Estonian Environment

ESTONIAN ENVIRONMENTAL REVIEW 2009

Environmental information

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Estonian Environment Information Centre
Tallinn 2010

Published in the
“Estonian Environment” series

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Design: Purk Ltd

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Environmental information

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ISSN (publication) 1736-3373
ISSN (e-publication) 1736-3519

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Foreword

This Estonian Environmental Review provides a thorough look at the state of the Estonian environment. It will inform you about which aspects are in good condition, but also honestly acknowledges the shortcomings and tasks ahead of us. In describing the state of the environment and pressure on the environment, this publication relies on hard data from different points in time; it is not merely conjectural.

The first review of its kind was published 20 years ago and the most recent one came out in 2005. Both the previous edition and this volume follow the requirements of the Århus Convention, one of the conditions of which is that state of the environment and pressure on the environment must be described in a manner understandable to all. It is a reasonable requirement. Although legal acts, strategies, development plans and other policy papers can be drafted by the hundreds, their benefits are limited if they are not readily comprehensible to people. The most decisive factor is each person's understanding of their role in the environment and the ability to assess the associations between and impact of their actions and omissions. Only this allows environmentally aware decisions to be made – to stop the hand poised to throw litter out of a car window or prevent the planning of a high-rise building in a protected area. I do not believe that people generally cause deliberate harm to the environment; the reason is predominantly low awareness.

The Estonian Environmental Review 2009 is yet another step toward greater environmental awareness for us all. I hope this volume makes for interesting reading, and I hope Estonia's beautiful, rich natural environment provides you much enjoyment!

Jaanus Tamkivi
Minister of the Environment

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Introduction

This environmental review is a publication about the state of Estonia's environment, including information about the quality of the environment and pressure exerted on the environment. Pursuant to the Århus Convention and EU and Estonian legislation, an environmental review must be published at least every four years.

The Estonian Environment Information Centre compiled the first review of the state of the Estonian environment in 1989, the year in which the "Keskkond" (Environment) series began to be published. The reviews published as part of this series were the predecessors of today's environmental reviews, which are now, 20 years later, published as part of the "Eesti keskkond" (Estonian environment) series.

This edition of the environmental review is similar in structure to the previous environmental review, published in 2005, in order to ensure comparability of the topics. The last review's tables reflected data up to the year 2003 or 2004 – the period in the run-up to Estonia's accession to the European Union. The data in this environmental review reflect conditions in 2007 and some of the indicators are as current as 2008. Thus the overview shows how Estonia has managed to get on in economically very successful years with the often stringent environmental objectives arising from European Union directives.

The topics reflected in the environmental review have been divided into two parts: socioeconomic background and the environment.

The environment review starts with a summary of Estonia's population and economy, as anthropogenic changes in the environment stem from the needs and consumer preferences of inhabitants. The summary is followed by an overview of each of the primary environmental sectors: use of natural resources, air and water quality, climate change, biological diversity, waste. The book also covers eco-labels and environmental management systems. On this occasion, the Estonian Environmental Review also focuses on currently salient topics such as urban sprawl, land use, soil conservation, environmental taxes and charges and the relationship between the environment and human health.

Each chapter in Part II of the book begins with a short overview of the primary legal acts in the given field and covers strategies and documents that set objectives.

The environment encompasses a very wide range of topics, which is why the environmental review attempts to remain comprehensive and convey only the most important information. For readers with a desire to know more, the end of each chapter has a list of references for finding further information.

At the time that the review was prepared, environmental data for 2008 were not yet available. Thus the issue of whether and how the current recession is affecting the environment will be addressed in subsequent environmental reviews.

We would like to thank everyone who played a part in putting together this volume.

Summary

Socioeconomic background

In terms of population and area, Estonia is one of the smallest countries in Europe. Estonia's population density is also one of Europe's lowest – 31.2 per km^2 – with most people living in urban settlements (between 67–70% based on various sources). As a result, environmental pressure is also greater in urban settlements.

Estonia joined the European Union on 1 May 2004. From that point on, Estonia has had to apply environmental conservation measures to a greater extent in order to conform to the fairly high requirements of EU directives. Environmental protection measures received about 4.8 billion kroons in funding from various sources in the period from 2005–2008. For a complete picture, we should add to this amount co-financing for projects funded from the environmental programme, and expenses incurred by local government and businesses on other environmental projects that did not receive state (co-)financing. Water economy and waste handling projects are the project categories that received the most funding.

Environmental investments have proved effective in reducing the environmental burden. At the same time, however, very rapid economic growth (in 2006, Estonia was second in Europe in terms of economic growth, behind only Latvia) and the increase in consumer spending has had a negative impact on the environment, which is reflected especially clearly in 2007 data.

Use of natural resources

Use of natural resources continues to be intensive. Mining of natural resources used in the construction industry (sand, gravel, limestone etc) has increased by several times since the early 1990s; it intensified especially from the beginning of the 2000s in connection with the construction boom.

Oil shale was mined to a greater extent than in the past in connection with the increase in electricity and shale oil output. In the years from 1999–2003, about 10 million tons of shale oil was mined annually; in 2007 and 2008, the figure had risen to around 14 million tons a year. Mining of oil shale and the oil shale industry has an impact on the Estonian environment in its entirety, naturally to the greatest degree in north-eastern Estonia.

The status of fish stocks in the Baltic Sea and inland waters varies from one species to the next. Stocks of Baltic herring and flounder – fish with among the highest yields in the Baltic Sea – are in fairly good condition, but sprat stocks have declined and cod and salmon stocks remain at a low. Perch, pike-perch and pike are the highest-yielding fish in inland waters. The pike-perch yield is decreasing due to poor food conditions, while pike and perch stocks are in satisfactory condition.

Forest land accounts for about 49% of Estonia's area (not including Lake Peipsi, 50.6%). Forest area and growing stock has increased primarily due to afforestation of land not in agricultural use. In addition, forest area and growing stock indicators have increased due to changes in the methods used to inventory forests. The annual yield in 2008 was 7.4 million m^3, while the increment was approximately 12 million m^3. Protected forest made up 31% of all forest in 2007, and the respective percentage of forest under strict protection was 8.2% (the target for 2010 is 10%).

Currently the main focus of hunting lies on bi-ungulates (cloven hoofed mammals), which are hunted both for meat and for sport. Hunting for small predators (raccoon dog, fox, pine marten, mink) has acquired more of a conservationist character due to the depressed state of the market for furs; abundance of these species is regulated in connection with their possible negative impact on other species. As the abundance of game animals such as wolf, bear, lynx, moose, wild boar, roe deer and beaver has increased in recent years, there has been an opportunity to increase hunting quotas.

Environmental quality

Climate. Global warming is under heightened attention throughout the world. The average Estonian temperature is also moving upward. In the period from 1951–2000 the temperature in Estonia rose 1.0–1.7 °C.

A number of agreements have been signed on the international level to reduce emissions of the greenhouse gases that cause global warming. Estonia has successfully fulfilled its objectives. Under the Kyoto Protocol, in the years 2008–2012 Estonia will have to reduce the quantities of greenhouse gases by 8% from 1990 levels. By 2007, Estonian greenhouse gas emissions had already dropped by over 50% from 1990.

Ambient air. Estonia's main sources of air pollution are the oil-shale-based energy sector and transport. When Estonia's air quality indicators per capita are compared with other European countries, the country often appears ranked among the greatest polluters. This is not necessarily the result of poor air quality but is due to Estonia's small population or low population density.

Monitoring data for recent years shows that the most problematic aspect with regard to quality of the ambient air is particles. Values in excess of the allowable limits for particles have been recorded in the Tallinn city centre in each of the last four years.

Nitrogen and sulphur compounds (such as NO_2 and SO_2) are acid-forming and a cause of acid rain, which threatens coniferous trees and water life. SO_2 levels in ambient air have decreased each year, while no clear trend can be seen in the case of NO_2. Despite the fairly low level of NO_2, it is a nutrient source that causes eutrophication of water bodies, with the consequence being a decrease in the number of aquatic biotic communities.

Water. The existence of clean fresh water is essential for life. Due to the climate and small population, Estonia's fresh water supply is sufficient. Nevertheless, there are problems with surface and groundwater quality in some areas, especially places with heavy industry and intensive agriculture, where the pollution load is great. To an increasing extent, evaluation of the status of water bodies takes into account biotic communities as well as the physical and chemical properties of the water.

The state of the Estonian coastal waters is moderate. The condition of coastal waters is impacted by the pollution load from land (river basins) as well as the general level of eutrophication in the Baltic Sea itself.

Soil and land use. Soil frequently goes unnoticed, yet it is a very crucial component in land-based ecosystems. Soil is closely connected with ground cover and the food on our tables. Soil quality has a direct impact on water quality, and water becomes purified as it filters through the soil. Agriculture (use of fertilizers, regulation of the water regime) effects the greatest changes on soil properties, but industry (alkalization and acidification of soils) and other economic sectors (soil displacement and construction) also have an impact. A total of 30% of cropland soils suffer from phosphorus deficiency and 50% from potassium deficiency. This points to shortcomings in the process of returning nutrients to the soil; microelement deficiencies in soil are an especial problem.

Soil is related to land cover, and the latter is related in turn to land use. Results of analysis of CORINE Land Cover data show that in the period from 2000–2006 Estonia gained 18.2 km^2 of built-up areas. Residential areas were created primarily on formerly agricultural land (12.2 km^2). These are large numbers, as building on natural areas (with residential buildings, parking lots, roads) exerts an irreversible impact on the soil and biota in such places – former cropland that has been turned into land underlying buildings or the vicinity of such land can no longer be restored to or used for its former purpose.

Biological diversity. Around 40,000 indigenous species of life are thought to be found in Estonia. By 2008, about 26,600 species had been found – about 67%. The distribution of most species on Estonian territory has likewise not been ascertained. Only the range of birds, mammals and vascular plants is completely or partially known. Other groups of species have been studied less consistently. The situation as regards habitats is slightly better, but there is as yet a lack of a comprehensive picture on the nationwide level with regard to distribution of habitats.

The of predator species at the top of the food chain – on land (brown bear, wolf, lynx), in freshwater (otter) and marine mammals (grey seal) has increased slightly in the last five years. The number of avian top-predators such as golden eagle, white-tailed eagle and osprey has risen somewhat and the abundance of the lesser spotted eagle has remained stable, but the number of pairs of the greater spotted eagle and black stork has decreased.

Viewing the environmental impact assessments from 2005–2008, including the ratio of Natura 2000 assessments initiated and not initiated, we see that the planning process still proceeds with too little regard for the natural environment. Besides deficiencies in the planning activity, alien species pose a threat to communities of plants and animals both on land and in water as they compete with indigenous species.

Waste. In the field of waste, the years 2004–2007 were characterized above all by changes occasioned by Estonia's accession to the European Union in 2004. A new Waste Act, the Packaging Act and legal acts established thereunder entered into force in that year.

The increase in the oil shale-based energy and shale oil output, industrial output and consumption led to an increase in the amount of waste generated. The amount of waste generated in 2007 was already more than 21 million tons, including 8.6 tons of hazardous waste. Over 80% of waste in 2003–2007 was generated by industry, with 72% of all waste generation comprising waste related to the oil shale industry and energy sector.

A consistent reduction took place in the number of landfills not in conformity with environmental requirements, while the percentage of waste recovered (including packaging waste) increased, and a deposit system for beverage packaging was implemented. The waste transport system organized by local governments does not yet cover all local governments, but it has made it possible to expand waste transport services to rural areas.

The environment and health. In Estonia, the natural environment has experienced fairly little change, but it does not always support human health. For example, thanks to the natural properties of groundwater, a number of Estonia's regions have problems with drinking water quality, above all due to high levels of radionuclides, fluoride and iron in the groundwater.

In areas overlying dictyonema shale formations, radon – a source of natural radiation – seeps and collects in the indoor air in homes. According to study of radon levels in homes conducted in 2001–2004, the measured radon level exceeded the allowable limit of 200 Bq/m^3 in 38% of homes.

The primary health problems arising as a result of air pollution are lung diseases and diseases of the heart and circulatory system. An assessment of the health impact of particles showed that they decreased average life expectancy by 0.95 years in Pärnu, 0.7 years in Tallinn and Tartu, 0.5 years in Narva and 0.3 in Kohtla-Järve. A high noise level is a problem in areas with high levels of highway and train traffic.

Part 1
Socioeconomic background

1. Population

1. Population

Human life relies on both living and lifeless components of nature. Demographic processes summon forth a string of changes in the environment. Changes are caused by the population of a given area, population density, habitat preferences, migration, demographic structure, and size of a household, among other factors. For example, growth of the population and suburban sprawl result in changes in the use of land and traffic flows and occasion the need for roads, water supply and sewerage in regions where they did not previously exist. Establishment of infrastructure alone results in direct environmental impacts.

As of 1 January 2008, Estonia was home to 1,340,935 people (if migration is accounted for, as well, the figure is 1,325,408), making it one of Europe's smallest countries in terms of population as well as in terms of area. In the European Union, only Cyprus, Malta and Luxembourg have a smaller population. Similarly to Finland and Sweden, Estonia's population density is one of Europe's lowest – 31.2 per/km² (map 1.1).

Since independence was restored, the population of Estonia has constantly decreased. The main reason for the decrease is the low number of births from 1990–2000. Estonia's population will continue to shrink in the future, according to various forecasts. The birth rate fell in the early 1990s and started growing slightly from 1998. In this century, the **population decline has slowed**, as in the last five years, the **birth rate is once more increasing and the death rate has stabilized.** One partial reason for the rising birth rate is family planning – people are once more having children after putting off having children for a number of years. In recent years, more second and third children have been born into families. Estonia's total birth coefficient was 1.64 in 2007 – equal to the average for Europe (map 1.2).

The longer lifespan and low birth rate has resulted in the ageing of the population. The share of the over-65 segment was already 17% in 2007. The lifespan of men and women living in Estonia is more than ten years apart, making it one of the biggest gaps in all of Europe. In 2007 men had a **life expectancy** of 67.1 years; and women, 78.7 years. **In Europe, only Latvia and Lithuania have a shorter male life expectancy**.

The population is growing due to natural growth in the Tallinn region, in the municipalities around Rakvere, the surroundings of Paide, Tartu and Pärnu, and in the city of Põlva.

As of 2007, Estonia's urban settlements have a total population of 930,936 and rural settlements, 409,999. In recent years, the percentage of the population living in rural settlements has stabilized at about 30–33% (figure 1.2).

The local government units surrounding Estonia's largest cities have seen a population increase, as a number of city residents have moved there, while retaining strong ties to their respective cities (work, school, service). For instance, the population has increased in the last five years in Kiili, Viimsi, Harku, Rae, Kernu, Saku and Saue rural municipalities (Tallinn region) and in Sauga (rural municipality adjacent to the city of Pärnu) and Ülenurme rural municipality (adjacent to the city of Tartu).

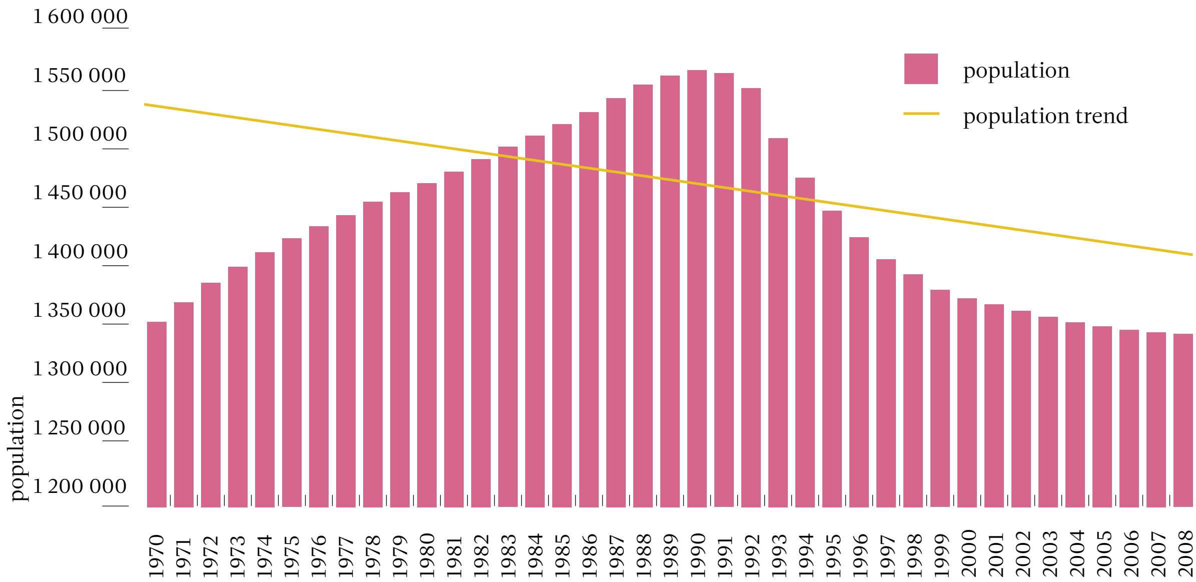
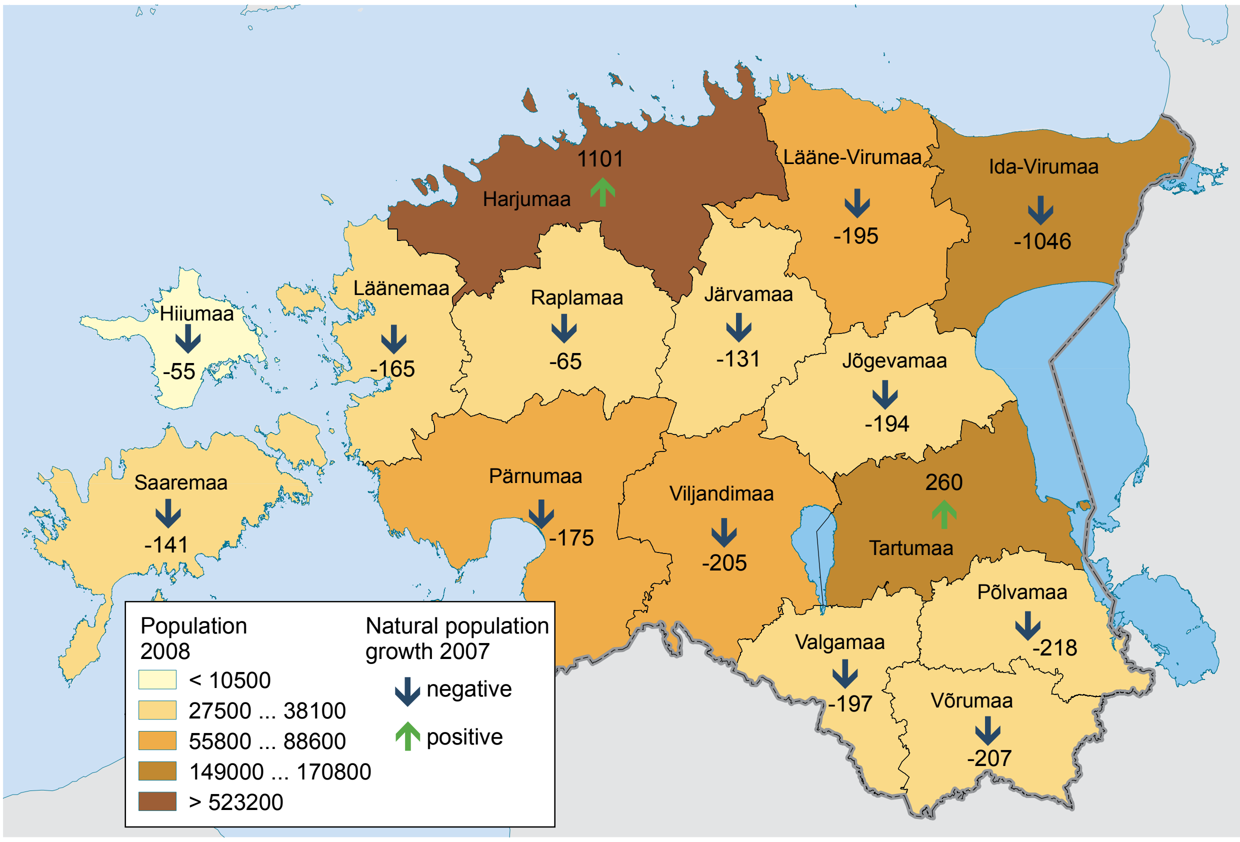
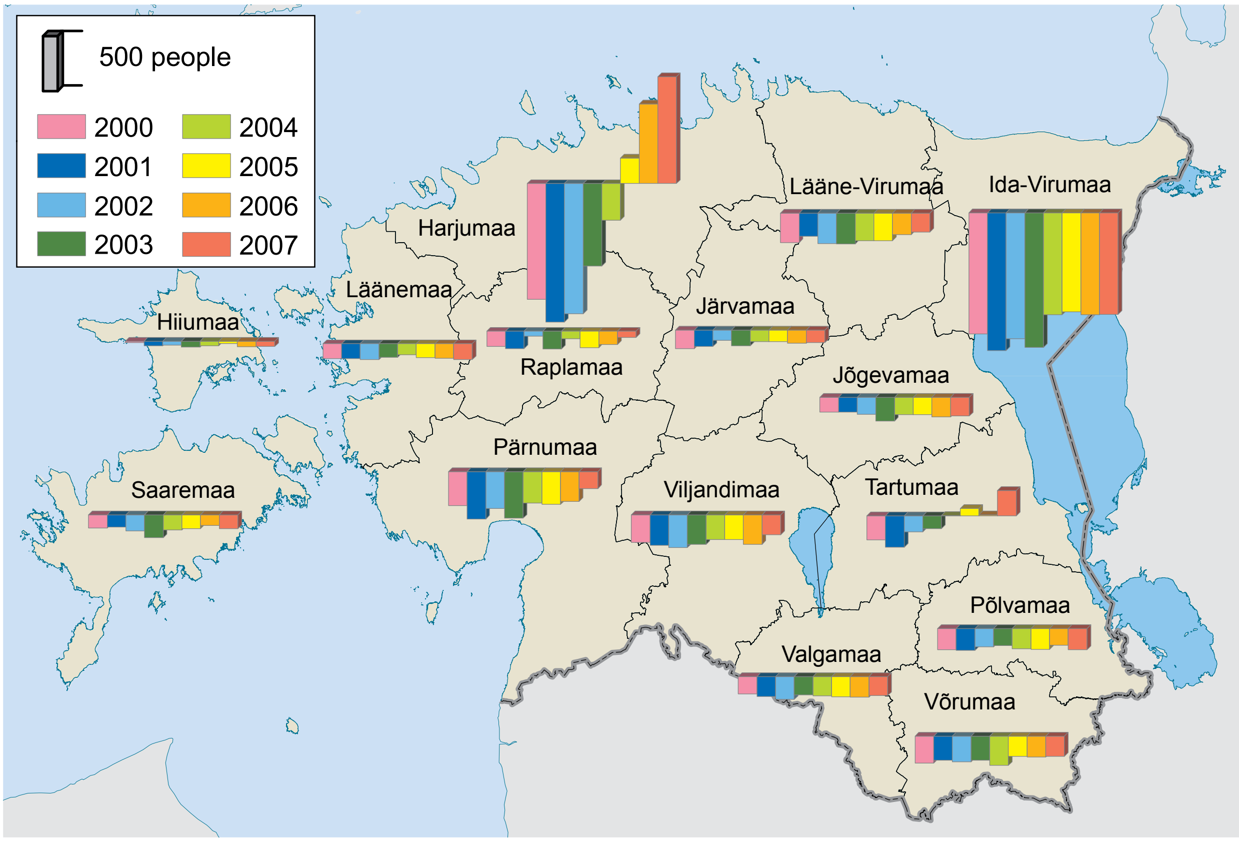


Figure 1.1. Population in 1970–2008. Data: Statistics Estonia.



Map 1.1. Population and population growth in each county, 2007. Data: Statistics Estonia.



Map 1.2. Natural population growth in 2000–2007. Data: Statistics Estonia.

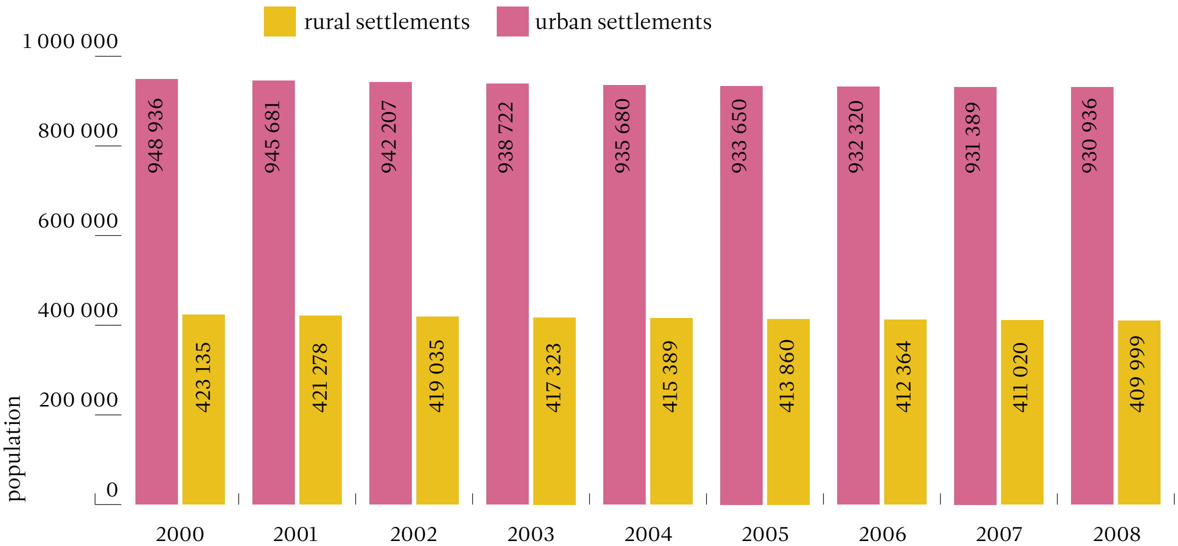


Figure 1.2. Urban and rural population in 2000–2008. Note: Urban settlements include cities, cities and towns within rural municipalities, while rural settlements include small towns and villages. Data: Statistics Estonia.

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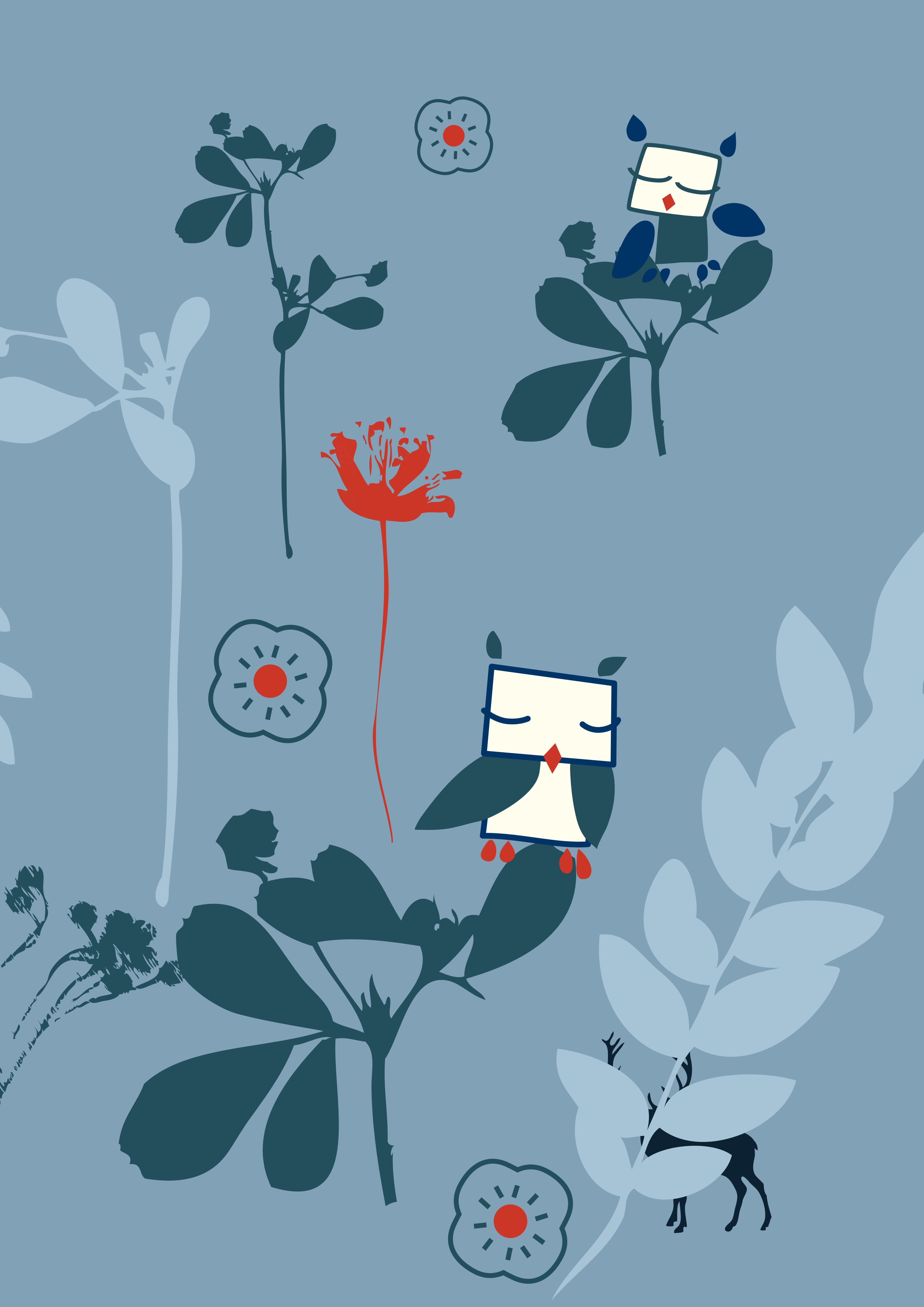
2. The economy



2. The economy

Estonia's economy experienced very successful years in the last decade. In 2006, Estonia ranked second in Europe in terms of economic growth. Even though economic growth is not necessarily accompanied by increased pressure on the environment, such has been the case in Estonia. High demand for transport, fuels and electricity during the boom in consumer spending and construction led to higher levels of emissions and amounts of waste generated.

2.1. Gross domestic product and consumer price index

Starting in the beginning of 2000, Estonia's gross domestic product (GDP) began growing very rapidly – more than 10% per year by 2006 (see figure 2.1, table 2.1). In Europe, Estonia was second only to Latvia in economic growth in 2006. The rapid economic growth was based primarily on brisk internal demand, which rose to record levels in 2004–2006 thanks to good loan conditions. Private consumption was also favoured by positive trends on the labour market, high consumer confidence, rapid wage growth, lowering of the income tax rate, and growth of old age pensions. Investments also grew, and their rapid growth was conditioned by the brisk investment activity on the part of companies, encouraged in turn by low interest margins and high influx of foreign investment. Compared to 2005, the gross domestic product increased 10.4% in 2006. This was the highest growth rate of the 2000s. Private consumer spending in 2007 was 2.8 times higher than in 1995.

The cooling of Estonia's economy took place gradually, when internal demand began decreasing in 2007. Growth fell from 10% in the first quarter of 2007 to 4.8% in the fourth quarter. While investment growth slowed down in early 2007, private consumer spending was at the highest level in recent years. But the major price rise and lower consumer confidence affected consumer behaviour and the second quarter of 2007 saw the beginning of lower consumer spending. This was accompanied by a cooling of the real estate market, which had seen very rapid development in the preceding years. Economic growth slowed down to pre-EU-accession levels. In 2008, internal demand continued to drop and as the impact of the international financial crisis began to be felt by Estonia's primary trading partners, the Estonian economy began rapidly heading downhill. In 2008, GDP fell 3.6%. In the fourth quarter alone, the drop was 9.7% year-on-year. According to the forecasts from Eesti Pank, the economy will contract by 12.3% in 2009.

Along with the rapid economic growth, prices rose as well. The standardized consumer price index was still 4.1% in 2005, but rose to 6.6% in 2007 (figure 2.2). The price rise was supported by rapid growth in internal demand and wages that persisted for several years and was reflected in the price of services. Even though internal demand fell in 2007, the rise in the prices was impacted by the rise in the price of fuel and external factors. The price increases continued in 2008 and the average for the year was 10.4%. The primary reason was the steep rise in oil and food prices in the world market. Along with the economic recession, inflation pressure started dropping as well. From autumn 2008, growth in consumer prices started slowing and in early 2009, the annual growth in the consumer price index had dropped to 3.9%. According to the forecasts from Eesti Pank, the economy will contract by 0.5% in 2009.

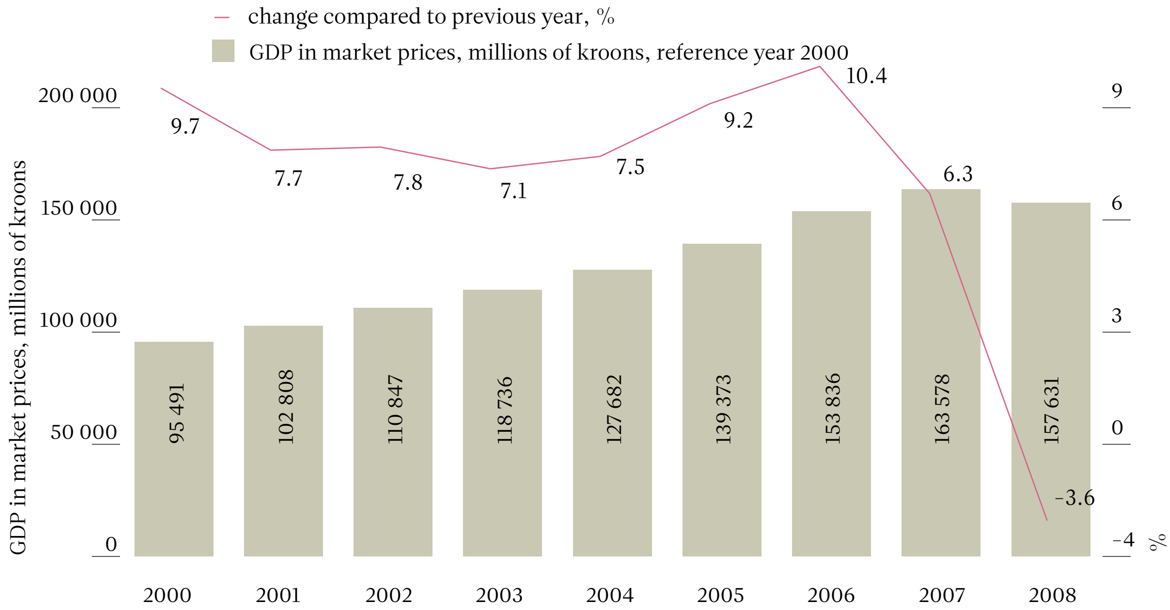


Figure 2.1. GDP in market prices in 2000–2008. Data: Statistics Estonia.

Table 2.1. GDP growth rate in European Union countries. in fixed prices with respect to the previous year's GDP growth rate (%). Data: Eurostat.

	2000		2004	2005	2006	2007	2008
EU (27 countries)	3.9		2.5	2.0	3.1	2.9	0.9
EU (15 countries)	3.9		2.3	1.8	2.9	2.7	0.6
Estonia	**9.6**		**7.5**	**9.2**	**10.4**	**6.3**	**-3.6**

Table 2.2. GDP change compared to the previous year (using the chain method) by field of activity (%). Data: Statistics Estonia.

	2000		2004	2005	2006	2007	2008
Agriculture and hunting	24.8		-9.8	-0.5	2.3	-12	7.6
Forestry	9.5		-8.1	-11.8	-15.3	-10.5	4.3
Fishing	-3.8		-9.9	1.6	4.2	8.1	3
Mining	16.4		-5.6	10.4	3.4	11.9	-6.9
Processing industry	19.4		10.9	11.1	11.9	9	-4
Electricity, gas and water supply	9.5		1.3	0.3	5.6	-3.3	-7.7
Construction	18.3		9.8	25.6	17.8	10	-6
Hotels and restaurants	7.5		13.9	10.9	8.6	6	-4.5
Transportation, warehousing and communications	7.2		8.9	8	10	6.5	-5.7

Table 2.3. GDP per capita as measured by the purchasing power standard (EL-27=100). Data: Eurostat.

	2000		2004	2005	2006	2007	2008
EU (27 countries)	100		100	100	100	100	100
EU (15 countries)	115.3		113.2	112.8	112.2	111.7	110.3
Estonia	**44.6**		**57.2**	**61.1**	**65.3**	**67.9**	**65.1**

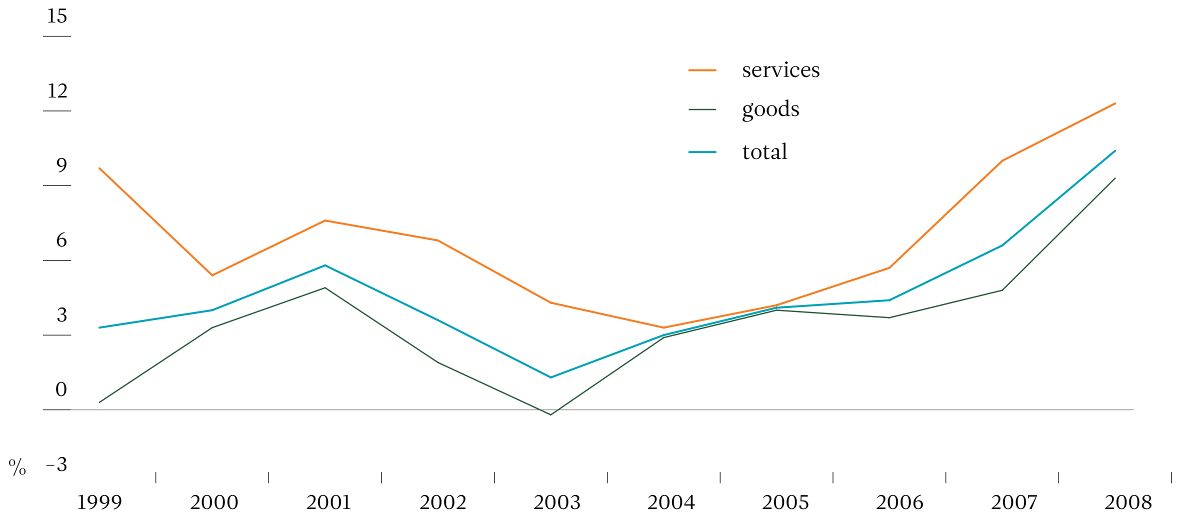


Figure 2.2. Change in consumer price index compared to the last year. Data: Statistics Estonia.

Sources:

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2.2. Energy production and consumption

Energy is a very important sector in the social and economic context, supplying the population with fuel, electricity and heat – this ensures social and economic well-being and transport of people and goods. In connection with the improved economic growth, energy consumption has also increased.

Estonia's most important local sources of energy (primary energy resources) are oil shale, peat and wood. Motor fuels and gas are imported.

Up to 2000, energy production and consumption decreased but then started growing again. Primary energy production grew 17% in the period 2004–2007, primarily due to an increase in oil shale production. Electricity production grew 18%; domestic electricity, 13% (figure 2.3). About 20% of the electricity generated in 2007 was exported. Oil shale output has also increased; one-half is sold to foreign countries.

Energy expenditures per kroon of gross domestic product has decreased, but energy expenditure in Estonia is still four times greater than the average for the European Union. Only Romania, Bulgaria and Lithuania[A] exceed Estonia in terms of energy intensiveness.

An increasing amount of renewable energy resources (biomass, hydro and wind energy) is being utilized for energy production. The use of renewable energy sources is growing but still makes up only 1.5% of total electricity consumption (figure 2.5).

The use of all energy resources **impacts the state of the environment**. Production of energy from local raw materials gives Estonia energy independence, but unfortunately the oil-shale-based energy sector is to this point one of the greatest sources of environmental pollution. Precise data on the burden from the energy sector are listed in the respective chapters on Ambient Air, Water and Waste.

Due to stringent environmental requirements and the growth of energy consumption, serious consideration is being lent to use of nuclear energy. Environmental risks are also associated with activities related to nuclear energy production, such as enrichment and transport of uranium ore, storage of enriched uranium, and processing and storage of radioactive nuclear waste.

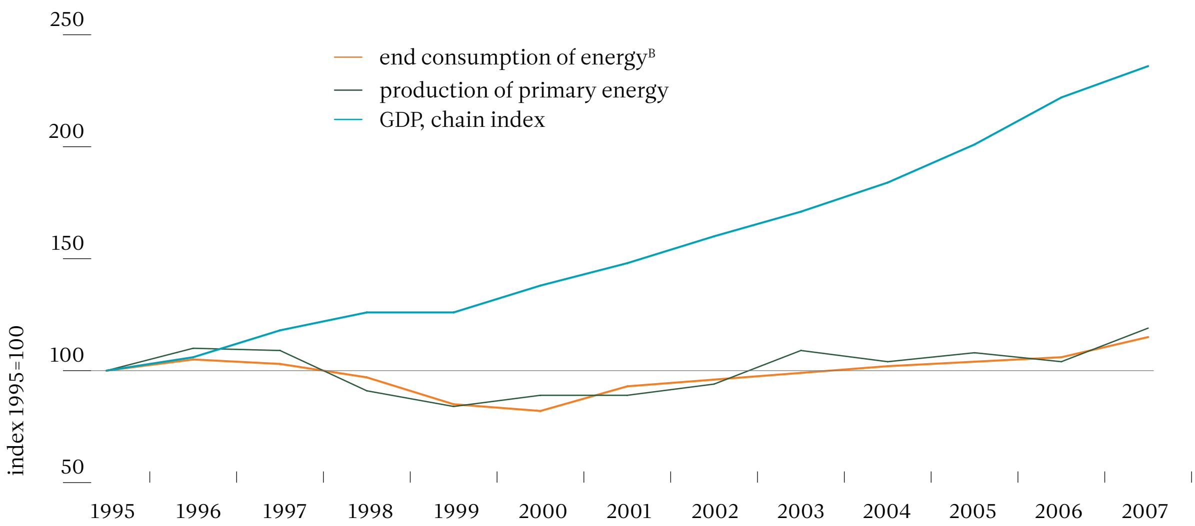


Figure 2.3. Energy production and consumption. Data: Statistics Estonia.

[A] Increased electricity export output. (Mullu suurendas elektritoodangut eksport.) [WWW] http://www.stat.ee/18874 (16.06.2009)
[B] Consumed directly without transformation to other types of energy.

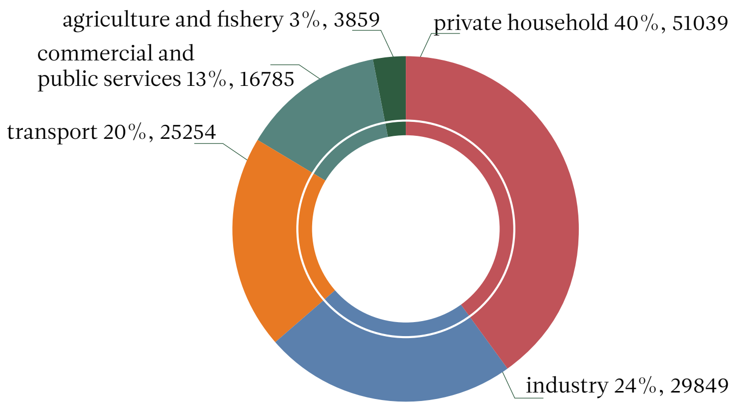


Figure 2.4. End consumption[B] of energy (electricity, heat and fuels) by economic sector in 2007. Data: EEIC.

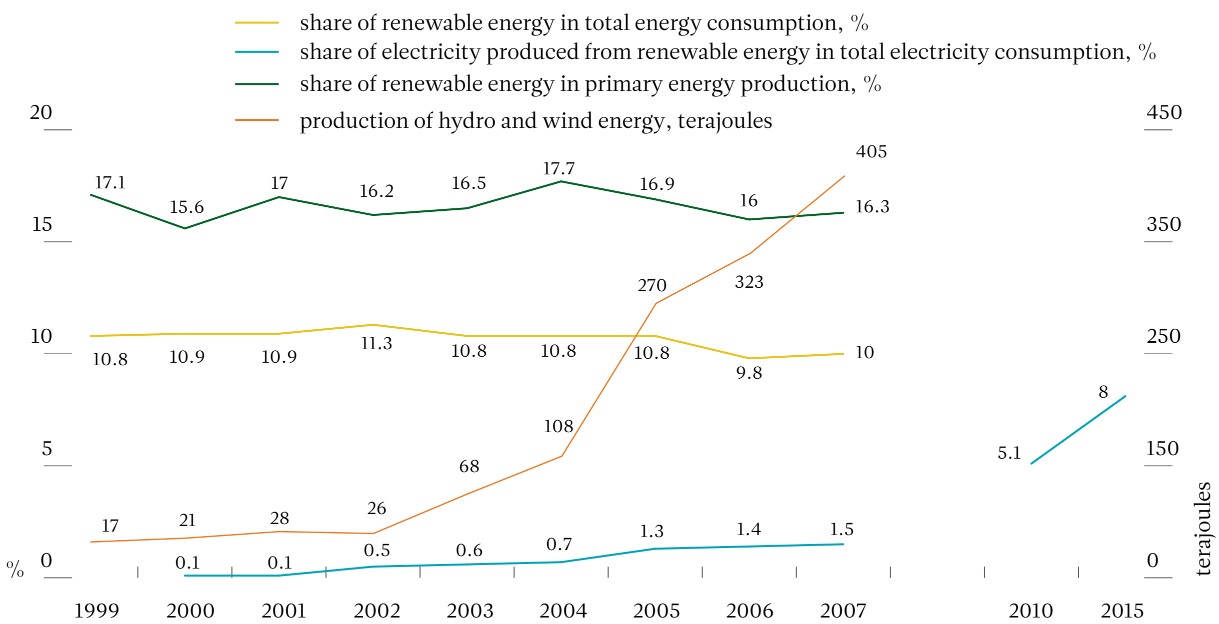


Figure 2.5. Production of renewable energy in 1999–2007 and objectives for 2010 (Long-term national development plan for the fuel and energy sector up to 2015) and 2015 (Estonian Environmental Strategy 2030). Data: Statistics Estonia.

Sources:

- Eesti elektri tarbimine aastatel 2005–2015. (Eesti elektritarbimine aastatel 2005–2015. (Estonia's electricity consumption in 2005–2015.) (2004). / Tallinn : Tallinn University of Technology. [WWW] http://www.mkm.ee/doc.php?9276 (02.03.2009)
- Eesti energeetika arvudes 2007. Estonian Energy in Figures (2007). Tallinn : Minister of Economic Affairs and Communications. [WWW] http://www.mkm.ee/doc.php?254417
- Elektrienergia tootmis- ja edastusvõimsuse vajadus ning arendusstsenaariumid Eesti elektrisüsteemis aastatel 2005–2015. (Need for electricity production and transmission capacity in the Estonian electricity system in 2015–2015.) (2004). / Tallinn : Tallinn University of Technology. [WWW] http://www.mkm.ee/doc.php?9277 (02.03.2009)
- Keskkonnanõuete mõju Eesti elektriturule ning elektri tootmishinnale aastatel 2005–2015. (Impact of environmental requirements on the Estonian electricity market and the electricity production price in 2005–2015.) (2004). / Tallinn : Tallinn University of Technology. [WWW] http://www.seit.ee/files/El-majanduse%20keskkonnanouded.pdf (02.03.2009)
- Statistics database. [WWW] http://pub.stat.ee/px-web.2001/dialog/statfile2.asp (15.06.2009)
- Tõhusa elektri ja soojuse koostootmise potentsiaal Eestis. (Potential for efficient co-generation of heat and power in Estonia.) (2004). / Tallinn : Tallinn University of Technology. [WWW] http://www.mkm.ee/doc.php?223813 (12.03.2009)

[B] Consumed directly without transformation to other types of energy.

2.3. Industry

Industrial output increased constantly from 2007 (figure 2.6). Internal demand and export growth can be considered to be the reason for this. The share of the processing industry in industrial output grew each year – according to Statistics Estonia it made up 87% of total industrial output in 2003, while in 2007 it was already 91.2%. Even though energy production has increased in recent years, its share in industrial output has decreased from 9% in 2003 to 6% in 2007. The share of the mining sector in industrial output was 3% in 2007.

The global financial and economic crisis is also reflected in the Estonian economy. In 2008, the industrial output dropped precipitously and due to lower demand, the output of industrial enterprises also fell. Industrial sectors with a greater relative significance (timber, construction materials etc) accounted for 30–40% of the decline in output, and sectors with a lower importance (such as production of paper and motor vehicles) up to 60%.

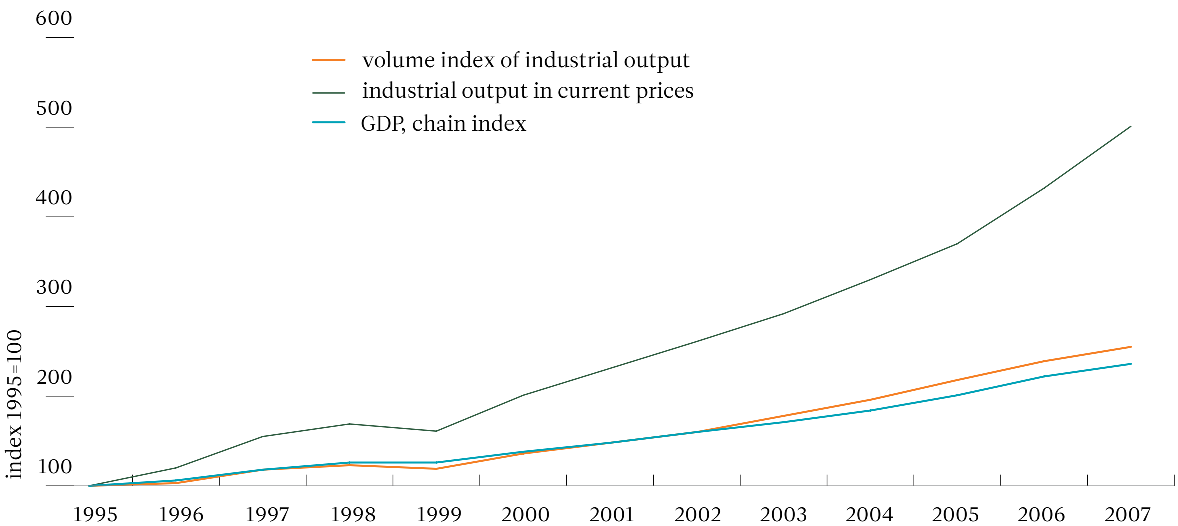


Figure 2.6. Change in industrial production and GDP in 1995–2007, as an index. Data: Statistics Estonia.

Sources:

- Eesti statistika aastaraamat 2008. Statistical Yearbook of Estonia (2008). / Ed. S. Linnas. Tallinn: Statistics Estonia [WWW] http://www.stat.ee/18920
- Statistics database. [WWW] http://pub.stat.ee/px-web.2001/dialog/statfile2.asp (22.05.2009)

2.4. Transport

Transport gives people the possibility of moving and transporting goods over land and water and by air, and has a decisive importance for socioeconomic development.

In recent years, the number of vehicles – primarily passenger vehicles – has grown (figure 2.7). In five years, about 100,000 passenger vehicles have been registered while the number of trucks and buses has remained fairly stable. Whereas in 1990, there were 154 cars per 1000 people and in 2003, 321; there were 412 cars in 2008. The increase in automobiles has been caused by a number of factors: economic growth, the consumer spending boom, sprawl, inefficient public transport systems in cities, especially in rural areas, underemployment in the countryside and the resulting commuting between countryside and city.

Of registered vehicles, old ones – over 10 years in age — are in the majority. The percentage of over 10-year-old motorcycles, passenger cars and trucks is between 50–60%, but 70% in the case of buses. With each year, the share of new vehicles under 2 years old grows – in 2005, the share of new vehicles was 7%, and in 2008, it had risen to 10%.

About 70% of motor vehicles run on petrol and 30% on diesel fuel; types of vehicles that consume more fuel, such as buses and trucks mainly use diesel.

Passenger and freight numbers increased from 2003–2007 — in 2007 freight and passenger volumes were, respectively 15% and 37% higher than they were in 2003 (figure 2.8).

Traffic has decreased slightly along with the recession — according to the Road Administration, traffic had decreased by 4% throughout the national road network compared to 2007.

Road transport pollutes the air and soil, creates noise and disrupts ecosystems, while building roads destroys or fragments habitats. **Road transport is one of the greatest sources of air pollution, apart from the energy sector.** Improved fuel quality, use of catalytic converters and more efficient motor vehicles have helped reduce amounts of emissions (CO, CO_2, NO_x) as well as heavy metals (lead in particular) at the same time that the number of vehicles has grown.

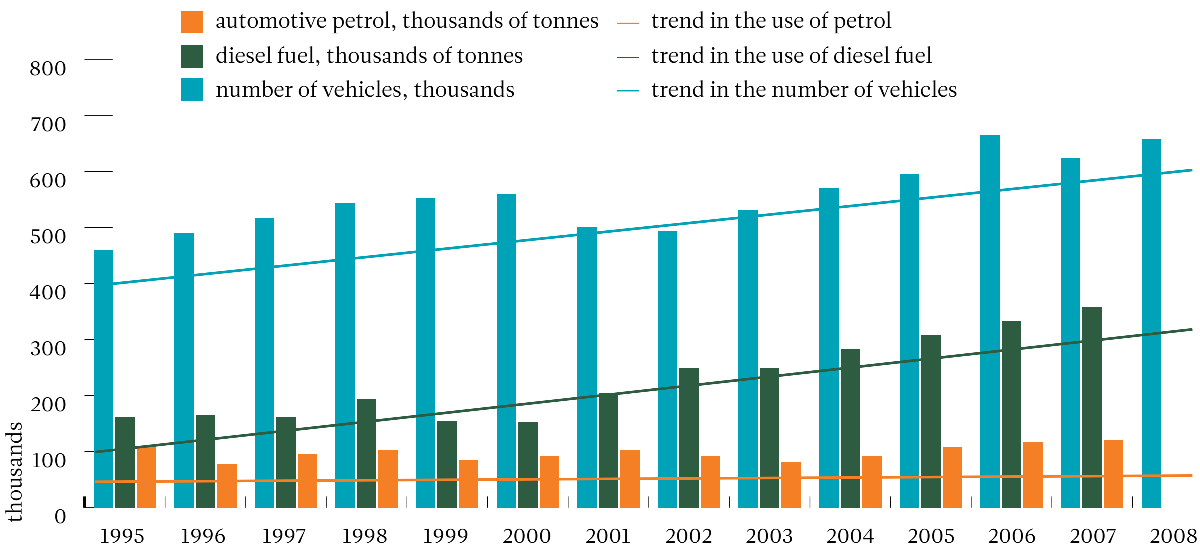


Figure 2.7. Number of registered motor vehicles (passenger vehicles and trucks, buses and motorcycles) use of petrol and diesel fuel in road transport. Note: The number of vehicles decreased in 2001, as cars not re-registered by 1 July 2001 were omitted from the calculation in the course of reorganization of the Motor Vehicle Registry database. Data: ARK, Statistics Estonia.

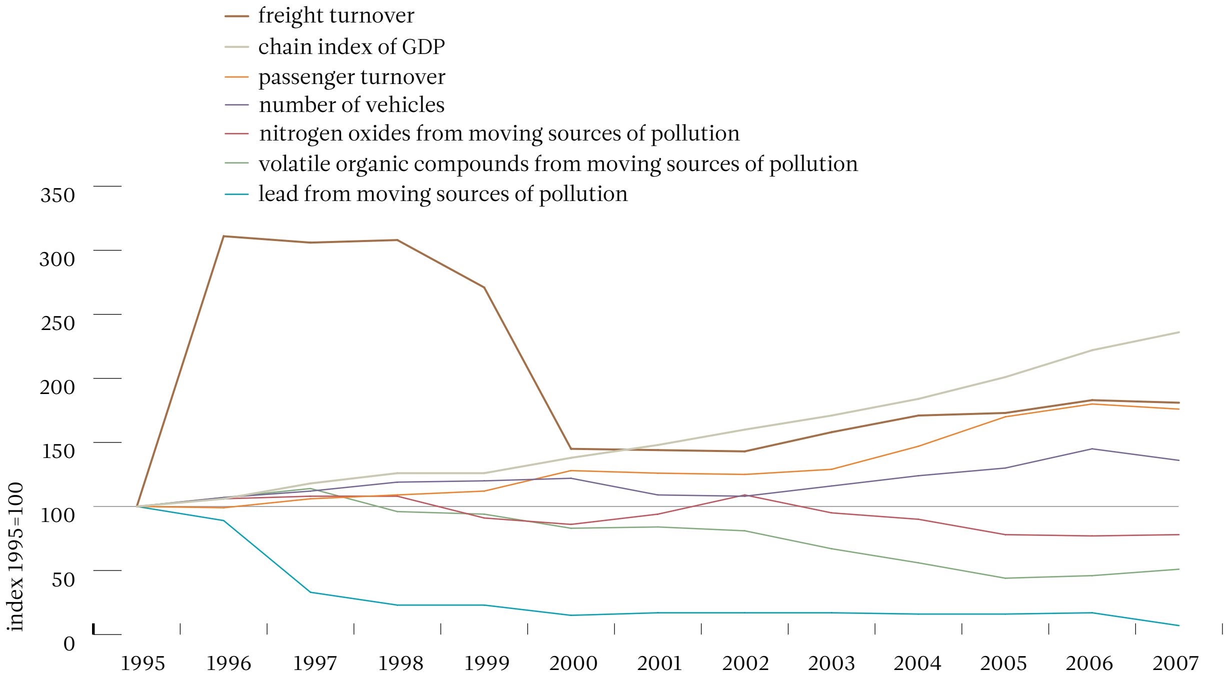


Figure 2.8. Transport and the environment. Data: Statistics Estonia, EEIC.

Sources:

- Estonian Road Administration website.
[WWW] http://www.mnt.ee (03.03.2009)
- National Motor Vehicle Register website.
[WWW] http://www.ark.ee (statistics, annual reports) (03.03.2009)
- The Estonian Environment Information Centre website.
[WWW] http://www.keskkonnainfo.ee (03.03.2009)

2.5. Tourism

After independence was restored, the number of tourists to Estonia has constantly increased. In 1999, slightly fewer than a million internal and external tourists were accommodated in Estonia; this figure was already 50% larger in 2008 – 2.38 million. Estonia's characteristically naturally scenic places continue to be one of the main factors motivating travel to Estonia.

The number of foreign tourists rose constantly from the early 1990s up until 2005, then dropped slightly for several years before resuming rise in 2008 (figure 2.9). The number of foreign tourists increased sharply in 2004, a possible reason being Estonia's accession to the European Union. The greatest number of foreign tourists arrived in Estonia in 2005 – 1.43 million. This was slightly more than Estonia's population. The greatest numbers of visitors to Estonia come from Finland, Germany, Sweden, Russia, Latvia and Great Britain. Finns account for 50% of all tourists to Estonia. About half of the Finnish tourists visiting Estonia spent one day in the country.

Besides external tourism, internal tourism has also grown constantly. Internal tourists used Estonian lodging services the most in 2007 (963,000).

The areas of Estonia most frequently visited are Tallinn and Harju County and the city of Pärnu and Pärnu County (figure 2.10). Each year there is an increase in the number of tourists who visit other Estonian regions besides Tallinn – such as western and southern Estonia.

Estonia's nature is an important factor motivating travel and an object of interest for all of the primary target markets. For example, 81% of German tourists wish to visit Estonia's naturally scenic sites, compared to 55% of Finns and 80% of Russians. Of potential travellers to Estonia, 69% are interested in spending time in nature and 42% in active pursuits in nature. The goal of tourists travelling to Estonia for short stays is usually shopping or pleasure. Since early 2000, visitation to Estonian spas and sanatoriums has also grown constantly.

Along with the constantly growing number of tourists, the number of accommodation providers has also grown on a consistent basis (map 2.1).

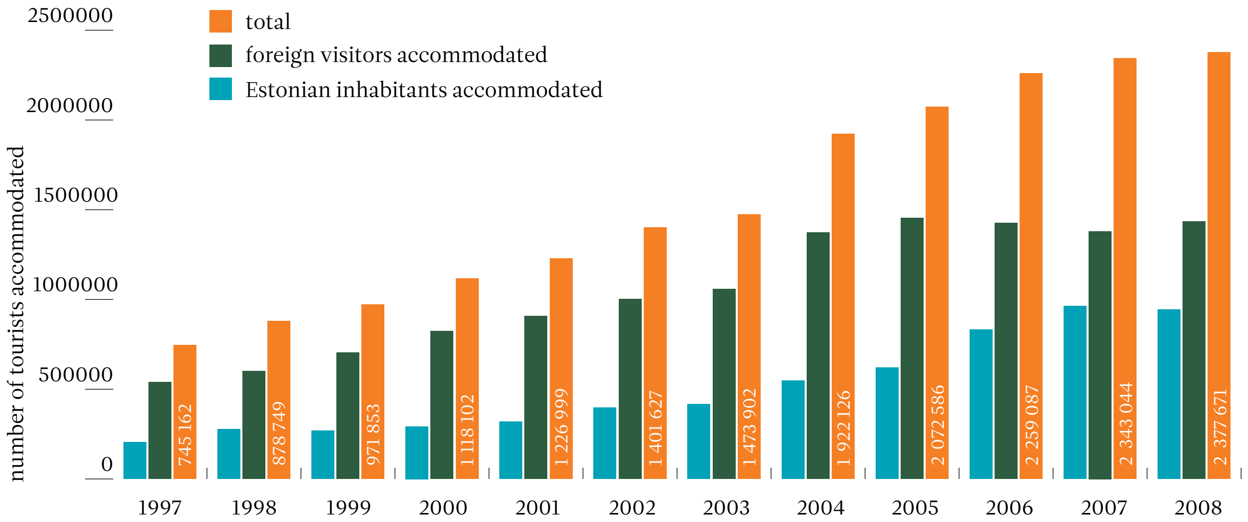


Figure 2.9. Percentage of internal and external tourists out of all tourists accommodated. Data: Statistics Estonia.

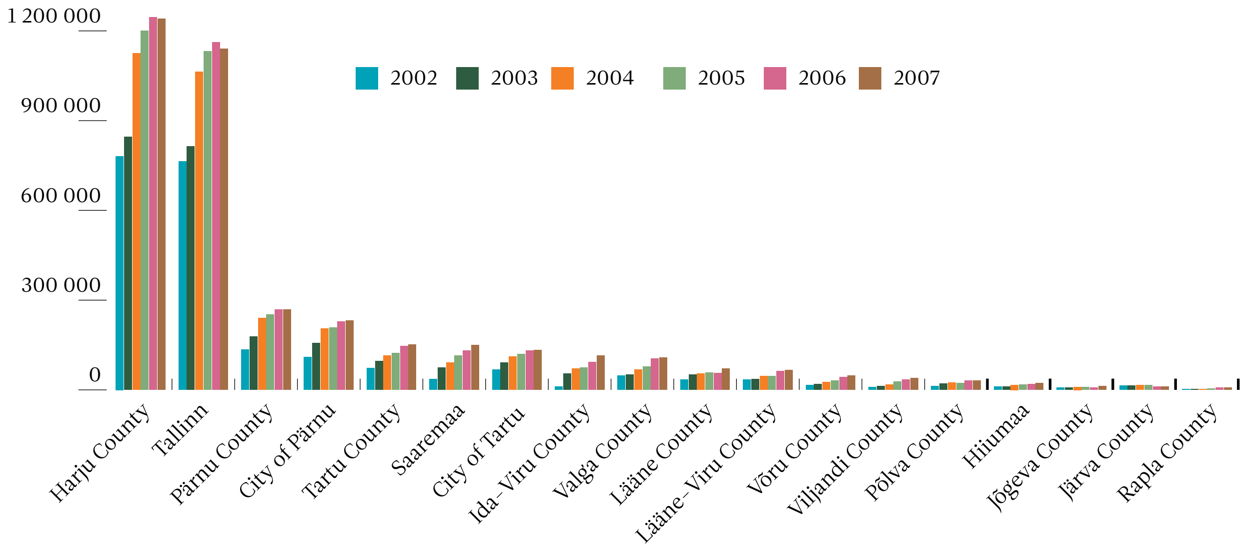
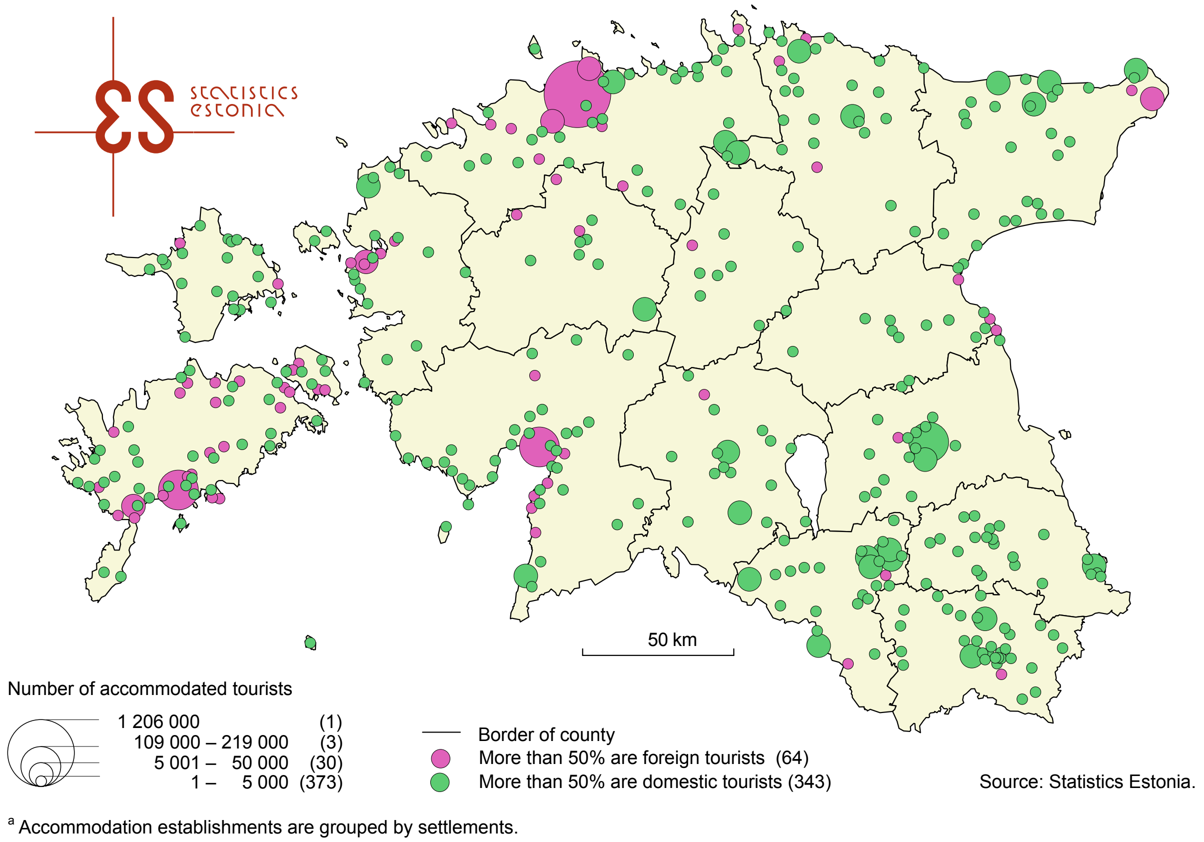


Figure 2.10. Number of tourists accommodated in each county in 2002–2007. Data: Statistics Estonia.



Map 2.1. Internal and external tourists accommodated in 2007. Map source: Statistics Estonia.

Sources:

- Eesti ja maailma turism 2008. aastal. (Eesti ja maailma turism 2008. (Estonia and world tourism 2008.) [WWW] http://public.visitestonia.com/files/statistika/Eesti_turism_2008.pdf (20.04.2009)
- Eesti loodusturismi pakkumise uuring: tulemused, 14 november 2008. (The market for Estonian outbound nature tourism: findings, 14 November 2008.) [WWW] http://public.visitestonia.com/files/statistika/Loodusturismi_pakkumise_uuring_EAS2008.pdf (08.04.2009)
- Eesti turismistatistika põhinäitajad 1993–2006. (Estonian tourism statistics, main indicators 1993–2006.) [WWW] http://public.visitestonia.com/files/statistika/Eesti_turismistatistika1993-2006.pdf (20.04.2009)
- Ministry of Economic Affairs and Communications website. [WWW] http://www.mkm.ee (08.04.2009)
- Statistics database. [WWW] http://pub.stat.ee/px-web.2001/dialog/statfile2.asp (09.04.2009)
- Statistics Estonia website. [WWW] http://www.stat.ee (09.04.2009)

2.6. Agriculture

The relative importance of agriculture in the Estonian economy has declined since the mid-1990s and the competitiveness of our agriculture sector is below the EU average, although a large part of the foodstuffs consumed in Estonia are grown on the spot. Agricultural production is one of the most characteristic activities in Estonia's rural areas. Agriculture supplies Estonians with food, offers work in rural areas and shapes the cultural landscape.

Animal husbandry

In light of Estonia's natural conditions, animal farming plays the most important role in Estonian agriculture. Dairy herds account for the majority of cattle. Besides cattle farming, pig, sheep, horse and bird farming is widespread. The abundance of agricultural animals has generally remained unchanged but compared to the earlier period, a rise in the abundance of goats and sheep can be seen (figure 2.11). The number of cattle has started declining slightly since 2005, but it has not been a large drop.

In 2007, meat import made up 40% and export 20% of total meat resources. The percentage of import and export of milk is very low, but cheese export outstrips import.

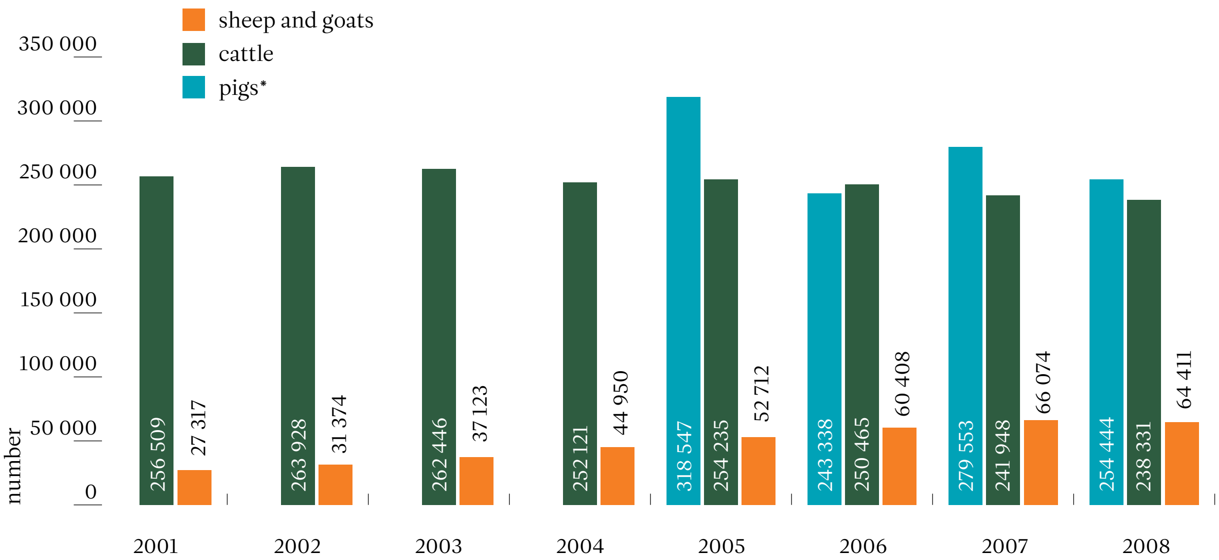


Figure 2.11. Abundance of cattle, pigs, sheep and goats from 2001–2008. Data: ARIB.
*The total number of pigs was derived from the numbers of pigs reported by farmers who reported their pig totals as of 1 May (from 2005).

Crops

According to land use data from the Agricultural Registers and Information Board (ARIB), the relative importance of crops has grown slightly since 2004 (figure 2.12). About 54,000 hectares more land was under crops in 2008 compared to 2004. The area under natural grasslands has decreased by 14,000 hectares since 2005. ARIB defines natural grasslands as more than 10-year grasslands and long-term grasslands are considered to be grasslands of 5–10 years.

The percentage of grain imported has decreased as of 2007, remaining in the 10–15% range, while export has risen to 20%. Potato demand is met primarily with domestic production and import accounts for a very low percentage.

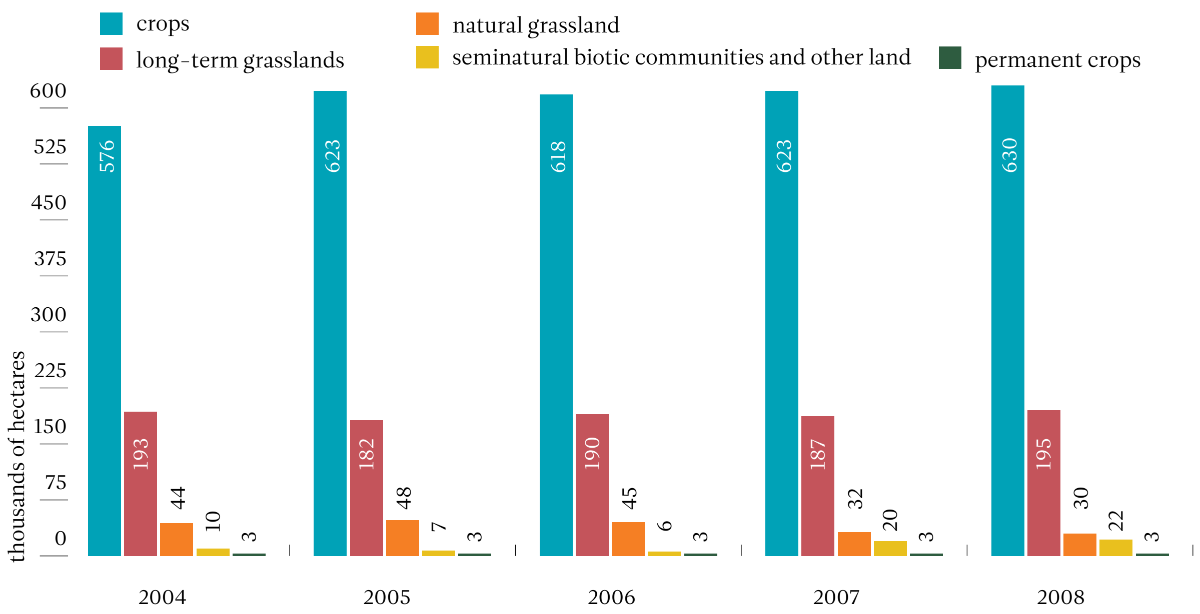


Figure 2.12 Declared land use in the years 2004–2008. Data: ARIB.

Fertilizer use

With regard to inorganic fertilizers, the amount of nitrogen and potassium introduced into the soil has decreased; the quantity of nitrogen has decreased the most (figure 2.13). As to organic fertilizers, the quantities of nitrogen, phosphorus and potassium have generally decreased (figure 2.14).

Intensive agriculture in Estonia, associated with fertilizer use on greater number of fields, is concentrated in the fertile soils in Lääne-Viru, Jõgeva, Tartu and Viljandi County. To a large degree, intensive agriculture coincides with karstic areas of unprotected groundwater – i.e. the nitrate vulnerable zones (map 2.2).

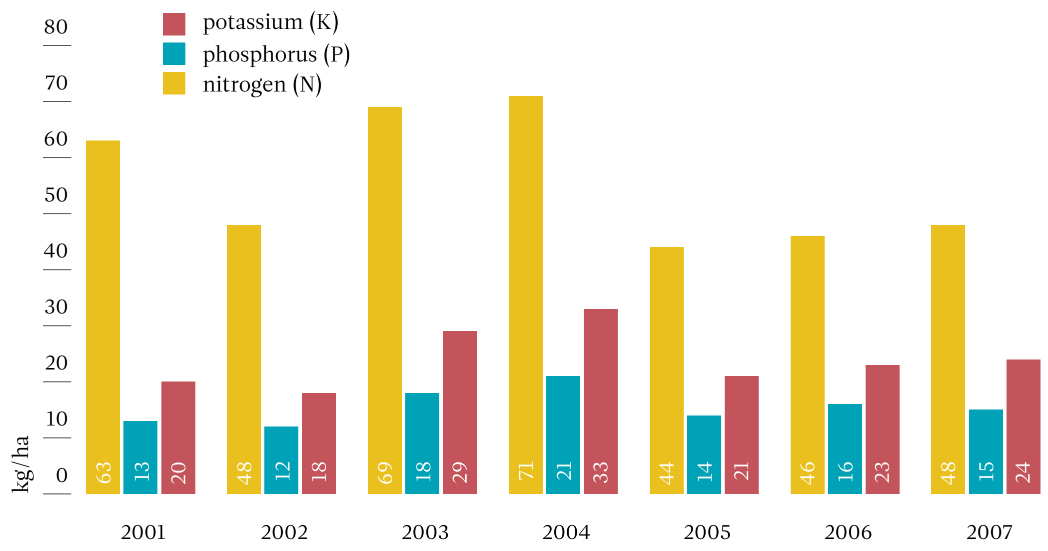


Figure 2.13. Use of mineral fertilizers, 2001–2007. Nutrients are given as oxides. Data: Statistics Estonia.

