THE FMI EMISSION INVENTORY AND SOURCE-RECEPTOR CALCULATIONS AT THE FINNISH EASTERN BORDER

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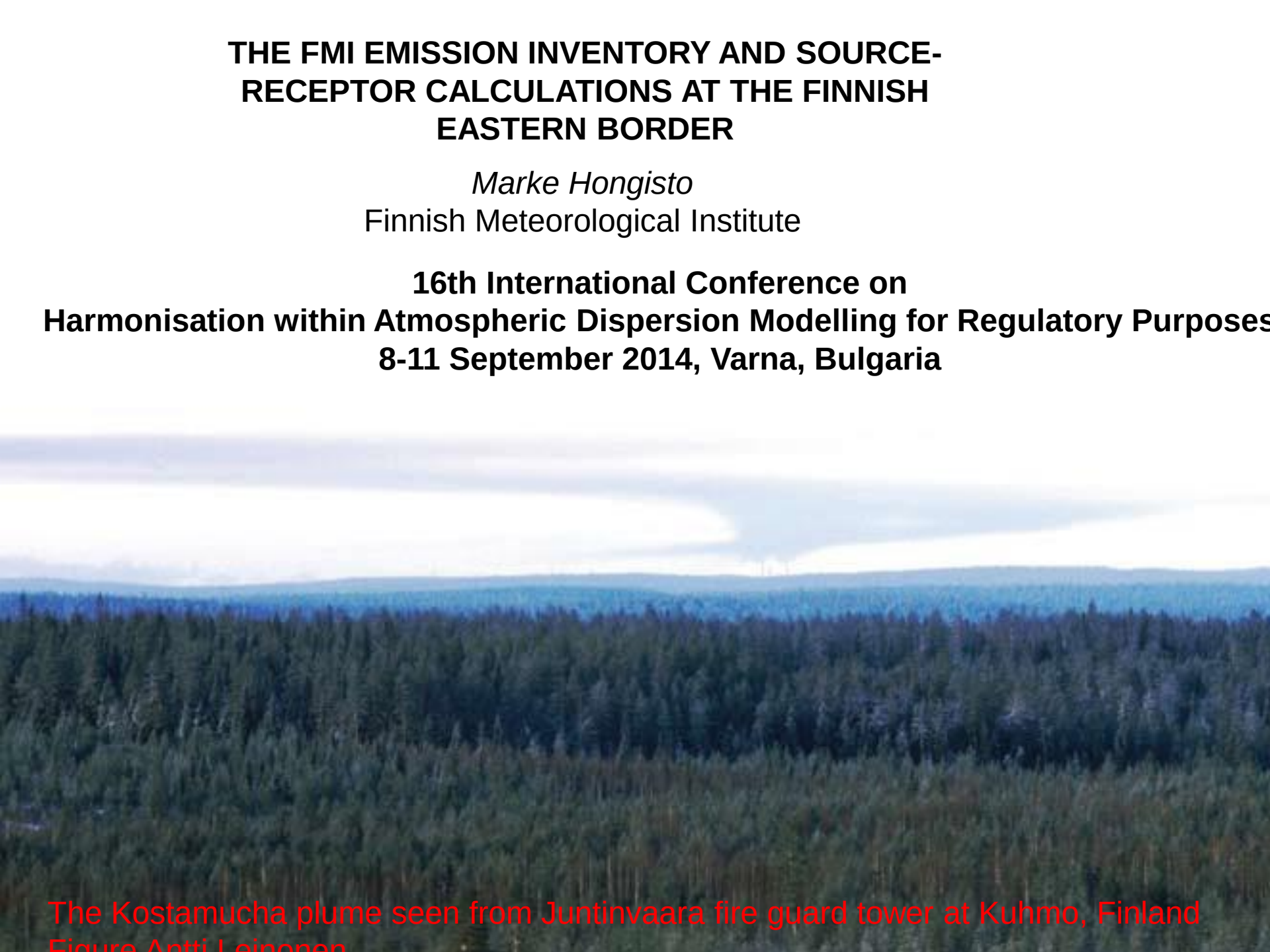


The Kostamucha plume seen from Juntinvaara fire guard tower at Kuhmo, Finland
Figure Antti Leinonen

Uncertainties in the modelling are related to the model resolution, physical parametrization and the input data: emissions and meteorology

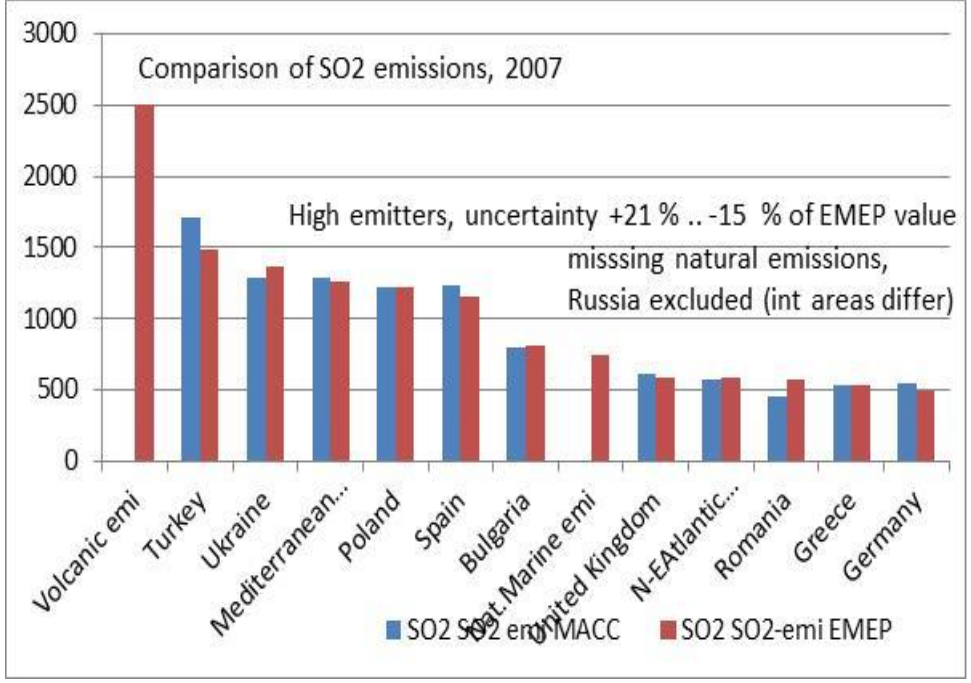
E: Macc does not include natural emissions and EMEP not all Russian sources

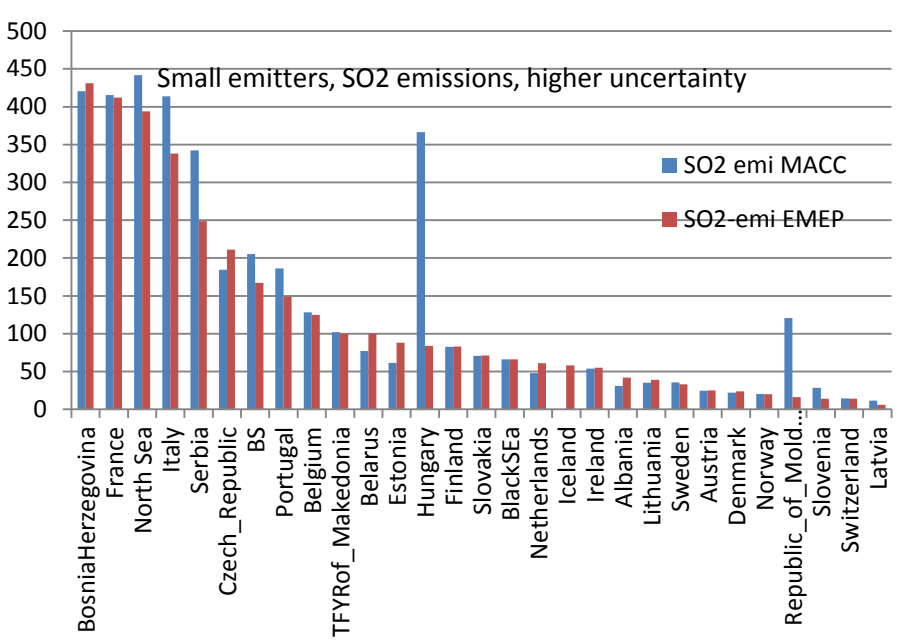
In the presentation some literature of existing sources of the area is presented
To proof that there are high pollution sources in the North-Western Russia, which are missing from the existing emission inventories

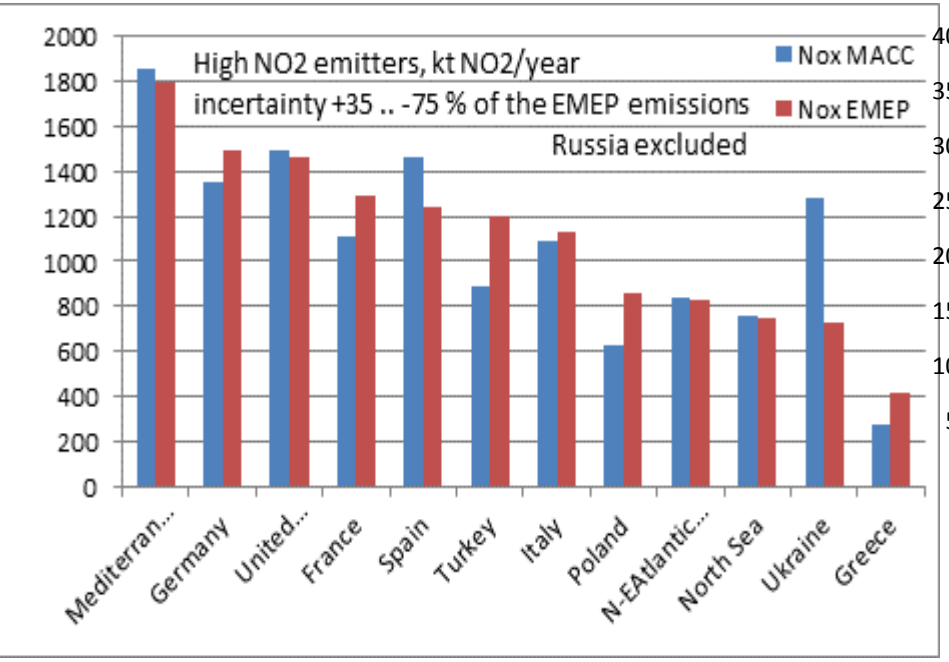
Right
Comparison of the TNO MACC
And EMEP emission
inventories

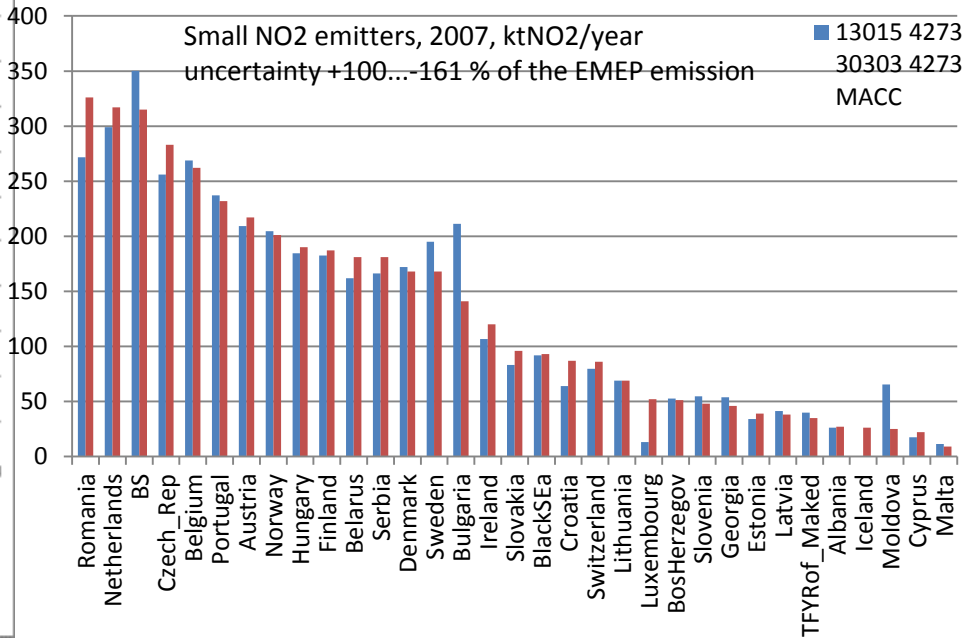
2007	Nox MACC	Nox EMEP		SO2 MACC	SO2 EMEP
Mediterranean Sea	1852	1796	Volcanic emi		2500
Germany	1353	1491	Turkey	1710	1490
United Kingdom	1489	1461	Ukraine	1294	1363
France	1109	1289	Mediterranean Sea	1294	1258
Spain	1459	1246	Poland	1216	1216
Turkey	888	1200	Spain	1232	1157
Italy	1094	1127	Bulgaria	799	819
Poland	631	860	Nat.Marine emi		743
N-EAtlantic Ocean	837	827	United Kingdom	608	586
North Sea	754	743	N-EAtlantic Ocean	575	586
Ukraine	1279	732	Romania	457	577
Greece	271	416	Greece	533	537
			Germany	545	497
sum	13015	13188			
small countries	4273	4338		4102	3605
MACC inventory area	30303	30714		14365	16934
BS	350	315		205	167
FMI emi	369			144	
share without RU, %	1,22			1,00	
Kola Peninsula	18	31		289	19

NH3: BS model area:
877 Gt EMEP,
922 Gt MACC

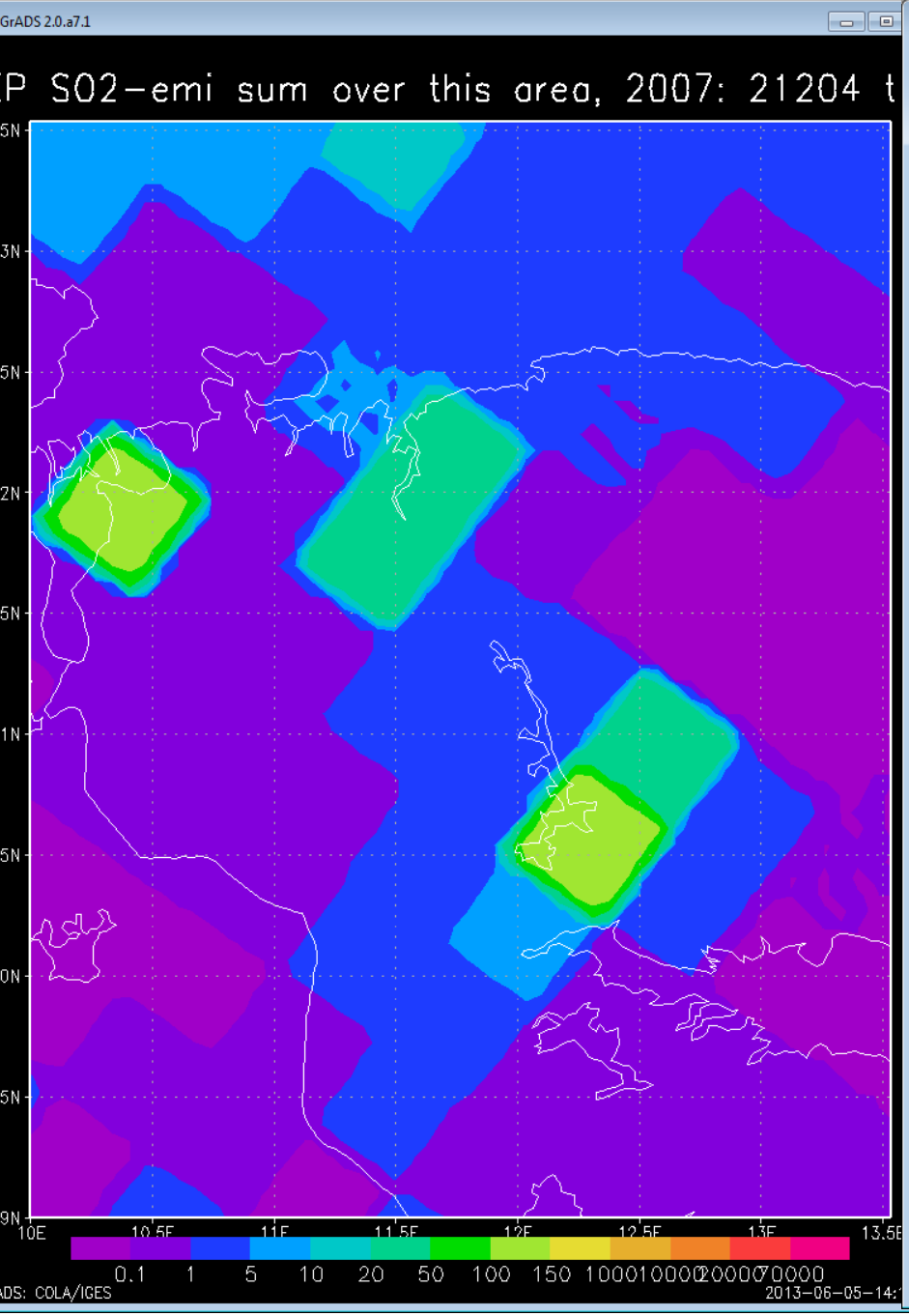


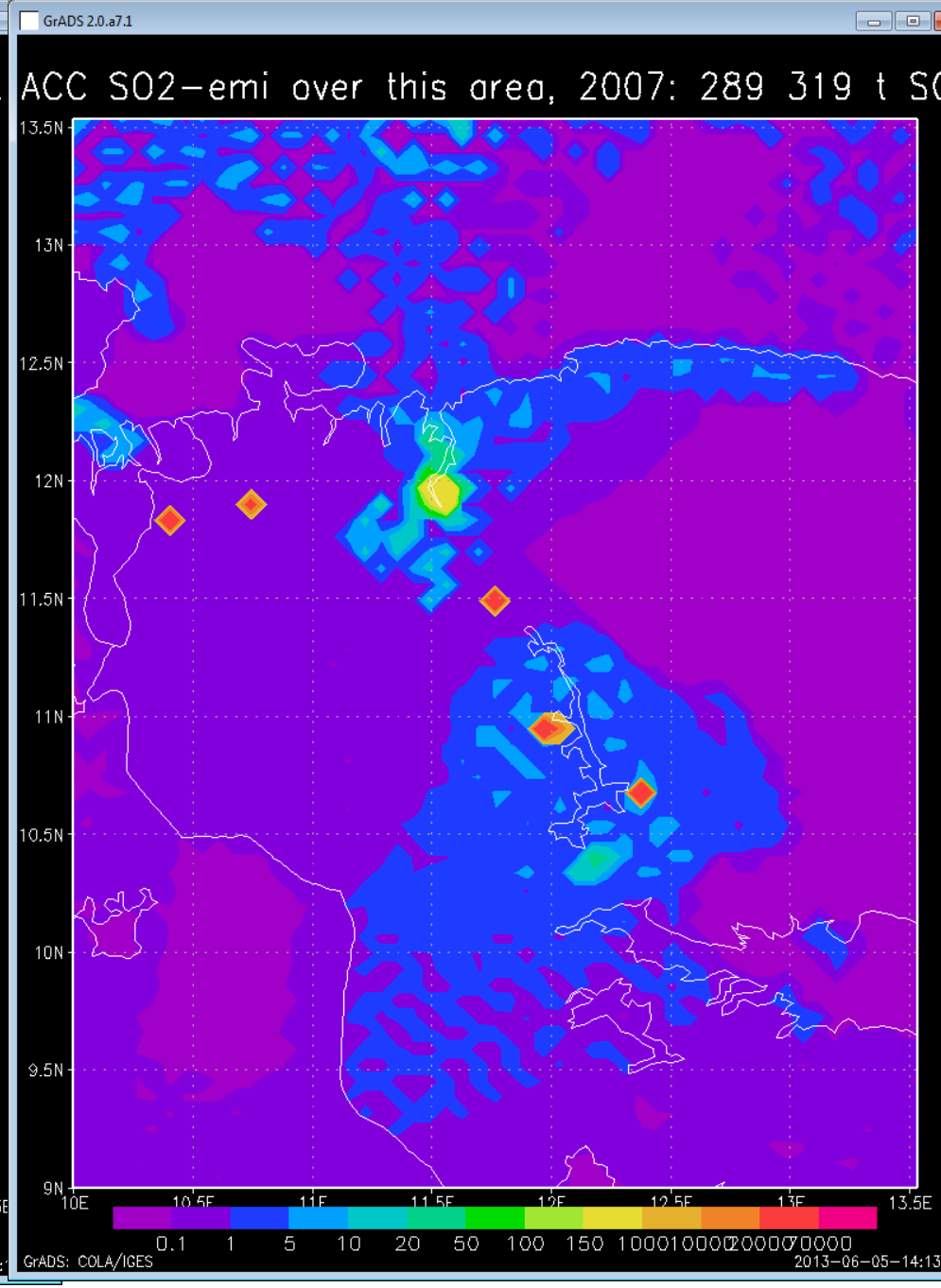






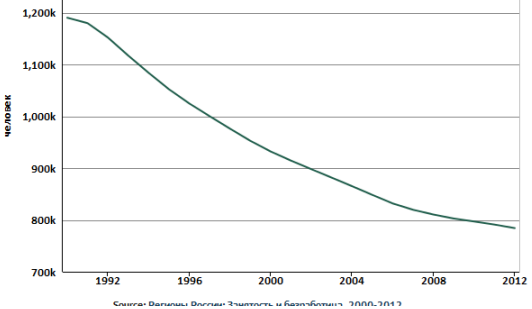
Comparison of EMEP and MACC 2007 emissions for high and small emitting coutries





EMEP SO2-emission sum over the area shown is 268 115 t SO2 smaller than in MACC inventory

KOLA PENINSULA MURMANSK OBLAST EMISSIONS



Population 784 174 people 2012, ~1.2M 1990

12 cities and 20 small towns, 91.4 % live in the urban area

5 municipal regions

Kantalahti (Кандалакшский район, 49 544, Kantalahti, population 35 654, Al factory,76kt Al/year)

Kuola (Кольский район, 44 670, Kuola, 10 437)

Lovozero (Ловозерский район, 11 820, Lovozero, 2 871)

Petsamo (Печенгский район, 38 920, Nikel, 12 756)

Turja (Терский район, 6 288; Umba, 5 532)

12 city districts

Apatity (Апатиты; 61 300, JSC Apatit mining and ore processing, Kola sci.center,CHPP ANOF 2,airport)

Kirovsk (Кировск; Hiipinä ,28 625, mining and ore processing)

Kouteron piiri (Ковдорский район, Kovdor 21297, mining, metallurgy, building materials)

Montšegorsk (Мончегорск ,45 361, Norilsk Nickel smelters, Cu, Ni)

Murmansk (Мурманск 307 257, Port, fishing fleets (Murmansk shipping company), power plant)

Olenegorsk (Оленегорск, 23072 iron ore extraction and processing, Air base, radar station)

Poljarnyje Zori (Полярные Зори 15 096, nuclear power plant)

Figure 1. Population concentrations, administrative districts and maj
Murmansk Region.

