30.1	29.9	30.8	28.6	– 2.2
Hungary	7.0	12.5	21.5	19.9	21.8	21.2	21.8	20.2	19.5	19.7	0.2
Latvia			27.0		19.0	17.8	15.0	10.0	11.4	11.3	– 0.1
Lithuania	1.0	16.0	15.8	14.9	17.6	23.8	23.3	20.8	12.2	15.9	3.7
Poland	7.1	17.7	25.6	34.8	40.4	45.6	51.5	46.7	37.4	35.8	– 1.6
Russian Fed.[c]			10.2				39.4	34.4			
Slovak Republic	28.5	41.8	31.3	21.1	30.0	29.1	35.6	35.8	28.0	23.3	– 4.7
Sweden	only conifers assessed							7.9	20.7	6.1	– 14.6

[a] Mainly trees older than 60 years assessed.
[b] For 1988 – 1990, only data for former Federal Republic of Germany.
[c] Only Kaliningrad and Leningrad Regions.

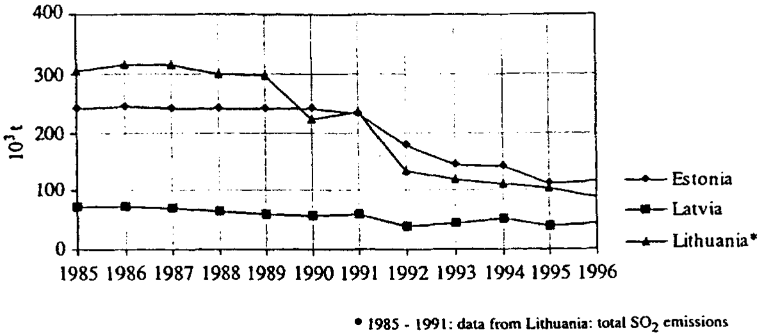

FIGURE 1 Sulphur dioxide emissions from stationary sources (thousand tonnes per year) (Baltic State of the Environment Report, 1998).

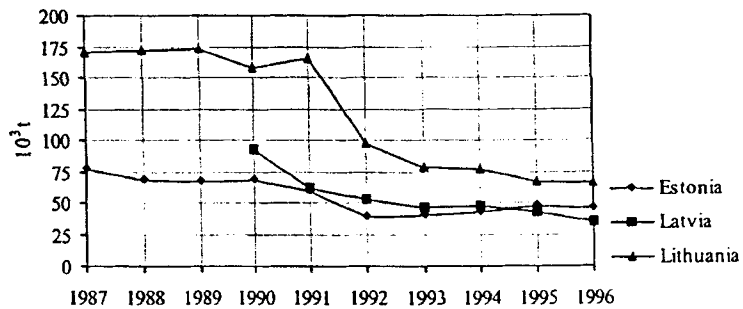

FIGURE 2 Nitrogen oxides emissions from stationary and mobile sources (thousand tonnes per year) (Baltic State of the Environment Report, 1998).

TABLE VI Yearly emissions of the main air pollutants originating from stationary sources in Estonia in 1987–1997 (thousand tonnes) (Estonian Environment, 1997; Estonian Environmental Monitoring, 1996)

Compounds	1987	1990	1991	1992	1993	1994	1995	1996	1997
Total emission	614.3	609.3	606.2	479.3	379.8	354.0	273.3	268.7	238.9
Solid	300.5	268.5	277.8	240.8	189.0	161.5	113.1	98.9	78.3
SO_2	210.6	238.3	232.7	179.2	145.0	141.1	110.3	117.2	111.0
NO_x	24.3	22.6	20.9	14.9	12.0	14.6	14.8	16.3	15.6
CO		59.9	56.8	32.5	27.8	31.8	27.2	29.4	26.7
VOC		18.0	16.5	11.2	5.7	4.7	6.5	5.6	6.3

Estonia and Lithuania have also set the goal of reducing pollution caused by transport, although they have not specified any targets. Estonia aims to meet the EU air quality standards by 2005 (Baltic State of the Environment Report, 1998).