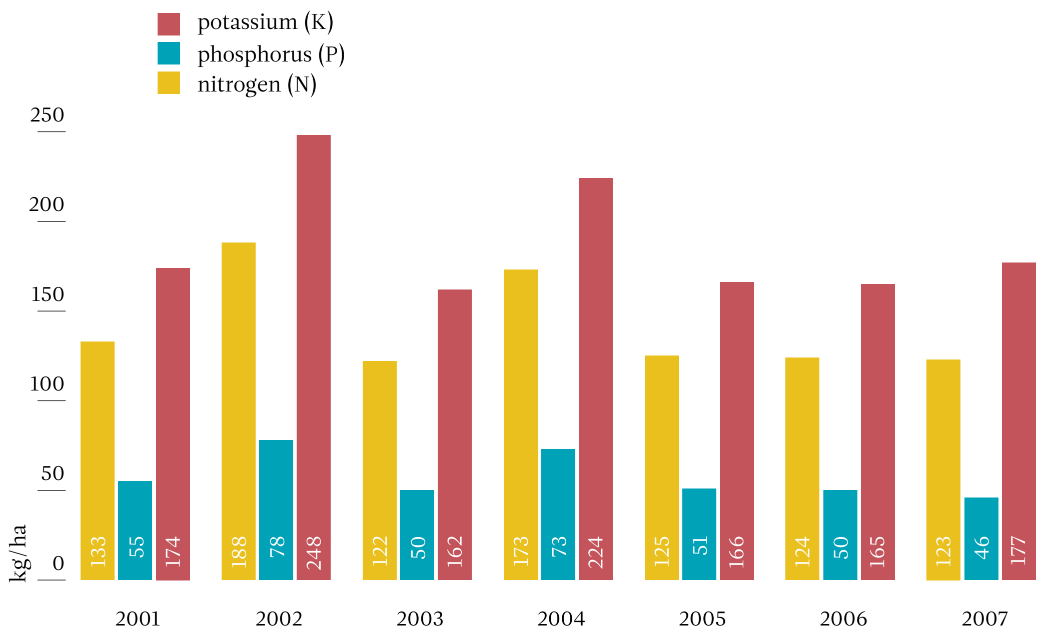
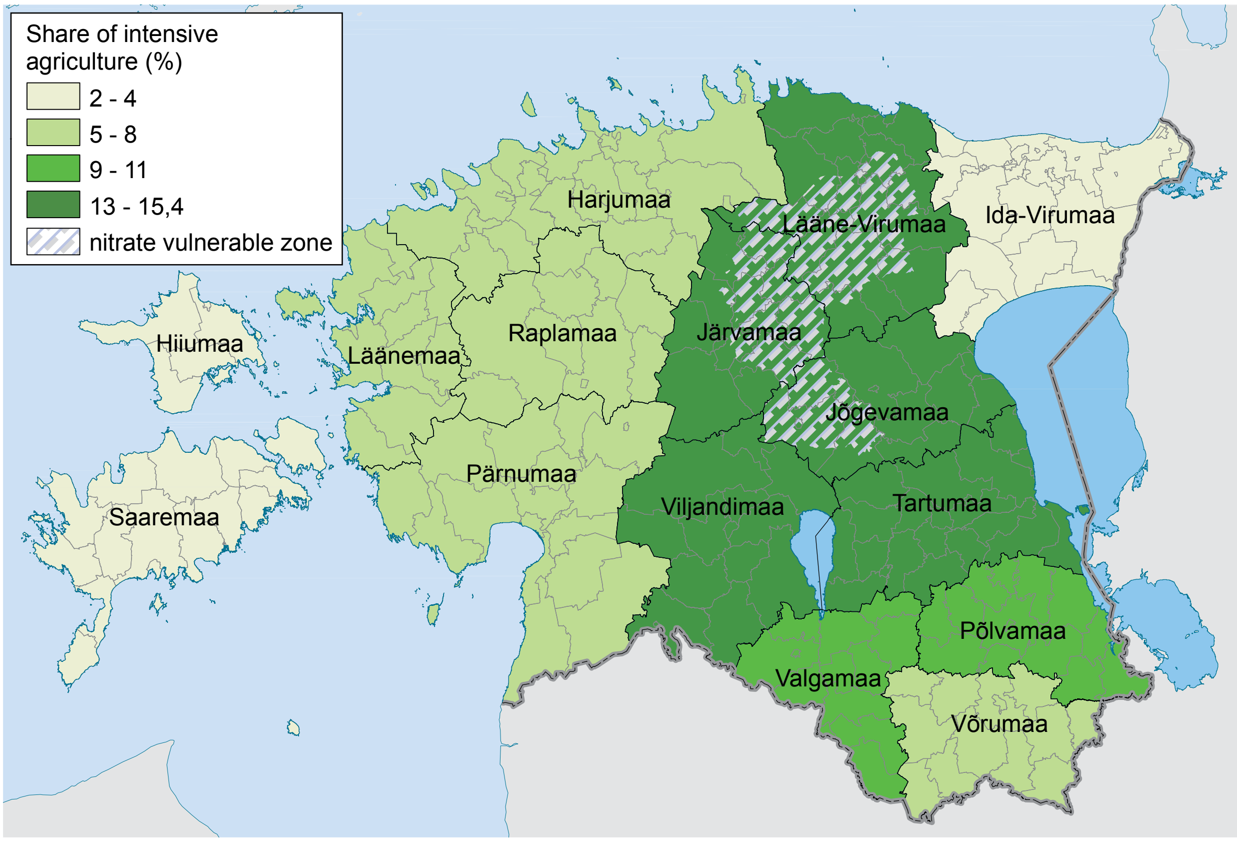


Figure 2.14. Organic fertilizer use, 2001–2007 (as nutrients). Data: Statistics Estonia.



Map 2.2. The nitrate vulnerable zone and the relative importance of intensive agriculture in the area of each county (%) as of 2007. The region of unprotected groundwater is located in counties with intensive agricultural operations. Data: Statistics Estonia, EEIC.

Agri-environmental support monitoring and assessment

Realization of the environmental problems associated with intensive agriculture, assistance – agri-environmental support scheme – is available to farmers/agricultural enterprises under the Estonian Rural Development Plan. Environmentally-friendly and organic farming schemes are applied to promote environmentally-friendly farming and enhance producers' environmental awareness.

To assess how effective the scheme is in achieving its objectives, a programme of monitoring and evaluation is applied in parallel to implementation of the scheme itself. The agricultural environment is assessed in the following thematic fields, among others: water, soil, landscape, biodiversity. From 2004–2007, the following fields and indicators were studied:

- **water** – gross nutrient balance, use of pesticides, concentration of nutrients in drainage water;
- **biodiversity** – richness of farmland bird species, abundance and population density; bumblebee diversity and abundance: vascular plant community structure, diversity and coverage of species; earthworm abundance and diversity and soil biomass[C] activity;
- **landscape** – changes in landscape structure in terms of point, linear and areal elements.

In the course of the research, the impact of agri-environmental support types such as environmentally friendly and, organic farming and for reference conventional farming (receiving SAPS)[D] was examined.

Water

On the basis of research on water, it was found that the amounts of **phosphorus** and **potassium** leached from monitoring fields of different support types were small and were not dependent on the support type. The **nitrogen** balance was in surplus in all studied enterprises and it was lowest in enterprises with organic farming.

Larger agricultural producers (with more than 100 ha of arable land) used more chemical **plant protection products** and **nutrient elements**. This may be related to the readiness of these companies to spend more money. Compared to conventional producers environmentally-friendly production reduced the amount of area sprayed with chemical plant protection products in the period from 2004–2006, but in terms of quantity, pesticide load was somewhat higher in environmentally-friendly production.

The findings of the pesticide study revealed that pesticides were used in environmentally- friendly production on 12% less area than in conventional production and in 2006 on an area 4% smaller. The agricultural enterprises in the sample of the pesticide use study used pesticides on 55–67% of the agricultural land in 2005 and 2006.

The level of mineral fertilizer use is still relatively low in Estonia. In companies with environmentally-friendly production, a study of the gross nutrient balance revealed increases in the use of mineral fertilizers (nitrogen from 56 to 68 kg/ha, phosphorus from 4.2 to 9.9 kg/ha and potassium from 9.9 to 22.6 kg/ha, as well as in pesticide use (from 0.8 to 1.1 kg/ha) but the increase was still small.

In 2006, support for organic production was applied for for 65,830 hectares. As the use of both mineral fertilizers and synthetic plant protection products are prohibited in organic farming, it can be said that the use of these compounds decreased by 100% on areas that received support for organic agriculture.

[C] Biomass – the total mass of living matter in an area of land or bottom of a body of water expressed in units of weight per unit of land area or water volume (m^3).
[D] Conventional producer – producers that receive single area payment (SAPS) and have not joined the agri-environmental support programme.

Biological diversity

With regard to biodiversity, the monitoring results showed that in addition to the requirements of the support, other factors also exert an impact on species – for instance, the surrounding landscape and soil and climatic conditions. As a result of the analyses it was found that as landscape diversity increased, bumblebee abundance, bird diversity and number of species on monitoring fields increased accordingly.

It was found that as field area increased, bumblebee abundance, number of bumblebee species, number of breeding bird species and bird diversity decreased. The abundance and number of species of bumblebees dropped significantly after fields exceeded 5–6 hectares in area. Such correlations show that the size of fields is linked to biological diversity, yet the agri-environmental support measures in the rural development plan in the 2004–2006 period did not contain any requirements regarding the field size.

Compared to plant species diversity in the field margins, no significant differences were found between different support types. The reason may be the fact that the impact of the support has not yet become evident or it has been overshadowed by differences in the landscape structure.

On the basis of monitoring results in the field of biodiversity, it can be said that both environmentally-friendly and organic production had a positive impact on the diversity of bumblebees, as in 2006 and 2007, the diversity of bumblebees in the fields farmed by these enterprises was higher than on the fields with conventional production. The reason for this may be the requirement of blend of 15% leguminous plants and a mix of leguminous grasses (the food resource for bumblebees) have to be grown in both organic and environmentally-friendly farms. The agri-environmental support measures presumably had a positive impact on earthworms and microbiota due to the crop rotation requirement, as the values for these indicators in organic and environmentally-friendly enterprises were for the most part higher than on fields farmed by agricultural companies using conventional farming.

Landscape

The most extensive and visible changes in the landscape in the period 2004–2007 took place in the agricultural landscape categories. Figuratively, one reference parcel has more different types of fields and the field areas are thus smaller. In the case of the most important linear elements, such as strips of vegetation cover between rotational crops and stone walls, some growth has taken place. In short, it can be said that the changes in the last three years in the number and occurrence of single-point objects have been minor.

The increase in the number of fields and reduced field area may be due to the fact that agricultural producers are required to implement crop sequence or crop rotation upon joining the agri-environmental support programme.

Read more:

- Agriculture Research Centre website. [WWW] http://pmk.agri.ee/pkt/ (AEM evaluation studies and results)
- Estonian Environment Information Centre website. [WWW] http://www.keskkonnainfo.ee/index.php?lan=EN&sid=647&tid=581&l1=2 (land use)
- Ministry of Agriculture website. [WWW] http://www.agri.ee/?lang=en
- Rural development plan 2007–2013. (2008). / Tallinn: Ministry of Agriculture. [WWW] http://www.agri.ee/public/juurkataloog/MAK/RDP_2007-2013.pdf

3. Natural resources

3. Natural resources

As people's well-being and quality of life improves, demand for natural resources also increases. Any sort of large-scale extraction of natural resources – whether involving mining of natural resources, logging or fishing – exerts direct pressure on the environment. During the years of economic growth, fairly intensive use was made of both renewable and unrenewable natural resources in Estonia. Alongside mining of oil shale, logging and fishing, extraction of natural resources for the construction sector also saw dramatic growth.

3.1. Mineral resources

Estonia is endowed with an average amount of mineral resources on the world level. Not all of the mineral resources found in Estonia are currently being mined; for example there is no phosphorite granite or graptolitic argillite (which contains some uranium) currently being exploited, due to their low benefit to cost ratio. However, granite will start to be quarried in the near future in the Maardu area. Oil shale (kukersite) and peat see intensive use. Each year, demand for natural construction materials such as sand, gravel, limestone and clay has grown.

The extraction of mineral resources is governed by the Earth's Crust Act and the Mining Act. Other significant legal acts pertaining to oil shale are the Ambient Air Protection Act and the Waste Act, which govern the use of oil shale in combustion devices and for producing oil. The National Development Plan for Use of Oil Shale 2008–2015 and the Development Plan for the Estonian Electricity Sector 2008–2019 have been approved. At the end of 2009, the Development Plan for Mineral Resources Used in the Construction Industry for 2010–2020 will be approved; it covers the mining and use of all limestone, dolomite rock, crystalline construction stone (which is primarily granite in Estonia), sand, gravel and clay.

3.1.1. Mineral resources with energy value

Oil shale

Estonia's most important energy-containing mineral resource is oil shale. Over 80% of the oil shale mined is used to generate heat and power; 90% of Estonia's electricity is produced from oil shale. Oil shale is also used to produce heating oil, oil coke, pitch, bitumen and other by-products. Only coarse-grade oil shale with high calorific value is suitable for oil plants.

Oil shale is mined in eastern Estonia, primarily in Ida-Viru County (map 3.1), and in recent years, a small amount in Lääne-Viru County as well.

Oil shale mining volumes have fallen since the early 1990s, but started rising again in 1999 (figure 3.1). In 2007, the efficiency of energy production was markedly higher than in the past (figure 3.2).

The increasing oil shale mining activity is on one hand conditioned by the increase in production of electricity; furthermore, demand for oil shale as a raw material for oil and chemical products has seen continuous growth. The rise in the price of oil has led to even greater interest in raw oil shale.

Peat

The other mineral resource with energy value mined in Estonia is peat. The primary type of peat used for heating is well-decayed peat. Peat is also used in horticulture and agriculture depending on its level of decomposition. Peat mining has fluctuated from one year to the next (figure 3.3), depending on the amount of precipitation. The greatest amount of peat is mined in Pärnu County (33%), followed by Tartu County (17%), Ida-Viru Country (15%) and Harju County (8%). The share of the other counties is around five or fewer per cent.

3.1.2. Mineral resources used in construction

The most diverse category of mineral resources is natural construction materials (mineral resources used in construction). Due to road construction and the construction boom, the mining of these mineral resources has grown markedly since 2002 (figures 3.4 and 3.5). Tallinna Sadam AS mined 1,745,000 m^3 of construction sand in the Naissaar deposit opened in 2003 and 492,000 m^3 from the Prangli deposit, which accounted for 60% of the entire volume of construction sand mined in 2003 (3,715,000 m^3).

Construction mineral resources were predominantly mined in Harju County (50%), followed by Jõgeva (10%) and Lääne-Viru County (9%). The share of the other counties is five per cent or less.

Mining of mineral resources is accompanied by a number of threats to the environment, which depend on particular mineral resource and extraction methods. Quarries with high and steep sides pose hazards for wild animals. Underground mining of oil shale may cause the mined areas to sink in future, as a result of which water flows into such areas, transforming them into marshland. In addition to the above, mining changes the water regime in bodies of water. Hundreds of millions of cubic metres of water are pumped into rivers from mines and quarries in the course of a year. The draining of mines causes the groundwater level to recede in the area. Use of oil shale creates more waste than is used up. Thus hills of ash, mine waste and semi-coke are formed, from which water (precipitation, ash slaking water) spread toxic substances (such as oil, phenol) destroying life and contaminating both ground and surface water.

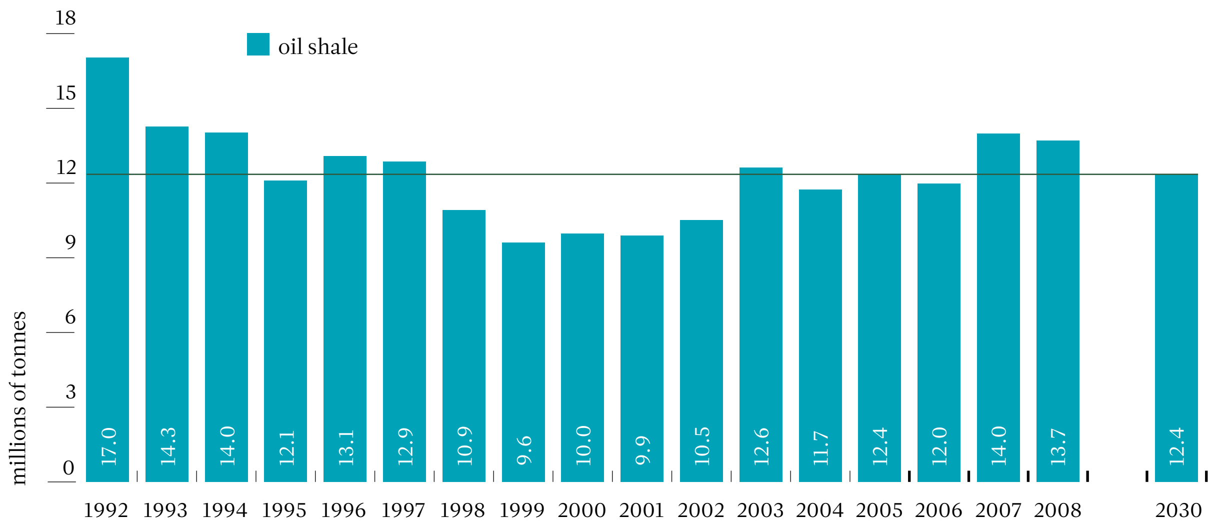


Figure 3.1. Mining of oil shale, 1992–2008. The objective in the Estonian Environmental Strategy 2030 is to keep the mined volumes on the level of 2005. Data: Land Board, Statistics Estonia.

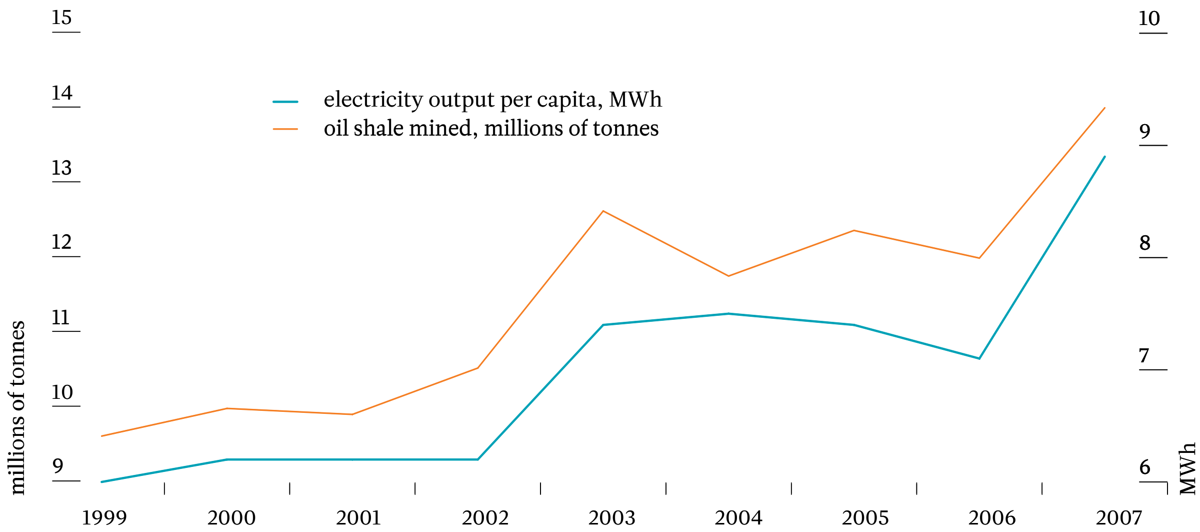


Figure 3.2. Energy efficiency – per capita electrical output with respect to the amount of oil shale mined in 1999–2007. Data: Statistics Estonia.

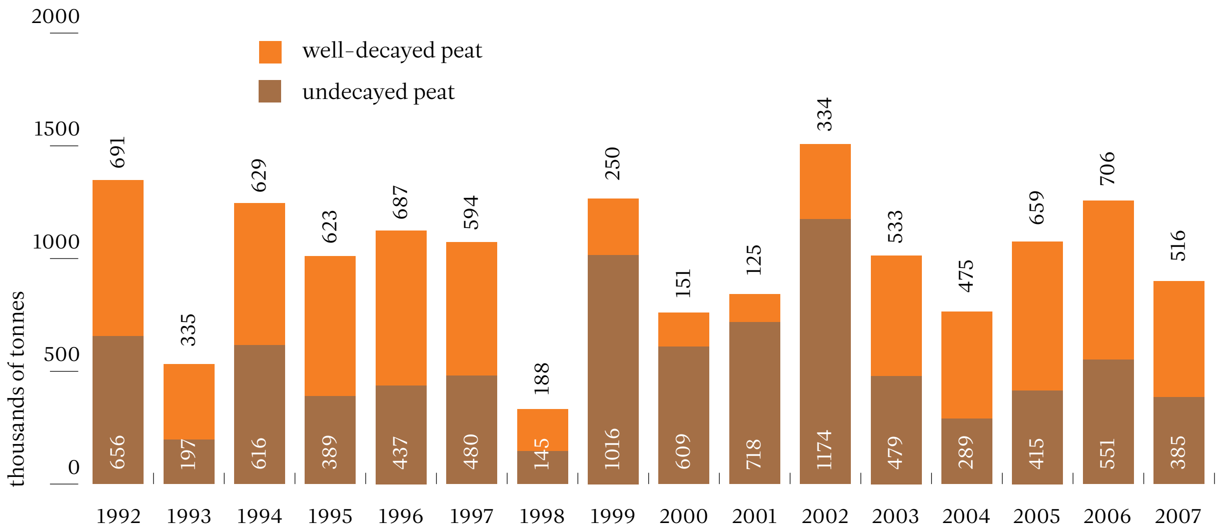
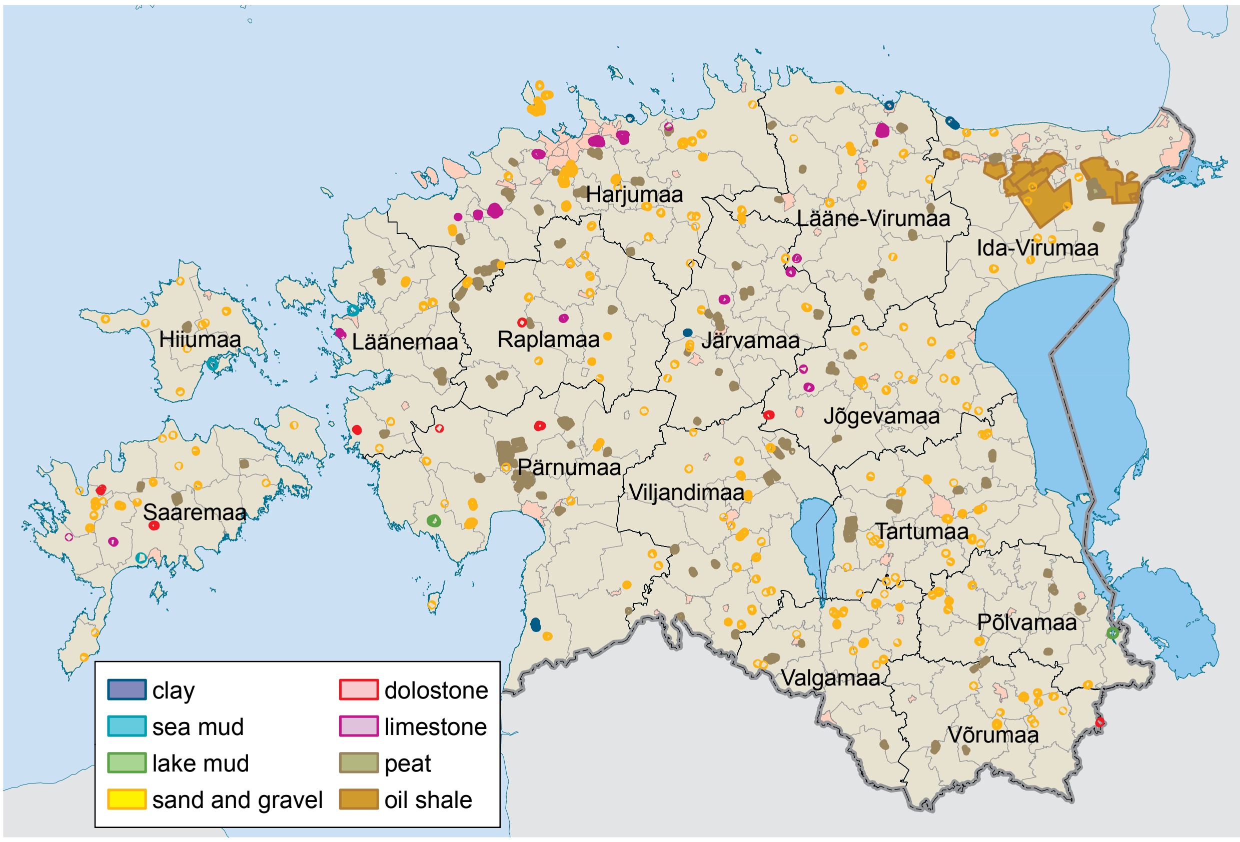


Figure 3.3. Peat mining in 1992–2007. Data: Statistics Estonia.



Map 3.1. Distribution of mineral resource extraction permit areas according to county in 2008. Data: Land Board.

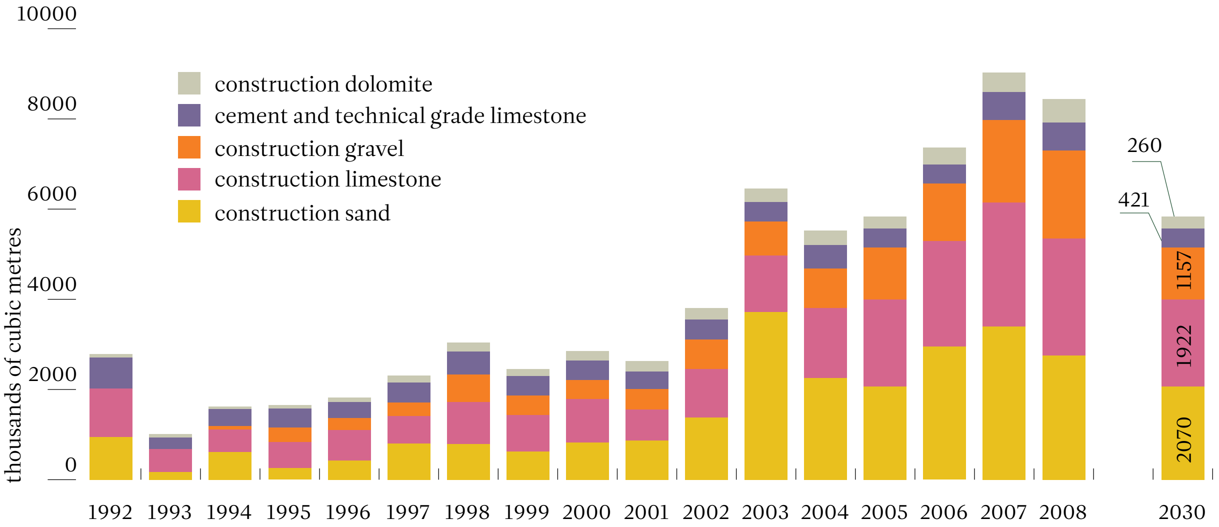


Figure 3.4. Mining of mineral resources used in construction in 1992–2008. The objective of the Estonian Environmental Strategy 2030 is to keep the mined volumes on the level of 2005. Data: Land Board, Statistics Estonia.

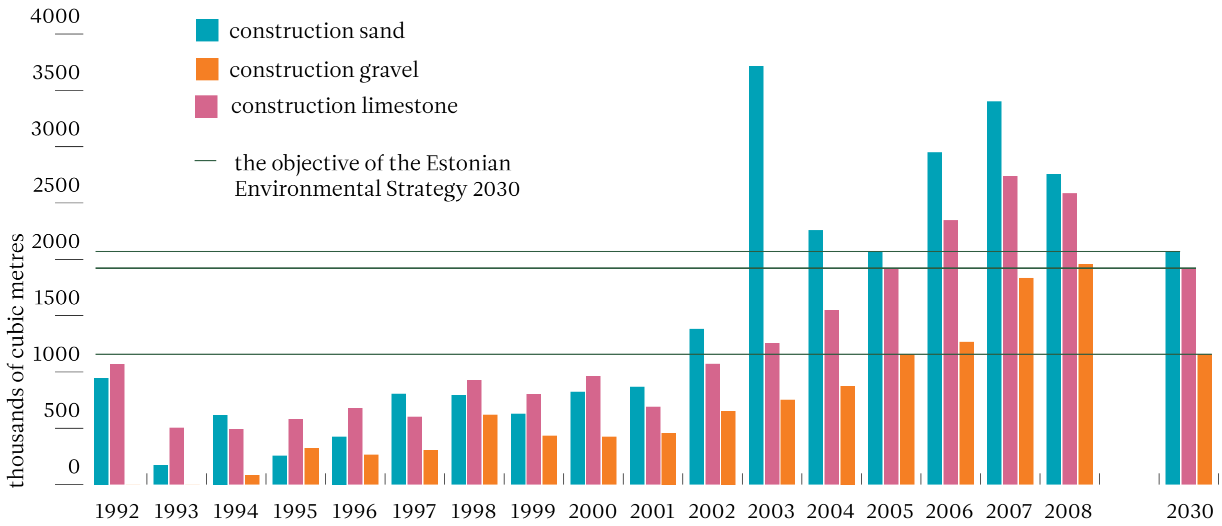


Figure 3.5. Mining volumes of the three most-mined mineral resources used in construction, 1992–2008.
Data: Land Board, Statistics Estonia.

Sources:

- Eesti statistika aastaraamat 2008. Statistical Yearbook of Estonia (2008). / Ed. S. Linnas. Tallinn: Statistics Estonia [WWW] http://www.stat.ee/18920
- Land Board website. [WWW] http://www.maaamet.ee (27.03.2009)
- Statistics database. [WWW] http://pub.stat.ee/px-web.2001/dialog/statfile2.asp (09.04.2009)
- Statistics Estonia website. [WWW] http://www.stat.ee (09.04.2009)

Read more:

- Estonian Environment Information Centre website. [WWW] http://www.keskkonnainfo.ee/index.php?lan=EN&sid=660&tid=594&l1=2 (peat resources)
- Ministry of the Environment website. [WWW] http://www.envir.ee/445160 (mineral resources)
- National arrangement of mining mineral resources used in construction. Report of the National Audit Office to the Riigikogu. [WWW] http://www.riigikontroll.ee/?lang=en (audit reports 2009)

3.2. Fishing

Nine countries have fishing interests in the Baltic Sea: Estonia, Denmark, Sweden, Finland, Russia, Latvia, Lithuania, Poland and Germany. In Estonia, fishing is governed by the Fishing Act. Besides fishing, this act regulates the collecting of aquatic plants and sets forth the punishments for violation of fishing requirements. Fishing procedures are put in place by the Fishing Rules, which determine closed periods and areas where fishing is prohibited, fishing gear and sets forth requirements for use of fishing gear, minimum fish sizes, by-catch conditions. The fees for conservation of fishery resources are determined on the basis of the Environment Charges Act.

The Baltic Sea has four species of fish that are internationally regulated: Baltic herring, sprat, cod and salmon. The specific standards for fishing for each of these species, such as quotas, fishing gear, prohibited times and places, are established by European Union regulations and are directly applicable for Estonia. In the European Union, fishing is one of the most thoroughly regulated fields. At the same time, these regulations do not regulate fishing in internal waters. Management of fishing in Lake Peipsi, Lake Pskov and Lake Lämmijärv is based on an agreement between the Republic of Estonia and the Russian Federation setting forth the maximum allowable catch and other measures for the conservation of fishery resources.

Estonia has acceded to the International Maritime Law Convention's agreement on Management of Straddling **Fish** Stocks and Highly **Migratory Fish** Stocks as well as the International Council for the Exploration of the Sea (ICES) Convention.

According to the Estonian Environmental Strategy 2030, the strategic objective of fishing is to ensure the good condition of fishery resources and diversity of fish species and to avoid negative impacts on ecosystems related to fishing.

3.2.1. Fish stocks

There are over 20,000 species of fish. Estonia has an estimated 75 species of fish and cyclostomata, and of these 44 species live in fresh water, while the rest are migratory species[A].

Fish populations are in a good condition when the fish stock is able to reproduce itself despite pressure from commercial fishing. Fishing exerts a negative impact on the ecosystem if undersize specimens are caught, fish habitats are damaged, spawning is disturbed or if marine mammals and birds are killed in traps.

Estonian fishing is distributed into three major categories: fishing in the Baltic Sea, fishing in internal waters and deep-sea fishing[B]. Statistics Estonia estimates that fishing accounted for 0,2% of the GDP in 2005–2007.

Status of fish stocks in the Baltic Sea

The main commercial[C] (used for human and animal consumption) fish species in the Baltic Sea are Baltic herring, sprat, cod and salmon. Fishing for these species is regulated by the establishing of limits on catch – i.e. international quotas. The quota is determined for each year by species, either in tons or the number of specimens (the latter in the case of salmon, for instance).

After reaching a low point in 2004, the **Baltic herring** spawning stock biomass started growing once more thanks to sustainable Baltic herring fishing in the Main Basin of the Baltic Sea and the Gulf of Finland. On the other hand, Baltic herring stocks in the Gulf of Riga have declined, and **sprat stocks** in the Baltic Sea have also decreased slightly.

The **cod stocks** in the Baltic Sea have been in a trough for a longer period, the reason being overfishing and high fishing mortality. The European Commission prepared a long-term management plan for cod stocks, which calls for a gradual decrease in cod fishing in the Baltic Sea. In the case of 4–7-year-old Eastern Baltic cod caught in Estonian waters (Atlantic cod found in the eastern part of the Baltic Sea), fishing mortality should not exceed 0.3 (30% of the spawning stock biomass of 4–7-year-old cod). In the years from 2006–2008, the average fishing mortality for cod was 0.53.

Salmon fishing in the Baltic Sea is primarily based on young fish raised in fish farms, as wild salmon populations in the Baltic Sea are still at an all-time low.

Besides the abovementioned species of fish, **flounder** is a common commercial fishing species. The flounder stocks are in good condition and no limits to quantity have been established for flounder fishing. In coastal waters, **smelt**, **pike** and (in the Gulf of Finland and Bay of Pärnu), **perch** stocks show some signs of improvement, as shown by the larger catches.

The situation with fish stocks in the Väinameri, which showed signs of improvement in 2003 thanks to strong perch generations established in 1999 and 2002, has again taken a turn for the worse and is in a deep trough. The fishing intensity has decreased in the area, but recovery of fish stocks is affected by the high natural mortality due to the increase in the cormorant (*Phalacrocorax carbo*) populations. From the early 1990s on, **pike-perch** has been in decline, and 90% of the pike-perch catch in coastal waters is comprised by Gulf of Riga pike-perch. Pike stocks, which also grew in 2003, are again in decline. Stocks of thermophilic fish such as **rudd**, **crucian carp**, **gibel carp**, **bream and white bream** are in good condition thanks to the warm summers of recent years and low fishing pressure on these species.

[A] Migratory fish undertake migrations; most of them (such as salmon and sea trout) feed and mature in the sea but head for fresh water to spawn. Some of them, such as the eel, live in fresh water but head for the ocean to spawn. Straddling fish – fish that feed and live in brackish water in bays but head for rivers to spawn – including vimba, ide and common whitefish.
[B] Deep-sea fishing – fishing in certain parts of the ocean defined based on specific criteria where fish stocks are caught pursuant to international treaties.
[C] Commercial species of fish – fish used for human and animal consumption.

Status of fish stocks in inland bodies of water

Fishing in inland bodies of water is largely driven by fishing in Lake Peipsi and Võrtsjärv. The primary fish species caught in Lake Peipsi is pike-perch, which is relatively plentiful, but unfortunately, due to the poor food supply, it grows slowly (in the absence of smelt and vendace). For this reason, pike-perch catches have been continuously decreased. Stocks of other major fish species, such as bream and pike, are in good condition and perch and roach stocks are in satisfactory condition with their catch having risen somewhat. The abundance of cold-water fish such as whitefish, vendace and burbot has decreased in the last decade due to unfavourable climatic conditions (lack of or transient ice cover, overheating of water in summer etc).

In the last years the stocks of commercially significant fish species in Lake Võrtsjärv have stabilized and the eel catch has risen slightly, but no significant increase in catches can be foreseen due to the decreased stocking from fishing farms.

3.2.2. Fisheries catch and fishing capacity

In 2008, catches accounted for 2,749 tonnes in inland waters and 83,575 tonnes in the Baltic Sea. The deep-sea catch was 14,559 tonnes, of which shrimp made up about 77% (figure 3.6). The primary species caught in inland waters were bream, perch and pike-perch, while in the Baltic Sea, the primary species were sprat and Baltic herring (figure 3.7). In the oceans (north-western and north-eastern Atlantic and around Spitzbergen) mainly shrimp and redfish are caught, as well as Greenland halibut and skate. Shrimp stocks have started improving in the last three years. Redfish, skate and Greenland halibut are also showing signs of improvement.

Being natural capital, fish stocks must be in balance with the capital at human disposal (i.e. fishing fleet and its fishing capacity). The excessive **fishing capacity** in the latter half of the 1990s brought about such pressure on fish stocks that the state of stocks is still impacted at the present time. One means of regulating fishing capacity is the register of fishing vessels, established in Estonia in 2004 and consisting of one part of the European Union's register of fishing vessels. The register includes all ships that fish the oceans, Baltic Sea, coastal areas and inland waters. Ships are divided into four segments according to the ship's fishing area and the overall length of the ship.

The indicator for fishing capacity is the gross tonnage (GT) which gives an idea as to the ship in its entirety. Gross tonnage is not calculated in the case of fishing vessels on inland bodies of water as the EU does not regulate fishing in inland bodies of water. In 2004 a total of 1,332 fishing vessels were entered into the register. As of 2006, the total number of ships was 1,411, of which 1,046 larger or smaller ships fished the Baltic Sea. In 2007 there were a total of 1,049 such ships, and in 2008, 1,056. For example, as of 1 May 2004, fishing capacity in the three segments totalled 26,613 tonnes, which had fallen by the end of 2008 to 17,780 tonnes (figure 3.8). Fishing capacity has declined especially in the Baltic Sea trawler segment (4S1). As a result, the fishing pressure on Baltic herring and sprat stocks has fallen, creating potential for the Baltic herring stocks in the Gulf of Finland and the open waters of the Baltic Sea to recover.

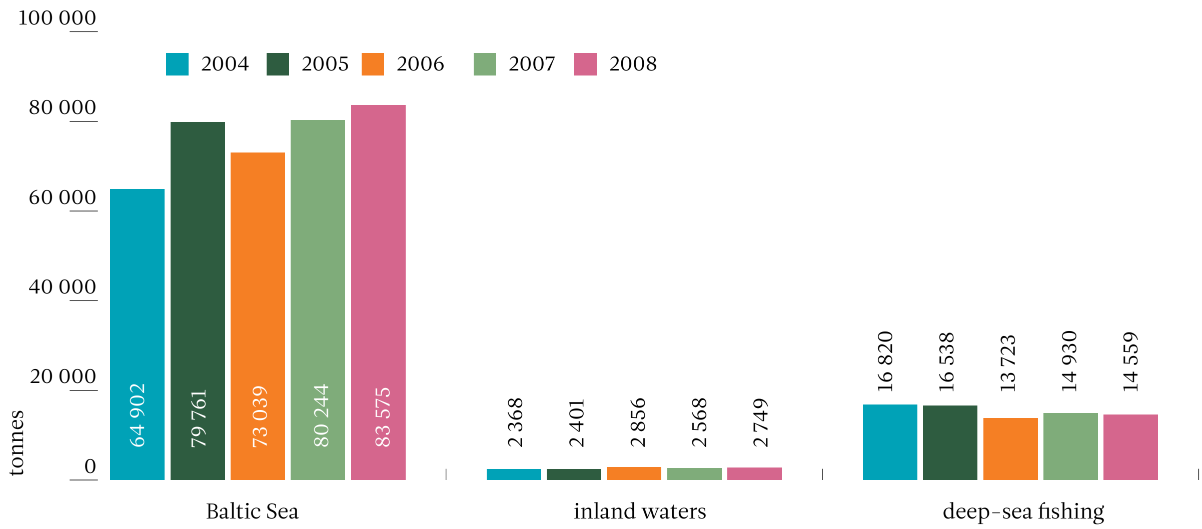


Figure 3.6. Fishing catches in 2004–2008. Note: Fish catches in inland waters without fish farms. Data: Statistics Estonia.

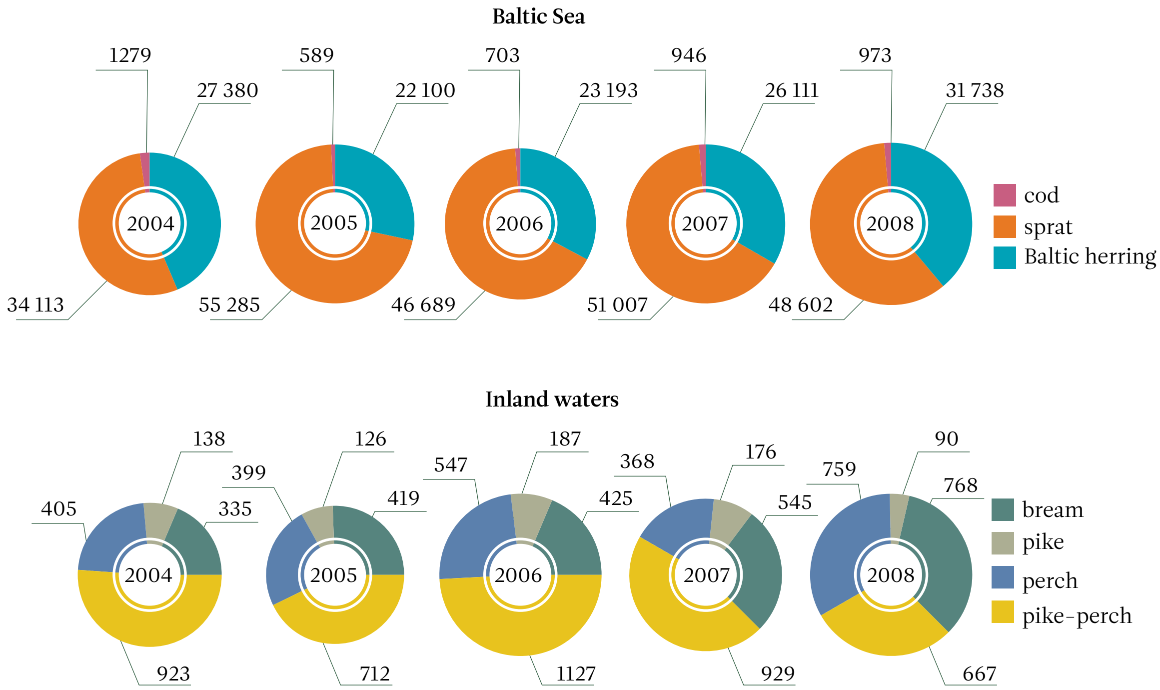


Figure 3.7. Breakdown of fish catches in the Baltic Sea and inland waters 2004–2008. Data: Ministry of Agriculture.

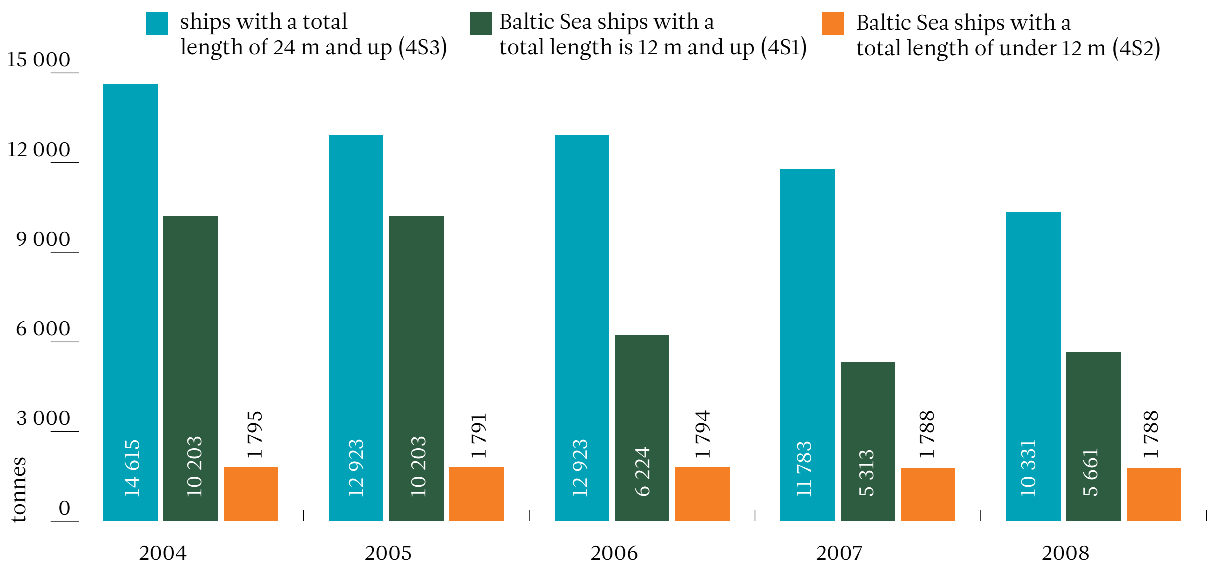


Figure 3.8. Fishing capacity of Baltic Sea fishing vessels from 2004–2008. Data: Ministry of Agriculture.

3.2.3. Restocking

As a consequence of overfishing or the lack of suitable spawning or feeding areas, many fish species are endangered and their ability to recover naturally is too low. Such species include salmon, eel and sea trout. To restore or strengthen the wild populations of endangered fish species, fish stocks are replenished. Restocking of fish means that bodies of water are stocked with juvenile fish reared in fish farms. As to which species must be stocked, this is set forth in the State programme of reproduction and re-stocking of fish 2002–2010.

Of the species farmed for stocking purposes, the most endangered is the salmon (Salmo salar). The possibilities for salmon to spawn have been significantly harmed due to poaching and weirs on rivers. The International Baltic Sea Fishery Commission (IBSFC) 1997 salmon plan calls for Estonia to ensure salmon spawning in potential salmon rivers of 50% of the maximum. Intensive salmon stocking began after the founding of the Põlula Fish Rearing Centre in 1994. Põlula is also the location of a gene bank for salmon from the River Kunda, which is the source for eggs for production of juveniles. A considerable number of salmon were tagged from 1997–2008. The tags on fish caught allow us to draw conclusions as to how productive the replenishment of fish stocks has been – in other words, how many of the juvenile fish reared on farms survived in the body of water. Unfortunately salmon catches – both professional and amateur fishing – are on the wane, which leads to the conclusion **that the results of stocking have been poor.** One reason is the lack of spawning areas and habitats due to weirs, and another reason is presumably related to changes in the Gulf of Finland's ecosystem. **ICES believes it is not possible to fulfil the set objective.**

Another major species being stocked is the **eel** (Anguilla anguilla) but the objective of stocking is the increasing of fishing possibilities in inland waters. As eel can no longer travel upstream of the Narva weir, constructed in the 1950s, eel fishing is based on eel stocked in the Lake Peipsi complex. **Eel stocks have fallen dramatically everywhere in Europe** and an eel stock recovery plan prepared at the initiative of the European Commission effective 2009. On the basis of the plan, **fishing will be reduced** over five years to the extent that the yield will fall 50%.

After salmon and eel, sea trout is the third most important stocked fish. Other species stocked include asp, pike-perch, tench, carp, pike and crayfish.

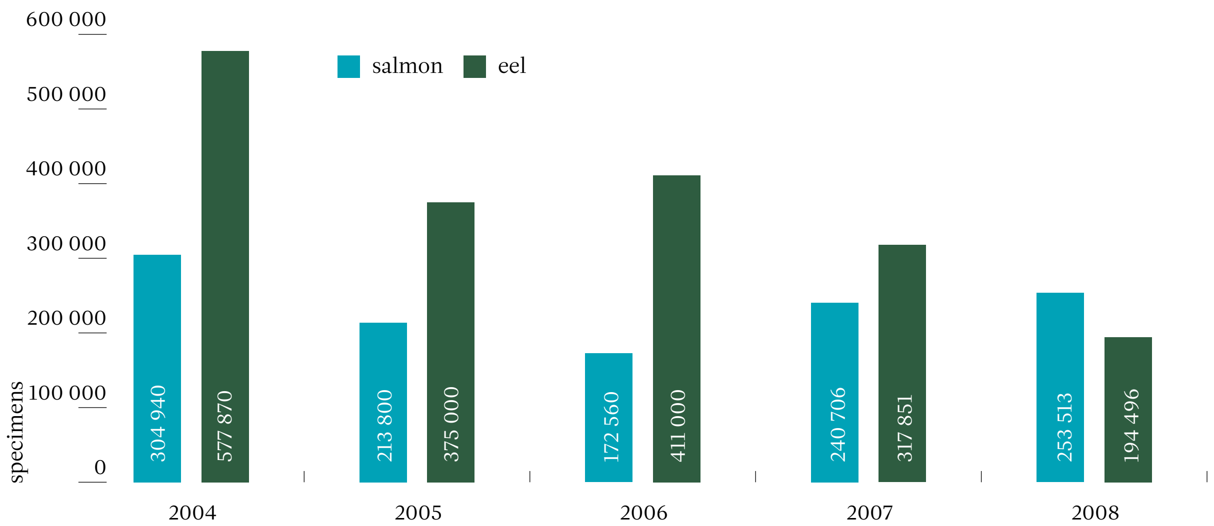


Figure 3.9. Salmon and eel stocked in 2004–2008. Data: Ministry of the Environment.

Read more:

- Joint Final Report on the Audit of Environmental Monitoring and Fisheries Management and Control in the Baltic Sea [WWW] http://www.riigikontroll.ee/upload/failid/final_report_on_audit_of_fisheries_management_12.01.2009.pdf
- Ministry of the Environment website. [WWW] http://www.envir.ee/67251 (Fishery and fish resources)

3.3. Forestry

The diversity, extent and importance of the values that forests offer to humanity have been acknowledged in a number of international forums. The principles set forth in the Statement of Principles of Forests declaration of the UN Conference on the Environment and Development (UNCED) held in Rio de Janeiro in 1992 can be considered to be first principles of sustainable management and conservation of forests to be recognized worldwide.

Of the regional efforts that continued where the Rio conference left off, the Ministerial Conference on the Protection of Forests in Europe is the most important. Principles for the sustainable management of forests, along with the measures for implementing them, were agreed upon at the level of ministers responsible for forestry.

According to the Estonian Forestry Policy[D] (1997), Estonian forests have great natural and ecological value. On the other hand, the basis of forest policy is the understanding that the Estonian forestry sector has strong potential for generating material and social benefits through income-earning activity and the use of forestry must be promoted to the extent that other benefits and virtues such as environmental ones do not suffer. The Estonian forestry policy, approved by the Government of the Republic and the Riigikogu, reflects the aspirations to comply with international obligations. The forestry development plan implements the principles of resolutions adopted by the Ministerial Conference for the Protection of Forests in Europe. In addition, there has been an attempt to follow the recommendations set forth in the UN Food and Agriculture Organization's corresponding basic document (National Forest Programmes; the Concept and its Potential).

The strategic objectives for forestry are derived from the Estonian forestry development plan up to 2010. It stipulates that the productivity, renewal capacity and vitality of forests must be preserved to ensure the long- and short-term production of benefits from forests. The preservation of all of the current elements of biological diversity in Estonian forests must also be guaranteed.

3.3.1. Forest area and growing stocks

Total forested area and growing stock has increased significantly in the last half-century (figure 3.10). Forest encompasses about one-half of Estonia's territory – taking into account Estonia's total area, forest makes up around 49%; without Lake Peipsi included, forest accounts for 50,6% of Estonia. The primary reasons for the increase in forest area and growing stock are the afforestation of land no longer used in agriculture and drainage of wetlands (1960–1980). In addition forest area and growing stock data have increased due to changes in the methods used to inventory forests. Forest resources data have been released since 1999 on the basis of National Forest Inventory data. Data in years past were based on data from forest management planning (stand-wise forest inventory).

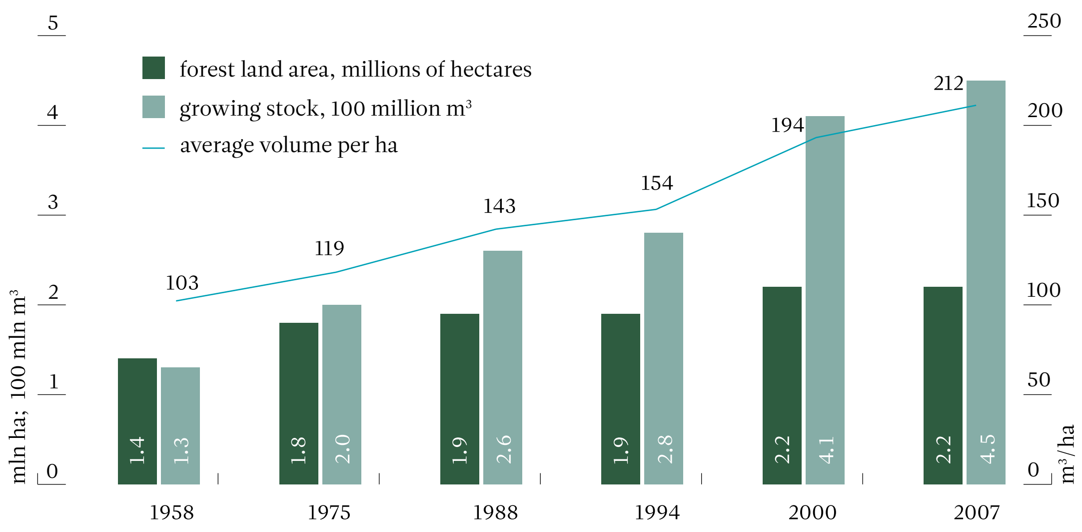
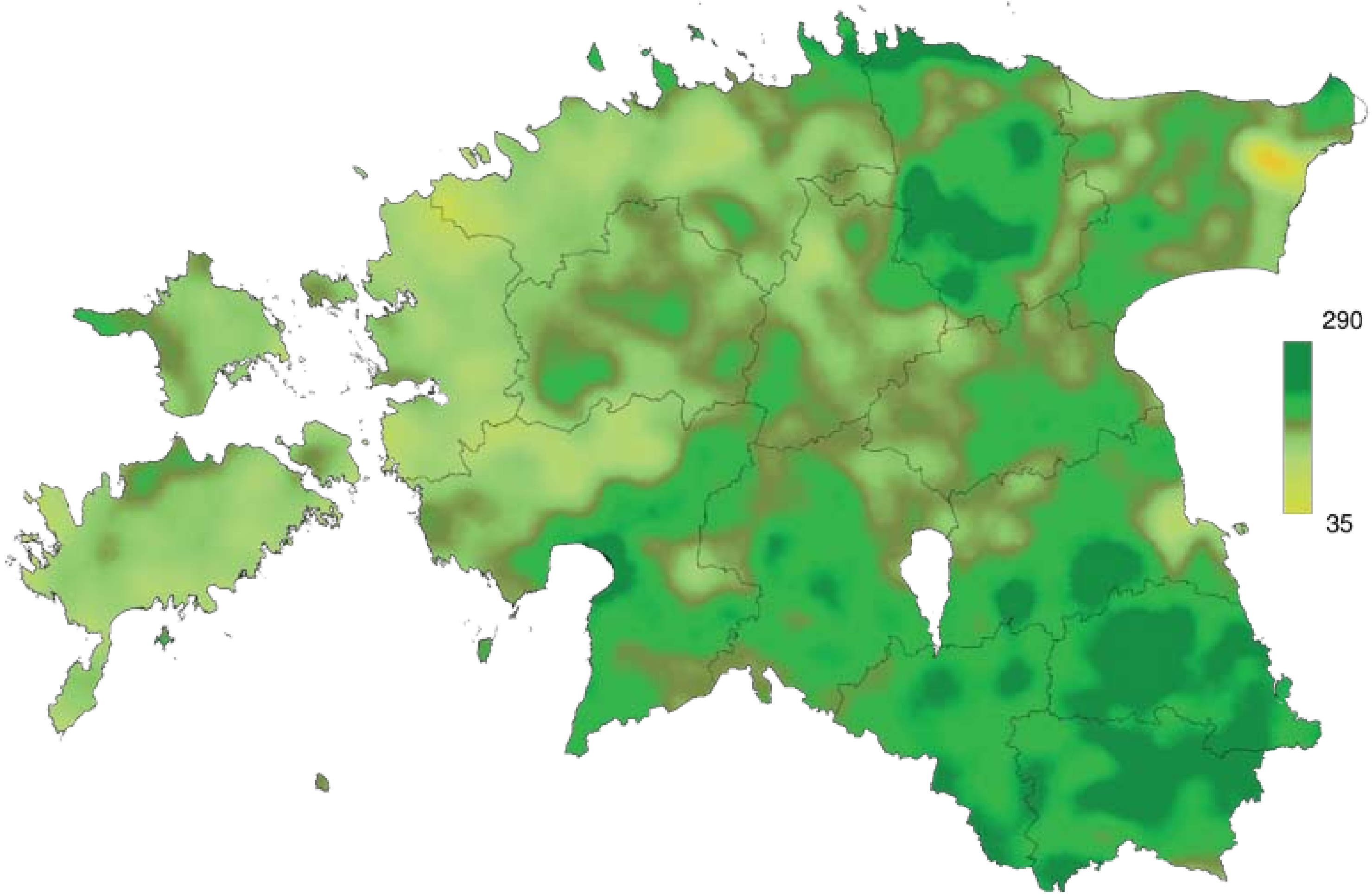


Figure 3.10. Forest area and growing stock volume and change in the volume per hectares of stands.
Data: 1958–1994 – stand-wise forest inventories, National Forest Inventory. Centre for Forest Protection and .

[D] Eesti Metsapoliitika (Estonian Forestry Policy) RTI, 26.06.1997, 47, 768. http://www.riigiteataja.ee/ert/act.jsp?id=73663



Map 3.2. Average volume per hectare of stands[E] in 2008, in m³/ha Data: Forest Register.

[E] Average volume per hectare of stands (m^3/ha) – volume of growing forest per hectare. Determined on the basis of the sum of per-hectare stock of all stand elements. The per-hectare stock of a stand element is calculated on the basis of the stand's height, basal area and stocking density or number of trees.

3.3.2 Share of tree species

Major changes have taken place in the structure of tree species. The share of stands of broad-leaved trees and mixed stands with a broad-leaved majority has increased (figure 3.11). The primary reasons for this are the change in forest inventorying methods and the afforestation of land no longer used for agriculture. The most common species of trees in Estonia are pine, birch and spruce.

The relative shares of tree species is affected by use of forest stocks. In the last decade, spruce and pine stands have found increasing use. Aspen and grey alder have been logged less, as a result of which their share is increasing with respect to pine and spruce in older stands. According to data from National Forest Inventory, mature aspen stands make up 66% of the total area of aspen stands, while the figure is 59% for grey alder.

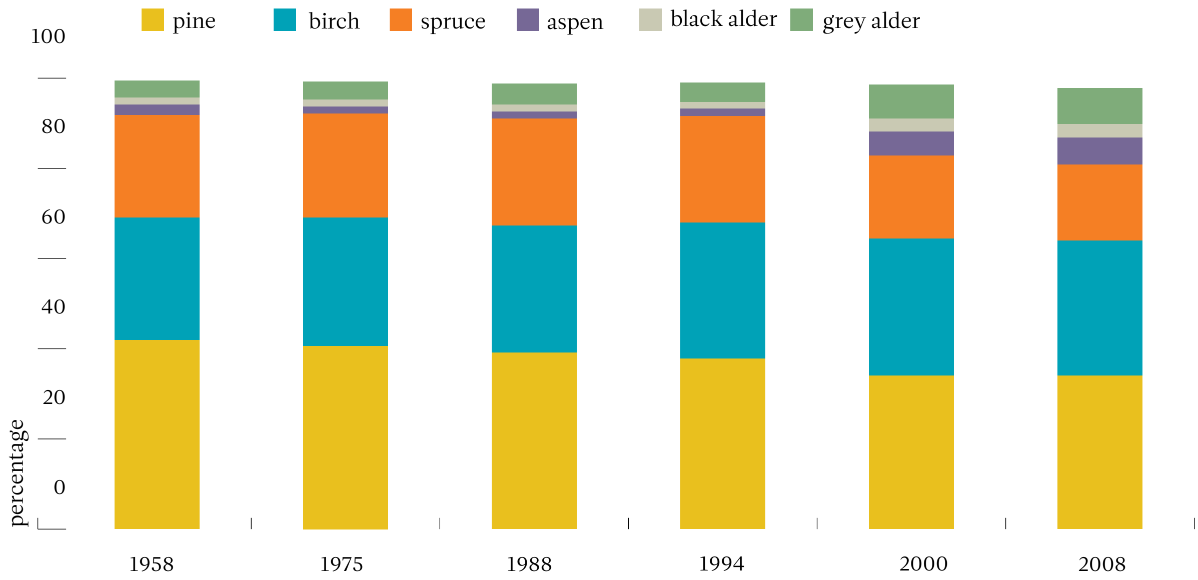


Figure 3.11. Change in the share of species of trees, listed according to dominant tree species of stands.
Data: Data from stand-wise forest inventories 1958–1994, data from National Forest Inventory are for 2000 and 2008; Centre for Forest Protection and Silviculture.

3.3.3. Fellings and increment

In the Estonian forestry development plan up to 2010, the optimum allowable cut for the decade is given as 12.6 million m^3 per year. In the early 2000s annual felling volumes rose to record levels, on the same order of magnitude as increment in stands, i.e. around 12 million m^3 (figure 3.12). The reasons were above all the high percentage of mature stands and not being actively managed, the active management of lands that have been transferred into private ownership in the course of land reform, rapid development of mechanical wood processing and high demand for wood products, especially real estate and construction sector.

Starting in 2003, the annual felling volume started falling. There was more processing of raw material and provision of services. Roundwood began to be imported. This situation was brought about by a tax system unfavourable to private forest owners, the reduction of unused forest land and mounting expenses of forest harvesting. A noteworthy drop in felling volume was also caused by the mild and short winters – a large part of forests suffers from excessive moisture during mild winters, but logging can only take place on frozen soil.

The region's timber market was also thrown into disarray by the "January storm" in 2005, due to which the market became saturated with cheap wind-damaged timber. The main emphasis in logging turned to eliminating storm damage. The consequences of the storm were still affecting the market in 2006 and the prices of wood recovered only in 2007. In these years, clearcutting and thinning dropped significantly and the area of sanitary cutting increased. In the conditions of lower felling volumes, a sudden increase in roundwood import from Russia helped to alleviate timber industry companies' demand for raw material. The Russian Federation established higher export tariffs on roundwood as of June 2007, followed by a so-called railway embargo in the wake of the April 2007 civil unrest, which in effect closed the primary transport route for roundwood. Due to the deepening global economic crisis in the second half of 2008, demand for timber and timber products has significantly dropped.

In 2006 softwoods (spruce and pine) made up 60% of the amount of timber cut. Of deciduous species, birch was logged the most (figure 3.13).

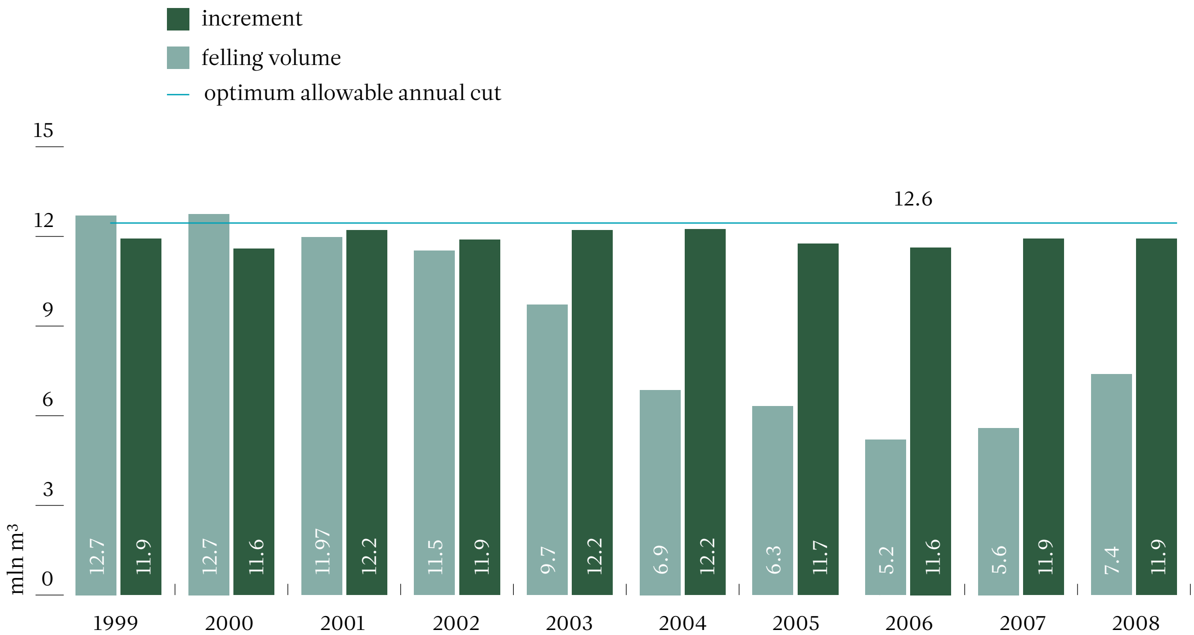


Figure 3.12. Felling volume and increment in 1999–2008.
Data: National Forest Inventory from 1999–2007; the basis for felling volume in 2008 with regard to the State Forest Management Centre is the actual felling data, while the felling volume for other owners is presented on the basis of data from forest notifications, which overestimate the actual yield slightly. Centre for Forest Protection and Silviculture.

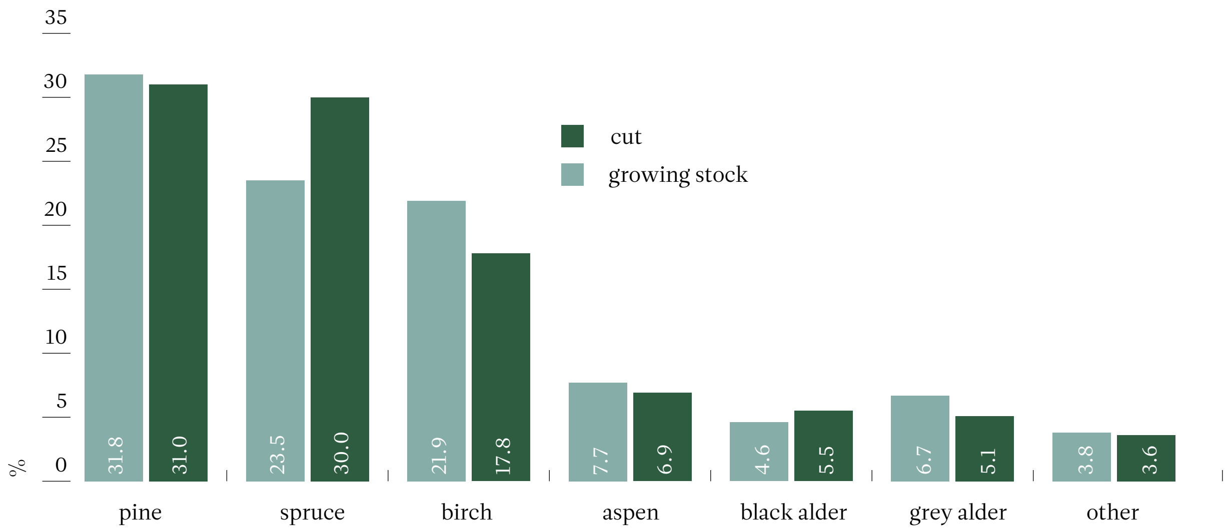


Figure 3.13 .Growing stock and quantities of logged timber by tree species.
Data: Cutting – on the basis of felling volume for 2006, National Forest Inventory 2007, Centre for Forest Protection and Silviculture.

3.3.4. Reforestation

In the last decade, the volume of reforestation work has grown slightly (figure 3.14). Reforestation support has played a role in this.

Forest planting accounted for the majority of the work. An average of 5,800 hectares of forest was planted over ten years (an average of 6,200 hectares a year from 2005–2008) and a total of 14 million forest tree plants were used for this purpose. The trees planted were 69% spruce, 18% pine and 12% birch. The annual average amount of **forest sowing** was 1,400 hectares.

In addition to reforestation work, **natural reforestation was promoted** (including sowing, planting, restricting the spread of competing plants) on around 2,000 hectares. To help reforestation work and contribute to natural reforestation, about 5,300 hectares of ground was prepared (mineralized). The rest of the clearcut or dead forest areas were left to natural reforestation.

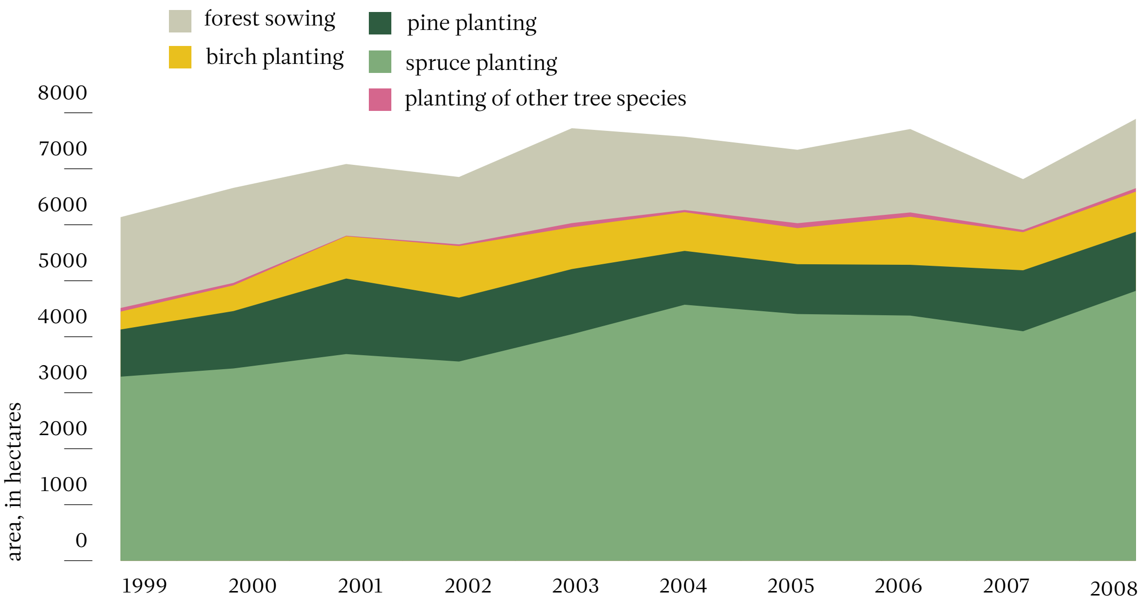


Figure 3.14. Forest sowing and planting in 1999–2008.
Data: Statistics Estonia, Centre for Forest Protection and Silviculture.

3.3.5. Forest fires

One of the extensive types of damage to forest caused by humans is a forest fire. The number and area of forest fires depends significantly on the weather during the period of fire danger[F]. The overwhelming majority of forest fires are caused by human activity. The greatest number of forest fires is seen in forests situated close to larger cities and towns in Harju County and Ida-Viru County. Natural factors such as lightning are the cause only in isolated cases. The majority of forest fires are caused by careless visitors (vacationers, berry pickers, children etc). Arson is also seen; forest fires also occur during forestry work, among other causes.

The occurrence of forest fires depends greatly on weather conditions. During a long dry spell, the forest fire danger is very high. For example, 2006 was a very dry year and an average of over 12 hectares of forest was destroyed per fire – this is much more than in any other year in the last 16 years (figures 3.15 and 3.16).

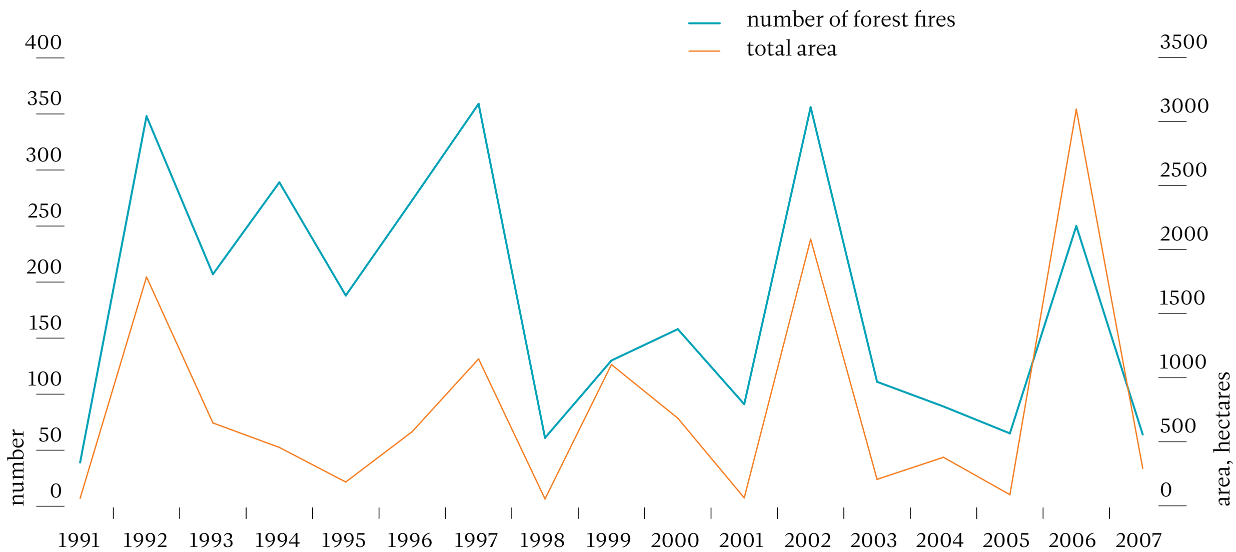


Figure 3.15. Number of forest fires and area, 1991–2007. Data: Rescue Board, Ministry of the Environment.

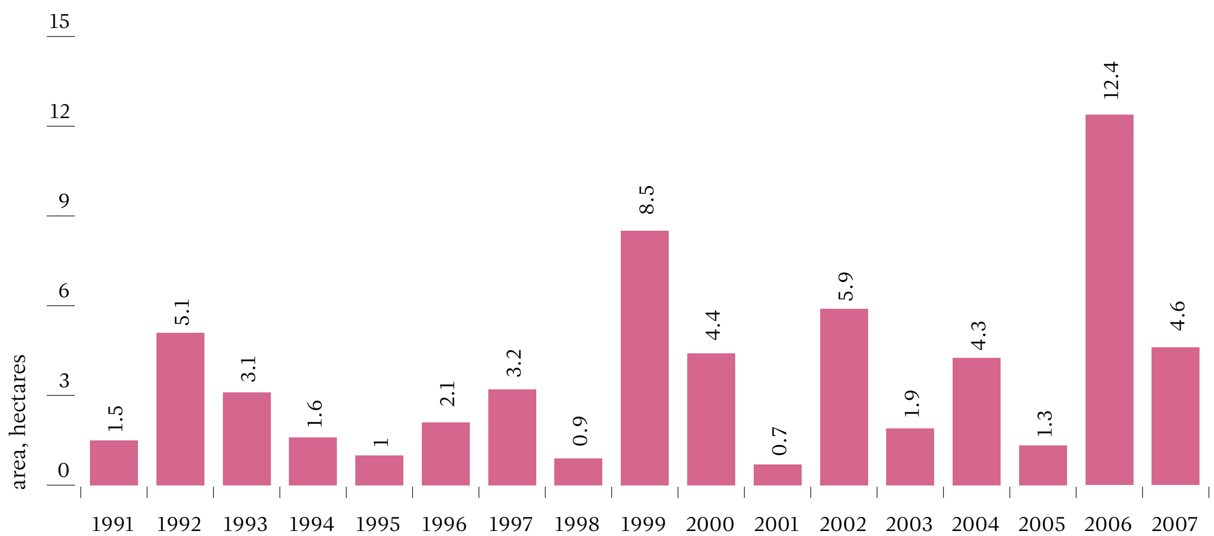


Figure 3.16. Average area of forest destroyed per fire, 1991–2007. Data: Rescue Board, Ministry of the Environment.

[F] Areas with a fire hazard are specified on the fire hazard map situated on the Estonian Meteorological and Hydrological Institute's website, http://www.emhi.ee/index.php?ide=14,93.

3.3.6 Distribution of forest land according to reasons for protection

The Estonian forestry development plan up to 2010 sets forth the goal to raise the area of forests under strict protection to 10% of the country's forest land.

The percentage of protected forests out of all forest has increased over the years. According to the 2007 measurement data from the National Forest Inventory, protected forests make up 690,000 hectares, which is 31.1% of all forests. Protected forests make up about 35% of the forests managed by the State Forest Management Centre, and about 29% of other forests.

The share of strictly protected forests among all forests was 8.2% (180,000 hectares) in 2007, according to data from the National Forest Inventory (figure 3.17). Reserves and special management zones, capercaillie strutting areas, habitats of category I protected species and, to a lesser extent, other areas (project areas). An analysis of strictly protected forest areas conducted by the Ministry of the Environment's Information and Technology Centre in 2008 produced a result of 210,000 ha. Strictly protected forest land was considered to include woodland key habitats more than 4 hectares in size in private forests protected under contract, woodland key habitats in state forests of more than 4 ha in size, permanent habitat special management zones and reserves and special management zones of protected areas.

The National Forest Inventory conducted in 2007 indicated there were 498,000 hectares in forests with protection restrictions – about 22% of forested land. The following were considered forests with protection restrictions: limited management zones of protected areas, protected areas with unrenewed protection procedures, water protection forests, infiltration areas, alvars, capercaillie protection zones and special conservation areas and other areas part of the Natura 2000 network (outside permanent habitats and protected areas).

Woodland key habitats made up a separate group – i.e. areas of up to seven hectares requiring protection in commercial forests or protection forests. There were 8,400 hectares of such forests (0.4% of forest land in 2007), according to data from the National Forest Inventory.

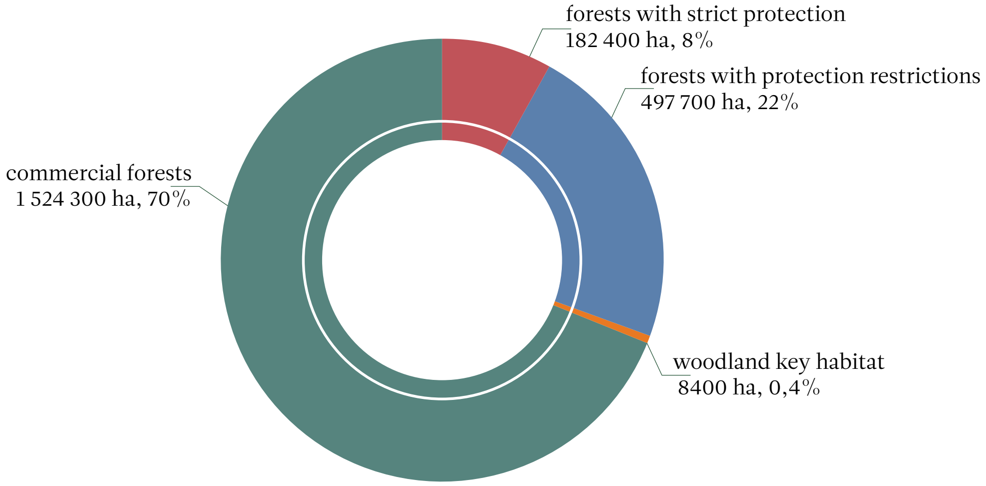


Figure 3.17. Distribution of forest land based on reason for protection in 2007 Data: Centre for Forest Protection and Silviculture.

Read more:

- Centre for Forest Protection and Silviculture website [WWW] http://www.metsad.ee/eng/main_e.html
- Conservation of valuable forest habitats in areas of the Natura 2000 network. Report of the National Audit Office to the Riigikogu. [WWW] http://www.riigikontroll.ee/?lang=en (audit reports)
- Estonian Meteorological and Hydrological Institute website. [WWW] http://www.emhi.ee/index.php?ide=14,93 (fire hazard map)
- State Forest Management Centre website. [WWW] http://wwweng.rmk.ee/index_eng.php3

3.4. Hunting

Hunting is closely related to the rural economy and the field of nature conservation. Wild game is one component of the usable natural resources, and the reasons for the use of various species are diverse. Currently the main focus of hunting lies on bi-ungulates (cloven hoofed mammals), which are hunted for meat and for sport. Hunting for middle-size and small predators (racoon dog, fox, pine marten, mink) has acquired more of a conservation character due to the depressed market for furs; abundance of these species is regulated in connection with their possible negative impact on other species. In the case of beaver, the need to hunt this species is related to the damage they cause, primarily in drained forest areas. Large predators (wolf, bear, lynx) are hunted mainly for sport; there are also efforts to regulate their populations as they feed on bi-ungulates, which are in the main sphere of interest of hunting. Aside from this, wolves can cause significant losses for sheep farmers, and bears pose a risk to apiculture.

The abundance of **moose** has fluctuated greatly in the last 17 years and in recent years has stabilized at a more or less acceptable level for different interest groups (figure 3.18), where as a renewable hunting resource the animal has a good potential for population growth. At the same time, the forest damage caused by moose remains within tolerable limits. At the beginning of the 1990s, moose numbers had grown too high and the damage caused to forests, consisting primarily of damage to middle-aged stands of spruce, was beyond tolerable limits. The obligatory hunting quotas set over the course of a number of years were significantly higher than the natural net population change and led to a rapid decline in moose numbers. Thanks to corrections to the hunting quotas, the declining trend was reversed in the mid-1990s and the population continued to rise until 2005, at which point the situation stabilized. As the abundance of moose increased, the damage caused to forests grew, especially to young stands of pine. To ease the situation, in 2006-2007 moose were hunted slightly in excess of natural population increase.