Closed cities

Aleksandrovsk (Александровск, Poljarnyi, 17 293 as. Russian Shipyard Number 10 (*Shkval*)

Ostrovnoi (Островной, 2 171, Naval base, decomission of nuclear vessels)

Severomorsk (Североморск, 50 060, Russian Northern Fleet administr and fkeets, dry dock)

Vidjajevo (Видяево, 5 771, serves submarine base of Zaozvorsk)

Zaozyorsk (Заозёрск, 11 199, old base for a nuclear underwater fleet)

Gadzhiyevo (Гаджи́ево, Skalisty, 11 068, naval base)

Roslyakovo (Росляково, 8 696, urban settlement)

Safonovo (Сафоново, 5 255, urban settelement)

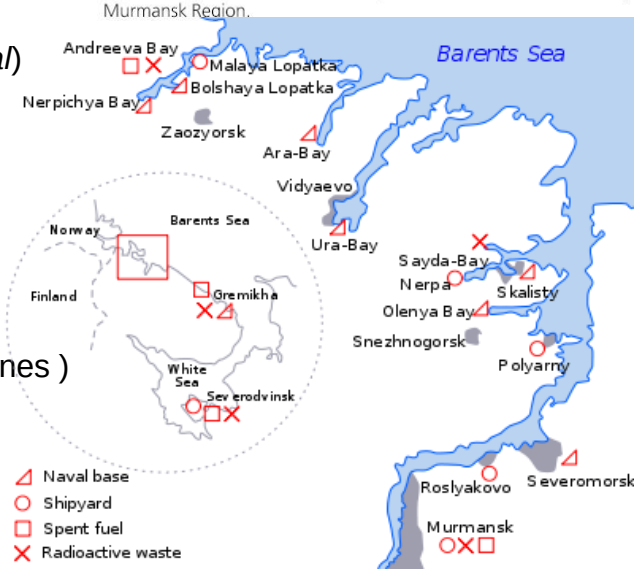
Snezhnogorsk (Снежного́рск,12 683, Northern Fleet Nerpa shipyard, nuclear submarines)

Pechenga (Пече́нга; *Petsamo*; 3 188, 200th independent motor riffle prigade)

Nikel (Ни́кель,Kolosjoki,12 756, Norilsk Nickel smelter)

Zapolyarny (Заполя́рный, 15 825, Norilk Nickel)

(Aleksandrovsk was grounded in 2008 from Poljarnyi, Skalistyi ja Snežnogorsk)



Map of Northern Fleet bases

Table 7.14. Distribution of the population in north-western Russia among various sectors of the economy (×1,000).
From *Socio-economical Development* ... (2003).

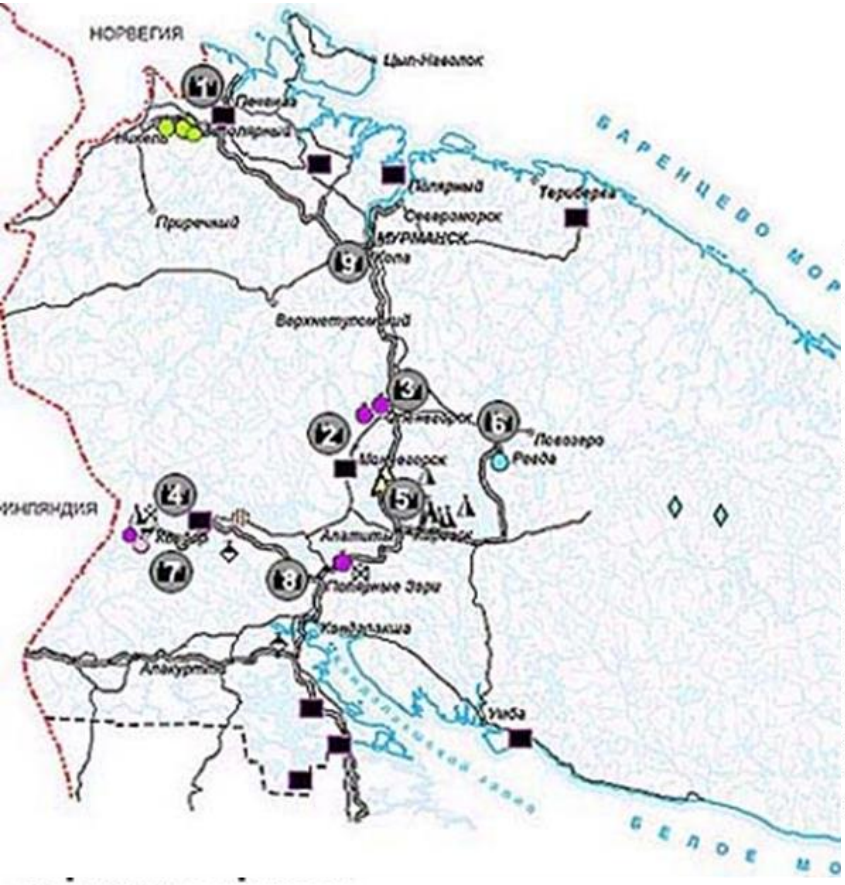
	Industry					Agriculture					Construction				
	1990	1995	1999	2001	2002	1990	1995	1999	2001	2002	1990	1995	1999	2001	2002
White Sea catchment															
Murmansk Oblast	201.4	141.9	111.0	115.4	114.0	13.1	10.1	8.3	9.2	8.6	83.7	41.9	20.2	19.9	21.0
Republic of Karelia	139.6	102.2	82.2	88.8	89.6	23.4	21.8	19.7	20.9	21.0	46.7	33.3	15.6	18.0	17.4
Arkhangelsk Oblast	254.6	185.1	153.2	163.4	167.7	61.1	47.2	38.8	39.0	36.3	70.2	43.9	31.1	31.8	31.3
Regions producing with little impact on the White Sea catchment															
Vologda Oblast	221.6	189.9	171.6	185.6	182.9	87.2	78.4	78.3	68.6	62.5	86.9	60.9	48.5	50.4	45.5
Komi Republic	192.8	150.6	123.6	121.3	115.2	39.9	34.7	27.8	26.0	24.5	115.2	62.5	32.6	36.3	34.0

	Transport and communications					Trade, public catering, and sales					Non-productive kinds of household service				
	1990	1995	1999	2001	2002	1990	1995	1999	2001	2002	1990	1995	1999	2001	2002
White Sea catchment															
Murmansk Oblast	54.6	47.6	41.1	45.0	44.5	54.4	54.9	63.9	73.0	73.9	29.8	31.2	32.2	30.2	29.4
Republic of Karelia	42.5	47.0	40.9	41.5	42.4	36.4	38.7	48.9	45.3	46.5	22.4	20.2	22.9	22.4	21.8
Arkhangelsk Oblast	91.6	79.8	65.5	69.8	70.1	66.5	65.1	72.9	86.7	87.4	39.5	34.5	36.2	34.8	36.7
Regions producing with little impact on the White Sea catchment															
Vologda Oblast	59.4	45.6	43.6	45.8	44.5	53.5	50.5	77.7	82.3	94.1	28.1	29.1	29.1	31.2	30.3
Komi Republic	70.3	64.9	51.7	54.4	55.4	60.4	49.7	71.0	77.0	78.2	37.9	32.1	32.1	33.0	34.1

http://www.barentsinfo.fi/beac/hotspots/

Code	Hot spot	Region	Sector	Status	
M1	Pechenganickel combined smelter, Nickel, Zapolyarny	Murmansk Oblast	Industrial sector	In progress	more
M2	Severonickel combined smelter, Monchegorsk	Murmansk Oblast	Industrial sector	In progress	more
M3	JSC "Apatit", Kirovsk	Murmansk Oblast	Industrial sector	In progress	more
M4	Heat and power plant, Apatity	Murmansk Oblast	Heat and power sector	In progress	more
M5	Kovdor mining and concentration combined enterprise (Kovdor GOC)	Murmansk Oblast	Mining sector	In progress	more
M6	Water quality in Kola river and Bolshoye Lake used for drinking water supply of Murmansk city	Murmansk Oblast	Drinking water quality	In progress	more
M7	Drinking water supply in Zelenoborsky-1 settlement	Murmansk Oblast	Drinking water quality	In progress	more
M8	Mercury-containing waste management, Kirovsk	Murmansk Oblast	Waste management	Excluded from the list	more
M9	Scrapped ships in the Kola Fjord	Murmansk Oblast	Scrapped ships	In progress	more
M10	Handling of oil containing wastes	Murmansk Oblast	Waste management	In progress	more
K1	Kondopoga JSC, Kondopoga (Old name of the hot spot: Gas emissions from Kondopoga pulp and paper combined mill)	Republic of Karelia	Industrial sector	Excluded from the list	more
K2	Gas emissions from Nadvoitsy Aluminium smelter, Nadvoitsy	Republic of Karelia	Mining sector	In progress	more
K3	Drinking water supply in towns and settlements of the Republic of Karelia	Republic of Karelia	Drinking water quality	In progress	more
K4	Poor water quality in water supply network of Petrozavodsk	Republic of Karelia	Drinking water quality	In progress	more
K5	Pollution of Onega lake with communal waste waters of Petrozavodsk	Republic of Karelia	Municipal waste water	In progress	more
K6	Absence of municipal sewage K6-1 treatment facilities a number of smaller towns	Republic of Karelia	Municipal waste water	In progress	more
K7	Oil and coal burning at boilers	Republic of Karelia	Heat and power sector	In progress	more
K8	Hazardous industrial solid wastes and communal wastes.	Republic of Karelia	Waste management	In progress	more
K9	Negative impact of former municipal dumping ground of sewage on ecosystems of Logmozero and Onega lakes, Petrozavodsk city	Republic of Karelia	Municipal waste water	In progress	more
K10	Stock of obsolete pesticides in the Republic of Karelia	Republic of Karelia	Obsolete pesticides	Excluded from the list	more

Murmans Oblast natural resources



- Apatite
- Iron
- Nickel, Copper
- Tantal, Niobium
- Zirconium
- Aluminous material
- Vermiculite
- Muscovite
- Ceramic material
- Magnesial refractory
- Amazonite
- Decorative stone

Convention

1. Pechenganickel Plant, PC Ko
2. Severonickel Plant, PC Kola
3. PC Olkon
4. PC Kovdor
5. PC Apatite
6. CC Lovozero Mining Concent
7. PC Kovdorsluda
8. Kola NPS
9. PC Kolenergo

© Bobylev, Leonid P.; Filatov, Nikolai; Johannessen, Ola M., Mar 06, 2007, White Sea : Its Marine Environment and Ecosy:
ISBN: 9783540276951

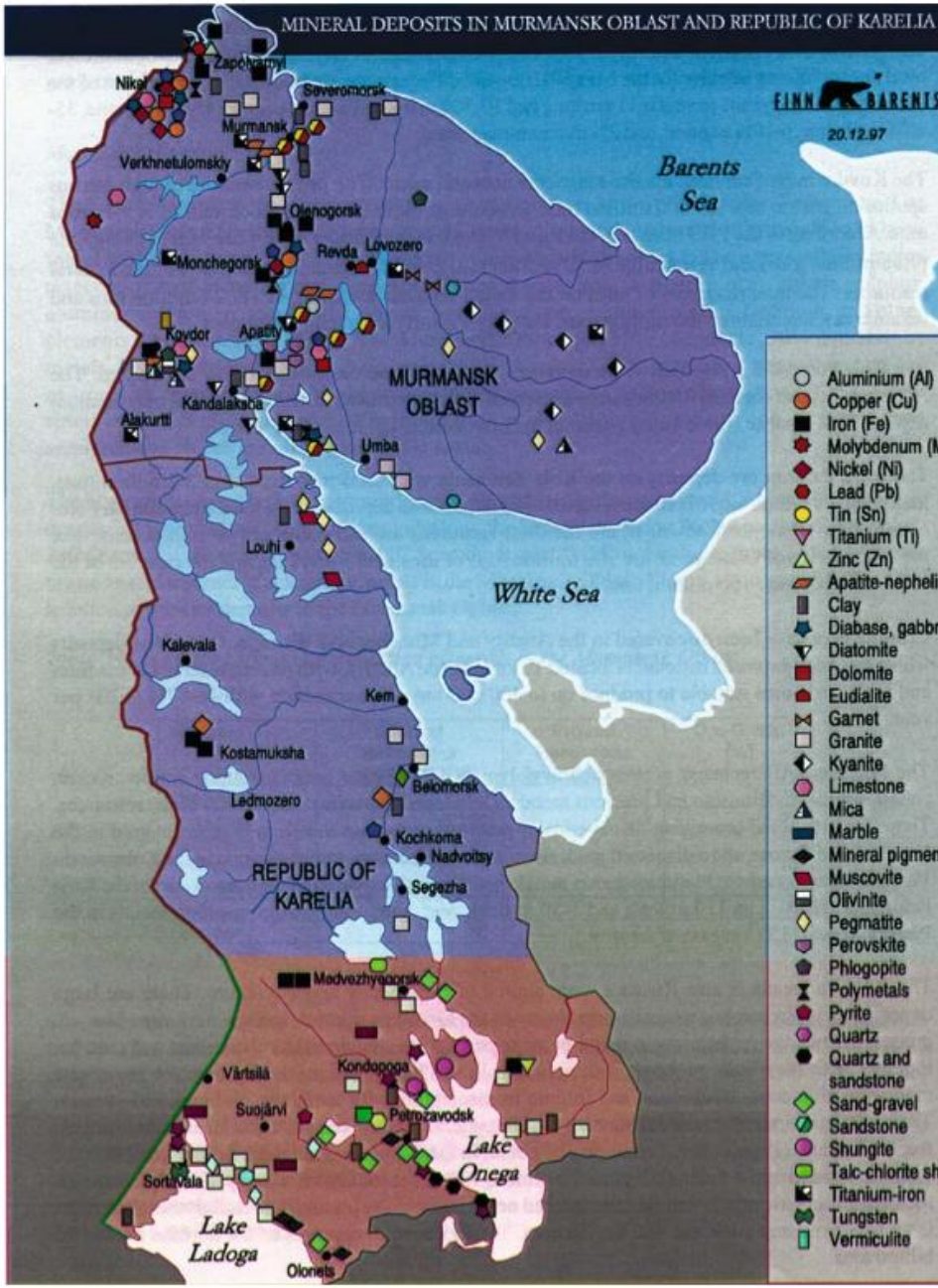
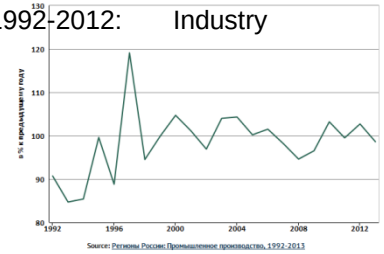
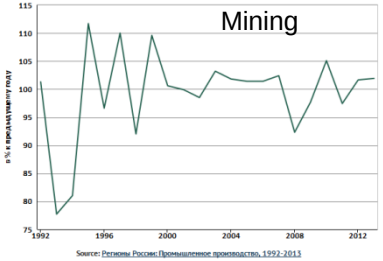


Figure 7.1. Distribution of mineral resources in the Murmansk Oblast and the Republi
Karelia.

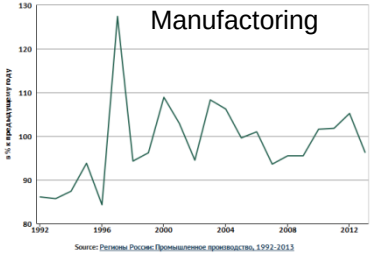
production indexes 1992-2012: Industry



Mining



Manufactoring



Murmansk Oblast.

- Mining (7)
  Metallurgy (3)
  Oil and gas (8) e.g. http://www.smng.com/ ; http://amige.ru/?lang=en ; http://en.murmanshelf.ru/ ; http://www.amngr.ru/ ; http://www.mage.ru/en/ ; http://www.murmanchanin.ru/seis_news.html;
  Food (12)
  Fish industry (11) http://en.wikipedia.org/wiki/Murmansk_Shipping_Company , others see forward
  Package and packing (4)
  Heat and power engineering (22) http://www.kolenergo.ru/ ; http://www.murmantec.com/ http://kolanpp.rosenergoatom.ru/wps/wcm/connect/rosenergoatom_copy/site_en/ ; http://www.tgc1.ru/en/home/
- Construction industry http://www.heidelbergcement.com/ru/en/country/production_sites/index.htm

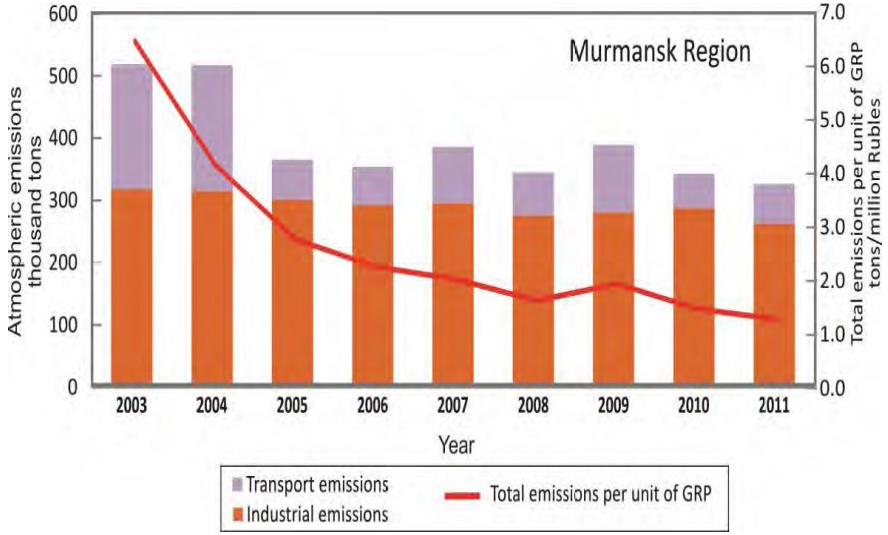
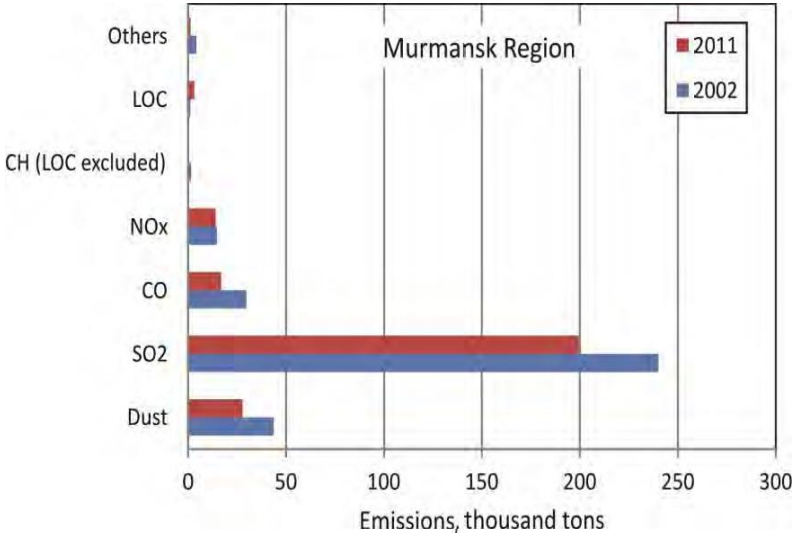


Figure 5.1.1. Dynamics of atmospheric emissions in the Murmansk region in 2003-2011 Assessment of the Barents Hot Spot Report 2013



Structure of industrial emissions in the Murmansk Region in 2002 and 2011

References for the last slide

http://www.murman.ru/guide/industry/index-eng.shtml.
Assessment of the Barents Hot Spot Report;
http://www.tgc1.ru/fileadmin/ir/Reports/Annual/2012/tgc_annual_en_2012.pdf;
http://knoema.com/atlas/Russian-Federation/Murmansk-Region/Industrial-production

Atmospheric emissions In 2011 the volume of industrial emissions was 263.132 thousand tons, which is 8.5% less than it was in 2010 (287.6 thousand tons), however, over the same period, transport emissions have increased from 55.5 thousand tons to 63.6 thousand tons. Overall, the decline in total emissions was typical of the 2003-2011 period, both in absolute terms and per unit of GRP.