The results of the 8-year UN/EC corrosion programme also point to the diminishing trend of air pollution in Europe. Scientists from 12 European countries (from the Baltic States, Estonians were the only ones who participated), U.S.A and Canada proved that the decrease in corrosion occurred first in Scandinavia between 1987–1988 and 1989–1990 and later in the Western and Central Europe between 1989–1990 and 1992–1993 (Statistical Analysis of 8 Year Materials Exposure...., 1998).

Within the framework of Helsinki Commission (HELCOM), the Baltic Sea countries have worked together for several years on pinpointing the "Hot Spots" of the Baltic Sea. For the present time 132 "Hot Spots" have been determined on the ground of the Baltic Sea Joint Comprehensive Environmental Action Programme (JCP).

On the basis of information available in 1992, it was estimated that implementation of the JCP would have an estimated cost of 18 billion ECUs and require a phased implementation period of 20 years (Baltic Sea Environment Proceedings, 1998).

The protection of surface water bodies and the coastal sea area is one of the priorities of the National Environmental Strategies of Estonia, Latvia and Lithuania. All three strategies include the target of reducing some water pollution in order to maintain the ecological balance.

Of the difference, nutrients found in the aquatic environment, total nitrogen and total phosphorus (include organic and inorganic compounds) play a key role as limiting factors in primary production. Therefore, these nutrients (and Biological Oxygen Demand (BOD)) have been chosen as indicators of the pollution load in the Baltic States.

Significant changes have taken place in Estonia. BOD_7 has been reduced to 25 per cent of the 1992 level. The significant reduction in phosphorus emissions is due to the installation of new biological–chemical waste water treatment plants, which began operating in the Estonia capital city – Tallinn – in 1993.

New waste water treatment plants have also started operating in Vilnius (Lithuania) in 1996 and in Riga (Latvia) in 1991.

Current data (Tab. VII) and Figures 3, 4 and 5 show a lead in decrease in point source pollution, in comparison with data from 1991 and 1992. The reasons for this include the decline in industrial

TABLE VII Pollution load from point sources, 1992 and 1996 (Baltic State of the Environment Report, 1998)

State	*Year*	*Pollution load (kg per capita)* BOD_7	N_{tot}	P_{tot}
Estonia	1992	11.8	3.7	0.44
	1996	2.9	2.2	0.21
Latvia	1992	8.9	1.5	0.27
	1996	3.6	1.5	0.23
Lithuania	1992	8.5	2.8	0.38
	1996	4.5	1.7	0.26

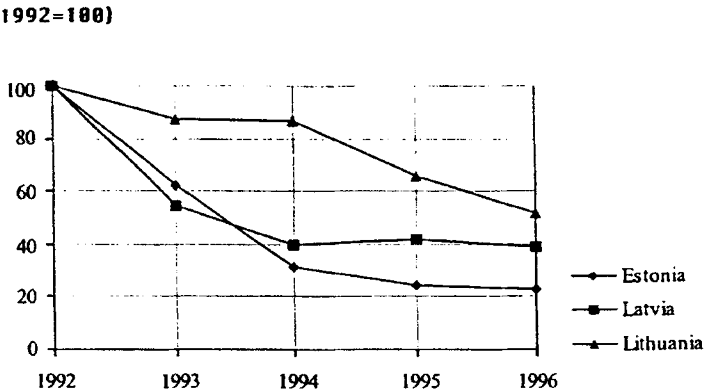

FIGURE 3 Biological Oxygen Demand (BOD) emissions from point sources (1992 = 100%) (Baltic State of the Environment Report, 1998).