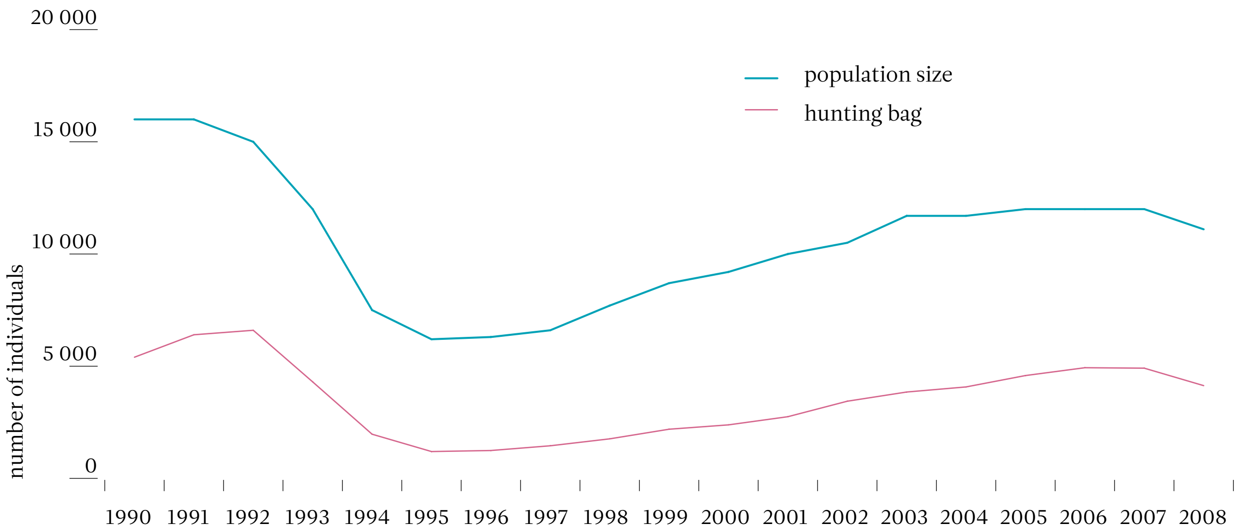


Figure 3.18. Moose census and hunting from 1990-2008. Data: Centre for Forest Protection and Silviculture.

The **wild boar** population in recent years has been larger than ever before, according to existing records. This is above all due to the relatively mild winters, more intensive supplemental feeding, low levels of hunting of breeding sows on the part of hunters, and low wolf populations (the main natural enemy for wild boar). All of this has led to a significant increase in net population change indicators for wild boar and decreased natural mortality. Similarly to moose, wild boar numbers fell in the early 1990s, primarily due to intensive hunting as well as due to rapidly growing wolf abundance, reaching the minimum levels by the middle part of the decade (figure 3.19). Due to the drop in wolf populations and less hunting of boar, wild boar abundance has again been on the upswing since the second half of the 1990s. There is no monitoring of damage caused by wild boar, but it is known that losses caused to agriculture have become intolerably great in many areas.

In the last 17 years, **roe deer** abundance has followed the same patterns as for the other bi-ungulates described above (figure 3.19). The reasons for the changes in abundance are also more or less the same as for the wild boar; only in the latter half of 1990s do we see, additionally, significant impact of the lynx as the roe deer's primary natural enemy on net population growth. The decrease in the number of lynx and low hunting pressure on roe deer in the early years of this century led to a rapid increase in the numbers of roe deer. 2006 saw more extensive forest damage caused by roe deer primarily in young stands of spruce. Increased hunting quotas, along with the increase in the impact of lynx and wolf, have in recent years slowed the rapid growth of the roe deer and in some areas, a decline can already be noted. The abundance of roe deer last reached such a peak in the mid-1970s.

The **beaver** is today not known as an attractive and valuable game animal; it is known primarily as a transformer of habitat. For some natural species, beaver activity can mean destruction of habitat – flooding of bodies of water – but for others it creates habitats. The latter can have only a short-term effect, acting as an "ecological trap". Beavers that flood forest and agricultural land cause damage. Currently most suitable bodies of water have been settled by beaver colonies and their abundance is the highest it has been in the last several decades (figure 3.20). An attempt is being made to direct beaver hunting increasingly to areas where their activity results in inevitable damage.

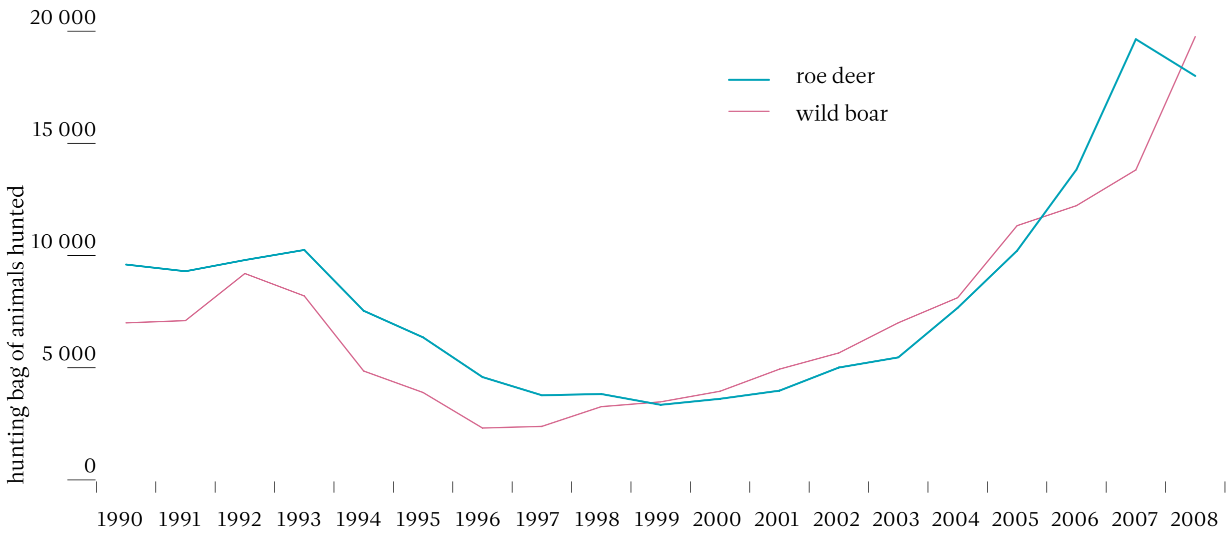


Figure 3.19. Hunting of wild boar and roe deer 1990–2008. Note: The changes in the abundance of wild boar and roe deer can be better tracked on the basis of hunting statistics, rather than census data, as the general census is based on subjective evaluation and unlike moose, the margin of error is too great for these data to be presented. Data: Centre for Forest Protection and Silviculture.

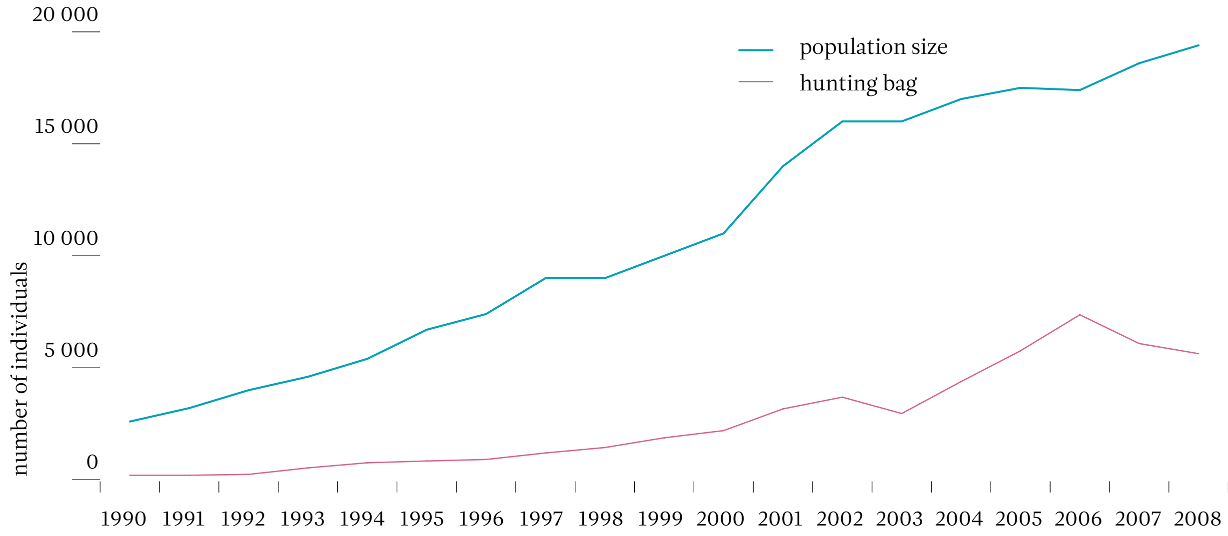


Figure 3.20. Beaver census and hunting from 1990–2008. Data: Centre for Forest Protection and Silviculture.

Read more:

- Centre for Forest Protection and Silviculture website.
[WWW] http://www.metsad.ee/eng/main_e.html (publications)
- Forest Register. [WWW] http://register.metsad.ee/avalik/
- State Forest Management Centre website.
[WWW] http://wwweng.rmk.ee/index_eng.php3

Part 2
The environment

4. Weather patterns and causes of climate change

4. Weather patterns and causes of climate change

Global warming is under heightened attention throughout the world. The average Estonian temperature is also moving upward, which is prompting inquiry. In the period from 1951–2000 the temperature in Estonia has risen 1.0–1.7 °C. A number of agreements have been signed on the international level to reduce emissions of the greenhouse gases that cause global warming. Estonia has successfully fulfilled its objectives. Under the Kyoto Protocol, in the years 2008–2012 Estonia will have to reduce the quantities of greenhouse gases by 8% compared to 1990 levels. By 2007, Estonian greenhouse gas emissions had already dropped by over 50% compared to 1990. Use of substances that deplete the ozone layer has ceased to a 90% extent in Estonia. The use of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) is down significantly.

4.1. Estonian weather and climate

Climate can be defined as the long-term average atmospheric condition in a given region. Climate is usually described in terms of the average and extreme periodic (monthly, seasonal etc) values for meteorological parameters measured over the course of decades. It is important to estimate the frequency and range of extreme values of hazardous weather phenomena such as extreme temperatures, storms, very dry or wet summers. The World Meteorological Organization (WMO) has selected a 30-year period as the convention for calculation of climatological normals. The most recent period was 1961–1990.

Weather pattern, on the other hand, consists of characteristic features of atmospheric conditions during a shorter period (such as 2005–2008). Meteorological figures that characterize weather are contrasted to climate indices.

In this environmental review, the meteorological elements in Estonia in 2005–2008 are compared to the period from 1961–2004 and climatological normal in the WMO standardized period from 1961–1990. It is evident that the long-term trend in air temperature is moving upward. A number of extreme weather conditions took place in 2005–2008: for instance, in January 2005, a violent storm and in August 2008 an enormous daily precipitation amount (table of extreme weather conditions in Appendix).

4.1.1. Air temperature

A characteristic feature of the weather pattern in 2005–2008 is higher than normal air temperature (1961–1990), this also applies to the period 1961–2004. Air temperature in 1961–2008 is characterized by a rising trend; with the average air temperature in the last three years higher than the value of the trend over many years (figure 4.1). From 1951–2000, the temperature in Estonia rose 1.0–1.7 °C (as measured at different stations: 1.0 °C according to data from Ristna station on the island of Hiiumaa and 1.7 °C in Võru)[A].

Average air temperature of all months in the last four years have also been higher than the respective averages for the same months over the period 1961–2004, with the exception of February (figure 4.2). From July to January, these temperature differences rise.

The map of distribution of the average air temperature in February (map 4.1) shows characteristic features of the Estonian climate – distinctions between the typically colder Eastern Estonia and warmer Western Estonia/islands region. The same map shows the minimum air temperatures at all weather stations for the years 2005–2008 and 1961–2004.

Distribution of air temperature in July – the warmest summer month – in 2005–2008 in Estonia is characterized by relatively low spatial variation: from +17.0 °C (Väike-Maarja) to +18.4 °C at several weather stations. In 2005–2008 the new maximum temperature records were set in different areas (Jõhvi, Kunda, Narva-Jõesuu, Sõrve and Valga). The largest rise in maximum temperature was recorded in Jõhvi – from +32.3°C in 1961–2004 to +33.6 °C in 2005–2008.

One characteristic feature of the weather pattern in 2004–2008 was a very warm December and January. For instance, in December the average air temperature exceeded the average of the previous period by 3.7 °C; in January, by 3.2 °C. December 2006 turned out to be the warmest, with new records set for average monthly air temperatures for the period 1961–2008 practically at every weather station.

[A] Jaagus, J. (2006). Climatic changes in Estonia during the second half of 20th century in relationship of changes in large scale atmospheric circulation. Theoretical and Applied Climatology Vol 83, p. 77–88.

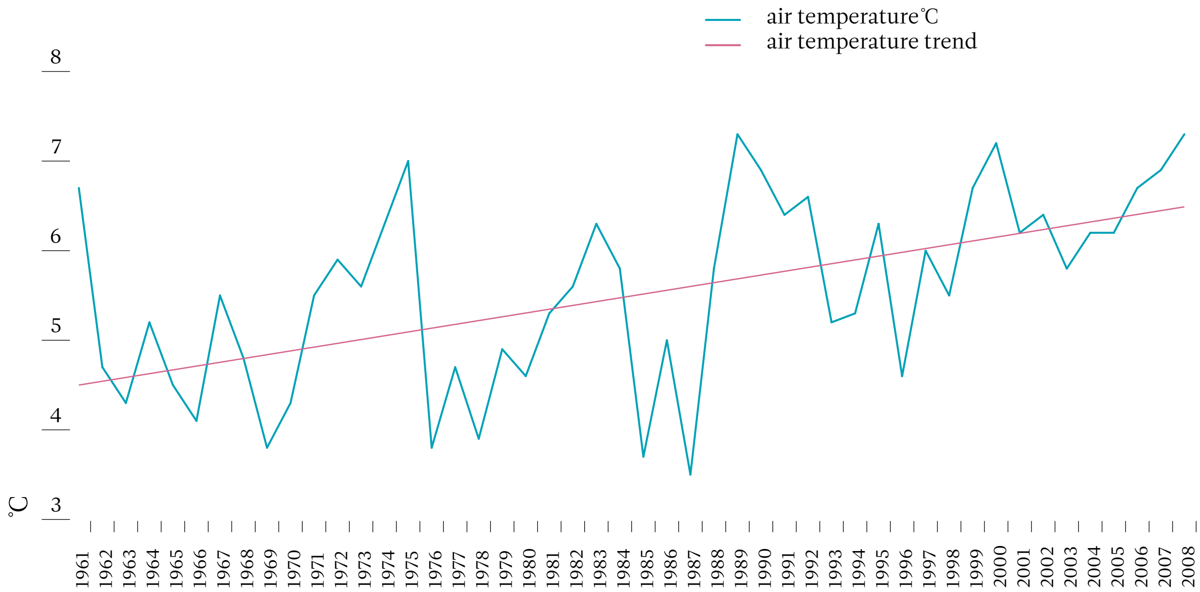


Figure 4.1. Average air temperature in Estonia and the trend in 1961–2008. Data: EMHI.

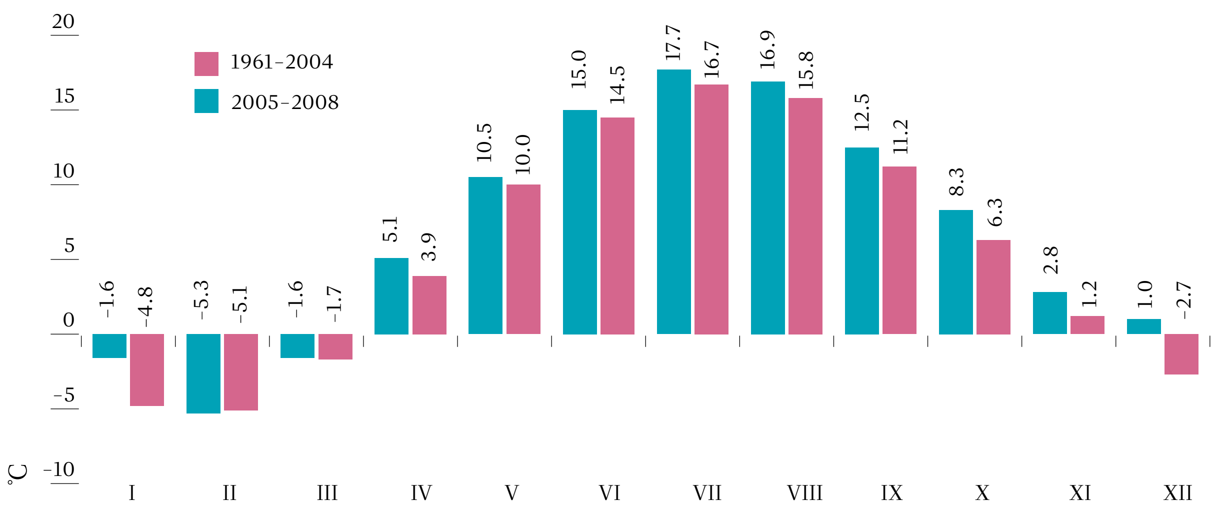
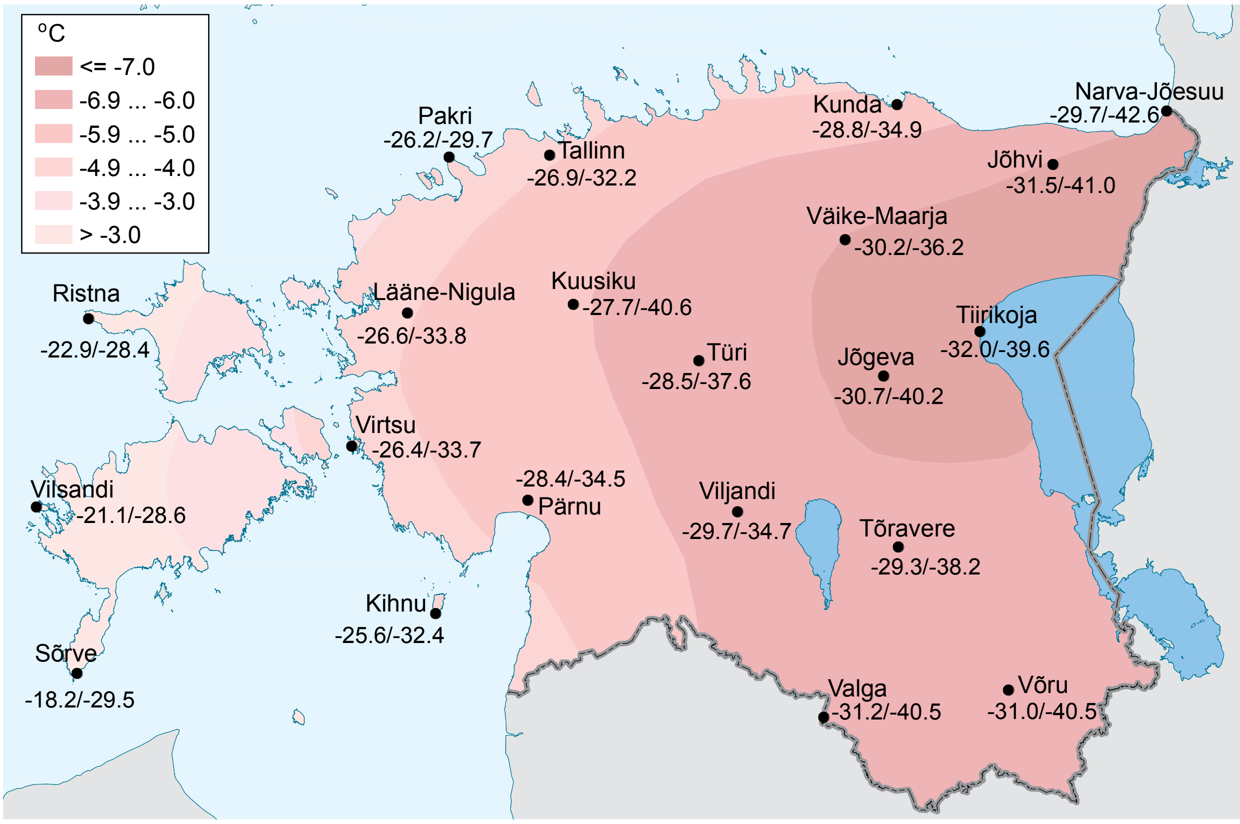


Figure 4.2. Monthly average air temperature in the last four years compared to data for the period 1961–2004. Data: EMHI.



Map 4.1. Average air temperature in February 2005–2008 (pink areas) and absolute minimum air temperature in 2005–2008 (to the left of the slash) and in 1961–2004 (to the right of the slash). Data: EMHI.

4.1.2. Precipitation

Even though the average amount of precipitation in Estonia in the years 1961–2008 is characterised by a rising trend (figure 4.3), it cannot be considered reliable due to the large amount of deviation. Here it can be noted that in just the last four years there were two years with extreme precipitation conditions – 2006 and 2008. The former was a very dry year and the latter one of the wettest.

Precipitation in the warm period makes up the bulk of the annual precipitation total. The amount of precipitation in the years 2005–2008 was largest in August exceeding the average total of August precipitation in 1961–2004 by 37%. Also in January the amount of precipitation was larger than average.

The greatest precipitation amount fell in the south-western and western part of the Estonian mainland; considerable amount of precipitation fell also in the Jõhvi area. In Jõhvi also a new precipitation record for a 24-hour period was set – 116 mm on 21 August 2008 (map 4.2).

4.1.3. Water levels and flow rates

Weather pattern and precipitation amounts caused fluctuation of the water level and flow rate in water bodies. A strong storm occurred on 9–11 January 2005 (winds gusting to 33–38 m/s), and in Pärnu the sea level rose to 275 cm over the Kronstadt datum. The same storm resulted in a sudden surge in the water level of rivers in northern and south-western Estonia, which exceeded previously recorded winter levels. Precipitation at the end of August and September 2008 had saturated the soil with water to the point that flooding was to have occurred even in conditions of average precipitation.

On the other hand, in the summer months of 2006 and 2007, water levels were lower than average. 2006 was an especially dry year: Lake Peipsi was 56 cm lower than the long-term average level, Lake Võrtsjärv, consequently 75 cm. In 2008, the lakes began to be replenished due to the surfeit of water in the rivers and by December, the level of Lake Võrtsjärv was nearly a metre higher than the long-term average.

Short-term fluctuations in the water regime of rivers occur, but the long-term linear trend of the annual average flow rate of rivers (1922–2008) does not show clear signs of increase or decrease. Analysis of the data has found that wet and dry periods alternate in approximately 25–30 year cycles. This leads to the supposition that a wet cycle has now begun.

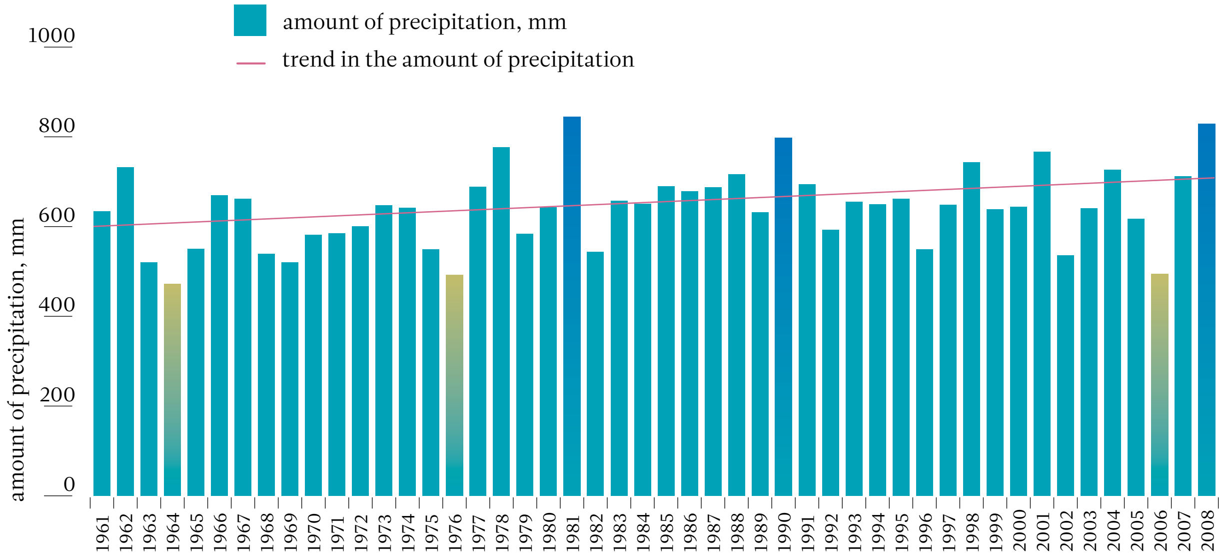
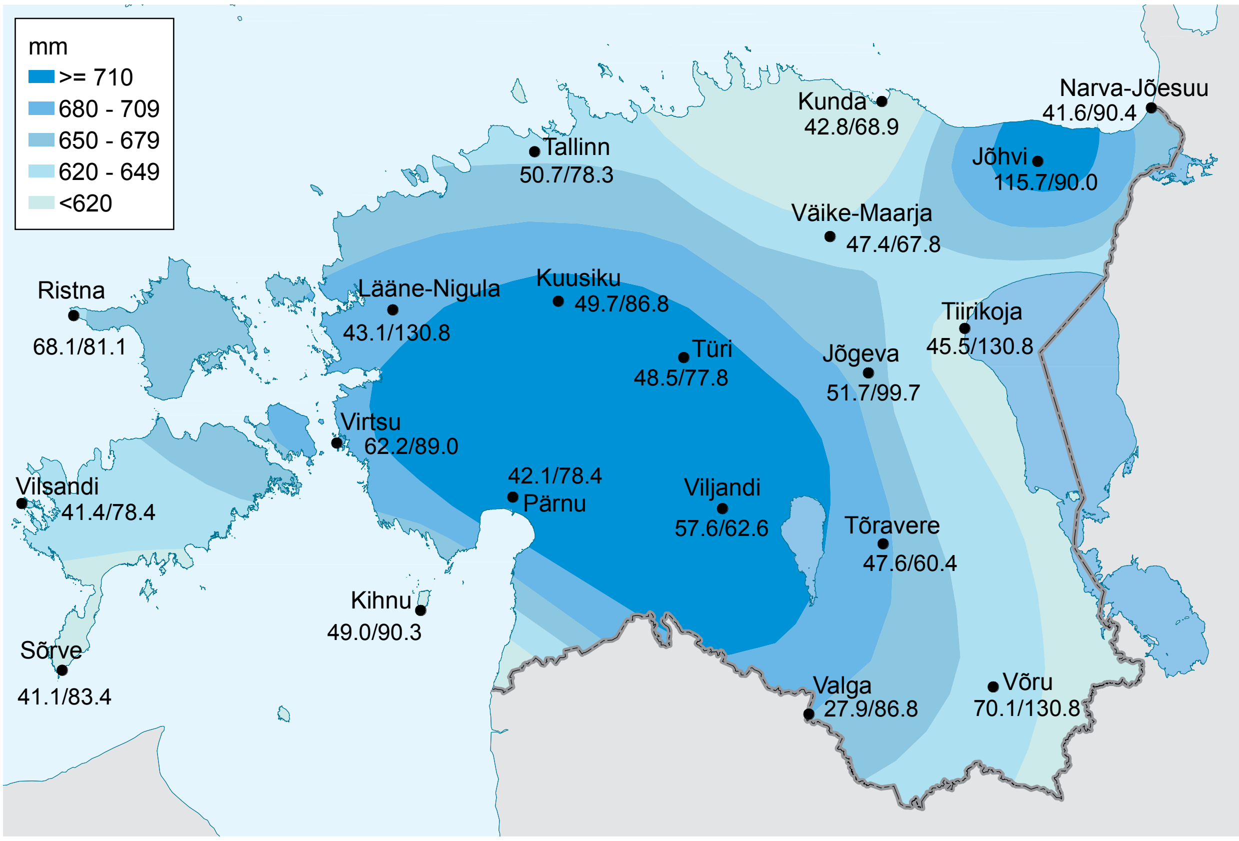


Figure 4.3. Average annual precipitation of Estonian meteorological stations and the trend in 1961–2008. Data: EMHI.



Map 4.2. Spatial distribution of average annual precipitation amount in 2005–2008 (blue area) and maximum precipitation amount in a 24-hour period in 2005–2008 (to the left of the slash) and in 1961–2004 (to the right of the slash). Data: EMHI.

Read more:

- Eesti statistika aastaraamat 2009. Statistical Yearbook of Estonia (2009). / Ed. K. Põder. Tallinn : Statistics Estonia [WWW] http://www.stat.ee/31365
- Estonian Meteorological and Hydrological Institute website. [WWW] http://www.emhi.ee/?ide=15 (weather observations)

4.2. Greenhouse gas emissions and ozone layer protection

4.2.1. Legal background

The primary international legal acts governing the field of **climate change** are the United Nations Framework Convention on Climate Change signed in 1992 (entered into force in 1994) and the Kyoto Protocol adopted in 1997 (entered into force in 2005). One instrument in fulfilling the objectives set forth in the latter is the greenhouse emissions allowance trading system established by EU directive 2003/87/EC. In Estonia, climate change issues are governed by the Ambient Air Protection Act, the 2005 Government regulation "List of fields of activities of operators and procedures for trading greenhouse gas emission allowances", the Government regulation "Allowable total emissions of greenhouse gases from stationary sources of pollution and National Allocation Plan 2008–2012", which entered into force in 2007, and the Minister of the Environment regulation "Requirements applicable to the application for greenhouse gas emission allowance trading permit and content of the trading permit, procedures for granting trading permits and procedures for submitting reports on greenhouse gas trading allowances, supervision and substantiation of data", which entered into force in 2005.

The first international environmental agreement on the **protection of the ozone layer** is the 1985 Vienna Convention (entered into force in 1988). It was the basis for the start of negotiations for combating the use and spread of chlorofluorocarbons. In 1987, representatives from 31 countries signed an agreement – the Montreal Protocol, which entered into force in 1989. Pursuant to the agreement, only reclaimed or recovered partially halogenated CFCs (HCFCs) may be used out starting in 2010 and their use prohibited from 2015 on. Estonia acceded to the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol Substances that Deplete the Ozone Layer in 1996.

In addition to the Montreal Protocol and the Vienna Convention, the use of substances that deplete the ozone layer is governed by Regulation 2037/2000/EC of the European Parliament and of the Council on Substances that Deplete the Ozone Layer, which entered into force in Estonia on 1 May 2004. Pursuant to this regulation, the use of chlorofluorocarbons is prohibited as of 2004.

Internal legal acts that govern ozone issues include the Ambient Air Protection Act and Government of the Republic regulations "Requirements applicable to substances that deplete the ozone layer" and the "Requirements applicable to procedures related to substances that deplete the ozone layer and procedures and format for reporting quantities of substances that deplete the ozone layer or fluorinated greenhouse gases contained in equipment".

4.2.2. Greenhouse gas emissions

The objective of the UN framework convention on climate change is to bring about stabilization in the atmospheric concentration of greenhouse gases at a level preventing human activity from having an impact on climatic systems. Countries that have acceded to the Kyoto Protocol have set a goal of reducing greenhouse gas emissions in 2008–2012 from an average of 5% compared to 1990; Estonia must reduce greenhouses emissions by 8% compared to the 1990 level.

The European Parliament adopted in 2008 the European Union climate change package, the primary goal of which is to decrease greenhouse gas emissions by at least 20% (as the EU average) from 1990. Estonia is implementing a greenhouse gas emissions unit trading system.

Economic restructuring in Estonia in the early 1990s has resulted in a noteworthy drop in greenhouse emissions (figure 4.4). Emissions are now one-half of 1990 levels. This has made it favourable to achieve the Kyoto target (38.6 million tonnes in CO_2 equivalent) in 2008–2012. Each year all of the data in the greenhouse gases is supplemented and updated, as a result of which the annual emissions and, as a result, the Kyoto target expressed in CO_2 equivalent, may change every year. Vigilance must be paid to making sure Estonia can continue to keep greenhouse gas emissions low in the future. **Emissions in 2007 rose 15% compared to 2006**, which is primarily due to the economic boom's effect on the energy sector. In the years ahead, the recession can be expected to curb greenhouse gas emissions.

As in years past, the oil shale-based energy sector generated the most greenhouse gases in 2007 (75%), followed by the transport sector (12%) (figure 4.5).

To reduce greenhouse gas emissions and thereby alleviate climate change, the objective of the Estonian Environmental Strategy 2030 is to bring about, by 2015, an increase in the share of electricity for domestic consumption produced from renewable sources to at least 8%; and, by 2020, the share of electricity produced in combined heat and power plants should increase to at least 20%. The percentages currently achieved are still quite low (figure 4.6).

The amount of electricity from renewable energy grows each year as new wind farms are established. In 2007, renewable electricity made up 1.5% of total consumption, which is about 19% of the objective set for 2015.

Estonia uses one of the two project based mechanisms under the Kyoto Protocol — joint implementation. It is currently possible to engage in cooperation with Finland, Denmark, the Netherlands, Sweden and Austria. The principle behind the project is that the investing country reduces greenhouse gases in some other country where it is cheaper to do so. In short, both sides win, as the receiving country gets new technology and knowledge, plus revenue from sale of greenhouse gas emissions allowances.

Currently, Estonia has eight joint implementation projects, with wind farms making up the largest contribution to reducing greenhouse gas emissions (figure 4.7).

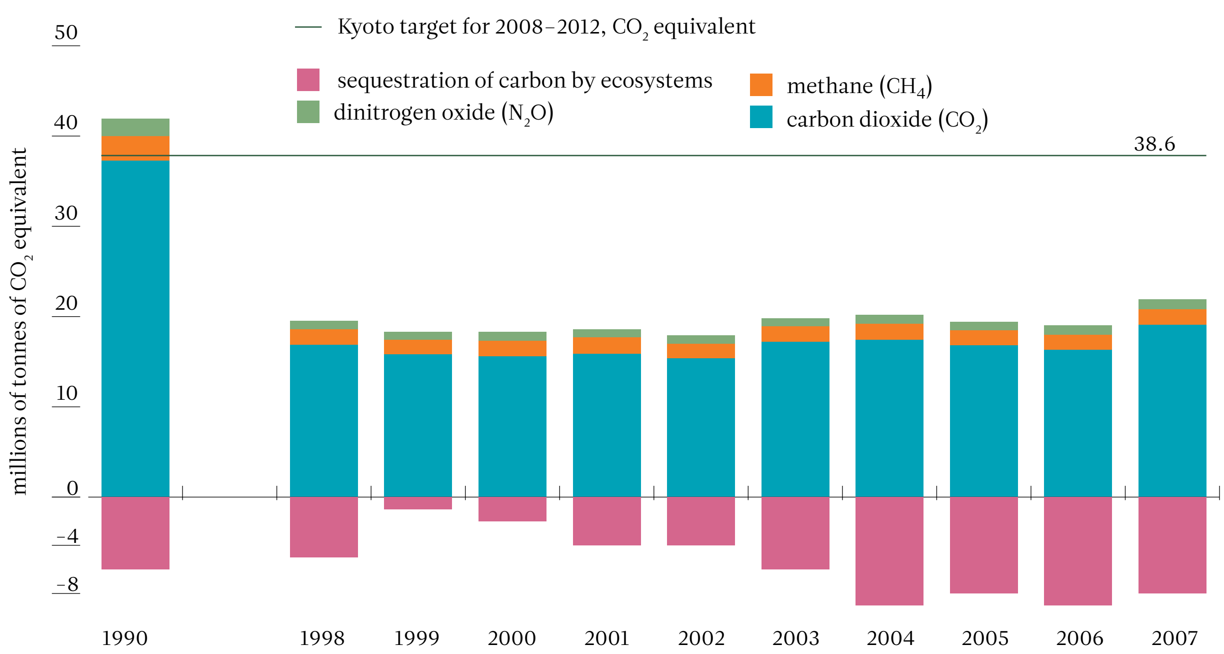


Figure 4.4. Greenhouse gas emissions. Data: Estonian greenhouse gas inventory 2009.

Table 4.1. Sources of greenhouse gases and sequestration, CO_2 equivalent (Gg[B]).
Data: Estonian greenhouse gas inventory 2009.

	Baseline year 1990	2004	2007
Energy	37285.23	17579.80	19087.28
including transport	3345.35	2148.92	2536.92
Industrial processes	945.59	674.24	901.17
Agriculture	3032.75	1273.53	1333.09
Land use, changes in land use and forestry	-6368.09	-8762.86	-7903.05
Waste	671.87	812.88	697.14
Total (including land use, changes in land use and forestry)	**35567.34**	**11577.60**	**14115.63**

[B] gigagram (Gg) = 10^9 g = 1000 t

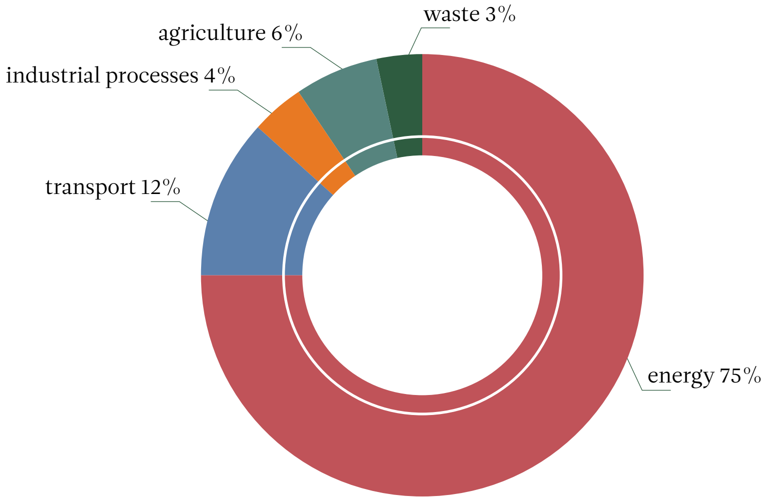


Figure 4.5. Sources of greenhouse gases in Estonia by sector, 2007. Data: Estonian greenhouse gas inventory 2009.

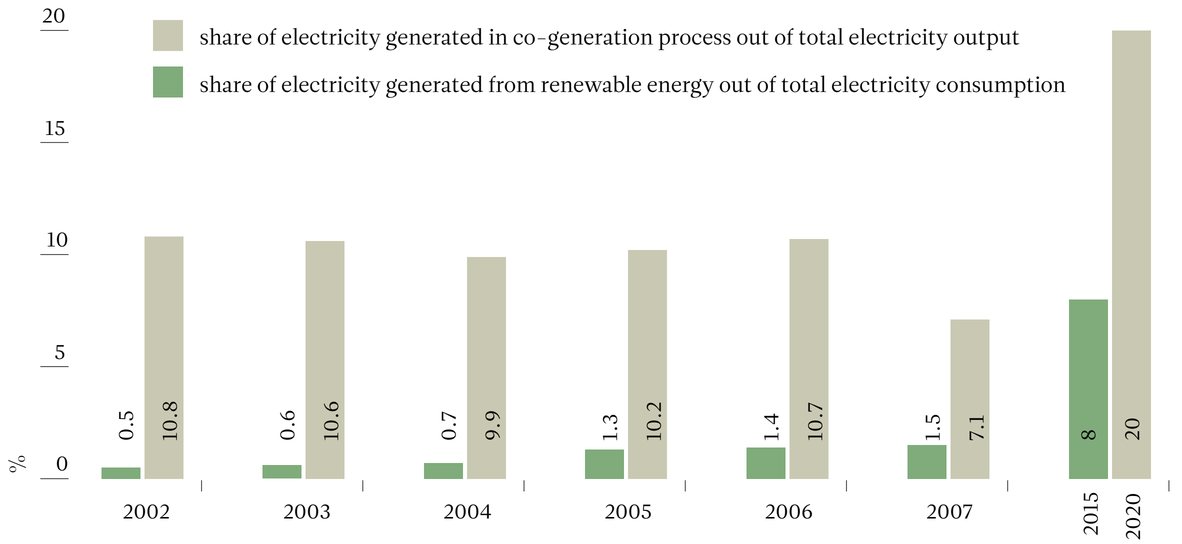


Figure 4.6. Share of electricity produced from renewable energy and co-generation process in total electricity consumption. Data: Statistics Estonia.

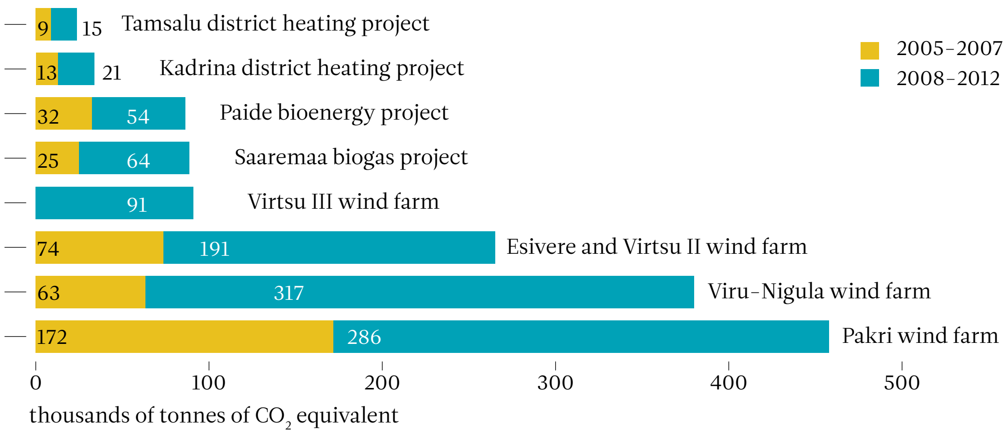


Figure 4.7. Greenhouse gas emissions to be reduced by joint implementation projects.
Data: EEIC.

4.2.3. Use and emissions of ozone depleting substances

The ozone layer is a part of the atmosphere where the concentration of ozone is greater than it is elsewhere. In general, the ozone layer is about 10–50 km in altitude and surrounds the entire earth. The ozone layer protects humans and the environment from excessive ultraviolet radiation. Ozone holes were discovered at the poles in the 1970s. To a lesser extent, the ozone layer varies seasonally in thickness in all geographic regions. The ozone layer is depleted by hydrocarbons that contain fluorine, chlorine or bromine. These compounds are very stable (they are inert, they do not readily react with other compounds) and if they are released they may end up high in the ozone later where they break down in sunlight and react with ozone molecules, thus depleting the ozone.

CFCs are considered among the greatest threats to the ozone layer. Freons are organic compounds that contain carbon and fluorine, and in many cases, other halogens (generally chlorine) and hydrogen. Depending on the elements contained in the compound, they are termed CFCs (fully halogenated chlorofluorocarbons) or HCFCs (partially halogenated CFCs or hydrochlorofluorocarbons). The latter were developed as a replacement for CFCs as they break down more easily and are less harmful to the ozone layer.

One-half of the CFCs originate from chlorine which is generated by humans and reaches the stratosphere. In the everyday world, CFCs have been widely used in refrigeration and climate equipment control, as a solvent in electronics industry, production of Styrofoam, paint and lacquer, fire extinguishers and the perfume and pharmaceutical industry. Once they enter the atmosphere, CFCs can stay there for up to 200 years, depending on the compound; some even longer.

Another class of substances that deplete the ozone layer are the **halons**. Halons are **bromine** compounds that contain fluorine as well, but instead of chlorine, the ozone-depleting element in them is bromine. Halons destroy ozone 3–10 times more than CFCs; at the same time they are used much less.

The Estonian Environmental Strategy 2030 sets the goal of gradually phasing out synthetic substances that deplete the ozone layer from both industry and households. No statistical overview of CFCs in household use has been conducted, but compliance with the goal has gone fairly well to this point with regard to industry/companies – use of halons and CFCs is down significantly. Instead, HFCs – which are harmless to the ozone layer – have entered use.

Strategic accomplishments:

- use of substances that thin the ozone layer has ceased to a 90% extent in Estonia (figure 4.8);
- agencies and procedures for use, collection and organization of substances that deplete the ozone layer have been formed;
- competency requirements have been established for mechanics working with equipment containing substances that deplete the ozone layer as well as for technicians engaged in installing, dismantling/demolishing and carrying leak inspections of such equipment and who use collection recovery equipment for such substances;
- use of CFCs and HCFCs has decreased significantly (figure 4.9).

Ozone depletion potential ODP

Various substances deplete the ozone layer at different rates. The harmfulness of substances to the ozone layer is expressed by the ODP, or ozone depleting potential. The ODP of CFC-11 is fixed at 1 and the ODP of all other compounds is expressed with respect to it.

Table 4.2. Comparison of the ODP of various substances. Source: EERC

Substance	ODP
Chlorofluorocarbons (CFC)	0.6–1.0
Halons	3–10.0
Carbon tetrachloride CCl_4	1.1
1,1,1-trichloroethane (methyl chloroform) CH_3CCl_3	0.1
Methyl bromide CH_3Br	0.7
Hydrobromofluorocarbons (HBFCs)	0.02–7.5
Hydrocholorofluorocarbons (HCFCs)	0.02–0.11
Chlorobromomethane	0.12

According to Statistics Estonia, CFC emissions were 14 kg in 2007 (figure 4.9), which is over 100 times less than in 1998. In 2003, atmospheric emissions of fully halogenated CFCs rose. The reason may be that CFCs were used while it was still possible – before accession to the European Union and the entry into force of the new restrictions. In 2004, atmospheric emissions fell significantly and have remained around 2–30 kg.

HCFC emissions are much higher than in the case of CFCs but they have less depleting impact on the ozone layer. In 1998, 1,567 kg of HCFC emissions were generated in Estonia. This figure was down to 188 kilograms in 2007.

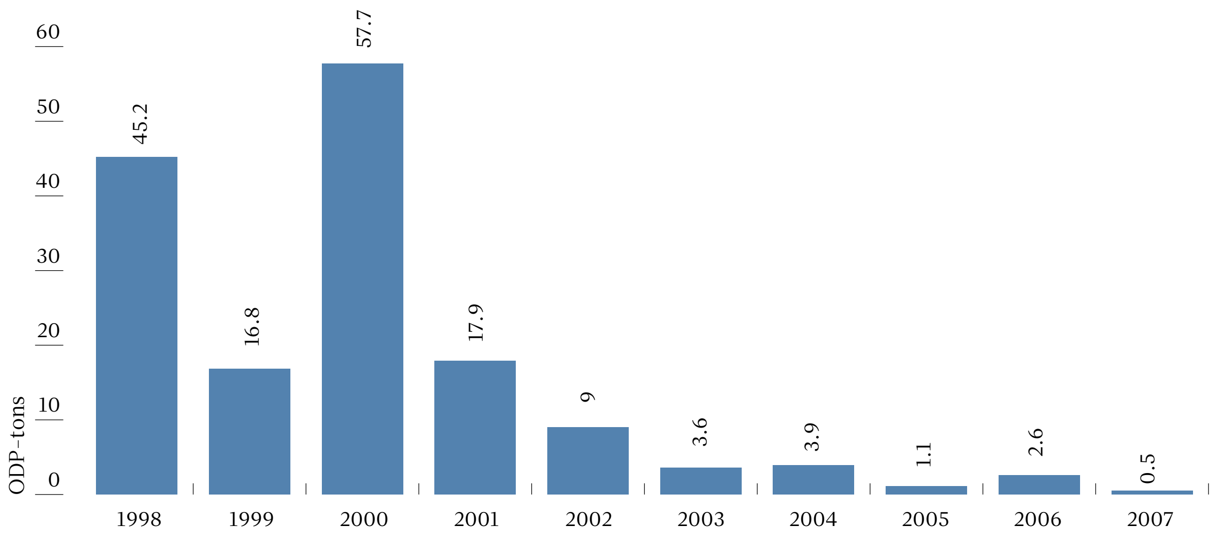


Figure 4.8. Use of Ozone Depleting Substances in 1998–2007. Data: Statistics Estonia.

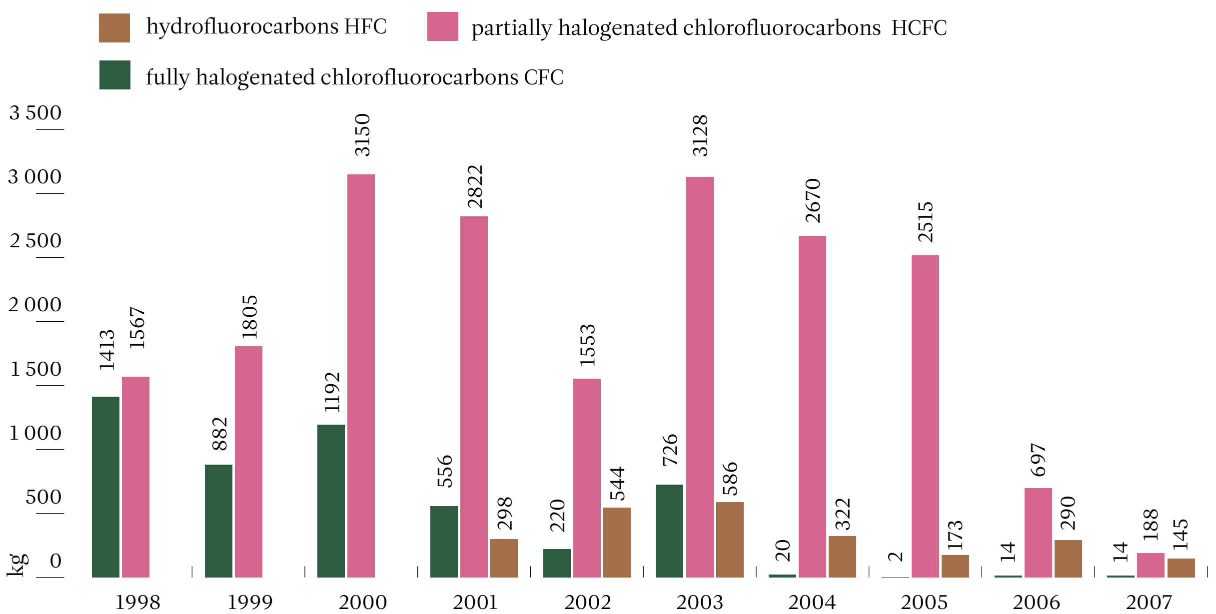


Figure 4.9. Generation of CFCs and hydrofluorocarbon atmospheric emissions in companies from 1998–2007.
Data: Statistics Estonia.

Sources:

- Estonian Environment Information Centre website.
[WWW] http://www.keskkonnainfo.ee/
index.php?lan=EN&sid=41&tid=36&l1=2 (climate)
- Greenhouse Gas Emissions in Estonia 1990–2007. National
Inventory Report to the UNFCCC Secretariat. (2009) / Tallinn :
Ministry of the Environment.
[WWW] http://www.keskkonnainfo.ee/
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[WWW] http://www.stat.ee/valjaanded?year=2008 (26.03.2009)
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pressure (2008). / Ed. S. Laud. Tallinn: Statistics Estonia.
[WWW] http://www.stat.ee/18898 (26.03.2009)

5. Ambient air

5. Ambient air

Ambient air quality is a factor that is critical to the state of ecosystems and human health. On the basis of monitoring data for recent years it can be seen that most problematic aspect with regard to quality of the ambient air is fine particles. Liivalaia monitoring station in the centre of Tallinn has recorded values in excess of the allowable limits for fine particles in each of the last four years. Fine dust poses a danger to human health, especially in the form of lung diseases.

Nitrogen and sulphur compounds (such as NO_2 and SO_2) are acid-forming and a cause of acid rain, which threatens coniferous trees and water life. The quantities of sulphur dioxide in the ambient air has decreased each year, while there is no clear trend in the case of nitrogen dioxide. Despite the fairly low level of nitrogen dioxide, it is one nutrient source that cause eutrophication of bodies of water, with the consequence being a decrease in the number of aquatic biota. Estonia's main sources of air pollution is the oil-shale-based energy sector and transport.

When Estonia's air quality indicators per capita are compared with other European countries, the country often appears among the greatest polluters. This is not necessarily the result of poor air quality but Estonia's small population.

5.1. Legal background

Activities that impact air quality in Estonia are governed by the Ambient Air Protection Act, adopted in 2004, and other legal acts adopted on the basis of the Act. The Act specifies 13 pollutants of the first importance considered in assessing and monitoring ambient air quality. These pollutants include sulphur dioxide, nitrogen dioxide, fine particulates, heavy metals etc.

Activities taking place on the basis of the Ambient Air Protection Act ensure compliance with international ambient air protection conventions (including the Geneva Convention on long-distance cross-border air pollution) and protocols thereto as well as legal acts of the Council of the European Union.

Objectives for reducing acidification arise primarily from regulation no. 299 of the Government of the Republic of 20 September 2004, "Limits for total emissions of sulphur dioxide, nitrogen oxides, volatile organic compounds and ammonia discharged from stationary and mobile pollution sources and terms for achieving them". This regulation assumed compliance with directive 2001/81/EC on the upper limits of air pollutants. On this basis, the Ministry of the Environment has prepared draft national programme on reduction of total emissions from stationary and mobile sources of pollution into ambient air for the years 2007–2015.

A Ministry of the Environment regulation separately establishes limits for SO_2, nitrogen oxides and particulate emissions discharged from large combustion devices, under which requirements for large combustion devices (over 50 MW) from directive 2001/80/EC were adopted. Considering the special nature of oil shale, Estonia has received a transition period for applying limits for SO_2 and particulate matter limits on oil-shale-fired combustion devices.

Air quality targets also stem from the environment strategies (up to 2010 and 2030) and the national programme 2006–2015 for reducing emissions discharged into ambient air from stationary and mobile sources of pollution.

A separate regulation establishes limits for emissions of volatile organic compounds discharged from use of solvents as well as emissions of pollutants discharged from motors on mobile sources of pollution.

5.2. Emissions

5.2.1. Emissions of acidifying substances

Sulphur and nitrogen compounds react with moisture in the air to form acids that fall as acid rain and cause damage to the environment, including forests, water ecosystems as well as buildings and materials.

Acidification is caused by sulphur dioxide (SO_2), nitrogen oxides (NO_x) and ammonia (NH_3) emitted into the air due to human activity. The largest sources of sulphur dioxide emissions are the energy sector and industry. Nitrogen oxide emissions primarily originate from transport and the energy sector, while ammonia emissions come mainly from animal husbandry and use of fertilizers. Acidification is expressed in terms of acidification equivalent. The emissions of each pollutant are converted into acidification potential: SO_2 – 0.03125, NO_x – 0.02174, NH_3 – 0.05882 [A]. The emissions reduction programme requires that emissions not exceed the following limits by 2015: SO_2 – 43,350 tonnes, NO_x – 36,240 tonnes and NH_3 – 7,330 tonnes. The limits established by in regulation no. 299 of the Government of the Republic of 20 September 2004, "Limits for total emissions of sulphur dioxide, nitrogen oxides, volatile organic compounds and ammonia discharged from stationary and mobile pollution sources and terms for achieving them" for 2010 (SO_2 – 100,000 t, NO_x – 60,000 t and NH_3 – 29,000 t) had for the most part been achieved by 2007, while the other targets depend on the measures to be implemented (renovation of power plants, reducing use of oil shale, developing renewable energy etc) (figure 5.1).

Sulphur dioxide SO_2

In 2007, a total of 2,766 tonnes of sulphur dioxide in acidification equivalent was emitted into Estonia's ambient air, of which the bulk was generated in the combustion of fuel in the energy and transformation industries (about 92%) and in the manufacturing industry (about 6%). 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 a high sulphur content to combustion of natural gas and wood. Use of lower-sulphur shale oil and light fuel oil has increased.

The changes of recent years are due to renovation of energy units at Eesti and Balti power plants, where the old dust burning technology was replaced with the new fluidized bed technology. The new technology means a rise in the efficiency of the boilers and a reduction in the amount of oil shale needed. Besides the renovation of the energy units, emissions reduction was also impacted by the decommissioning of old energy units at Balti power plant.

Compared to 2005–2006, sulphur dioxide emissions increased in 2007. The increase in emissions can be explained by a 22% increase in the output of Narva Elektrijaamad AS compared to 2006, owing to the export of electricity to Finland via the Estlink submarine cable.

Nitrogen oxides NO_x

In 2007, around 749 tonnes of nitrogen oxides in acidification equivalent was discharged into ambient air in Estonia. Of this, one-half was generated by mobile sources of pollution (vehicles) from use of motor fuel. The transport topic is dealt with more thoroughly in the section on ozone (chapter 5.2.2). The rest of the NO_x emissions was 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.

Compared to 1990, nitrogen oxide emissions have dropped by 53%. There were no material changes in nitrogen oxide emissions in specific economic sectors. Compared to 2005 and 2006, nitrogen oxide emissions increased in 2007.

Ammonia NH_3

In 2007, a total of 570 tonnes of ammonia in acidification equivalent was emitted into Estonia's ambient air, of which the bulk was generated by agriculture. A small part of the ammonia was discharged into ambient air from transport and production processes. In agriculture, pollution of ambient air with ammonia is primarily due to animal farming buildings, manure storage facilities and fields fertilized with manure and mineral fertilizers.

Compared to 1990, ammonia emissions have dropped by nearly 63%, namely due to a reduction in the share of agriculture. In the last decade, ammonia emissions have remained stable.

Compared to other European Union member states, Estonia's emissions of pollutants per capita are high, much greater than the average for the European Union (figure 5.2). The amount of pollution per capita is only exceeded by Bulgaria, which has heavy industry and burns coal. Estonia's high position in the rankings can be attributed to the large percentage of oil shale with a high-sulphur and ash content in the Estonian energy sector and the small population. At the same time, the emissions of SO_2, NO_x and NH_3 in Estonia make up only 0.5% of the total emissions in the European Union.

[A] The larger the number, the stronger the oxidant.

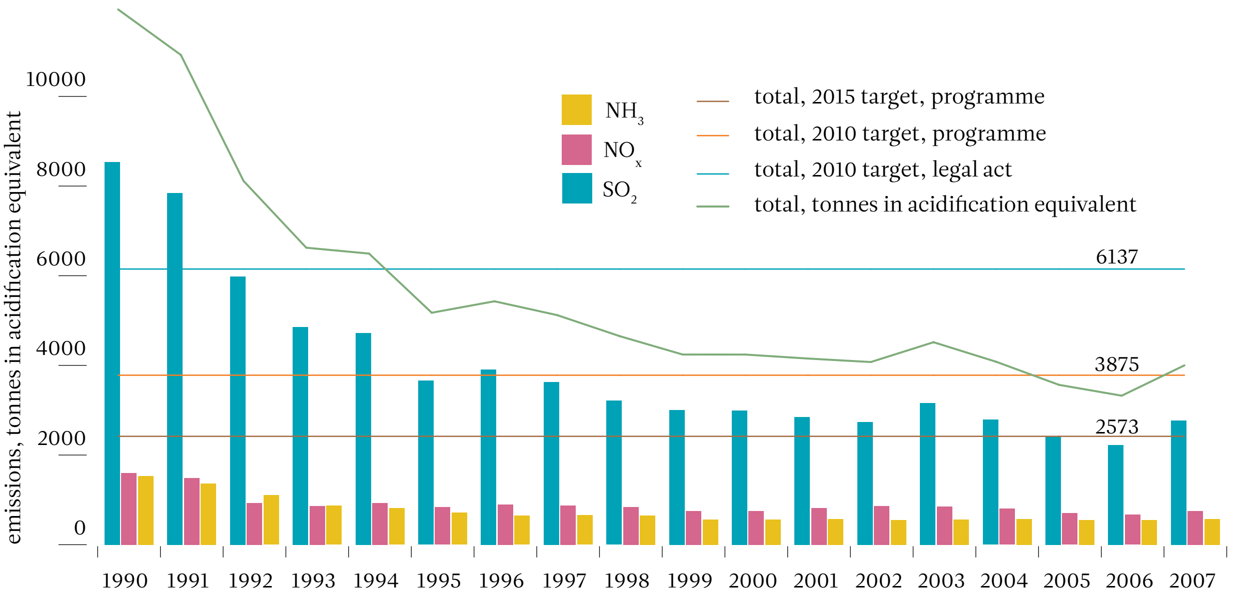


Figure 5.1. Emissions of SO_2, NO_x and ammonia (NH_3) in acidification equivalent[B] in 1990–2007. Data: EEIC.

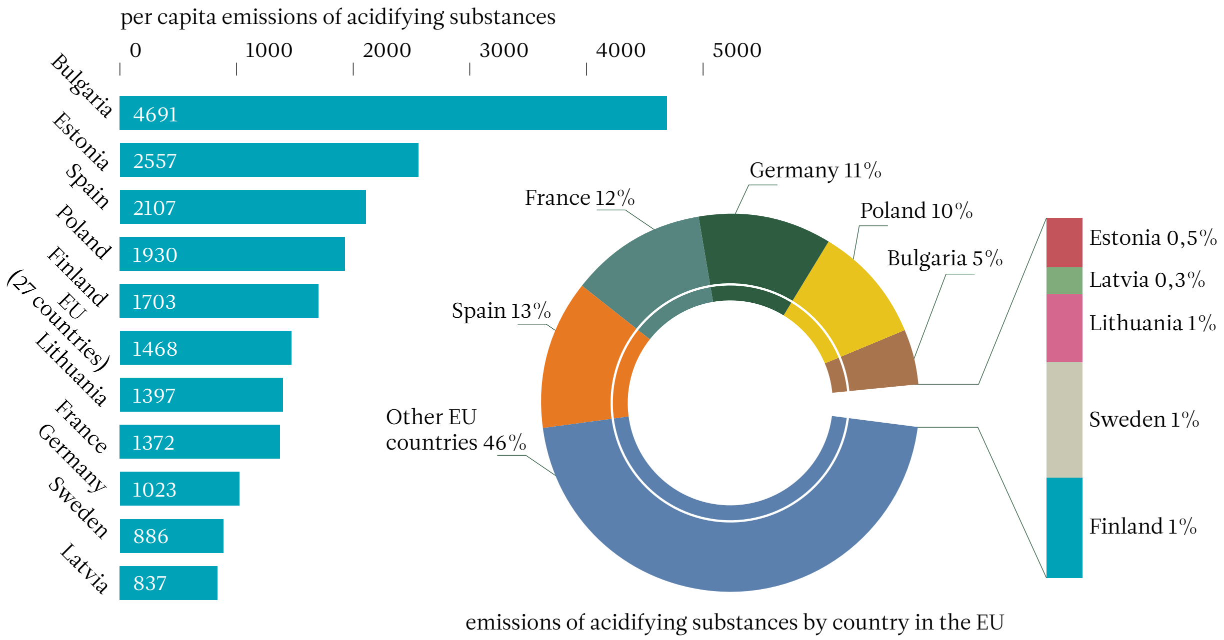


Figure 5.2. Emissions in acidification equivalent compared to neighbouring countries and major industrial countries in the EU in 2006 (per capita vs total percentage). Data: EEA, Eurostat.

[B] Acidification is expressed in terms of acidification equivalent of the pollutants discharged into the air (Aeq).

5.2.2. Tropospheric ozone precursors

Ground-level ozone is harmful to the surrounding environment due to its corrosive and oxidizing effect on the environment.

Ground-level ozone is not given off directly in the course of technological and combustion processes but is generated in photochemical reactions. Thus ozone is a secondary pollutant that is generated in the troposphere by solar radiation and various compounds called **ozone precursors**, such as carbon monoxide (CO), non-methane volatile organic compounds (NMVOC), methane (CH4) and nitrogen dioxides (NO_x).

The precursors of ground-level ozone are expressed by emissions of pollutants discharged into ambient air in terms of NMVOC equivalent. The emissions of the aforementioned pollutants are converted to a figure expressing their potential for forming ground-level ozone (non-methane volatile organic compounds – 1; nitrogen oxides – 1.22; carbon monoxide – 0.11 and methane – 0.014) and the result is the total emissions of four pollutants in thousands of tonnes in ground-level ozone equivalent.

Estonian government regulation no. 299 establishes the limits for total emissions from stationary and mobile pollution sources for 2010: NO_x – 60,000 tonnes per year and NMVOC – 49,000 tonnes per year. The emissions reduction programme sets the goal of reducing emissions to the following level by 2015: NO_x – 36,200 tonnes per year and NMVOC – 41,730 tonnes per year.

There will be no problems complying with the values established for 2010 and 2015, as the emissions of nitrogen oxides and NMVOCs were as of 2007 already lower than the allowable limits.

As of 2007, the greatest source of tropospheric ozone precursors was non-industrial combustion (primarily from domestic households), which accounts for 30% of the total (figure 5.3) emissions into ambient air. Other significant sources of pollution include transport and the energy sector, with a share of 24% and 21% respectively. Other areas of activity, such as use of solvents, agriculture and industrial processes, have less importance in generation of ground-level ozone.

The primary sources of nitrogen oxides are transport and energy. Non-methane volatile organic compounds are discharged into the air from road transport, household wood heating, solvent use and fuel distribution. The primary sources of carbon monoxide pollution are road transport, small combustion devices powered by solid fuel, and wood-burning stoves in households. The highest methane emissions are from agriculture, waste management and fuel distribution.In 1990–2007, the emissions of the pollutants responsible for **ground-level ozone** dropped by about 50%. The emissions of nitrogen oxides and non-methane volatile organic compounds decreased the most. In the period from 2004–2007, major changes have not been observed in emissions (figure 5.4).

Compared to 1990, **nitrogen oxide** emissions have dropped by nearly 47%, primarily due to changes in the energy and transport sector. The intensity of the energy sector has decreased significantly, and the equipment in use has been renovated or replaced which also results in lower emissions. Changes have also occurred in the transport sector: an increase in use of diesel fuel each year and an increase in the number of new cars with catalytic converters. In 2004–2006 NO_x emissions decreased slightly but rose again in 2007 due to the growth in energy production.

Carbon oxide emissions have decreased 54% since 1990, which is above all the result of a decrease in the number of old cars.

Emissions of NMVOC dropped 52% in the period 1990–2007. The changes are due primarily to the use of petrol and in the last few years the reduced number of automobiles with gasoline engines.

Methane emissions have fallen 63% since 1990. The reasons for the drop are decreased animal husbandry and a fall in the distribution quantities of natural gas.

Compared to other EU member states, tropospheric ozone precursor emissions per capita in Estonia are significantly higher than the average European level, yet Estonia discharges only 0.3% of the emissions generated in the whole European Union (figure 5.5).

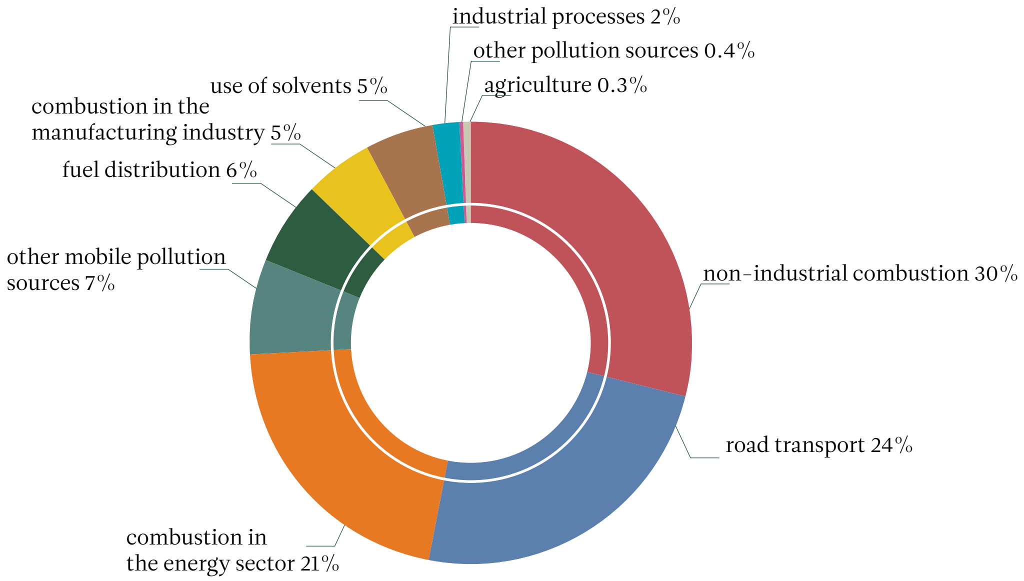


Figure 5.3. Total emissions of tropospheric ozone precursors in NMVOC equivalent by each field of activity in 2007. Data: EEIC.

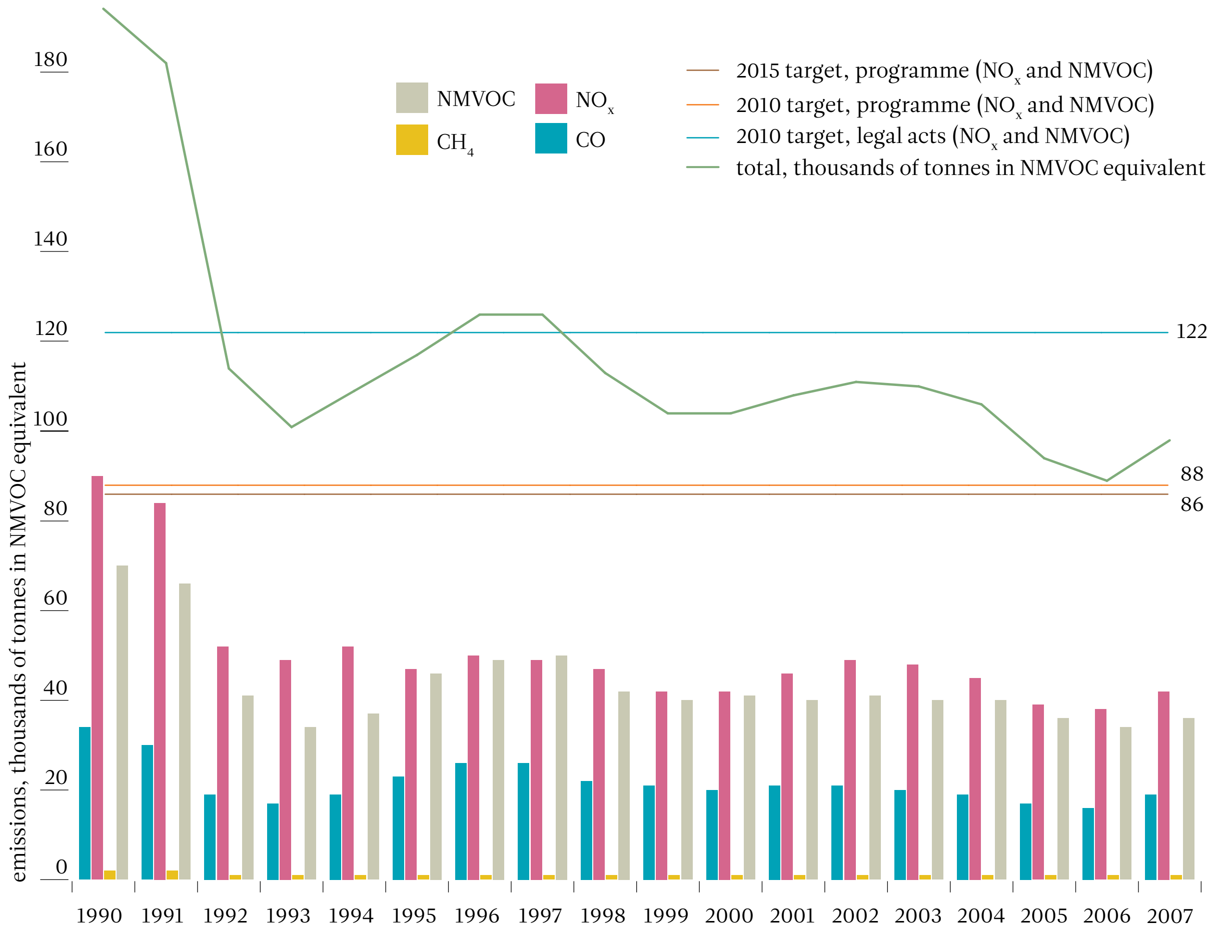


Figure 5.4. Emissions of NO_x, CO, NMVOC and CH_4 in NMVOC equivalent, 1990–2007. Data: EEIC.

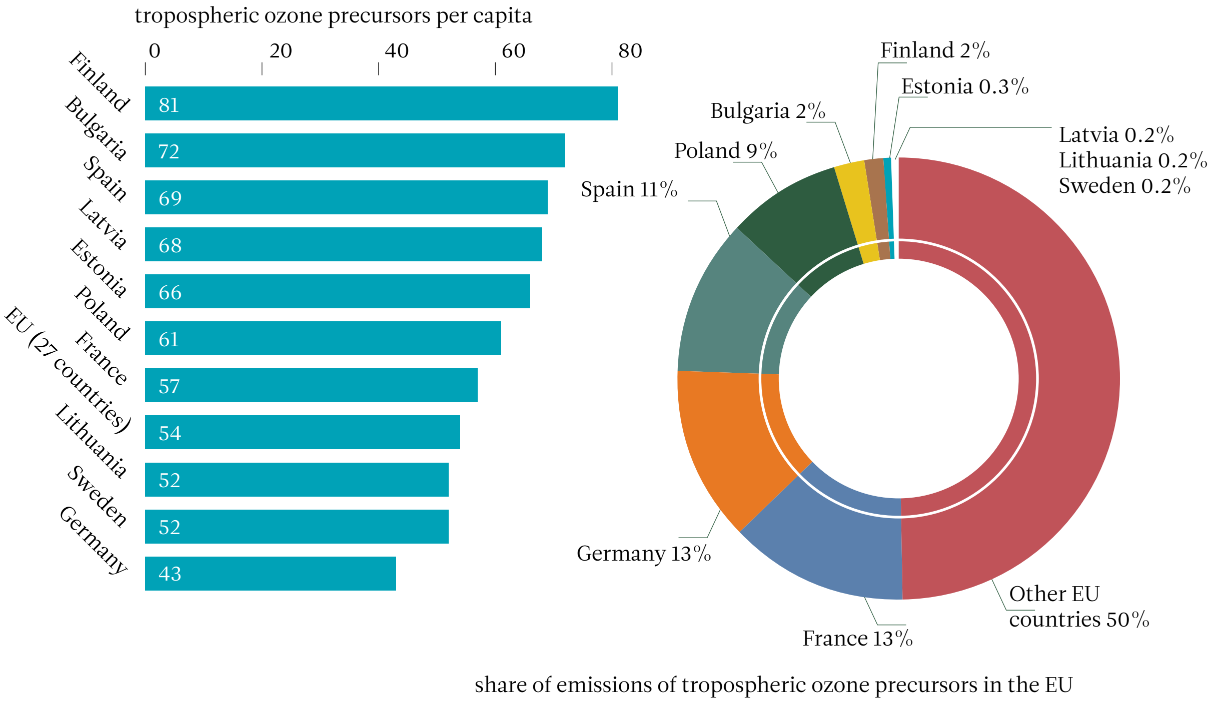


Figure 5.5. Tropospheric ozone precursor emissions (per capita vs total percentage) in NMVOC equivalent compared to neighbouring countries and major EU industrialized countries. Data: EEA, Eurostat.

5.2.3. Particulate matter and fine particles

In recent years, more attention has begun to be paid in Europe and Estonia to particulate matter and to the risks that fine particles pose to human health. Particulate matter includes fine particles (basically, fine dust), which are complex mixtures of very small particles and liquid droplets. These particles consists of many components, including acids (nitrates and sulphates), organic compounds (polyaromatic hydrocarbons (PAHs) and metals, and soil and dust particles. Particles with a(n) (aerodynamic) diameter smaller than 10 micrometers (PM_{10}) come above all from soil, road pavement and industrial enterprises. Fine particles, smaller than 2.5 micrometers ($PM_{2.5}$), originate from vehicle emissions, various combustion processes (boiler plants, district heating, industrial enterprises) and chemical reactions in the atmosphere. Scientific studies have proved that particulate matter, and especially fine and ultrafine particles (PM0.1 < 0.1 µm) may be damaging to the health at even lower concentrations than the limits currently in force. It is likely that fine particles account for the majority of the health impacts of air pollution in Estonian cities (see also chapter 10, "The environment and health").

In 1990–2006, total **particulate matter emissions** have dropped significantly – by a total of around 90%. In 2007 emissions grew slightly compared to 2006, in connection with increased oil shale combustion in the energy sector (figure 5.6).

Pursuant to the requirements of the national emission ceilings directive, Estonia has set the goal of reducing emissions of particulate matter discharged into the ambient air from stationary and mobile sources of pollution so that by 1 January 2010, emissions would be under 25,510 tonnes; and from 2015, under 23,340 tonnes.

If we compare particulate matter emissions by source of pollution in 1990 and 2007 (figure 5.7), we see that the three primary sources of pollution have remained the same, but their percentages have changed significantly. The percentage of particulate matter emissions in the energy sector and manufacturing industry has dropped 22% and 24%, respectively since 1990. This is due to the increase in efficiency of combustion devices and cleaning installations as well as from the decrease in electricity production and cement production. The share of non-industrial combustion has increased 33% as the importance of other sectors has declined.

Since 2000, Estonia has kept statistics on particulate matter with an aerodynamic diameter of under 10 micrometers (PM_{10}) as well as particulate matter under 2.5 micrometers in diameter ($PM_{2.5}$). Even though emissions of respirable fraction particles ($PM_{2.5}$) in the first years that statistics were recorded (2000–2002) grew 8.6% in connection with increased emissions in transport and the manufacturing industry, the trend for PM_{10} and $PM_{2.5}$ declined until 2006 (figure 5.8). In 2007 emissions of PM_{10} and $PM_{2.5}$ grew fairly suddenly as the amount of oil shale burned in the energy sector grew.

Pursuant to the NEC programme[C] the goal set for 2010 was to reduce PM_{10} emissions to 17,330 tonnes and $PM_{2.5}$ emissions to 14,770 tonnes. By 2015 emissions must fall to 16,520 and 14,640 tonnes, respectively.

Comparing Estonia in terms of fine particle emission to other European Union countries on a per capita basis, Estonia cannot be satisfied with its result as PM_{10} emissions per capita exceed the average level of the EL 25[D] countries more than threefold even though total emissions in 2006 accounted for less than 1% of the amount of PM_{10} discharged into the ambient air by the 25 European Union countries (figure 5.9).

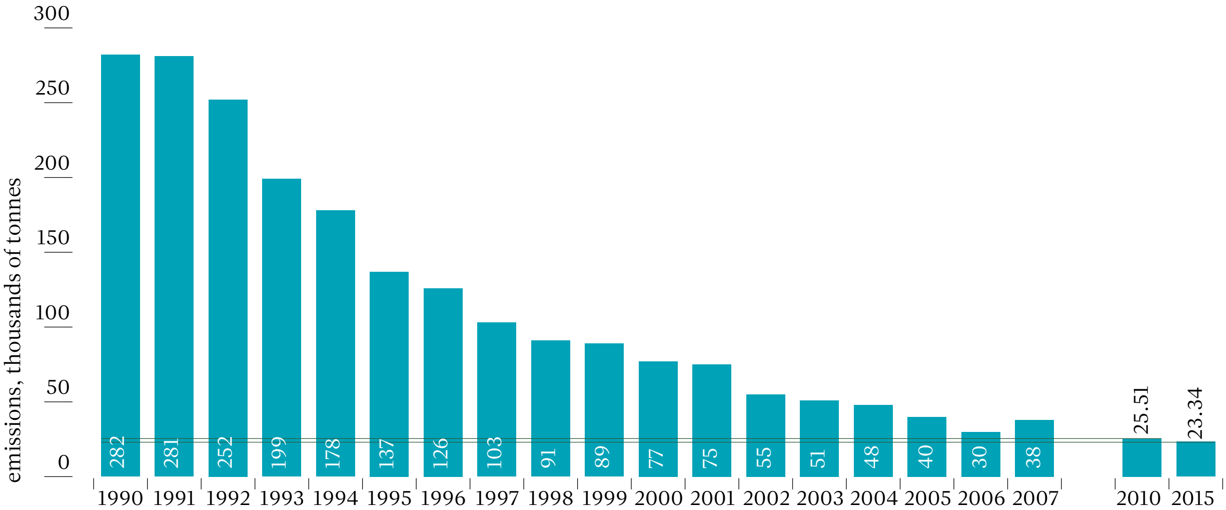


Figure 5.6. Emissions of total particulate matter from 1990–2007 (total) and targets pursuant to the NEC programme for 2010 and 2015. Data: EEIC.