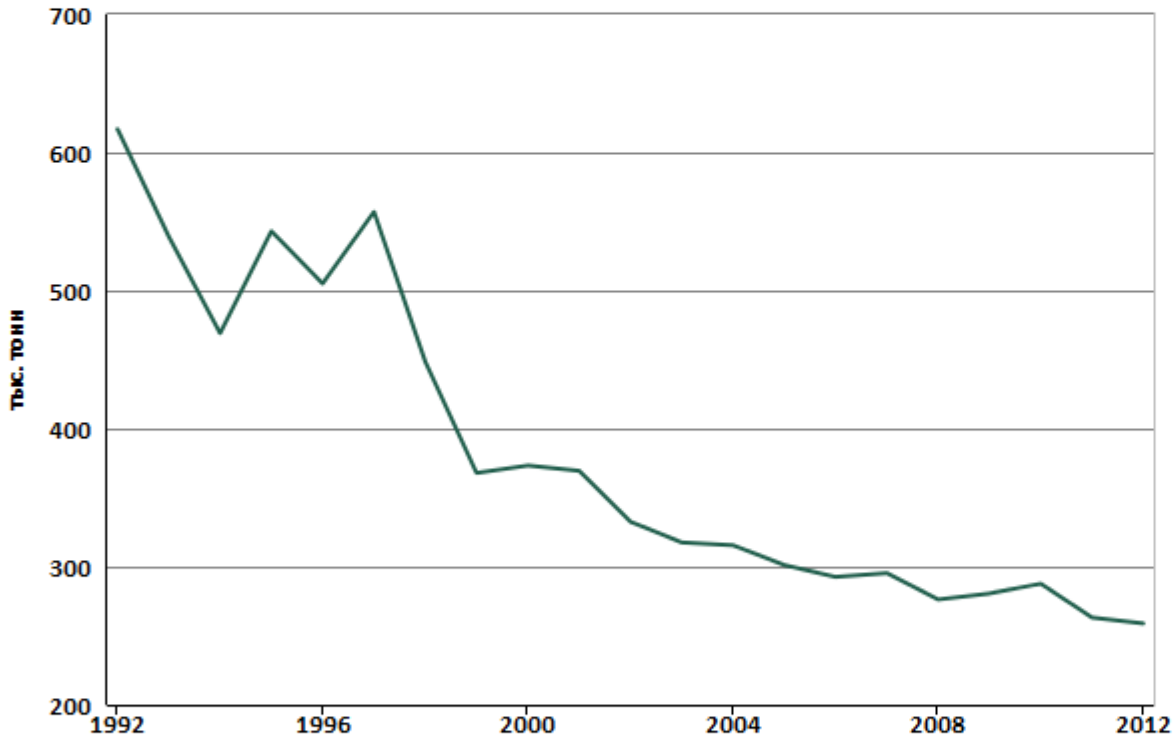
Murmansk Region - Emissions of air pollutants from static sources

258.9

(Thousand tonnes)
in 2012

Emissions of air pollutants - emissions of air pollutants, which have adverse effects on human health and the environment, from stationary and mobile sources of emissions.

Compare | Export | Explore data | Embed | View Ranking | View Map



Date	Value	Change, %
2012	258.9	-1.63 %
2011	263.1	-8.52 %
2010	287.6	2.52 %
2009	280.6	1.56 %
2008	276.2	-6.46 %
2007	295.3	0.94 %
2006	292.6	-2.84 %
2005	301.1	-4.56 %
2004	315.5	-0.65 %
2003	317.6	-4.50 %
2002	332.5	-9.99 %
2001	369.4	

Source: Регионы России: Население, территория, здравоохранение, экология

See also: Emissions of air pollutants per sq. m of area, Neutralized pollutants

http://knoema.com/atlas/Russian-Federation/Murmansk-Region/Emissions-of-air-pollutants

INDUSTRIAL POTENTIAL

http://eng.gov-murman.ru/about_region/indystry/

Mining and metallurgy complex enterprises are the basis of the Murmansk Region economy.

In the Murmansk Region, there are **over 60 large deposits** of various raw minerals where 30 types of useful minerals are extracted. Most deposits of the minerals are of national significance, and of international significance as far as apatite, nepheline and cyanite ores and rare metals are concerned.

The economic specialisation of the region includes **extraction and processing of ferrous and non-ferrous metal ores, industrial production of copper, nickel, cobalt, semi-fabricated precious metals products, primary aluminium and apatite concentrate** that is a raw product for phosphate fertilisers.

The share of the Kola land of the total Russian production is 45% in nickel, 11 % iron-ore concentrate and 7% of refined copper. The Region is the only producer of apatite, nepheline and baddeleyite concentrates (100% are produced in the Murmansk Region).

JSC “Kolskaya GMK” is a single complex for extraction of sulphide copper and JSC ores and production of precious metals.
JSC “Apatit” extracts and processes apatite and nepheline ores of the Khibiny deposits which are part of the largest and richest deposits in the world as well as the basis of phosphorous raw materials in Russia.
JSC “Kovdorsky GOK” develops the Kovdor deposit and produces iron-ore, apatite and baddeleyite concentrates.
JSC “Olkon” extracts banded iron formations and sells high-quality iron-ore concentrate.
“KAZ-SUAL”, a branch of JSC “SUAL” smelts aluminium from aluminium oxide delivered there.

The major production facilities were built decades ago, and the enterprises currently aim at deep-level mining and underground mineral extraction which requires upgrading and expanding the mining industrial infrastructure.

ENERGY

Murmansk Oblast

The Apatitskaya CHPP of TGC-1's Kolsky Branch is the only source of heat for Apatity city and its adjacent industrial zones.

Structure of the heat market of Apatity city of Murmansk Oblast*

Name of organization	Installed heat capacity, GCal/h	Connected heat capacity, GCal/h	Heat output for consumers, thous. GCal	Market share, %
TGC-1	735	402	1,167	100

* – Data indicated was recorded during formation of heating energy tariffs in 2012.

Since 2011, TGC-1 has been implementing a project for the construction of heating mains from the Apatitskaya CHPP to Kirovsk city in Murmansk Oblast, in cooperation with the Government of Murmansk Oblast and Apatit JSC. The implementation of this project will expand TGC-1's zone of power supply and increase production at the Apatitskaya CHPP, which has a considerable power reserve. Completion of the project's construction is planned for the beginning of the 2013 – 2014 heating season.

Apart from the Apatitskaya CHPP, TGC-1's subsidiary company Murmanskaya CHPP provides heating output in Murmansk Oblast as the main supplier for consumers in Murmansk.

Currently, Murmanenergosbyt JSC can be considered to be the Murmanskaya CHPP's only competitor.

Structure of Murmansk city heat market*

Name of organization	Installed heat capacity, GCal/h	Connected heat capacity, GCal/h	Heat output for consumers, thous. GCal	Market share,%
Murmanskaya CHPP	1,111	715	2,217	75
Murmanenergosbyt JSC	552	227	740	25

* – Data indicated was recorded during formation of heating energy tariffs in 2012

ENERGY. Two coal-heated power plants: Apatity and Murmank. Nucleae PP and HPP:s http://www.tgc1.ru/fileadmin/ir/Reports/Annual/2012/tgc_annual_en_2012.pdf

Murmanskaya CHPP

ENERGY

At present, the Murmanskaya CHPP consists of a combined heat and power plant and two boiler facilities with 1,111 GCal/h installed heat capacity and 12 MW installed electric capacity. The total length of heat network calculated as a single-pipe is 103.5 km.

TGC-1 owns 95.03 % of ordinary shares of the Murmanskaya CHPP, and the share of TGC-1 in the charter capital of the Murmanskaya CHPP is 90.34 %.

In order to optimize the costs of the Murmanskaya CHPP, the Board of Directors of the Murmanskaya CHPP decided on 3 June 2011 to establish Kola Heating Company LLC with 100 % participation of the Murmanskaya CHPP in its capital. Kola Heating Company was registered on 17 June 2011.

On 16 September 2011, the property of the Murmanskaya CHPP, which is used for heat generation (electric boiler houses and heating grids located in Murmashi settlement and Verkhnetulomsky settlement), was transferred as a contribution to the authorized capital of Kola Heating Company. The transfer of this property by the Murmanskaya CHPP enabled its separation from fuel oil facilities. On 27 April 2012, 100 % of the shares of Kola Heating Company were sold to a third party

Hibiny Heat Company

Hibiny Heat Company was established in order to act as a customer in implementation of the investment project “Renovation of the Apatitskaya CHPP and construction of the heating mains till the city of Kirovsk with installation of a central transformer station”, which included commissioning and operation of the heating mains. The founders of Hibiny Heat Company are TGC-1 JSC and Apatit JSC with equal shares.

In 2012, construction of the heating mains that started in 2011 was continued. Reconstruction of the Apatitskaya CHPP of the Kolsky Branch is progressing, having started at the same time as the construction of the heating mains. At present, the scope of work for reconstruction of the Apatitskaya CHPP is more than 90 % complete and it is planned to finish the project in 2013.

On 22 August 2011, FFMS of Russia registered an additional securities issue of HHC in the amount of 800 million shares with a nominal value of 1 ruble each, to be placed by closed subscription. From February to May 2012, TGC-1 paid an additional contribution to the authorized capital of HHC amounting to RUR 400 million, following which the share of TGC-1 remained unchanged because Apatit JSC paid an equivalent contribution. On 2 August 2012, FFMS of Russia registered the report on the results of the additional securities issue of HHC

Murmansk District Mining (7)

- **Kovdor ore mining and processing enterprise** (Kovdor)
  Mineral chemical company "Eurochim". Open mining of ore of ferrous metals. Mining and enrichment of ore of less-common metals. Mininmg and chemical production.
  http://www.eurochem.ru/about-2/operations/production/kovdorskiy-gok?lang=ru

- **Kovdorsluda, PC** (Kovdor). Mining, ore dressing. Production of alumosilicates, insinglass stone products. Geological and drilling and blasting works. vermiculite, phlogopite and pegmatite. http://kovdorsluda.com/en http://companies.globalmarket.com/kovdorsluda-llc-151056.html

- **Open Society "Kola mountain-metallurgical company"** (Murmansk region)
  the branch of Norilsk nickel. "Mountain-metallurgical combine "Pecheganickel" and "Combine "Severonikel". Industrial enterprises of Open Society "Kola MMC" are located in a settlement Nickel, in cities Polarny and Monchegorsk in the Murmansk region. Combines are dominant employer for these settlements. http://www.kolagmk.ru

- **Murmansk PE** (Apatity).. Murmansk prospecting expedition. Investigation, drilling.
  http://www.mgre.ru Added: 03.09.07, hits: 2266, per week - 6 |

- http://www.szfk.ru/en/ Kirovsk, Oleniu Ruchey deposit on Umba river basin, 67º 41' North 34º 12' East, mining and processing for North-Western Phosphorous Company NWPC

- **Olkon, PC** (Olenegorsk) Severstal OAO Olkon http://www.severstal.com/eng/media/news/document6467.phtml
- The Olenegorsk Mining and Concentration Works
  Olenegorsk mining dressing enterprise. Production and selling of iron-ore concentrate, ferrite stronic powder, rubble. The main industry storage of iron ore are concentrated in five locations, there are 4 open cast mines in exploitation.
  http://www.olcon.ru

- **Techoborudovanie, JSC — Drilling Equipment**
  Rock Driling Tools & Equipment, Drifting and Down the Hole equipment, Demonition Tools, professional down the hole pumps and hoses, Spare parts, World fraht
  http://tekhobor.ru Added: 30.08.11, hits: 481, per week - 3 | Modify | Delete
- **Central Kola Expedition** (Monchegorsk)
  "Central Kola Expedition" - official site of the company.
  http://www.ngu.no/Kola/cke.html http://www.ngu.no/Kola/index.html Last reference 2010

- See : http://conference.ncci.ru/%28en%29 **"Mining Industry in the Barents Euro-Arctic Region: View to the Future" which will take place in Kirovsk, Murmansk Region, Russia on the 20 – 21 of November, 2014**
- http://conference.ncci.ru/previous-events/conference-2012
- http://www.kolasc.net.ru/english/index.html Kola science center
- http://www.eurochem.ru/wp-content/uploads/2014/04/EuroChem-Annual-Report-2013-ENG1.pdf

Norilsk Nikel http://www.nornik.ru/en/about-norilsk-nickel/operations/kola-mmc

Kola MMC is the largest industrial producer in the Murmansk region and is fully integrated into the transport infrastructure of the North-Western Federal District.

In the Kola MMC, three mines extract disseminated sulfide ores containing nickel, copper and other useful components from the Zhdanovskoye, Zapolyarnoye, Kotselvaara and Semiletka deposits

Kola MMC ore mining and metals production

	2011	2010	2009	2008	2007	2006	2005	2004
Ore mining (thousand metric tonnes)	8147	8336	7892	8149	7636	7634	6802	6692
Metals output (thousand metric tonnes)								
Nickel	113	111	109	110	116	122	120	116
Copper	60	56	59	62	66	74	91	94

The extracted ore is processed at the Concentrator, producing collective copper and nickel concentrate. The Concentrator produces copper and nickel concentrate that is further transferred to the Roasting section of the Smelting shop for further processing.

Kola Peninsula's refining capacities at Monchegorsk process both Kola Peninsula high-grade matte and matte received from the Polar Division. The ke products are nickel and copper cathodes, carbonyl nickel, cobalt concentrate, precious metal concentrates and sulfuric acid.

The Company has outsourced the refining of precious metal concentrates from the Kola Peninsula under a tolling agreement to an independent precious metals refinery – Krasnoyarsk Precious Metals Plant.

M1(1): Pechenganickel MMC of Kola GMK JSC, Nikel and Zapolyarny
Pechenganickel Mining and Metallurgical Combine (MMC) of the Kola Mining and Metallurgical Company (Kola GMK) of **Norilsk Nickel**

2003: The largest emitter of air pollutants, particularly SO_2 in the Murmansk region; large volumes of waste water discharges, particularly salts
SO_2 emission to air:: 2003: Nikel and Zapolyarny – 124.3 kt/year
2011: Nikel – 55.3 k t/year; Zapolyarny – 45.4 kt/year;
Wastewater discharge: 24.6 million m3/year , 13.3 mln. m3/year(2011)

Measures taken: Reconstruction and modernisation of production to reduce industrial emission discharge of contaminants
Measures planned: Reduction of SO2 emission to air: completion of modernisation with conversion to briquetting technology in Zapolyarny;reduction of sulphate discharges with wastewater
Investments: 2.2 billion rubles (€ 55 million) project in Zapolyarny
Status: Proposed for continued joint actions

http://www.barentsinfo.fi/beac/hotspots/

Norils Nikel annual Corporate Social Responsibility Report
http://www.nornik.ru/_upload/NN_20082013.pdf

Pollution Loads and the Extent of the Contaminated Territory

Ambient concentrations of pollutants in both Nikel and Zapolyarnyy have monitored since 1967. The peak reported values for Nikel were 5.00 mg/m^3 of dust in 1978, 7.14 mg/m^3 of SO_2 in 1971, and 1.18 mg/m^3 of NO_x in 1978. The peak reported values for Zapolyarnyy were 3.25 mg/m^3 of SO_2 in 1979, and 1.87 mg/m^3 of NO_x in 1967 (Emissions of pollutants in Russia 1966–2006).

In spite of a substantial emissions decline (Table 2.14), high levels of ambient sulphur dioxide still occur at Nikel; for example, concentrations of 2.6 mg/m^3 (exceeding the sanitary limit of 0.05 mg/m^3 by a factor of 52) were officially reported on 4 and 15 July 2007 (www.kolgimet.ru). Importantly, the levels of ambient sulphur dioxide measured by an international research project from 1992 to 2005 were around three times higher than those officially reported by the Murmansk Hydrometeorological service, and they are considered unacceptably high (Stebel et al. 2007).

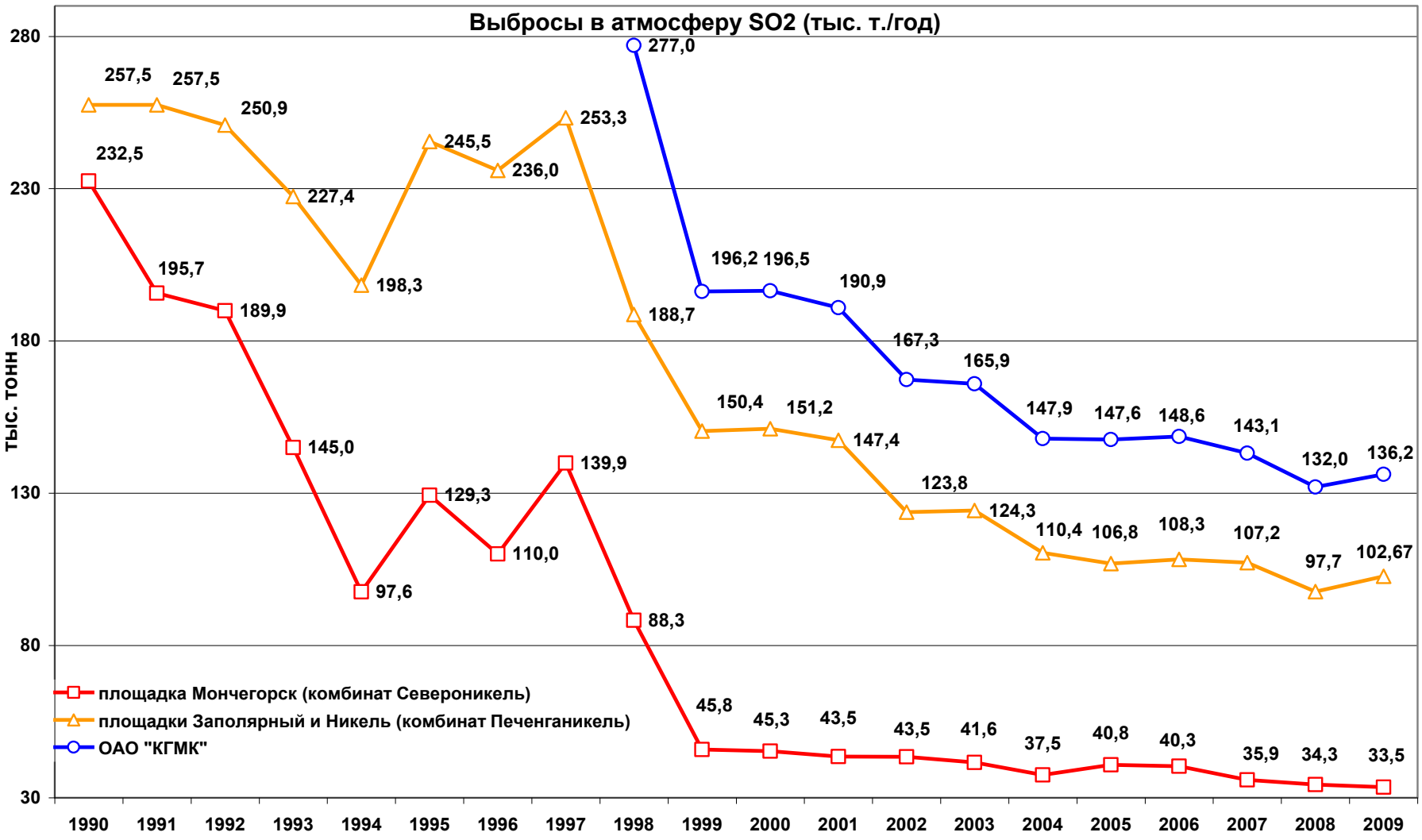
The long-term emissions impact resulted in slight soil acidification and severe contamination by metals. The peak reported metal concentrations in soils were 3,489 and 1,020 mg/kg of copper, and 2,990 and 2,230 mg/kg of nickel (for Nikel and Zapolyarnyy, respectively) (Niskavaara et al. 1996; Reimann et al. 1998; Kozlov & Zvereva 2007a). During the period 1987–1989, annual depositions of sulphur and nitrogen in Nikel were 3,300 and 200 kg/km^2, respectively (Vasilenko et al. 1991).