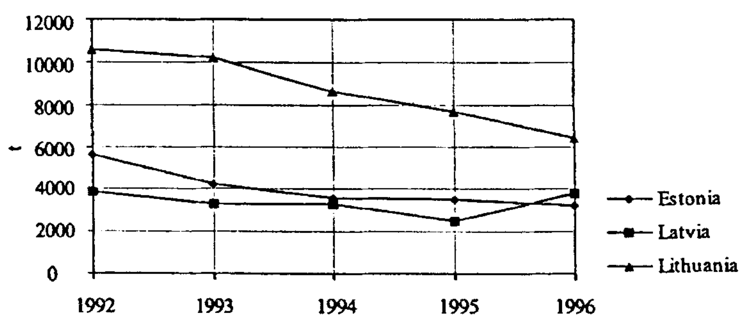

FIGURE 4 Total nitrogen (N_{tot}) emissions from point sources, tonnes per year (Baltic State of the Environment Report, 1998).

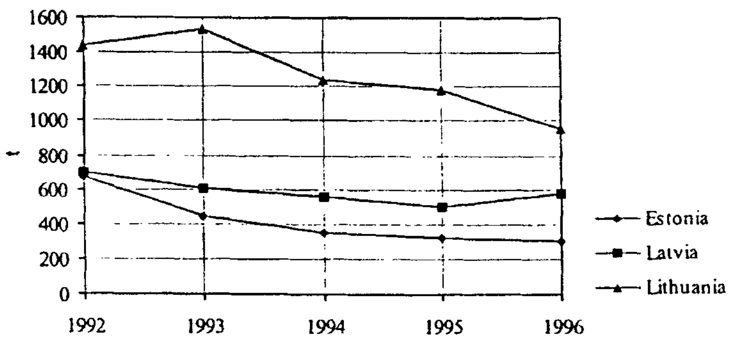

FIGURE 5 Total phosphorus (P_{tot}) emissions from point sources, tonnes per year (Baltic State of the Environment Report, 1998).

production, substantial national and foreign investments in water purification measures for large cities and smaller municipalities, the increase in taxes on water consumption and pollution, and increased efficiency in waste water treatment.

The Estonian and Latvian strategies set realistic targets for reduction of nitrogen (N) and phosphorus (P) emissions from point and diffuse sources. The targets are in accordance with the HELCOM recommendations adopted by all three countries:

- Latvia: to reduce total nitrogen emissions into water from point sources and leaching of nitrogen and phosphorus from agriculture by 50 per cent of the 1994 level by the year 2010;
- Estonia: to bring the concentrations of phosphorus and Biological Oxygen Demand (BOD) in the main municipal and industrial waste water effluents in line with the HELCOM recommendations ($BOD_5 < 15\,mgl^{-1}$ and total phosphate $< 1.5\,mgl^{-1}$) by the year 2000;
- Estonia: to remove nitrogen compounds from waste water of municipalities with more than 5,000 inhabitants in order to maintain the ecological balance of water bodies sensitive to nitrogen emissions by the year 2010.

As the three Baltic States aim to become members of the European Union, they must realize their general goals and specific targets in terms of emissions from waste water treatment plants and agricultural activities and of surface water quality standards (Estonian National Environmental Strategy, 1997; Baltic State Environment Report, 1998).

A number of positive changes have taken place since Baltic States regained their independence. Air pollution from stationary sources (summary emission) has decreased in Estonia over 2.5 times during 1991–1997, emissions of solid particle and sulphur dioxide have declined 3.5 and 2.1 times, respectively (Roots, 1999).

Transboundary air pollution affects primarily South-Estonia and West-Estonia, which receive long-range pollution from Central and Western Europe. Nevertheless, the situation is hopeful because all the countries "contributing" to Estonian air pollution have reduced sulphur dioxide emissions during 1991–1995; Czech Republic 1.6; Germany 1.4; Poland 1.3 times. (EMEP/MSC-W Report 1/97).

In spite of the above-mentioned facts, in 1996, snow samples with the highest acidity ($pH < 4.5$) occurred in South Estonia (Leevi-Veriora-Värska line). Snow with the highest alkalinity ($pH > 8.5$) was, as expected, in North-East Estonia (oil-shale region) (Roots, 1999).

European air pollution prognosis up to the year 2010 gives us even more reasons for being optimistic (EMEP MGSC-W, report 1/97).

Although there are still many things waiting to be done, the improvement of the Baltic environmental situation during the years of independence gives us a cause to be optimistic.

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