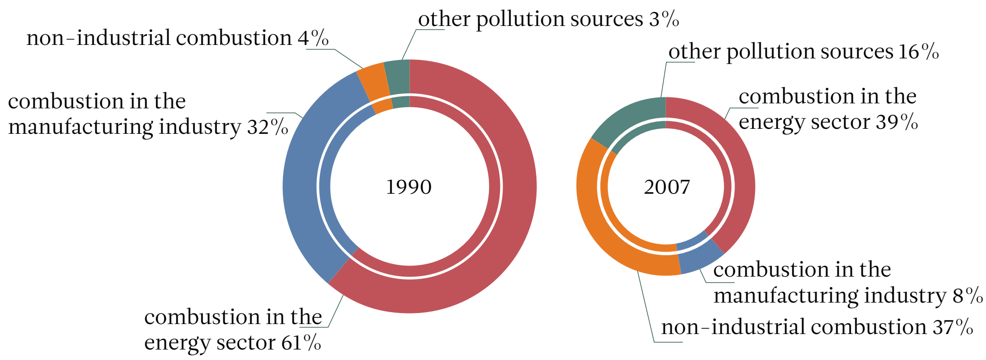


Figure 5.7. Total particulate matter emissions by sources of pollution in 1990 and 2007.
Other sources of pollution: various industrial processes, road transport, mobile pollution sources, distribution of fuel (at terminals, filling stations, gaseous fuel distribution) and agriculture. Data: EEIC.

[C] NEC programme – the main objective of the programme is to reduce emissions of pollutants into ambient air and to protect human health and the environment from the harmful effect of pollutants pursuant to international obligations arising from the Geneva Conventions and protocols thereto as well as to requirements of EU legal acts. For more, visit http://www.envir.ee/462236

[D] The 25 countries of the European Union – EU member states not including Bulgaria and Greece, as there are no data for these countries.

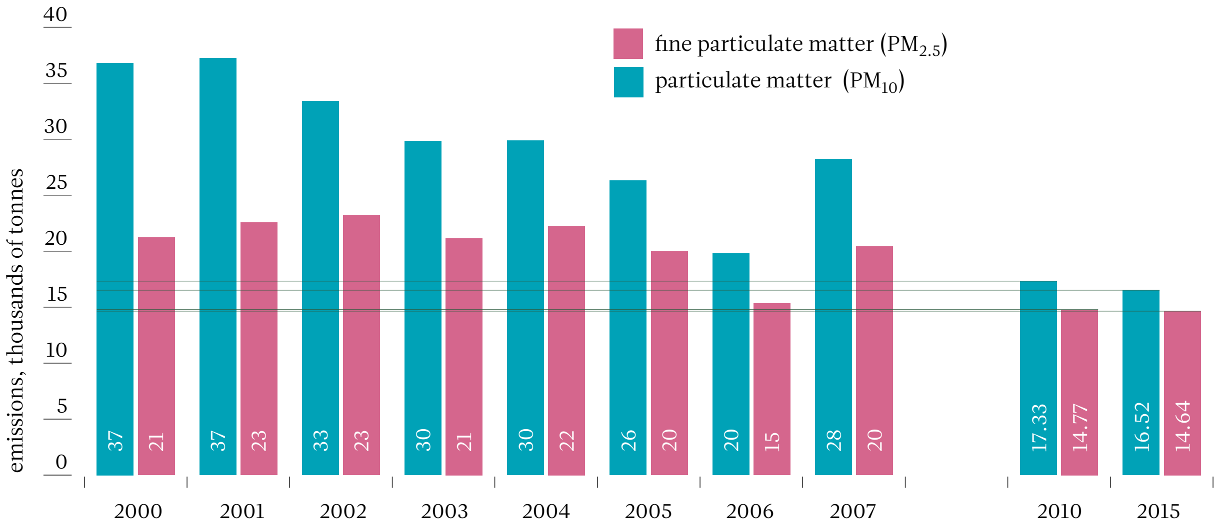


Figure 5.8. Emissions of particulate matter (PM_{10}) and fine particulate matter($PM_{2.5}$) in 2000–2007 and the target for emissions of fine particles for 2010 and 2015 pursuant to the NEC programme. Note: Emissions are obtained on the basis of expert reports and are not based on data gathered by companies. Data: EEIC.

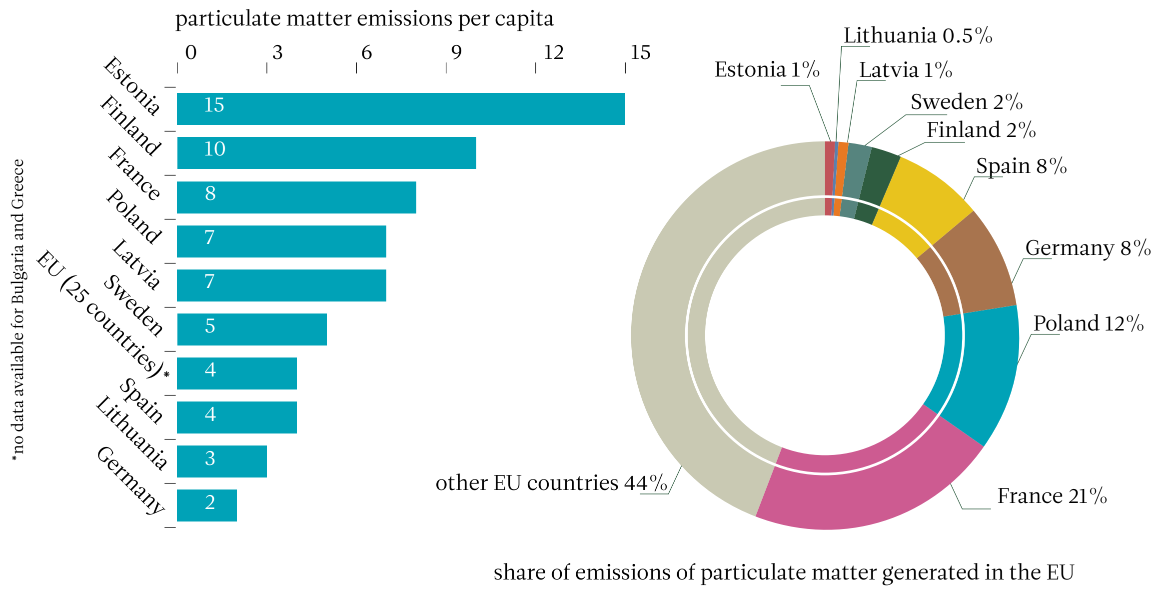


Figure 5.9. Emissions of particulate matter (PM_{10}) in 2006 in neighbouring countries and major EU industrialized countries in PM_{10} equivalent. Data: EEA, Eurostat.

5.2.4. Heavy metals

Heavy metals are chemical elements that in the periodic table fall between copper and bismuth with a density greater than 5 g/cm³. Almost all of the heavy metals are toxic starting from a certain level, accumulating in the body and causing liver and kidney damage. Heavy metals are usually released into the environment by human activity, either by fuel combustion, industry or in traffic, depending on the specific compound.

Pursuant to the Ambient Air Protection Act, lead (Pb), cadmium (Cd) and mercury (Hg) are the most important pollutants that must be considered in assessing and testing ambient air quality.

Lead, cadmium and mercury are mainly released by combustion in the energy sector and in the production of energy in industry.

The emissions reduction programme must achieve a level by the year 2010 where heavy metal emissions do not exceed the following limits: Pb – 39.12 t; Cd – 0.63 t and Hg – 0.61 t. By 2015, emissions must be under the following limits: Pb – 34.63 t; Cd – 0.53 t and Hg – 0.51 t.

In 2007, a total of 40 tonnes of **lead** was emitted into Estonia's ambient air, which is slightly more than the 2010 target (figure 5.10). The bulk of the lead was generated in the combustion of fuel in the energy and transformation industries (about 91%) as well as from road transport (4.5%). The share contributed by other sectors in 2007 was low. The greatest polluters are Eesti and Balti power plants in Ida-Viru County. Compared to 1990, lead emissions into ambient air have dropped by 80%. Above all, this is due to modernization of the cleaning equipment at Narva power plants and the use of lead-free automotive fuels. In 1990, road transport was responsible for 36% of lead emissions, but in 2007 the figure was only 4.5% (figure 5.11). The use of ethylated petrol was discontinued in Estonia in 2000.

In 2007, a certain increase in lead emissions could be seen compared to the year before, which can be attributed to the increase in electricity production volumes at Balti and Eesti power plants.

In 2007, 680 kg of **cadmium** was discharged into ambient air, and 650 kg of mercury, which is within the range of the target for 2010. The overwhelming majority of both heavy metals (90% of Cd and 94% of Hg) was released by combustion of fuel in the energy and transformation industries (figure 5.13).

Compared to 1990 (figure 5.12), Hg and Cd emissions into ambient air have dropped by 39% and 88%, respectively, due to a decrease in electricity and cement production as well as modernization of cleaning installations. Similarly to lead emissions, in 2007 a certain increase in these emissions could be seen compared to the year before, which can be attributed to the increase in electricity production volumes at power plants.

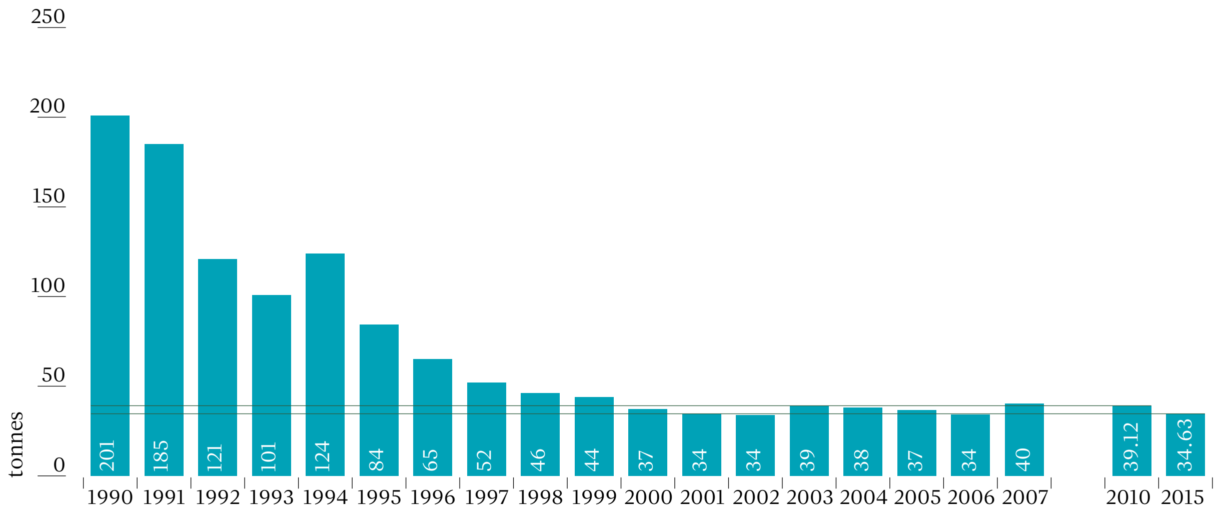


Figure 5.10. Lead emissions, 1990–2007, and emissions reduction targets for 2010 and 2015. Data: EEIC.

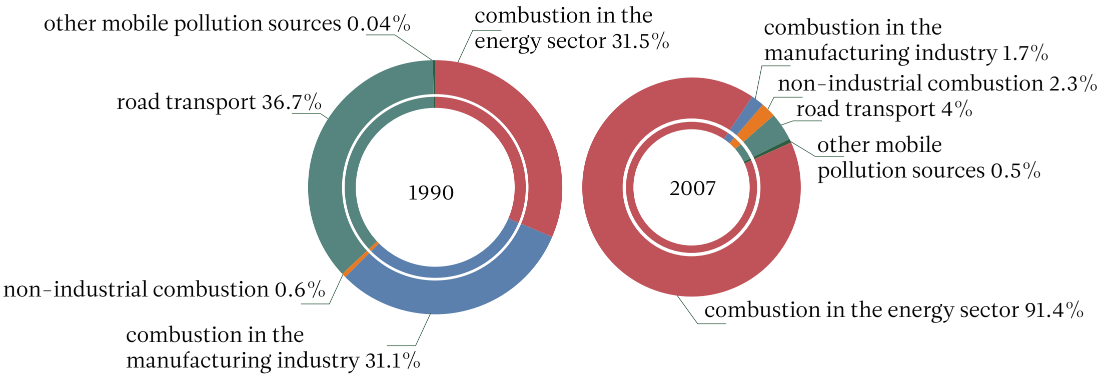


Figure 5.11. Lead emissions by economic sector in 1990 and 2007. Data: EEIC.

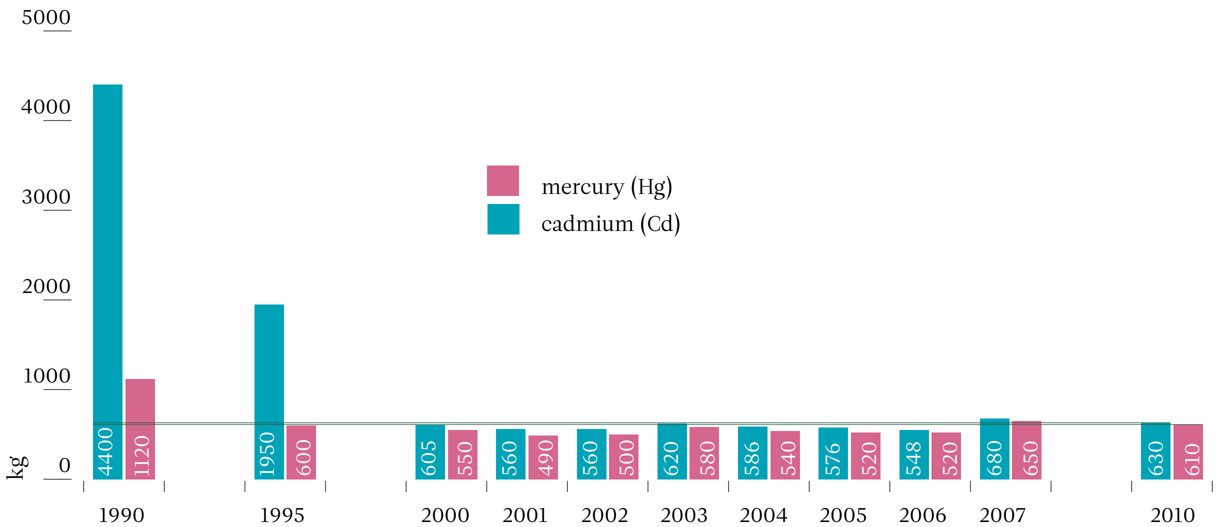


Figure 5.12. Cadmium (Cd) and mercury (Hg) emissions, 1990–2007, and emissions reduction targets for 2010 and 2015. Data: EEIC.

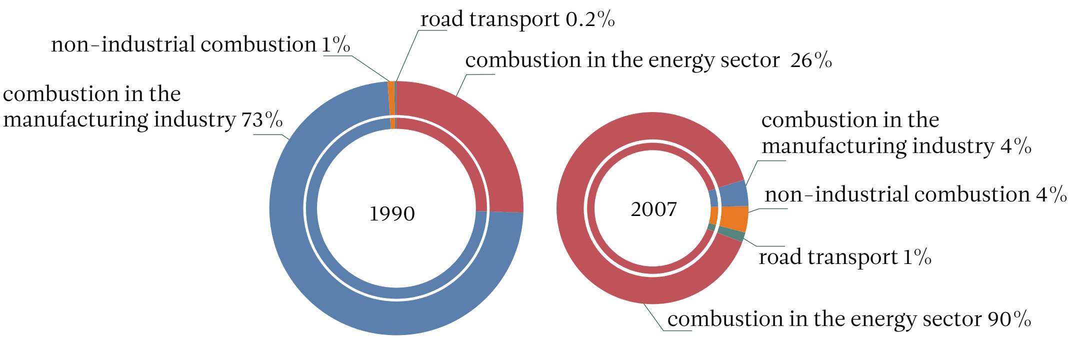


Figure 5.13. Cadmium emissions by economic sector in 1990 and 2007. Data: EEIC.

5.2.5. Persistent organic pollutants

Persistent organic pollutants remain in the environment in a stable form, travel long distances, accumulate in fatty tissue and are toxic.

The primary sources of airborne organic pollutants in Estonia are energy production units at power plants – burning of oil, peat and wood chips in the energy sector, along with combustion of heavy and light fuel oil and shale oil. A large share of the persistent organic pollutants is generated by combustion processes in households (combustion of solid fuels).

In 2007, emissions of PAH amounted to 13.219 tonnes, which is 8% more than in 1990 and 11% higher than in 2006 (figure 5.14). This is related to an increase in combustion in the energy sector. The drop in the interim period can be attributed to reduced economic activity. The high emissions from 1995–1997 are due to the fact that boiler plants began making more extensive use of wood chips instead of liquid fuels and gas.

Persistent organic pollutants also include **dioxins**, which are mainly generated as by-products in industrial processes and by combustion of organic fuels and waste. Especially high levels of emissions are discharged in uncontrolled incineration of waste in households and in landfill, forest and spring brush clearing fires. Dioxin emissions are also high in the case of burning of hospital waste.

By 2007, dioxin emissions had fallen 15% compared to 1990 (figure 5.15). Compared to 2006, a 45% increase took place, due to the increase in combustion in the energy sector. The increases in dioxin emissions in the interim years were caused by an increase in the non-industrial combustion in the mid-1990s and an increase in incineration in the manufacturing industry in 2003.

The target for dioxin emissions established by the NEC programme is not to exceed a level of 3.51 g I-TEQ[E] by 2010 and 3.46 g I-TEQ by 2015. These targets can be achieved if implementation of emissions reduction measures continues.

In 2007, the greatest amount of dioxins was discharged by the following sectors: combustion in the energy sector 40%, combustion in domestic households (non-industrial burning of fuels) 34%, combustion in the manufacturing industry 19%, and boiler plants that burn hazardous waste 6% (figure 5.16).

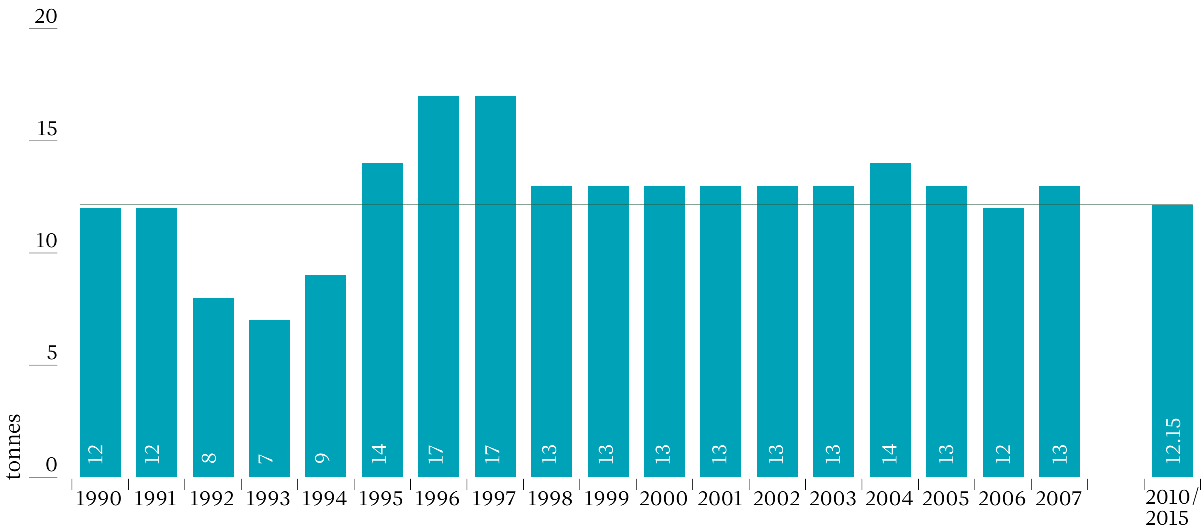


Figure 5.14. Emissions of polycyclic aromatic hydrocarbons (PAH) in 1990–2007 and the target for 2010 and 2015. Note: The diagram shows cumulative data for emissions of four PAHs: benzo(a)pyrene, benzo(k)fluoranthene, benzo(b)fluoranthene and indeno(1,2,3-cd)pyrene. Data: EEIC.

[E] g I-TEQ – dioxin emissions unit, international toxicity equivalent or poisoning caused by a mixture of dioxin-like compounds.

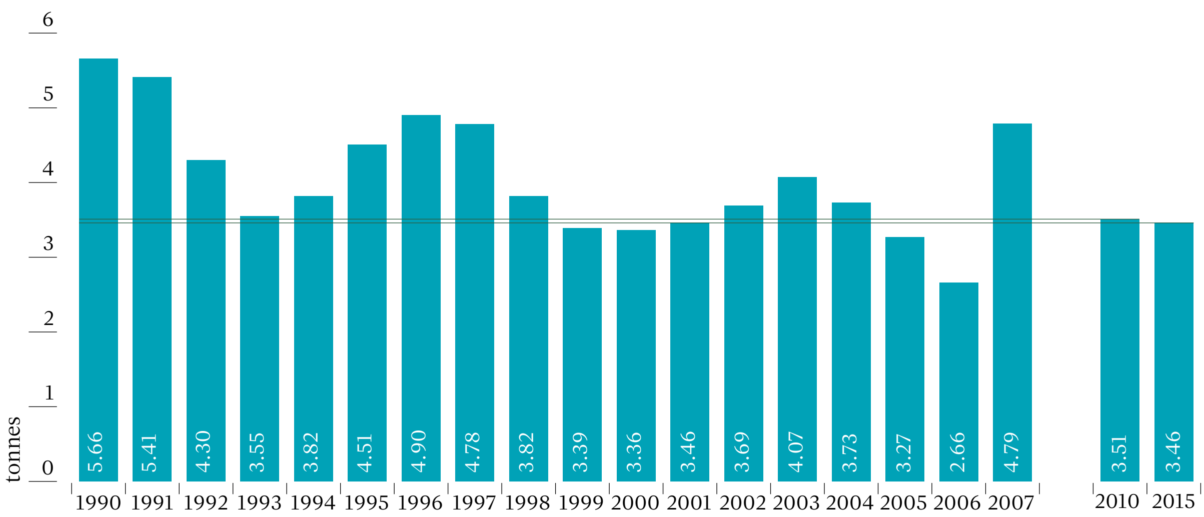


Figure 5.15. Dioxin emissions in 1990–2007 and the target for 2010 and 2015. Data: EEIC.

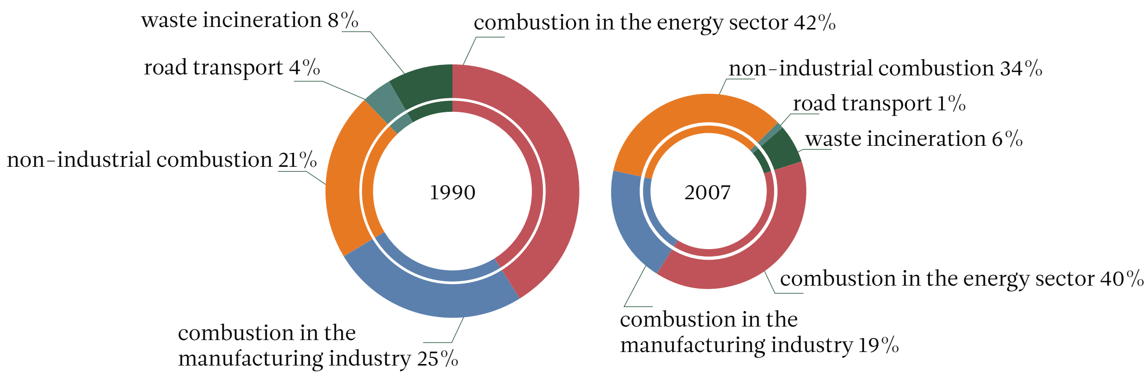


Figure 5.16. Distribution of dioxin emissions by field of activity in 1990 and 2007. Data: EEIC.

5.3. Ambient air quality

5.3.1. Urban air monitoring

Continuous urban air monitoring is performed in Estonia at six urban air monitoring stations, situated in Tallinn, Kohtla-Järve, Tartu and Narva. In Tartu and Narva, monitoring has been taking place since the second half of 2008. Background air monitoring is performed at three monitoring stations – Vilsandi Island, in Lahemaa National Park in northern Estonia and at Saarejärve in Jõgeva County.

The locations of the air pollution measurement stations are on streets with busy traffic, residential districts or industrial areas. Most of the pollutants monitored are related to transport as this is the main source of ambient air pollution in urban areas. A total of 15 different parameters are monitored at the stations, including SO_2, NO_x, O_3, CO, fine particles and heavy metals[F].

The increase in the level of nitrogen dioxide in years past has in the last two years yielded to a decrease at all Tallinn monitoring stations (figure 5.17), in spite of the increase in the number of cars in these years. One reason can be considered to be the number of new cars and the accompanying drop in emissions. If the current trend continues, there is no risk of exceeding the annual average limit, as seen in years past. The **NO_2** level at Kohtla-Järve monitoring station has been low and stable in years past. The hourly average limit (200 µg/m³) was not recorded in 2008 at any of the monitoring stations.

Sulphur dioxide levels have dropped continuously over the years. This reflects directly the impacts of the sulphur content limits established on fuel in Europe. If the current development continues, the sulphur problem that has impacted all of Europe for decades can be considered alleviated. Due to the low levels, some countries have been phasing out or have discontinued monitoring for sulphur. Sulphur dioxide still tends to be fairly high in the Kohtla-Järve area, where a certain rise in the pollution level could be seen from the monitoring results last year. Nevertheless, the level at all locations was lower than the corresponding hourly average and daily average limit (350 µg/m³ and 125 µg/m³, respectively).

Carbon oxide levels appear to be following a continued declining trend and on the basis of the measurements taken to this point it can be said that carbon dioxide is not a problem pollutant in Estonia. Compared to the limit (10 mg/m³ 8h average) the maximum recorded level is significantly lower; neither have values exceeding the limit been recorded at Estonian monitoring stations in years past.

Ozone levels have never been a major problem in the urban monitoring stations and over time it has remained fairly stable and has been associated to a greater degree with intensity of solar radiation. Last year, values exceeding the limit (120 µg/m³ 8h average) were recorded on two occasions at the Õismäe monitoring station.

The level of particles (PM_{10}) is a major problem at the Liivalaia monitoring station in the centre of Tallinn. Whereas at other monitoring stations, the level is stable or declining, a growth trend can be seen at Liivalaia (figure 5.18).

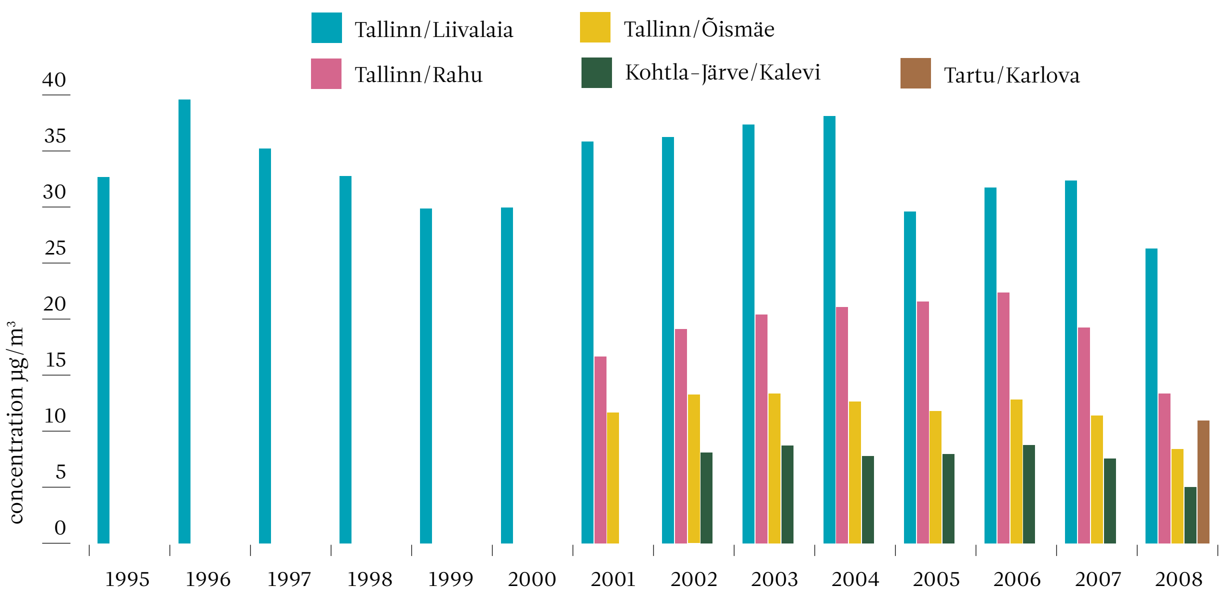


Figure 5.17. Changes in nitrogen dioxide levels, 1995–2008. Data: EERC.

[F] For a more detailed list of the monitored pollutants, visit the Estonian Enviromental Research Centre website, http://www.klab.ee

Compared to years past, the number of times the limit was exceeded at Liivalaia station increased significantly (50 µg/m³ 24h average, 40 µg/m³ annual average) (figure 5.19). One reason for this is the construction activity taking place around the monitoring station. Nevertheless it is clear that, even in the absence of construction activity, the level would have exceeded the limit, similarly to years past.

Fine particle ($PM_{2.5}$) monitoring began at Õismäe monitoring station in 2006. Extra fine particle monitoring began at Tartu and Narva monitoring station in 2008. There are not yet enough years of data to draw conclusions.

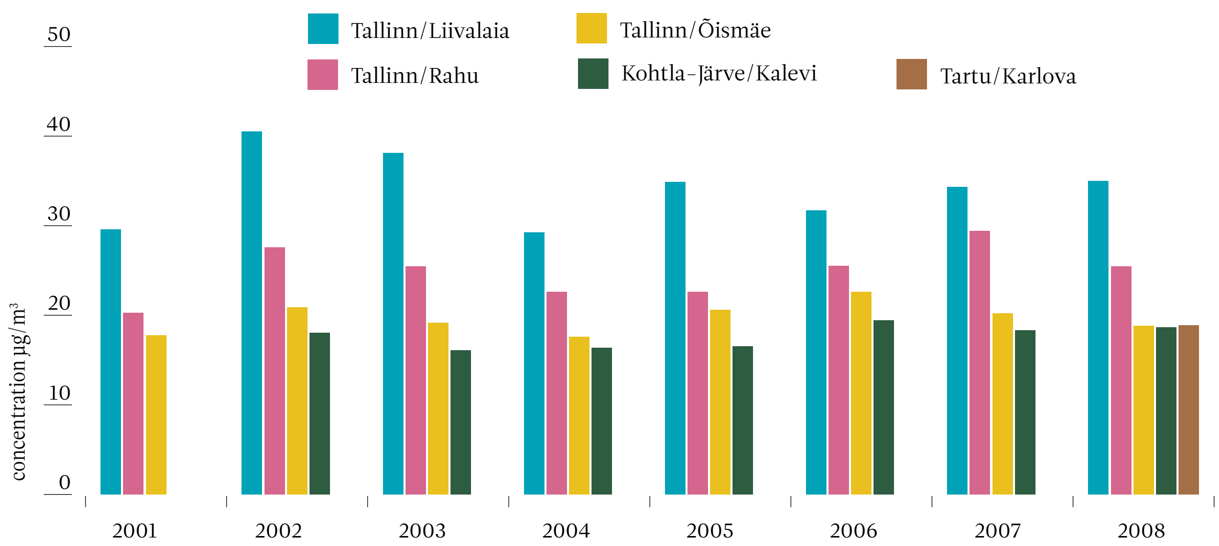


Figure 5.18. Changes in fine particle (PM_{10}) levels, 2001–2008. Data: EERC.

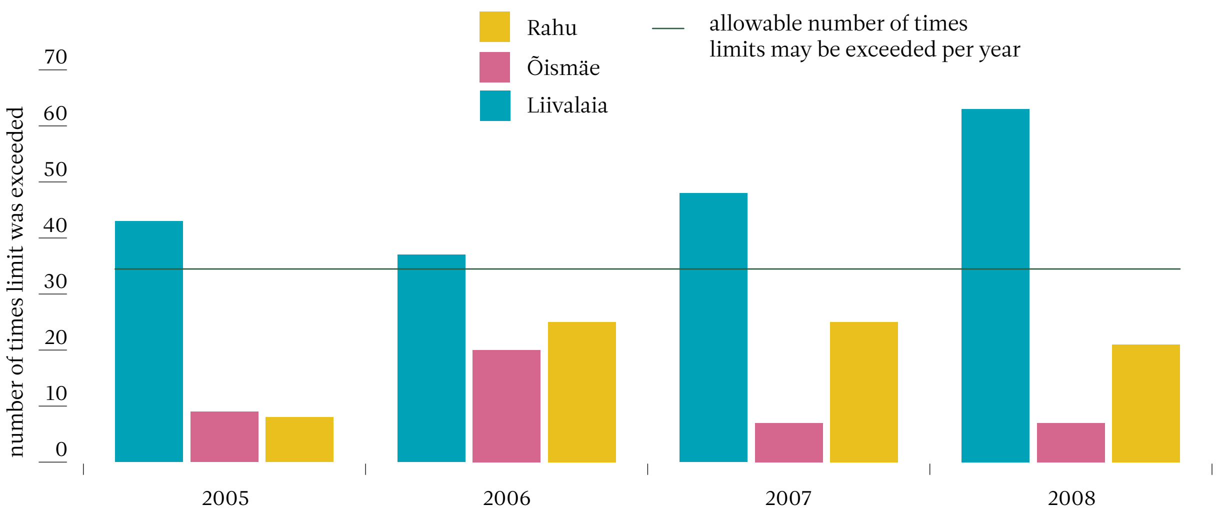


Figure 5.19. Number of times the PM_{10} limit has been exceeded, 2005–2008. Data: EERC.

5.3.2. Fuel monitoring

The fuel used in internal combustion engines exerts a direct impact on ambient air quality, especially in cities. Fuel that does not conform to requirements creates more emissions, and breathing in these exhaust gases increases the chances of illness. Another important aspect is that degraded fuel (removing the colour on specially marked diesel) constitutes excise duty evasion and deprives the state treasury of revenue.

The main legal act aimed at improving fuel quality is European Commission directive 98/70/EÜ, amended by directive 2003/17/EÜ. Both of these legal acts are directly aimed at ensuring fuel quality and environmental requirements.

The directives impose on Estonia the obligation to analyze the liquid fuels marketed by implementing a fuel quality monitoring system conforming to the European monitoring standards, which establishes the procedures for accounting for fuel quality.

A central laboratory was created at the Estonian Environmental Research Centre to prepare for enforcement of these legal acts. A fuel monitoring database[G] was compiled and it has an important function in exchange of data between institutions that inspect fuel quality.

Fuel monitoring is performed on motor fuel. Fuel oil and marine fuels also undergo monitoring. Because the share of biofuels, above all biodiesel[H] in the Estonian market is expected to increase in the years ahead, biofuels have been added to the monitoring plan as well.

On the basis of the fuel monitoring results, the Ministry of the Environment submits an annual report to the European Commission regarding quality of liquid fuels. The first reports were prepared reflecting the status of 2004.

Motor fuels

National motor fuel monitoring for each type of fuel takes place year-round, with samples taken during two basic periods – summer and winter.

The following indicators for petrol are determined: octane number, vapour pressure, distillation parameters[I], oxygen and oxygen compound content, and sulphur and lead content.

In the case of diesel, testing determines the cetane number[J], density at a temperature of 15 °C, distillation parameters, polycylical aromatic hydrocarbon and sulphur content, special marking substance and marker content.

In 2008, motor fuel samples (petrol and diesel) were taken from 223 filling stations in the framework of national fuel monitoring. A total of 541 motor fuel samples were taken in 2008, of which 24 did not conform to the valid requirements – 17 petrol and 7 diesel irregularities. The greatest number of irregularities occurred in Ida-Viru County, followed by Lääne County, Harju County and Viljandi County (map 5.1).

The primary irregularity in the case of diesel quality control was greater than allowable sulphur content. With regard to petrol, besides high sulphur there were also problems with vapour pressure, octane number and aromatic hydrocarbon content.

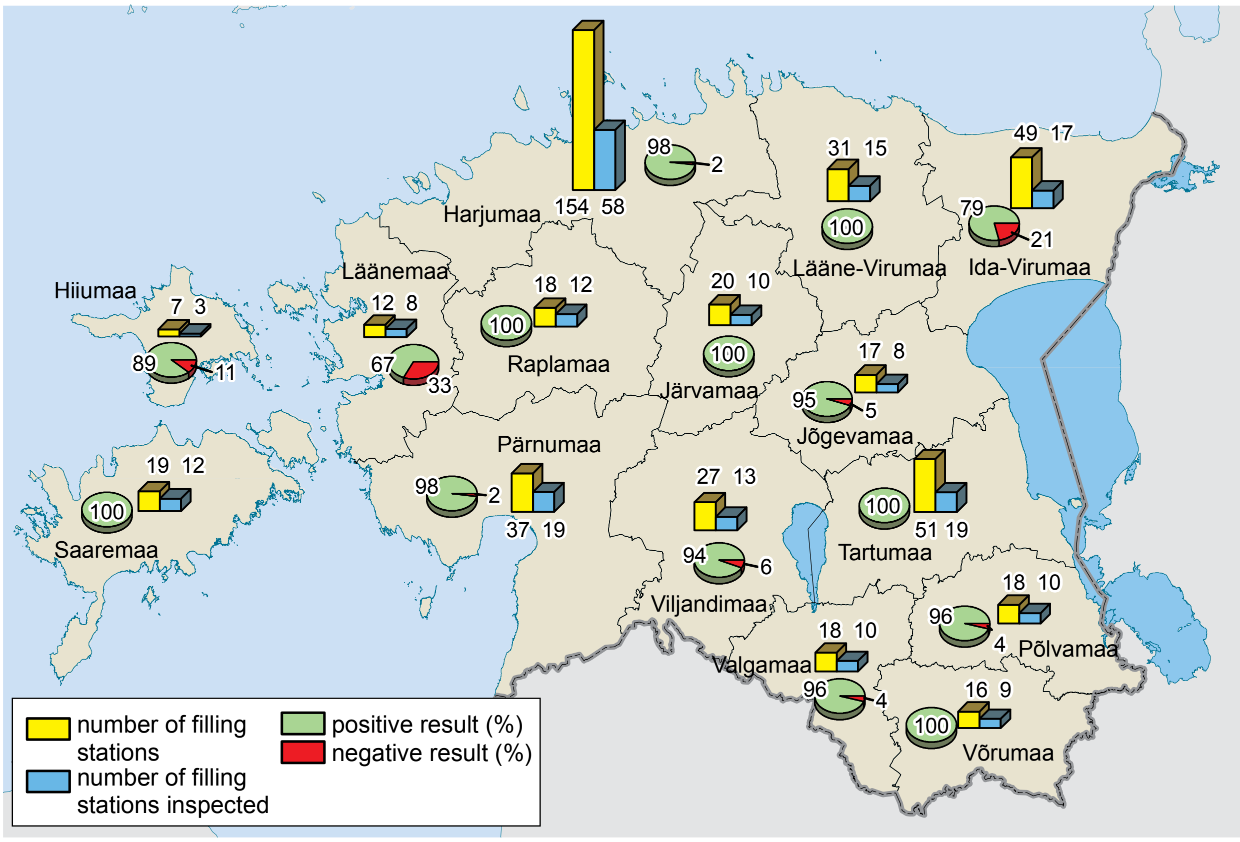
Over the last five years, the number of non-conformities of motor fuel detected during fuel monitoring has been 4–5% of samples (2004 – 5%, 2005 – 5%, 2006 – 6%, 2007 – 3%, 2008 – 4%).

Fuel oils, fuels used on ships and biofuels

High-sulphur fuels such as light and heavy fuel oils and marine fuels are subject to quality requirements established by a number of European Union directives. The objective is to gradually reduce the sulphur content of fuels and thereby reduce the environmental impact from sulphur compounds. With regard to biofuels, European Union directive 2003/30/EÜ aims to promote use of biofuels in the transport sector – in each stage, biofuel must make up the required percentage of all liquid fuel consumed in motor vehicles.

For these purposes, Estonia in 2008 conducted monitoring of fuel oils, fuels used on ships and biofuels. Sulphur content is the primary parameter determined in the course of laboratory analysis of fuel samples. A total of 20 samples were taken in 2008 in order to determine sulphur content in fuel oil. A total of 30 samples of fuels used on ships were taken to determine sulphur content. The 2008 monitoring plan also included one biodiesel (FAME) sample. All of the samples analyzed conformed to the established requirements.

[G] Fuel monitoring database https://kytus.keskkonnainfo.ee
[H] Biodiesel fuel is a blend of long-chain methyl esters used as a fuel in diesel engines. It is made from renewable natural sources, above all plant-based or animal-based lipids.
[I] Distillation parameters are the amount of vaporization of motor fuels, expressed in percentage by volume, at 100 oC and 150 oC.
[J] The cetane number is a measurement of the ignition delay and combustion quality of diesel fuel.

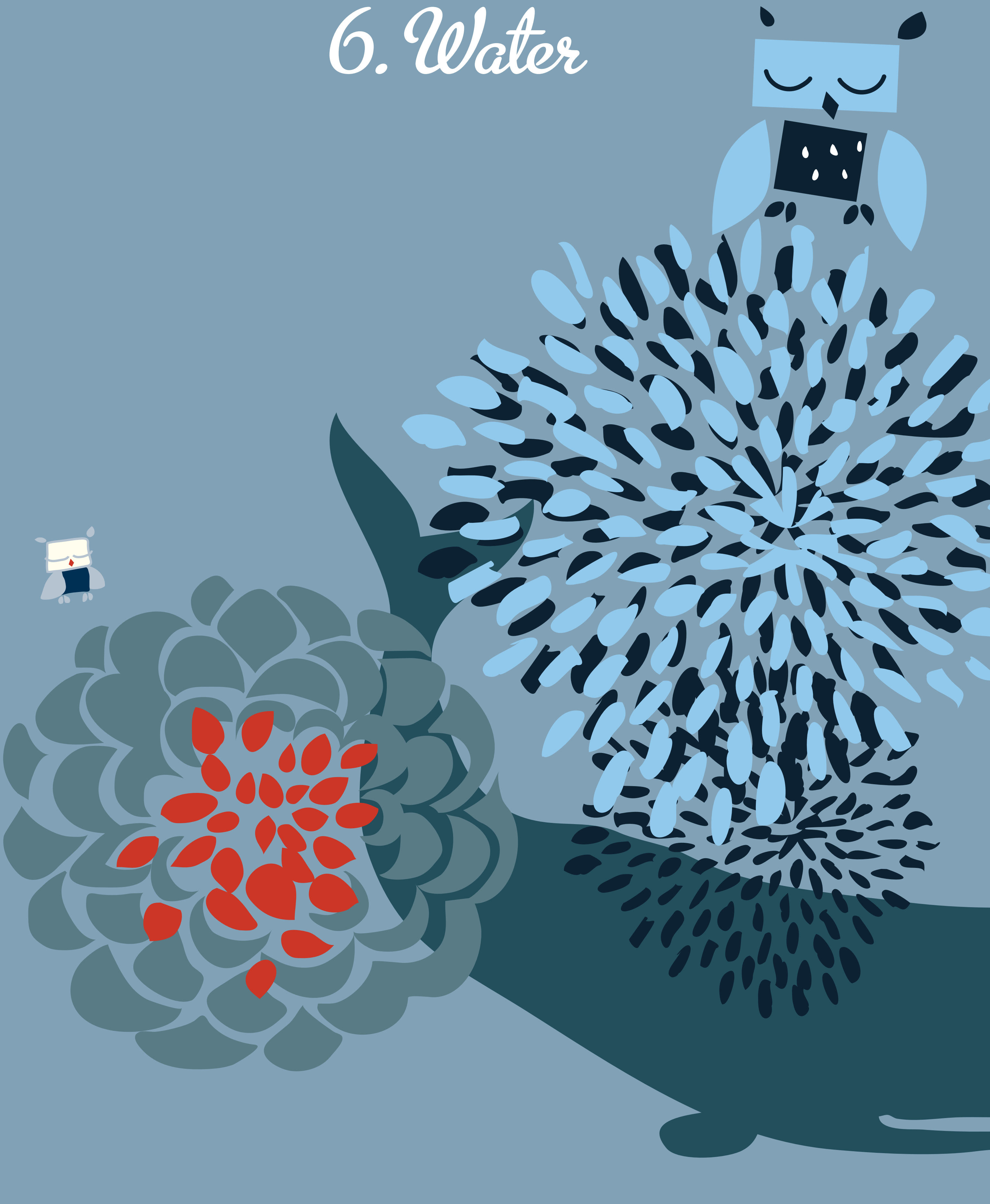


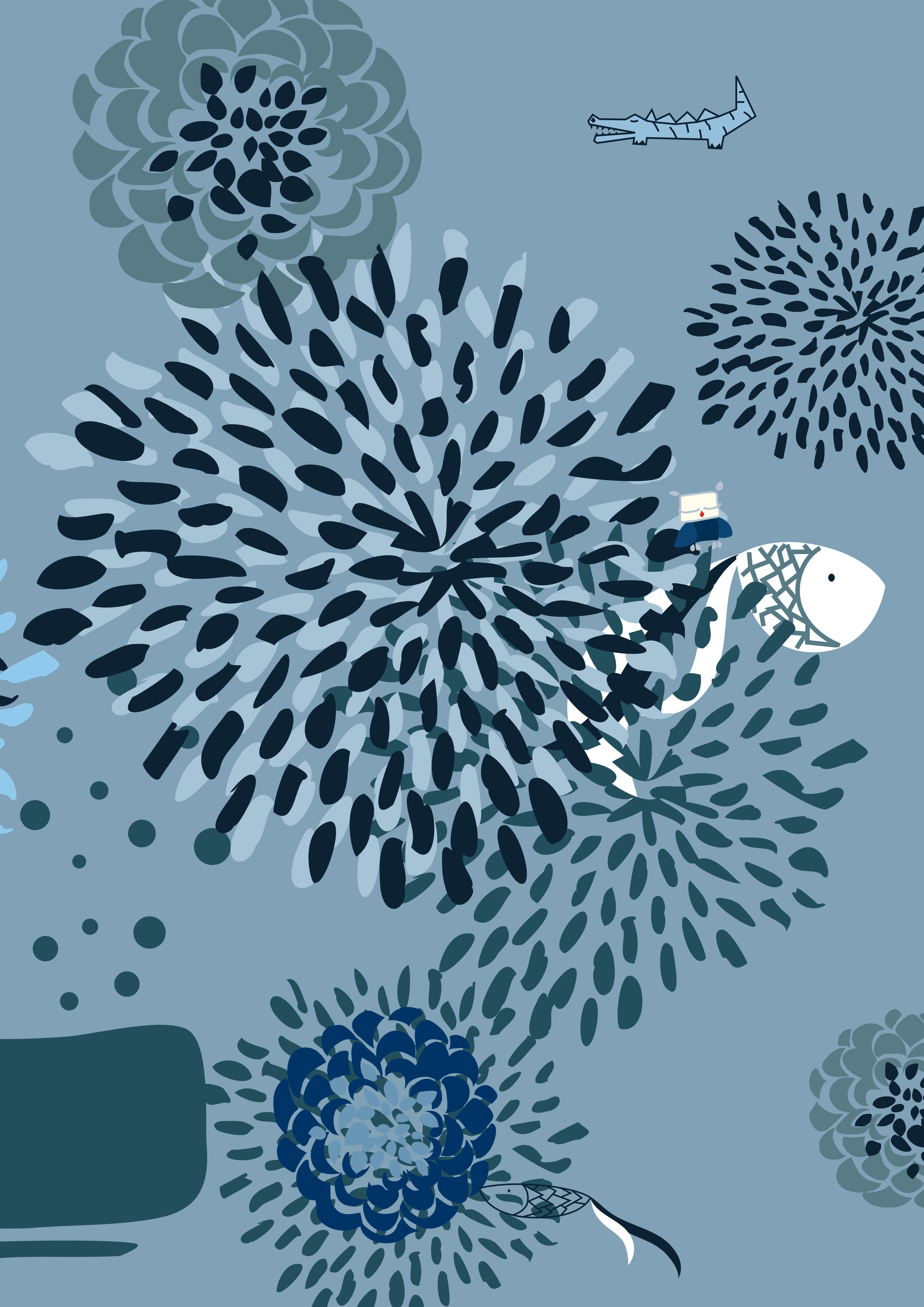
Map 5.1. Number of filling stations in each county and fuel monitoring results in 2008. Data: EEIC.

Read more:

- Estonian Environmental Research Centre website.
[WWW] http://www.klab.ee/infomaterjalid/publikatsioonid/
(publications in English)
- Ministry of the Environment website
[WWW] http://www.envir.ee/1104350 (ambient air)
- The Estonian Environment Information Centre website
[WWW] http://www.keskkonnainfo.ee/
index.php?lan=EN&sid=2&tid=2 (state of environment)

6. Water





6. Water

The existence of clean fresh water is essential for life. Due to the climate and small population, Estonia's fresh water resources are sufficient; there is fresh water both in underground aquifers and freshwater lakes and rivers. Nevertheless, there are problems with water quality in some areas, especially places with heavy industry and intensive agriculture, where the pollution load is great. To an increasing extent, attention is being devoted to biota as well as the physical and chemical properties of water. Taking into consideration all quality elements creates the preconditions for attaining good status of water bodies which is the main objective of the water framework directive . Considering the overall assessment of Estonia's coastal water bodies, the status of the coastal water tends toward poor rather than good. The status of the coastal water bodies is impacted by the pollution load from land (river basins) as well as the general level of eutrophication in the Baltic Sea itself.

6.1. Legal background

A number of key documents and legal acts constitute the basis for management and conservation of water bodies. The Estonian Environmental Strategy 2030 sets the objective of improving the status of surface water (including coastal waters) and groundwater to good and to conserve water bodies whose status is already good or high. Evaluation of the status of groundwater is based on the times that the limits for nitrates, plant protection products and other hazardous substances are exceeded. The assessment of the status of water bodies is based on ecological status and chemical indicators, monitoring trends in nutrient content and concentrations of hazardous substances in surface water.

Directive 2000/60/EC of European Parliament and of the Council – known as the Water Framework Directive, which establishes a single framework for activity for planning and organizing water protection. The primary objective of the Water Framework Directive is to bring all waters (including groundwater, surface water, lakes, rivers, coastal waters) into good or high status by 2015.

The function of the Water Act is to ensure the purity of inland water bodies, coastal sea and groundwater as well as the ecological balance of water bodies.

Regulation no. 269 of the Government of the Republic of 31 July 2001 – "Procedures for discharging wastewater into water bodies or soil" establishes the corresponding requirements and measures for enforcing the requirements.

The Public Water Supply and Sewerage Act governs the organization of supplying water consumers with water and the diversion and treatment of wastewater, rain water, drainage water and other soil and surface water though the public water supply and sewerage. It also sets forth the respective rights and obligations of state, local government, water enterprises and customers.

Directive 91/271/EEC on urban wastewater treatment governs the collection, processing and return to the environment of wastewater originating from settlements and some industries in order to protect water bodies and groundwater from pollution.

The objective of the so-called nitrates directive (directive 91/676/EEC) is to reduce nitrate pollution from agriculture in groundwater and surface water.

6.2. Water supply and use of water

Europe's water resources is slightly under 3500 km^3/year[A], while **Estonia's water resource** is about 11 km^3/year or 0.3%.

Both groundwater and surface water are used in Estonia. The water demand of most Estonian communities and companies are covered by groundwater, but in Tallinn and Narva and at some industrial companies, including Sillamäe, Kohtla-Järve and Kunda primarily surface water is used for water supply as groundwater reserves would not be sufficient there.

To see how sustainably the water resources are being used, the amount of water taken from bodies of water is compared to the long-term annual average, i.e. the water use index is calculated (%). The water use of the population and manufacturing is calculated, along with the amount of water pumped out of mines and quarries, but cooling water for Narva power plants is omitted from the calculation as it is drawn from the Narva River and returned to the same river after use. **The water use index for Estonia is low – under four per cent** – and is under the critical water resources use limit, which is 20%.

Nine countries in Europe exceeded the critical limit, according to 2005 data: Germany, Cyprus, Spain, Belgium, Bulgaria, Italy, England, Malta and Macedonia, whose population comes to slightly under one-half of the total population of Europe[B].

[A] Water availability. European Environment Agency. [WWW] http://www.eea.europa.eu/themes/water/water-resources/water-availability (27.02.2009)
[B] Use of freshwater resources – Assessment. European Environment Agency. [WWW] http://themes.eea.europa.eu/IMS/ISpecs/ISpecification20041007131848/IAssessment1197887395187/view_content (27.02.2009)

6.2.1. Water extraction and water use

In Estonia, water extraction[C] dropped sharply from 1990 to 2003. From 2003, annual water extraction has stayed around 100 million m^3; surface water extraction in recent years has been a fair amount greater than in 2003 and 2004 (figure 6.1).

In 1992–2007, water use more than halved in connection with a decline in manufacturing, better availability of water data, and more sustainable use of water in domestic households and industry (figure 6.2). Investments and politoeconomic decisions that raised the price of water forced both the population and companies to save water and accelerated implementation of accurate metering of water, and renovation of pipes and plumbing. In 2007 a total of 44.3 million m^3 water was used for human consumption; industrial use consumed 34.3 million m^3, and agriculture used 5.8 million m^3 of water.

In most European countries, water extraction has dropped compared to the early 1990s. This is related to economic changes and restructuring in the direction of more economical use of water, especially in new EU countries. An increase in water extraction has been noted in the Netherlands, Great Britain, Greece, Finland, Slovenia, Spain and Turkey[D]; this is attributed to acceleration of climate change and tourism. A decrease in the use of water can be observed in Eastern and Western Europe: in Poland, Bulgaria, Romania, Great Britain and Germany.

Industrial water use has dropped in all European countries, due to the implementation of new water-saving technologies and reutilization of water. There is less parity between countries with regard to use of water in agriculture; water use is down in Western Europe and especially in Eastern Europe while it has increased in southern Europe[E].

Extraction of water for human consumption is also down since the early 1990s; in recent years the trend has remained stable (figure 6.3). Per capita use of water for human consumption was 69 m^3 in 1992 while by 2004 it had fallen to 30 m^3; it had risen to 33 m^3 by 2007. In 1992 a total of 188 litres of water per person per day was used for human consumption, while the respective figure for 2004 was 83 and for 2007, 90.

Of the average income of one Estonian household member – 5285.70 kroons according to Statistics Estonia in 2007, 1.7% was spent on water and sewerage systems.

Of the cities, the greatest water consumers are Tallinn and Narva. A total of 23 million m^3 of water was taken from Lake Ülemiste for the city of Tallinn in 2007 (figure 6.4) and a little under 4 million m^3 of groundwater. A total of 7.27 million m^3 of water was extracted from the River Narva and a total of 33,000 m^3 of groundwater. About 15% of Tallinn's water needs are covered by groundwater, and under 1% in Narva. In both cities, 99% of the population was supplied from public water works. The rest of Estonia uses groundwater. The greatest amount of groundwater is extracted from the Cambrian and Silurian Ordovician water complexes (figure 6.5).

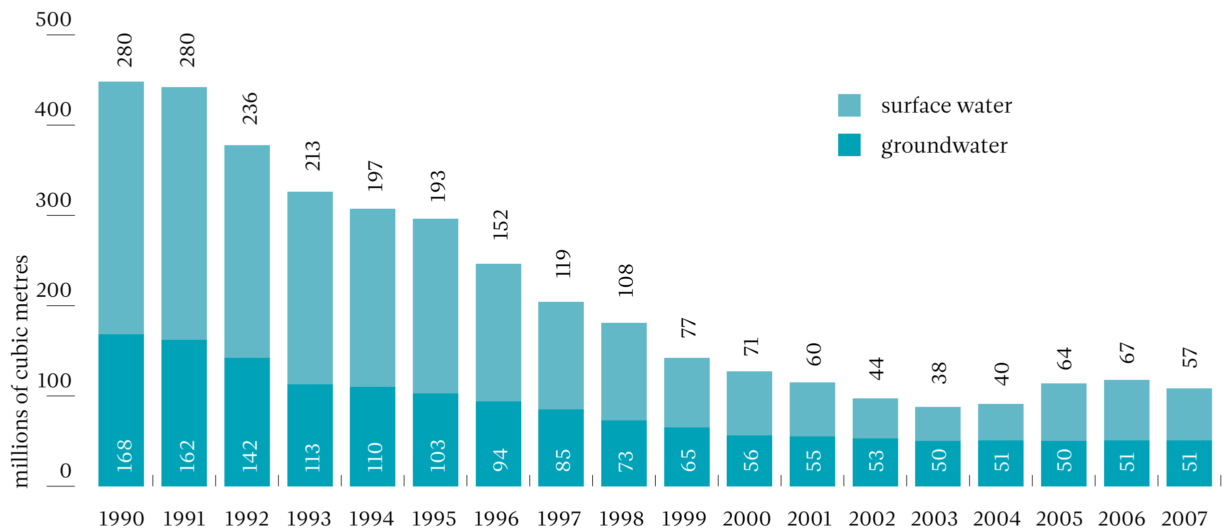


Figure 6.1. Water extraction (not including mining and cooling water), 1990–2007. Data: EEIC.

[C] The water extraction indicator shows the amount of surface water and groundwater extracted per year in millions of cubic metres, not including mining water, cooling water for heating and power plants, fish pond water or extraction from wells at detached homes for which no special use of water permit is necessary.
[D E] Use of freshwater resources – Assessment. European Environment Agency.
[WWW] http://themes.eea.europa.eu/IMS/IMS/ISpecs/ISpecifcation20041007131848/IAssessment1197887395187/view_content

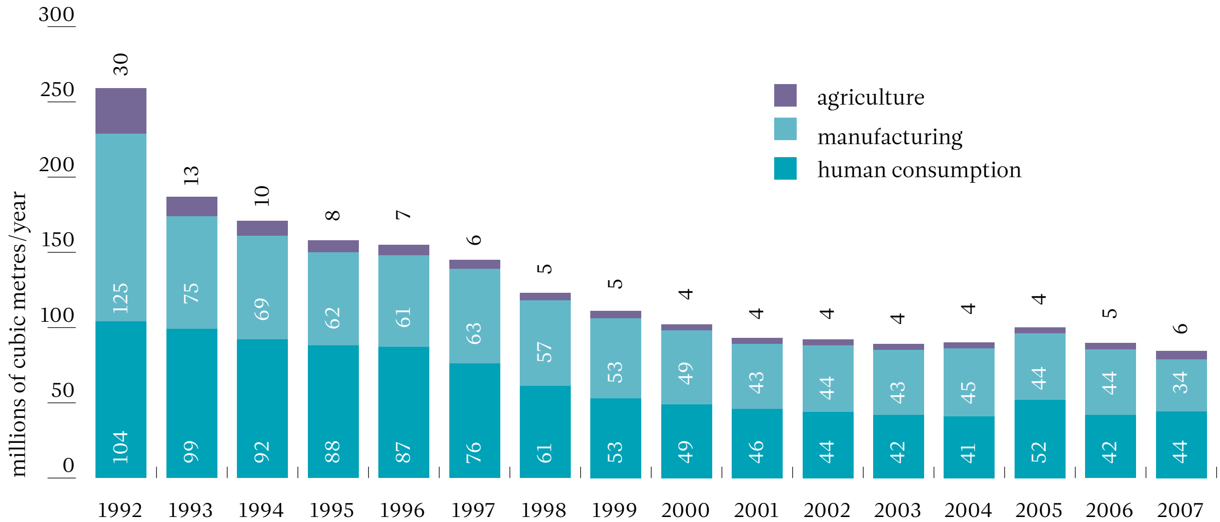


Figure 6.2. Water use for human consumption, manufacturing and agriculture, 1992–2007. Data: EEIC.

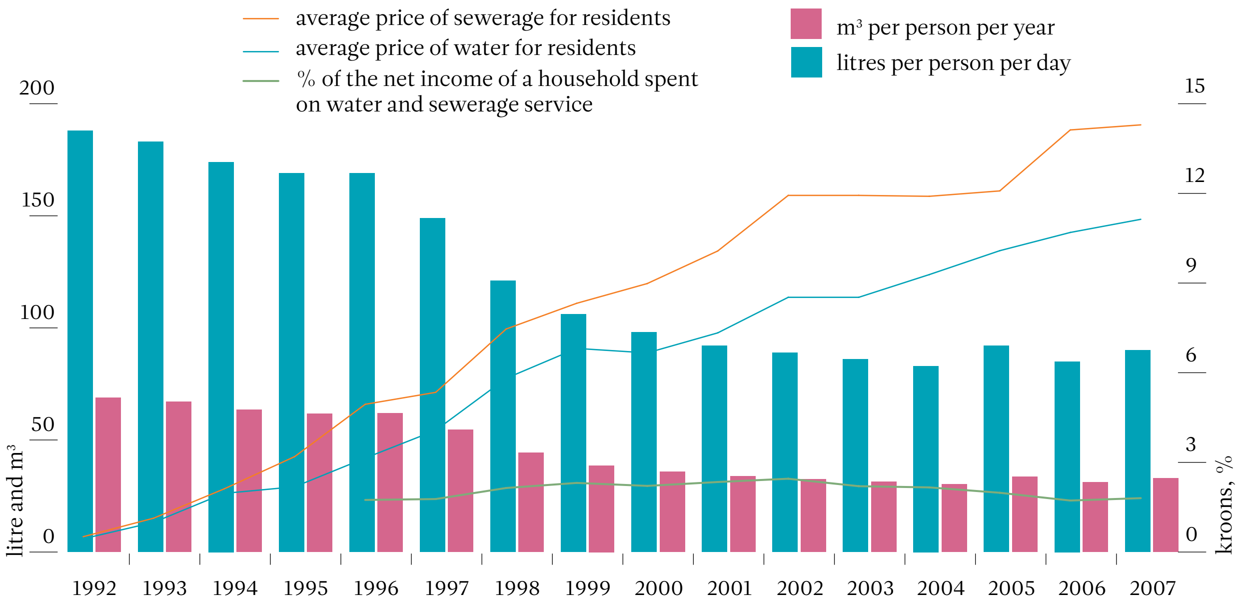


Figure 6.3. Water use for human consumption and the price of water, 1992–2007. Data: EEIC.

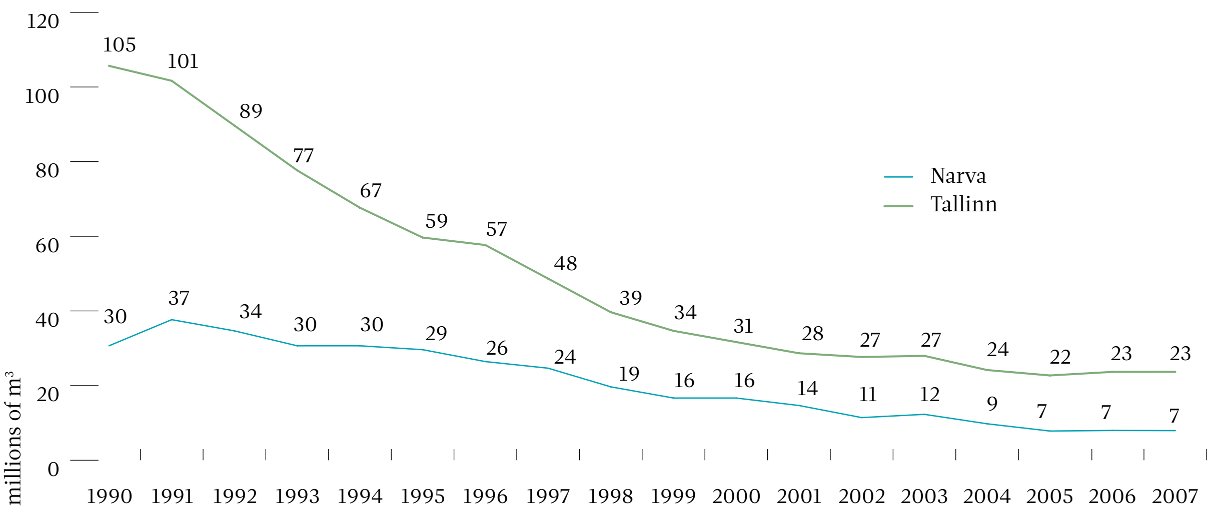


Figure 6.4. Surface water extraction for the cities of Tallinn and Narva, 1990–2007. Data: EEIC.

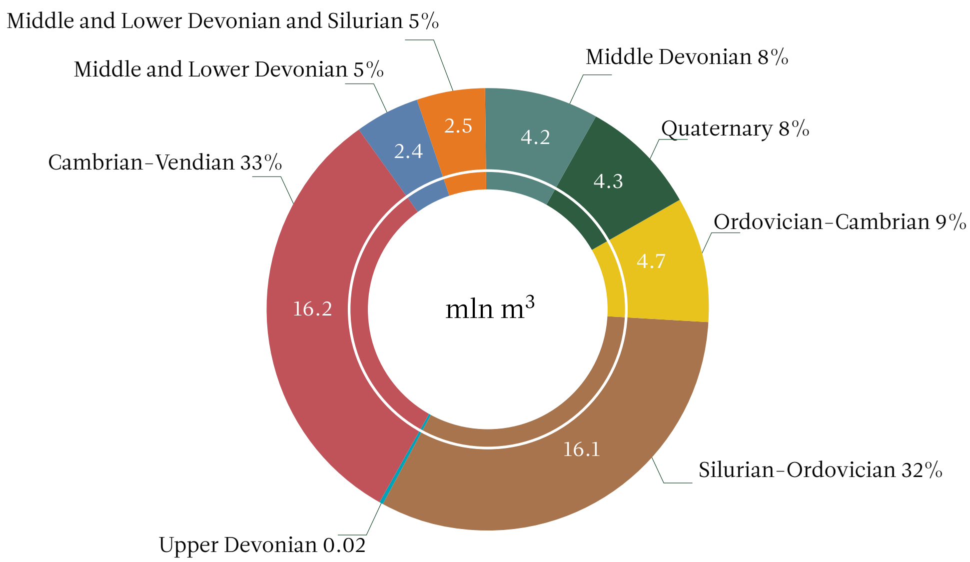


Figure 6.5. Groundwater extraction from aquifer systems throughout Estonia in 2007 (not including mining water). Data: EEIC.

6.2.2. Mining and cooling water

In the period from 1992–2007, the amount of mining water varied widely – between 160 and 300 million m³ (figure 6.6). In 2007, 200 million m³ of water was pumped out. Of mining water, over 90% is pumped out of the Ordovician aquifer in north-eastern Estonia.

The power plants located in Ida-Viru County (Eesti and Baltic power plants) use surface water for cooling, taken from the River Narva or the Narva reservoir. The plants are major users of water, but not major water consumers, as they are located in a chain with respect to the river, as a result of which the water is effectively re-utilized – the water used at Eesti power plant is redirected into the river, is then used at the downstream Baltic power plants and again returned to the river.

Extraction of water for cooling purposes was greatest in the early 1990s, reaching 2411 million m³ per year. Cooling water extraction fell up to 2002, but since 2003 it has started growing again in connection with energy production. In 2007, Eesti power plant used 1091 million m³ of cooling water for production of energy; Baltic power plant, 442 million m³.

Cooling water made up an average of 13% of the annual average amount of water drained by the Narva River in 1990–2007 (ranging from 8–20%). If the power plants are viewed separately, Balti power plant's cooling water in 2007 made up an average of 5% and at Eesti power plant, an average of 11%.

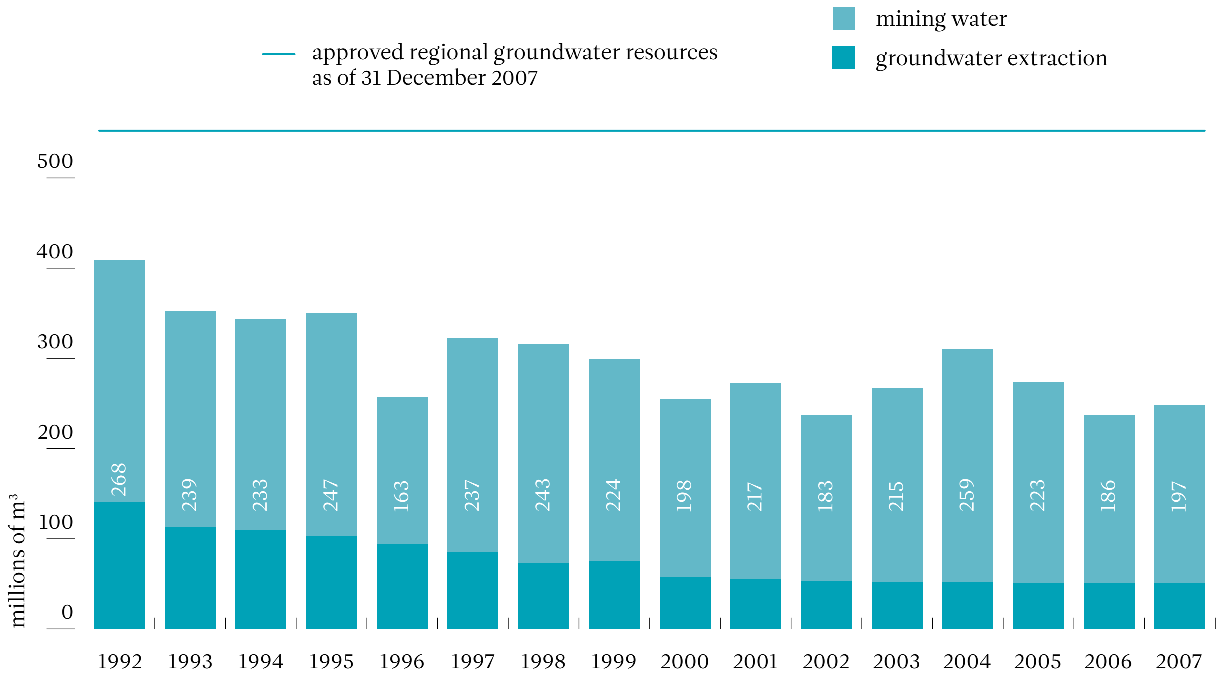


Figure 6.6. Groundwater extraction along with mining water and approved groundwater resources from 1992–2007. Data: EEIC.

6.3. Water pollution load

To plan water treatment equipment and determine the level of water contamination risk, the pollution load must be known – i.e. the amount of waste substances that constitutes the load on the treatment facility, water body or environment. The primary indicators used to evaluate the water released from the treatment facility into the water bodies are biochemical oxygen demand (BOD_7)[F], suspended solids, phosphorus and nitrogen content. Pollution load is expressed in population equivalent – a unit that stands for the average water pollution load generated by one person in a 24-hour period. The population equivalent value of biochemical oxygen demand (BOD_7) is 60 g of oxygen per day.

Starting from 1992, the pollution load in Estonia has decreased significantly (figure 6.7). Compared to 1992, the annual BOD_7 load has decreased 94%, while the drop in phosphorus and nitrogen in the same period has been 79% and 71%, respectively. The most important reason for the drop in the load is the decrease in industrial and agricultural production starting in the beginning of the 1990s. In recent years, the drop in the load had accelerated thanks to significant investments as a result of which a number of wastewater treatment plants have been built and renovated. One reason for reduced pollution load is also the rise in pollution taxes and stricter requirements for wastewater treatment. By 2007 the decline in pollutants in wastewater had halted and remained on the level of 2006.

An average of 85–95% of pollutants are removed from wastewater during wastewater treatment. In 2007, 99% of all water needing to be treated was treated.

The effectiveness of treatment has grown rapidly in recent years. Removal of phosphorus and nitrogen (tertiary treatment) is today one of the primary goals of wastewater treatment, and as a result the share of biological chemical **treatment**[G] has risen (figure 6.8). Currently around 78% of all residential and industrial wastewater that needs treatment undergoes tertiary **treatment**. Whereas only 63% of treated water was sufficiently pure in 1992, the figure had risen to 98.7% as of 2007. Forty per cent of wastewater that requires treatment is generated in Tallinn. Before being returned to water bodies, mining water first undergoes partial treatment (primarily removal of suspended particles) in settling basins. Mining waters do not have a significant impact on the composition of natural waters; only sulphate concentrations increase significantly. Most Estonian wastewater is cooling water, which does not require treatment. To this point, the lowest amount of wastewater was generated in the extraordinary dry year of 2006.

Directive 91/271/EEC of the Council of the European Union governs wastewater treatment in over settlements with a more than 2000 population equivalent. Around 900,000 people live in such areas – about 69% of Estonia's population. In 2007, 92% of these people were furnished with sewerage connections and 94% of them used public water works.

In 2007, the volume of wastewater and total nitrogen increased while BOD_7 fell. The BOD_7 indicator dropped by 25% over the year, primarily on account of the city of Kehra. The amount of nitrogen increased by 5% on account of Kohtla-Järve and Tallinn. The trend is the same with regard to total phosphorus. The pollution level in the water routed to Tallinn treatment plant has risen in recent years in connection with city sewerage and connection of new areas to the system. Nitrogen removal was launched in Tallinn in mid-2005; the level of 10 mgN/l for water discharged into the environment, established in the urban wastewater directive, has not yet been achieved (the average for 2007 was 10.5 mgN/l).

Renovation of the Kohtla-Järve treatment plant was in progress in 2007; the treatment capacity was reduced and therefore the goals of 70% nitrogen and 80% phosphorus reduction were not achieved. The treatment plant is now completed and in operation.

Starting in 2003, wastewater treatment plants were renovated in Tallinn, Kohtla-Järve, Narva, Tartu, Valga, Põltsamaa, Otepää, Kohila and Jüri. The Märjamaa treatment plant is being renovated. By the end of 2004, in connection with the completion of the Kösti treatment plant, Viljandi's untreated wastewater is no longer released directly into the environment. In 2007, the new wastewater treatment plant in Paldiski was launched, where emissions were previously treated mechanically (primary purification). The treatment efficiency of some treatment plants is still not sufficient to bring wastewater into conformity to the requirements. Türi and Tõrva's wastewater treatment plants still must be renovated – currently wastewater is treated in bio-ponds, the capacities of which are several times below the increasing load.

[F] Biochemical oxygen demand BOD7 indicates the amount of oxygen necessary for biological decomposition of (an)organic matter contained in water over 7 days.
[G] Biological chemical treatment – besides conventional biological treatment, nitrogen and/or phosphorus is also removed from wastewater.

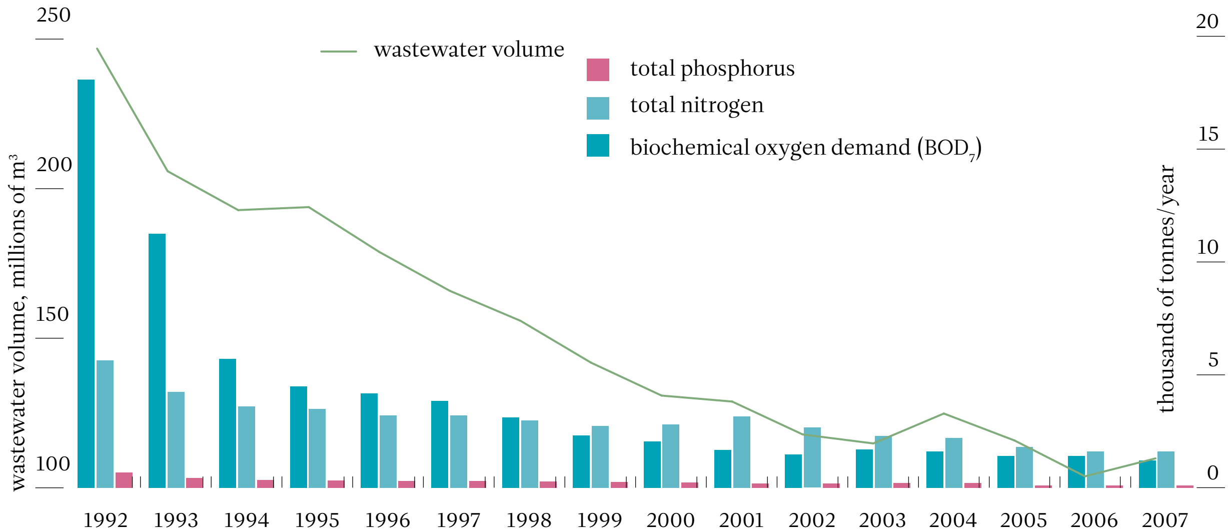


Figure 6.7. Point-source pollution load in Estonia by quantity of wastewater and pollutant in 1992–2007. Data: EEIC.

Table 6.1. Pollution load from point sources by river basin districts and sub-districts in 2005–2007, tonnes per year. Data: EEIC.