Polluted site 2-1, located 1.4 km E of smelter at Nikel (2007): industrial barren. Pollution ıd soil erosion have greatly modified growth form of mountain birch. Photo: V. Zverev

Plate 47 Polluted site 2-1, located 1.4 km E of smelter at Nikel (2007): industrial barren. Pollution combined with climatic stress caused branch mortality on willow, *Salix myrsinifolia* ssp. *borealis*, which is one of most tolerant local woody plants. Photo: V. Zverev

Kozlov Mikhail; Zvereva Elena; Zverev Vitali, 2009 | Impacts of Point Polluters on Terrestrial Biota. Springer Series: Environmental Pollution, 15 , V. 15

Открытое акционерное общество
«Кольская горно-металлургическая компания»



Norilsk Nikel, 2013. http://www.kolagmk.ru/ecology/monitoring: the link to ppt Презентация - Мониторинг окружающей среды в зоне влияния ОАО «Кольская ГМК» и рекультивация нарушенных земель 34 p. (9.12.2013)

Table 2.14 Aerial emissions (t) from industrial enterprises at Nikel, Russia

Year	Dust	SO_2	CO	NO_x	Ni	Cu	Co
1943	–	55,000[a]	–	–	–	–	–
1971	–	131,800	–	–	–	–	–
1972	7,300	255,500	–	–	–	–	–
1973	7,300	255,500	–	14,600	–	–	–
1974	7,300	335,800	–	14,600	–	–	–
1975	7,300	335,800	–	14,600	–	–	–
1978	5,200	339,000	–	14,600	–	–	–
1979	5,200	339,000	–	14,600	–	–	–
1980	5,000	328,200	100	200	–	–	–
1981	4,800	290,100	100	–	–	–	–
1982	4,600	292,800	100	200	–	–	–
1983	4,700	293,200	200	400	240	170	10
1984	4,700	290,500	100	–	220	140	10
1985	4,400	274,900	200	100	210	130	10
1986	4,300	261,100	200	100	220	150	10
1987	4,000	257,900	200	100	190	130	6
1988	4,100	211,400	200	100	160	140	20
1989	3,900	199,600	200	200	170	110	10
			800[b]				
1990	3,900	190,100	200	200	136	92	5
			4,200[b]	600[b]			
1991	3,900	189,800	200	200	131	88	5
			3,800[b]	600[b]			
1993	3,500	160,600	300	200	130	87	5
1994	3,700	129,200	300	200	136	82	5
1995	3,900	175,400	340	160	137	85	5
1996	3,300	183,700	300	100	136	92	5
1997	3,700	183,500	300	100	155	96	5
1998	2,400	125,500	200	100	143	93	5
1999	2,500	90,100	700	200	155	100	5
2000	2,600	85,600	500	100	171	108	6
2001	2,600	85,600	500	100	171	108	–
2002	2,800	62,300	200	200	150	83	–
2003	2,400	60,600	100	200	149	83	5
2004	2,300	56,400	100	200	154	86	5
2005	2,200	55,500	70	10	157	88	5

Non-referenced values were extracted from Emissions of Pollutants in Russia (1966–2006).
Other data sources:
[a] Honkasalo (1989).
[b] Kryuchkov (1993a).

Table 2.15 Aerial emissions (t) from industrial enterprises at Zapolyarnyy, Russia

Year	Dust	SO_2	CO	NO_x	Ni	Cu	Co
1971	9,900	52,900	–	–	–	–	–
1972	9,900	58,000	–	–	–	–	–
1973	10,950	60,200	–	3,700	–	–	–
1974	10,950	63,900	–	3,700	–	–	–
1975	10,950	63,900	–	3,700	–	–	–
1978	5,300	56,700	–	–	–	–	–
1979	5,300	60,000	–	8,600	–	–	–
1980	5,500	70,600	300	300	–	–	–
1981	6,300	71,300	300	–	–	–	–
1982	5,400	65,100	300	200	–	–	–
1983	5,500	75,500	300	300	190	90	–
1984	5,200	74,900	300	200	190	90	8
1985	4,600	79,300	300	200	170	90	10
1986	4,100	81,500	200	200	160		
1987	4,100	79,700	200	200	200	100	5
1988	4,100	78,600	300	200	200	100	5
1989	4,100	77,800	400	300	130	90	5
	4,500[a]		3,400[a]	1,200[a]			
1990	4,100	63,700	400	300	165	88	6
	4,500[a]		5,200[a]	1,500[a]			
1991	4,100	67,600	400	300	148	–	–
	4,500[a]		4,700[a]	1,400[a]			
1993	3,900	66,600	500	300	152	74	5
1994	6,400	69,200	500	300	161	81	5
1995	6,500	70,200	400	300	161	93	6
1996	5,900	52,500	400	200	162	85	5
1997	6,100	69,900	400	300	166	87	6
1998	5,800	65,200	400	200	180	95	6
1999	5,600	62,500	1,000	200	175	93	6
2000	5,500	65,600	900	200	183	98	6
2001	5,500	65,600	900	300	183	98	–
2002	5,500	61,600	70	300	183	86	–
2003	4,600	63,700	60	300	180	84	–
2004	4,300	56,000	100	300	175	82	–
2005	3,900	51,400	200	300	171	84	–

Non-referenced values were extracted from Emissions of Pollutants in Russia (1966–2006).
Other data sources:
[a] Kryuchkov (1993b).

Kozlov e.a., 2009

M2(2): Monchegorsk industrial site of Kola GMK JSC, Severonickel combined smelter

2003: The second largest emitter of air pollutants, particularly SO2
2003: Emission to air: SO2 – 41.6 kt/year (2003); 31.3 k t/year (2011)
Discharge of wastewater: 15.7 M m3/year (2003); 14.1 M m3/year (2011)

Measures taken: Part of the copper production transferred to the roastingleaching-electro-winning process; gas pipeline reconstructed; gas collector replaced; new catalytic re-combiner installed at one technological line in the sulphuric acid department
Measures planned: Modernisation aimed at a reduction in contaminants discharge with wastewater – elimination of industrial discharge from nickel converting unit
Investments: € 122 million of own means by 2011
Status: Applied for exclusion from the "hot spot" list (air emission)
Proposed for criteria definition (water discharge)

http://www.barentsinfo.fi/beac/hotspots/
Kozlov e,a., 2009

Table 2.12 Aerial emissions (t) from industrial enterprises at Monchegorsk, Russia

Year	Dust	SO_2	CO	NO_x	Ni	Cu	Co
1960	–	134,000[a]	–	–	–	–	–
1961	–	139,000[a]	–	–	–	–	–
1962	–	136,000[a]	–	–	–	–	–
1963	–	147,000[a]	–	–	–	–	–
1964	–	148,000[a]	–	–	–	–	–
1965	–	200,000[a]	–	–	–	–	–
1966	–	191,000[a]	–	–	–	–	–
1967	–	199,000[a]	–	–	–	–	–
1968	–	76,400[a]	–	–	–	–	–
1969	–	94,000[b]	–	–	–	–	–
1970	–	101,000[b]	–	–	–	–	–
1971	–	117,200	–	–	–	–	–
1972	–	117,200	–	–	–	–	–
1973	7,300	138,700 215,000[b]	–	–	–	–	–
1974	7,300	138,700 259,000[b]	–	–	–	–	–
1975	9,100	259,200	–	–	–	–	–
1976	–	268,000[b] 307,100[c]	–	–	–	–	–
1977	–	253,000[c]	–	–	–	–	–
1978	8,600	254,200 237,000[c]	–	–	–	–	–
1979	8,600	254,200 189,000[b]	–	–	–	–	–
1980	11,800	206,100	200	1,300	3,420[c] 5,600[d]	1,370[c]	–
1981	11,700	204,900 187,000[b]	400	2,900	–	–	–
1982	13,300	239,200	400	3,500	2,970[c] 3,200[d]	1,600[c]	–
1983	15,500	278,200	400	4,000	1,560[d]	2,130[c]	–
1984	19,900	257,200	400	4,000	3,110	2,490	116[b]
1985	17,800	254,500 236,000[b]	400	4,000	3,013	2,420	82[b]
1986	17,600	243,600	1,200	5,100	6,770[c]	5,000[c]	–
1987	17,500	224,400	1,200	5,100	7,480[c]	5,670[c]	–
1988	17,100	212,200	1,200	5,100	2,710[c]	4,110[c]	–
1989	16,600	200,400	1,300 5,400[e]	5,100 5,500[e]	3,100	2,200	100
1990	15,786[f]	232,600	1,200 6,600[e]	5,100 5,600[e]	2,712	1,813	97
1991	15,422[f]	196,200	1,400 9,700[e]	5,100 6,100[e]	2,660	1,739	97
1992	14,147[f]	182,000[b,c]	–	–	2,118[b]	1,456[b]	91[b]
1993	12,528[f]	136,900 145,000[f]	1,300	5,100	1,960	1,049	89
1994	10,206[f]	97,700	900	1,300	1,619	933	82
1995	8,445[f]	129,400	1,000	1,000	1,366	726	56

(continued)

Plate 30 Nickel-copper smelter at Monchegorsk, Russia (2007). Photo: V. Zverev

Table 2.12 (continued)

Year	Dust	SO_2	CO	NO_x	Ni	Cu	Co
1996	7,729[f] 9,800	110,500	2,300	1,000	1,309	699	41
1997	8,092[f]	140,200	1,500	700	1,348	761	37
1998	7,246[f] 8,500	88,600	1,400	700	1,304	873	35
1999	6,016[f] 7,200	46,100	2,000	800	1,128	856	32
2000	9,900	45,800	4,000	1,500	1,216	873	34
2001	9,100	43,900	3,600	1,300	1,200	827	44[b]
2002	7,700	43,900	3,800	1,200	818[f] 910	696	–
2003	7,200	42,100	3,800	800	734[f]	699	10
2004	6,500	37,900	2,900	800	687	580	12
2005	6,500	41,100	2,400	700	501[f]	608	12

Non-referenced values were extracted from Emissions of Pollutants in Russia (1966–2006).
Other data sources:
[a] Alexeyev (1993).
[b] Barcan (2002b).
[c] Mokrotovarova (2003).
[d] V. Nikonov (personal communication, 1998).
[e] Kryuchkov (1993b).
[f] Miroevskij et al. (2001), the data refer to the smelter only.
[f] Severonikel smelter (statistical forms TP-2).

Plate 33 Polluted site (additional) located 4 km W of smelter at Monchegorsk (2007): dead

Kozlov e.a., 2009

Plate 43 Nickel-copper smelter at Nikel, Russia (2006). Photo: V. Zverev

Plate 32 Polluted site (additional) located 8 km NW of smelter at Monchegorsk (2007): dead coniferous stand. This landscape is gradually transforming into industrial barren. Photo: V. Zverev

Plate 35 Polluted site 2-3, located 5.7 km S of smelter at Monchegorsk (2007): industrial barren Note the spatial extent of the disturbed landscape. Photo: V. Zverev

Plate 34 Polluted site 1-2, located 5 km NW of smelter at Monchegorsk (2007): industrial barren. The upper soil horizons (about 20 cm) have been removed by erosion; stunted mountain birches shown in this photo are at least 50 years old. Photo: V. Zverev

M5(5): Kovdorskiy GOK (GOC), Kovdor; Kovdor mining and concentration combined enterprise

2003: It is the second largest, after JSC "Apatit" discharger of industrial waste waters. Since the 1st Report, its discharges increased by 40% including more than doubling of sulphates discharges
Annual production capacity 2.7 M tons of apatite, 5.7 M tons of iron ore and 8.85 M tons of baddeleyite.
wastewater discharged 2003: 45.2 M m3; 2011: 36.8 M m3
Measures planned: Modernisation of wastewater treatment facilities and reduction of wastewater discharges
Investments: 70.4 M rubles (€ 1.75 M) in 2008 of own means; 9.6 M rubles (€ 240 thousand) in 2011.
http://www.barentsinfo.fi/beac/hotspots/

http://companies.globalmarket.com/kovdorsluda-llc-151056.html

Our mining enterprise **Kovdorsluda, LLC** is situated in Kovdor town, Murmansk region, Russia.
Beginning from 1936 our enterprise is in charge with production of alumosilicates, mica of different kinds and grades. We are the leading producer and exporter of phlogopite mica, vermiculate concentrate, pegmatite in Russia. We manufacture raw materials for production of porcelain, ceramics, electro- isolation materials, for production of fire-resistant materials in construction industry, for agriculture, mica plates for metallurgy etc.
The quality of our raw materials is the best in Russia. We have three factories for manufacture of vermiculate, phlogopite and pegmatite. We have possibility to offer plagioklaze also

http://kovdorsluda.com/ru/proizvodstvo/gornyj-tsekh

.

M3(3): Apatit JSC, Kirovsk, PhosAgro Group

2003: Since the 1st Report, industrial emissions increased almost twice, with corresponding increase of all major pollutants. Some increase of wastewater discharge is also documented
Impact, 2003: Emission to air: SO2 – 7.0 thousand t/year; CO – 1.8 thousand t/year; NOX – 3.2 thousand t/year
Discharge to water: n/d

Impact, 2011: Emission to air: SO2 – 6.0 thousand t/year; CO – 0.6 thousand t/year; NOX – 2.3 thousand t/year; Discharge to water: exceeding MAD on specific contaminants
Measures taken: A number of measures implemented to reduce industrial air emissions
Measures planned: Reduction in acidifying compounds and dust emissions; reduction in discharges of organic matter and salts
Investments: 2 million rubles (€ 50 thousand) of own means invested in a wastewater management project in 2011
Status: Proposed for criteria definition and continued actions
http://www.barentsinfo.fi/beac/hotspots/

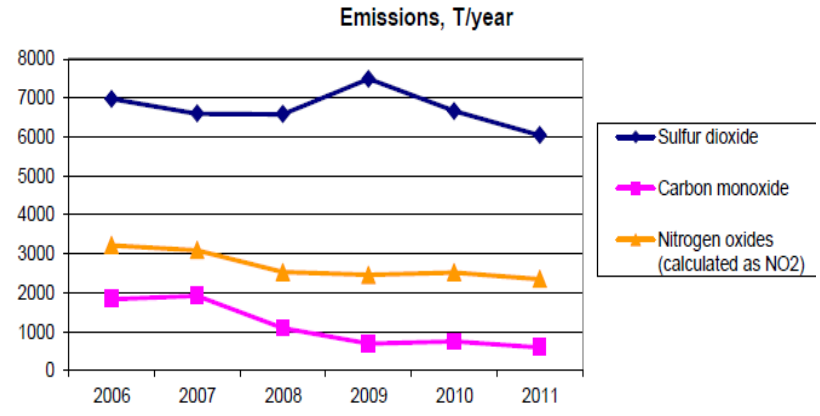


Figure M3.1. Emissions of SO_2, CO and NO_x by Apatit JSC

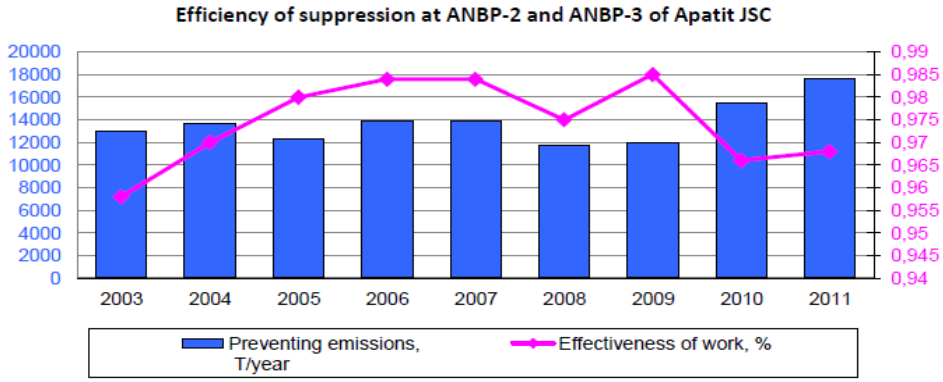


Figure M3.2. Efficiency of dust suppression at ANBP-2 and ANBP-3

Table 2.4 Aerial emissions (t) from industrial enterprises at Apatity, Russia

Year	Dust	SO_2	CO	NO_x
1972	14,600	51,800	–	–
1973	14,600	51,100	–	12,800
1974	14,600	51,100	–	12,800
1975	18,250	51,100	–	12,800
1978	19,500	25,500	–	2,100
1979	17,400	31,300	–	3,300
1980	17,700	31,200	10	3,200
1981	14,400	21,500	200	2,900
1982	13,900	31,800	100	2,500
1983	15,800	30,800	5,000	2,700
1984	19,000	36,900	4,900	2,800
1985	19,700	35,300	5,500	3,300
1986	15,200	31,000	8,300	4,500
1987	16,300	36,400	800	4,500
1988	14,400	30,700	900	4,100
1989	13,800	29,400	600	2,700
			4,900[a]	3,200[a]
1990	16,100	31,900	700	3,500
			9,200[a]	4,400[a]
1991	17,600	28,200	300	3,200
			8,800[a]	4,100[a]
1993	10,200	21,400	700	6,900
1994	7,100	14,600	300	5,600
1995	7,400	11,800	400	5,500
1996	7,300	14,700	200	5,100
1997	8,900	16,200	1,100	5,300
1998	8,600	17,900	700	4,500
1999	8,100	16,800	500	4,200
2000	7,300	16,200	300	4,000
2001	7,200	14,300	300	4,200
2002	5,800	12,000	200	3,900
2003	5,300	7,300	200	3,600
2004	6,000	10,300	100	3,900
2005	5,100	8,200	100	3,300

Non-referenced values were extracted from Emissions of Pollutants in Russia (1966–2006).
Other data sources:
[a]Kryuchkov (1993b).

Kozlov e.a., 2009

The intensive growth of Apatity (from seven inhabitants in 1926 to 4,000 in 1939 and 15,200 in 1959) was associated with the development of the apatite mining and processing industry. The main employer of Apatity is the joint stock company 'Apatit', the largest mining and concentrating enterprise in Europe.

The coal-fired power plant ('Kirovskaya GRES', now named 'Apatitskaya TEC') was launched in 1959 and reached its full capacity in 1961. For the first 2 decades, it mostly produced electricity (up to 37% of the total output of the Murmansk region), but since the late 1970s, it is used almost exclusively for heating the town. The power plant employed 983 people in 2003, but only 520 people in 2005; it achieves peak capacity (80 MWt) during the winter, when daily coal consumption reaches 2,800–3,000 t. In the summer, the daily coal consumption is around 650 t and the capacity is 10 MWt. The station mainly uses coal from Inta, Northern Ural (sulphur content 1.5–1.9%), but sometimes from Spitsbergen or Khakassia (sulphur content 0.7–1.0%).

The power plant is the only local emitter of sulphur dioxide and some metals, such as iron, zinc, chromium, cadmium and lead (Golubeva 1991). The station contributed 99.0% of the sulphur dioxide and 75.4% of the mineral dust to overall emissions of Apatity (summarised in Table 2.4).