River basin district	Biochemical oxygen demand (BOD_7)			Phosphorus			Nitrogen		
	2005	**2006**	**2007**	**2005**	**2006**	**2007**	**2005**	**2006**	**2007**
East Estonian river basin district	**551.9**	**589.4**	**445.4**	**52.9**	**45.1**	**48.2**	573.5	**613.1**	**601.9**
Peipsi sub-district	175.3	129.9	88.0	24.3	18.8	16.3	190.6	168.2	141.3
Võrtsjärv sub-district	28.6	33.3	21.3	4.7	4.3	3.2	49.9	34.0	41.4
Viru sub-district	348.0	426.2	336.0	23.8	22.0	28.8	333.1	410.9	419.2
West Estonian river basin district	**563.1**	**579.3**	**488.8**	**86.7**	**77.5**	**81.4**	894.0	**700.5**	**811.6**
Harju sub-district	394.6	433.7	357.5	63.0	55.9	63.0	759.0	581.2	679.6
Matsalu sub-district	29.5	27.9	25.7	4.2	4.2	3.6	38.1	38.7	31.1
Pärnu sub-district	109.1	94.3	81.0	12.3	12.1	11.2	68.6	56.7	67.7
Western archipelago sub-district	29.9	23.4	24.7	7.1	5.3	3.7	28.3	23.9	33.3
Koiva river basin district	**2.9**	**2.2**	**2.3**	**0.6**	**0.4**	**0.5**	**1.9**	**1.8**	**1.9**

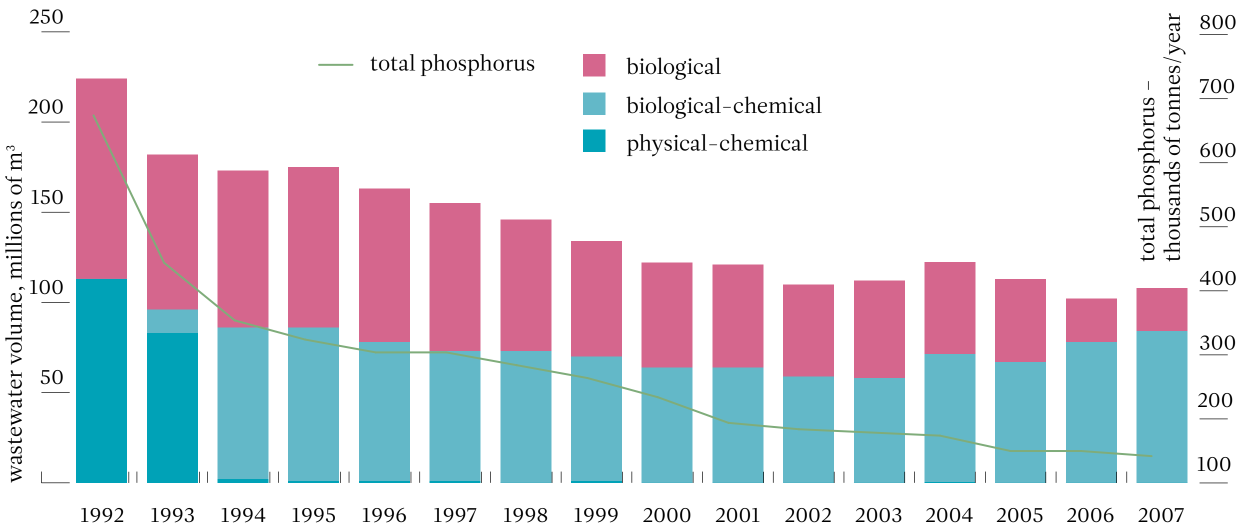
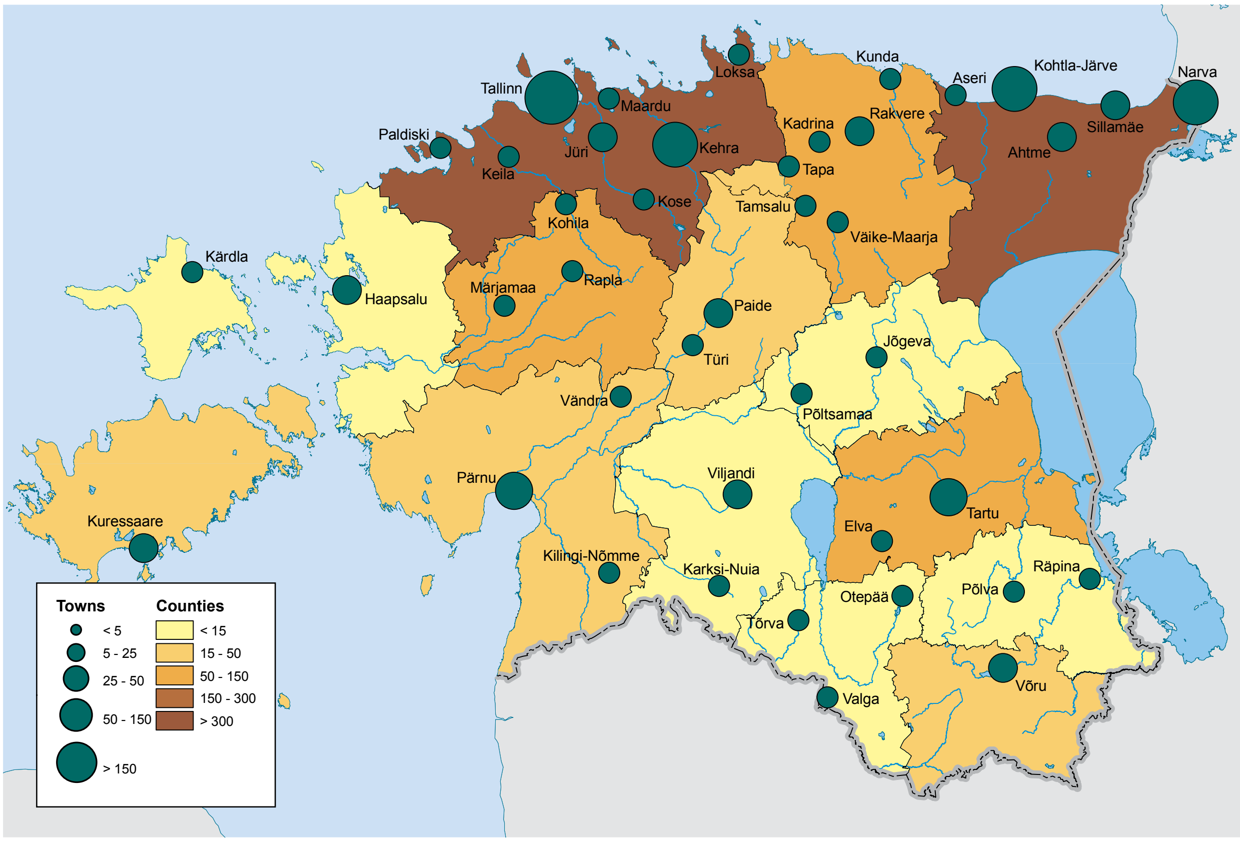


Figure 6.8. Treatment of wastewater in 1992–2007. Data: EEIC.



Map 6.1. Pollution loads of Estonian counties and communities with more than 2000 population equivalent[H] according to biological oxygen demand (BOD_7) in 2007. Data: EEIC.

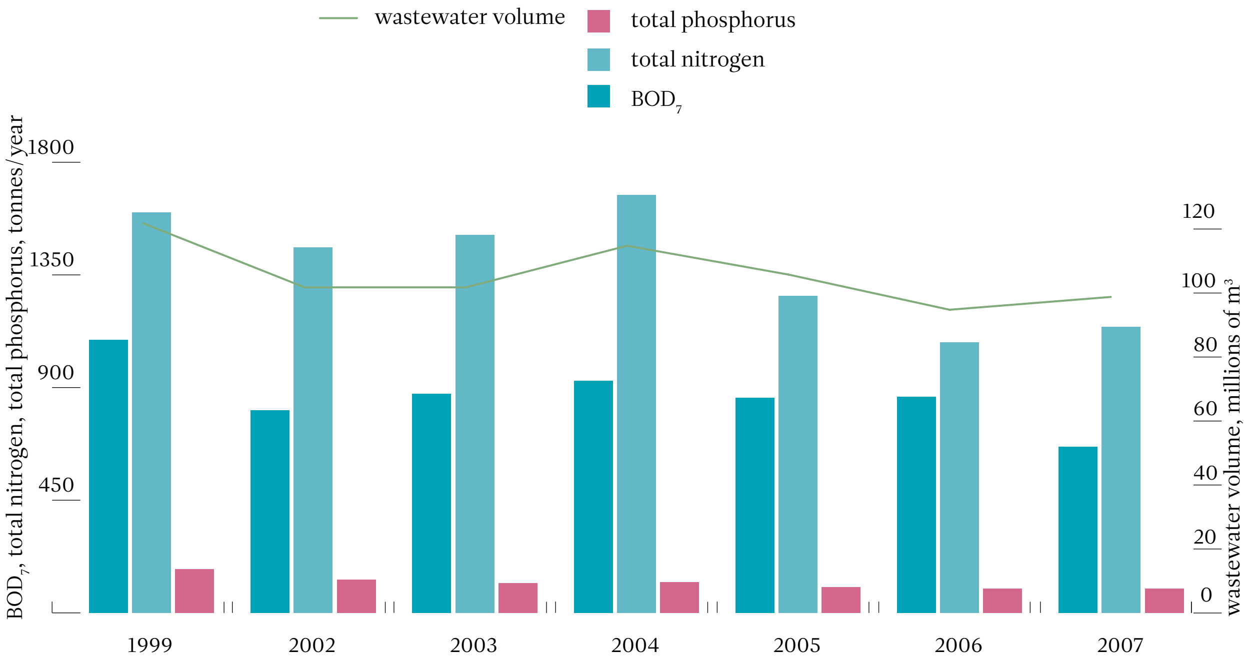


Figure 6.9. Pollution load in settlements with over 2000 human equivalent in Estonia in 1999 and 2002–2007. Data: EEIC.

[H] Population equivalent – unit representing the average water pollution load caused per capita in a 24-hour period.

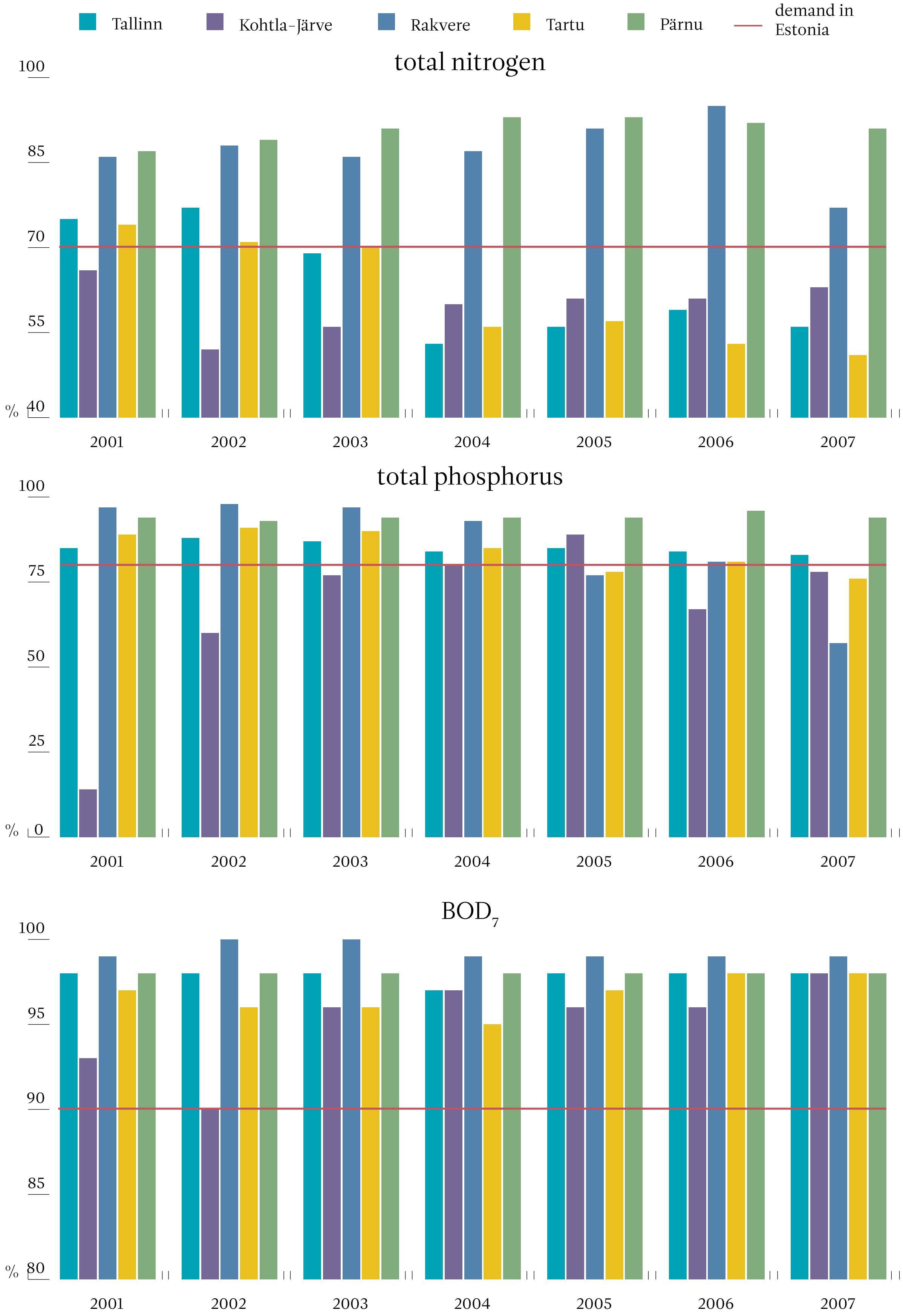
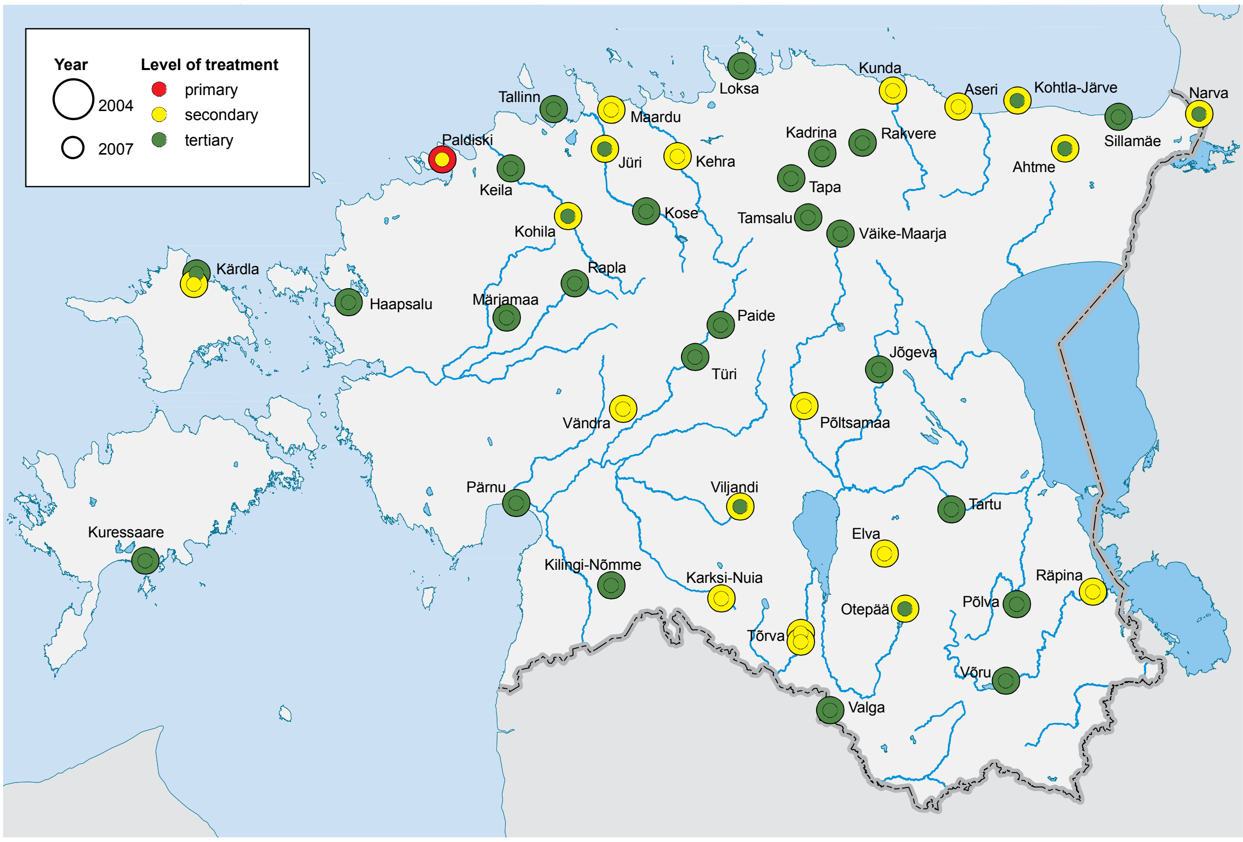


Figure 6.10. Efficiency of wastewater treatment plants over 100,000 population equivalent according to biochemical oxygen demand (BOD_7), total phosphorus and total nitrogen in 2001–2007. Data: EEIC.



Map 6.2. Treatment of wastewater in settlements of over 2000 population equivalent in 2004 and 2007. Data: EEIC.

6.4. Status of water

6.4.1. Groundwater status

Groundwater is the primary source of drinking water, which is why monitoring the status of groundwater is of key importance. The Water Act stipulates that the status of groundwater must be kept as close to natural as possible. This objective is set out in Minister of the Environment regulation no. 47 of 10 May 2004, "Water classes for groundwater bodies, values of quality indicators corresponding to water classes and procedures for determining water classes". A total of 15 different groundwater bodies have been identified in Estonia on the basis of the primary groundwater layers, and the status of each is evaluated according to various qualitative indicators (figure 6.11).

The status of the Ordovician Ida-Viru **oil shale basin groundwater body is poor** due to high sulphate content, high mineral content, hardness and presence of hazardous substances (above all phenols). In addition to Ida-Viru County, limited groundwater contamination or quality impairment is seen above all in the case of the Silurian-Ordovician **groundwater bodies** with unprotected groundwater in all of Estonia. **The overall qualitative status of other groundwater bodies in Estonia can be considered good.**

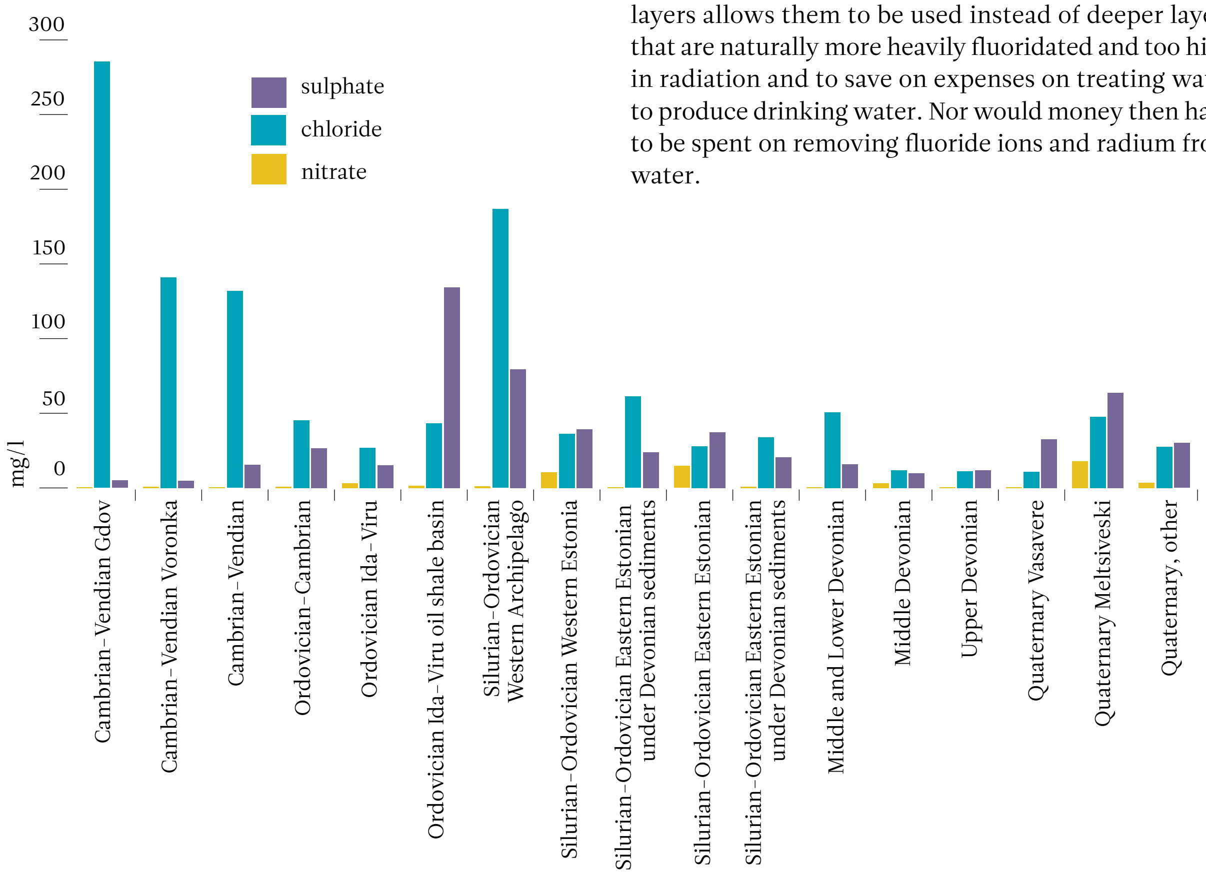


Figure 6.11. Average values of selected quality indicators for groundwater bodies, 2006–2008. Data: EEIC.

The **Pandivere and Adavere-Põltsamaa nitrate vulnerable zone (NVZ)** has a territory of 3250 km², which is 7% of Estonia's total area. The quality of the upper groundwater layers of the NVZ improved (as measured by nitrate ion concentration) up until 1995, after which time the groundwater quality was relatively stable. Starting in 2006, nitrate concentration has risen significantly. In the Pandivere area's groundwater, nitrate concentration rose in 2008 to the highest levels of the post-independence period (figure 6.12). The reason for this is the resumption of intensive agricultural production, but apparently also the weather conditions in 2007–2008 – the warm winter of 2007 and the rainy summer of 2008 promoted leaching of nitrates from the soil into surface water and groundwater.

There are few data on how agriculture impacts groundwater outside of the NVZ. In 2006, the contamination of the Tapa water intake areas located in a nitrate vulnerable area was likely caused by the careless use of organic fertilizers in the vicinity of the catchment area.

A fair number of residual polluted areas – former military and industrial sites – originate from the so-called socialist era and pose a direct threat to the environment. All of the abandoned hazardous liquid waste, including storage tanks containing oil shale waste from old asphalt concrete plants, must be eliminated.

Keeping the water quality good in upper groundwater layers allows them to be used instead of deeper layers that are naturally more heavily fluoridated and too high in radiation and to save on expenses on treating water to produce drinking water. Nor would money then have to be spent on removing fluoride ions and radium from water.

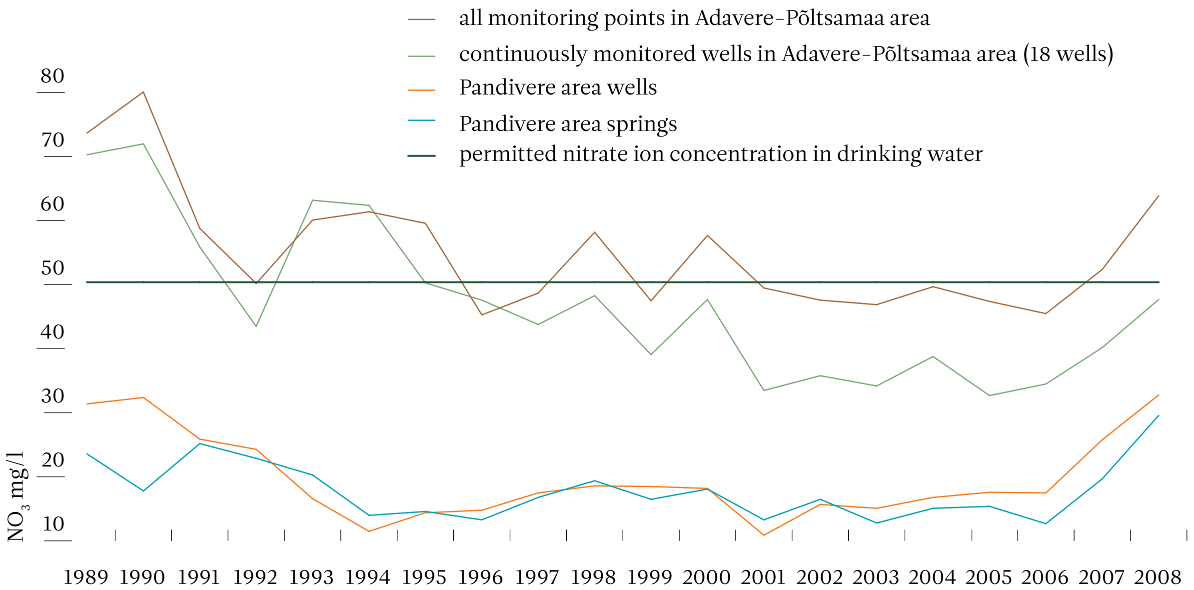
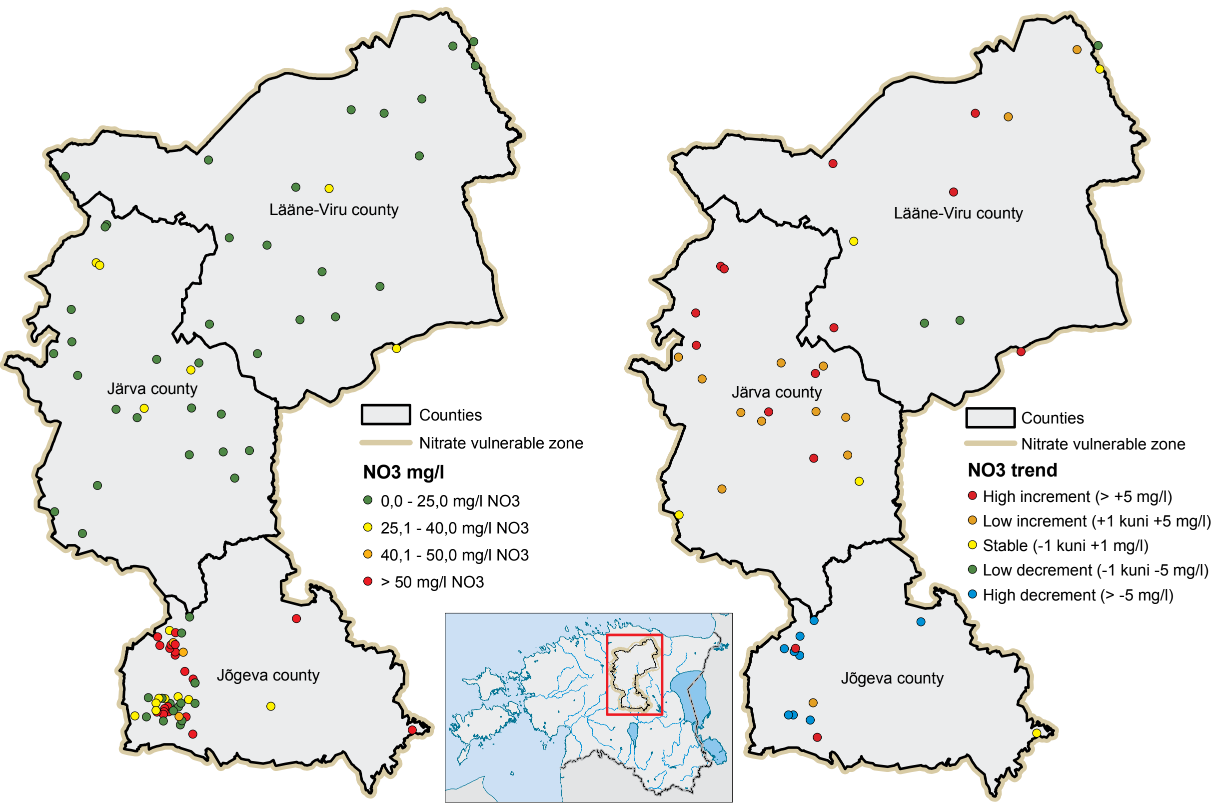


Figure 6.12. Changes in nitrate concentrations in upper groundwater layers in Pandivere and Adavere-Põltsamaa NVZ in 1989–2008. Data: EEIC.



Map 6.3. Average nitrate concentration in groundwater in NVZ and changes in the last decade. Data: EEIC.

6.4.2. Evaluating the status of surface water bodies

Ensuring water quality and ecological balance is important on both the local and the international level. The primary objective of the EU's framework policy is thus to ensure that the status of water bodies and groundwater is good in all EU countries. In order to learn which are the problematic water bodies, what causes them to be in poor condition, and how to improve the situation, first the status of water bodies is evaluated. The assessment of the state of water bodies is the basis for preparing the programme of measures for water management plans to bring water bodies that are in moderate and poor condition into good condition. If necessary, restrictions are established to prevent the condition of water bodies that have a good and high status from becoming worse.

The assessment of the state of water bodies set out in this overview covers the period from 2004–2008 and is based on the relevant regulation of the Minister of the Environment[1].

The evaluation of the ecological status of rivers, lakes and coastal waters is based on three groups of quality elements: biological, hydromorphological and physical-chemical quality indicators. The main emphasis is on the aquatic biota – evaluating biological quality elements which depending on the type of body of water are phytoplankton, phytobenthos, macrophytes, zoobenthos and fish. Hydromorphological conditions include water regime, flow rate, weirs and other obstacles on rivers and depth and width of the body of water. Physical chemical indicators are water temperature, oxygen content, transparency and nutrient content.

Besides the ecological status, the chemical condition of the water is also evaluated – i.e. pollutant levels are determined (such as heavy metals, plant protection products, hazardous substances) and whether they exceed the established limits or not.

In evaluating the status of the body of water, the body of water being studied is compared to quality indicators for a similar comparison body of water that is in a natural condition unimpacted by human activity. The combined rating is for the most part assigned based on the worst biological quality element.

The rating is expressed on the basis of a five-level classification:

- **high status** – lack of or minimal human impact, biological quality element elements conform to the comparison criteria with minimum deviation;
- **good status** — human impact is low, biological quality element values indicate minor deviation due to human activity from comparison conditions;
- **moderate status** — human impact is moderate, biological quality element values vary moderately from comparison conditions and indicate more major disruption than in the case of good status;
- **poor status** —human impact is strong, and the biological quality element values deviate strongly from the comparison conditions or a large share of conventional biological communities is lacking;
- **bad status** — human impact is very strong, biological quality element values deviate strongly from the comparison conditions or biota is lacking altogether.

[1] The Minister of the Environment Regulation no. 44 of 28 July 2009, "Procedures for establishing surface water bodies, list of surface water bodies whose status class is to be determined, status classes for surface water bodies and procedures for determining quality indicator values corresponding to the status classes".

6.4.3. State of the Estonian coastal waters

The state of the coastal waters is impacted by nutrient load originating from land, processes taking place in the coastal sea and exchange of water and matter with the open sea.

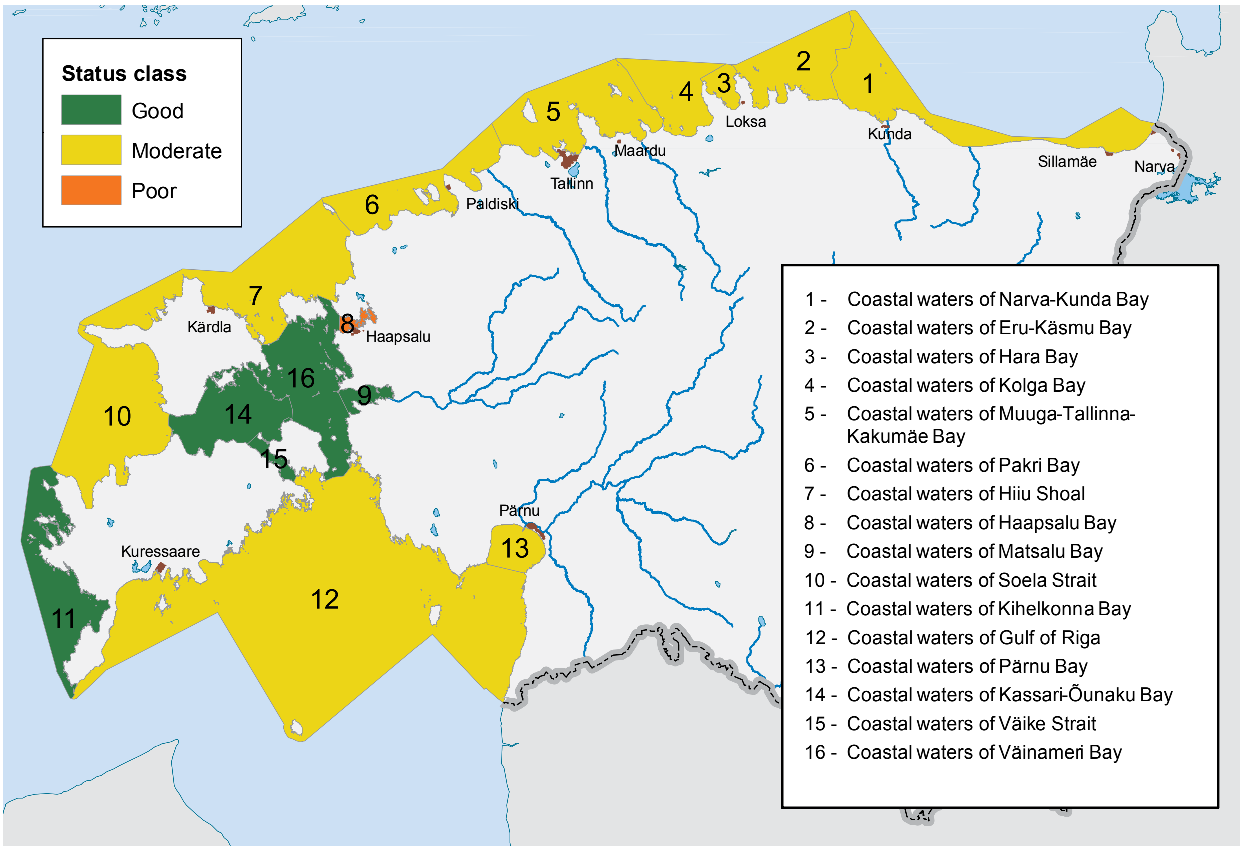
The Estonian coastal sea is divided based on physical-ecological conditions into 16 water bodies. None of the water bodies met the requirements of "high" quality class, while 4 water bodies were classified as "good" and as "moderate". The only water body to be classified "poor" was Haapsalu Bay (map 6.4).

The status of the macroinvertebrates of the Bay of Haapsalu is poor and the status of the aquatic flora is good, but due to the poor status of the physical-chemical quality elements as well as of the phytoplankton, the combined rating was nevertheless "poor". It should be stressed that the wastewater from the city of Haapsalu has been treated since 1998 in a contemporary treatment plant. Key reasons for the poor status of the bay are the shallowness of the water body, the low water exchange rate and nutrients released from the sediment. The Haapsalu Bay is also a massive nesting area for birds, which increases the bay's pollution load significantly. The area has also been declared a problem area in past assessments, and ongoing monitoring of the coastal waters is performed there.

The factors that result in a drop in status class are mainly physical-chemical or phytoplankton indicators. In a number of cases, a water body has been classified in "moderate" condition not due to a load arising from a coastal sea catchment area but from the general condition of the Baltic Sea. In such cases, measures implemented within the catchment area are not sufficient but rather international measures pertaining to the entire Baltic Sea must be the basis.

The data for the Pärnu Bay and the Gulf of Riga clearly show a reduction in concentrations of phosphorus. On the other hand, nitrogen concentrations have remained on the same level. In Narva Bay, a certain increase in nitrogen and phosphorus concentrations can be seen compared to the 1990s, but in recent years the upward trend has abated. From the beginning of the 2000s, nitrogen concentrations in the Tallinn area have started growing, but phosphorus has started diminishing.

It is difficult to identify a clear trend in the case of phytoplankton chlorophyll a. Both in the Tallinn-Muuga area and in the Narva Bay, a trend of growth in concentrations of chlorophyll a can be noted in summer. The average chlorophyll content in seawater has been ascertained in the Tallinn area and Narva Bay for the periods 1993–2001, 2002–2006 and 2007–2008. In the Tallinn area, the results are 3.5, 4.5 and 5.0 mg/m^3, respectively; in the Bay of Narva, 3.9, 6.1 and 6.5 mg/m^3.



Map 6.4. Evaluation of the ecological status of marine water bodies in 2004–2008. Data: EEIC.

6.4.4. Status of rivers

Proceeding from the requirements of the Water Framework Directive, Estonian rivers, streams and ditches with a drainage area of more than 10 km^2 were divided based on their type and condition into water bodies. A total of 639 water bodies were identified. The status of water bodies was assessed on the basis of monitoring data or, in the absence of such data, on the basis of expert judgement on pressure factors. In the case of 443 water bodies (69% of the total), there was availability of comprehensive monitoring data or data which characterized at least one biological quality element. For the remaining 196 water bodies (predominantly smaller rivers, streams and ditches) the status was rated on the basis of expert opinions. The status was determined based on the poorest biological quality element or according to combined water quality status (table 6.2, figure 6.13, maps 6.5 and 6.6).

Of the 639 water bodies identified in Estonia, 9 (about 1%) were in high status, 469 (about 74%) were in good status, 143 (about 22%) in moderate status and 21 (about 3%) in poor status. None of the water bodies was in bad status.

Water quality was assessed only in water bodies belonging to the national hydrochemical river monitoring programme. There are 50 of such bodies, which makes up only 8% of all water bodies. Water quality was rated poor in the rivers Selja and Vääna, and moderate in two Keila river bodies as well as in the midstream of the Jägala River and in the Pudisoo River. Individual water samples were taken primarily in the course of hydrobiological river monitoring in an additional 165 water bodies, but it is difficult to reliably evaluate water quality on the basis of these samples, which were predominantly taken in summer and often in low water period. Thus these data were considered as additional data in interpreting biological quality indicators, but the combined ecological rating was not lowered on the basis of these data.

The fairly good water quality in Estonia's water bodies is also corroborated by the rating given to **phytobenthos** – the aquatic flora near and on the bottom of the body of water, in terms of which none of the rivers in Estonia is in poor condition and only 7 are in fair condition. Diatoms indicate above all how nutrient-rich the river water is (the trophic level) and thus the ratings coincide fairly well with water quality ratings.

The status of macroinvertebrates was evaluated in 366 water bodies, i.e. 57% of all bodies evaluated. According to this indicator, most of our water bodies are in good or high status, while 13% are in moderate and 2% and 1% are in poor and bad status, respectively. Macroinvertebrates are sensitive above all to organic pollution and to fluctuations in the water level due to land improvement and hydroelectric power plants.

The status of **fish populations** could be evaluated in the case of one-half of the water bodies. The status of fish was good or high in 70% of the flowing water bodies, 25% in moderate, 4% in poor and 1% in bad status. Fish was the sole factor responsible for a moderate or poor rating in the case of 60 bodies, which is 40% of all of the bodies rated fair or worse on the basis of the monitoring data. A primary reason for the generally fairly poor condition of fish life was the dams on rivers, which fragment the river into isolated segments and impede access to spawning areas for migratory fish as well as non-migratory fish species. Of the 95 water bodies with moderate or poor fish life, 60 of them had a total 148 dams. Additionally there are numerous other human or beaver-constructed dams on many tributaries and streams. On the rest of the water bodies, fish was most impacted by work performed during land improvement such as straightening of rivers and lowering of the water level, as a result of which the water regime has changed and spawning areas have been left dry or buried under sediment. **The water quality itself is a limiting factor for fish in only a few water bodies.**

The status of water bodies is the best in Matsalu and the Western Archipelago river basin sub-districts with a relatively smaller human impact. The share of moderate and poor water bodies is the highest (about 50%) in the Pandivere sub-district, where the primary pressure factors (agriculture, wastewater release, land improvement and weirs) have a stronger impact. One reason for the less than good status of the Viru sub-district, aside from the abovementioned factors, is the oil shale industry. The status of rivers in the Harju sub-district is lower than the Estonian average, presumably due to the dense population of Tallinn and its environs and numerous dams on rivers.

Table 6.2. Ecological status of Estonian water bodies in 2004–2008. Data: EEIC.

	High	Good	Moderate	Poor	Bad	Water bodies evaluated
Fish	22	200	80	13	2	317
Macroinver-tebrates	145	165	46	6	4	366
Phytobenthos	58	39	7	0	0	104
Water quality	20	24	4	2	0	50
Combined rating	8	468	141	21	0	639

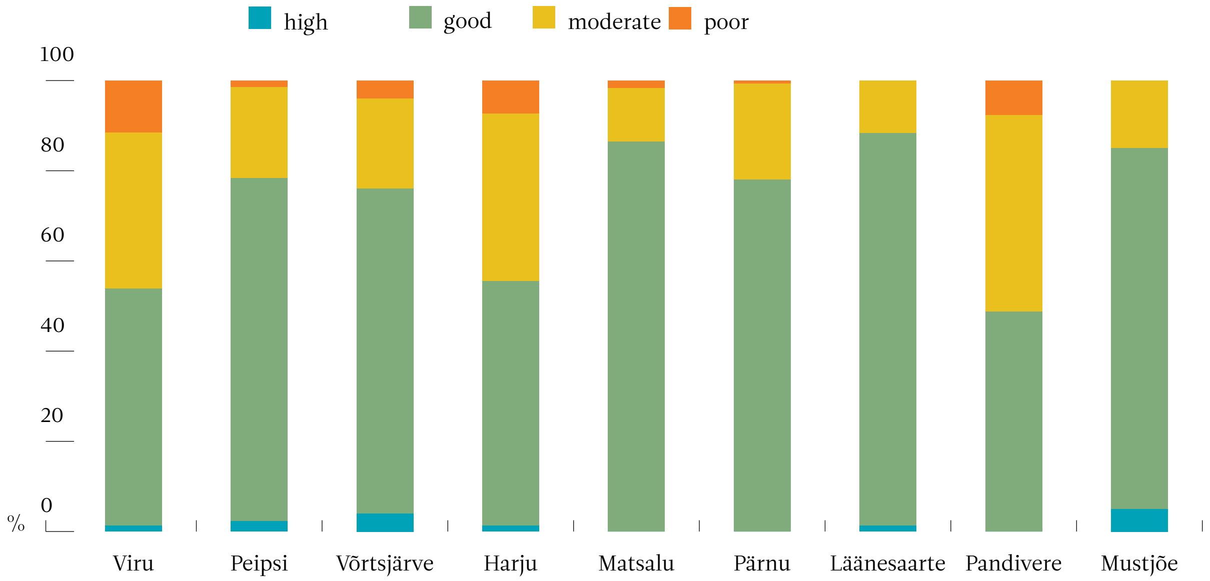
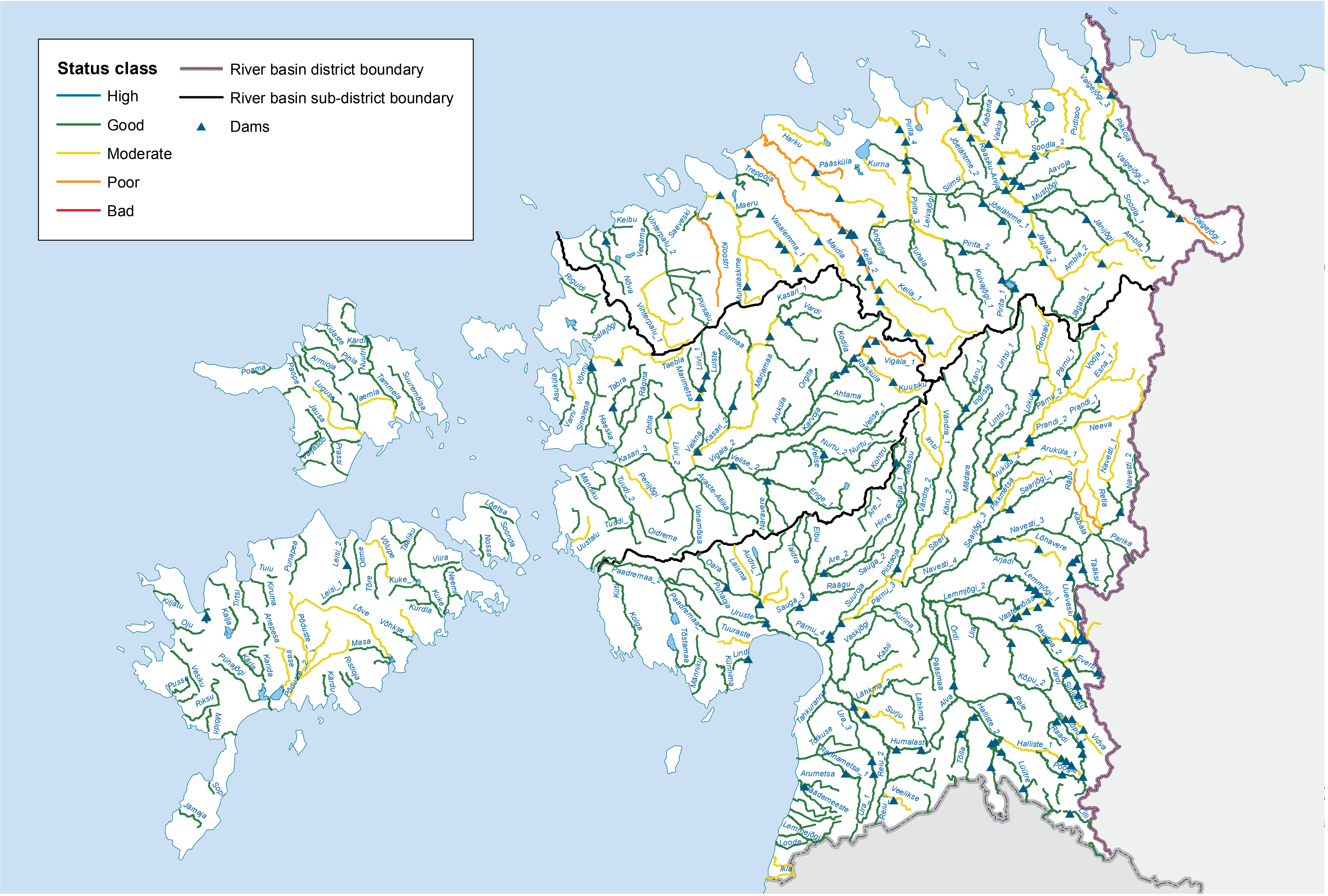
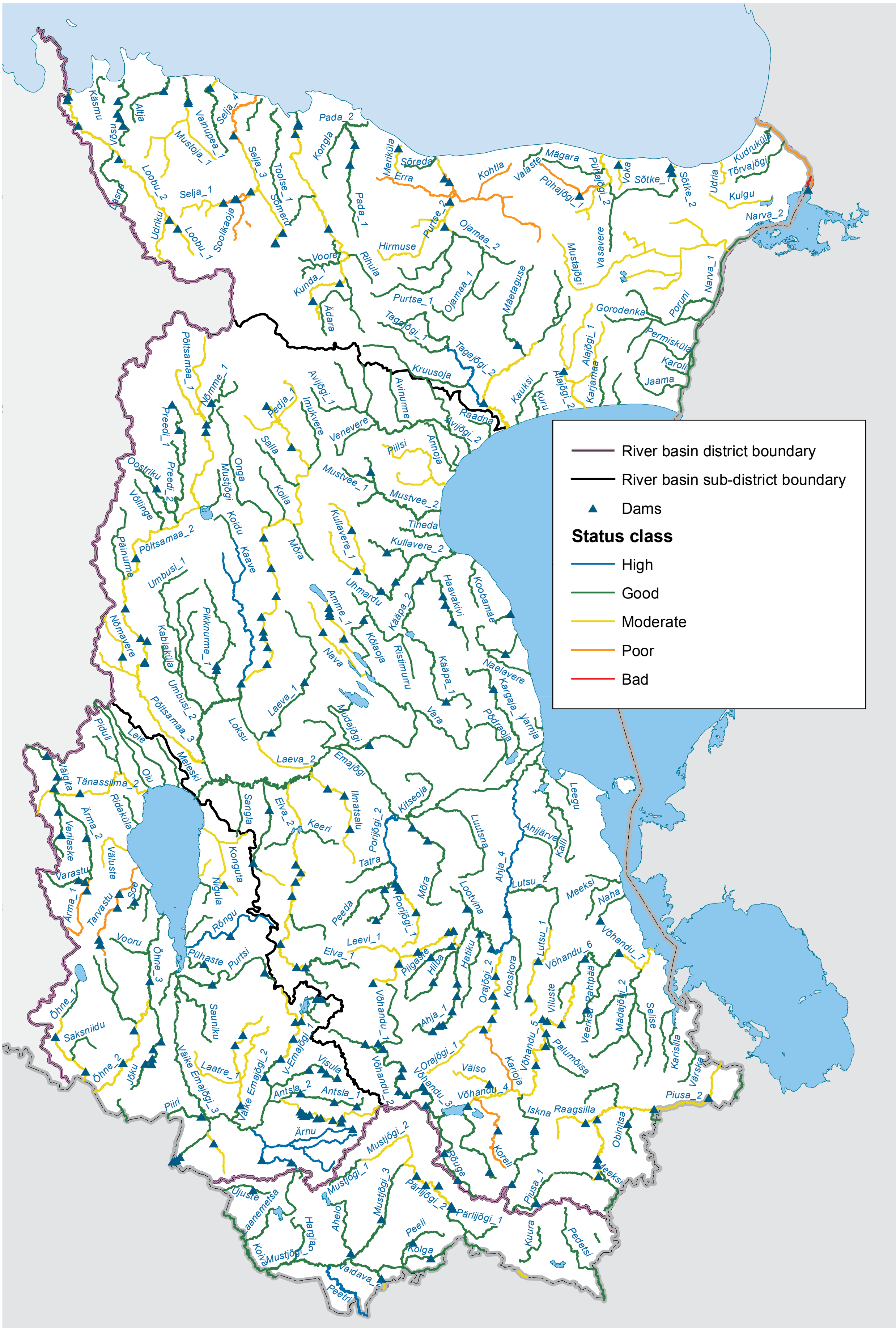


Figure 6.13. Ecological status of rivers in the years 2004–2008 by river basin sub-districts. Data: EEIC.



Map 6.5. Ecological status of the West Estonian water bodies in 2004–2008. Data: EEIC.



Map 6.6. Ecological status of the East Estonian and Koiva river basin districts. Data: EEIC.

6.4.5. Status of lakes

The ecological status of lakes was assessed on the basis of biological and physico- chemical quality indicators. In the process, the status of fish was not taken into account as the determination of class boundaries for fish is still in progress.

On the basis of the rating, most Estonian lakes are in the "good" or "moderate" status (figure 6.14). The so-called 2/3 rule was used to assess the status of lakes. According to this rule, at least one quality indicator was to be used from each biological quality element and physico-chemical general conditions. The number of quality indicators used had to be at least seven, with all of the indicators having equal weight. The status rating is assigned to the status category of 2/3 of the indicators. Some of the quality indicator values may indicate a quality lower than that of the combined rating, but the number of such quality indicators should not exceed 1/3 of the total number of indicators.

The ecological status of **Lake Peipsi and Lake Pskov** has worsened in recent years. This is above all due to eutrophication from excessive phosphorus load. The percentage of blue-green algae with respect to all algae has increased in the summer months, while diatom biomass has decreased. Algal toxin concentrations in water have repeatedly exceeded the permitted limit values for bathing water. Due to the proliferation of algae, fish spawns have become muddy and fish reproduction conditions have worsened. Overall, the ecological status of Lake Peipsi was rated moderate and that of Lake Pskov, poor.

The ecological status of **Narva reservoir** has remained relatively stable in this decade. For the most part, the reservoir's ecosystem behaves similarly to the northern part of Lake Peipsi. In the last few years, a rise in both phosphorus and nitrogen concentrations has been observed in Narva reservoir. Phytoplankton concentrations have also increased – especially blue-green algae biomass and chlorophyll a concentrations – as a result of which the ecological status of the reservoir was rated moderate.

The indicators for the status of **Lake Võrtsjärv** depend significantly on the lake's water level, which in recent years has been quite low. For this reason, the water quality and status of the phytoplankton in this water body were assessed on the basis of data for the last 10 years. The combined rating of the ecological status of Lake Võrtsjärv on the basis of phytoplankton, macrophytes and water quality was deemed good. The major fluctuations in the water level of recent years make it difficult to distinguish between natural and anthropogenic changes and thus reduce the reliability of the rating.

Status of **smaller lakes**. The existing data made it possible to assess the status of 152 small lakes[J] (figure 6.14, map 6.7). Of the lakes assessed, 17 were in high status, 76 were in good status, 50 were in moderate and 9 were in poor status. The status of macrophytes in Estonian lakes is the poorest indicator. Regarding water quality it can be said that on the basis of nitrogen, over half of the lakes were in moderate or worse condition, while on the basis of phosphorus, slightly over 20% of the lakes were in moderate or worse status. Of the largest lakes, Ülemiste, Maardu and Harku in Harju County were in moderate condition, as were Kaiavere in Jõgeva County and Vagula and Tamula lakes in Võru County. The condition of Veisjärv in Viljandi County is poor.

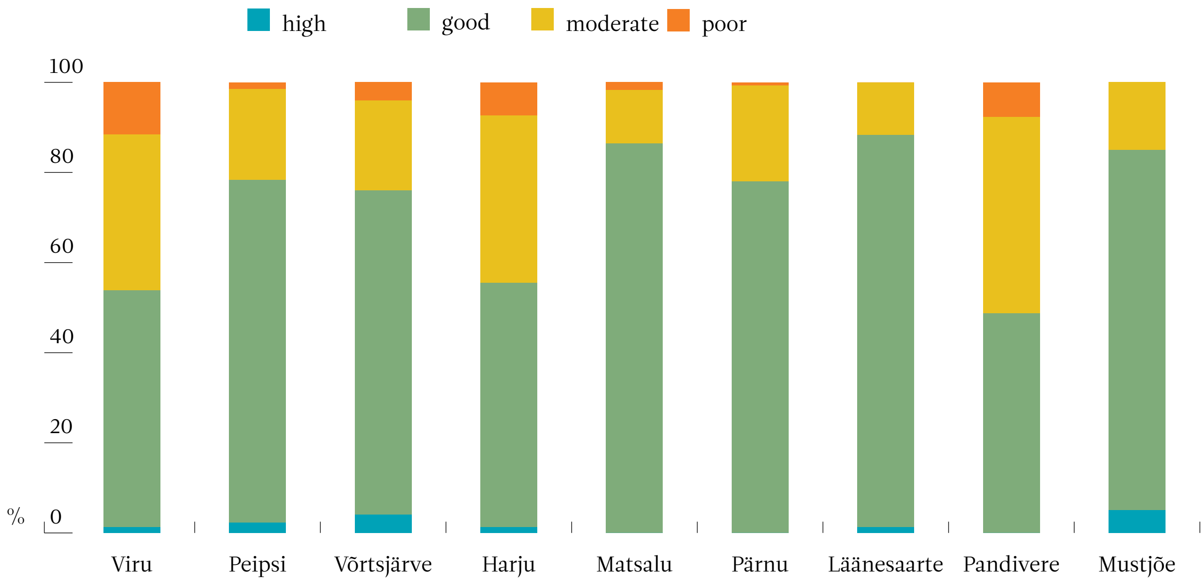
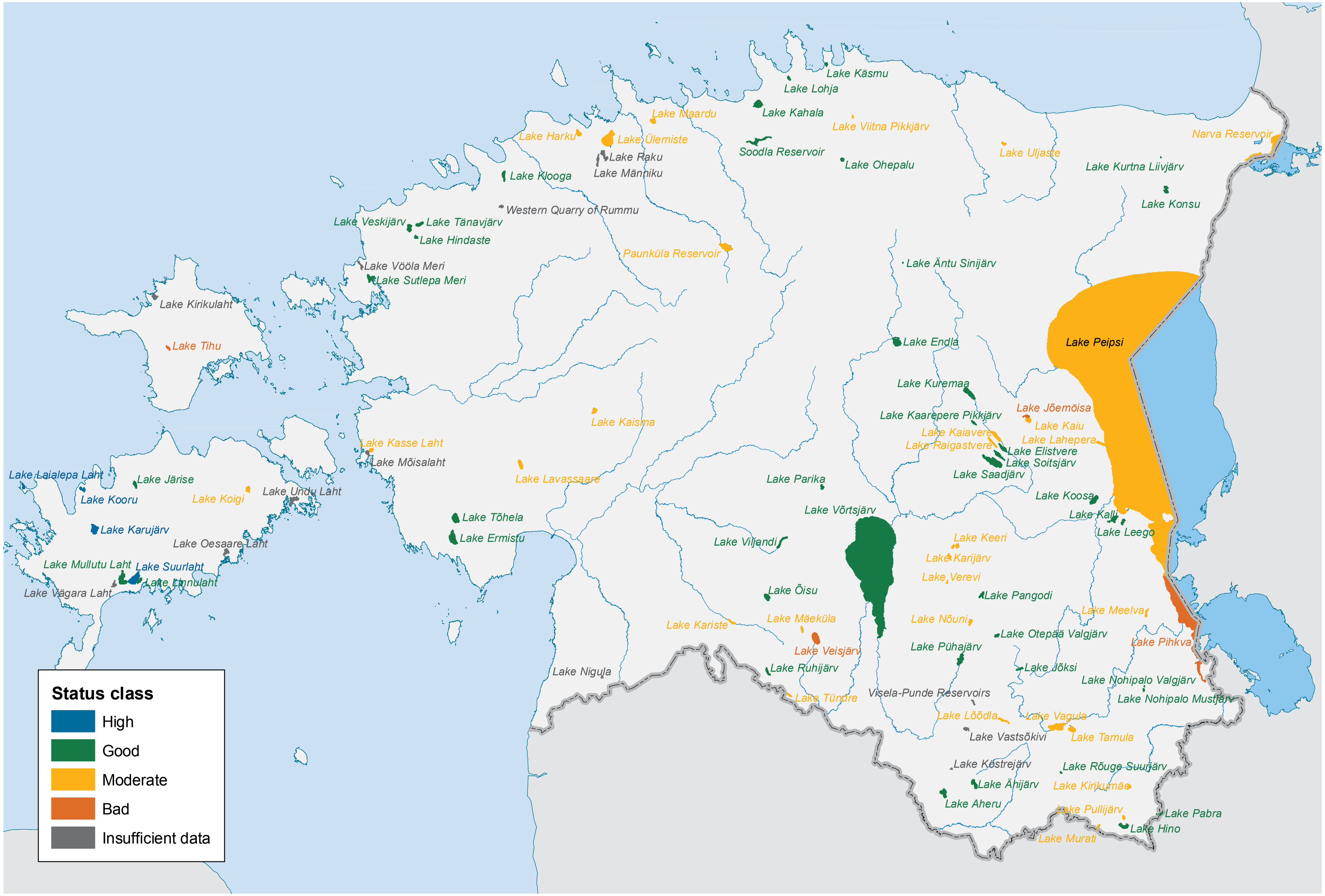


Figure 6.14. Ecological status of small lakes in Estonia, 2004–2008. The number indicates the number of lakes in the given status class. Data: EEIC.

Read more:

- Advanced WISE water map viewer.
[WWW] http://www.eea.europa.eu/themes/water/mapviewers/advanced-wise-viewer/
- Estonian Environment Information Centre website.
[WWW] http://www.keskkonnainfo.ee/index.php?lan=EN&sid=2&tid=2 (state of environment)
- Ministry of the Environment website.
[WWW] http://www.envir.ee/67250 (water)

[J] Small lakes – all lakes besides Peipsi, Pskov and Võrtsjärv.



Map 6.7. Ecological status of lakes, 2004–2008. Data: EEIC.

7. Soil and land use

7. Soil and land use

Soil frequently goes unnoticed, yet it is a very crucial component in land-based ecosystems. Soil is closely connected with land cover and the food on our tables. Soil quality has a direct impact on water quality, and water becomes purified as it filters through the soil. Soil is thus the basis of diversity of biota and landscapes. As soil is under pressure from increased human activity, soil needs protection, just like animals, birds, air and water. Without examining the condition of the soil, it is not certain that the benefits provided by the soil will be lasting. In planning protection, it is first necessary to know the condition of the soil and factors that put pressure on the soil.As mentioned, soil is related to land cover, and the latter is related in turn to land use. Results of analysis of CORINE Land Cover data show that in the period from 2000–2006 Estonia gained 18.2 km² of built-up areas. The new residential areas were built primarily on formerly agricultural land (12.2 km²). These are large figures, as building on natural areas (with residential buildings, parking lots, roads) exerts an irreversible impact on the soil and biota in such places – former cropland that has been turned into land underlying buildings or the vicinity of such land can no longer be restored to or used for its former purpose.

7.1. Soil

7.1.1. Legal background

Legislation in Estonia and many other European countries treat soil topics fairly modestly. Neither Estonia nor the European Union has a separate Soil Act on soils and soil conservation. Recognizing that soil, as a component of land-based ecosystems with many important functions, is under ever-increasing pressure (unsuitable methods used in agriculture, forestry and industry and urban development), the European Commission has prepared a draft soil framework directive. Establishing the directive has become hindered, however. The purpose of the soil directive is to ensure, through a single framework for soil conservation, that soils are in good condition in the EU member states. The directive's measures related to improving soil health impose requirements on the private sector as soil is primarily in private ownership.

Estonian legal acts include a chapter on soil in the Earth's Crust Act, while the Land Improvement Act and the Plant Protection Act mention soil monitoring. One of the most important legislative acts that sets forth activities related to the soil is the Minister of Agriculture regulation entitled "Detailed requirements for obtaining agri-environment support and detailed procedures for applying for assistance, processing applications and disbursement of assistance".

Producers that join the agri-environment support programme are obliged to collect soil samples from their cropland and to ascertain mobile phosphorus and potassium concentrations, soil reaction and organic matter content in their arable soils. As a result, it is possible to evaluate use of cropland and plan agricultural technology suited to a particular soil type – an important part of cropland soil conservation.

The topic of soil conservation is also addressed by the Estonian Environmental Strategy 2030, which sets the objective of environmentally friendly use of natural and cultural landscapes as well as preventing buildings and roads from being established in too many areas in the course of development and construction activity.

7.1.2. Soil formation

Soil is created as a result of long-term natural processes that take place over the long term. The primary factors that shape the soil are climate, the parent material (mineral or rock on which the mineral fraction of soils is based), the relief of the surface of the land, the age of the soil and the time spent on soil formation and the action of a number of plants and micro- and macroorganisms. The mutual actions of soil and plants are the driving force behind soil formation – naturally occurring plants colonize places that are suitable for their growth and shape surface soil into contours that are suitable for their growth. Soil plays an important part in delivering the water and nutrients that plants need. Soil is inhabited by millions of microorganisms (bacteria, fungi etc) and macroorganisms (earthworms, insects, arachnids etc), which, among many other functions, convert nutrients into forms available to plants, thus taking part actively in soil formation. In the course of the biochemical processes, new and more complicated forms of organic matter are created – such as humus, the embodiment of soil fertility. Soil comprises not only the humus-rich topsoil – dark in colour from organic matter – but also includes layers to a depth of several metres, to which plant roots extend, where soil organisms also are active and where the effects of humus can be noted.

Estonian soil is shaped by the following key processes:

- topsoil formation – formation of humus and humus layer; occurs in nearly all soils;
- clay formation and accumulation – upon weathering, clay minerals are created and form complex bonds with the humus in the soil, and the soil profile or part of the soil profile becomes enriched with clay particles;
- lessivation – migration of clay particles from upper levels of the soil to lower levels through the action of water and gravity;
- pseudopodzolisation – temporary combined action of surface water and precipitation and lessivation at the boundary of layers with a different soil texture or in the uppermost layers of clay and clay-sand;
- podzolisation – decomposition of minerals and organic matter in the soil due to the action of humic acids and elluviation of products of the decomposition from the soil;
- gleying – creation of bluish or greenish-grey patches and layers in anaerobic or waterlogged conditions, as the oxygen necessary for converting organic matter is extracted from mineral com pounds. Fe^{3+} compounds are reduced to Fe^{2+} compounds;
- peat formation – seen in soils where organic matter does not decompose due to waterlogged conditions.

7.1.3. Characteristics of Estonian soils

The most important characteristics of soils are the soil type, texture type (ratio of clay to sand), structural grade, acidity, humus content, thickness of the topsoil, mineral nutrient content, existence of water, air and warmth and soil biota.

In Estonia, the primary factors responsible for distinctions between soils are the chemical composition of the source mineral (calcareousness, nutrient supply), soil structural type, rockiness and water conditions (drought-susceptible or dry, moist, excessively moist).

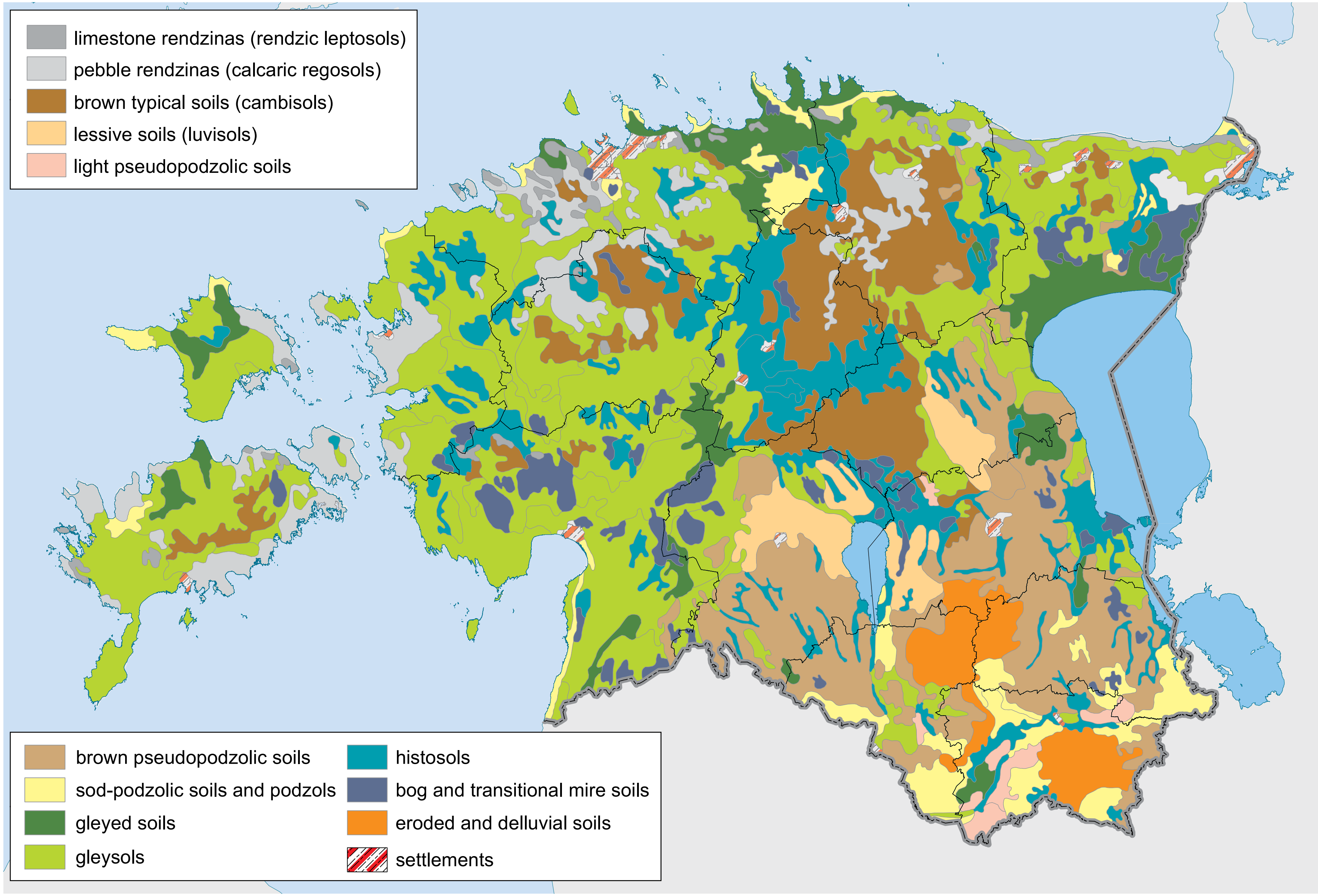
The following characteristics describe Estonian soil:

- great variability of the soil;
- extensive range of calcareous soils;
- high percentage of soils that have excessive moisture;
- occurrence of limestone rock in the soil profile and high rockiness of soils.

The classification of Estonian soils distinguishes between around a dozen soil types and within these, nearly a hundred subcategories of soil. The most common soils are calcareous rendzinas, cambisols (typical brown soils), and podzolic (lessive) soils, pseudopodzolic soils, sod-podzolic soils, podzols, gleyed soils (moist soils), gleysols (wet soils) and histosols (map 7.1).

Soil maps on very different scales have been prepared for Estonia and a number of them have now been updated. The soil map in this publication is based on the 1: 1 000 000 scale Estonian soil map. Perhaps the most valuable resource for ordinary users is the 1:10,000 digital soil map compiled in 1997–2001, which along with the corresponding database is available on the Land Board website (www.maaamet.ee). The digital map is a good way above all for farmers to learn about their soils and use them accordingly.

Land use is determined primarily by soil fertility. As a result, more fertile land is in agricultural use and less fertile land is used in forestry. Often settlements and technical works are built on more productive soils as human settlement develop on better lands.



Map 7.1. Estonia's primary soil types. Based on the 1 : 1 000 000 scale Estonian soil map. Data: ARC, compiled on the basis of L. Rooma and L. Reintam.

7.1.4. Soil status

The status of soils in natural areas is based predominantly on natural soil formation processes and is thus fairly easy to predict and self-regulating. Today, human activity is having an increasing impact on soil properties. The smaller changes in forest management occur in connection with management of forests – erosion risk, removal of nutrients, regulation of the water regime, and compaction etc. More extensive changes in soil properties are brought about by agriculture (soil cultivation, fertilization, water regime regulation etc). Industry also has an indirect effect on soils (alkalization and acidification of soils) as do other sectors of the economy (erecting buildings on soil, soil displacement i.e. construction degradation).

Attention should be paid to a number of factors related to use of arable soils.

To restore and increase soil's humus supply, organic fertilizers should be used periodically, and if necessary, straw should be ploughed into the soil. Thanks to Estonia's soil and climatic conditions, the situation is not as urgent as it is in Western Europe.

A total of 30% of cropland soils suffer from phosphorus deficiency and 50% from potassium deficiency. Over time, the deficit has increased (figure 7.1). Returning nutrients to the soil is thus lacking and soil is left most in need of microelements.

Due to mineralization, the use of histosols (peaty soils) in agriculture reduces the thickness of the peat layer by an amount ranging from 1.4 cm per year (grassland) to 2.4 cm per year (cropland) and it also releases greenhouse gases into the air. Histosols (peat soils) are used on about 50,000 hectares of agricultural land.

In connection with intensive real estate development in recent years, the extent to which soil has been built up and the fertile soil layer removed has increased significantly. As a protective measure, soil fertility must be taken into account in planning processes.

Certain areas (map 7.2) are vulnerable to erosion. An analysis of land use conducted by the Centre for Agricultural Studies revealed that on the basis of land use, about 15,000 hectares of cropland soil had become eroded in 2008. In recent years, this amount increased at the expense of the figure for cultivated grasslands. In limited areas – especially in coastal areas with sandy soils – there is the risk of deflation (wind dispersal, wind erosion).

The compaction of soils has decreased compared to the end of the 1980s, but the renewed intensification of agriculture may aggravate the problem yet again. Soil monitoring has disclosed the first signs of this happening.

The levels of plant protection products and pollutants in soil are in general low. Residues such as DDT that are very slow to break down continue to be a problem to this day.

The soils of southern Estonia, based on an acidic parent material, are too acidic and are not suitable for a number of crops. Thus soils must be limed in order to create a more favourable growing environment.

Producers' knowledge regarding their soils must be considered important as well. Knowledge of soils helps improve and adapt agrotechnology according to the particular soil conditions.

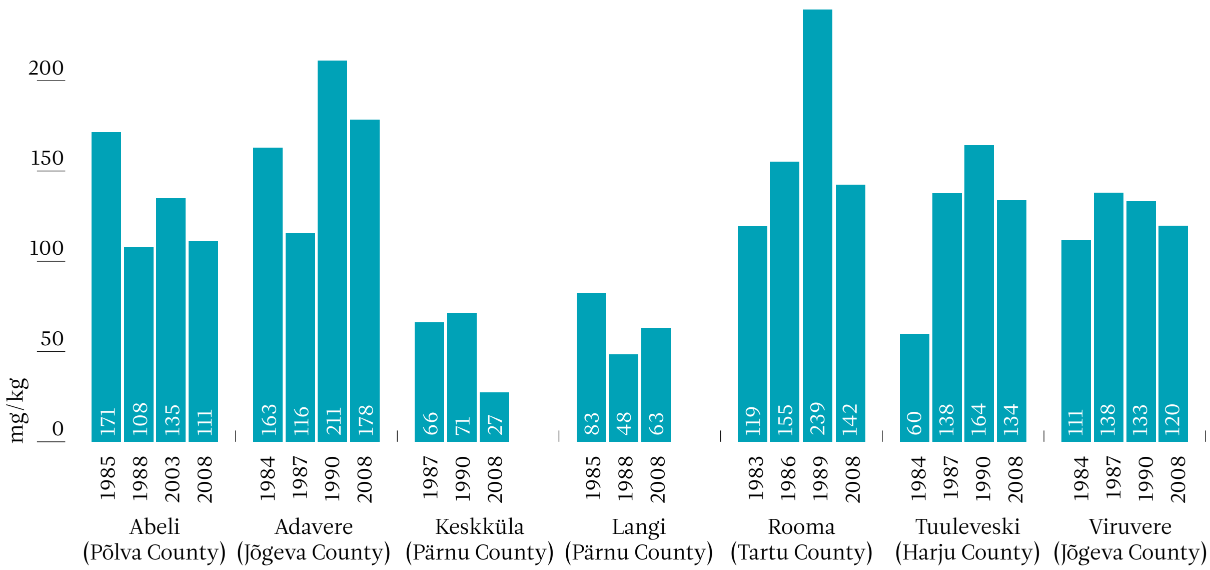
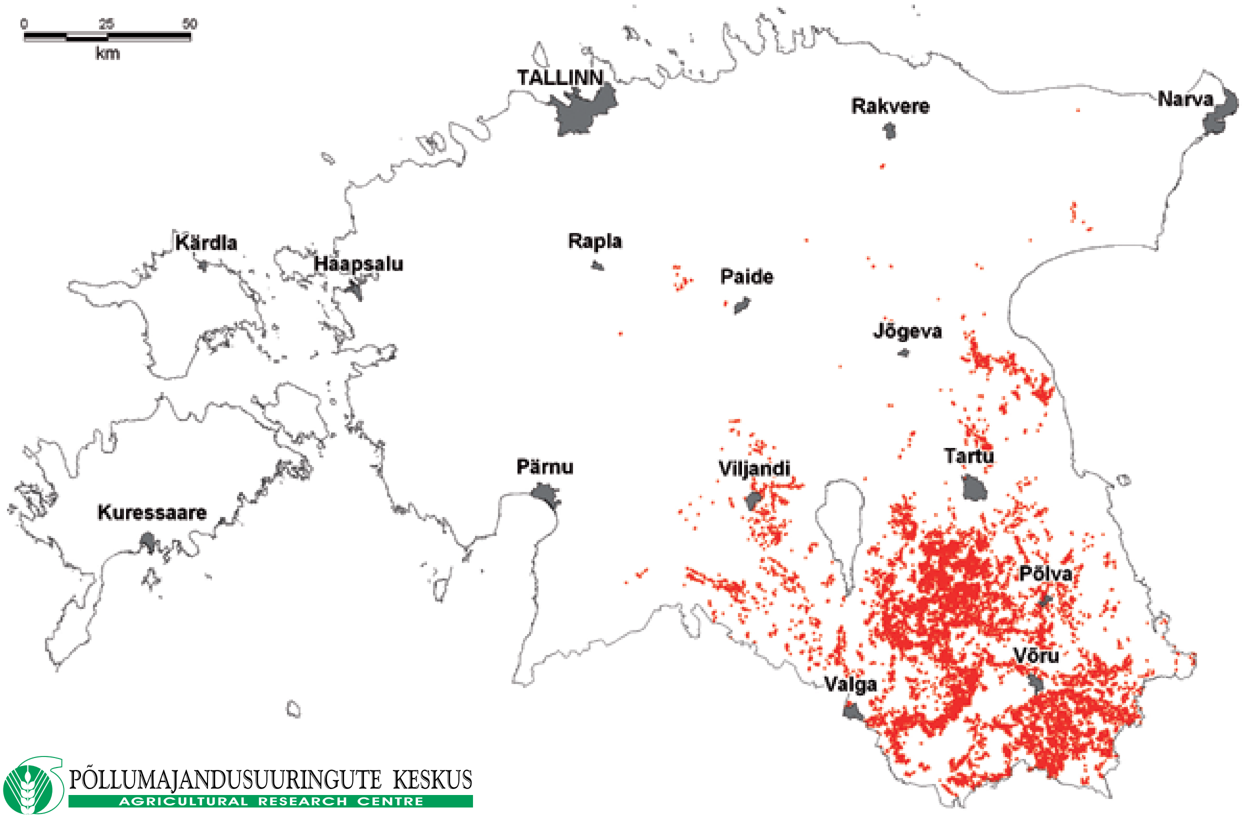


Figure 7.1. Mobile potassium concentrations on national environmental monitoring testing areas 1985–2008. Data: ARC.



Map 7.2 . Cropland complexes on eroded soil. Data: ARC.

Read more:

- Agriculture Research Centre website.
[WWW] http://pmk.agri.ee/est/index.php?sid=98&mid=18
(publications)
- Proposals for a soil framework directive. – European Commission.
[WWW] http://ec.europa.eu/environment/soil/pdf/
com_2006_0232_en.pdf

7.2. Changes in land use

7.2.1. Changes in land cover reflected in CORINE databases

CORINE Land Cover

CORINE Land Cover database is the outcome of a pan-European project in the course of which the land cover in different countries was mapped using the same categories and same methods. The result is a set of comprehensive data that are fairly comparable from one country to the next and can be used for domestic analyses as well. Three CORINE land cover maps have been prepared on Estonian territory, reflecting 1990, 2000 and 2006 (the year denotes the status characterized by the respective layer and is related to the date stamp on the satellite imaging used for the mapping). The existence of three layers reflecting different points in time allows changes in land cover to be analyzed.

Land cover can be either living or lifeless matter including artificial surfaces, agricultural cropland, forests, semi natural areas, wetlands and bodies of water. To a great degree, land cover expresses the impact of land use on the appearance of the surface of the land. Knowing these interrelations, it is possible to analyze land use to a considerable degree on the basis of land cover. **Land use** would perhaps be of more interest to us, but mapping it is much more labour-intensive. Land cover types can however be reliably identified from satellite images. Land cover distinguishes between different levels in the CORINE classification – the three most general ones are the same throughout Europe and the fourth – the most detailed level – varies slightly from one country to the next and is interpreted on the spot for Estonia. The classification, intended to encompass all of Europe, also distinguishes land cover units that are not especially important for Estonia (not all 12 land cover types are found in Estonia) and some of the land cover types that are important for us are not sufficiently distinguished (such as various marshes). The resolution of CORINE land cover mapping – the minimum mapping unit is 25 hectares (and in mapping changes, an area of 5 hectares) – is fairly general and undoubtedly impacts the results. The level of generalization of CORINE data means that minor changes in land cover are not reflected and that the actual changes are presumably somewhat more extensive than is evident from the data. Still, this data set gives a key overview of changes in land cover.

Analysis of the changes cannot distinguish actual changes in land cover from cartographic changes, which are the result of error corrections or varying interpretations. Nevertheless, we can suppose that there are not many such purely cartographic changes and that the results do characterize the actual changes in land cover with sufficient accuracy.

Changes in land cover on the basis of the CORINE data set

Changes in land cover in Estonia in 1990–2000 primarily had an effect on four land cover categories — the percentage of pastures and forest areas decreased and heterogeneous agricultural and transitional woodland-scrub areas increased. Changes in the rest of the land cover categories are minimal. They can be attributed to the fact that coastal pastureland has decreased, forests have been replaced by clear-cut areas and arable land has become overgrown.

In the period 2000–2006, land cover changes saw a partial continuation of the same trends seen in years past. Transitional **woodland-scrub areas** on mineral land are the land cover category that experienced the greatest net change in this period – a total of 658 km² gained primarily at the expense of forest land (including 295 km² at the expense of coniferous forests and 270 km² at the expense of mixed forests, and 68 km² at the expense of broad-leaved forests). This shows the extent of logging, as clear-cut areas are classified as transitional woodland-scrub areas in the CORINE land cover maps. The total area of these transitional areas covered with brush has increased somewhat at the expense of heterogeneous agricultural land and pastures (approx. 5 km² in each case) but the process of arable land becoming overgrown has slowed compared to the 1990s. The after-effects of logging in the previous decade can be seen in the loss of transitional woodland-scrub areas – a total of 229 km², of which 218.5 km² is on mineral land. These areas have primarily turned into broad-leaved forests (110 km²) and mixed forests (88 km²). Little coniferous forest has been accrued in comparison to clear-cut areas (10 km²). The logged areas that replaced forest are once more becoming forested: Logging has been more intensive in the 2000s but as the forest land (according to long-term use) has not been transformed into anything else, there is no cause to speak of significant changes. This is a situation where land cover changes temporarily (from forest to clear-cut area and back to forest) but the land use (profit-yielding forest land) does not change. The replacement of coniferous forests with broad-leaved forests does merit attention, however. As to what extent this involves the predominantly deciduous forest phase in the natural post-logging renewal process, after which the coniferous forest ultimately again returns, or to what extent the change is permanent, it is not possible to say on the basis of the CORINE data set.

In the period 2000–2006, Estonia gained 18.2 km² of discontinuous urban fabric. Residential areas were created primarily on formerly agricultural land (12.2 km²); 2.6 km² of construction site land turned into urban fabric, and 2 km² of natural grasslands and transitional areas. It is important to stress that in the CORINE land cover data set, most residential areas are classified as discontinuous urban fabric (such as the districts of Mustamäe, Lasnamäe and Annelinn). Only areas with adjoining block housing are classified as continuous urban fabric, i.e. if nothing besides potted plants fit between the buildings, figuratively speaking. The category of discontinuous urban fabric includes all of the new residential districts. If we add to this total the 4.6 km² new industrial and commercial areas (of which 2.2 km² are on former agricultural lands and 1.3 km² on forest land) and to a lesser degree other new built-up areas, we obtain a figure of 23 km² of new built-up areas.

There is a total of 8.2 km² of new construction sites, of which 5.6 km² are at the expense of former agricultural land and 2.6 km² of forest land. Where as 6% of the new residential areas were gained at the expense of forest land, a total of 30% of the new construction sites are on former forest land.

New mineral extraction sites have been created (16 km²), peat extraction areas (12 km²) non-irrigated arable land (98 km²) (primarily at the expense of pastures, which may signify an essentially insignificant change).

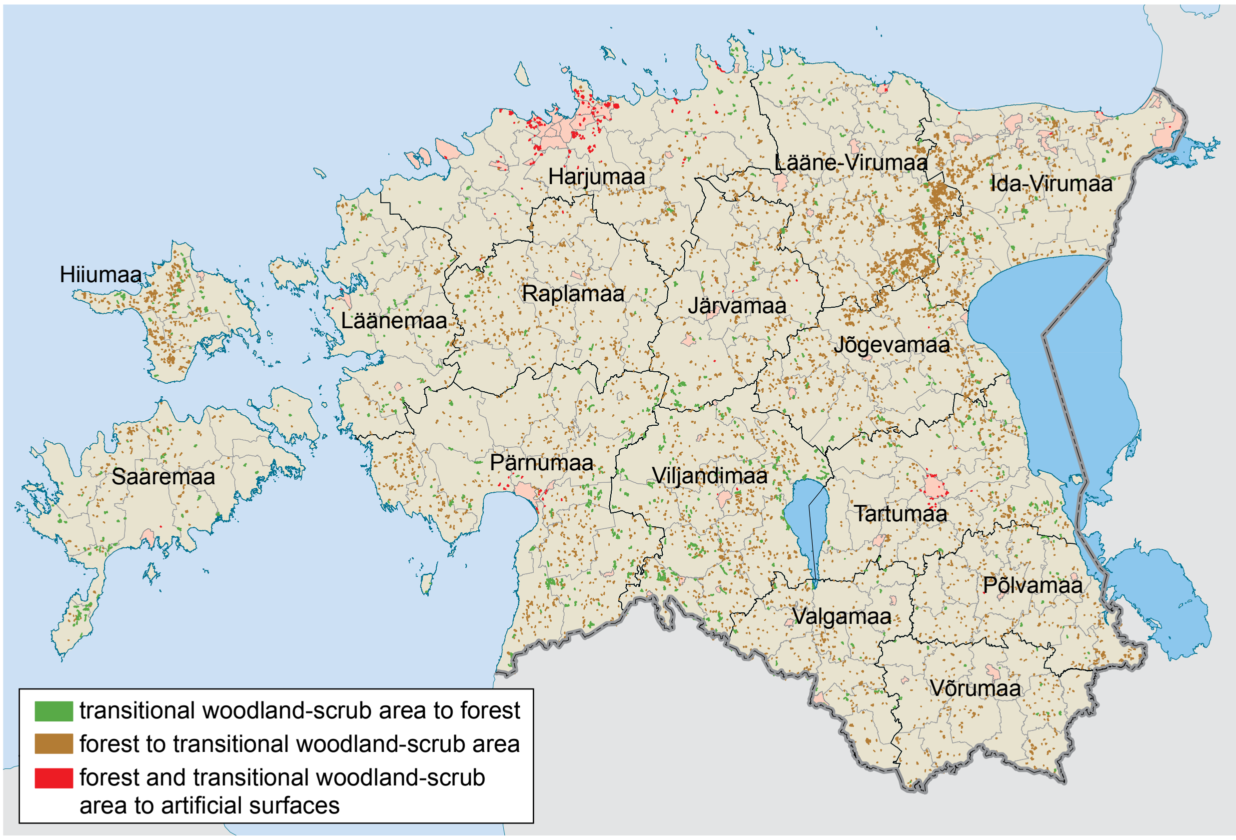
There has been a loss of 13 km² of mineral extraction sites, 22 km² of non-irrigated arable land, 110 km² of pastures and 647 km² of forest, including 299 km² of it coniferous, 271 km² mixed and 76 km² broad-leaved. These increases and decreases reflect changes in total area of land cover categories.

Considering the appearance and disappearance of individual land cover units, we can identify the net balance for Estonia in the years 2000–2006, in the course of which, as in the previous decade, the area of transitional woodland-scrub on mineral land has again increased – by 274 km². The area under coniferous forest has decreased by 291 km² and the figure for mixed forest by 51 km². The decrease in the area of pastureland is continuing – by 109 km². The area of broad-leaved forests increased (125 km²) as well as the area of non-irrigated arable land (84 km²). The area of artificial surface (urban fabric and industrial-commercial sites) increased 25.8 km² (map 7.3). A decrease was noted in the area under beaches and coastal dunes (24 km²) and sparse vegetation (21 km²).

The addition of artificial surface is not large in terms of percentage – about 0.05% of total land, but unlike many other changes it can be classified as **irreversible.** Cropland transformed into built-upon land or its vicinity can never be restored to their former use.

Viewing the changes **regionally**, we see that most of the new construction developments are based in Harju County, where 18 km² of former croplands and natural areas have been replaced by built-up areas and 2.5 km² of areas that were construction sites in 2000 have been completed. A total of 3.8 km² of new construction sites accrued. In Pärnu County, 2.2 km² of urban fabric and construction sites were added; and 2.9 km² in Tartu County.

Of the built-up areas accrued in the period 2000–2006, 15.9 km² of urban fabric and 2.3 km² of construction sites are located within 5 kilometres from the coast.



Map 7.3. Changes in CORINE land cover 2000–2006 in the categories with the most significant changes.
The areas marked in red are new urban fabric and construction sites, the brownish ones are areas where forests have been replaced with transitional woodland-scrub areas and greenish areas are where transitional woodland-scrub areas have been supplanted by forests. Data: CORINE land cover database.

7.2.2. Changes in land use as reflected by Statistics Estonia data

Certain changes in land use can also be seen in the data collected by Statistics Estonia. Statistics Estonia emphasizes that the data are not definitive. Spring-time cultivation areas are registered by the Farm Structure Survey, which may vary from the ultimate cultivation areas classified according to harvest purpose. The data have also been rounded off. Still, they provide some sense of the dynamics at work here.

According to data from the **Farm** Structure Survey, the total area of agricultural land has not changed significantly in the 21st century, fluctuating between 8,000–9,000 km² (figure 7.2). The same can be seen in the case of arable land, which fairly consistently makes up 2/3 of agricultural land. Considering the decline in the previous decade, the modest rise from 2003–2007 may represent an important shift. Comparing these data with the agricultural land data in use, we see a variance of up to 10%, which can be put down to margin of error for the data. At the same time, the number of agricultural holdings more than halved from 2001–2007. Agricultural land accounts for 75% of the land in the ownership of holdings – up from 65%. The percentage of agricultural land not utilised for agricultural production compared to agricultural land in use has more than halved – from 8.5% to 3.5%. This along with the modest rise in arable land area (also seen from CORINE data) attests to the rise in the value of cropland.

For purposes of comparison it should be said that the area of arable land in the 20th century changed little, ranging between 11,000–12,000 km² and a significant decrease to approx. 8,500 km² took place in the 1990s. At the same time, the land cover changes do not indicate a similar drop in this period. The decrease in agricultural land and increase of forest land in the 20th century took place mainly through afforestation of grasslands[A], but in the first ten years, the growth of forest does not yet show up on satellite imaging of land cover.

Data from the **forest inventory** conducted do not indicate a decrease in the area of coniferous forests or an increase in the area of deciduous forests (figure 7.3). The total areas of forest stands have not significantly changed. On the basis of inventory data, Estonia's total forested area has remained between 47 and 49 per cent in the 21st century. In interpreting fluctuation of total forest areas, it is difficult to differentiate between margin of error and actual fluctuation – the data show that forest land decreased by 450 km² in 2001–2002 and that it increased by 615 km² in 2002–2003, for example. Theoretically it is possible that in a given year a quantity of forest land is inventoried under another use and the next year, a quantity of overgrown fields will be recorded as forest land. Yet even then, such a variation would be due to a statistical change (accounting), not actual land use.

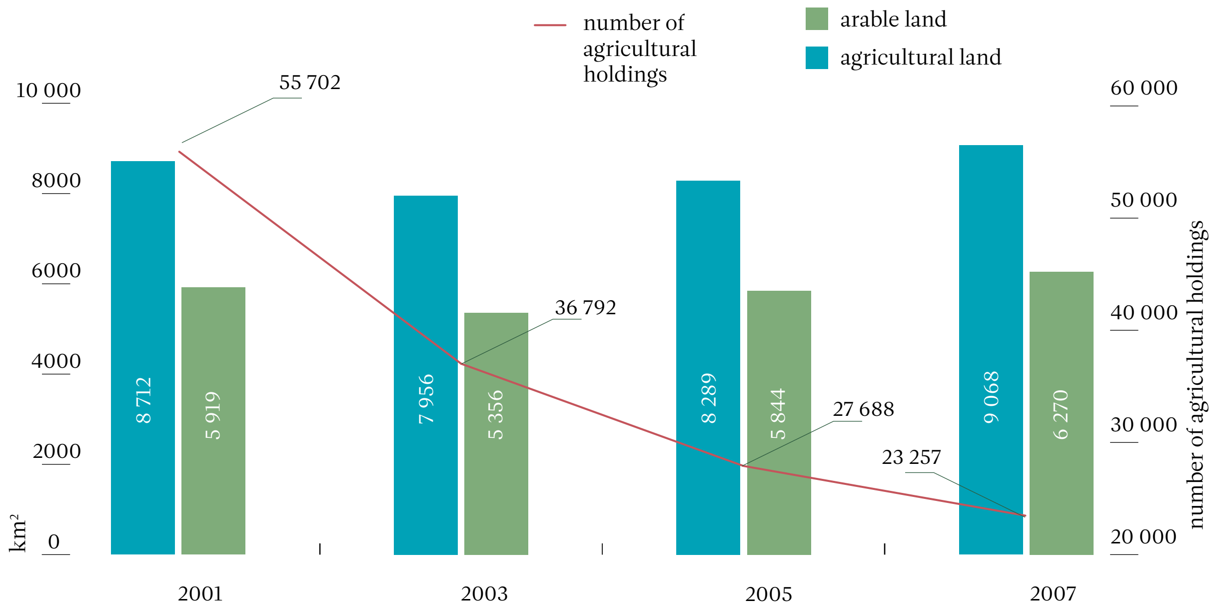


Figure 7.2. Change in the amount of agricultural land, arable land and number of agricultural holdings, 2001–2007. Data: Statistics Estonia.

[A] Mander, Ü., Palang, H. (1994). Changes of landscape structure in Estonia during the Soviet period. – GeoJournal, 33(1), 45–54.

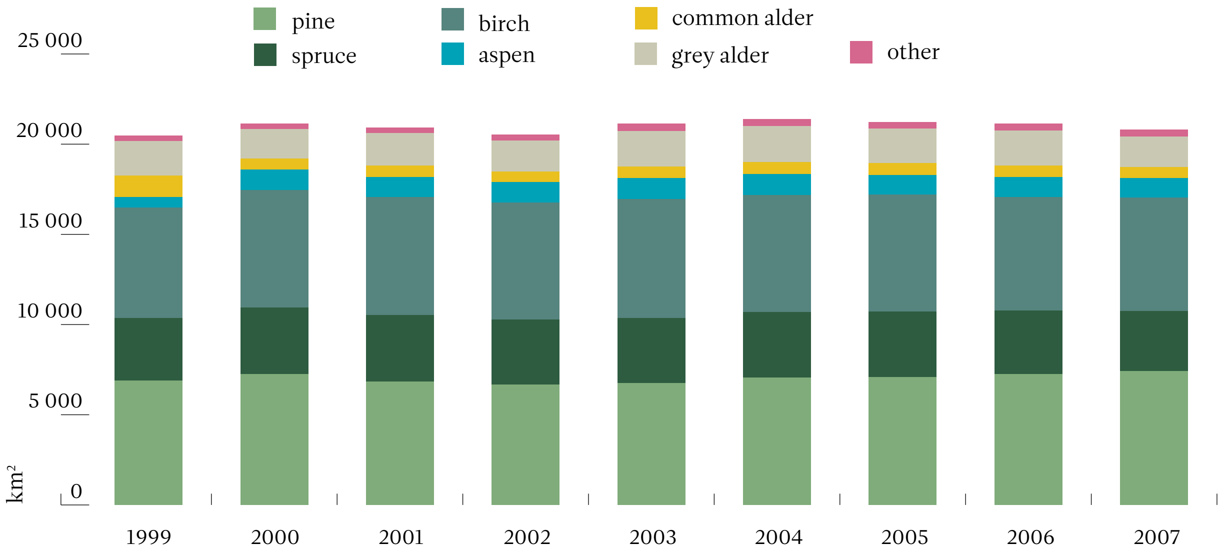


Figure 7.3. Change in forest land based on forest inventory by statistical sampling method, 1999–2007. Data: Statistics Estonia.

7.2.3. Land cover, CORINE data compared to Statistics Estonia data

Comparing Statistics Estonia land use data to CORINE Land Cover, we see that the **forest area** as shown by CORINE data in 2006 coincides with the total area of forest stands obtained from official statistics with a less than 1% discrepancy; but there is nevertheless 6–7% more forest land according to Statistics Estonia data (figure 7.4).

The differences are greater when it comes to interpreting **agricultural land** – even cropland, which should explicitly be cultivated fields, accounted for 5,600 km² in 2006; at the same time CORINE data suggest that there should be 6,750 km² of cultivated land. The difference is 20%, which cannot be explained by agricultural land not in use (which is not necessarily distinguishable in land cover) (figure 7.4).

According to CORINE data, there was nearly 15,000 km² of total **agricultural land cover** (including partially cultivated areas and areas with partial natural vegetation), but Estonian statistics reports nearly one-half of that amount (8,500 km²) (figure 7.4). Integrating land cover and land use data is much more difficult in the case of agricultural lands.

Viewing the changes in land cover in the Statistics Estonia data from 2002–2008 and comparing it to the CORINE land cover database, significant differences become evident in **interpretations** of land cover and land use. For example, Statistics Estonia keeps data according to the purpose of land use (figure 7.5) – the distribution of land according to planning purposes. Both forest land and arable land fall under the purpose of profit-yielding land (34,330 km² in 2008) while part of forest land falls under the purpose of protected lands (1,388 km² in 2008).

The dynamics of the Statistics Estonia data indicate the increase in land with different purposes in the case of nearly all designated purposes; the relative proportions do not change very much. In 2008, the total area of all of the land recognized in the Statistics Estonia data set was about 21% greater than it was in 2002, but still amounts to only 84% of Estonia's total area. The data do not reflect unreadjusted land (land that is not registered in the land register), as a result of which a large part of the ostensible increase in land use is due to the increase in the percentage of land covered by land readjustment.

Comparing CORINE Land Cover types and distribution of land use purposes in 2006 (figure 7.6), we find a few very comparable categories – for instance, there were 650 km² of residential land designated for a specific purpose and the CORINE land cover data indicated a total of 545 km² of urban fabric. The difference may be partly attributable to unrealized plans. Production land designated for a specific purpose totalled 202 km², which is relatively comparable to the 194 km² of industrial and commercial land recognized in land cover data. The same is true for waste disposal sites (48 km²) and dump sites recognized in the land cover data (36 km²). Land cover data indicated 413 km² of mining lands and a total of 315 km² of mineral extraction and peat extraction sites. Here, as in the case of residential lands, the reason may be that the planned uses do not yet show up on land cover images. At the same time 366 km² was devoted for the land use purpose of transport, but land cover indicated only 67 km² as being under transport infrastructure. The reason may be the fact that land designated for transport use also includes maintenance zones surrounding roads, where the land cover might be grassland, for instance. The other designated purposes of land use and land cover categories are much more difficult to compare head to head.

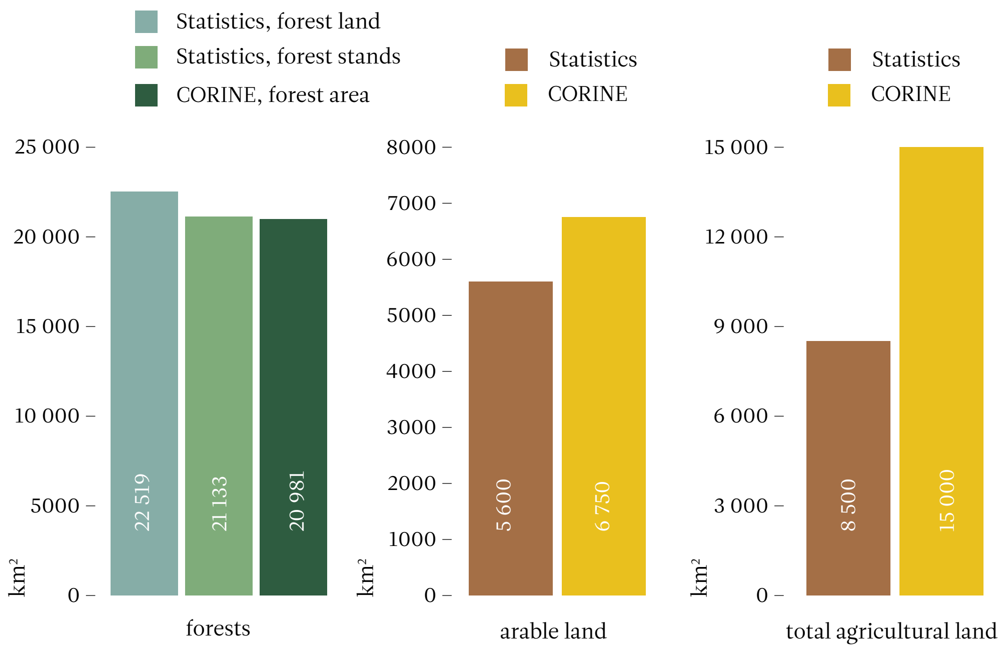


Figure 7.4. Difference in forested area on the basis of CORINE land cover data and Statistics Estonia data, 2006; Difference in arable land area on the basis of CORINE land cover data and Statistics Estonia data, 2006; Difference in agricultural land on the basis of CORINE land cover data and Statistics Estonia data, 2006.

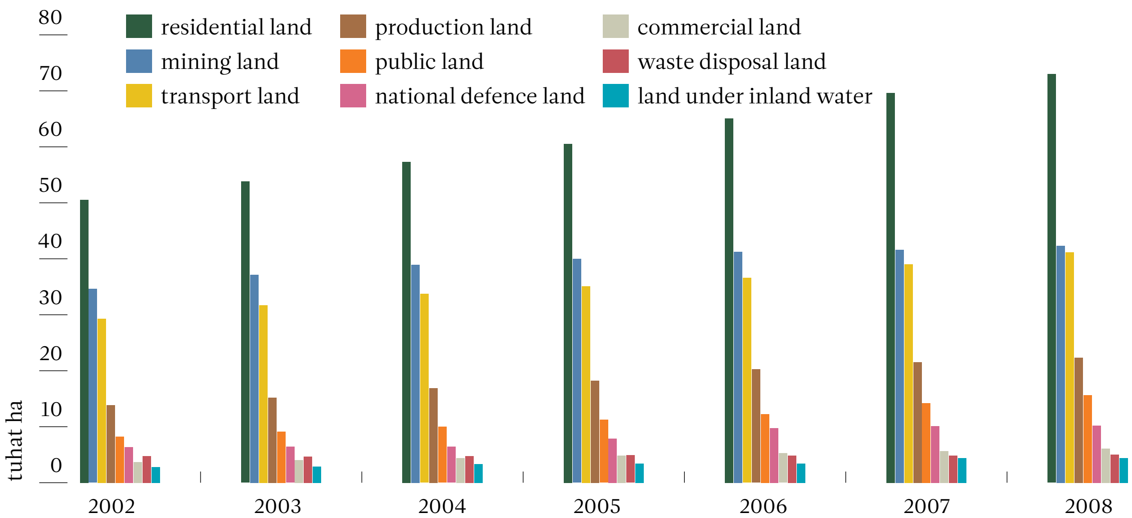


Figure 7.5. Land use dynamics according to intended purpose based on Statistics Estonia data in 2002–2008. Note: The figure omits profit-yielding land, of which there is nearly 50 times more than residential land, and protected land, of which there is nearly twice as much as residential land, and likewise land not specified for a specific purpose and land with an unspecified purpose.

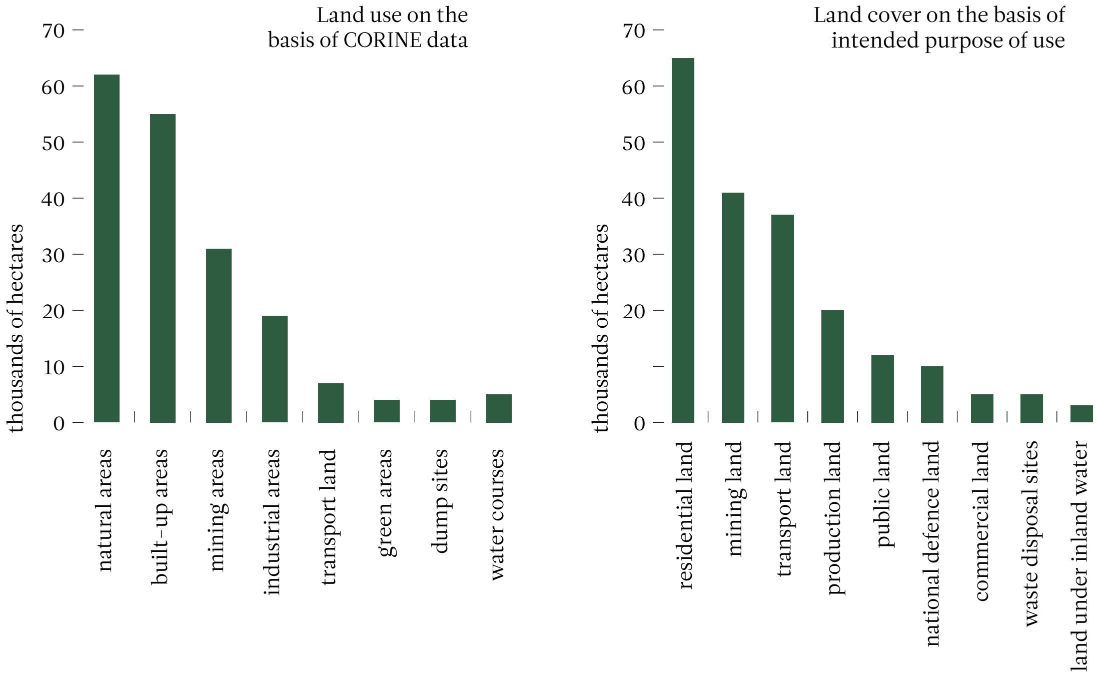


Figure 7.6. CORINE land cover (left) and land use by designated purpose (right) by each category in 2006. Note: The graph omits more extensive land cover categories (forests, agriculture, marshes, bodies of water and sea) and designated purposes (profit-yielding land, protected land).

Read more:

- CORINE map application.
[WWW] http://ks.keskkonnainfo.ee/website/Corineservice/
- Estonian Environment Information Centre website.
[WWW] http://www.keskkonnainfo.ee/
index.php?lan=EN&sid=647&tid=581&l1=2 (land use)

7.3. Urban sprawl

Suburban sprawl is when cities expand — residential areas spread from city centres to the suburbs and beyond, to the rural areas near the city, where land is cheaper. One reason for urban sprawl is the rapid rise in the standard of living. Sprawl is accompanied by changes in land use and dependence on transportation. The increase in automotive transportation is on one hand a precondition for sprawl, but on the other hand it is also the outcome, as families who have settled in new residential communities depend on city centres for jobs, schools, shops, and entertainment venues. Many negative impacts accompany sprawl both with regard to the natural environment and living environment (traffic jams, noise, air pollution).

Tallinn and its near vicinity have a rapidly growing number of inhabitants and it is the area of Estonia that generates the greatest monetary turnover, which is why it is logical that housing construction pressure is much greater here than it is in the rest of Estonia (see also map 7.3).

Housing construction, which was relatively modest in the 1990s (and fell short of the housing construction volumes in the Soviet period), saw rapid growth in the 2000s in the Tallinn areas and many areas that were previously reserved for other purposes were rezoned as residential areas. Primarily the areas adopted for residential purposes were seaside areas that were under Soviet border regime restrictions and former cropland. The internal structure of the new residential areas is different from the previous housing areas typical to rural areas; the spatial layout of the new areas is based on the previous sprawl distribution (proximity of infrastructure and existing residential areas has a positive impact). Detached home construction has been predominant, while lately the share of apartment buildings has grown[B].

In 1991–2005 the vicinity of Tallinn gained about 5,600 households with 17,200 inhabitants (map 7.4), of which 1,900 were established in 2005, about 900 in 2004 and 750 in 2003. In 2001 and 2002 in the same area, about 300 houses per year were constructed and before that the number of new housing hovered for a longer period of time around 100 per year[B].

Hidden processes are also a part of sprawl — for example turning summer cottages into full-time residences and the transformation of former summer cottage areas into residential areas. From the standpoint of land use, the change is not necessarily so dramatic as in the case of new housing projects established on cropland or forest land. At the same time, the volume of the process tends to be larger in scale. During the Soviet era, about 26,000 summer cottages were built in the vicinity of Tallinn; in 2002 experts believe about 60% of these summer cottages could be potentially used as year-round residential buildings which is nearly three times more than the number of new housing units built in the independence period. A study of summer cottages in 2007 showed that 35% of the summer cottages in the vicinity of Tallinn are in use as residential buildings — about 9,000 households[C]. The primary period in which summer cottages were converted into year-round residential buildings was 2002–2007. The locations of the summer cottage districts follow a somewhat different pattern than the case of development of new housing projects.

Sprawl is directly related to changes in the population. Whereas the average population density in Harju County did not change from 2001–2009 according to Statistics Estonia data (121 people/km^2), in some rural municipalities in the vicinity of Tallinn a clear increase can be noted; and in more distant municipalities, a decrease can be seen. The population density in Viimsi rural municipality has risen 11% over the nine years (the density of 122 in/km^2 exceeds that of Harju County including the cities and towns), while the figure for Harku rural municipality is 8% and for Kiili rural municipality, 7%. The increase in population density in Rae, Saue and Saku rural municipalities (4, 2.7 and 2.5%, respectively) is also noteworthy. Population density has decreased the most in Aegviidu rural municipality (8.5%) while the drop has also been noticeable in the rural municipalities with the lowest density in Harju County – Kõue (5.37 people/km^2) and Padise (4.73 people/km^2). Of the cities, the population density of Saue has risen (by 4%, to a level of 1486 in/km^2), which along with the rise in the population density of Saue rural municipality points to major residential growth. The population density of the city of Tallinn has fallen slightly (2518 people/km^2 in 2009). The particulars of population density arising from changes in the boundaries of rural municipality boundaries – where the population actually does not change – has been disregarded for the purposes of the analysis.

[B] Tammaru, T., Leetmaa, K., Silm, S., Ahas, R. (2009). Temporal and Spatial Dynamics of the New Residential Areas around Tallinn. European Planning Studies Vol. 17, No. 3, March 2009, p. 423–439.
[C] Leetmaa, K., Anniste, K., Brade, I. (2009). Hidden new residential areas in the Tallinn metropolitan area: soviet summer cottage settlements in residential suburbanisation. [Manuscript being prepared for publication].

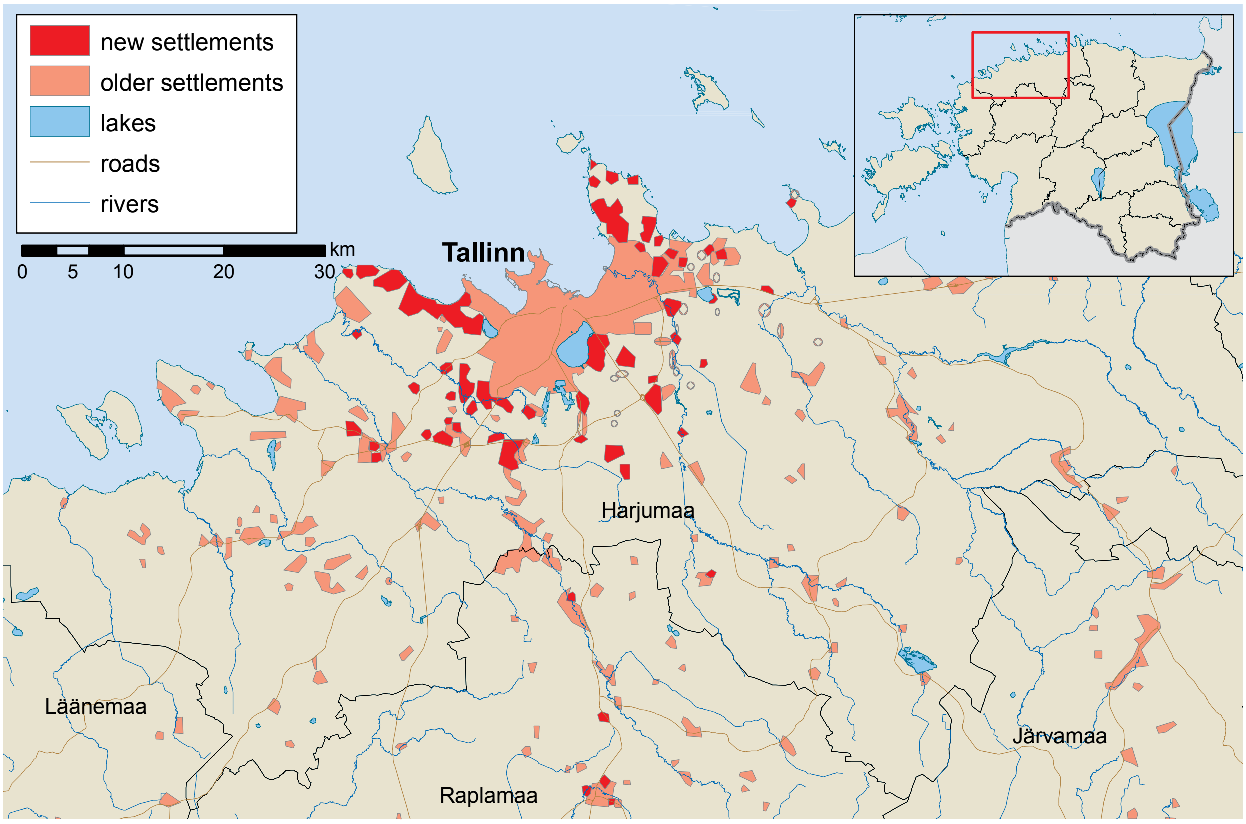
The Tartu area is another region in Estonia where sprawl is perceptible, even though the process is less intensive compared to that of the Tallinn vicinity.

The new housing developments in the rural municipalities in the vicinity of the city in Tartu County are relatively little reflected in changes in population density, according to Statistics Estonia – population density is up 1.5% in Luunja rural municipality and by the same amount in the city of Tartu (2,650 in/km² in 2009), while the growth in population density in Ülenurme rural municipality has been minimal. In the other rural municipalities, population density has dropped (by the greatest amount in Piirisaare – 25%, in Peipsiääre rural municipality by 13%, by 11% in Meeksi rural municipality and by 10% in Alatskivi rural municipality). Apparently the declining population in parts of the other parts of the rural municipalities is counterbalanced with the gain in population from new housing developments close to the city.

The changes taking place in the vicinity of the city of Tartu were studied by analyzing detailed plans[D]. A total of 274 detailed plans were analyzed, with a total of 2,865 residential buildings. The research examines the changes in population on the basis of data from local governments (in Luunja, the number of inhabitants rose 9.6% from 2000–2007 and in Ülenurme rural municipality by 20.6%), which is not reflected in Statistics Estonia data.

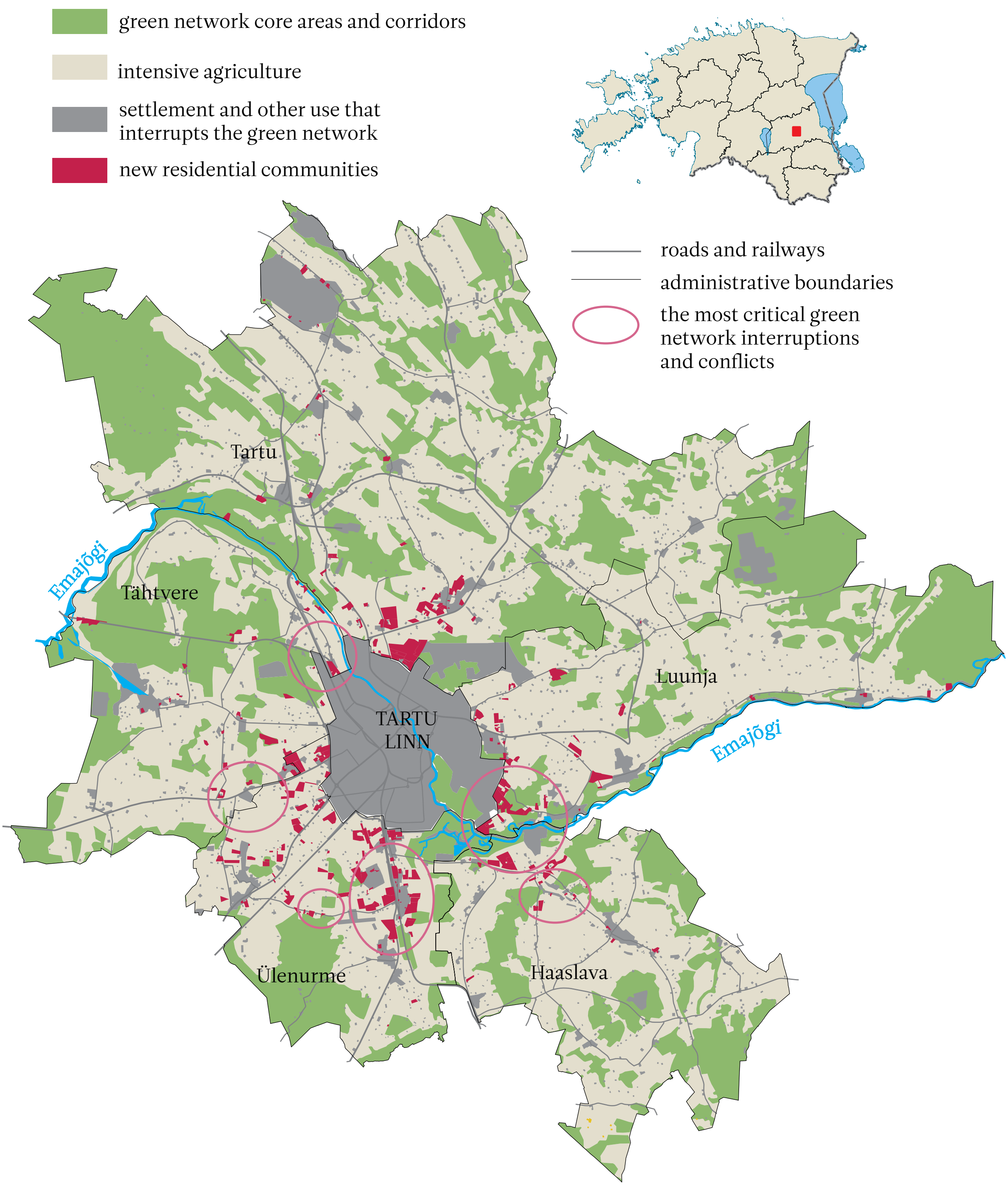
But even more relevant is the period of rapid suburbanization[E] from 2003–2006 cited by the authors, preceded by a relatively slow period of suburbanization from 1998–2002 and followed by slowing suburbanization. The latter will undoubtedly be impacted significantly by the recession. New residential communities are located primarily 5–10 km from the city centre (21% about 5 km, 14% within a 6 and 7 km radius, 12% in a 8 km radius); as the distance increases the number of new communities decreases evenly. Thus in the Tartu vicinity the primary pressure from sprawl on the city centre is much closer than in Tallinn.

The new residential communities are located primarily on former cropland (45%); and 28% on former low-density areas and 16% on natural grasslands. The new communities simplify the landscape significantly – the planned areas comprise a uniform (repetitive) pattern and include fairly small land units with a simple shape[D]. At the same time, preservation of ecological networks is not ensured by the planning and it is not uncommon for ecological corridors to be severed; the habitats of species become intermixed with urban areas (see also section 8.2.2, "Reasons for decreased biological diversity – urban sprawl").



Map 7.4. New residential communities in the vicinity of Tallinn. Data: Leetmaa et al 2009[F].

[D] Roose, A., Kull, A. (2008). Segregated suburban landscapes: Transformations on the fringe of Tartu. Estonia. Geographical studies 10. Roosaare, J. and Mander, Ü. (Eds.). Publicationes Instituti Geographici Universitatis Tartuensis, vol. 107, pp. 68–87.
[E] Suburbanization – movement of people from city centres to suburban areas, the vicinity of cities or the countryside.
[F] Leetmaa, K., Anniste, K., Brade, I. (2009). Hidden new residential areas in the Tallinn metropolitan area: Soviet summer cottage settlements in residential suburbanisation. [Manuscript being prepared for publication].



Map 7.5. New residential communities in the vicinity of Tartu and conflict areas. Author: Ain Kull, University of Tartu. Copyright: Ain Kull.

Read more:

- Leetmaa, K., Anniste, K., Brade, I. 2009. Hidden new residential areas in the Tallinn metropolitan area: Soviet summer cottage settlements in residential suburbanisation.
- Roose, A., Kull, A., 2008. Segregated suburban landscapes: Transformations on the fringe of Tartu. Estonia. Geographical studies 10. Roosaare, J. and Mander, Ü. (Eds.). Publicationes Instituti Geographici Universitatis Tartuensis, vol. 107, pp. 68–87
- Tammaru, T., Leetmaa, K., Silm, S., Ahas, R. 2009. Temporal and Spatial Dynamics of the New Residential Areas around Tallinn. European Planning Studies Vol. 17, No. 3, March 2009, p. 423–439

8. Biological diversity

8. Biological diversity

Considering Estonia's small human population, the amount of land under nature conservation – over 18% of the country's territory – is relatively high and it might be presumed that Estonia's natural environments are in good condition. An objective for the year 2010 is to halt the loss of biological diversity. This objective has thus far not been fulfilled.

In the interests of sustainable development of the balance of ecosystems[A] and the natural resources within the ecosystems (timber, game animals, water) the ecosystem must be viewed as a whole, as the aggregate of all of the values contained in it, not just as a source of natural resources. Ecosystem services must also be taken into account. These are services that benefit all of humanity which are offered by ecosystems, including clean drinking water and food production, decomposition of waste, preservation of the balance between climate and disease agents, preservation of food webs and preservation of food stocks through maintenance of pollinators, and provision of aesthetic pleasure and recreational opportunities. All of these services have a real price that has thus far not been taken into account.

The general risks to marine and freshwater ecosystems can be characterized by the latest findings about climate change. Species living in reedbeds[B] that are in the process of expanding their habitat are a sign of eutrophication of the aquatic environment. For a short period of time, this might even be considered a positive development with regard to biological diversity, but certainly not over a longer period, nor is this characteristic of the aquatic ecosystems of Estonia's biogeographic zone.

8.1. Legal background

Both internationally and domestically, a number of strategic objectives have been set and directives, regulations, strategies and action plans have been compiled along with other legal documents in order to ensure preservation of the biota.

One of the most important international legal documents for Estonia is the Convention on Biological Diversity signed in 1992 and ratified in 1994. The parties to the convention decided in 2002 in The Hague to bring the decrease in biological diversity to an end by the year 2010. Achieving this aim will mean the following for Estonia:

- halting the increase in the number of species at risk;
- halting the decrease in the abundance of (individual plants and animals) of already endangered species;
- halting the decrease in the habitat area and quality of endangered species;
- elimination of (or significant reduction in) the primary risk factors to species;
- planning and building human living environments and activities so that the previous four requirements would be ensured.

The primary objective of the European Union habitat directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora) and the bird directive (Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds) is to introduce a coherent network of protected areas (Natura 2000). The network must ensure that the species and habitats listed in the annexes to the directives are protected and remain vital. Compliance with these directives directly supports bringing the decrease in biological diversity to an end.

Domestic objectives are set forth by the national strategy for the sustainable development of Estonia ("Säästev Eesti 21" in Estonian; up to 2030) and the Estonian Environmental Strategy 2030. The former sets the aim of applying reserve status for 5% of Estonia's territory not used for economic purposes[C] by 2010 in order to preserve the ecological balance. The environmental strategy sets the goal of maintaining the percentage of nature reserves in Estonian territory at around 18%; besides this, the objective is to increase the abundance of animal species under stricter protection.

The Estonian Rural Development Plan 2007–2013 also sets forth nature conservation objectives. The nature conservation development plan 2020 is being prepared, which develops the general objectives of the environmental strategy on a more detailed level.

The most important Estonian legislative acts that govern protection of biodiversity or impact it relatively directly are the Nature Conservation Act, the Planning Act and the Environmental Impact Assessment and Environmental Management System Act.

The obligations and objectives for assessing the status of aquatic biota is set forth in the European Union Water Framework Directive, which entered into force in 2000 (2000/60/EU), which stipulates that assessment of the status of rivers, lakes and coastal waters should be based mainly on biological quality elements. The Water Framework Directive sets the objective of bringing all bodies of water into good ecological and chemical condition.

[A] An ecosystem is a self-regulating and developing integral whole comprising organisms interdependent through food webs along with their abiotic surroundings. The constituent elements of an ecosystem are the biocoenosis – i.e., the biotic communities (plant communities, fungal communities, animal communities, microorganisms) and the ecotope or living environment (air, water and soil environments).

[B] Elts, J. (2009). Linnuatlase viimane spurt. (Finishing spurt for the bird atlas.) – Linnuhuvilise teabeleht Tiirutaja, (nr 5).

[C] Territory not used for economic purposes – an area preserved completely inviolate or where only activities necessary for preserving the (semi-)natural state are permitted.

8.2. Land

8.2.1. Species and habitats

Around 40,000 indigenous **species of life** are thought to be found in Estonia. By 2008, about 26,600 species had been identified – that is, about 67%. The remaining species are yet to be discovered, even though they are known elsewhere in the world and present in Estonia's biogeographical region.

The **distribution of most species** on Estonian territory has likewise not been ascertained. Only the range of birds, mammals and vascular plants is completely or partially known. Other groups of species have been studied less consistently. The situation is slightly better in the case of habitats. A number of classifications and inventories have been prepared, but there is as yet a lack of a comprehensive picture on the nationwide level with regard to distribution of habitats. Knowledge about the range of seminatural communities can be considered to be better. The extent to which forest habitat structure has been studied has improved in recent years thanks to the existence of the forest management database.

Top-predators

The abundance of predator species at the top of the food chain – on land (brown bear, wolf, lynx), in freshwater (otter) and marine mammals (grey seal) has increased slightly in the last five years (figure 8.1). This indicates to favourable natural conditions in these years. At the same time, the efficacy of nature conservation in the area cannot be confirmed, as all of the species are extremely mobile and wide-ranging. However, the protection of these species can be said to have been successful on species level.

The number of avian top-predators such as golden eagles, white-tailed eagles and ospreys has risen somewhat and the abundance of the lesser spotted eagle has remained stable, but the number of pairs of the greater spotted eagle and black stork has decreased. Target abundance levels have been established for all of the abovementioned species (table 8.2).

In the case of terrestrial mammals, all of the top-predators listed are species that inhabit large forest massive areas. Changes in their abundance cannot be directly linked to any sort of habitat change. On the other hand, the trend in the abundance of the spotted eagles and black stork can be correlated to the average age and status of the older-category deciduous and mixed forests that are their habitats in Estonia.

Table 8.1. General facts and comparisons in Estonia and Europe.
Data: European Environmental Agency and CORINE Land Cover database.

Ecosystem distribution	**EU, Norway, Switzerland**	**Estonia**
	% of territory	
forest	30%	47%
cropland	33%	28%
pastureland	16%	7%
manmade landscape	2%	2%
other	19%	16%

Species diversity	**Pan-European**	**Estonia**
	number of species	
mammals	250	64
fish	500	75
birds	700	372
reptiles	150	5
amphibians	70	11
vascular plants	31,000	1,500

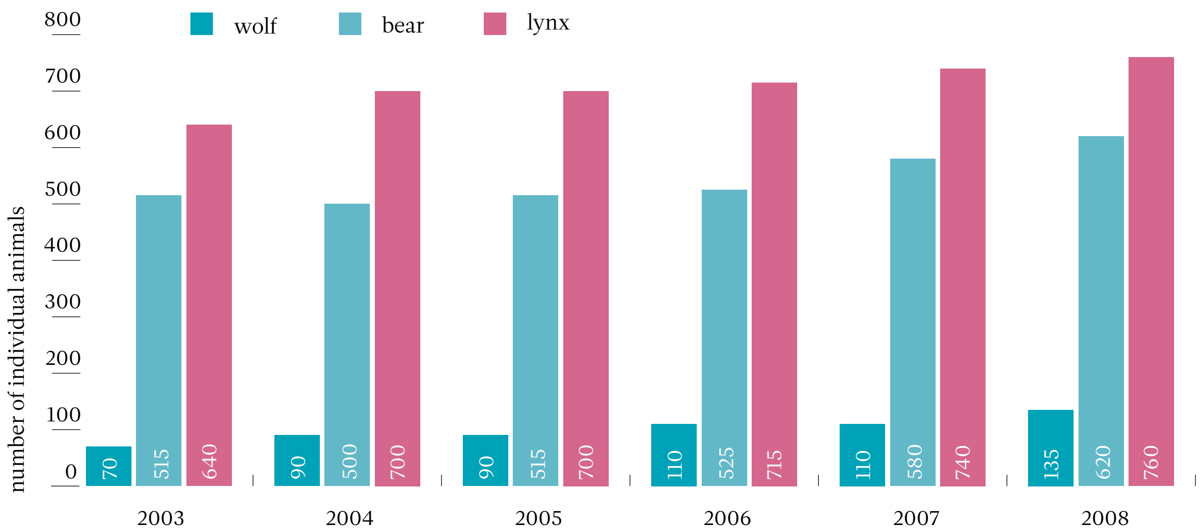


Figure 8.1. Abundance of predators at the top of the food chain (terrestrial mammals) in 2003–2008. Note: The number of animals shown on the figure expresses the minimum abundance of lynx and bear and the likely abundance of wolf before the reproduction period. Data: National Environmental Monitoring Programme.

Table 8.2 Abundance and trends for top-predators specified in the Environmental Strategy. Data: National Environmental Monitoring Programme, Eagle Club.

Category	Baseline level in 2004, number of pairs	Status, number of pairs in 2008	Trend
Black stork	100–115	80	decline ↘
White-tailed eagle	140	165	rise ↗
Osprey	45	55	rise ↗
Golden eagle	45	55	rise ↗
Greater spotted eagle	20–30	20	decline ↘
Lesser spotted eagle	500–600	550	stable →

Threatened species

According to the list of species in the Estonian Red Book, the level of threat of only about 4300 species indigenous to Estonia (16%) has been assessed. As a result of the last assessment, there are 1296 threatened species in Estonia (about 30% of the species assessed)[D]. A total of 295 species (7% of all species assessed and around 1% of all species found in Estonia) are considered extinct or nearly extinct in Estonia.

Based on the above it can be concluded that biological diversity in Estonia has been little-studied, especially in the case of groups with greater numbers of species and ones that are more difficult to investigate such as invertebrates, fungi and algae (figure 8.2).

Of the species assessed, the abundance trend is known in the case of only one-quarter of them – 1004 species. For 34 of these, the abundance trend is rising. The abundance trend for about one-half (498) of the species has been assessed stable and 418 species evince a declining trend (figure 8.3).

On the basis of the Red List, the total number of threatened species in the period 1978–2008 rose from 245 to around 1300 (figure 8.4). This does not necessarily mean that the threat for species has grown, as it is possible that many of the threatened species as early as in 1978 were simply not assessed back then. Thus it can only be conjectured that the actual threat has risen the most for vascular plants, as the likely extent to which they were assessed was the same already in 1978. On the other hand, the rise in the number of threatened species among mosses, fungi and lichens may point to a more comprehensive level of study and fuller assessment, which does not however mean that these groups of species are in any less danger. The abovementioned groups make up 87% of the total number of threatened species. The apparent decrease in the number of threatened invertebrate species in comparison between 1998 and 2008 is due to the change in assessment methods, as a result of which a great number of the species assessed as threatened in 1998 were assessed as poorly studied in 2008.

Only one-quarter of almost 100 species with pan-European importance and protection value can be assessed as having favourable species protection status and slightly over one-quarter of other species require more study before they can receive any sort of assessment. Nearly one-half of the species has poor or insufficient status; i.e. the conservation of vital populations[E] of these species in Estonia is not guaranteed (figure 8.5).

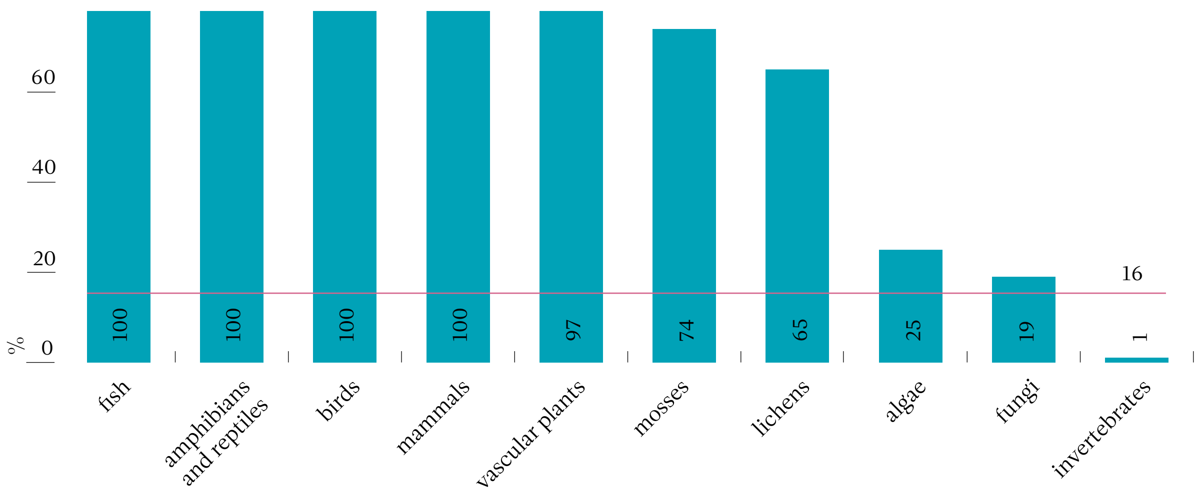


Figure 8.2. The graph shows, by each group of species, how great a share of the known species has had their threat level assessed. The red line is showing total share. Data: Estonian red list 2008.

[D] Threatened species – in the given case, the following categories in the Estonian Red List: Near Threatened – NT, Vulnerable – VU, Endangered – EN, Critically endangered – CR or Regionally Extinct – RE. The categories derive from the IUCN Red List manual at: http://www.iucn.org/themes/ssc/redlists/RLcats2001booklet.html
[E] Population – group of organisms (individuals) of the same species which inhabit a common territory.

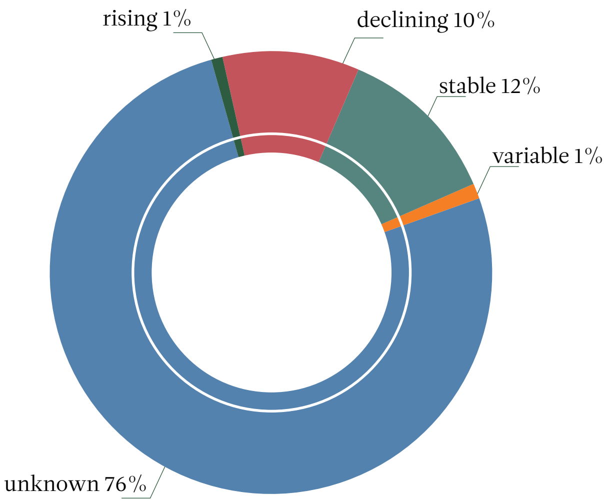


Figure 8.3. Trend in the abundance of threatened species as of 2008. Data: Estonia's Red Books (Lists) 1979, 1988, 1998 and 2008.

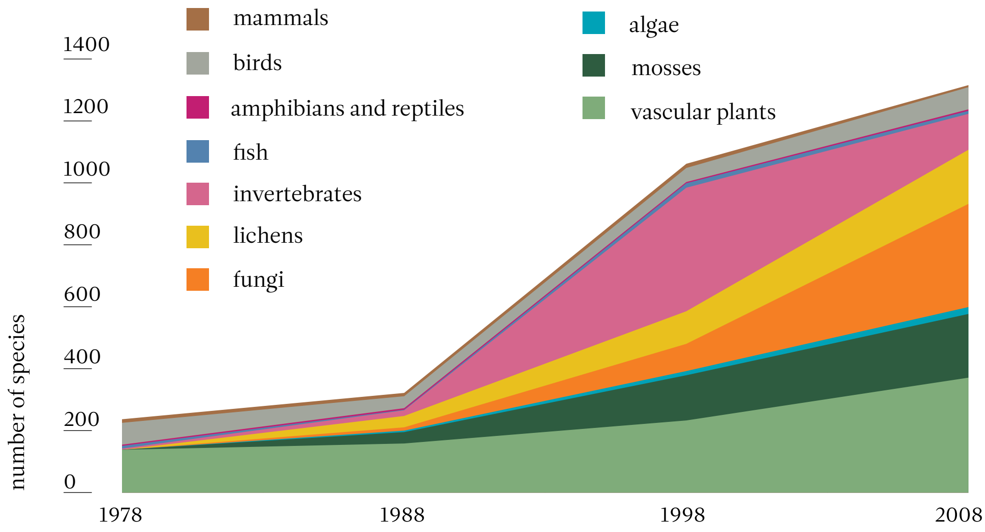


Figure 8.4. Number of threatened species in 1978–2008. Data: Estonia's Red Books (Lists) 1979, 1988, 1998 and 2008.

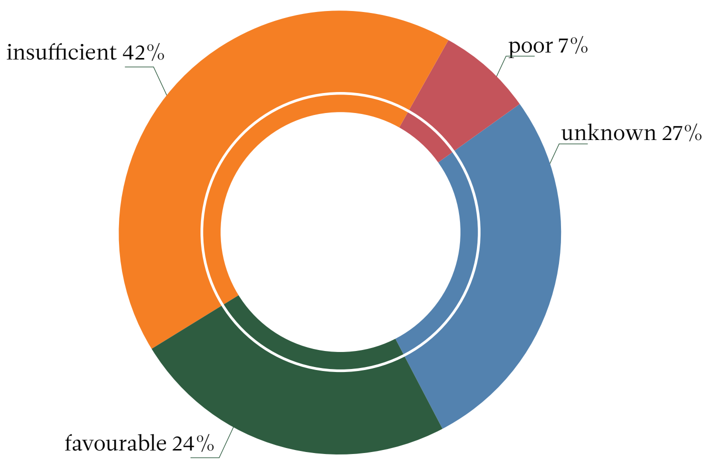


Figure 8.5. Rating of the protection status in Estonia of the species listed in the annexes to the EU directives.
Data: Ministry of the Environment.

Species habitats

The status of habitats can be assessed by comparing the distribution of habitats within the protected areas with the number of threatened species inhabiting them. Using the Red Book data as of 1998 and 2008 and the CORINE land cover categories from 2000 and 2006 as a basis, it can be concluded that the status of natural grasslands and coniferous forests is fairly good. Of these habitats, over 20% is located in protected areas, and this percentage has risen compared to 2000 (table 8.3). Attention should be paid to protection of deciduous forests and mixed forests. These are the habitats of many threatened species. Less than 20% of deciduous and mixed forests are protected and the trend in protection of such forests is declining or stable.

The status of habitats with pan-European importance and protection value appears to be better than the situation with species, as over 40% can be considered to be in a favourable nature protection status (figure 8.6). Still, nearly one-half of the habitats are still in poor or insufficient status and conservation of these is not guaranteed.

Estonia's **seminatural communities** (such as wooded meadows, coastal meadows, alvars) are unique habitat types in Europe, which is why Estonia has a duty to conserve semi-natural biotic communities.

In the interests of conservation of biodiversity of **meadows and other open landscapes ecosystems**, it will be necessary to promote and develop extensive smallholding-based agriculture in addition to conservation of the semi-natural communities recovery and maintenance support system.

In addition, seminatural community recovery and maintenance support must continue to be disbursed and increased. Of the meadows deemed valuable in 2002, 18% has been restored. Each year, maintenance is performed on only one-quarter of the meadows with value, with each passing year, three-quarters of these approach a state where the value of restoring them is questionable due to the high demand for resources.

Table 8.3. Protection for selected CORINE land cover categories in Estonia in 2000 and 2006.

	Total area (hectares)	**% of land area**	**Under protection in 2000 (%)**	**Under protection in 2006 (%)**	**Trend**
Built-up areas	37,133	1	4	4	stable
Brushland	29,3694	7	18	16	declining
Parks and gardens	59,972	1	6	6	stable
Agricultural land	1,474,152	34	5	5	stable
Natural grasslands	56,192	1	58	59	rising
Deciduous forests	446,264	10	15	15	stable
Coniferous forests	802,121	18	24	25	rising
Mixed forests	838,720	19	14	14	stable
Marshes	305,922	7	64	64	stable
Coastal habitats	39,088	1	69	69	stable

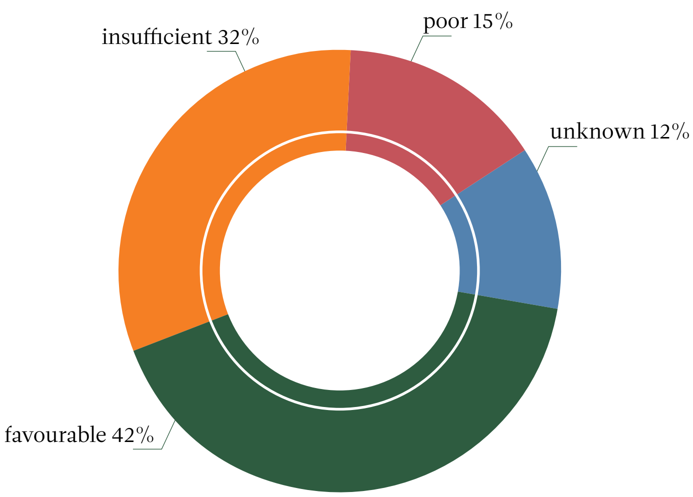


Figure 8.6. Rating of the protection status in Estonia of the habitats listed in the annexes to the EU habitat directive. Data: Ministry of the Environment.

8.2.2. Reasons for biodiversity loss

Planning economic activities and assessing their environmental impact

Conservation of diverse wildlife only on protected areas is not a solution for conservation of biodiversity. In addition to protected areas, activities must be planned in conditions with a strong human impact so that they would not harm biodiversity. Planning requires the ability to assess and forecast the impact of human activity on the natural environment. The environmental impact assessment system for economic activities was launched for this very purpose. But practice shows that environmental impact assessments primarily focus on the impacts on the human environment and the impact on the wildlife is often left aside.

While it is true that the Nature Conservation Act defines the protected species and categories of protected areas, it does not define the impact of human activities on these outside protected areas. For this reason, the current situation can only be assessed with regard to the Natura 2000 areas, within which or in the area of which, in the case of planned activities, the impact should be assessed according to the Environmental Impact Assessment and Environmental Management System Act. This Act clearly sets forth the obligation to assess the impact of planned activity each time, if the activity may, either by itself or in conjunction with other activities, significantly impact the Natura 2000 network area.

Viewing the environmental impact assessments from 2005–2008, including the ratio of Natura 2000 assessments initiated and not initiated (figures 8.7–8.9), it turns out that in general the initiation of environmental impact assessments has grown (the ratio in 2005 was 52: 48 and in 2008 it was 67: 33 in favour of initiation), but the percentage of Natura 2000 assessments shows a declining trend (68 : 32 in 2005 and 34:66 in 2008)[F]. The results of this study show also that only one in six decision-makers adheres to the obligation arising from legislation to report the possible impact on Natura areas.

All of the country's administrative-level planning and environmental impact assessment systems should make a transition to **ecosystem-based balanced planning of all human activities.** To do so, the current status of economic activity and biodiversity should be simultaneously documented for ecosystems throughout the country and on this basis the necessary areas should be defined both for sustainable economic activity and the existence of balanced ecosystems.

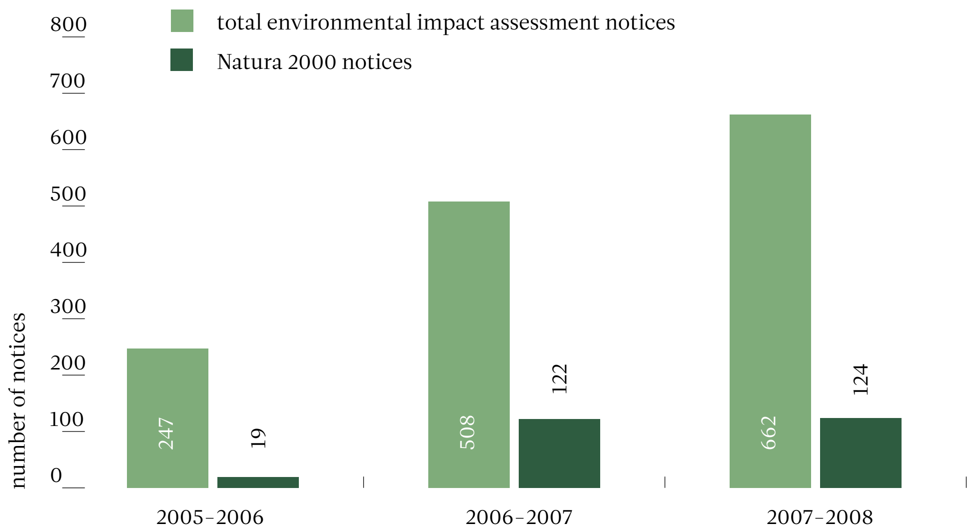


Figure 8.7. Number of environmental impact assessment notices, 2005–2008. Data: SEIT.

[F] Peterson, K. (2008). Natura-hindamise algatamine: tänane praktika. (Natura assessment initiation: current practice.) – Keskkonnatehnika (6), 16–19

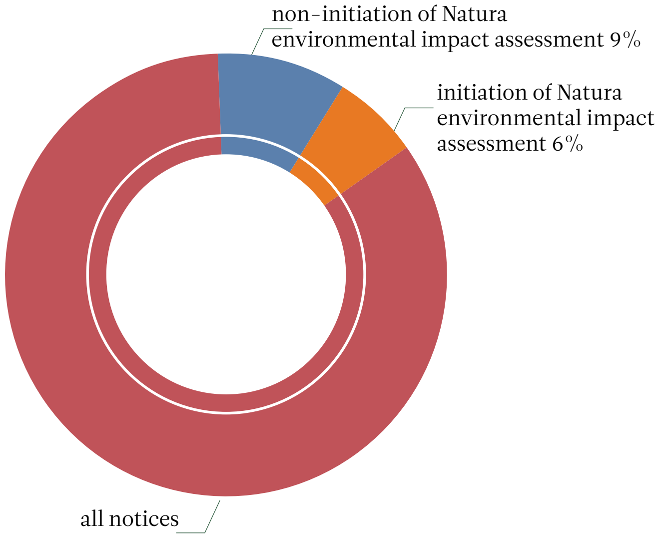


Figure 8.8. Initiation and non-initiation notices regarding assessment of the impact of economic activities on Natura 2000 areas as a percentage of all environmental impact assessment notices in 2005–2008. Data: SEIT.

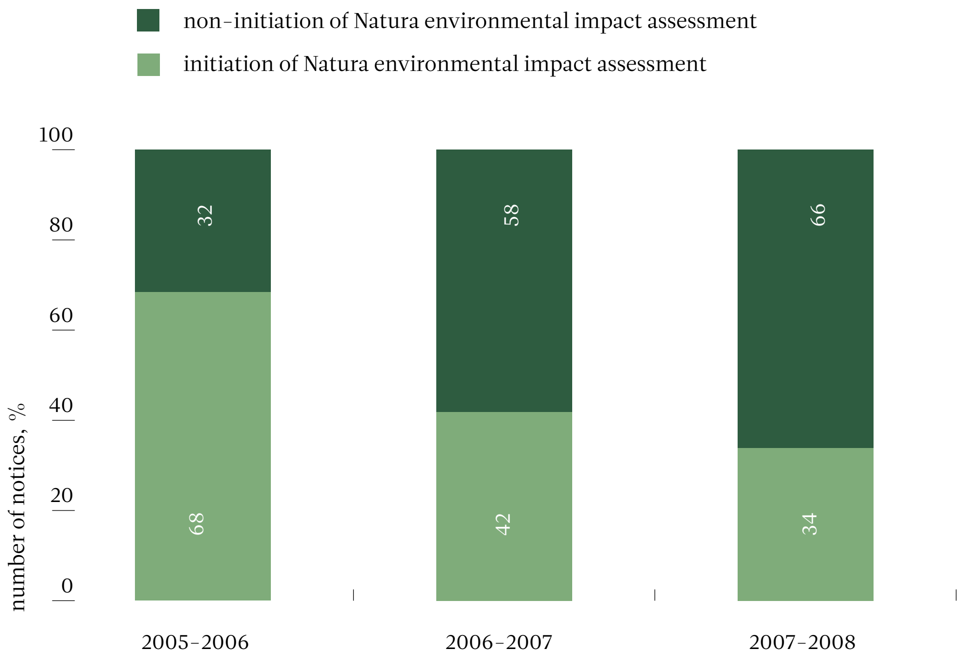


Figure 8.9. Ratio of initiation to non-initiation of Natura environmental impact assessment, 2005–2008. Data: SEIT.

Urban sprawl

Fairly rapid growth takes place in residential areas near the cities. This results in species habitats being overrun and loss in the region's biological diversity. According to Statistics Estonia, Tallinn had a population in 2008 of 397,617 inhabitants and if they all were to live in detached homes, with an average of four people and a 1000-square-metre plot, 10,000 hectares would be required solely for residential areas.

The total area of Tallinn, however, is only 15,827 hectares[G], moreover commerce and infrastructure also require space, as do public land and recreation areas. In conditions of unbalanced and undirected spatial planning, spontaneous urban sprawl has taken place within a radius of 30 km of Tallinn (as well as in the vicinity of other cities) which is also indicated by analysis of changes in CORINE land cover (see the areas marked red on map 7.3 in chapter 7.2.1).

[G] Eesti statistika aastaraamat 2008. Statistical Yearbook of Estonia (2008). / Ed. S. Linnas. Tallinn: Statistics Estonia [WWW] http://www.stat.ee/18920, p 7.

Alien species

Most alien species are in their country of origin common plants and animals and do not pose a danger to the local ecosystem there as they are its natural part. A majority of the alien species in a new environment do not manage to survive in the new conditions and do not pose a threat to Estonian nature. About one in ten adapts to the new conditions and one-tenth of those in turn becomes invasive – they can pose a risk to the ecosystem or parts thereof; they may have a noteworthy negative effect on the environment, agriculture and human health. Invasive alien species are estimated to account for one in four or even one in two (primarily on the islands) most important factors[H] that reduce local biodiversity.

Alien species that have adapted to the new conditions may invade niches in natural communities inhabited by indigenous species. The newcomers do not have connections to other species in the local ecosystem to the extent that native species do; as a result the networks of interconnections in the ecosystem become weaker and biological diversity generally declines as well. The influx of alien species can be accompanied by new diseases and pests who find new food sources in their new land. Often alien species intermingle with native relatives, thus changing the species gene pool. The most dangerous alien species are the ones that become domesticated, i.e. become widespread and reproduce independently in local natural communities. Unfortunately we are not able to foresee invasiveness of alien species, and the shift in timescale may be especially misleading. An explosive spread may occur decades after the species is introduced. The clearest sign of danger is the invasiveness of a species in a region with similar natural conditions[I].

A total of 942 alien species had been registered in Estonia as of 2009. The invasive ones amount to 133, including 76 plants, 35 invertebrates, 14 fish, 4 mammals and 3 species of birds and 1 amphibian species (figure 8.10).

The invasive species with the biggest impact on Estonia and the ones that have caused the greatest losses are the American mink, raccoon dog, mosquito (*Culex pipiens molestus*), pharaoh ant (*Monomoria pharaonis*), the webbing clothes moth (*Tineolea biselliella*), the Sosnowski's hogweed (*Heracleum sosnowskyi*), the giant hogweed (*Heracleum mantegazzianum*), Turkish rocket (*Bunias orientalis*) and Garden Lupin (*Lupinus polyphyllus*). Without immediate control measures, American crayfish (*Pacifastacus leniusculus*) and Spanish slug (*Arion lusitanicus*) may cause great damage in the near future.

Arion lusitanicus is a rapidly reproducing slug, data on which began to be collected in Estonia in 2008. This pest with a rapid reproductive capacity is mainly spread through places that sell plants and nurseries.

In the near future, species from North America that have reached Europe may spread to Estonia, such as the Canadian beaver (*Castor canadensis*), Canada goose (*Branta canadensis*) and eastern gray squirrel (*Sciurus carolinensis*). Their influence on the European beaver, Eurasian red squirrel and greylag goose may lead to their extinction.

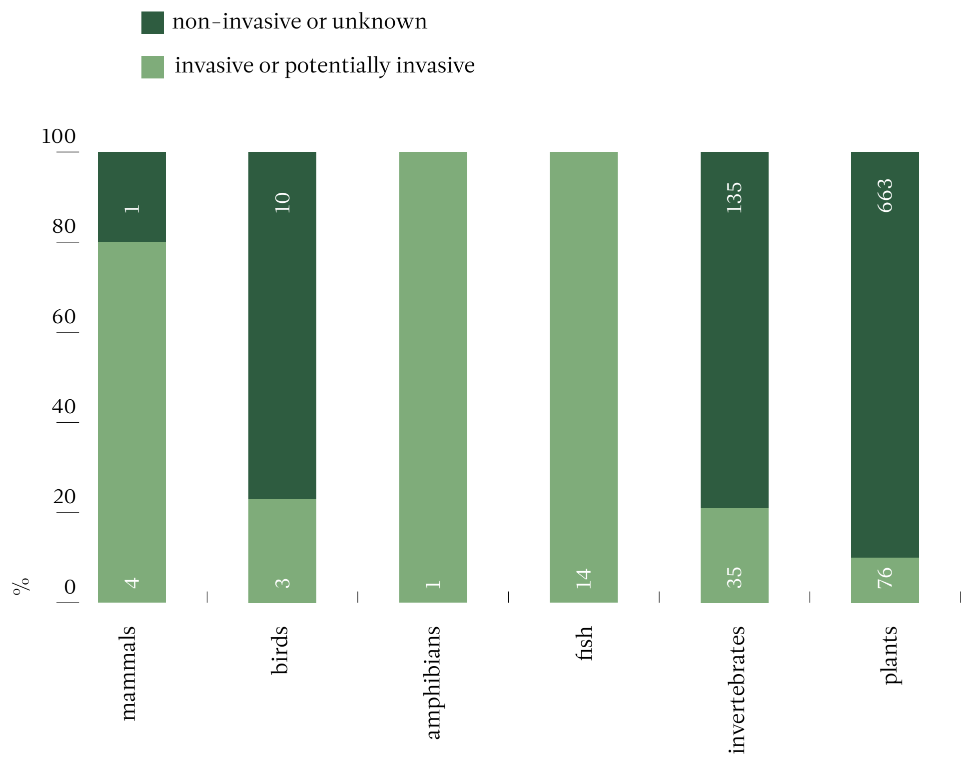


Figure 8.10. Number of alien species in Estonia as of 2009. Data: Ministry of the Environment.

[H] Maismaa võõrliikide käsiraamat. (Handbook of the world's alien species.) (2008). / Ed. L. Eek, T. Kukk. Tallinn : Ministry of the Environment.
[I] Invasiivsed võõrliigid Eestis. (Invasive species in Estonia.) (2005). / Compiled by. T. Kull, Ed. T. Kukk. Tallinn : Ministry of the Environment. [WWW] http://www.envir.ee/orb.aw/class=file/action=preview/id=89801/Invasiivsed_voorliigid.pdf

8.2.3. Achieving protection of biological diversity and targets

Estonia's national strategy for sustainable development "Sustainable Estonia 21" (up to 2030) sets forth the goal of placing 5% of Estonia's territory out of any economic use by 2010. As of the end of 2008, the percentage is 4.1% (figure 8.11). To achieve the goal, it would be necessary to take an additional approximately 39,000 hectares of land under the same protective regime in 2009.

Of the various habitats, marshes account for the most land under the strictest level of protection (a total of nearly 95,000 hectares), followed by coniferous forests with 40,000 hectares and sea areas with 30,000 hectares. This result was to be expected, as in general human intervention is not necessary in order to keep a diverse biota in these habitats.

The Estonian Environmental Strategy 2030 defines the target level of areas with conservation restrictions on land at 18%, which was achieved in 2005, after the creation of the Natura 2000 areas, and has remained at around the same level in recent years (figure 8.12). The area under protection in Estonia has a balance between sea and land areas, but the European Commission still expects greater effort from Estonia with regard to open sea protection (figure 8.13).

Besides the protected areas arising from the Nature Conservation Act, Estonia can also consider the green network areas defined in county thematic plans as area with protection potential. This area is only advisory in nature in terms of legal status, even though comprehensive plans must take it into account. Legal acts allow the comprehensive plan to be changed in detailed plans, as a result of which living nature cannot be considered protected.

Over one-half of the areas in green network corridors are covered by forests (figure 8.14). Forest management should be organized in harmony with the objective of preserving animal migration corridors to keep populations vital. Currently this is not regulated by any legal act or regulations.

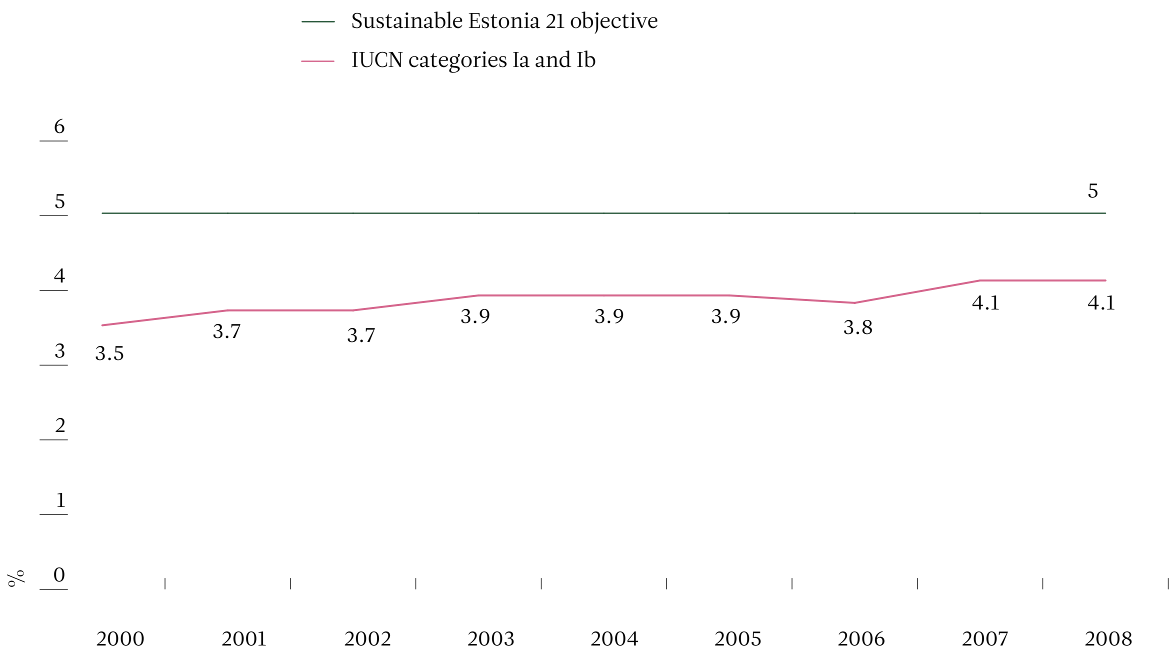


Figure 8.11. Areas with protection regime that conserves their natural condition (corresponding to IUCN categories Ia and Ib) in 2000–2008 and the corresponding objective according to "Sustainable Estonia 21". Data: EEIC.

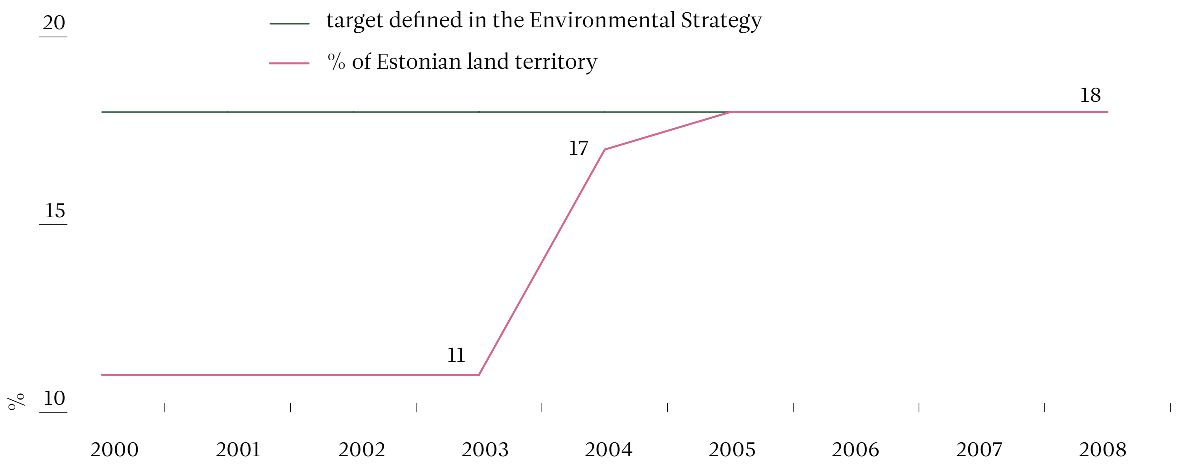


Figure 8.12. Protected land area in Estonia in 2000–2008 and the corresponding goal in the Estonian Environmental Strategy 2030. Data: EEIC.

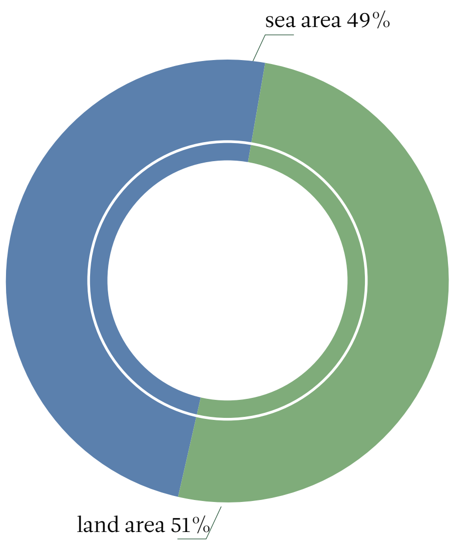


Figure 8.13. Distribution of protected area in Estonia between sea and land areas. Data: EEIC.