Ambient concentrations of pollutants in Apatity have been monitored since 1972; the peak reported values were 1.4 mg/m^3 of dust in 1972 and 1.43 mg/m^3 of SO_2 in 1982 (Emissions of pollutants in Russia 1966–2006). During the period 1987–1989, annual depositions of sulphur and nitrogen in Apatity were 3,100 and 400 kg/km^2, respectively (Vasilenko et al. 1991). Concentrations of chromium, arsenic and lead in the leaves of the speckled alder (*Alnus incana*) in 1992 were below the detection limit (10 mg/kg), even within a few hundred meters of the power plant. Foliar concentrations of nickel, copper and zinc showed no relationship to the distance from the polluter. The peak concentrations of strontium were detected 4–7 km northwest of the power plant and were obviously associated with dust contamination from tailing ponds of the apatite and nepheline-processing factory (located 400–800 m from these sites). Foliar concentrations of iron appeared to be a good measure of pollution load; they exceeded the background level by a factor of 3 within 2 km of the power plant and approached regional background levels at about 5 km (Kozlov 2003). Consistently, soil contamination was detected only within approximately 2 km^2 east of the power plant (Kalabin 1999). On the other hand, from 1986 to 1991 a doubling of pollutant deposition (relative to the regional background) was recorded for the 800 km^2 around Apatity (Prokacheva et al. 1992).

Pollution Loads and the Extent of the Contaminated Territory

Ambient concentrations of pollutants in Jonava have been monitored since 1974; the peak reported values were 4.2 mg/m^3 of dust in 1975, 4.63 mg/m^3 of SO_2 in 1979, 0.34 mg/m^3 of NO_x in 1975, 0.70 mg/m^3 of HF in 1979, and 5.00 mg/m^3 of NH_4 in 1974–1975 (Emissions of pollutants in Russia 1966–2006).

In 1987–1989, annual depositions of sulphur and nitrogen in Jonava were 1,900 and 1,100 kg/km^2, respectively (Vasilenko et al. 1991). However, according to another data source (Armolaitis 1998), total (wet and dry) annual deposition of sulphur at a distance of 1–2 km from the factory in the mid-1980s comprised 5,000 kg/km^2 but was reduced to 1,500 kg/km^2 by the mid-1990s. To our knowledge, pollution loads have never been mapped; at the time of peak emissions (in the mid-1980s), the contaminated zone most likely ranged from 500 to 1,000 km^2.

Habitat Transformation due to Human Activity

Local forest damage was recognised in 1972 and l
since 1979, when crown defoliation in conifers was re
direction of prevailing winds, and complete dieback c
the polluter (Juknys et al. 2003). By 1983, 20 km^2
by pollution (Dauskevicius 1984). Despite essent
(Table 2.7), at the end of the 1980s the forest damage
direction of prevailing winds. Some signs of recovery
(Juknys et al. 2003).

Kozlov e.a., 2009

Plate 1 Power plant at Apatity, Russia (2008). Photo: V. Zverev

M4(4): Apatity Heat and Power Plant of Territorial Generating Company # 1 Kolenergo JSC

Reasons, 2003: HPP in Apatity is the largest air polluter among HPPs in the Murmansk Oblast, which emits 18 500 tons of contaminants, including almost 12 000 of SO2 (84% of total air emissions in the town of Apatity)
Impact, 2003: n/d

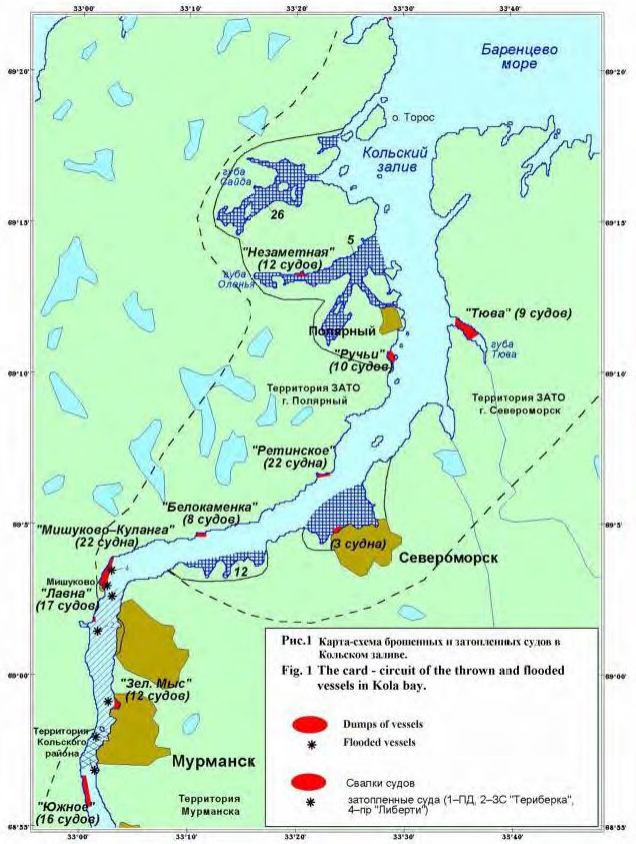
Impact, 2010: Emission to air: SO2 – 11 013 t/year; NOx – 2772 t/year
Measures taken: Equipment modernisation completed (new Venturi pipes installed). In 2000-2006, the Apatity HPP put a system in place on all its active boilers to use spent fire gases in order to desiccate the fuel, thus improving the safety of the fuel preparation process and cutting emissions of nitrogen oxides.Using low-sulphur coal from the Kuznetskoe field,
Measures planned: Introduction of ISO 14001
Status: Applied for exclusion from the "hot spot" list

M6(6): Water quality in the Kola River and Bolshoye Lake

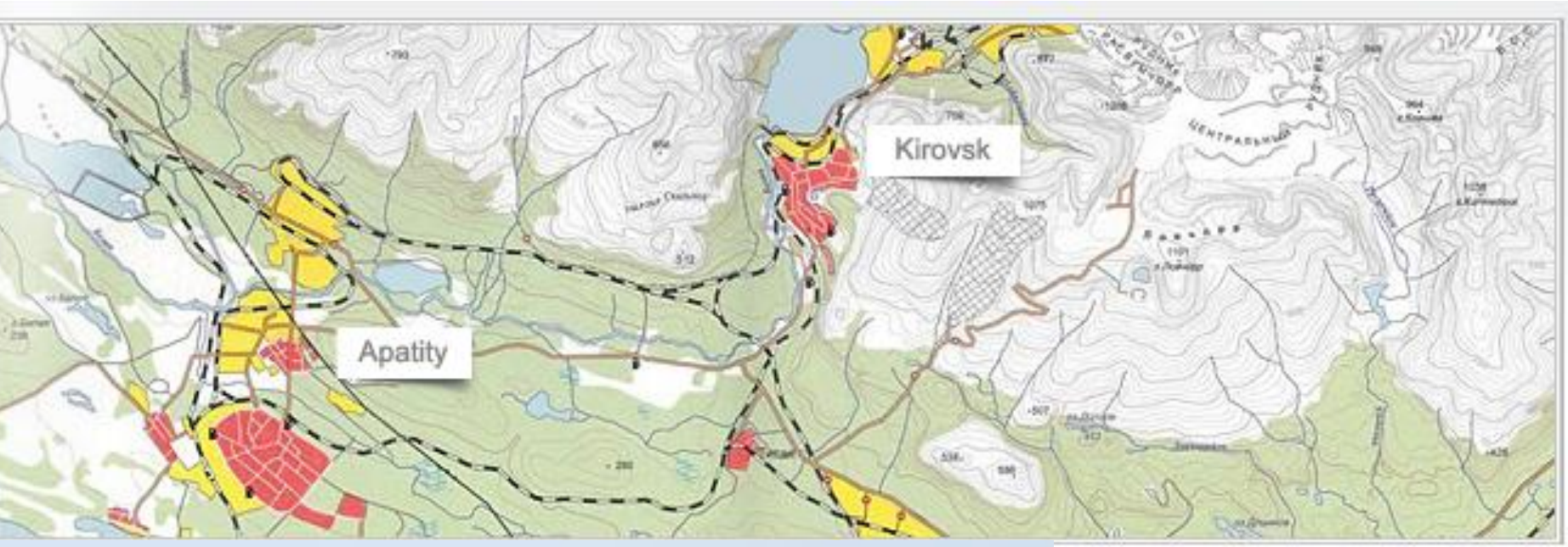
M7(7): Drinking water supply in Zelenoborsky-1 settlement
Knyazhaya village located near Kandalaksha town.

M8(8): Mercury-containing waste management of Ecord Ltd, Kirovs

M9(9): Sunken and abandoned ships in the Kola Bay:
122 scrapped ships located in the Kola Fjord contributing to its pollutio causing economic losses. Measures taken: The dump site near Lavna was partly cleaned (20 ships removed).

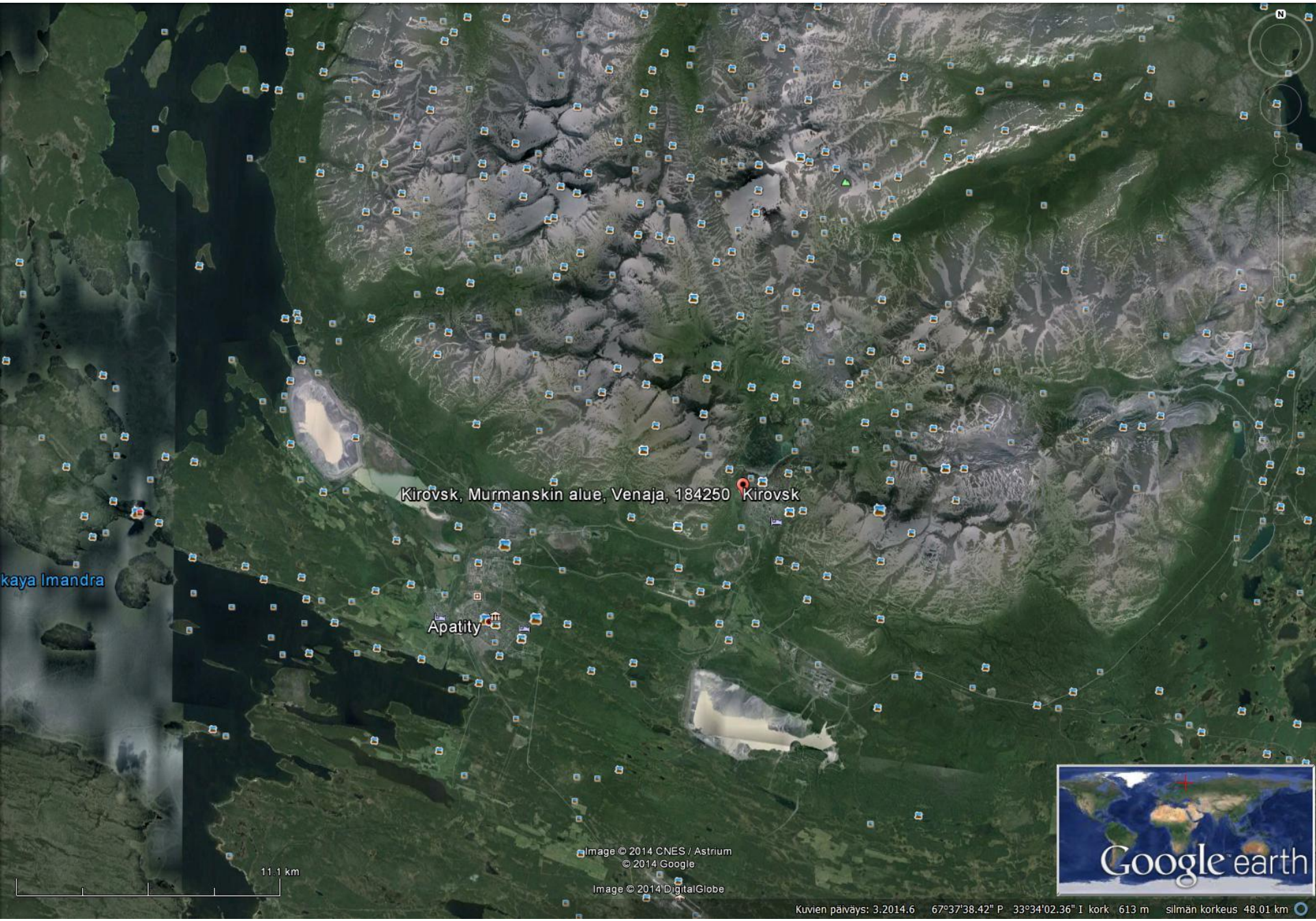


M10(10): Oil-containing waste management: Murmansk company “Arcticeco-A” planned biological treatment of oil-containing slams from the Murmansk and Kola districts with a capacity of 800 t/year using outdated and inefficient technology… http://www.barentsinfo.fi/beac/hotspots/



OLENIY RUCHEY

The mining and processing complex at the Oleniy Ruchey apatite-nepheline ore deposit is being constructed and operated by North-Western Phosphorous Company.


Kirovsk, Murmanskin alue, Venaja, 184250
Kirovsk
kaya Imandra
Apatity
11.1 km
Image © 2014 CNES / Astrium
© 2014 Google
Image © 2014 DigitalGlobe
Google earth
Kuvien päiväys: 3.2014.6 67°37'38.42" P 33°34'02.36" I kork 613 m silmän korkeus 48.01 km

•http://www.szfk.ru/en/ Kirovsk, Oleniu Ruchey deposit on Umba river basin, 67º 41’ North 34º 12’ East, mining and processing for North-Western Phosphorous Company NWPC

APATITY-KIROVSK:
OJSC APATIT, https://www.phosagro.com/about/holding/item636.php

The Apatit mining and beneficiation complex was founded on 13 November 1929 to mine the unique apatite-nepheline ore from the Khibiny deposit.

Business profile: mining and processing of apatite-nepheline ore from the Khibiny deposit, production of phosphate rock and nepheline concentrates, and also other mineral concentrates - syenite, titanite and titanomagnetite.

Apatit today:
Apatit is the world's largest producer of high-grade phosphate ore (P_2O_5 content > 35.7%) – phosphate rock and Russia's only producer of nepheline concentrate.
Apatit is developing six deposits: Kukisvumchorrskoye, Yuksporskoye, Apatitovy Cirque, Plateau Rasvumchorr, Koashva and Njorkpakh.

The ore is extracted from four mines:
Kirovsky, Rasvumchorr (underground mining), Central and Vostochny (open-pit mining), with a combined ore extraction capacity of approximately 26 million tonnes a year.
The ore is processed at two apatite-nepheline beneficiation plants - ANBP-2 and ANBP-3.
High grade ore: phosphate content (in P_2O_5) is as high as 15.1%; aluminium oxide content (Al_2O_3) is 13.6%.
22.05 billion tonnes – apatite-nepheline ore reserves at Apatit's mined deposits. The proven and probable reserves at Apatit's mines will enable the enterprise to maintain production of phosphate ore for more than 75 years (based on current production levels, 2013).
The high quality of the phosphate rock is confirmed by a UPZ 98 01 19674 15 International Certificate.
The enterprise enables PhosAgro to be self-sufficient in phosphate rock for the production of phosphate-based fertilisers.
The resource base contains significant reserves of aluminium oxide (Al_2O_3) and more than 41% of all Russia's reserves of rare earth elements.
In the period from 1929 to 2013 inclusive over 1.83 billion tonnes of apatite-nepheline ore were produced at Apatit's mines, which translates into over 649 million tonnes of phosphate rock and over 66,8 million tonnes of nepheline concentrate.

Kirovsky mine
The combined Kirovsky mine was formed in 1989 from two underground mines – Kirovsky used to mine the Kukisvumchorrskoye deposit since 1929 and Yuksporskoye, which had been mining the deposit of the same name since 1954.

Rasvumchorr mine
The Rasvumchorr mine, operational since 1954, mines the Apatitovy Cirque deposit and the open pit part of the Plateau Rasvumchorr deposit.

Central mine
The Central mine was commissioned in 1964. The mine is located on the Plateau Rasvumchorr 1,050 metres above sea level. The open-pit mine is 3.5 kilometres long and 590 metres deep. The mine was nicknamed Little Antarctica by journalists.

Vostochny mine
Vostochny mine, Apatit's newest mine, celebrated it 34th birthday in February 2012. The mine is located in the southeast part of Khibiny and mines the Koashva and Njorkpakh deposits using the open-pit mines bearing the same names.

Beneficiation plant
The apatite-nepheline ores are processed at the beneficiation plant, which includes ANBP-2, ANBP-3, the Central Laboratory and the Technical Control Department. ANBP-2 was commissioned in 1963, while nepheline production at ANBP-2 commenced in December 1992, ANBP-3 launched, while in 1984 the crushing plant began operating (in 1988 – at full capacity).

PhosAgro is a Russian vertically integrated company and one of the world's leading producers of phosphate-based fertilisers. Its core line of business is the production of phosphate-based fertilisers, high-grade phosphate rock (P2O5>35.7%), and also feed phosphates, nitrogen fertilisers and ammonia.

PhosAgro's primary assets include Apatit, PhosAgro-Cherepovets (established as a result of the merger of Ammophos and Cherepovetsky Azot), Agro-Cherepovets, Balakovo branch of OJSC Apatit, Metachem, PhosAgro-Trans, PhosAgro-Region and NIUIF.

The Company is Europe's largest producer of phosphate-based fertilisers, the world's largest producer of high-grade phosphate rock and the world's second largest producer (excluding China) of MAP and DAP (according to Fertecon), Russia's only producer of feed monocalcium phosphate (MCP), and also the sole producer of nepheline concentrate in Russia.

http://www.phosagro.com/production/

PhosAgro's apatite-nepheline ore reserves are of igneous origin and are characterised by a very low level of heavy metals content, including mercury and lead. Unlike sedimentary deposits, toxic heavy metals are not accumulated during the formation of igneous origin deposits.
The Company's apatite-nepheline ore contains numerous useful elements, such as phosphate, aluminium oxide, titanium dioxide and other rare earth elements, while the content of harmful and hazardous elements, such as cadmium, arsenic, mercury and lead, is very low. Ore from Apatit is characterised by an extremely low level of radioactivity. This enables the Company to process the phosphate rock without any restrictions or additional process stages (and accordingly additional costs) into all types of phosphate-based fertilisers, phosphoric acid, feed, industrial and food-grade phosphates. The concentration of harmful impurities in PhosAgro ore is extremely low. This ensures the high content of useful substances in the concentrate. Phosphate rock produced from ore mined from igneous sources requires less sulphuric acid to produce the quantity of phosphoric acid necessary for the production of phosphate-based fertilisers and other phosphate-based products.

Consequently, the use of phosphate rock facilitates the production of highest-quality products and results in significantly lower processing costs. As a rule, the quality of the phosphate rock is determined by the level of P_2O_5 content. PhosAgro produces high quality and high-grade phosphate rock with 39%-40% P_2O_5 content, whereas the phosphate rock produced by most peers has far lower P_2O_5 content levels of 28%-32%. PhosAgro sell phosphate rock primarily to Russian consumers of complex fertilisers and European producers of food phosphate products and industrial phosphate products, which require phosphate rock with a high nutrient content and low levels of harmful impurities.

PhosAgro is Russia's only producer of Monocalcium Phosphate (MCP), a valuable food additive for livestock and poultry.
Metachem, under the management of PhosAgro AG, is Russia's only producer of granulated high-concentrate chlorine-free potassium sulphate, and also sodium tripolyphosphate – the main raw materials for the production of synthetic detergents.

Production and sales volumes – Apatit mine and beneficiation plant

	Production volumes			Sales volume[1]		
	2013 kmt	2012 kmt	Change y-o-y %	2013 kmt	2012 kmt	Change y-o-y %
Phosphate rock	7,713.0	7,903.6	(2.4)	2,920.50	3,541.80	(17.5)
Nepheline concentrate	990.6	1,056.7	(6.3)	991.50	1,041.30	(4.8)

1. Excluding intra-Group sales.

PhosAgro's ore resources as at 1 January 2014

Deposit	Resources, 000 t (Categories A+B+C1)	Average P_2O_5 content, %
Kukisvumchorr	412,914	14.63
Yukspor	530,488	14.19
Apatitovy Cirque	113,989	14.29
Plateau Rasvumchorr	333,979	12.98
Koashva	599,567	16.88
Njorkpahk	62,875	13.23
Total	**2,053,812**	**14.84**

Phosagro 2013 annual report; http://ar2013.phosagro.com/

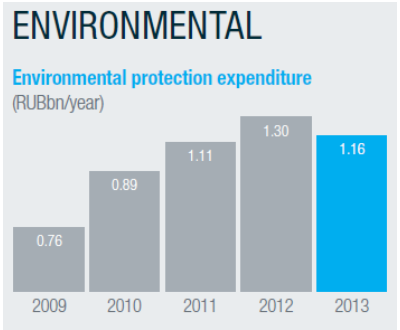
M5(5): Kovdorskiy GOK (GOC), Kovdor; Kovdor mining and concentration combined enterprise
Reasons, 2003: It is the second largest, after JSC "Apatit" discharger of industrial waste waters. Since the 1st Report, its discharges increased by 40% including more than doubling of sulphates discharges
Annual production capacity totals 2.7 million tons of apatite, 5.7 million tons of iron ore and 8.85 million tons of baddeleyite.
Impact, 2003: 45.2 million m3 of wastewater discharged
Impact, 2011: 36.8 million m3 of wastewater discharged
Measures taken: Organisational and technical measures to reduce water use and wastewater discharge
Measures planned: Modernisation of wastewater treatment facilities and reduction of wastewater discharges
Investments: 70.4 million rubles (€ 1.75 million) in 2008 of own means; 9.6 million rubles (€ 240 thousand) in 2011
Status: Proposed to continue actions within the investment programme of the company
http://www.barentsinfo.fi/beac/hotspots/

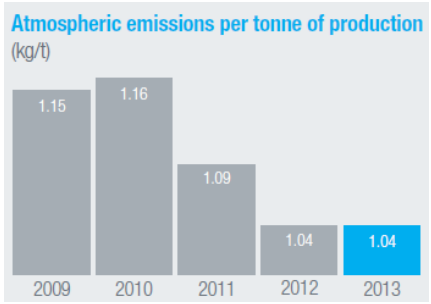
Figure Kozlov e.a., 2009.
Text Barentsinfo

Eurochem, Kovdorskiy GOK

- **an integrated mining and processing facility and is the second largest producer of apatite concentrate in Russia; it is the only producer of baddeleyite concentrate in the world.**
- We mine magnetite-apatite ore, which is high-quality phosphate rock, from our Kovdorskiy GOK mine (P2O5 content of between 37% and 38% with very low cadmium content, it is also the only phosphate mine in the world to be blessed with iron ore and baddeleyite embedded in the same deposit)
- and extract apatite concentrate from the ore at our beneficiation plant.
- We then use the apatite concentrate output as a raw material to produce phosphate-based fertilizers and sell a portion of this apatite concentrate production to third parties.
- We also extract baddeleyite concentrate and produce iron ore concentrate from iron ore extracted from the Kovdorskiy GOK mine to sell to third parties.
- Apatite (high-quality phosphate rock) from our Kovdorskiy GOK mining facility and benefi ciation plant supplies our three phosphate facilities:
- • Phosphorit (Russia)
- • Lifosa (Lithuania)
- • EuroChem-BMU (Russia)
- apatite production, in its current confi guration, is at full capacity.
- In 2013, we completed the first phase of our expansion project by increasing beneficiation capacity from 15 MMT to 18 MMT of magnetite-apatite ore.
- The next phase will see capacity expanded to 20 MMT of ore by 2018.
- A third phase, which could possibly bring capacity to as much as 25 MMT per year, is currently being reviewed.

- VIEREINEN YKSIKKÖ; 5700 KT Fe ore





- EuroChem-Annual-Report-2013-ENG1.pdf
- http://www.eurochem.ru/what-we-do/production/kovdorskiy-gok/?lang=ru#.U_W0nGPivf0

Kovdorsluda, Llc

Company Profile | Other Companies of Machinery & Equipments

Our mining enterprise Kovdorsluda, LLC is situated in Kovdor town, Murmansk region, Russia.
Beginning from 1936 our enterprise is in charge with production of alumosilicates, mica of different kinds and grades. We are the leading producer and exporter of phlogopite mica, vermiculate concentrate, pegmatite in Russia. We manufacture raw materials for production of porcelain, ceramics, electro- isolation materials, for production of fire-resistant materials in construction industry, for agriculture, mica plates for metallurgy etc.
The quality of our raw materials is the best in Russia. We have three factories for manufacture of vermiculate, phlogopite and pegmatite. We have possibility to offer plagioklaze also.
We export our goods to China, Belorussia, Ukraine, Sweden, Finland, Korea, India, France, Belgium, UK, Germany, etc.

Company Type: Manufacturer

Main Products and Service: Pegmatite;phlogopite;vermiculate;Rare Earth & Products

Annaul Business Volume: US$2.5 Million – US$5 Million

Target Market: North America,South America,Eastern Europe,Southeast Asia,Africa,Oceania,Mid East,Eastern Asia,Western Europe<

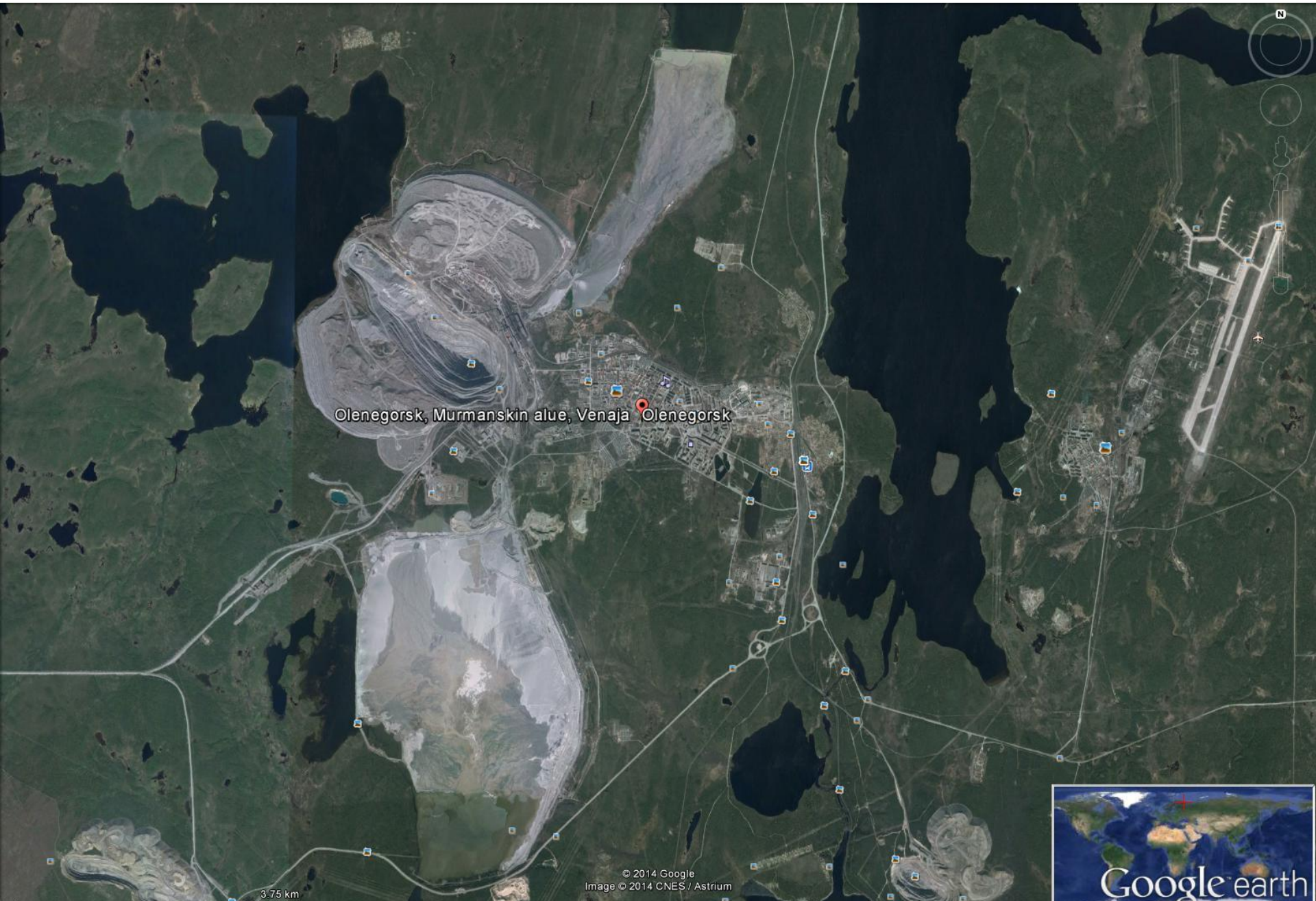
Number of Staff: 501 – 1000 People

Year to Start: 1936

Our company JSC "Kovdorsluda" was established in 1935 on a Kovdor complex phlogopite-vermiculite deposit, since 1964 we also operate pegmatite (quarz-feldspar) deposit.
We supply following materials:
- phlogopite mica (blocks up to 100cm2, scrap 1-35cm2, powder 315 and 630 micron)
- vermiculite concentrate and exfoliated vermiculite (all grades)
- pegmatite (blocks and powdered).
http://jsc-kovdorsluda.tradenote.net/

http://companies.globalmarket.com/kovdorsluda-llc-151056.html

The Olcon Olenegorsk Iron Ore Complex (OAO Olcon) mining and processing plant in Olenegorsk, part of OAO Severstal.
Mines: Kirovogorsky, Professor Bauman, the 15th Anniversary of October, Komsomolsky and Olenegosk; 4.8 mln metric tons of Fe ore in 2008



KANDALAKSHA

Kozlov e.a., 2009

Table 2.8 Aerial emissions (t) from industrial enterprises at Kandalaksha, Russia

Year	Dust	SO_2	CO	NO_x	F-containing dust	HF
1970	–	–	–	–	–	>1,300
1971	–	–	3,100	–	–	1,300
1973	7,300	5,500	1,800	–	–	1,100
1974	7,300	5,500	1,800	–	–	1,100
1975	7,300	5,500	–	–	–	1,100
1978	20,100	5,500	8,300	–	–	1,425
1979	19,400	5,500	8,300	800	–	550
1980	20,100	4,200	7,600	300	–	790
1981	18,000	4,100	7,200	1,500	–	800
1982	23,200	3,700	7,300	300	–	800
1983	23,300	5,200	8,000	500	836	795
1984	23,700	6,600	8,900	200	833	790
1985	9,100	5,500	7,800	300	830	790
1986	8,600	5,200	7,000	200	824	800
1987	8,400	5,000	6,900	900	821	800
1988	8,100	4,700	6,800	200	816	784
1989	8,500	5,200	7,100	300	814[a]	780
			15,500[a]	600[a]		
1990	7,600	4,600	6,600	200	806	660
			8,800[a]	300[a]		775[a]
1991	5,244[b]	3,800	7,500	200	936	659[a]
	9,500		19,400[a]	1,400[a]		
1992	5,193[b]	–	–	–	–	–
1993	5,198[b]	5,800	9,300	600	848	705
	10.800					
1994	5,158[b]	8,700	11,300	800	–	694[b]
	9,400					848
1995	5,126[b]	4,800	7,800	340	–	693[b]
	8,900					848
1996	5,031[b]	5,300	8,100	300	–	688[b]
	9,000					839
1997	4,992[b]	5,100	8,500	300	–	688[b]
	9,700					839
1998	4,946[b]	5,700	8,700	300	–	687
	9,700					
1999	4,950[b]	5,800	8,200	300	–	686
	9,300					
2000	8,400	6,100	7,100	600	–	686
2001	8,400	6,200	7,300	600	–	672
2002	8,200	5,400	7,200	600	–	670
2003	5,400	5,400	7,100	600	–	383
2004	5,000	5,800	7,400	600	–	349
2005	3,800	6,000	6,700	500	–	274

Non-referenced values extracted from Emissions of Pollutants in Russia (1966–2006); emission of CO in 1983 corrected from the reported 800 to 8,000 t – the typing error presumed.
Other data sources:
[a]Kryuchkov (1993b).
[b]Kruglyashov (2001), data refer to the aluminium smelter only.

The industrial development of Kandalaksha started in 1915 with the building of the railway connecting St. Petersburg and Murmansk. The next important events were construction of the Niva hydropower station (completed in 1934) and the mechanical factory (launched in 1936). Building of the aluminium plant started in 1939 but was interrupted by World War II, and the smelter was only commissioned in 1951. Its main products are primary aluminium ingots, aluminium wire rod and billets. Annual production of aluminium in the late 1990s was 63,000 t (US Geological Survey 1999). During the period 2001–2007, the smelter employed 1,400 people and produced 70–75,000 t of aluminium annually (Boltramovich et al. 2003; www.rusal.ru).

The aluminium smelter contributed 70–80% of all aerial emissions reported for the town of Kandalaksha in 1989–1991; in 1993–2000, its share declined to 53–64% (Emissions of pollutants in Russia 1966–2006), in particular due to 'severe pressure from nature protection agencies, up to demand to reduce production of aluminium by 12%' (Kruglyashov 2001). All emissions of both aluminium oxide (around 5,000 t in the mid-1990s; Evdokimova et al. 2007) and fluorine-containing substances (Table 2.8) originate from the smelter. In 2005, the new gas-cleaning system was put into operation, and a further decrease in emissions is expected in the coming years.

Kandalaksha Aluminium factory

Plate 15 Aluminium smelter at Kandalaksha, Russia (2007). Photo: V. Zverev

Kozlov e.a., 2009

Ambient concentrations of pollutants in Kandalaksha have been monitored since 1967; the peak reported values were 1.60 mg/m^3 of dust in 1967, 2.21 mg/m^3 of SO_2 in 1982, 0.43 mg/m^3 of NO_x in 1971, and 1.30 mg/m^3 of HF in 1970. Importantly, high concentrations of HF (0.30–0.50 mg/m^3) were recorded up to 2 km from the smelter in 1971–1973 (Emissions of pollutants in Russia 1966–2006).

A local increase in sulphate deposition from 1979–1983 was detected within approximately 300 km^2 (Kryuchkov & Makarova 1989). However, by the late 1980s–early 1990s, the sulphur-contaminated territories around major industrial centres of the Murmansk region had merged, and no local increase in sulphur deposition near Kandalaksha was detected in the 1990s (Kalabin 1999). In 1987–1989, annual depositions of sulphur and nitrogen in Kandalaksha were 1,000 and 300 kg/km^2, respectively (Vasilenko et al. 1991). The impact of the aluminium smelter on the local geochemistry in the mid-1990s was characterised as 'surprisingly small' (Reimann et al. 1998); however, emissions caused a substantial increase in the pH of both snow precipitation and forest litter (Evdokimova et al. 2005). The peak concentrations of fluorine in soils exceeded the regional background by a factor of 25–30 (Evdokimova et al. 2005).

During the period 1986–1991, a doubling of pollutant deposition (relative to the regional background) was recorded for 250 km^2 around Kandalaksha (Prokacheva et al. 1992). The content of fluorine in forest litter suggests that approximately 500 km^2 have been recently contaminated, with the severely contaminated zone (fluorine content increased by a factor of 6–25 relative to the regional background) limited to 2.5 km from the smelter (Evdokimova et al. 1997, 2007).

Agriculture, Murmansk region

	2007	2008	2009	2010	2011	2012
Agricultural production						
Amount of all agricultural production categories in then-current prices, million RUB.	2102.1	2596.4	2632.2	2938.8	3245.3	3345.1
Agricultural production index, % to the previous year	106.5	103.3	101.6	98.9	101.8	99
Production of the most important agricultural products:						
- all types of mea, live weightt, thousand tonnes	9.1	10.3	10.9	12.6	15.8	19.5
- milk, thousand tonnes	28.1	29.5	29.2	28.1	28.5	27.9
- eggs, million	164	168.5	179.5	144.9	82.4	38.9
Number of cattle and poultry, thousand						
Bovine cattle and poultry, including	8.7	8.6	7.77	7.83	7.8	7.7
Cows	4.2	4.2	3.92	3.91	3.92	3.9
Pigs	44.6	45.8	42.2	49.7	44.5	48
Birds	935.8	935.1	919.9	933.75	723.7	711.4

	2007	2008	2009	2010	2011	2012
Alimentary production, including beverages						
Amount of shipped own-produced goods, performed works and services in then-actual prices, million RUB	-	-	-	23169.5	26104.3	27314.05
Production index, % to the previous year	-	-	-	103.5	97.1	98.1
Production of main alimentary products:						
- meat and byproducts of slaughtered animals, thousand tonnes	-	-	6.4	4.09	4.89	4.9
- whole-milk products (calculated as milk), thousand tonnes	37.1	38.3	37.2	35.1	34.1	32.9
- bread and bakery products, thousand tonnes	37.8	36.2	34.2	33	32.7	30.9
- onshore-produced alimentary fish products, thousand tonnes	44.2	45.5	42.5	-	-	-
- processed and tinned fish and fish products, thousand tonnes	-	-	515.6	553.5	494.6	449,5

http://murmanskstat.gks.ru/

Fish industry

16% of the overall Russian catch. About 90% of fish is processed immediately at sea.

The sector is based upon the fisheries fleet and the onshore complex that includes port facilities, onshore fish-processing enterprises and shipyard companies.

141 organisations employing about 7.4 thousand people are active in fishing, fish farming, processing and tinning fish products and seafood in the Murmansk Region. 105 organisations are active in industrial and coastal fishing.

About 600 thousand tonnes of aquatic bioresources are harvested each year. The annual amount of fish production is 500 thousand tonnes, 60% of the production going to the Russian domestic market.

Industrial fishing, fishery fleet
The Murmansk Region is the leading region in the European Russia in aquatic bioresources harvesting: over 55% of the total catch. Fishery accounts for almost 7% of the gross regional product.Industrial fishing mostly takes place in 200-mile zones of foreign countries under international fisheries treaties and agreements
The fishery fleet of Murmansk region enterprises includes 207 vessels, including: 11 extra large vessels, 11 large vessels, 117 medium-size vessels and 68 small vessels, their average age being 25 years.
Coastal fishing and industrial fishing in inland waters
Over 50 fisheries and individual entrepreneurs are active in coastal fishing in the Murmansk Region. The fleet varies at about 100 vessels of different types.
Port infrastructure
the biggest, the Murmansk port, provides vessel servicing, fuel loading and petroleum storage, moorings, loading and unloading facilities, production storage and selling facilities. 2012 the port received 220 thousand tonnes of fish products which made up about 80% of the total cargo turnover and serviced over 1070 vessel and about 400 rail cars with fish products. The port can potentially service up to 3 m tonnes of cargo per year.
Onshore fish processing About 40 onshore fish processing factories making over 200 production units
Aquaculture: three fish hatcheries, 7 organisations operate in commercial fish farming, the annual breeding amounts to rise to 25–30 thousand tonnes in the medium term. Hugh potential, large water resources.

Leading enterprises and sector associations: Fish industry

All-Russia Association of Fish Producers and Exporters (VARPE).

The non-profit **Union of Northern Fisheries** includes 52 companies with over 5000 employees, 98 vessels in the fleet supplying about 200 thousand tonnes of alimentary fish products to the domestic market, 2.3 million of standard food tins and over 2 thousand tonnes of fish flour.

The Murmansk Regional Union of Collective Fisheries unites 20 enterprise of the fishery complex, 7 of them being agricultural production cooperatives and core enterprises creating jobs for residents of small settlements of the Murmansk Region. 1000 people are employed by the union's enterprises.

The non-profit partnership **North-West Fisheries Consortium** unites 8 companies harvesting and processing fish and crabs and selling the products on the domestic and external markets. The partnership members' fleet includes 14 vessels, 11 being crab-harvesting vessels. The enterprises employ over 800 people.

The Association of Coastal Fisheries and Fish Farms includes 31 enterprises and individual entrepreneurs, among them: 22 fish-harvesting and 6 fish-processing enterprises, 1 coastal infrastructure enterprise and 2 educational institutions. The share of the association members is 52% of the overall catch under the regional coastal quotas. The number of employees of the association's enterprises is about 800 people. The fishery fleet is 30 vessels. The coastal fishing enterprises annually supply no less than 1500 tonnes of live and refrigerated fish in a "from the ship to the shop" scheme.

The non-profit partnership **Union of Shipyards** unites 13 organisations specialising in ship repairs and maintenance for the fisheries fleet vessels and employing over 1500 people.

The Murmansk Trawl Fleet is one of the leading fishery enterprises of the Arctic Basin. The main fishing areas are the Russian economic zone, open areas of the World Ocean as well as 200-mile zones of foreign countries off the coasts North-Eastern, North-Western and Central Eastern Atlantic. The enterprise catches about 170 thousand tonnes of fish, produces up to 150 thousand tonnes of fish products, operates 12 fishery vessel including 5 extra large vessels for oceanic fishing. The total number of employees is 1605.