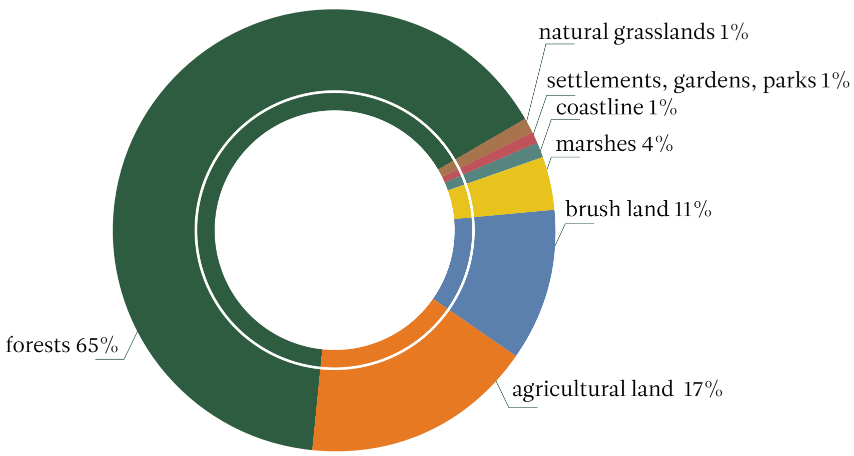


Figure 8.14. Distribution by ecosystems of green network space outside of protected areas in 2008. Data: EEIC.

Management plans

Currently there are management plans for 27 protected areas and for organizing protection for seminatural communities of approximately 200 limited-conservation areas. Management plans have been established for 14 nature reserves, 8 protected landscapes and 5 limited-conservation areas, making up only 7% of all protected areas in Estonia. As the areas covered by the management plans are primarily on land, the plans can be considered to cover only 14% of protected land area. That means 86% of protected land and almost all protected sea area is not under management plans. The protection of areas in green network corridors is also not under management plans.

There are 25 action plans for conservation of species, which set forth protection measures for a total of 40 protected species (15 of them in protection category I, 23 in category II and 2 in category III). There are a total of 570 protected species. Management plans have been prepared for 23% of the species in protection category I (a total of 64 species), 9% of category II species (a total of 262 species) and less than 1% of category III species (a total of 244 species). This means that management plans establish protection for only 7% of protected species.

Restoring and maintaining habitats

Placing habitats under protection is not sufficient to ensure their existence. It is only a foundation for organizing further protection. Consistent management is necessary for existence of species richness of some habitats, including semi-natural communities. In the last 8 years, the amount of semi-natural communities that have been restored through state coordination with the nature conservation subsidies is slightly lower than the amount maintained on average annually. The area of the semi-natural communities maintained is about one-quarter of the total area of semi-natural communities. On average, only about 3% of the total area of semi-natural communities is restored per year.

The Estonian rural development plan for 2007–2013 stipulates that by 2013, the area of semi-natural biotic communities that receive maintenance support from the state must be 35,000 hectares and the number of recipients of assistance should be 1,500. Currently slightly over 40% of the targets have been achieved in the first case and slightly over half in the second case. Thus the maintenance support for semi-natural biotic communities should be expanded in the next four years by about 20,000 hectares and the number of beneficiaries should grow by 750.

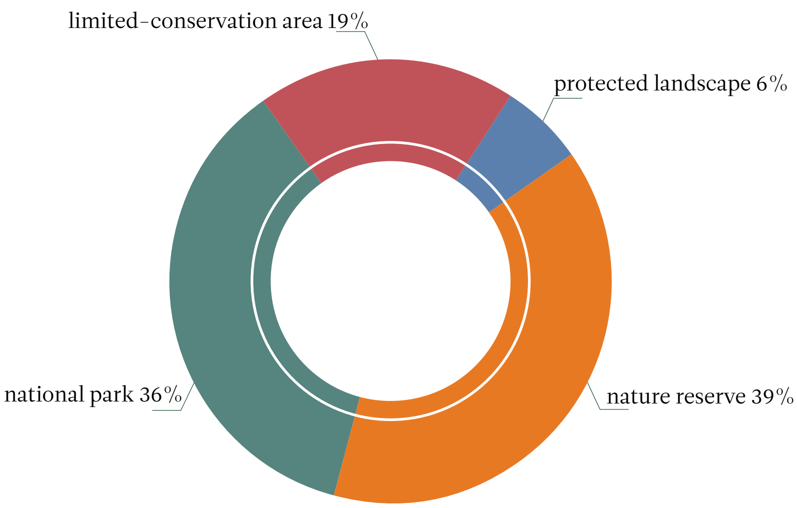


Figure 8.15. Distribution of areas covered by management plans by type of protected area, as of 31.12.2008.
Data: Ministry of the Environment, EEIC.

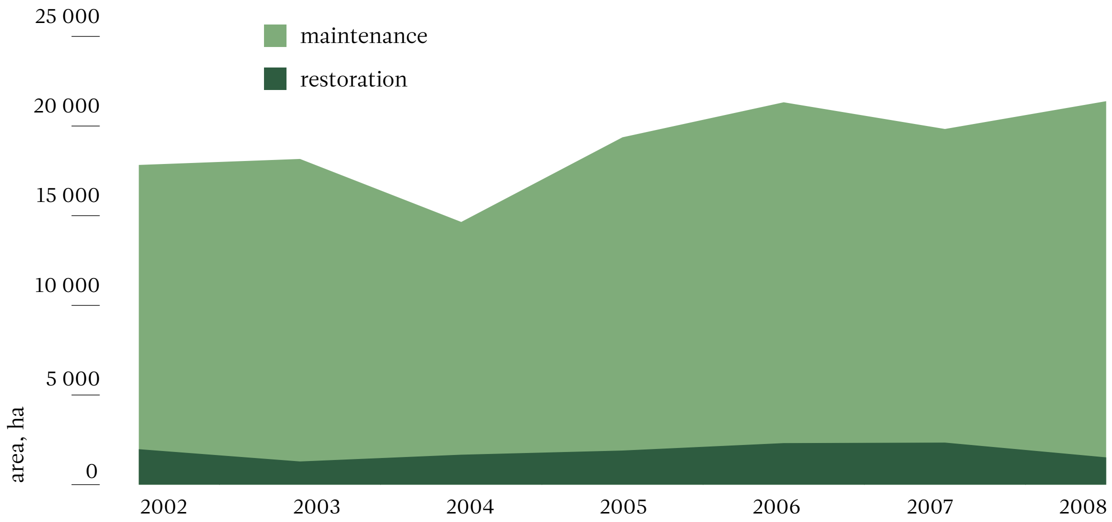


Figure 8.16. Restoring and maintaining semi-natural communities in 2002–2008. Data: Ministry of the Environment, EEIC.

Read more:

- Convention on biological diversity website.
[WWW] http://www.cbd.int
- Estonian Clearing-house Mechanism
of Convention on Biological Diversity.
[WWW] http://loodus.keskkonnainfo.ee:88/English/index_html
- Estonian Environment Information Centre website.
[WWW] http://www.keskkonnainfo.ee/index.
php?lan=EN&sid=23&tid=22&l1=2 (biological diversity)
- Ministry of the Environment website.
[WWW] http://www.envir.ee/67247 (nature conservation)
- Red Data Book of Estonia.
[WWW] http://www.zbi.ee/punane/english/index.html
- The Eagle Club website.
[WWW] http://www.kotkas.ee/ENG/index.html

8.3. Inland water bodies

The diversity of Estonia's inland water body ecosystems is great in spite of Estonia's small area. This is due to the transitional zone between the maritime and continental climate, the difference in the bedrock in northern and southern Estonia (limestone and sandstone, respectively), interchanging uplands and plains, high percentage of forested land and fairly large number of marshes. The dense network of flowing water bodies has primarily been shaped by the great variation in precipitation and landscapes. In terms of total area of inland water bodies, Estonia ranks fourth in Europe, thanks to Lake Peipsi (4.8%). The unique aspect of Estonian inland water bodies is the broad spectrum of hydrochemical and physical values. Estonia has water bodies with very light and dark, and very soft and hard water. The typical Estonian water bodies are rich in humic substances and high in mineral content; they are unique in Europe. The status of a number of water bodies or a part thereof has worsened as a result of human impact. This has led to a decline in the biological diversity of water bodies.

8.3.1. Habitats

Freshwater habitats are found in rivers, streams, springs and lakes. **Lakes** fall into various types of categories distinguished on the basis of trophic level, shape (morphology), hardness, water thermal stratification, colour and connection to the sea and other criteria. This is the basis for distinguishing between habitats such as dystrophic lakes, naturally eutrophic lakes, oligotrophic lakes with moderately hard water, and so on. The nature of lakes is similar from one region to the next, which is why Estonia has been divided into seven limnological sectors. Most of the lakes in south-western Estonia and north-eastern Estonia are oligotrophic and dystrophic; in upland Estonia, they are eutrophic; on the Pandivere upland, alkalitrophic; in intermediate Estonia, dystrophic; in Low Estonia, dyseutrophic; and in western Estonia, halotrophic. Peipsi and Võrtsjärv are hardwater eutrophic lakes[J].

Loading of organic matter, nutrients and point pollution sources from catchment tends to blur the differences between lake types. Currently two types of human origin are distinguished aside from the natural lake types. The human-origin types are hypertrophic (with very high nutrient content) and macrophytic (with extensive macrophytic algae cover, overgrowing).

Impoverishment of biological diversity can be noted in the case of all of the types. In stratified lakes, the share of the oxygen-poor, deeper layers has expanded (often the lower 2/3 of the water column is without oxygen in summer). In shallow, dyseutrophic lakes (the predominant lake type in Estonia) the loading of humus substances and nutrients has led to the introduction of so-called pond species, that have adapted to life in water with high content of organic matter. Production of microalgae has dropped. Fish diversity has also declined. Coverage of macrophytic vegetation has increased.

The two main habitat types in Estonia's **running water bodies** are fast-flowing and slow-flowing rivers or river segments. Fast-flowing rivers (river segments) mainly have low water and a stony or gravely bed. Slow-flowing segments have sandy, muddy or clay bottoms. The species in each are different. The greatest biological diversity is seen in medium-sized river segments where the rapid and slow-flowing parts alternate. Spring-fed river segments are light-coloured and have minor seasonal variations in water level. Summer water temperatures in those segments are low and the water's oxygen content is high. They are suitable as habitats for cold-water and oxygen-demanding species. River segments containing a small percentage of groundwater are characterized by darker water that is richer in humic substances, greater variations in water level and a higher percentage of warm-water species.

For more about assessment of water bodies and their condition, see Chapter 6, Water, sections 6.4.2–6.4.5.

8.3.2. Species

Lake Peipsi

The structure of the species in **phytoplankton** in Lake Peipsi has changed. The percentage of blue-green algae has increased significantly and diatom biomass has decreased. Even though the summer of 2008 was cool and rainy, intensive blue-green algae blooms were seen in all parts of the lakes in August. In the southern parts of the lake, species of one of the most toxic blue-green algal genera, *Microcystis*, have been predominant in recent years. The concentration of algal toxins in water has repeatedly exceeded the allowable limit for bathing water. Water blooms and algal toxins pose risks to the biotic communities of Lake Peipsi, the balance of the entire ecosystem, and human health as well. Algal toxins are apparently also a reason that the amount of zooplankton has declined significantly since 2001. The decline in zooplankton means that the food resources for fry and plankton-feeding fish have dropped. In 2006, fat duckweed (*Lemna gibba*) was found in Peipsi, a plant that indicates the presence of domestic waste water.

Reed proliferation is occurring in Lake Peipsi, as a result of which a number of more sensitive species of plants are in retreat. These species include many rare species: water awlwort, narrowleaf water-plantain and slender-leaved pondweed – these should be accorded protection. Macrophytes in Lake Peipsi are showing signs of impoverishment, evidenced by a drop in the occurrence of 31 taxons. A northward shift in reed growth is occurring and

[J] Järvede nimestik. Looduslikud ja tehisjärved. (List of Estonian lakes. Natural and manmade lakes.) (2006) / Compiled by R. Tamre. Tallinn : EEIC the density of reed shoots has increased in the last two years. The concentration of new reed areas is also great on the north coast of Lake Peipsi, which was previously free of reeds. The area under reeds in the Estonian part of the lake has increased by several hundred hectares over the last few decades due to rising trophic level.

The abundance and biomass of **organisms living on the bottom of water bodies** (macrozoobenthos) has remained high in Lake Peipsi and the biotic community continues to be biologically diverse. On the area close to shore with a harder bottom, the amphipod *Gmelinoides fasciatus* is profilerating. Introduced in the 1970s from Lake Baikal for the purpose of increasing the fish food supply; the species has nearly completely driven out the local amphipods *Gammarus lacustris* and *Pallasea quadrispinosa*.

The **pollution of water near the shoreline** of Lake Peipsi has increased. This can be seen in the sudden rise in the vegetation on the surface of the water.

Due to the proliferation of algae, **fish spawning grounds have become muddy** and as a result, fish reproduction conditions have worsened. For fish that inhabit cold, clean water such as vendace, whitefish, burbot and smelt, the Peipsi is no longer a suitable habitat. A shift has taken place toward more dominant pike-perch and bream populations as they prefer eutrophic, warm and turbid water.

Due to intense fishing, the number of large predator fish is too low and thus the fish populations are not held in balance. Pike-perch is caught too early. Young fish predominate in the pike-perch catch (1–2 generations) and they cannot yet function as predators. The Peipsi fish populations are out of balance. The abundance of pike-perch is not in conformity with stocks of its primary prey – plankton-eating smelt and vendace. The smelt stock is almost depleted in the lake. The loss of equilibrium in the fisheries affects the entire ecosystem negatively through food chains, changing the proportions of other habitat groups, above all the relationship of phyto- to zooplankton. The rotan (*Perccottus glenii*), an undesirable alien species that has appeared in the Narva river and reservoir, has not yet reached the Peipsi.

Lake Võrtsjärv

There are no certain data regarding changes in the balance of species in the Lake Võrtsjärv; but a number of species found previously in 1995–2001 were not seen. Of the quantitative changes the most important were the continuing development of a belt of common reed (*Phragmites australis*) encircling the entire lake, and the earlier supplantation (1965–1966) of massive underwater plants in the southern part of the lake such as *Chara contraria* and Canadian pondweed (*Elodea canadensis*) with whorled water-milfoil (*Myriophyllum spicatum*) communities, which is now seen over a broader area and in other parts of the lake. The common hornwort (*Ceratophyllum demersum*) has also become widespread in the southern part of the lake, another indicator of eutrophication.

With regard to the biomass of zoobenthos (not including family *Unionidae*) only one species has absolute dominance – the buzzer midge (*Chironomus plumosus*). The introduced zebra mussel (*Dreissena polymorpha*) has grown rare in Võrtsjärv. The fish are under strong fishery pressure and there have not been major changes in recent years.

For more about the condition of aquatic biotic communities, see chapter Water, sections 6.4.3–6.4.5.

8.3.3. Reasons for reduced biological diversity

Large lakes

The ecosystem in water bodies are impacted by malfunctions in waste water treatment facilities in settlements, contamination with nutrients, toxic chemicals, petroleum products as well as by overfishing and introduction of alien species. The movement of fish in rivers is impacted by weirs and dams and other obstacles erected on rivers.

The ecosystem is also impacted by natural fluctuations in the water level and temperature, extreme weather conditions and ice conditions, etc. The state of many lakes (including Peipsi and Võrtsjärv) becomes especially bad when the high temperatures coincide with low water level. When water level is low, the wave action impacts the bottom of the lake as well. This is hazardous for living creatures as the waves stir up nutrients from the sediments on the bottom, which promotes water blooms. Winter brings with it the risk of anoxia and fish kills happen if water levels are low.

In the case of Võrtsjärv, it can be said that the impact of nutrients from agriculture and waste water from settlements has been less in the 2000s than in years past and exerts less of an impact on the lake than does the natural fluctuation of lake water levels. Still, the increase in bacteria and ciliates shows that eutrophication is continuing in Võrtsjärv. Due to the abundance of nutrients, both phyto- and zooplankton and biological diversity of zoobenthos is decreasing, and the areas inhabited by shoreline and aquatic plants is increasing.

The Peipsi ecosystem's equilibrium is jeopardized above all by excess phosphorus content, which makes algae proliferate. This leads to nighttime oxygen deficiency as the oxygen is used by decomposition processes in the algae and fish may asphyxiate. Large predator fish and especially pike-perch should not be caught too early in their life cycle. To protect fish stocks, the fishing for undersize fish should be restricted and the size of the eyelets in nets should be increased.

Small lakes

The equilibrium of smaller lakes is thus far jeopardized primarily by diffuse and point-source pollution in the drainage area. Due to the construction of water treatment facilities, the pollution load from point sources has decreased significantly. The load from diffuse sources have also decreased to a noteworthy extent. The impact of the oil shale industry is also milder on lakes. At the same time, activity has begun to broaden views of lakes, to landscape shorelines, to establish buildings on hillsides near shores, to establish new swimming areas (or restore existing ones), to mow aquatic plants, to remove lake sediment. Unfortunately most of these activities have taken place without taking into consideration the extent to which they would impact the aquatic ecosystem. Changing the natural appearance of shores may significantly change the circulation of matter in a lake. The removal of the trees and brush from the shores of the soft-water Inni lake, located in the Otepää upland, and partial removal of shoreline plants was especially striking. As a result, the plankton structure changed in the same year's vegetative period and a bloom occurred due to toxin-producing blue-green algae. The objective of activities for rehabilitating lakes should generally be the achieving of a situation so that ecosystem function would be in balance. A few such activities that disregard that objective may cause harm rather than good.

Running water bodies

Biological diversity in flowing water bodies is at risk from contamination of water, exchange of water, the riverbed and drainage area. The combined effect of several harmful factors is especially dangerous. Untreated wastewater must be kept from entering flowing water. Organic matter has a direct impact on changes to the oxygen regime of life. Even more destructive is toxic wastewater. High levels of nutrients are not necessarily always harmful to riparian life but certainly impacts the standing water bodies into which rivers empty. The physical condition of rivers is most impacted by land improvement work and dams. In the first case, larger stones are removed from the riverbed and meandering beds with varying width, depth and speed of flow are straightened into a uniform channel, which is much poorer in habitats and biota. Dam-building primarily disrupts fisheries as it prevents fish from migrating between feeding, wintering and breeding areas. Unfortunately, often it is precisely the stretches of rivers with rapids that suffer due to dams and weirs where the fall of the river is greater and which are better choices as dam locations. The straightening of rivers and building of weirs exerts a uniformly negative impact on water quality, the speed at which sediments are deposited, temperature and water exchange. The biota is also negatively impacted by hydroelectric power plants. There are currently over 40 of them on Estonian rivers and all of them operate cyclically. Thus river segments that are downstream from hydro plants suffer from regular reduction in the flow of water.

8.3.4. Protection

A number of legal acts govern protection of lake and river biotic communities. All are required by the Water Act to avoid pollution and excessive reduction of water, littering of water bodies and harm to aquatic biota. Ice cover on water bodies may not be polluted or littered by petroleum products, chemicals, waste and other pollutants. To protect water from diffuse pollution and avoid erosion of banks and shorelines, a water protection zone is established on the shores or banks of the water body. It reaches 20 m from the ordinary water line in the case of the Baltic Sea, Peipsi, Pskov and Võrtsjärv. In the case of other lakes, reservoirs, rivers, streams, springs, ditches and canals and land improvement system channels, it is 10 m. If dams are erected on water bodies, fish must be ensured access both upstream and downstream. As affluence grows, and watercraft are used to a greater extent, maintenance and use requirements are important. To prevent harm to the condition of the water body, a maximum speed of 30 km/h has been established for watercraft on non-navigable inland water bodies. It is prohibited to use watercraft with engines on lakes whose surface is under 100 hectares and on rivers whose minimum width on a segment allowing watercraft to be used is under 10 metres. Watercraft must be kept in a condition that will not damage, pollute or litter nature. Under the Nature Conservation Act, protection rules may be established to govern use of floating vessels, fishing, gathering of reed, changes to the water level and to the shoreline. **Management plans** are prepared for the purpose of organizing protection in protected areas. Few management plans are as yet in harmony with the most recent legal acts. The Fishing Act establishes the minimum measurements of fish, fishing seasons, fishing areas and permitted fishing gear. Fishing for the following species is prohibited: grayling, wells catfish, asp, spined loach, loach and bullhead.

Read more:

- Ministry of the Environment website
[WWW] http://www.envir.ee/114585 (LIFE-Nature project – Protection of *Triturus Cristatus* in the Eastern Baltic Region)
- Ministry of the Environment website
[WWW] http://www.envir.ee/67388 (water)
- Ott, I., Kõiv, T. (1999). Eesti väikejärvede eripära ja muutused. Special features and changes of Estonian small lakes. Tallinn: Estonian Environment Information Centre, Academy of Sciences, Institute of Zoology and Botany of the Estonian Agricultural University

8.4. Coastal waters

The Baltic Sea is the world's second-largest body of brackish water after the Black Sea. Due to its low salinity, the Baltic Sea is not very rich in species, but there are nevertheless many important species and habitats with importance on the level of Europe and world in terms of biological diversity. The primary environmental problems for the Baltic Sea are eutrophication due to the influx of wastewater into the sea, invasion of alien species and oil pollution.

The following primarily focuses on the sea bottom habitats and inhabitants of the Estonian coastal waters and related aspects.

8.4.1. Habitats

Annex I to the European Union Habitat Directive lists priority habitats, protection of which requires the creation of special areas to be protected. Six of the maritime biotopes listed in the directive are found in Estonia: large shallow inlets[K] and bays; sandbanks which are slightly covered by seawater all of the time; estuaries; mudflats and sandflats not covered by seawater at low tide; coastal lagoons and reefs. In addition, Boreal Baltic islets and small islands fall into this category.

Of these habitats, **sandbanks** are the most frequently occurring in Estonian coastal waters, which are mainly concentrated in the western Estonian coastal waters and Väinameri area. Sandbanks are characterized by the occurrence of higher plants, including eel-grass, pondweed and horned pondweed (photograph 8.1). **Reefs** are a fairly common habitat type as well. They are found in seaside areas (such as the western and northern coast of Vormsi, Saaremaa's western coast, Pakri island area) and in banks in the area of open sea (Neugrund, Apollo etc). In shallower depths on banks near the coast, biotic communities of a perennial brown alga, bladder wrack are characteristic (photograph 8.2), but in general perennial plants are lacking in the more open areas and blue mussels (photograph 8.3) and ephemeral filamentous macroalgae are typically predominant. Wide and smaller shallow bays (inlets), coastal lakes (lagoons[L]) and to a great extent mudflats and sandflats[M] as well, are found only in the coastal waters of western Estonia and the islands. The only area with estuary status is Matsalu Bay. In all four of the last-mentioned habitats, a characteristic feature is the occurrence of higher plants and charophytes (photograph 8.4).

Photograph 8.1. Sandbank with eelgrass community.

Photograph 8.2. Reef with bladder wrack community.

Photograph 8.3. Reef with blue mussel community.

Photograph 8.4. Estuary with charophyte community.

[K] Inlet – small, shallow bay.
[L] Lagoons – coastal lakes created when shallow bays became detached from the sea.
[M] Mudflats and sandflats – a coastal area left dry temporarily due to water level variation.

8.4.2. Species: seals

With the mild winters of recent years, the status of the two seal species in Estonian waters, the grey and ringed seal, has come under attention. The **grey seal** primarily inhabits coastal areas adjacent to open sea and rocks that just barely protrude over sea level. Expeditions in search of food are often long and they catch food at a depth of 50–100 m. The use of feeding areas varies seasonally; in autumn the creatures prefer shallower areas closer to the coast. They prefer ice floats for giving birth, but in the absence of such ice they are capable of giving birth on dry land. The abundance of grey seals has risen in the last decade in Estonian coastal areas and throughout the Baltic Sea. This is a case of a population that inhabits the entire Baltic Sea and which grows about 7–8% a year in their native habitat in the central part of the Sea. The Baltic grey seal is currently no longer threatened.

The **ringed seal's** habitat is in the straits where they mainly spend night hours on the rocks lining the islands' coasts. They head for deeper water in summer to search for food, at a depth of 30–80 metres. Ringed seals are more stationary than grey seals and their primary habitat in Estonia is in the Väinameri straits and the Gulf of Riga. When ice forms on the Väinameri, they usually head to the northern part of the Gulf of Riga and the Bay of Pärnu, where their primary reproduction areas are located. Their reproductive success depends completely on the existence of ice and how long it lasts. In the last five years, only 2003 and 2006 have seen solid ice cover, while the rest of the winters have been warmer than the average. In 2008, reproduction was completely unsuccessful as the ice was nearly lacking. The abundance of ringed seals in Estonia is not known exactly but it is not estimated to exceed 1500 animals. The Estonian population is detached from other populations in the Baltic Sea and no migration takes place. The ringed seal is an endangered species in Estonia, and the population's status may worsen given the frequent mild winters.

Figure 8.17. Grey seal abundance in 1999–2008. Data: Environmental Board.

8.4.3. Reasons for biodiversity loss

There are many reasons for biodiversity loss, of which most important are oil spills, climate changes, invasion of alien species and eutrophication.

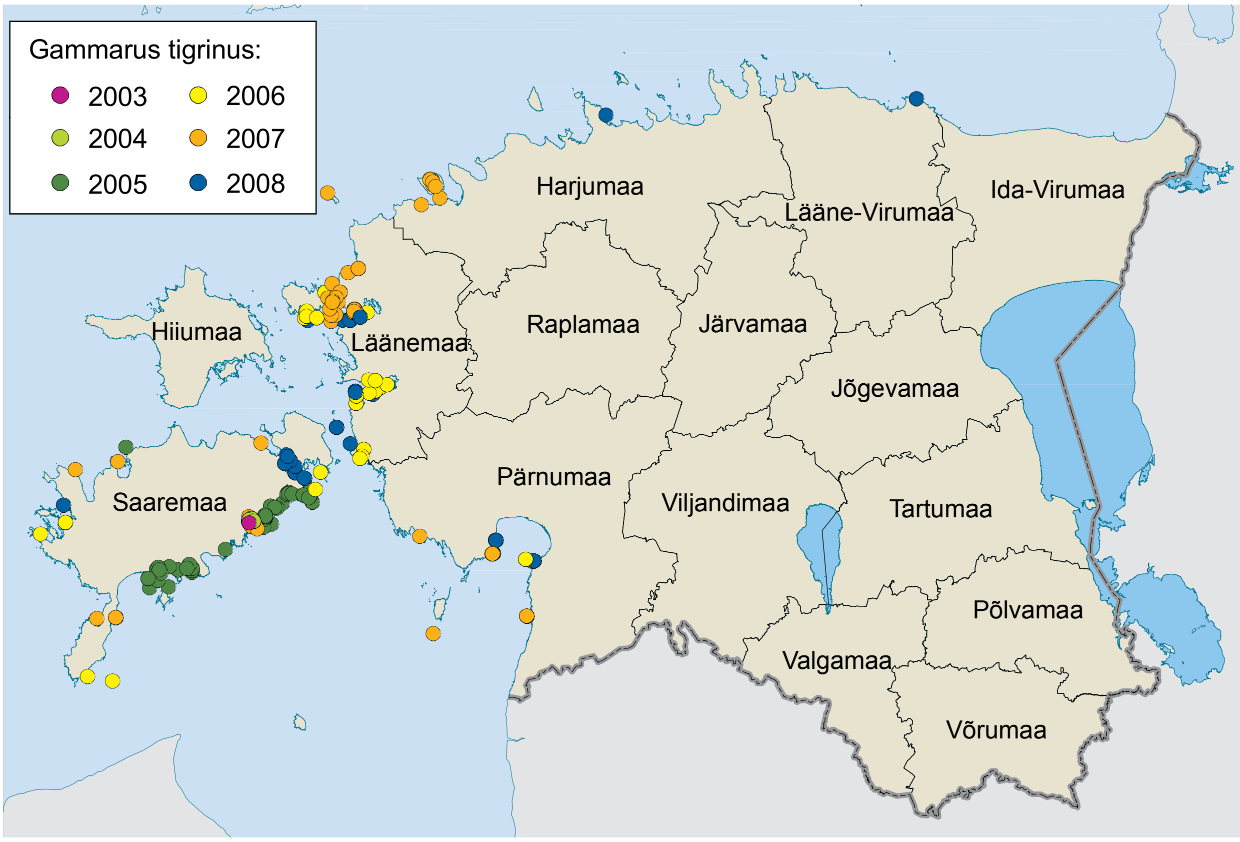
Alien species

A total of 120 alien species have been recorded in the Baltic Sea; 77 have established[N]. The percentage of alien species among bottom inhabitants is surprisingly great – there are 27 stable populations, which is about 35% of all invasive species in the Baltic Sea. The following is a short overview of the most important alien species found in Estonian coastal waters over the last 10 years.

Paramysis intermedia, a crustacean similar in shape to the shrimp but smaller (about 1.5 cm), was first found in 2008 in the eastern part of the Gulf of Finland and the central part of the Gulf of Riga near Ruhnu. This is the first time it has been found in the Baltic Sea.

Both *Pontogammarus robustoides* and *Chelicorophium curvispinum* were found in Estonian waters for the first time in 2005 – in the Gulf of Finland near Sillamäe. In 2008, individual animals were found in the eastern Bay of Narva. The populations in both areas are permanent. The nearest populations of the species are located in the Curonian Bay in Lithuania.

The amphipod crustacean *Gammarus tigrinus* was discovered in Estonian waters in 2003, in the northern Gulf of Riga. The nearest population in the case of this population as well is in the Curonian Bay in Lithuania. The amphipod crustacean *Gammarus tigrinus* is an example of an invasive foreign species found in coastal sea biotic communities. Since first being discovered in 2003 the species' range in Estonian coastal waters has increased with each year and in 2008 it was already found in the central and eastern Gulf of Finland (map 8.1). Nevertheless, in the Gulf of Finland the species was found only in port areas and these were not permanent populations. The amphipod crustacean *Gammarus tigrinus* is a very thriving species. It has adapted to a wide range of salinity, is highly tolerant of pollution and is extremely fertile. As a result it is able to spread throughout Estonian coastal waters and reduce natural diversity as this is an extremely strong competitor to local amphipod crustaceans.



Map 8.1. Invasion of *Gammarus tigrinus* in Estonian coastal waters. Data: Estonian Marine Institute.

[N] Baltic Sea Alien Species Database. [WWW] http://www.corpi.ku.lt/nemo/mainnemo.html (10.03.2009)

Proliferation of macroalgae

Costal sea bottom biological communities are impacted by the general level of eutrophication of the Baltic Sea as well as by local sources of pollution. The higher nutrient concentration is responsible for the massive proliferation of ephemeral filamentous macroalgae (map 8.2). Proliferation of algae in turn has a strong impact on light conditions and leads to competition for space as a result of which mats of filamentous algae may suffocate higher plant and perennial algal (bladder wrack) communities.

Oil pollution

The Baltic Sea is an area of very busy shipping traffic – passengers, goods, oil and other hazardous cargoes are transported on this body of water. In recent years, shipping traffic has increased along with the likelihood of oil spills and the number of intentional pollution events[O]. In 2008, the border guard discovered 69 spills, in 2007, 99 and in 2006, 62.

The impact of oil spills is specific to each species. For example in the case of bladder wrack communities, species of algae and fauna that are related to the bladder wrack community bear the brunt of the pollution. The sensitivity of the kelp itself to short-term oil pollution is low, yet in areas sheltered from waves, mineralized oil may asphyxiate the communities in their entirety, including the bladder wrack. As a consequence of severe oil spills, the whole bottom-dwelling biota is generally destroyed. In terms of feeder groups, filter feeders in the sedimentary layer are the first to experience the most severe harm. As the hydrocarbons are broken down, the sedimentary layers closest to the surface become clearer and the animals living within the sediment are affected. Herbivores disappear from the polluted area due to the toxic effects of the oil.

Besides oil spills, construction activity and mineral extraction in coastal waters, and hazardous material contamination are potential risks and factors impacting bottom-dwelling biotic communities.

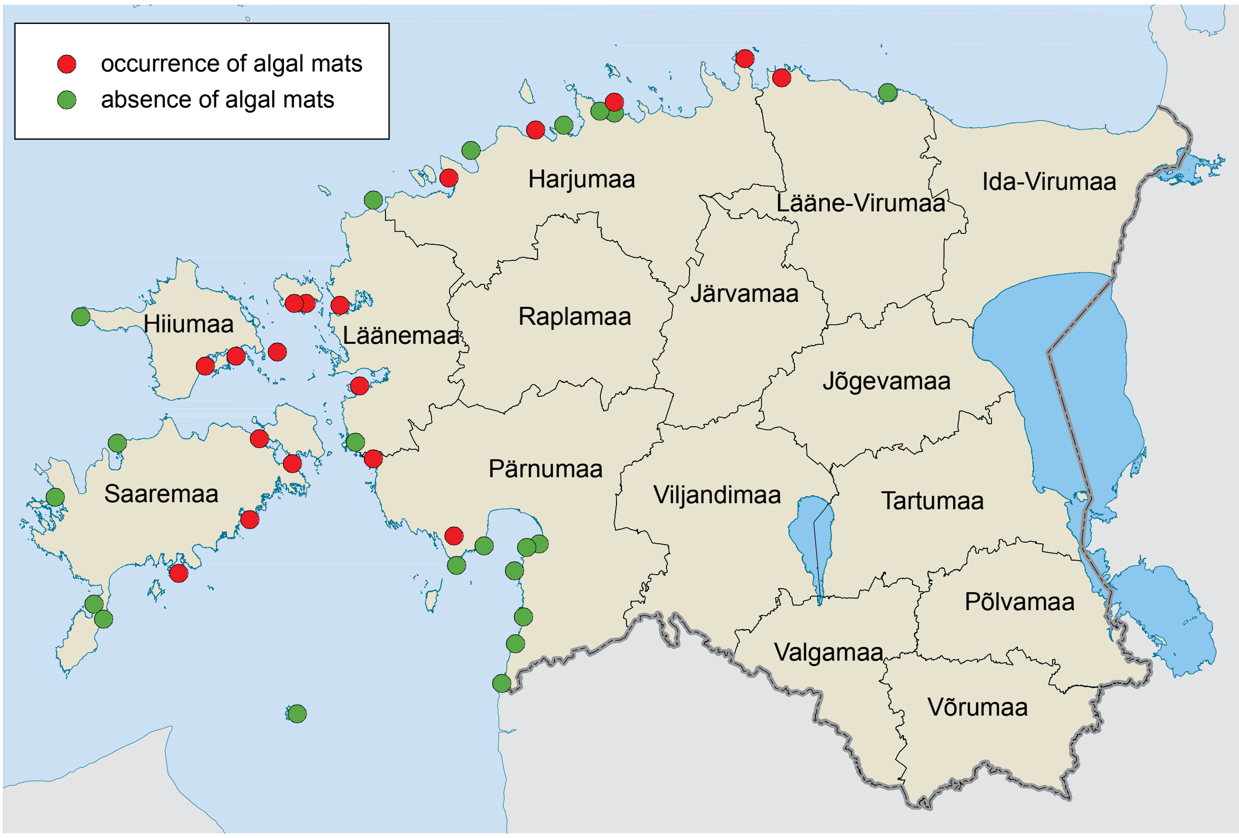
Invasion of alien species to the Baltic Sea has increased exponentially and above all it is caused by more intensified shipping traffic and is related to environmental instability, which in turn is caused by climate change and eutrophication.

8.4.4. Protection

It is not possible to apply working measures on the local level to combat present eutrophication in the Baltic Sea. At the same time, if all of the countries bordering the Baltic Sea were to contribute to lessening the local impact, it would be effective on a wider scale. Possible measures to reduce the impact of pollution of coastal origin include retracting influx, channelling and better treatment of waste water. More sustainable use of water would also help. In the case of construction activity, dredging and dumping, the implementation of restrictions in special conservation areas and in the immediate vicinity are important; in some cases, ship speed restrictions are necessary to avoid disruption of habitats on the seabed. In the case of oil pollution, prevention and implementation of navigational restrictions and pollution control play the most important roles.

Marine alien species may enter a new area in many ways, but above all on ships – in ballast water or attached to the ship's hull. Human-made canals also have an important role. Individual animals may also escape into nature from home aquariums and aquaculture farms. Thus prevention is the most important thing for preserving local diversity and preventing invasion of alien species (including carrying out the recommendations of the International Maritime Organization).

[O] Kaugseire Eestis. (Remote sensing in Estonia.) (2008) / Ed. K. Väljataga, K. Kaukver. Tallinn : EEIC. [WWW] http://www.keskkonnainfo.ee/index.php?lan=EE&sid=65&tid=67 (Õlireostuse tuvastamine SAR kujutistelt (Identifying oil spills from SAR images), p 195)



Map 8.2. Spread of algal mats in Estonian coastal waters in 1995–2001. Data: Estonian Marine Institute

Read more:

- Helsinki Commission website.
[WWW] http://www.helcom.fi (publications)
- Recommendations of the
International Maritime Organization, regulation D-1.
[WWW] http://www.imo.org/conventions/
mainframe.asp?topic_id=867

9. Waste

9. Waste

In the field of waste, the years 2004–2007 were characterized above all by changes occasioned by Estonia's accession to the European Union in 2004. A new Waste Act came into force then, along with the Packaging Act and legal acts established on their basis. The waste management situation was also impacted by rapid economic growth. Increased production of oil shale energy and oil, industrial output and consumption led to increased amounts of waste generated.

Noteworthy changes in the restructuring of the field of waste handling included a consistent reduction in the number of landfills not in conformity with environmental requirements, the increase in the waste recovery rate (including packaging waste), development of collection of municipal waste by category and the successful implementation of the deposit system for beverage packages. The waste transport system organized by local governments does not yet cover all local governments, but it has made it possible to expand waste transport services to rural areas. There has been investment into a network of waste stations (regional waste collection and sorting facilities) that allowed inhabitants to return recoverable waste free of charge. The hazardous waste collection network has grown, with new waste recovery stations and new collection points.

New legislative provisions in the field of products of concern and packaging and the entry into force of EU directives has expanded implementation of the principle of producers' responsibility. Legal acts have also promoted the creation of producers' responsibility organizations that act on behalf of manufacturers to create collection networks for collection and recovery of waste electric and electronic equipment (WEEE), used tyres and packaging. There has also been an increase in the number of end-of-life vehicle collection and demolition points conforming to environmental requirements.

Changes in the development of waste treatment have led to innovations in accounting for waste, and collection and processing of data on waste.

9.1. Legal background

Strategic objectives for the waste sector are established based on the general European Union and Estonian environment policy, the main goal of which is to avoid waste generation and promote recovery, including reuse and recycling. The development of waste treatment in 2004–2007 has been primarily based on the Riigikogu's national waste management plan approved in 2002. In 2008, the Government approved a new waste management plan that sets forth general development areas in the waste management sector up to the year 2013. The strategic objectives for the waste sector, measures for achieving them and indicators for measuring performance derive from these documents. In the field of legislation, the Waste Act should be mentioned; it sets forth general requirements for waste prevention and the avoidance of health and environmental hazards stemming from waste, along with waste management procedures for reducing the hazardousness of waste and liability for violation of the requirements. The Waste Act also stipulates the precise extent and conditions of the principle of waste transport organized by local governments. The national packaging waste collection and recovery system is based on the Packaging Act adopted in 2004.

9.2. Waste generation

Over the years, the amount of waste generated has increased; the greatest growth has taken place with regard to non-hazardous waste in the last five years, crossing the 20 million tonne mark in 2006 (figure 9.1). The generation of hazardous waste has been relatively stable from one year to the next, averaging 7 million tonnes a year.

In 2003–2007, over 80% of waste was generated in industry, with 72% of all waste generation comprising waste related to the oil shale industry and energy sector (figure 9.3). A significant share of industrial waste was generated by the timber industry and cement industry and this waste was largely directed to recovery.

The primary reason for the increase in amounts of waste is general economic and commercial growth. The relative change in GDP compared to waste generation shows that waste generation has grown less than economic growth (figure 9.2). Energy production based on oil shale is and will continue to be the most waste-intensive industrial sector in Estonia, as long as technology and production volumes do not undergo major change (figure 9.3).

Figure 9.1. Generation of hazardous and non-hazardous waste, 1995–2007. Data: EEIC.

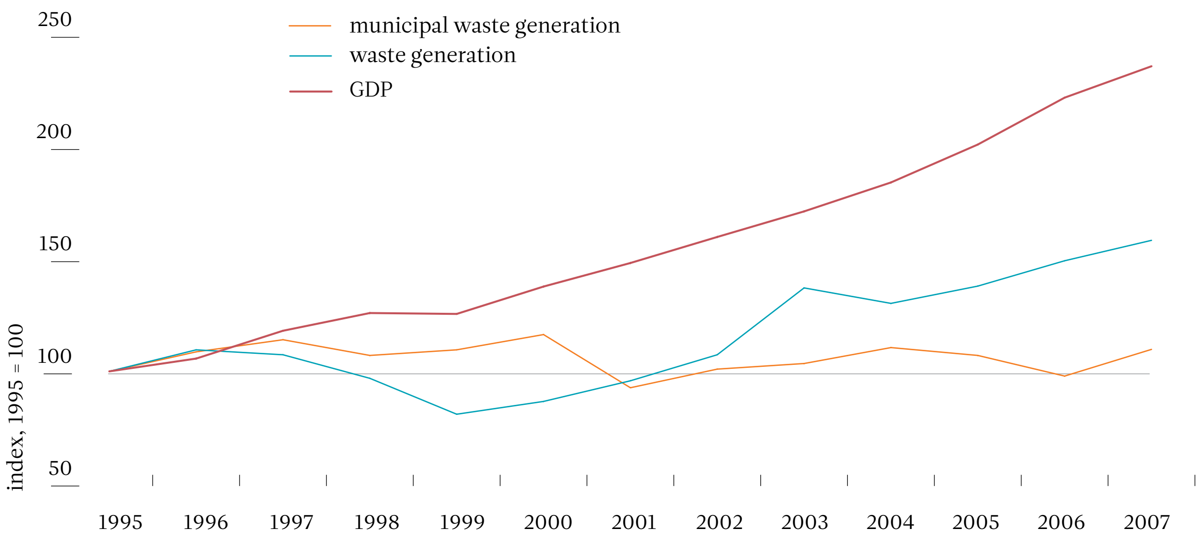


Figure 9.2. Change in waste generation and GDP in 1995–2007, as an index, baseline level 1995. Data: EEIC.

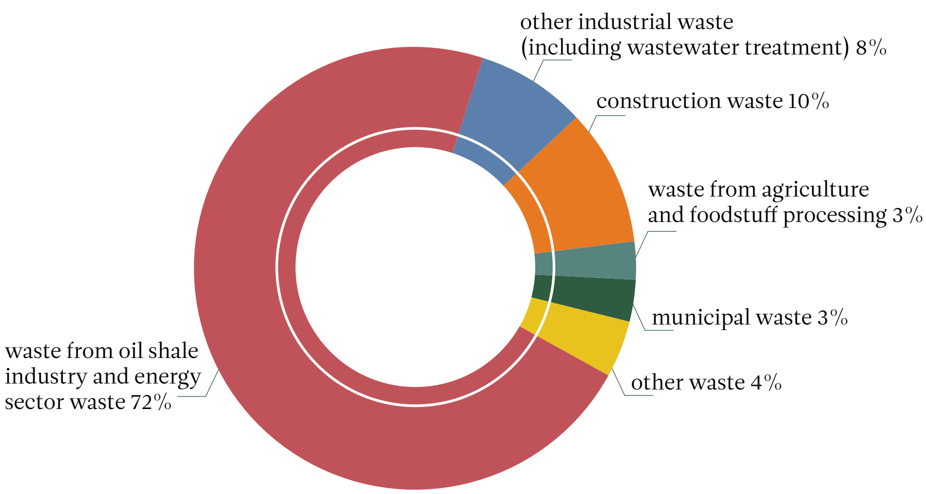


Figure 9.3. Average distribution of waste generation by sector in 2003–2007. Data: EEIC.

9.3. Hazardous waste generation and handling

Great quantities of hazardous waste are generated in the production of oil shale energy and oil. Over 95% of all hazardous waste is generated by production of oil shale energy and shale oil (figure 9.4). This is also reflected by the share of hazardous waste out of total waste generated. In years past, the percentage of hazardous waste has exceeded 50% of all waste generated. Thanks to some improvement in production efficiency, this percentage has consistently dropped, the exception being 2007, when energy and shale oil production grew abruptly, also affecting the quantities of waste and the ratio of hazardous waste to non-hazardous waste.

The amount of other hazardous waste generated has been more or less stable, and per capita it is comparable to generation of hazardous waste in other EU member countries.

The moderate decrease in hazardous waste that took place in 2005–2006 was due to the fact that Kunda Nordic Tsement AS did not declare clinker dust that was recovered in the agriculture sector for use as lime fertilizer (44,000 and 43,000 tonnes respectively); this had a noteworthy impact on the overall balance.

After oil shale waste, the primary hazardous waste generated in 2007 was as follows: clinker dust (60,000 t); various waste containing petroleum products and oil, including storage tank waste and bilge water (57,000 t); soil contaminated by hazardous materials (19,000 t); asbestos waste primarily categorized as construction waste including roofing material Eternit containing asbestos (3,600 t); end-of-life vehicles containing hazardous liquids (5,400 t); acid waste (3,700 t); slag generated by recycling of lead batteries (1,200 t); hazardous waste of household origin (2,700 t) etc.

The relative proportions of solid waste generated by shale oil production has declined over the years (except for 2007); this is due to optimized use of oil shale.

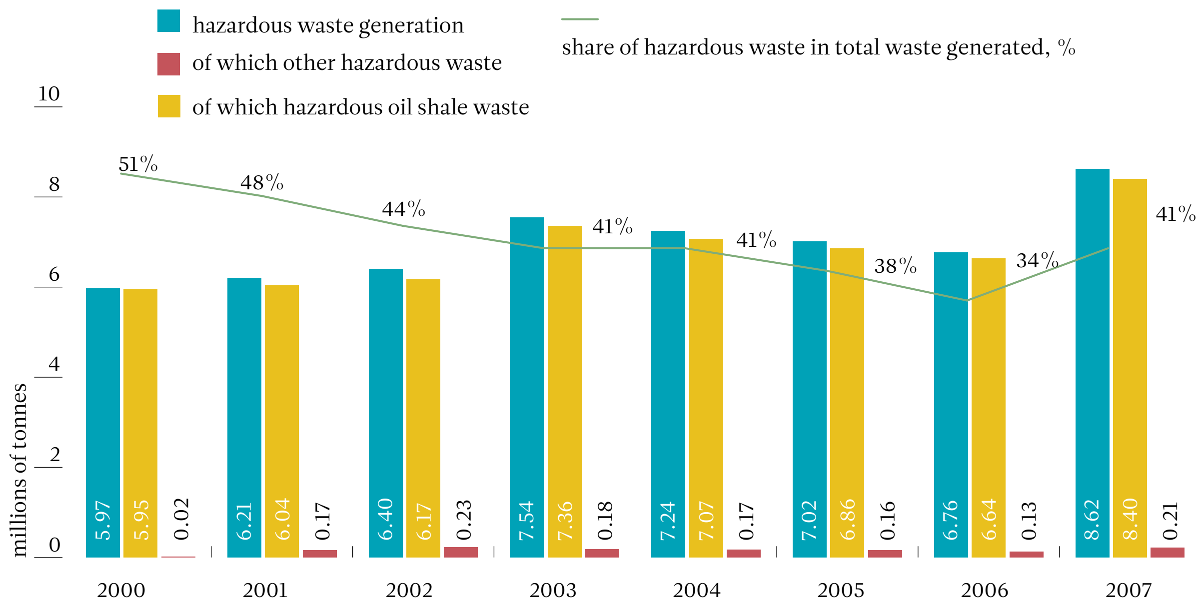


Figure 9.4. Generation of hazardous waste in 2000–2007. Data: EEIC.

Table 9.1. Dependence of solid waste generated in production of shale oil and oil shale energy on production volumes. Data: EEIC.

	2001	2002	2003	2004	2005	2006	2007
Solid waste per tonne of shale oil, t	3.9	3.9	3.9	3.7	3.6	3.5	3.2
Oil shale ash per TJ of energy generated, t/TJ	46.3	48.1	47.9	48.3	44.5	42.9	47.4

9.4. Municipal waste generation and handling

The rise in the standard of living, along with construction and renovation work, expenditures on home furnishing and the rise in consumer spending have resulted in increased quantities of waste. Experiences of other countries and long-term studies[A] show that municipal waste generation stabilizes at a certain level of affluence. One precondition for preventing and reducing the amount of municipal waste generated lies in increasing public awareness of the environment. People should be educated about ways to prevent waste generation. For instance, reuse of packaging, abandoning the practice of overpackaging goods and free distribution of plastic bags in shops, reducing the amount of paper used in officialdom and other places are some of the ways to reduce waste generation.

An average of 400 kg of municipal waste was generated per capita in 1999–2007. The reduced amount of municipal waste generated (figure 9.5) is partly due to methodological changes and improved quality of waste data. Great attention has been paid since 2001 to the proper classification of waste. Whereas in years past, packaging waste was included under municipal waste and mainly deposited in landfills, in 2002, separate collection of packaging waste has increased each year and separate records are kept on each category of waste. Thus separately collected packaging waste is not included in the figures on municipal waste even though they are predominantly of consumer origin. The study on mixed municipal waste conducted by the Sustainable Estonia Institute revealed that about 30% of municipal waste is packaging waste[B].

Most **separately-collected municipal waste** is scrap paper and cardboard, followed by glass, metal and wood waste and biodegradable kitchen and canteen waste. The share of municipal waste separately collected was relatively stable in 2003–2007, making up an **average of 11% of all municipal waste generated**. Other municipal waste includes garden and park waste, septic tank sludge (human waste from dry toilets), street-cleaning residues waste and bulky waste (furniture etc).

Generation of **hazardous municipal waste** has risen slightly in the last five years – making up 0.2% of all household waste in 2003 and 0.4% in 2007. The national waste management plan approved in 2002 set the goal of completing the establishment of a network of collection points for hazardous waste generated by domestic households. This objective has been partly fulfilled: in places the hazardous waste collection network is well developed. From August 2005, a requirement came into effect that companies marketing electrical and electronic equipment for domestic households must accept taking back free of charge from consumers equipment that is of the same type and fulfils the same function. The WEEE collection network is well-developed. Three producers' responsibility organizations are operating: MTÜ Eesti Elektroonikaromu, MTÜ EES-Ringlus and the Estonian subsidiary of the Latvian entity Ekokaisma SIA. Implementing the given measures and mechanisms has led to significant development in efforts to collect hazardous municipal waste from the population, and this is reflected also in the official data on municipal waste. In years past, much hazardous waste was classified as mixed municipal waste, which is why the rise in the hazardousness of municipal waste does not stem from an actual increase in the percentage of hazardous municipal waste but rather from more professional waste handling and improved quality of waste data.

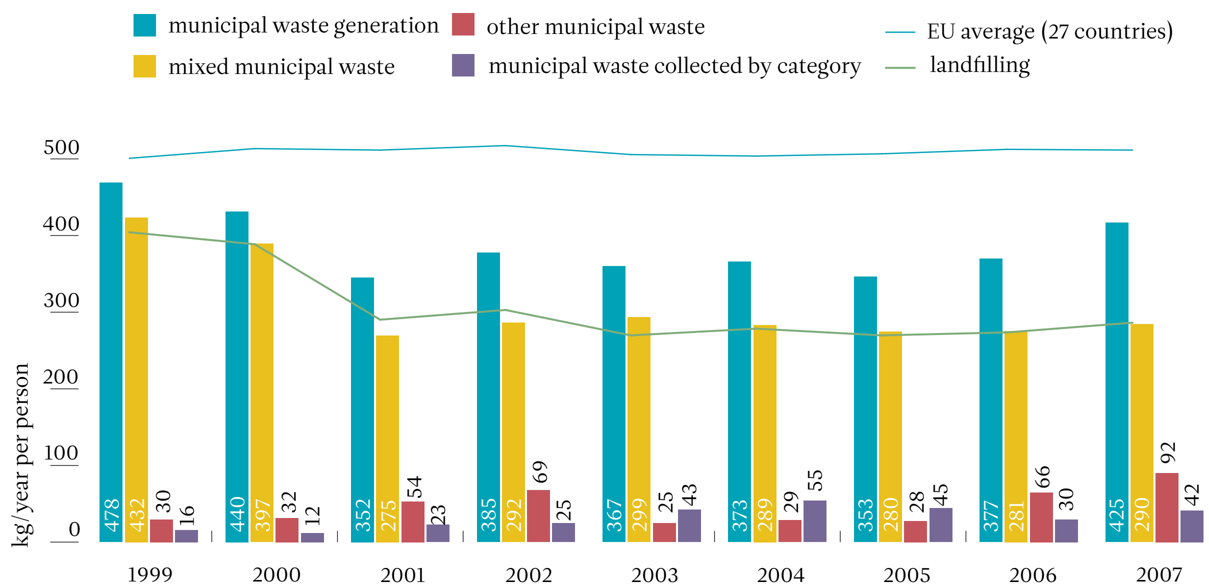


Figure 9.5. Generation and deposition in landfills, municipal waste in 1999–2007. Data: EEIC.

[A] Beigl, P., Schneider, F., Wassermann, G., Salhofer, S. (2003). Municipal Waste Generation Trends in European Countries and Cities. – Ninth International Waste Management and Landfill Symposium, S. Margherita di Pula (Cagliari), Italy, October 6–10, 2003: Proceedings. – Abstract; Langfassung auf CD, pp. 109–110.
[B] Eestis tekkinud olmejäätmete (sh eraldi pakendijäätmete ja biolagunevate jäätmete) koostise ja koguste analüüs. Segaolmejäätmete sortimisuuring. (Analysis of the composition and quantities of municipal waste generated in Estonia (including separately for packaging waste and biodegradable waste). Study on the sorting of mixed municipal waste.) (2008). / H. Moora. Tallinn : Stockholm Environmental Institute, SEI-Tallinn. [WWW] http://www.envir.ee/orb.aw/class=file/action=preview/id=1085199/Olmej%E4%E4tmete+uuring+2008.pdf

The deposition of municipal waste in landfills has decreased significantly in the period 1999–2007 (figure 9.6). The primary category of waste that ends up in landfills is partially-sorted mixed municipal waste. In 2003–2007, mixed municipal waste was sorted by Tallinna Jäätmete Sorteerimise Tehas OÜ, and in 2008, Narva Jäätmekäitluskeskus OÜ also entered this field. As the separate collection of municipal waste has greatly expanded and become more convenient for inhabitants, the exhaustive sorting in specific central facilities is no longer as salient and necessary.

The recovery of municipal waste has increased; most of it is comprised by land treatment and organic recycling (composting, first and foremost). A large part of street-cleaning waste and municipal soil and stone waste is handled as land treatment. Garden and park waste, biodegradable kitchen and canteen waste, municipal wood waste and some paper and other cellulose-based waste are sent to organic recycling. Recycling of materials involves recovery of domestic metal and plastic waste, while primarily wood waste is recovered as fuel. Activities undertaken in preparation for recovery of municipal waste (collection for treatment including sorting mixed waste) is also considered to be recovery (figure 9.7). Part of the collected and sorted municipal waste is exported (paper and cardboard, metals, WEEE) and is recovered outside of Estonia. Packaging waste is also separated from municipal waste in the sorting process, and recovery of packaging is accounted for separately under packaging waste.

One of the biggest problems is illegal dumping – municipal waste is left lying in roadside ditches, forests near urban areas, riverbanks and lakeshores and the most unexpected places where people go. All are illegal activities which sometimes can be quite harmful to the environment. To prevent this situation, the objective was set in the national waste management plan (2002–2008) to provide the population household waste transport services.

In order to provide waste transport service to as many people as possible, local governments with at least 1500 people (there are 143 of them) were obliged, starting in 2005 to organize waste transport service on their administrative territory. **Organized waste transport** means that the local government announces a call for tenders to select a waste transporter in its administrative area. All companies in the field of waste transport can participate in the tender. Thus waste transport organized by local governments helps prevent waste from being introduced into the environment, and on the other hand it enables a more favourable price of waste transport service for those that generate waste. The Waste Act also stipulates the precise extent and conditions of the principle of waste transport organized by local governments.

As long as waste transport has not been organized or is not yet operational, it is a **free market**. This means that people select their own service provider to empty their dumpsters. Inhabitants of an organized waste transport area no longer have the option of selecting their own waste transport company: the local government has made that decision for them. Until the beginning of organized transport, the free market system applies, open to all waste transport companies.

The percentage of the population supplied with organized waste transport service should be 94%. Implementing waste transport has become a true stumbling block for local governments; and the percentage is only 55% as of early 2009.

More active organizing of tenders began only in late 2007, a time at which many local governments drafted basic joint groundwork acts and formed joint transport areas (Central Estonian Waste Management Centre, Eastern Estonian Waste Management Centre). By the end of 2009, 21 local governments with an obligation to announce waste transport tenders had not yet done so (map 9.1).

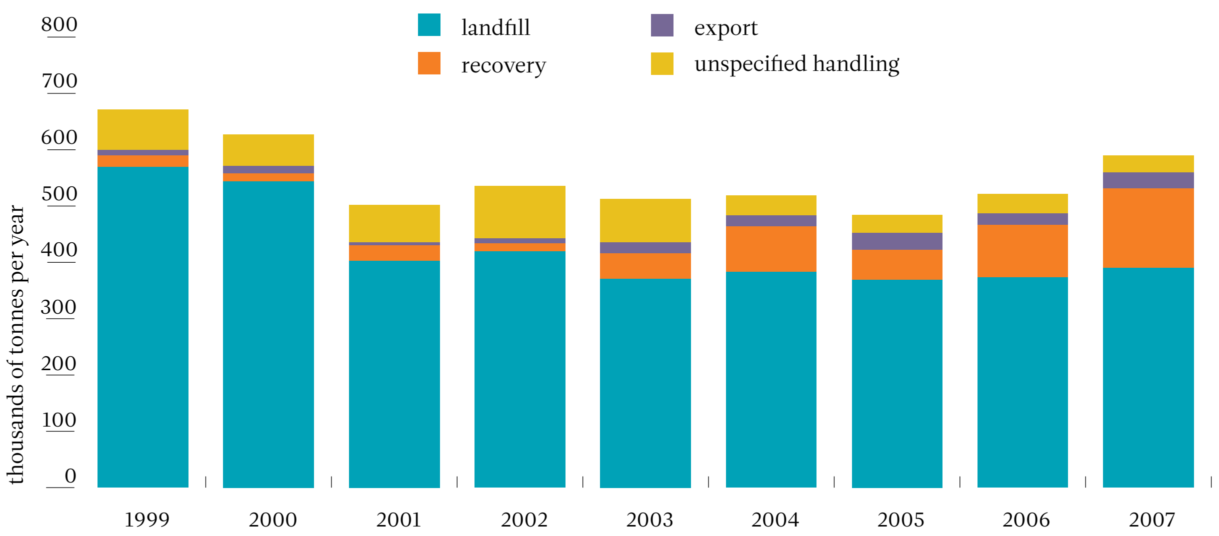


Figure 9.6. Municipal waste handling in 1999–2007. Data: EEIC.

The primary reasons for the delay are the lack of sufficient know-how and the necessary specialists, the time and effort needed to enter into cooperation and look for solutions with neighbouring municipalities, challenges to tender results, ill-defined aspects to waste handling network and waste handling system in certain areas.

Over a period of 1.5 years (from the end of 2007 to middle of 2009) the price of waste transport service on the so-called free market rose about 35%. At the same time, prices in organized waste transport areas have remained the same or grown by a few per cent as the service has been launched. In addition to stable prices, the price level in the given areas is on average 50% less than on the free market.

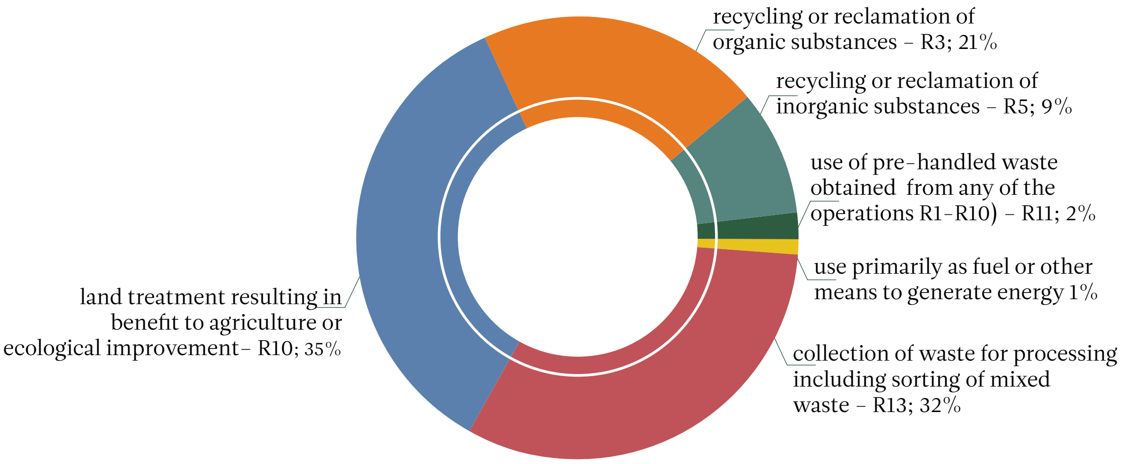
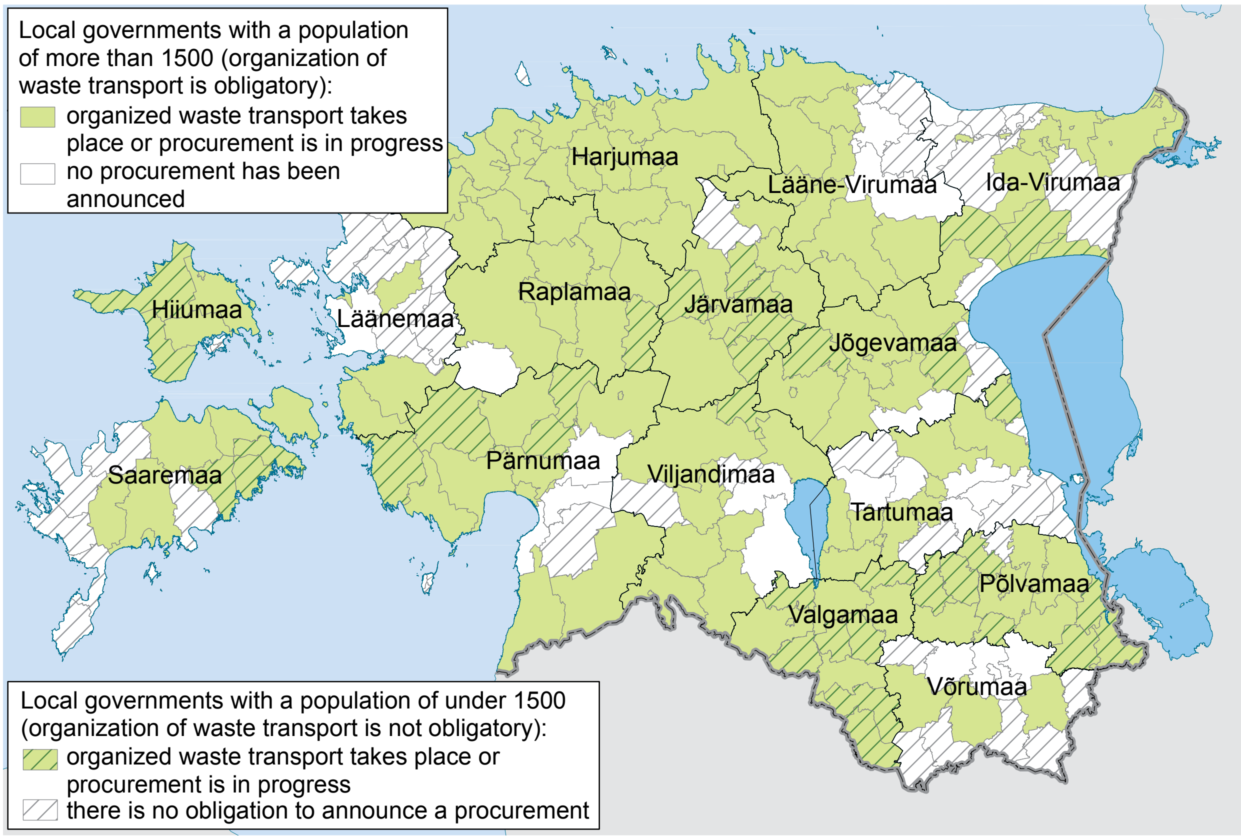


Figure 9.7. Recovery of municipal waste (average distribution) in 2003–2007. Data: EEIC.



Map 9.1. Waste transport organized by local governments as of February 2009. Data: Ministry of the Environment.

9.5. Packaging waste

The adoption of the new Packaging Act on 21 April 2004 laid the foundation for collection of packaging waste and establishment of a nationwide system for recovery of packaging waste. To achieve the goals of the Packaging Act, a new economic measure was implemented as of 1 May 2005 – (a) the obligation to accept back all packages – and (b) deposits were established for a number of beverage containers. Effective 1 July 2005, a packaging excise duty came into effect for sales packaging other than alcohol and beverages, to be applied if packaging is not recovered in the quantity specified in legislation.

The rapid economic growth seen up to 2008 significantly increased consumer spending on goods, as a result of which quantities of packaging waste increased each year as well. Whereas in 2001 the amount of packaging waste generated in Estonia was estimated at 110,000 tonnes, in 2007 the figure had already grown to 162,000 tonnes.

In 2007–2008, a study[C] commissioned by the Ministry of the Environment examined sorting of municipal waste, and also studied separately what kinds of packaging waste were found in municipal waste. The results showed that plastic packaging made up the greatest share of the packaging waste, of which an average of 65% was soft plastic (plastic bags, plastic film etc). Hard plastic (plastic bottles, boxes, lids, caps etc) made up an average of 35% of plastic packaging. Glass packaging and paper and cardboard packaging made up an approximately equal share of packaging waste. A positive sign noted was the fact that the percentage of beverage packaging with deposits (returnable packaging) was very small. This points to the fact that the deposit system for packaging is functioning effectively.

The high percentage of packaging waste in municipal waste is a problem in many countries. It is also one reason that in 1994 the European Union Packaging and Packaging Waste Directive was adopted (94/62/EU). It established the basic requirements and objectives in the field of packaging including targets for recovery of packaging waste; these requirements and targets were also adopted in the Packaging Act. Pursuant to the Packaging Act an undertaking engaged in packaging of goods or importing packaged goods must ensure recovery of packaging waste in the following extent as of 1 May 2004:

- at least 50% a year of the total mass of packaging waste;
- at least 25% of the total mass of packaging waste must be recycled a year along with at least 15% of the total mass of each packaging material.

The obligation to comply with recovery targets came into effect back in 2004, but the general recovery level of 50% was reached only in 2006 (figure 9.8). This was largely due to the fact that there was lack of thorough oversight and no recovery organizations to which packaging companies could transfer their obligation to collect and recover packaging waste; these organizations were launched only in mid-2005. The launch of operations by recovery organizations dealing with collection of mixed packaging was hindered to a significant degree by the dearth of collection resources and low level of investment.

The requirement in the Packaging Act according to which at least 15% of the total mass of each packaging material had to be recycled was fulfilled already in 2005 (figure 9.9).

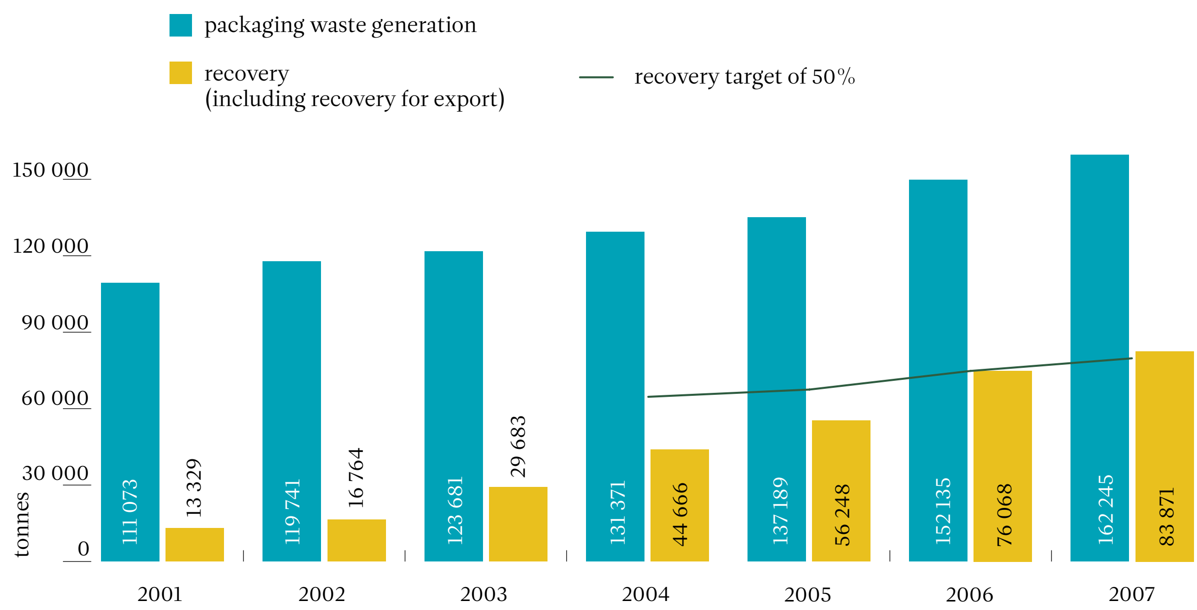
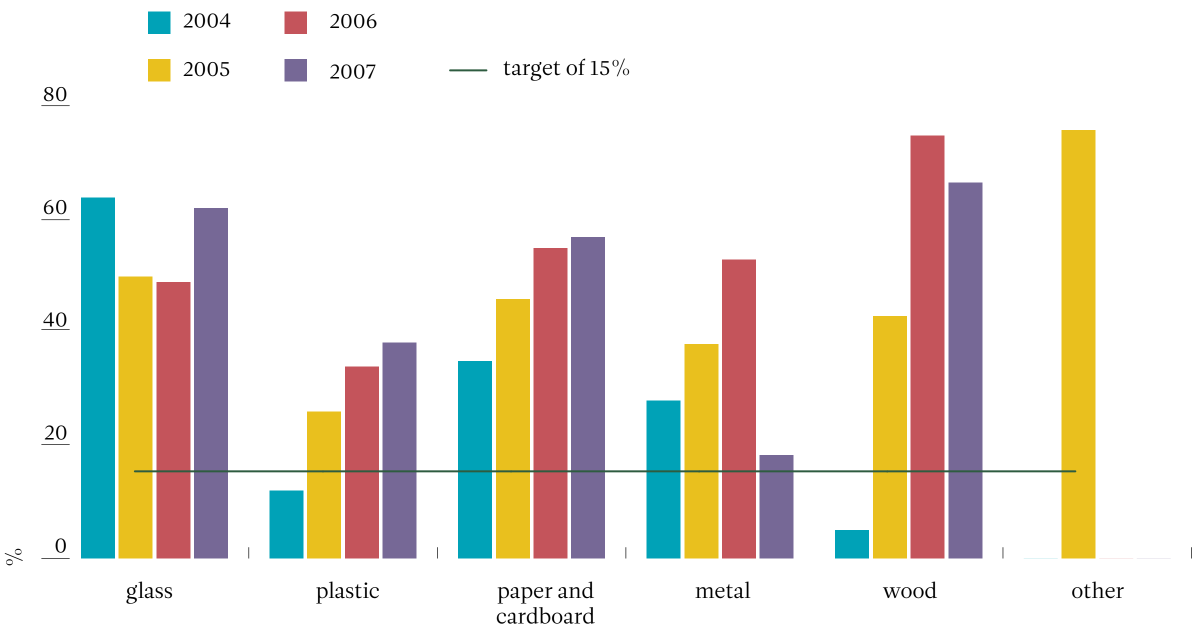


Figure 9.8. Generation and recovery of packaging waste in 2001–2007. Data: EEIC.

[C] Eestis tekkinud olmejäätmete (sh eraldi pakendijäätmete ja biolagunevate jäätmete) koostise ja koguste analüüs. Pakendijäätmete sortimisuuring. (Analysis of the composition and quantities of municipal waste generated in Estonia (including separately for packaging waste and biodegradable waste). Study on the sorting of packaging waste.) (2008). / H. Moora. Tallinn : Stockholm Environmental Institute, SEI-Tallinn. [WWW] http://www.envir.ee/orb.aw/class=file/action=preview/id=1085200/Pakendiuuring+2008.pdf



9.9. Recycling of packaging material in 2004–2007. Data: EEIC.

9.6. Products of concern

A product of concern, for the purposes of the Waste Act, is a product the waste resulting from which causes or may cause health or environmental hazards, environmental nuisances or excessive pollution of the environment. Such waste may fall into the category of either hazardous or non-hazardous waste. Products of concern include electrical and electronics equipment and parts thereof, most motor vehicles (passenger cars and vans) and parts thereof, batteries, accumulators and tyres.

Producers' responsibility is applied with regard to products of concern. Producers' responsibility takes place based on the principle that the polluter pays – the responsibility for handling the waste is imposed on the producer. A producer according to the Waste Act is a person who manufactures and sells products under the person's trade mark or trade name, engages in the resale of products manufactured by others, regardless of the method of sale, including mail order sale and sale by electronic means, or imports products into Estonia in order to market or resell them. All producers of products of concern have the obligation to collect and send to further waste treatment (recovery, recycling or disposal) waste from products of concern that it has introduced to the market. For instance, a seller of refrigerators must accept back old refrigerators from a person buying a refrigerator. Producers must generally accept the waste free of charge and bear all costs related to waste handling. Consumers will still indirectly cover the costs, as the costs of handling are "priced in" the new product.

Producers' responsibility for products of concern is a relatively new field in Estonia; it took effect on 1 May 2004 along with the new Waste Act. From 13 February 2006, all producers of products of concern must register with the register of products of concern (PROTO), and file data on products introduced to the market, and collected and recovered quantities of waste. As of 1 January 2009, 309 producers of products of concern had been registered in the register. Although most of the largest producers and sellers of products of concern are registered, many smaller companies have not done so yet; thus registration continues.

A fair amount of information has already been gathered regarding collection and handling of end-of-life vehicles and used tyres, on the basis of which conclusions can be drawn, but there are still few data regarding other products of concern.

The requirement for collection and handling of end-of-life vehicles and used tyres entered into force for manufacturers on 1 January 2005, and for WEEE on 13 August 2005. As the field is a new one, the problems related to the implementation of this obligation have not yet been resolved, but trends show the situation is improving.

Legislation has also set forth targets for recovery and recycling of waste from products of concern. From 1 January 2006, producers are obliged to recover at least 85% of the mass of end-of-life vehicles. The mass of components, materials and substances reused and recycled must be at least 80%. Starting 1 January 2015, the respective figures will be 95% and 85%.

In 2006 a total of 11,035 end-of-life vehicles were collected; in 2007, the figure was 12,664. A total of 83% of the total mass of collected end-of-life vehicles was recovered and reused in 2006; in 2007, 82% (figure 9.10).

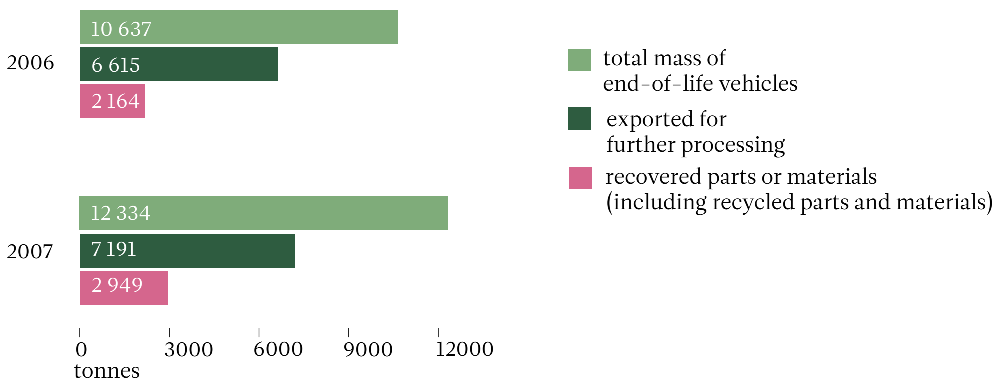


Figure 9.10. Collection and handling of end-of-life vehicles in 2006 and 2007. Data: EEIC.

9.7. Transboundary movement of waste

The import and export of waste – especially of recoverable waste (secondary raw material) – is fairly significant, as Estonia is not capable of processing all types of waste. Estonia has not imposed any restrictions on import or export of recoverable waste within the EU. Estonian companies export primarily types of waste in the case of which collection and sorting expenses are lower than the income from sale of secondary raw material. Such types of waste include, for instance, metal and plastic waste. The import and export of waste is greatly dependent on world market prices.

In 1997–2007, waste **import** made up an average of 0.7% and **export** an average of 3% of waste generated.

The type of waste primarily imported to Estonia is metal waste, which makes up an average of 70% of all imported waste. The metal waste is sorted and pre-processed in Estonia and then exported for further processing to waste handlers in third countries or as secondary raw material. Scrap metal is brought to Estonia primarily from Russia, Kazakhstan as well as from Latvia, Finland and other countries.

Until 2005, scrap metal was primarily exported to Finland. In recent years the majority of metal waste has been exported to Turkey and Spain.

Aside from metal waste, in 2006–2007 sawdust import from Latvia has increased, and import of lead batteries from Latvia and Finland as well as from Lithuania, Sweden and Belarus has grown as well.

In autumn 2003, AS Ecometal was launched in Estonia – a plant for processing used batteries in Sillamäe. The plant is completely in conformity with the principles of European Union Batteries Directive. The capacity of the plant is up to 20,000 tonnes of used batteries per year. Since the plant was launched, there is no longer a need to export used lead batteries for processing. In 2004, a total of 4721 tonnes of lead batteries were imported; in 2007, the figure had risen to 14,838 tonnes of lead batteries. The lead and lead alloys obtained as a result of battery processing are predominantly sold back to European battery manufacturers. It is to be hoped that the battery processing plant in Sillamäe will accelerate the process of used battery collection in both Estonia and other countries so that the hazardous waste is no longer deposited in landfills.

Luminescent lamps (natural daylight lamps, energy saver bulbs), and other mercury-containing waste are exported, as they are not handled in Estonia. They are taken to Latvia for processing. With each year, export of paper, glass, plastic and wood waste to nearby countries – Lithuania, Latvia, Finland, Sweden – has increased.

9.8. Recovery of waste

Recovery of waste to as great an extent as possible is one of the top priorities for waste management, apart from avoiding waste generation in the first place. Reuse of waste is preferred followed by recycling as material or raw material and only then, the use of the potential energy contained in the waste. This hierarchy requires that waste be separately collected and that waste handling centres be established. **Waste stations** have been established in all of the larger populated areas in counties. In 2007, Estonia had 29 waste stations, while in 2008, there were already 61[D] waste stations and collection points. Waste stations and collection points are the first collection site for recoverable waste generated in domestic households. It is important that they have good accessibility, located in a public place and relatively close to the waste producer. In accordance with the objective set forth in the waste management plan, at least 70 waste stations should be established by the year 2013.

The waste recovery process is impacted by a number of economic measures, such as pollution charge, packaging excise duty and the principle of producers' responsibility, which has been implemented in addition to packaging waste for used tyres and WEEE as well.

Almost 100% of the waste from the wood processing industry is recovered. Much oil shale mining waste, construction and demolition waste (including excavated soil), waste generated in agriculture, dairy industry waste, metal, waste water treatment, garden and yard waste is recovered as well. Many kinds of water-based liquid waste, such as is generated in producing electricity or in the cellulose and paper industry, are recovered but this is not recovery in the usual sense; rather it is on-site recovery which stems from the nature of production technology. **Recovery also is considered to include preparatory activities of recovery** – collecting waste for processing, sorting mixed waste and crushing waste. Metal and construction waste is the most common type of waste that undergoes crushing and sorting before its ultimate recovery.