Performance of the Murmansk Region Fishery Complex

	2007	2008	2009	2010	2011	2012
Catch of the aquatic biological resources, thousand tonnes	550.4	557.2	609	664	623.2	576.6
Alimentary fish products (not tinned) produced on board of fishing vessels, thousand tonnes	462.9	464.5	492.3	-	-	-
Tinned fish and fish products, thousand tonnes	-	-	515.6	553.5	494.6	449.5
Frozen fish, thousand tonnes	338.2	331.6	391.3	429.6	393.3	348.8
Frozen fish fillet, thousand tonnes	6.1	7.7	17.5	20.5	28.7	33.55
Herring, all types of processing, thousand tonnes	70	77.7	79.1	73.4	46.02	41.9

Source: Murmanskstat

http://murmanskstat.gks.ru/

	2009	2010	2011	2012*
Cargo traffic by transport type, thousand tonnes	38434.5	42256.1	41968.5	35780.1
rail	23928	28231	28251.7	28393
automobile	6144.4	5734.1	6730	2496.1
sea	8361.6	8290.6	6986.6	4890.6
air	0.5	0.4	0.22	0.4
Cargo turnover				
Total, m tonne-km	56554.6	57557.7	44360.6	35574.7
Public passenger transport, m people	113.2	110.2	105.4	97.7
rail	1.2	1.0	0.996	1.055
bus	70.5	69.1	65.7	59.2
trolleybus	41.3	39.7	38.3	37.1
sea, thousand	127.4	109.9	66.5	47.1
air, thousand	181.2	242.7	288.5	282.5
Passenger turnover, public transport				
Total, m passenger-km	1559.9	1510.5	1430.1	1356.2

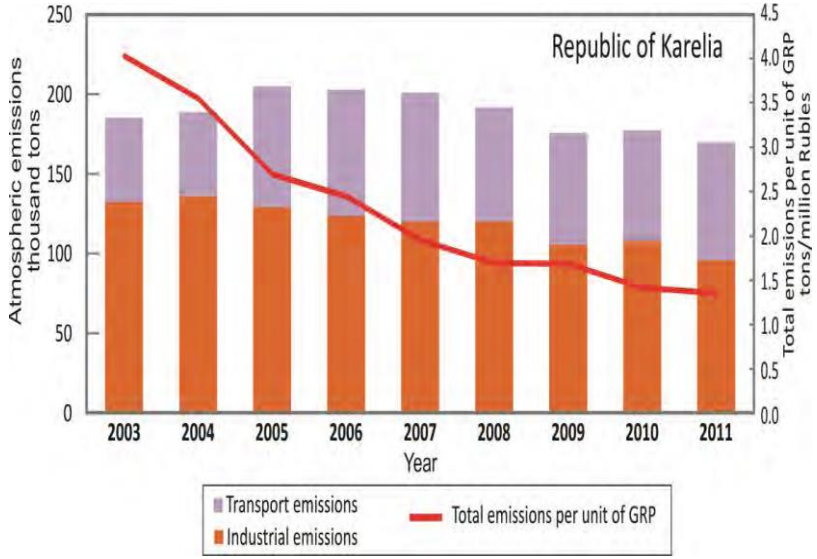
* transported by shipping companies of the Murmansk region

Transport

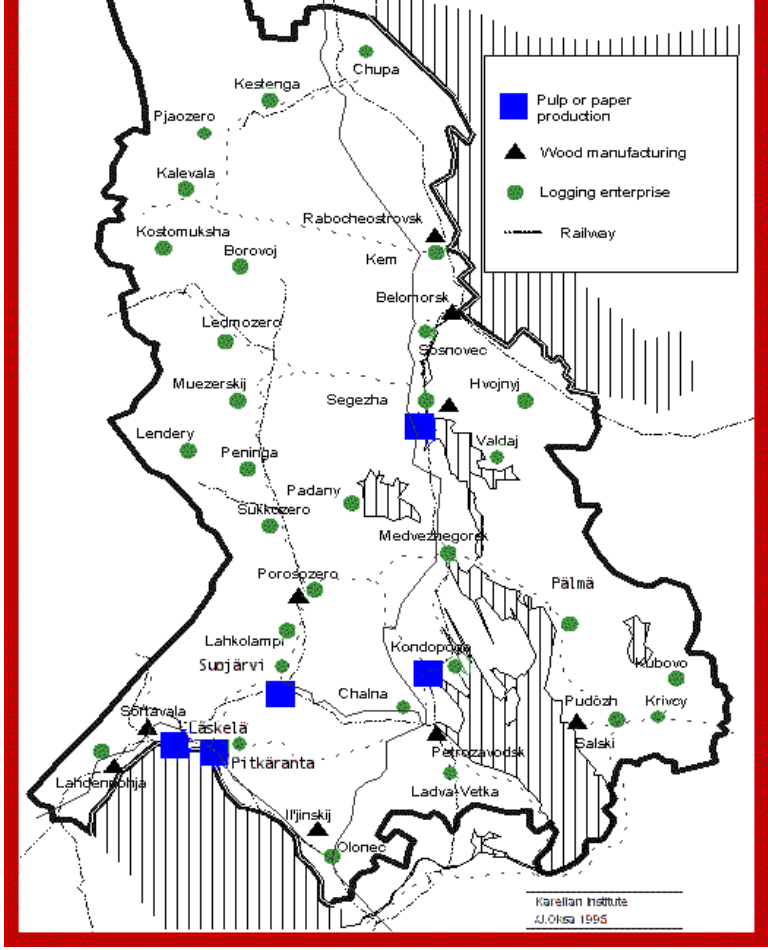
Gateway to the Arctic
non-freezing deep-water
open access to major oceanic routes.
eliable sea, railway, road and air links with I
industrial Russian regions

Port infrastructure
Core Murmansk Port, capable of receiving
vessels of up to 300 thousand tonnes deadwei
any time of the year
infrastructure for receiving, servicing and
repairing vessels
fleet of nuclear icebreakers
general and liquid cargoes, containers, fish
and fish products.
Coal, apatite and iron-ore concentrates,
non-ferrous metals, manganese ore, container
and other cargoes
Kandalaksha and Vitino ports
Development of the Murmansk transport hub
New cargo terminal on the westernshore of the
Kola Bay,
Northern sea route
Eurasian transport corridor
Passenger transport infrastructure: tourist
cruses to the North Pole, islands and
archipelagos of the Central Arctic.
550 thousand passengers /year

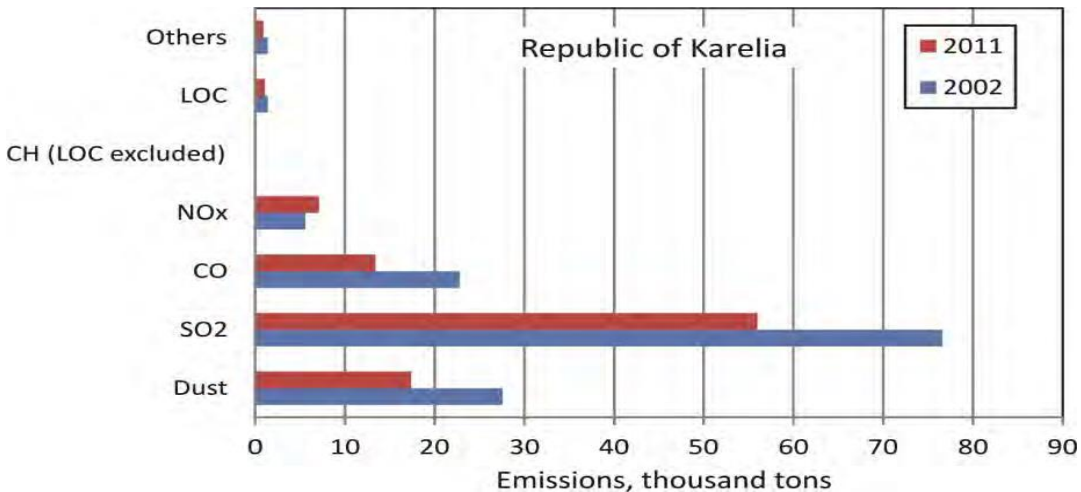
the Republic of Karelia



Atmospheric emissions in the Republic of Karelia in 2003-2011
http://www.barentsinfo.fi/beac/hotspots/
Figure right from Myllylä Yrjö, 2012
http://aluekehitys.internetix.fi/fi/sisalto/05_julkaisut/kyamk2010



The main contribution to the total industrial emissions (77.949 tons) comes from
Karelsky Okatysh JSC,
NAZ-SUAL branch of SUAL JSC,
Kondopoga JSC,
Segezhsky PPM JSC and
CZ Pitkyaranta JSC



The Republic of Karelia comprises 127 municipalities, including 16 municipal districts, 2 town districts, 22 towns and 87 villages.
About 45% of the housing utilities' services account for the heat and hot water supply. The average wear of equipment in the boiler houses exceeds 60%.
Most of the boiler houses in small settlements of Karelia were built for burning coal and heavy fuel oil
The implementation of regional programmes on converting boilers to natural gas and biofuels resulted in a reduction in the shares of coal used from 15.2% in 2005 to 10.5% in 2010, and heavy oil from 27.2% in 2005 to 19.7% in 2010, in the Republic of Karelia's annual fuel consumption

The Republic of Karelia

The Petrozavodskaya CHPP of TGC-1's Karelsky Branch provides about 80 % of consumers' heat in Petrozavodsk.

That being said, 98 % of heat is sold to wholesale buyer-resellers of Petrozavodsk Utility Systems JSC for further delivery to consumers.

Apart from TGC-1, activities for generating electricity and power in Saint Petersburg, the Republic of Karelia, Leningrad Oblast and Murmansk Oblast are also carried out by the Rosenergoatom Concern (represented by the Leningradskaya and Kolskaya Nuclear Power Stations), OGK-2 (represented by the Kirishkaya TPP), as well as Inter RAO – Electrogeneratsiya (the Severo-Zapadnaya TPP Branch), which supplies electricity for export.

K1(11): Kondopoga JSC, Kondopoga pulp and paper combined mill

Reason, 2003: Kondopoga PPCM is responsible for 18% of total industrial air emissions in Karelia. It is the only large polluter in the Republic, which emissions increased since 1995

Impact, 2003: Emission to air: SO2 – 18 635 t/year; CO – 1299 t/year; NOX – 1626 t/year; coal ash – 3534 t/year; fuel oil ash – 11 t/year

Impact, 2011: Emission to air: SO2 – 2374 t/year; CO – 1915 t/year; NOX – 1478 t/year; coal ash – 463 t/year; fuel oil ash – 2 t/year

Measures taken: Modernisation of the heat generation system and change of the company's boiler plants to natural gas instead of coal and fuel oil

Measures planned: Modernisation of sewage treatment facilities and production processes for the reduction of pollutants discharged to water

Investments: 4054 million rubles (approximately € 100 million) of own means

Status: Applied for exclusion from the "hot spot" list

SHE proposed partial exclusion from the list (air emission).

Kondopoga JSC is the largest producer of newsprint in Russia with about 30% share of the country's newsprint production. In 2011, the company produced 769 thousand tons of paper, Including 759 thousand tons of newsprint.

Kondopoga JSC also operates a heat and power plant (HPP) that produces heat and hot water for the town of Kondopoga, and biological sewage water treatment facilities used for both industrial and communal wastewater.

In 2004, the natural gas pipeline to Kondopoga was launched. In the period 2000-2006, five boilers of Kondopoga HPP were converted from burning heavy fuel oil to natural gas. From 2007 to 2011, HPP facilities were modernised and three new boilers on natural gas with a capacity 160 t/hour each were built. This resulted in a reduction of the total air pollution emission from almost 26 thousand tons per year in 2003 to 7 thousand tons per year in 2011, with emissions of SO2 reduced from 18 635 to 2374 t/year and coal ash from 3534 to 463 t/year. In order to mitigate NOX emissions when converting the HPP facilities from burning coal and heavy fuel oil to natural gas, low NOX burners were installed.

K2(12): Nadvoitsy Aluminium Plant, NAZ-SUAL Branch of RUSAL, Nadvoitsy

Annual production capacity of 81 thousand tonnes of aluminium. The smelter uses Söderberg smelting technology. One of the four potrooms operates using prebaked anode technology.

Reason, 2003: The smelter is responsible for 97% of total air emissions in
Nadvoitsy. Emissions from the smelter, particularly of fluorine compounds, create significant human health problems
Impact, 2003: Emissions to air: 6800 t/year
Impact, 2011: Emissions to air: 8876 t/year
Measures taken: Modernisation of the heat generation system and change of the company's boiler plants to natural gas in place of coal and fuel oil
Measures planned: Modernisation of wastewater treatment facilities and production processes for a reduction of pollutants discharged to water
Investments: 144.2 million rubles (approx. € 3.6 million) of own means
Status: Proposed for joint actions

K3(13): Drinking water supply in towns and settlements of the Republic of Karelia

K4(14): Drinking water quality in the water supply system of Petrozavodsk

K5(15): Sewage treatment in Petrozavodsk

K6(16): Sewage treatment in towns and settlements of the Republic of Karelia

K8(18): Waste management in the Republic of Karelia

K9(19): Waste dumping ground Gorelaya Zemlya in north Petrozavodsk

K10(20): Stocks of obsolete pesticides in the Republic of Karelia
(Barents area hot spots)

Table 2.13 Aerial emissions (t) from industrial enterprises at Nadvoitsy, Russia

Year	Dust	SO_2	CO	NO_x	F-containing dust	HF
1978	1,700	12,900	7,200	200	–	360
1979	1,700	12,900	7,200	200	–	360
1980	6,200	–	7,200	200	–	400
1981	4,700	1,500	16,200	200	–	400
1984	5,000	1,500	7,500	100	–	410
1985	4,600	1,500	7,500	100	3,330	400
1986	4,700	1,400	7,500	100	3,330	400
1987	6,100	2,300	5,200	100	4,704	375
1988	5,900	2,300	5,100	100	4,700	373
1989	6,000	2,200	3,700	100	4.487	437
1990	5,700	2,200	3,500	100		
	3,450[a]					
1991	4,300	1,800	3,300	100		
1993	3,900	1,900	3,300	100		
1994	4,100	1,600	4,000	100		
1995	4,100	1,400	3,700	50		
1996	4,100	1,200	3,600	40		
1997	4,000	1,000	3,000	40		
1998	3,400	1,200	3,000	50		
1999	3,500	1,300	3,000	40		
2000	4,300	1,400	3,200	40		
2001	4,300	1,200	3,500	100	–	–
2002	3,400	1,200	2,700	40	–	288
2003	3,000	1,200	2,700	70	–	318
2004	4,200	1,000	2,600	60	–	497
2005	3,000	1,200	2,400	70	–	313

Non-referenced values were extracted from Emissions of Pollutants in Russia (1966–2006).
Other data sources:
[a] Ministry of the Environment of Finland (1991b).

Plate 42 Aluminium smelter at Nadvoitsy, Russia (2008). Photo: V. Zverev

Pollution Loads and the Extent of the Contaminated Territory

Ambient concentrations of pollutants in Nadvoitsy have been monitored since 1978; the peak reported values were 0.30 mg/m³ of SO_2 in 1981, and 0.27 mg/m³ of HF in 1982 (Emissions of pollutants in Russia 1966–2006). In 1990, ambient air monitored 1,200 m north–northwest of the smelter contained on average 0.037 mg/m³ of SO_2, 0.026 mg/m³ of NO_x and 0.0084 mg/m³ of HF, with peak values of 0.15, 0.08 and 0.027 mg/m³, respectively (Ministry of the Environment of Finland 1991b). On the other hand, it was reported (Kozlovich 2006) that ambient fluorine in Nadvoitsy during 2 days of measurements in 2005 was 0.021 and 0.230 mg/m³ (i.e., 4 and 46 times higher than the sanitary limit of 0.005 mg/m³).

A doubled level of pollutant deposition (relative to the regional background) during the period 1986–1991 was recorded for 40 km² around Nadvoitsy (Prokacheva et al. 1992). At the same time, the footprint of the plant had not been detected in the course of mapping of the entire territory of Karelia for sulphur and metal concentrations in green mosses and forest litter (Fedorets et al. 1998).

Kozlov e.a., 2009

Missing hot spot from most of the inventories

The iron ore pellet factory of Karelsky Okatysh, JSC consists of three separate production lines, each line having its own stack for flue gases coming from respective induration furnace.
One of the stacks is furnished with a flue gas desulphurization (FGD) process LIFAC®.
Commissioning tests of the process were done in 1994. The process was never taken into continuous operation anyhow, but it has been staying cold until now.
Recently, new interest has aroused for flue gas cleaning in Kostomuksha, and an evaluation was started to find a cost-effective solution for sulphur removal of the flue gases of induration furnace #

The exhoust gas volume of one stack line is 222 m3n/s with SO2 concentration about 5 g/m3n.
With full capacity it makes 32 kt SO2 in year for one line. The maximum annual emission with this concentration is 96 kt SO2 with 8000 h/v operating hours ..
The operating hours have not been as high; the emissions are assumed to be 30-40 kt SO2 /year

The decision to build the Kostomuksha ore mining and processing enterprise was made in 1969, and a contract with Finnish companies that conducted a substantial part of the work was signed in 1977. Mining of depleted ferruginous quartzite began in 1978, and production of iron-ore pellets (high-grade metallurgical stock) was launched in 1982. Development continued until 1985, when the full capacity had been achieved. In 1993, the enterprise was reorganised into an open joint-stock company, Karelsky Okatysh, which is the principal employer (8,600 persons in 2001) of the town (okatysh.home.spb.ru). In 2004, the company mined 22,320,000 t of ore and produced 7,584,000 t of iron pellets (ru.wikipedia.org).

Kozlov e.a., 2009, above FMI internal data

Emissions Data

Karelsky Okatysh contributed 99.4–99.8% to the total emissions of pollutants at Kostomuksha (Emissions of pollutants in Russia 1966–2006). Only the amounts of gaseous pollutants have been reported (Table 2.10); no data are available on emissions of either metals (with dust) or organic pollutants. However, metal emissions can be roughly estimated from the amount of dust using concentrations reported by Shiltsova and Lastochkina (2004); 6,900 t of dust (emitted in 2000) is likely to contain approximately 350 t of iron, approximately 27 t of zinc, and approximately 0.6 t of copper.

Table 2.10 Aerial emissions (t) from industrial enterprises at Kostomuksha, Russia

Year	Dust	SO_2	CO	NO_x
1987	5,400	61,300	400	2,500
1988	5,100	61,900	400	2,700
1989	4,800	62,500	400	2,700
1990	4,700	62,200	2,200	3,400
1991	5,200	54,700	600	2,500
1992	6,000[a]	60,400[a]	1,300[a]	2,200[a]
1993	5,300	53,100	600	1,600
1994	6,400	48,100	600	1,500
1995	5,000	44,600	600	1,300
1996	6,400	47,400	500	1,200
1997	6,000	32,200	900	1,500
1998	6,400	37,700	900	1,600
1999	6,900	34,400	1,000	1,300
2000	6,900	30,200	1,100	1,300
2001	6,500	30,000	1,200	1,400
2002	6,400	32,700	1,300	1,400
2003	6,600	33,500	1,300	1,400
2004	6,400	35,400	1,200	1,400
2005	6,100	36,500	1,400	2,100

Non-referenced values extracted from Emissions of Pollutants in Russia (1966–2006).
Other data sources:
[a] Krutov et al. (1998).

Plate 24 Iron pellet plant at Kostomuksha, Russia (2006). Photo: V. Zverev

Kozlov e.a., 2009

http://books.google.fi/books?id=LMkeLcaGrtEC&pg=PA35&lpg=PA35&dq=Kandalaksha+Aluminium+factory+production+emissions&source=bl&ots=T1UsJUwE4_&sig=XnimaHLI98h7wSu0AzO7Dq0C6NM&hl=en&sa=X&ei=7tUFVIWsGcfnygOw0oHwCA&ved=0CCEQ6AEwAA#v=onepage&q=Kandalaksha%20Aluminium%20factory%20production%20emissions&f=false

Kostomuksha is a town district with a population of 29 000 people (Kareliiastat 2011, 121). The town district of Kostomuksha includes the town of Kostomuksha with 28 400 inhabitants (Kareliiastat 2011, 122), the village of Voknavolok (with a population of approximately 500 people) and a number of tiny villages: Ladvozero, Sudnozero, Ponanguba (Kostomuksha 2003, 4; Kareliiastat 2011, 19). The town of Kostomuksha is the fourth largest town in the Republic of Karelia (Federal State Statistics Service 2011b). It is the second most urbanised district in Karelia with 98.1% of its population living in an urban area. Only the capital of the Republic of Karelia Petrozavodsk is more urbanised with a 100% urban population. The share of the urban population in other districts varies from 92 to 25% (Kareliiastat 2011, 125).