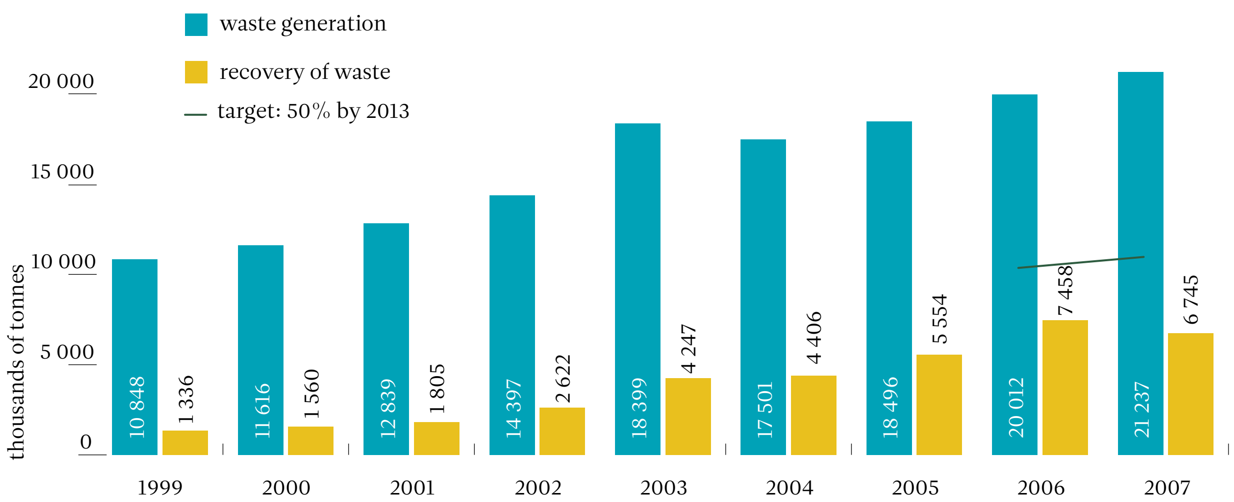


Figure 9.11. Generation of hazardous waste in 1999–2007. Data: EEIC.

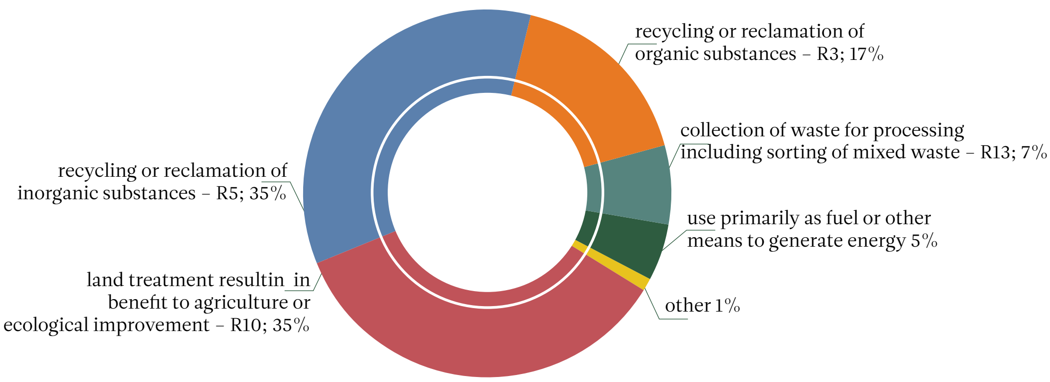


Figure 9.12. Recovery of waste (average distribution) in 2003–2007. Data: EEIC.

D Ülevaade jäätmehoolduse olukorrast valdades ja linnades. Kas vallad ja linnad on jäätmeseadusest tulenevaid ülesandeid täitnud? (Overview of the situation with waste management in rural municipalities and cities. Are rural municipalities and cities complying with obligations arising from the Waste Act?) (22.07.2008). Riigikontrolli aruanne Riigikogule. (Report of the State Audit Office to the Riigikogu.) [WWW] http://www.envir.ee/orb.aw/class=file/action=preview/id=1077573/Ylevaade+jaatmehooldusest.pdf

9.9. Waste disposal

9.9.1. Waste disposal volumes

The main method for disposal of waste in 2003–2007 was **deposition of waste in landfills** and this will continue to be the predominant method in future as well – as long as oil shale continues to be mined and used for energy and shale oil production. Waste related to oil shale mining and energy sector accounted for 95% of all landfilled waste in the years under observation.

Whereas the quantities of waste disposed of in 2003–2007 stayed more or less on the same level, the amount of waste compared to all waste generated has decreased with each year – from 69% in 2003 to 58% in 2007 (figure 9.13). Thus the general objective in the national waste plan (2002) regarding reduction of quantities of waste deposited in the environment has been fulfilled.

Besides landfilling waste, one of the most important of the other disposal methods in 2003–2007 was physical-chemical processing. This is in essence preliminary processing in the course of which waste is made suitable for the purpose of further disposal. This method is used on bilge water in ports and other oil-containing waste, laboratory chemicals, septic tank sediments, whey and other liquid waste, potentially containing hazardous materials.

Incineration of waste without the energy recovery has decreased (from 2,500 tonnes in 2004 to 21 tonnes in 2007).

The amount of landfill-bound waste generated in the oil shale industry depends on the energy and shale oil production output and technologies used, but the introduction of other kinds of waste into the environment can be reduced by intensive separate collection of waste by category, sorting and increasing the effectiveness of re-use and recovery of sorted types of waste. Considering the composition of mixed waste and experiences of other countries, it is possible to reduce the releasing of waste into the environment by 50%[E].

A key possibility for reducing quantities of mixed waste to the landfill is so-called mechanical-biological treatment. This method of handling waste allows a large part of energy-value mixed waste to be separated; it can be incinerated in cement kilns. As such, mechanical-biological treatment of waste can be seen as one part of the process of waste recovery, which can be used to reduce the volume of mixed waste left over in post-sorting by 50–60%. Mass incineration of waste will likely be implemented as a second alternative for handling mixed waste in the Tallinn area in 2011–2012.

To reduce the amounts and hazardousness of waste released into the environment, a number of restrictions on landfills have been established by the Waste Act. For example, from 1 January 2003, only treated waste may be deposited in landfills. It is prohibited to landfill liquid waste, waste with certain hazardous properties, and undefined substances. Effective 16 July 2003, it is prohibited to landfill unshredded tyres and from 16 July 2006, deposition even of shredded tyres is prohibited. From 16 July 2009, it is no longer allowed to deposit waste in landfills that do not conform to the requirements. From 2010, the municipal waste deposited in landfills may not include more than 45% biodegradable waste by weight.

[E] Deposition and handling of municipal waste is described in detail in the subsection “Hazardous waste generation and handling”.

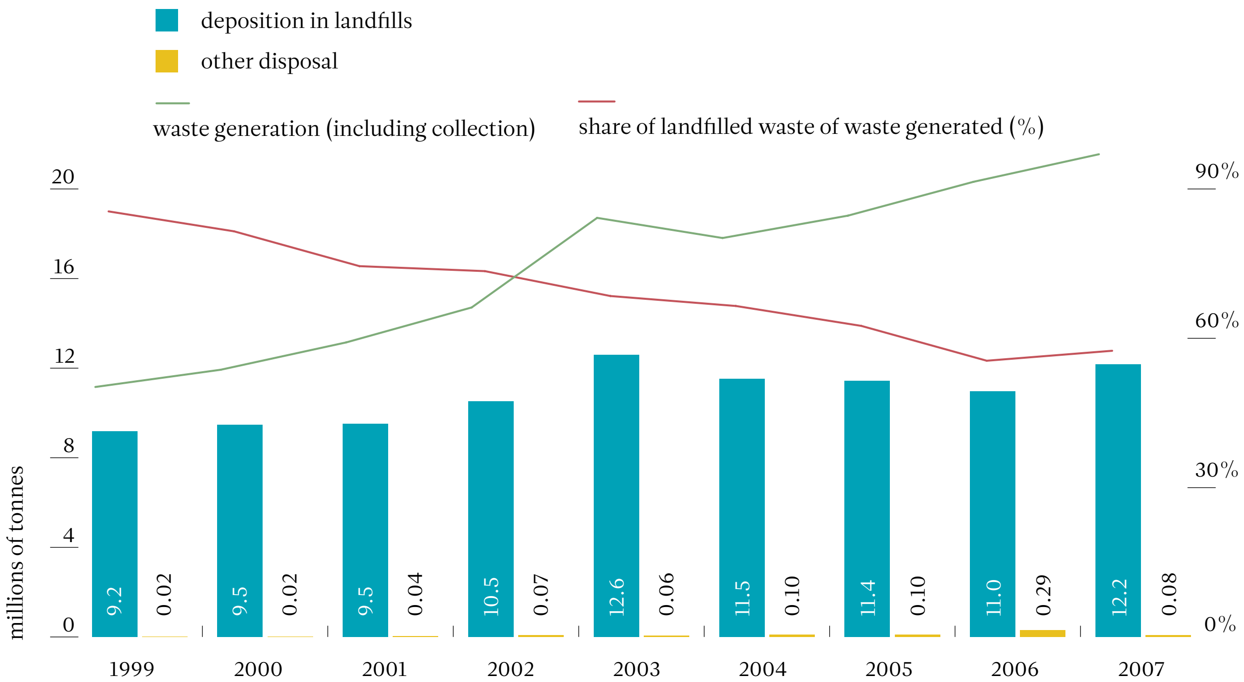


Figure 9.13. Disposal of hazardous waste, including in landfills in 1999–2007. Data: EEIC.

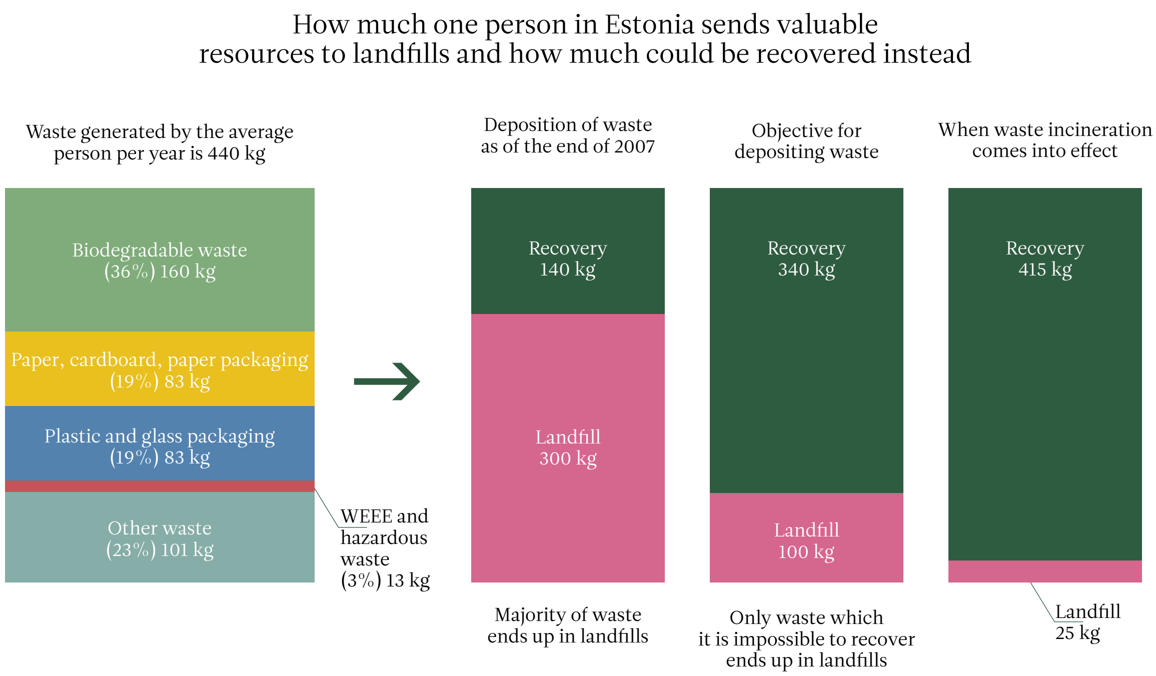


Figure 9.14. Waste generation in 2007 and possible recovery amount. Data: Ministry of the Environment.

9.9.2. Number of landfills in use and classification

The requirements for the establishment, use, closure and aftercare of landfills are set forth in the Waste Act, the European Council Landfill Directive 1999/31/EU and the Minister of the Environment regulation no. 38 of 29 April 2004, “Requirements for the establishment, use, closure of landfills”.

By 16 July 2009, all landfills that do not conform to the requirements of the Estonian landfill regulation[F] must be closed and they must be conditioned by 16 July 2013.

As the terms and conditions set forth in the landfill regulation are fairly strict, 2001 saw the beginning of massive closures. In 2001 there were still 157 landfills in operation (figure 9.15), in 2002 there were only 59 left. In 2007, there were 18 landfills for non-hazardous waste, 10 for hazardous waste and 2 inert waste landfills. All of the landfills closed in 2001–2007 have not yet been conditioned.

There will be 6 **landfills for non-hazardous waste left** operational after 16 July 2009. These are regional landfills that are capable of serving more than one county. Non-hazardous waste landfills are used to deposit mixed municipal waste and other non-hazardous waste.

Hazardous waste landfills are used to deposit hazardous waste, mainly oil shale waste – 5 landfills are for deposition of oil shale ash, 2 are for waste generated from production of shale oil and 3 are for depositing other hazardous waste. As these predominantly belong to companies, bringing these into conformity with the landfill regulation is the duty of the companies.

Since 2003, the deposition of pitch waste from oil shale in semi-coke deposits has been terminated. The semi-coke landfills in Kohtla-Järve and Kiviõli will be closed and restructured by 2013 and new landfills conforming to environmental requirements will be established on the rest of the territory of these landfills.

Inert waste landfills are for waste produced in the mining of oil shale. In essence these are storage areas for mining waste, and these will later not be classified as landfills.

Closure of a landfill does not mean that waste handling is no longer allowed on such a territory. Sorting and intermediate deposition of construction and demolition waste and composing of biodegradable waste may continue on such areas on the basis of waste permits. These types of waste may be used upon closure of landfills as well, if the approved closure project so permits. Thus there is no need to redirect all of the waste that has thus far been deposited in the landfills to be closed.

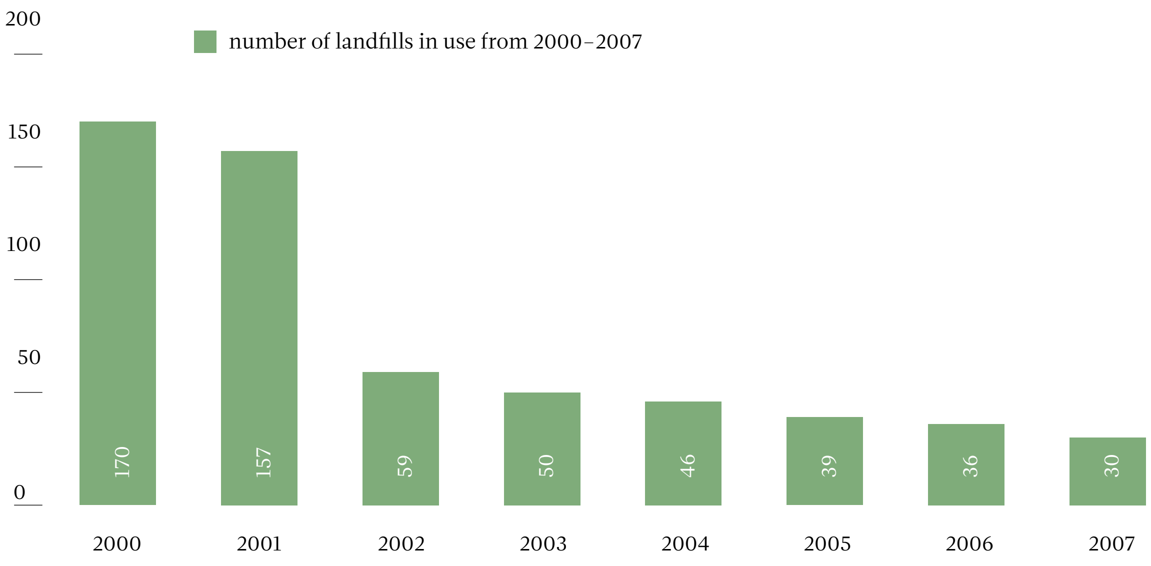


Figure 9.15. Number of landfills in use from 2000–2007. Data: EEIC.

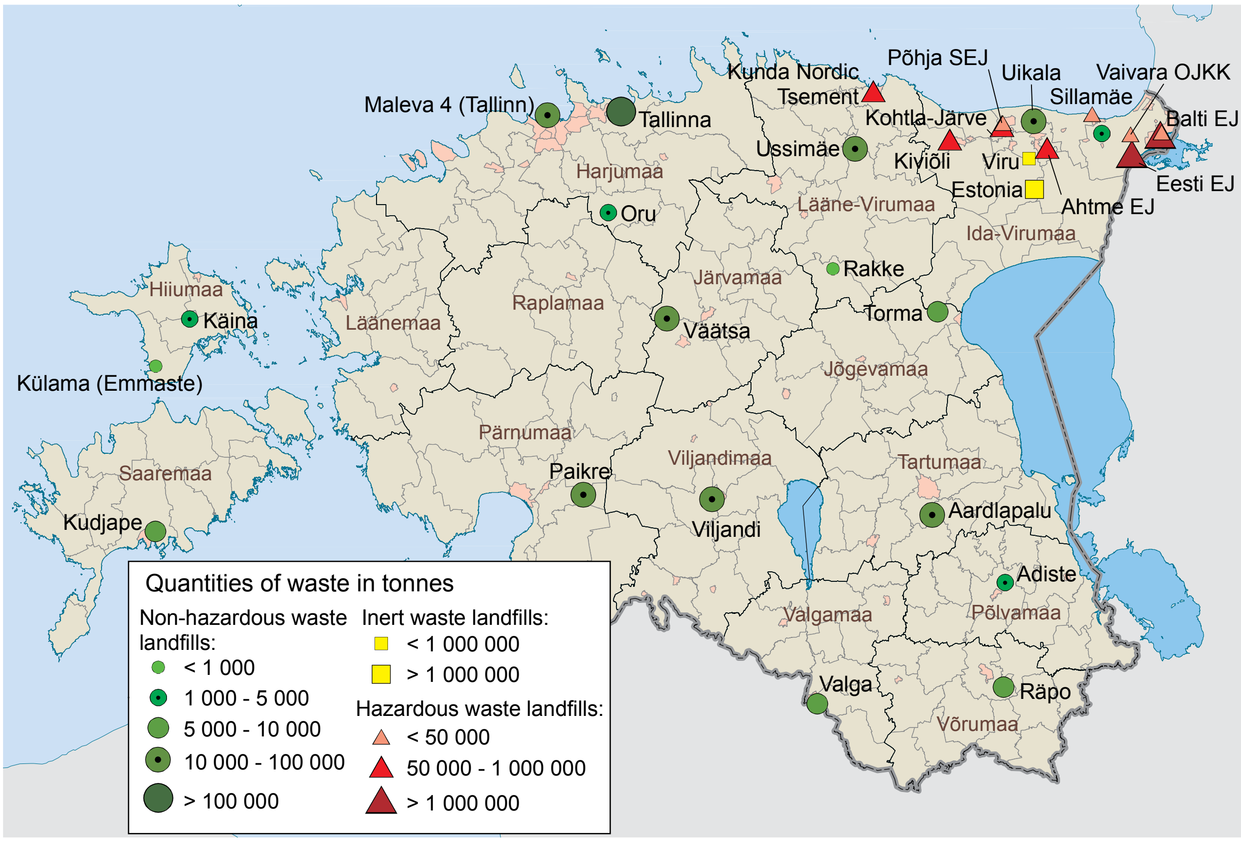
[F] The landfill regulation – i.e., Minister of the Environment regulation no. 34 of 26 June 2001 “Requirements for the establishment, use and closure of landfills” (RTL 2001, 87, 1219; 2002, 146, 2127) transposes the primary requirements on landfills in European Council directive 1999/31/EU. The landfill regulation entered into force on 1 September 2001.

Table 9.2. Number of landfills in 2003–2007. Data: EEIC.

Type of landfill	2003[G]	2004	2005	2006	2007	Landfills conforming to the requirements of the landfill regulation
hazardous waste landfill	10	10	11	10	10	2
non-hazardous waste	37	33	26	24	18	6
inert waste landfill	3	3	2	2	2	0

Table 9.3. Status of landfills as of 2009. Data: EEIC.

Type of landfill	To be closed 16.07.2009	Closed as of 2008 but not put in order
Non-hazardous waste landfill	10	17
Hazardous waste landfill	8	4
Inert waste landfill	2	0
TOTAL	20	21



Map 9.2. Landfills in use in 2007 and quantities of waste deposited into them (tonnes). Note: OJKK – hazardous waste handling centre; SEJ – thermal power plant; EJ – power plant. Data: EEIC.

Read more:

- Estonian Environment Information Centre webpage [WWW] http://www.keskkonnainfo.ee/index.php?lan=EN&sid=44&tid=394&l1=2 (waste)
- Ministry of the Environment website. [WWW] http://www.envir.ee/67249 (waste and waste management)

[G] Starting in 2003 a new classification of landfills entered into force based on the landfill regulation (non-hazardous, inert and hazardous waste landfills). Before that, landfills were classified as either consumer or industrial waste landfills; industrial landfills included both hazardous and non-hazardous waste landfills.

10. The environment and health

10. The environment and health

The environment around us often has a greater health impact than we perceive. A number of risk factors – including physical, biological and chemical factors – stemming from the environment affect our health. The impact often emerges only years later, in the form of an allergy, central nerve system impairment and damage or tumour. Thus the environmental impact on health can be complex and depends on the nature of the environmental factors and the exposure time. Environmental factors have the greatest impact on children — 40% of the negative environmental health impacts come at the expense of those under 5 years of age. Besides children, pregnant women and the elderly[A] are very susceptible to environmental impacts.

In Estonia, the natural environment has experienced fairly little change but it does not always support human health. For example, due to the natural properties of groundwater, a number of Estonia's regions have problems with drinking water quality, above all due to high levels of radionuclides, fluoride and iron in groundwater.

With regard to regional environmental health problems, the impact of air pollution on chronic diseases of the respiratory system, such as allergic coughs and colds – above all in the larger cities – has become increasingly significant.

It is not possible to repair human health only by treating the condition. Prevention of harm from environmental pollution must also be ensured.

As a positive trend in recent years, the living environment (including infrastructure, cities, residential districts) planning process in Estonia has begun to include evaluation of health risks in the framework of environmental impact assessments and strategic environmental assessments.

10.1. Legal background

The political document approved by the UN World Health Assembly (1998) – "Health for all in the 21st century" – and the WHO Europe region's Health 21 framework policy on the basis of the former both stress that there should be significantly less human contact with hazardous pollutants in water, air, waste and soil and that a sufficient quantity of high-quality drinking water must be made available to people. In Estonia, the Public Health Act governs matters directly related to public health.

Use of drinking water and drinking water requirements are governed by the European Union's Drinking Water Directive 98/83/EC. The requirements of the Drinking Water Directive are transposed to Estonia in the Public Health Act, the Water Act and regulations established on their basis. Estonia was obliged to comply with some of the Drinking Water Directive's requirements upon accession with the European Union, i.e. from 1 May 2004; a transitional period was granted for other indicators. Estonia must be in full compliance with the requirements of the Drinking Water Directive by 2013.

The requirements of noise in ambient air are stipulated by the Ambient Air Protection Act and the Public Health Act, on the basis of which limits for noise and requirements for preparing a strategic noise map are established. The allowable limits for noise are set forth in Minister of Social Affairs regulation no. 42 of 4 March 2002, "Noise levels in living and recreational areas, residences and buildings in public use and methods for measuring the noise level".

Strategic objectives with regard to environmental health are set forth primarily in two national development plans: the Public Health Development Plan 2009–2020 and the Estonian Environmental Strategy 2030.

[A] Rahvastiku Tervise Arengukava 2009–2020. (Population Health Development Plan 2009–2020) (2008). Tallinn : Ministry of Social Affairs. [WWW] http://www.sm.ee/index.php?id=851 (21.05.2009).

10.2. The impact of ambient air pollution on human health

The extent to which air pollution harms health depends on many factors, including the pollutant, the quantities, an exposed person's medical history, as well as whether the person is exposed to the polluted air for a short or long term, and whether the person is a child or adult. Often diseases are caused by a complex long-term interaction of several factors.

An analysis of monitoring data from the last few years shows that the greatest problem related to ambient air quality is the amount of particulate matter, especially in the spring. Fine dust, or more precisely **particulate matter**, is a mixture of very small particles consisting of nitrogen and sulphur oxides, acids (nitrates and sulphates), organic substances (polyaromatic hydrocarbons – PAHs), metals and soil and dust particles. The primary sources of particles are vehicle emissions, wood-burning stoves and fireplaces, boiler plants and industrial enterprises.

As to what health problems emerge as a result of air pollution, this depends on how long a given person is exposed to air pollution and the specific individual (age, medical history etc). The primary health problems arising as a result of air pollution are lung diseases and diseases of the heart and circulatory system. The finer the particles, the deeper into the respiratory tract they penetrate – particulate matter with a diameter of under 10 micrometers reach the alveoli and may form pockets of inflammation if they remain there. Particulate matter under 0.1 micrometer in diameter may travel through the lung's alveoli into the bloodstream and on to other organs.

An assessment of the health impact of particulate matter[B] has been conducted in Estonia; it showed that particles can reduce life expectancy. On the basis of this assessment, the average life expectancy decreased by 0.95 years in Pärnu, 0.7 years in Tallinn and Tartu, 0.5 years in Narva and 0.3 in Kohtla-Järve. The decrease is quite high in Pärnu due to the fact that a significant share of the city's population lives in the city centre, which is the most polluted. This means 450 early deaths per year, 6000 lost years of life, plus hundreds of days spent in hospital. The financial toll to society is more than 1 billion kroons. In comparison, particulate matter reduces life expectancy by 0.75 years on average in Europe, by an average of 2 years in the Netherlands and by 1.8–3.1 years in large cities in North America.

Scientists have found that the limits for particles in the directives are not sufficient to protect human health. Unfortunately, the impact of other pollutants such as polyaromatic hydrocarbons (PAHs); carbon monoxide (CO); sulphur dioxide (SO_2) has not been studied in Estonia, but a large part of their effect is tied to the impact of particulate matter. Insofar as many chemical pollutants become deposited on particulate matter, findings regarding the impact of particulate matter are the summation of both physical (particle size, mechanical irritation) and chemical factors.

10.3. Drinking water quality

Groundwater in Estonia has been considered a source of quality drinking water for many years, as for the most part groundwater is well-protected from pollution of human origin. As the quality requirements for drinking water, especially its chemical requirements, have become stricter over the years, a situation has been reached where Estonian groundwater often does not conform to the quality requirements set forth in the Drinking Water Directive. The non-conformity is not due to pollution of human origin but rather the fact that the groundwater contains a naturally high level of a number of elements and substances, significantly in excess of the requirements applicable to drinking water. This situation means that groundwater must be purified before it can be used for drinking water.

There is a proved correlation between high levels of chemical components in water (nitrates, fluorine, boron, aluminium, barium, cadmium, nickel etc) and certain non-infectious chronic diseases. These diseases develop in the case of long-term consumption of substandard drinking quality, as a result of which it is hard to determine a causal connection to drinking water quality.

In Estonia, a number of groundwater complexes with different water properties are used for drinking water and household water (table 10.1).

In 2008, there were no public water works with over 2000 consumers where the **microbiological indicators** did not conform to the requirements. In the second half of the year, there were problems with the water supply in the Järve district of the city of Kohtla-Järve. The reason for the non-conformity of microbiological indicators was

Table 10.1. Description of groundwater complexes used as sources of drinking and household water from the aspect of use as drinking water. Data: Health Protection Inspectorate.

Water complex/Water layer	Primary problems
Quaternary (Q)	Light pollution, low level of protection
Late Devonian (D3)	Iron
Middle Devonian (D2)	Iron
Middle and Early Devonian complex (D2-1)	Iron
Middle-Early Devonian Silurian (D2-1-S)	Iron, chlorides, fluorine
Silurian-Ordovician (S-O)	Nitrates, iron, fluorine, chloride, occasionally boron
Ordovician-Cambrian (O-€)	Iron
Cambrian-Vendian (€-V)	Chlorides, manganese, radionuclides, occasionally sodium and barium

[B] Välisõhu kvaliteedi mõju inimeste tervisele Tallinna linnas. (Impact of ambient air quality on the health of people in the city of Tallinn.) (2007). / H. Orru et al. Tartu : University of Tartu [WWW] http://www.envir.ee/392990 a deficiency in the technical condition of a bore well and water storage tank; chlorination was used to stabilize the water quality. Deviations in smaller public water supply systems from the required microbiological parameters are the result of depreciation of drinking water pipes and reservoirs and technical malfunctions in distribution networks. In Estonia, there have been no infectious waterborne outbreaks caused by public water supplies in 14 years. The last recorded infectious outbreak was in 1993, when 614 people in Sõmeru in Lääne-Viru County fell ill with hepatitis A. With regard to microbiological indicators, the depreciation of public water supply systems impacts water quality.

Of the **chemical** indicators of drinking water, 104 water supplies did not conform to the fluoride content requirements in 2008. Of these, in 103 water supplies the problem involved excessive fluoride content (over 1.5 mg/l) – and in the case of 7, excess boron was involved – and in one supply (city of Narva water supply) the total trihalomethane[C] content.

With regard to **indicators**, the most frequent problem in water supplies was non-conformity of iron, manganese and chlorides to the requirements. These compounds are of natural origin or are due to the poor condition of pipes. The high iron and manganese content of drinking water causes deviation in colour, taste and opacity. In the Cambrian-Vendian groundwater complex in northern Estonia, occasional high radionuclide content has been noted, as a result of which the effective radiation dose exceeds the limit of 0.1 mSv per year established by Estonian law for drinking water.

Besides drinking water, the quality of **bathing water** also impacts human health; it is in general good. The number of analyses that have disclosed substandard bathing water has decreased over the years and is under 5%.

Table 10.2. Number of people who use drinking water from public water supplies not in conformity to the requirements (%). Data: Health Protection Inspectorate.

Years	Non-conformity with regard to microbiological indicators (%)	Non-conformity with regard to chemical indicators (%)	Non-conformity with regard to indicators (%)
2002	0.02	1.3	35.3
2003	0.006	2.3	28
2004	0.004	2.5	29.6
2005	0.01	2	29
2006	0.01	7	27
2007	0.01	8.9	26
2008	0.1	8.6	21.6

10.4. Ionizing radiation

The more radiation the human body absorbs, the more cellular damage occurs and the higher the risk of tumours and hereditary diseases.

A predominant part of the ionizing radiation that surrounds us is of natural origin, but manmade radio-isotopes also exist. Manmade radionuclides are released into the environment due to human activity, as it is unlikely that radiation will leak into the environment from manmade radiation sources. Possible sources of **radioactive contamination** are primarily considered to be nuclear power plants in Russia (Sosnovyi Bor); in Finland (Loviisa) and in Lithuania (Ignalina).

The activity of radionuclides found in nature is routinely measured, but traditionally the yardstick for whether the environment is polluted or not is the manmade radionuclide Cs-137. The caesium found in the environment originates in equal parts from the extensive atmospheric nuclear testing conducted in the mid-20th century and the Chernobyl nuclear power plant disaster in 1986. Due to the action of wind and forest and bog fires, pollution that has fallen to earth re-enters the atmosphere. Caesium levels (microbecquerels per cubic metre) are measured in Estonia in tropospheric air at three points (Harku, Narva-Jõesuu and Tõravere). The systematic several-fold variation in the results measured at Narva-Jõesuu and Harku (3.7 microBq/m^3 in the former, 1.5 microBq/m^3 in the latter in 2005–2007) can be attributed to the fact that the Cs-137 from Chernobyl fell here primarily in north-eastern Estonia.

[C] Trihalomethanes – undesirable byproducts of chlorination of water with a high content of organic matter.

Results of analysis of tropospheric air shows that the level of Cs-137 in Estonia is more or less uniform, which means that no additional atmospheric contamination has occurred. Nevertheless, toward the end of the late summer of 2006, Narva-Jõesuu station data showed an order of magnitude higher activity concentrations (the maximum value was 89.7 microBq/m^3, while the average value in 2006 was 3.6 microBq/m^3). This is believed to be related to extensive forest fires in Russia, in the course of which caesium from Chernobyl in forests was re-dispersed into the atmosphere, and carried to Estonia by wind.

The primary source of **environmental radiation** in Estonia is **radon**, a colourless and odourless gas, which becomes concentrated in the indoor air in homes. Radon seeps into buildings due to poor construction quality and through cracks formed as the building ages. The primary source of radon is soil. The areas with the highest radon content are related to the dicthyonema shale formation in the klint zone in northern Estonia. The areas with a radon risk are also the areas of glauconitic sandstone and karst. As a result, the areas with the highest radon risk – where radon levels in homes range from 400–1000 Bq/m^3 – primarily occur in rural municipalities in northern Estonia, as well as in Rapla County, Viljandi County and Tartu County, but high radon levels can be found nearly everywhere in Estonia.

In terms of the level of radon in indoor air in homes and areas with a potential radon risk, Estonia is comparable to Sweden and Finland, which are among the countries in Europe with the highest radon risk.

In 2001–2004, joint Estonian-Swedish research project measured indoor radon levels. The study found that radon levels in homes, expressed as averages for rural municipalities, ranged from 58–641Bq/m^3, except for Kunda, which had an average level of 2,349 Bq/m^3. The average radon level in the buildings studied was 268 Bq/m^3. Of the measurements, 38% exceeded the allowable level, which is 200 Bq/m^3. Inhalation of air high in radon increases the risk of lung cancer[D].

10.5. Noise

Noise is disruptive to humans and harms human health and well-being. Environmental noise is an integral part of modern living environments; it is created by various equipment, transport, technological systems and industrial enterprises. In Tallinn, ships and aircraft are an additional source of noise pollution.

In early 2008, the first noise maps were completed of the city of Tallinn and road segments with heavier traffic[E].

Noise from traffic has the greatest impact on Tallinners. Twenty per cent of Tallinn's population lives in areas where the noise level from traffic exceeds a level of 55 dB (decibels), and 9% live in areas where the night-time noise level is over 50 dB.

The number of people impacted by **railway traffic** noise is lower than in the case of road traffic. Due to the night-time freight train traffic, the noise level near the railway is relatively high – over 70 dB. A total of 5.5% of Tallinners live in an area where the noise is over 55 dB and 4.3% live in a territory where the night-time noise level is over 50 dB.

About 1,400 people – 0.35% of Tallinners – live near Tallinn Airport, where the **aircraft noise** is over 55 dB during the day. A total of 47 people, or 0.01% of Tallinners live in places where the night-time noise level is over 50 dB.

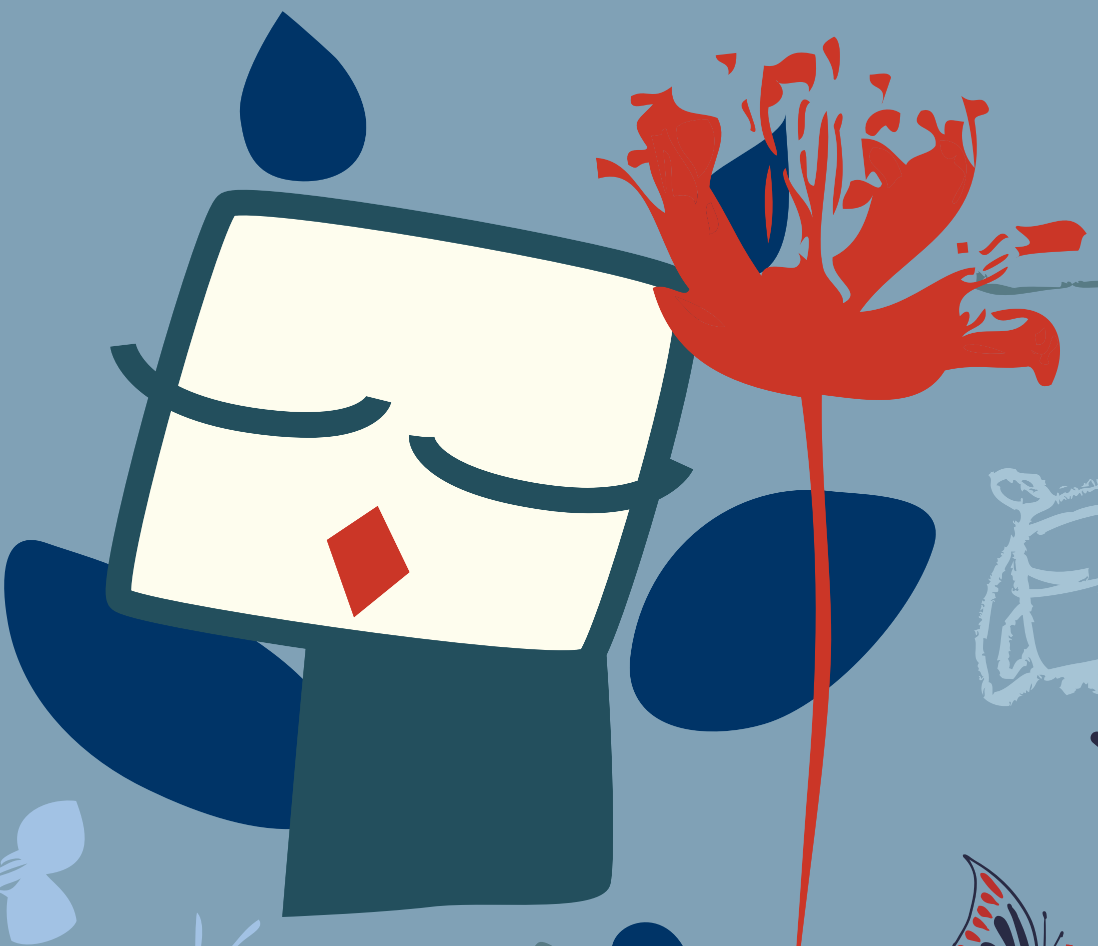
Skilful and timely planning allows disruptive environmental noise to be reduced. It is important to perform a prior environmental impact assessment in the planning process; the EIA must include an assessment of noise caused by the planed activity (industrial enterprise, road etc). The primary basis for planning is the strategic noise maps.

Read more:

- Estonian Environment Information Centre webpage. [WWW] http://www.keskkonnainfo.ee/index.php?lan=EN&sid=25&tid=24&l2=22&l1=2 (air, quality of urban air)
- Estonian Environment Information Centre webpage. [WWW] http://www.keskkonnainfo.ee/index.php?lan=EN&sid=657&tid=591&l2=655&l1=2 (bathing water and drinking water quality)

[D] Eesti Keskkonnaseire 2004–2006. (Estonian Environmental Monitoring 2004–2006.) (2008) / Ed. K. Väljataga. Tallinn : Estonian Environment Information Centre. [WWW] http://www.keskkonnainfo.ee/index.php?lan=EE&sid=65&tid=67, pp 114–115
[E] Noise maps can be found on the Health Protection Inspectorate website (in Estonian), http://www.tervisekaitse.ee/?page=237

11. Economic instruments for environmental protection and funding for environmental protection measures



11. Economic instruments for environmental protection and funding for environmental protection measures

Besides environmental protection restrictions and supervision, a number of economic instruments[A] are also used in environmental policy – environmental taxes and charges, deposits on returnable products, and tradable pollution permits etc. Implementation of environmental economic instruments is often considered a superior means of establishing economic instruments as entrepreneurs have an incentive for finding the most inexpensive way of bringing their activity into conformity with environmental requirements. Implementation of environmental protection economic measures are supported to a maximum extent by the Organization for Economic Cooperation and Development and the European Union, even though there are only few requirements that are uniform for all member states. Energy taxation (i.e. excise duties on fuel and electricity) is regulated by directives on the EU level along with trading of greenhouse gas emissions, but the member states have been given free rein to implement other additional measures such as environmental charges. The importance of environmental economic instruments in future is shown by the European Commission Green Paper[B] released in 2007. It deals with market-based instruments in environmental policy and initiates a discussion on the more active use of market-based instruments, above all as pertains to indirect taxation.

11.1. Legal background

The basis for development of economic instruments for environmental protection as well as the making of financing decisions on environmental measures is Estonia's national strategy for sustainable development, "Säästev Eesti 21" and the Estonian Environmental Strategy 2030 along with the action plan for 2007–2013. Activity must proceed from the objectives in strategic basic documents in environmental sectors (for instance, the National Waste Plan 2008–2013). Development of environmental charges and taxes takes into account the bases for ecological tax reform[C] approved by the Estonian government in June 2005 and the draft Principles of Development of Environmental Charges up to 2020[D], prepared in 2008–2009. The most important legal acts that govern environmental charges and taxes in Estonia are the Alcohol, Tobacco Fuel and Electricity Excise Duty Act, and the Environmental Charges Act. The legal framework for financing environmental protection measures is determined by the source of funding – whether Estonian state budget resources or European Union structural funds, or other funding, are used. The amounts that the state allocates to environmental protection measures are in direct dependence with revenue from environmental charges. The use of revenue from environmental charges is governed by the Environmental Charges Act. The most important documents for use of European Union support are the Estonian national development plan for the implementation of the EU structural funds 2004–2006 and the operational programme for the development of the living environment 2007–2013. Many EU strategic guidelines and regulations also serve as a basis for activities in this field.

11.2. Environmental taxes and environmental charges

Estonia has used economic instruments for environmental protection since the 1990s. **Environmental taxes** used include the fuel excise duty, the excise duty on packaging and the heavy goods vehicle tax. An excise duty on electricity was established in 2008. Unlike many other countries, Estonia has not established a separate vehicle tax on passenger vehicles. A special feature of environmental taxes is the fact that the revenue flows to the state budget to fund the state's general needs. Environmental taxes are paid by the consumer and as they do not go toward goods and services production costs, they do not motivate producers to pollute less. Revenue from environmental taxes flows into the state budget and in 2008 they made up 7% of all state budget tax revenue (about 5 billion kroons).

The most important factor in achieving the objectives of environmental policy and polluter/consumer-pays principle is environmental charges, which have also been implemented since 1991. The grounds for implementation of environmental charges and procedures for calculation

[A] Economic instrument – economic method used as motivation for the more expedient use of natural resources and environmental components.
[B] Roheline raamat. Turupõhised vahendid keskkonnapoliitikas ja sellega seotud valdkondades. (Green Paper. Market-based instruments in environment and related fields.) [WWW] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0140:FIN:ET:HTML
[C] A document that treats the grounds for environmental tax reform, found on the Ministry of Finance website: http://www.fin.ee/?id=14277
[D] Keskkonnatasude kontseptsiooni koostamine. (Preparation of the environmental charges principles.) [WWW] http://www.envir.ee/1051528

and payment, rates and use of the state budget revenue from the charges are governed by the Environmental Charges Act and acts enacted thereunder[E].

An environmental charge is a price placed on the right to use the environment. The purpose of environmental charges is to avoid or reduce potential losses related to emissions of pollutants into the environment and waste disposal. Environmental charges are applied to motivate undertakings to invest into production with a lower environmental load and to use Estonian natural resources more expediently and sustainably. When redirected back to environmental conservation, the amounts garnered from environmental charges also help prevent and reduce environmental pollution and damage related to use of natural resources. Environmental charges are unlike environmental taxes in the sense that they are paid by producers and thus are included in the costs of producing goods and services. This has an effect on the product's cost price and ultimately the competitiveness of the good or service in the market. Environmental charges motivate companies to apply environmental protection measures to reduce the environmental impact of production and thus pay less in environmental charges.

Environmental charges are state budget revenue, from there they are channelled into the preservation of the state of the environment, replenishing natural resources and redressing environmental damage. To a certain extent, environmental charges also flow into local government budgets, where they are used pursuant to local needs (often not for environmental protection purposes). Local governments receive the 100% of the environmental charges payable for natural resources extracted from a mineral deposit of local importance and one-half of the charges for resources from a mineral deposit of national importance. Local governments also receive one-half of the revenue from water abstraction charge and a certain share of the pollution charge for waste. In 2008, the state budget received around 1.1 billion kroons in environmental charges (including forest regeneration charge) and local budgets received about 284 million kroons. The environmental charges revenue for the state budget made up 1.5% of all tax revenue in 2008.

Environmental charges can be divided into two categories: charges for rights to use natural resources and pollution charges. Pollution charges are paid when emissions are released into ambient air, bodies of water, groundwater or soil or if waste is deposited.

Natural resource charges further fall into the following categories: forest regeneration cutting charge, mineral extraction charge, water abstraction charge, fishing charge, hunting charge. Forest charge is paid for the right to perform regeneration cutting in state-owned forest. In recent years the state has received over 200 million kroons a year in revenue from this charge. Revenue from fishing charge and hunting charge is lower, totalling about 13–15 million kroons per year.

11.3. Pollution charges and natural resource charges

Since 1994, over 6 billion kroons in pollution charges and charges for the use of natural resources have been received. Of this amount, 76% (about 4.6 billion) was received by the state budget and the rest by local government budgets (figure 11.1).

Over the years, revenue from environmental charges has increased, as the impact on the environment has increased in some regard (for example, use of natural resources and waste generation has increased) and the rates of environmental charges have gradually increased.

Environmental charges were originally established at very low rates considering the purchasing power of the population and to support entrepreneurial development. The rates rose in 1991–1994 pursuant to the consumer price index. As the economy developed, it was possible to devote more attention to environmental protection, and thus from 1996, a 20% yearly increase was applied to the rates and in the case of natural resource charges, the rate rose 5–10% a year. In 2005, the government decided to apply the principles of environmental tax reform, as a result of which the levels of all environmental charges were increased significantly in 2006. The rise in rates stemmed from the need to make economic instruments more effective and give producers and the population a clear signal that the Estonian state wanted to use its natural resources and environment sustainably. In 2007, moderate growth continued up to 2009, and it can be said that the rates are now approaching a level where their stimulus effect on environmental protection is becoming evident. Adjustment and raising of the rates will still be necessary in future as well.

To decide what the future of the environmental charges will be, the Ministry of the Environment in 2007 started preparations for developing a concept for environmental charges development back in 2007. In cooperation with interest groups, draft guidelines for further implementation of environmental charges was developed in 2008, which set forth means for making environmental charges even more effective and adjusting the rates in light of Estonia's economic situation and adoption of the euro[F]. Final decision-making power regarding implementation of the environmental charges concept lies with the Government of the Republic.

The entities that pay the most in environmental charges are companies with a material environmental impact – oil shale industries, chemical and paper manufacturers, water companies and landfills, and companies that mine and process natural resources. In 2007, the ten largest environmental users paid 80% of the charges. Companies that do not use natural resources in large quantities or which have adopted environmental protection measures for reducing environmental impacts also pay much less in environmental charges.

[E] Government of the Republic regulations no. 316 and 317 of 22 December 2005, Rates for mining rights in state-owned natural resource deposits and rates for special use of water in the case of water extraction from groundwater or groundwater layer in 2006–2009 (RT I 2005, 71, 553 ja RT I 2005, 71, 554).
[F] Environmental charges development concept for 2010–2020. Draft. [WWW] https://www.osale.ee/konsultatsioonid/files/consult/60_KKTA_kontsepts_osale.pdf

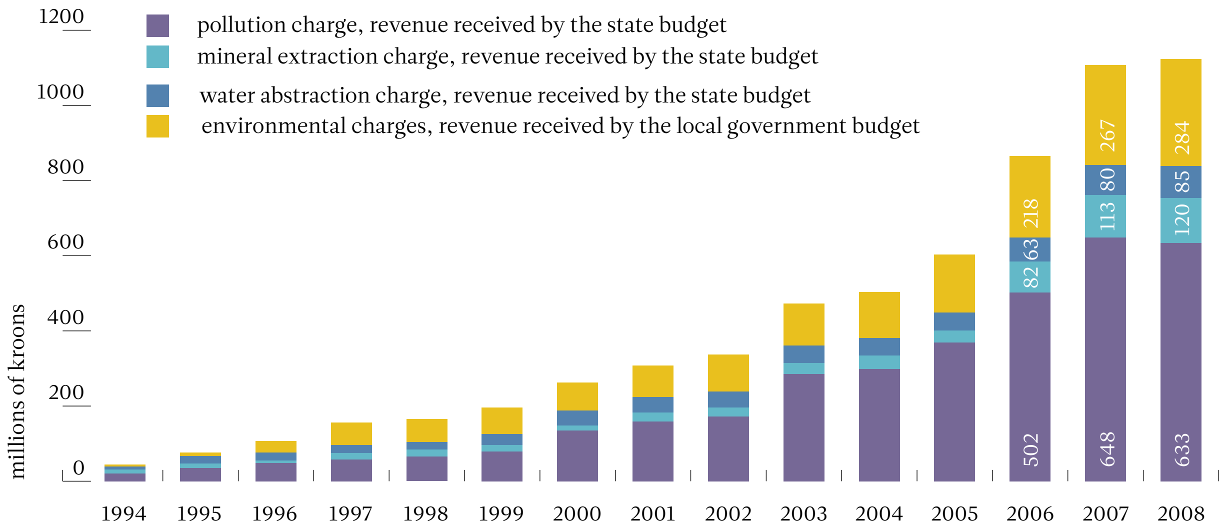


Figure 11.1. Revenue from environmental charges 1994–2008. Note: The figure reflects only revenue from pollution charges, charge for water abstraction and mineral extraction. Data: Ministry of the Environment.

11.4. Funding environmental protection measures

The environmental charges implemented in Estonia are considered fairly effective as environmental protection instruments. Due to environmental charges, especially the implementation of higher rates in the case of non-conformity to the requirements, environmental investments have increased. Environmental charges have been a factor in the renovation of waste water treatment equipment, installation of pollutant filtration equipment, establishment of landfills, more effective use of resources and much more. It should be borne in mind that the impact of environmental charges is never seen right away as the implementation of environmental protection measures from planning investments to the actual reduction of pollution is a very lengthy process.

The funds received in the state budget from environmental use are used pursuant to the Environmental Charges Act – they are routed through Environmental Investment Centre (SA Keskkonnainvesteeringute Keskus, KIK) for promoting environmental protection. The **KIK's environment programme** is the state's primary measure for funding environmental protection.

A total 3.4 billion kroons in support was paid through the environment programme in 2000–2008 (figure 11.2). In connection with the fact that the European Union has established stringent deadlines for bringing drinking water, water treatment and sewerage systems into conformity, a large share of the revenue from environmental charges has been used to bring water economy into conformity with the requirements. There have also been significant resources invested into bringing landfills and waste disposal into compliance with the requirements. A total of about 2 billion kroons was invested into water and waste management infrastructure in 2000–2008 through the environment programme. In addition, beneficiaries have made their own contributions.

Local governments have received a very significant share of support for their environmental investments. For instance, many local governments used state support to close landfills that did not conform to the requirements (including Kilingi-Nõmme, Moora landfill), or to build waste stations and collection points (Lääne County, city of Võru etc). Wastewater treatment centres owned and operated by local governments have been renovated (Elva, Türi) and water and sewerage pipelines have been constructed (Keila, Võhma etc). In the field of nature conservation, many significant projects have been funded: among others, maintenance has been performed in conservation areas, efforts mounted to combat non-native species, investment have been made into nature protection infrastructure. In the field of forestry, there have been significant resources contributed to the development of private forestry. In the environmental management field, noteworthy support has been provided to renovation of heating systems and reducing the environmental impacts of the energy sector, as well as ensuring the capability of monitoring and carrying out fuel monitoring. Subsurface surveying has also been performed. In the framework of the environmental awareness programme, funding has gone to improved availability of environmental information, environmental educational initiatives and production and publishing of environmental protection related materials, pamphlets and information media.

Besides the environment programme, **foreign aid** is an important source of funding for environmental investments. In 2005–2008, Estonia received about 2 billion kroons in foreign aid for developing the country's environmental protection infrastructure. Support primarily came from the EU's Cohesion Fund, of which three-quarters (1.5 billion) was used for various investments into water economy, related to improvement of the quality of drinking water and organizing the collection and treatment of wastewater. Large-scale water economy projects took place in the Emajõgi and Võhandu river drainage area, the Matsalu drainage area and the hydrographic basin of the Pärnu River. The city of Narva's water and wastewater pipes and wastewater treatment facility and the Kohtla-Järve wastewater treatment system were also renovated. In the waste management sector, funding was provided for the closing of ash field no. 2 at Balti power plant and restructuring of Pärnu's waste treatment sector.

In the period from 2005–2008, about 4.8 billion kroons was provided from various sources for environmental protection measures (figure 11.3). The data do not reflect all resources spent on environmental protection projects. To get a full picture, we should also include co-financing for projects funded from the environmental programme, and expenses for other environmental projects (that did not receive state (co-)financing) incurred by local government and businesses.

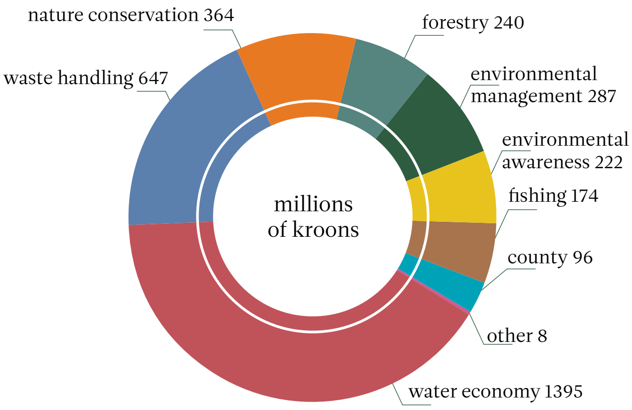


Figure 11.2. Distribution of financing of each field in the environment programme in 2000–2008. Note: The data reflect the actual disbursements. Data: KIK.

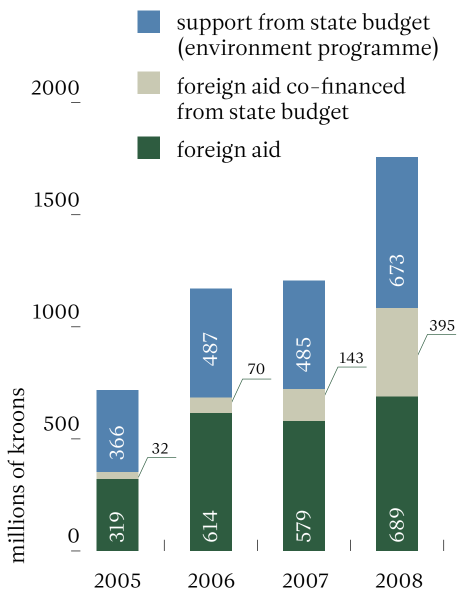
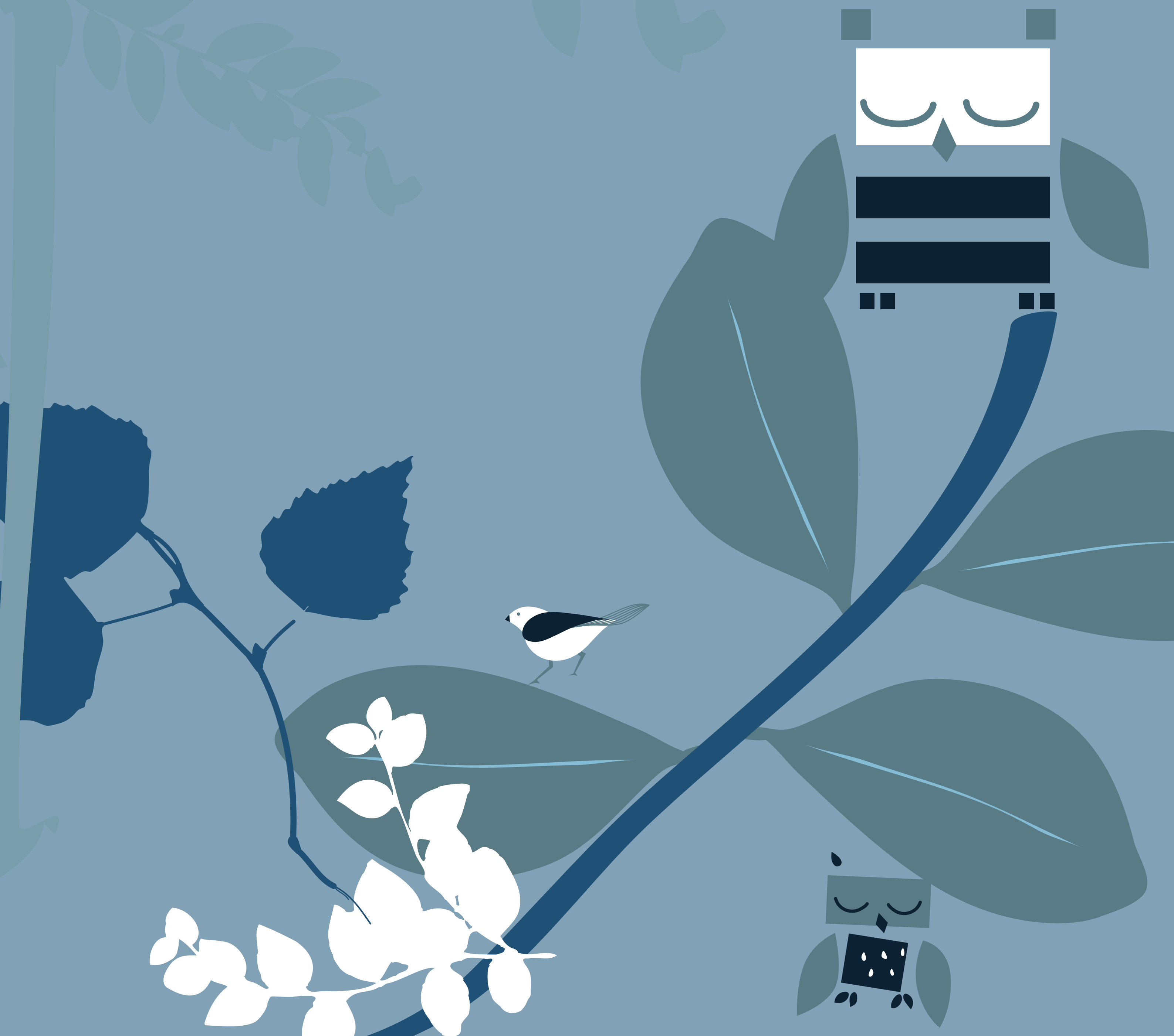


Figure 11.3. Funding for environmental projects in 2005–2008. Note: The data reflect actual disbursements in the specified years. Data: Ministry of the Environment, KIK.

Read more:

- Environmental Investment Centre webpage. [WWW] http://www.kik.ee/?setlang=eng
- Environmental Taxes. Final Report. (2009). Tallinn : Statisics Estonia [WWW] http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/publications/economic_environmental_accounts
- Lüpsik , S. (2008). Estonian Ecological Tax Reform Successfully Launched. – Critical Issues in Environmental Taxation. International and Comparative Perspectives Volume V. Hardback : Oxford.
- Ministry of the Environment website. [WWW] http://www.envir.ee/1106192 (environmental economics)

12. Environmental management tools



12. Environmental management tools

There has been a great increase in interest in environmental topics in recent years. When resolving environment-related matters, companies and organizations must take into consideration increasingly stringent legal acts and more demanding consumers. Environmental management systems, such as EMAS and ISO 14001, are used by service providers or merchants to prove that these organizations or companies avoid activities that may cause environmental problems. Various eco-labels are created so that environmentally friendly products and services could be distinguished from others. As of the beginning of 2009, 269 companies had been certified in accordance with the ISO 14001 standard in Estonia, and two companies held registration certificates pursuant to the EMAS regulation. In addition to the goods of foreign producers, a product made by an Estonian company and sold domestically also bears the European Community eco-label – one of the eco-labels with the strictest requirements – AS Eskaro's ceiling paint Primo 2

12.1. Legal background

In 2004, Estonian organizations became eligible to join the European Community's eco-management and audit scheme (EMAS) and the European Community's eco-label award scheme. Initially, EMAS was established in 1992 by regulation no. 1836/93 of European Parliament and of the Council, which was meant only for the industrial sector, but regulation no. 761/2001 of 2001 expanded EMAS, allowing organizations in other sectors to join the system. The awarding of the Community eco-label is governed by regulation no. 1980/2000 of the European Parliament and of the Council of 17 July 2000. Pursuant to the Environmental Impact Assessment and Environmental Management System Act, the competent body for the EMAS and eco-label is the Ministry of the Environment; the functions of the body are performed by the Estonian Environment Information Centre, which deals with registration of organizations pursuant to the requirements of the EMAS regulation and issues the authorization to use the Community eco-label.

12.2. Environmental management systems

One option for organizing and improving the environment-related activity of a company or organization in a planned manner is to implement various environmental management systems. An environmental management system is part of the general management of an organization, the goal of which is to verify, reduce and prevent negative impact to the environment arising from the organization's activity. An environmental management system may be implemented either formally – by applying for the respective certificate or non-formally – by performing specific environment-related functions.

Enterprises are showing increasing interest in implementing environmental management measures related to a product or service – for instance, product development is taking into account the principles of eco-labels, eco-design[A] and lifecycle assessment[B].

Certainly yet another key influence is the fact that society is becoming increasingly environmentally conscious. When making their consumer decisions, many consumers think about whether a good or service is environmentally safe and harmless to the health and they expect manufacturers to provide information on this aspect. Nor can the media's increasing interest in covering environmental topics be underestimated. Promoting and publicizing companies' environment-related progress and environmentally friendly goods to the public and business partners are important for winning trust and achieving a good reputation.

[A] Ecodesign (aka environmentally clean design) – prevention and reduction of environmental impact that may arise throughout the product's life cycle – already in the phase of planning/designing the good or service

[B] Life cycle – chain of consecutive and interrelated stages of a product, the so-called lifetime of the product from "cradle to grave". The product life cycle begins with the selection of the materials used to manufatcture the product, consumption and production of energy resources until the use of the project, waste handling and final

In today's competitive conditions, the existence of a standardized environmental management system or eco-label may be just the factor that ensures success for a company.

Implementation of environmental management systems in Estonia

The best-known environmental management systems are the ISO 14001 standard created by the International Organization for Standardization and the EU's Eco-Management and Audit Scheme. The requirements of the EMAS regulation largely coincide with the requirements of the ISO 14001 standard. The biggest difference can be considered to be the fact that the EMAS regulation requires that an environmental report be prepared for the public.

Estonian companies started to take a greater interest in systematic development and improvement of environmental activity only about ten years ago. Since the end of the 1990s, the implementation of standardized environmental management systems has seen constant growth. The predominant share of local companies has preferred an environmental management system conforming to the ISO 14001 standard. In 1999–2000 there were only a few progressive companies but as of February 2009, there were already **269 companies in Estonia certified in accordance with the ISO 14001** standard.

As for EMAS, Estonian companies first developed the option of implementing an environmental management system based on the EMAS regulation when Estonia joined the European Union in 2004. Unfortunately implementation of an environmental management system conforming to the EMAS regulation has taken place on a much lower scale than hoped-for. As of February 2009, only 2 companies in Estonia – AS Tallinna Vesi and OÜ Iru Elektrijaam – hold EMAS registration certificates.

In spring 2008, an environmental management system implementation study was conducted in Estonia. More than 350 undertakings were interviewed – among them, companies that have already implemented the ISO 14001 or EMAS, have begun implementation or intend to do so.

The study revealed that the most important reasons cited for implementation of an environmental management system were the obligation to ensure conformity to legal acts and the need to improve corporate image, including sensing environmental responsibility. Another factor that gives impetus to implementation of environmental management systems is the requirement arising from management or parent company policy to achieve savings on potential environmental expenditures. No less important a role is played by direct requirements of customers and business partners, especially in companies that specialize in subcontracting and export.

Positive aspects include the fact that the surveyed companies were generally content with the environmental management system implemented and acknowledged the benefits of the system. Improved corporate image was noted as the greatest benefit. Positive results were also obtained by avoiding potential risks and accidents; in addition, customer satisfaction and competitiveness increased and management generally improved.

As expected, the primary obstacle to implementation of environmental management systems proved to be lack of resources; the surveyed companies cited lack of time as well as of money. They also mentioned the fact that environmental management systems are little-known. With regard to both EMAS and ISO 14001 implementation, companies also mentioned the lack of specified motivational systems and additional obligations and bureaucracy related to implementation.

Most of the respondents said they intended to develop their implemented environmental management system further or maintain it at the present level. Only some of the respondent companies intended to discontinue the environmental management system, above all, for economic considerations. The current difficult economic conditions are having a negative impact on implementation of environmental management systems. It can be presumed that savings on costs and reorganization of companies as well as dissolutions will also bring about an increase in the number of companies that will lose or discontinue their environmental management system certification.

Companies cited the need for state support for promoting environmental management systems and for implementing it on a broader level. Creating publicity for environmental management systems on the national level and distributing financial support, as well as supporting and recognizing eco-friendly companies and products and creating competitive advantages for them will ensure that environmental management systems are better-known and in higher demand.

Implementation of environmental management systems has long ceased to be in the province of industrial undertakings. Public sector organizations would do well to lend more consideration to implementing environmental management systems. By acting in a concerted and more mindful fashion, even the environmental impact of office work can be reduced. The public sector, the total consumption of which makes up a very large percentage of Estonia's gross domestic product, can push the market toward greater environmental conservation through its purchases and procurements.

12.3. Environmental labels

Consumers who care about the environment and consider environmental conservation important will find very many different labels on goods and services. Among them are both obligatory and voluntary quality labels and organic labels, both domestic and international ones, more reliable and prestigious labels and ones that are less so. Environmental labels were adopted to simplify decisions for the consumer; their objective is to promote products that have a smaller negative environmental impact than other products with the same purpose.

Environment-related labels fall into three categories in accordance with the International Organization for Standardization:

- Type I – eco-labels (ISO standard 14024);
- Type II – self-declared labels (ISO standard 14021);
- type III – environmental declarations (ISO standard 14025).

The eco-label (type I) is considered the most strict environmental label. These are labels that are awarded voluntarily to environmentally friendly products and services. The information is conveyed as a symbol that can be displayed on the product, the product packaging, label, on documents accompanying the product, or advertisement. Authorization to use the eco-label is conferred by a neutral institution solely for a product or service that conforms to the established criteria. The criteria are developed based on the product's environmental impact during its entire life cycle. The life cycle begins with production of raw material and ends with disposal of waste. The established criteria are strict and they are constantly reviewed and made more stringent in order to ensure that products constantly improve in terms of their environmental soundness.

Environmental labels in Estonia

In spring and summer 2008, a study was conducted to gain an overview of the existing products with the eco-label in Estonia and importers and sellers of the products.

Above all, the study focused on eco-labels under the ISO 14024 standard common in Estonia's region. These are the European Community eco-label, the Nordic Swan and the German Blue Angel. The study primarily examined paper products, cleaning supplies, textile products, paints and timber products, among others. The labels on food products were not considered in the scope of this study.

The study revealed that the most frequent label found on products sold in Estonia was the Nordic Swan, with about 150 products on the market. The Community eco-label was second with 45 products and the Blue Angel was third with 17 products. The greatest number of products bearing the ISO type I eco-label were found in the paper and cleaning supplies product groups, and less in the timber and textile product groups, and energy-consuming appliances. The Ökotex label was common on textile products, while the Energy Star label was popular on appliances and in the case of timber products, the FSC label.

The most common type I eco-labels – the strictest eco-labels in Estonia

The European Community eco-label.

The Community eco-label – now known all over Europe – was first adopted in 1992. The advantage of the eco-label compared to domestic labels are that single criteria are valid in all European Union member states. All member states take part in creating the criteria for the flower logo along with interest groups such as environmental organizations, research bodies, representatives of industry and consumer protection organizations. All eco-label criteria are established by the European Commission after a vote in which EU member states participate. The criteria are generally in effect for 3-5 years, after which they are reviewed and if necessary made more strict to keep up with changes in technology and to ensure conformity to increasingly stringent environmental requirements.

The eco-label can be applied for only in the case of products and services for which criteria for awarding the eco-label have been established. The criteria for the flower logo were prepared for several product groups – divided into seven groups. These are cleaning supplies, equipment, paper products, home and garden, clothing, tourism and lubricants. The Community eco-label is not awarded for food, beverages or pharmaceuticals.

As of February 2009, over 700 eco-labels have been awarded. The greatest number of products with EU eco-labels are registered in Italy, France, Denmark and Germany. The most popular fields are textiles, tourism, (dishwashing) detergents, cleaning supplies and paints and varnishes. In addition to the goods of foreign producers, the product made by **one Estonian company and sold domestically** bears the European Community eco-label – AS Eskaro's ceiling paint Primo 2.

Nordic Swan (Svanen). The Nordic Swan is one of the most successful eco-label systems, created in 1989 by the Nordic Council of Ministers. The authorization to use the swan logo is awarded in Denmark, Finland, Iceland, Norway and Sweden.

Over 60 products in various product groups are eligible to apply for the Nordic Swan label. Featuring an image of a swan, the logo can be found on detergents, soft paper products, furniture. Accommodation service providers have also been awarded the Swan. More information: http://www.svanen.nu.

Blue Angel (Blauer Engel). The oldest environmental-related label is the German national eco-label Blue Angel, established back in 1977. Over 80 product groups are eligible to apply for the Blue Angel label. The logo can be found on detergents, soft paper products, construction materials, various appliances, and more.

More information: http://www.blauer-engel.de.

Other environmental labels

Many labels are similar to the eco-label, but they do not conform precisely to the requirements of the type I eco-label. In general, the entire life cycle is not taken into account. Often they are tied more to one stage in a product's life cycle – production process and activity.

Ökotex. A specific label awarded for textile products and clothing that primarily restricts the use of hazardous substances in the product.

More information: http://www.oeko-tex.com

FSC. A label on timber products, construction materials and paper that indicates that the raw material is from forest that has been managed sustainably taking into account environmental, social and economic aspects.

More information: http://www.fsc.ee

Energy Star. Label for office appliances, home appliances, light bulbs, etc, indicating that the product is energy-efficient.

More information: http://www.eu-energystar.org/

Green Key A label for accommodation services recognizing environmentally friendly activity and promoting the principles of sustainable management. The Green Key programme has proved rather successful in Estonia; as of February 2009, 19 lodging providers have been awarded the Green Key.

More information: http://visitestonia.com/green/

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Appendix

APPENDIX

The most hazardous meteorological phenomena and extreme meteorological and hydrological readings in Estonia, 2005–2008. Source: EMHI. Authors: Ain Kallis, Külli Loodla, Tiina Tammets, Lidia Klaus, Olga Kovalenko, Ilona Vahter.

year	month, day	place	event	indicator
2005	**9–11 January**	Western and Northern Estonia	storm	Winds gusts up to 38 m/s on islands; 31 m/s on mainland; record sea and river water level rise
		Kihnu	wind gusts	maximum wind speed 38 m/s
		Pärnu	rise in sea water level	water level 275 cm above normal
		Narva-Jõesuu		194 cm above normal
		Tallinn		152 cm above normal
		Ristna		176 cm above normal
		Rohuküla		120 cm above normal
	January	Tartu	excessive precipitation	86 mm of precipitation (296% of normal)
		Tartu	high flow rate in Emajõgi River caused by precipitation	Flow rate 150 m^3/s
	May	Jõhvi	excessive precipitation	98 mm of precipitation (238% of normal)
	June	Pärnu		100 mm of precipitation (200% of normal)
		Tõravere	high UV index	7.7 (over 7 is high)
	September	Hiiumaa	lack of precipitation	3 mm of precipitation (5% of normal)
2006	**year**	Tõravere	sunny weather	1817 hours of sunny weather (ranks 2nd in time series)
	18 January – March	Estonia	long period of lower than normal air temperature	average air temperature in February -7.8 °C (normal: -5.7 °C); March -4.9 °C (normal: -2.1°C)
	February, March	Võru	frozen soil	to a depth of 99 cm by the end of February
	April	Estonia	occasional drought	precipitation 44% of normal
	June	Estonia	nights with frost	temperature at the height of 2 cm: -2.3 °C (Jõgeva)
		islands	drought	precipitation 10% of normal
		Tõravere	UV index	8.3 (over 7 is high)
	July	Türi, Virtsu	drought	3 mm of precipitation (3% of normal)
	summer	Estonia	warm and dry	fall in the level of water in rivers, rates of flow up to 60% lower than the long-term average
	April - September	Lake Peipus	low water level	monthly average water levels 63-76 cm lower than long-term average

year	month, day	place	event	indicator
2006	**September – November**	Tartu	record heat	air temperature anomaly +2.8 °C
	March – December	Lake Võrtsjärv	low water level	monthly average water levels 64-92 cm lower than long-term average
	December	Estonia	record warmth	absolute air temperature maximum for December measured at most weather stations
		Valga		Absolute maximum air temperature for December recorded in Estonia – +11.9 °C
2007	**January**	Estonia	precipitation	amount of precipitation up to 350% of normal)
		Ristna		138.1 mm of precipitation during the month – record
	9-10 January	Pärnu	rise in sea water level	176 cm above normal
		Kuressaare, Narva		134 cm above normal
	March	Estonia	record warmth	air temperature anomaly +6.6 °C; many stations recorded new absolute time maximum air temperature for March (Tartu 22 March: +18.4 °C)
	May	Estonia	record heat	on 29 May, many stations recorded new absolute maximum air temperatures – Haapsalu 31,3 °C; Pärnu 31,2 °C; Lääne-Nigula 31,1°C
	spring (March, April, May)	Tartu	record warmth/heat	air temperature anomaly +2.9 °C (rankes first in time series)
	1st half of June	Estonia	long period without precipitation	up to 15 days without precipitation (in Jõgeva)
	June	Tõravere	UV index	8.3 (over 7 is high)
	July	Estonia	thunderstorms	hail, storm damage
	August	Estonia	extremely uneven distribution of precipitation	133.8 mm of precipitation during the month in Tallinn 30.6 mm in Võru
		Paide, Kuressaare, Vao	spouts, waterspouts	damage
	October	Estonia	excessive precipitation	amount of precipitation 122% of normal);
		Viljandi	excessive precipitation	111.9 mm of precipitation
	December	Estonia	very warm	air temperature anomaly +4.7 °C
		Valga		absolute maximum air temperature +7.8°C

year	month, day	place	event	indicator
2008	January	Estonia	very warm	air temperature -0.5 ˚C (norm -6.3˚C)
	19-Jan	Ristna		absolute maximum air temperature +6.2 ˚C
	winter December 2007, January and February 2008)	Estonia	record warmth	air temperature anomaly +0.5 ˚C (warmest)
	March	Estonia	very warm	air temperature anomaly +3.6 ˚C
		Narva-Jõesuu		absolute maximum air temperature on 31.March: +15.1˚C
	April	Estonia		air temperature anomaly +3.3 ˚C
	May	islands (Ristna)	drought	4 mm of precipitation during the month (Ristna)
	June	Kunda	excessive precipitation	176 mm of precipitation (300% of normal)
	July	Võru	downpours, thunderstorms	70 mm of precipitation in 3.5 hours
		Tõravere	UV index	8.6 (over 7 is high)
	August	Estonia	excessive precipitation	average amount of precipitation: 177 mm (226% of normal)
		Jõhvi	downpours, excessive precipitation	116 mm in 24 hours, amount of precipitation during the month: 242.2 mm (normal: 86 mm)
	end of August, beginning of September	SE Estonia	high water level (flood surge)	higher than spring flood levels
	October	Estonia	excessive precipitation	average amount of precipitation: 104 mm (154% of normal),
		Kuusiku		maximum amount of precipitation during the month: 131.2 mm (normal: 78 mm)
	23-24 November	Estonia	snowstorm	wind speed with blowing and drifting snow up to 30 m/s; damage
	23-25 November	Estonia	precipitation (snow)	snow depth on mainland up to 30-50 cm; 8 cm on islands
	25 November	Kuusiku	snow	record snow depth 56 cm
	December	Estonia	very warm	air temperature anomaly +3.1 ˚C
		Estonia - rivers	high water level (flood surge)	higher than spring flood levels, new long-term highs for water level in December
		Tartu	high flow rate in River Emajõgi caused by precipitation	rate of flow 155 m^3/s
		Lake Võrtsjärv	water level	about 1 m higher than average

Abbreviations used

ARC – Agricultural Research Centre
ARIB – Estonian Agricultural Registers and Information Board
ARK – Estonian Motor Vehicle Registration Centre
EEA – European Environment Agency
EEIC – Estonian Environment Information Centre
EERC – Estonian Environmental Research Centre
EMHI – Estonian Meteorological and Hydrological Institute
KIK – Environmental Investment Centre
SEIT – Stockholm Environment Institute Tallinn Centre
WEEE – waste electric and electronic equipment

Documentation Page / Bibliograafiline info

Publisher	Estonian Environment Information Centre
Date	February 2010
Editor	Karmen Kaukver
Title of publication	Estonian Environmental Review 2009
Theme of publication	Estonian Environment
Abstract	The environmental review is a publication on the state of Estonia's environment containing information about the quality of the environment and pressure exerted on the environment. Beginning with a summary of Estonia's population and economy, the environmental review then focuses on each of the primary environmental sectors: use of natural resources, air and water quality, biological diversity, soil, land use, climate change as well as waste, environmental charges and taxes, and environmental management systems. A separate chapter is devoted to the topic of the environment and health. The 2009 edition of the environmental review is similar in structure to the previous review published in 2005, in order to ensure comparability of each topic. The data in this environmental review reflect conditions in 2007 and some of the indicators are as current as 2008. Thus the overview provides a picture of Estonia's success in years of strong economic growth with regard to implementing the often quite stringent environmental objectives arising from European Union directives.
Keywords	Estonia, environment, socioeconomic development, mineral resources, fishery, forestry, hunting, weather, climate change, air, water, soil, land use, urban sprawl, biological diversity, waste, health, financing of environmental protection, environmental management systems
Electronic publication	www.keskkonnainfo.ee
ISSN (hard copy)	1736-3373
ISSN (online)	1736-3519
No. of pages	184
Language	English
Distributor	Estonian Environment Information Centre, Mustamäe tee 33, 10616 Tallinn, Estonia Tel: +372 673 7577, Fax: +372 673 7599, info@ic.envir.ee
Place and year of publication	Estonian Environment Information Centre, Tallinn 2009

Kirjastaja	Keskkonnaministeeriumi Info- ja Tehnokeskus
Väljaandmise aeg	Veebruar 2010
Toimetaja	Karmen Kaukver
Pealkiri	Keskkonnaülevaade 2009
Väljaande sisu	Eesti keskkond
Kokkuvõte	Keskkonnaülevaade on väljaanne Eesti keskkonnaseisundi kohta, mis sisaldab teavet keskkonna kvaliteedi ja keskkonnale avaldatava surve kohta. Keskkonnaülevaade algab kokkuvõttega Eesti rahvastikust ja majandusest. Järgneb ülevaade kõigist peamistest keskkonnavaldkondadest: loodusvarade kasutamine, õhu- ja veekvaliteet, looduse mitmekesisus, mullastik, maakasutus, kliimamuutus, aga ka jäätmed, keskkonnamaksud ja -tasud, keskkonnajuhtimise vahendid. Väljaanne sisaldab eraldi peatükki keskkonna ja tervise teemal. Keskkonnaülevaade 2009 sarnaneb ülesehituselt eelmise, 2005. aastal ilmunud keskkonnaülevaatega, et tagada teemade võrreldavus. Käesoleva keskkonnaseisundi ülevaate aegread ulatuvad 2007., mõned ka 2008. aastasse. Seega on ülevaatest näha, kas või kuidas on Eesti majanduslikult väga edukatel aastatel saanud hakkama Euroopa Liidu direktiividest tulenevate, sageli üsna kõrgete keskkonnaalaste eesmärkide saavutamisega.
Märksõnad	Estonia, environment, socioeconomic development, mineral resources, fishery, forestry, hunting, weather, climate change, air, water, soil, land use, urban sprawl, biological diversity, waste, health, financing of environmental protection, environmental management systems
Võrguväljaanne	www.keskkonnainfo.ee
ISSN (trükis)	1736-3373
ISSN (e-trükis)	1736-3519
Lehekülgede arv	184
Keel	inglise
Väljaande levitaja	Keskkonnaministeeriumi Info-ja Tehnokeskus, Mustamäe tee 33, 10616 Tallinn Tel: +372 673 7577, Faks: +372 673 7599, info@ic.envir.ee
Väljaandmise koht ja aeg	Keskkonnaministeeriumi Info-ja Tehnokeskus, Tallinn 2009