The area around Kostomuksha is, however, rural and sparsely populated. While the average population density in the Republic of Karelia is 3.6 people per sq. kilometre (Kareliiastat 2011, 8) and 7.2 persons in Kostomuksha (Kareliiastat 2011, 19), the neighbouring districts Loukhi, Kalevala and Muezerskii have the lowest population densities in Karelia – less than 1 person per sq. kilometre (Kareliiastat 2011, 124).

Kostomuksha was founded in 1977. In 1983 it received the status of a town.

In 1993 the Kostomuksha mining combine was privatised and renamed Karelskii Okatysh. The town has remained highly dependent on the mining combine. In 2008 the share of ferrous metallurgy in the town's industrial output was 86.5% (Administration of Kostomuksha 2009). The same year, the sector

See also http://epublications.uef.fi/pub/urn_isbn_978-952-61-1390-6/urn_isbn_978-952-61-1390-6.pdf. Progrohova E., 2014

K7(17): Heat and power plants burning fuel oil and coal in the Republic of Karelia
(Barents hot spots)
Reason, 2003: For production of heat during heating season, one boiler (type PTVM-30) needs 14.8 thousand tons of boiler oil. It forms 0.82 thousand tons of SO2

Impact, 2003: Emissions of contaminants to air from stationery sources of:
K7-1: Petrozavodskmash – 1563 tons (Atomenergomash Group – the machine-building division of Rosatom State Corporation – is one of the largest machine-building enterprises in Russia.

K7-2: Olonets – 1358 tons
K7-2: Muezersky – 0.161 tons
K7-3: Suoyarvi – 2164 tons

Impact, 2011: Emission of contaminants to air from stationery sources of:
K7-1: Petrozavodskmash – 40 tons
K7-2: Olonets – 1476 tons
K7-2: Muezersky – 0.003 tons
K7-3: Suoyarvi – 1493 tons
Measures taken: Petrozavodskmash JSC converted its boilers from heavy fuel oil to natural gas in 2009. In Muezersky district, the municipal boiler house in Ledmozero village was converted to biofuel – timber waste.
Measures planned: In Suoyarvi district, there is a plan to reconstruct the fuel oil boiler house in Veshkelitsa village and build a new boiler house (25 MW) in Suoyarvi burning local biofuel – wood, sawdust, peat.

In Olonets district, a new automated heating plant on liquid fuel is due to be constructed in 2013. There is also a plan to build a heat and power plant (20 MW) on peat in Olonets.

In Muezersky district, there is a plan to construct a mini-heating and power plant (0.015 MW) in Kimovaari village.
Investments: 125.5 million rubles (€ 3.1 million) invested in local biofuel production in 2007-2010
Status: K7-1 proposed for exclusion from the "hot spot" list. Other "hot spots" proposed for joint actions

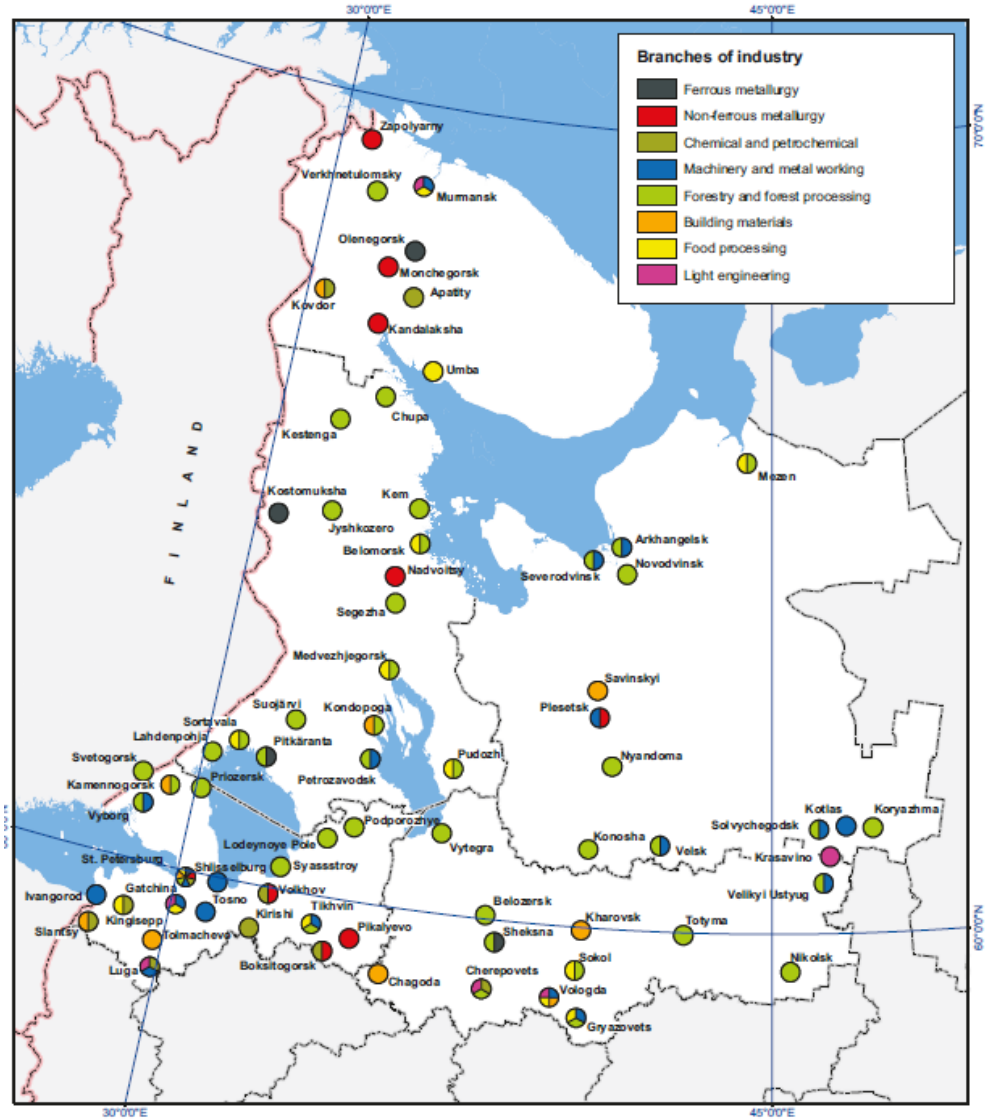
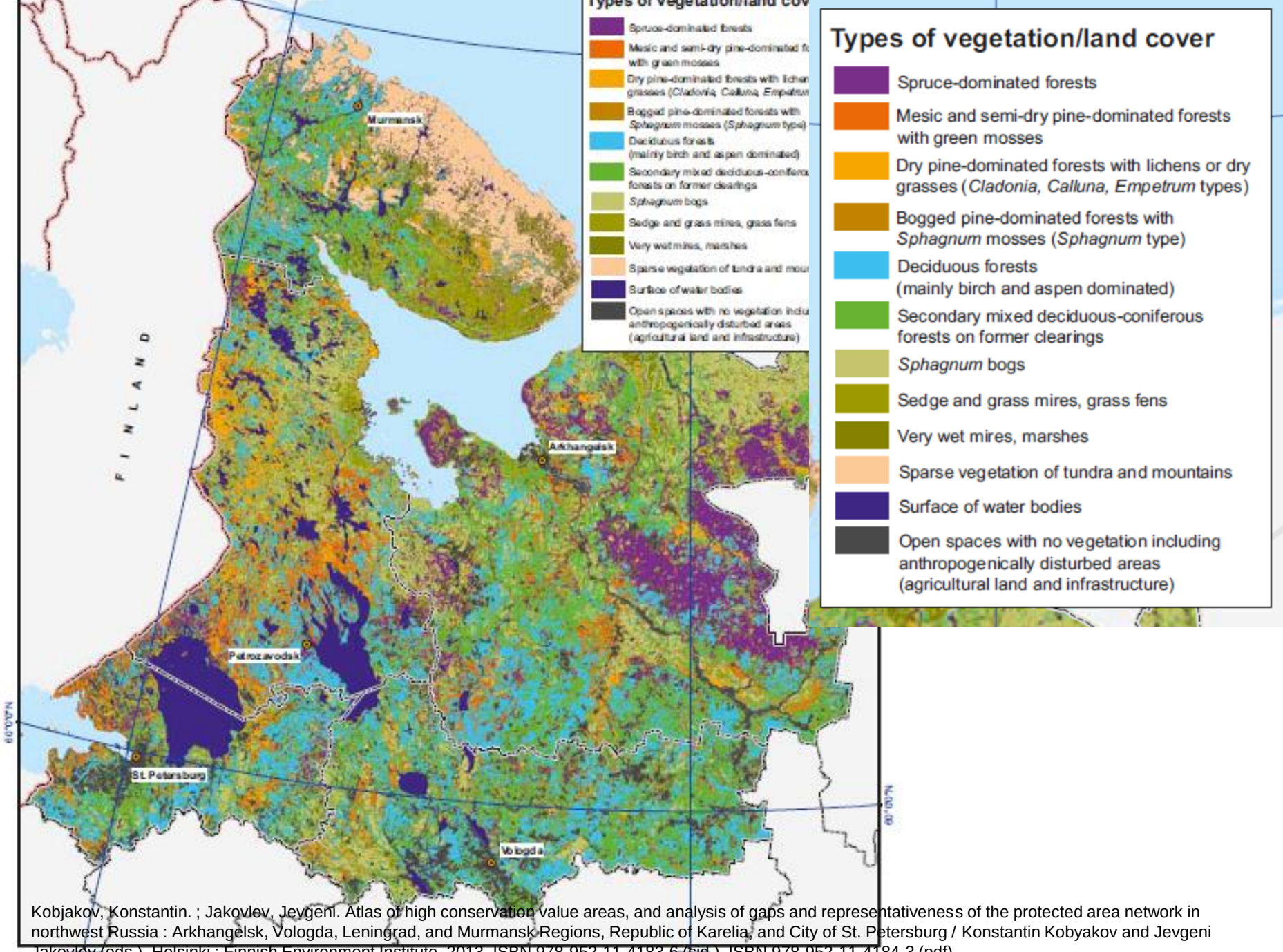


Fig. I.8. Industrial centers in northwest Russia.

http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1140076462969

Atlas of high conservation value areas, and analysis of gaps and representativeness of the protected area network in northwest Russia : Arkhangelsk, Vologda, Leningrad, and Murmansk Regions, Republic of Karelia, and City of St. Petersburg / Konstantin Kobyakov and Jevgeni Jakovlev (eds.).
Helsinki : Finnish Environment Institute, 2013 (Helsinki : Edita Prima Oy), 517 p.



Kobjakov, Konstantin. ; Jakovlev, Jevgeni. Atlas of high conservation value areas, and analysis of gaps and representativeness of the protected area network in northwest Russia : Arkhangelsk, Vologda, Leningrad, and Murmansk Regions, Republic of Karelia, and City of St. Petersburg / Konstantin Kobyakov and Jevgeni Jakovlev (eds.). Helsinki : Finnish Environment Institute, 2013. ISBN 978-952-11-4183-6 (sid.), ISBN 978-952-11-4184-3 (pdf)

Fig. 2.6. Map of vegetation types, after semi-automatic interpretation of Landsat satellite images.

St. Peterburg and Leningrad Oblast

HELCOM list of hot spots:
No. 14 Syaskiy Pulp and Paper Mill (PPM) http://syas.ru/er
No. 15 Volkhov Aluminium Plant - Metankhim Ltd
1) Branch VAZ-SUAL of the OJSC SUA
2) Metakhim Ltd
3) Parosilovoe hozyaystvo Volkhov Ltd (Energy production)
Kirishi oil refinery

http://eng.lenobl.ru/economics/industry

	NOx		SOx		PM 2.5	
	2010	2011	2010	2011	2010	2011
St. Petersburg, tousend of tons						
traffic	37.5	36.2	2.2	2.4		
industry	21.6	23.9	6.5	7.1	1.6	1.9
ships	5.85	9.6	0.52	0.6		
total	65	69.7	9.22	10.1	1.6	1.9
Leningrad Oblast, tousend of tons						
industry	19.4	16.4	30.4	25.5	17.6	13.9

Leningrad Oblast main point sources (total 15)

t SO2 and NO2	lat	lon	SO2	NO2
Kirishi	59.47	32.03	15100	7110
Sjastroi	60.17	32.57	1000	500
Kingisepp	59.38	28.58	2000	600
Olhava	59.90	32.37	200	400
Svetogorsk	61.12	28.87	150	1280
Viipuri.	60.72	28.75	933	500
Kamenogorsk	60.97	29.07	200	100
Lesogorsk	60.97	28.93	200	150
Sovetski,Johannes	60.55	28.72	700	700
Pikalevo	59.53	34.17	200	500

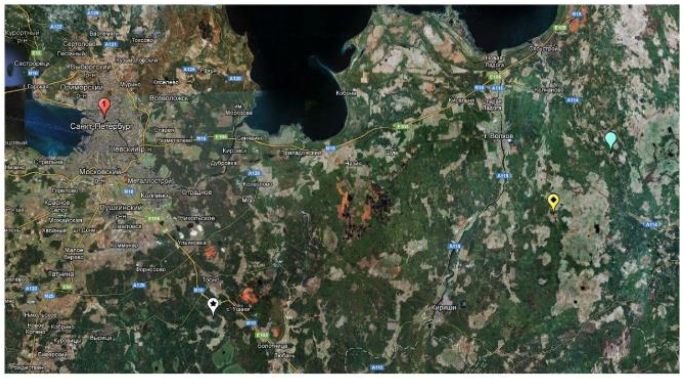


Figure 1. Hot Spots of St. Petersburg and Leningrad Region:

No.18. (sub-hot spots 18.1-18.19). Municipal wastewater treatment in St. Petersburg

No. 23 Hazardous Waste Landfill - State Unitary Nature Conservation Enterprise (SUNE)
- Krasny Bor Landfill

No. 15 Volkhov Aluminum Plant (Metankhim Ltd.)

No. 14 Syaskiy Pulp and Paper Mill (PPM)

No. 24 Large livestock farms (sewage water treatment and sediment processing)

Plate 61 Aluminium smelter at Volkhov, Russia (2008). Vegetation is not dead (compare with Plate 63); this picture was taken in late autumn. Photo: V. Zverev

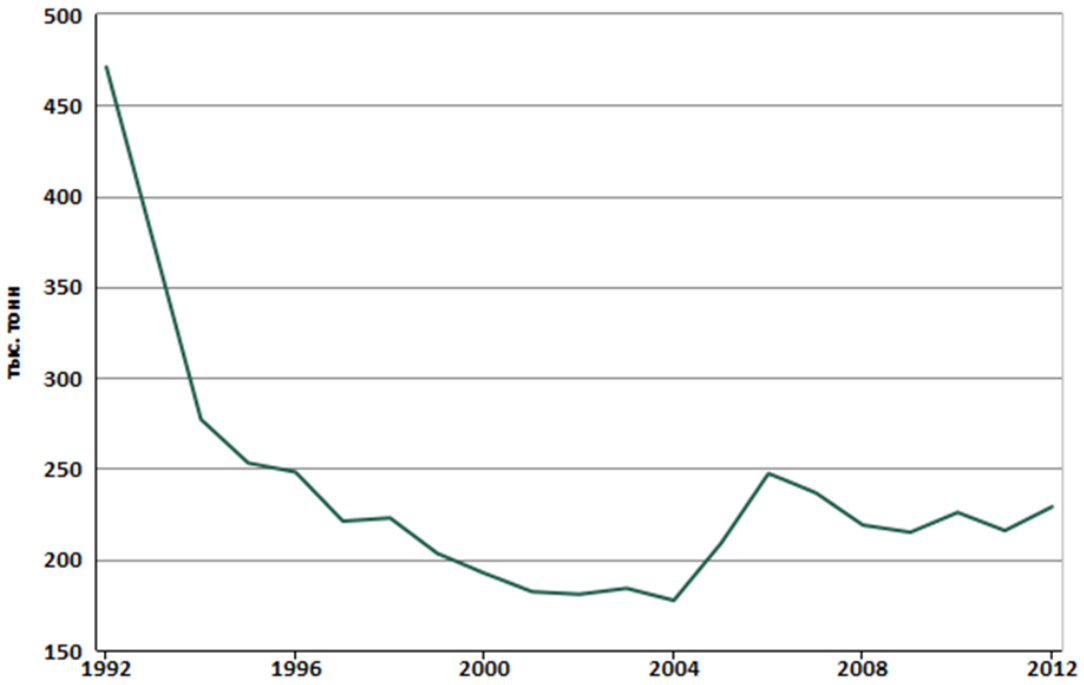
Leningrad Region - Emissions of air pollutants from static sources

228.9

(Thousand tonnes)
in 2012

Emissions of air pollutants - emissions of air pollutants, which have adverse effects on human health and the environment, from stationary and mobile sources of emissions.

Compare | Export | Explore data | Embed | View Ranking | View Map



Date	Value	Change, %
2012	228.9	6.08 %
2011	215.8	-4.42 %
2010	225.8	5.08 %
2009	214.9	-1.80 %
2008	218.8	-7.51 %
2007	236.6	-4.31 %
2006	247.2	18.33 %
2005	208.9	17.79 %
2004	177.4	-3.62 %
2003	184.0	1.82 %
2002	180.7	-0.77 %
2001	182.1	

Source: Регионы России: Население, территория, здравоохранение, экология

http://knoema.com/atlas/Russian-Federation/Leningrad-Region/Emissions-of-air-pollutants

Ref to previous page
http://www.internationalpaper.com/EMEA/EN/Company/Facilities/Svetogorsk.html.
Kingisepp chemical, glass, and food industries; Slantsy sementtiotehdas puuttuu

http://eng.lenobl.ru/economics/industry

THE CHEMICAL AND PETROCHEMICAL INDUSTRY

The chemical and petrochemical industry includes 13 large and medium-sized enterprises, the largest of which are listed below

- OAO Fosforit;
- OAO Era;
- OAO Volkhov Chemical Plant;
- AO Khimik;
- OAO Lesogorsk Factory;
- Zavod Imeni Morozova State Enterprise.

The assortment of industrial product is quite wide. In 1999, the production volumes were as follows:
sulfuric acid, 665,000 tons; soda ash, 163,400 tons; mineral fertilizers, 197,500 tons; synthetic resins and plastic masses, 7,300 tons.

THE CONSTRUCTION MATERIALS INDUSTRY

The construction materials industry of the Leningrad Region includes quarries of natural construction materials, such as ceramic clay, fireproof clay, limestone, dolomite, crushed rock, sand, and gravel, as well as factories that produce cement, lime, clay, construction ceramics, slate, roofing, brick, and concrete and ferroconcrete construction. The industry includes 35 large and medium-sized enterprises.

In 1999, the production volumes were as follows: cement, 1.5 M tons 1999, ~4 Mt 2010 (Slanzy Cessla 0.8 Mt/2010); construction brick, 114 million pieces; ferroconcrete constructions, 89,100 cubic meters; ceramic facing tile, 3.4 million square meters; non-metallic construction materials, 8.7 million cubic meters.

ENGINEERING AND METAL PROCESSING

The engineering sector of the Leningrad Region includes over 60 large and medium-sized enterprises, which produce a wide assortment of industrial and technological products.

The main corporations in the engineering sector are listed below:

- The Transmash Plant;
- The Luga Abrasive Plant;
- The Tosno Bus Plant;
- Burevestnik;
- Ladoga, and a number of other enterprises.

THE FUEL AND ENERGY SECTOR

The electric power sector:

The Leningrad atomic power plant (LAES) produces almost 60 percent of the power that the region needs.

OAO Lenenergo is the operating company. Its largest source of electric energy is the Kirishi Main Regional Power Plant

.THE OIL REFINING SECTOR:

The Kirishinefteorgsintez (subsidiary of Surgutneftegaz) plant is one of the largest oil refineries in Russia.

The shale industry:

OAO Leningradslanets. This plant also produces and sells limestone facing tile, anchor chains, spare parts for mining equipment, and other products

The Slantsy Plant does shale processing. It produces shale oil, mastic, oil polymer resins, heat, and electric energy, and fires coke.

THE PEAT INDUSTRY:

There are 18 peat enterprises employing 2,500 people in the Leningrad Region.

The gas sector:

Natural gas is supplied from the United Gas Supply System of Russia. The gas supplying organization is LENTRANSGAZ, and the distributing organizations ar

OAO Lenoblgaz and OAAT Gatchingaz, which also provide for liquefied gas supplies. The gas distributing organizations include 13 inter-district enterprises which have their own balance sheets. These enterprises have 42 production and technical facilities and 15 emergency and dispatching services.

LIGHT INDUSTRY

The light industry of the Leningrad Region includes 22 large and medium-sized enterprises. The sector leaders are listed below:

- OAO Uzor;
- OAZT Luzhsky Trikotazh;
- ZAO Volkhovchanka;
- OAO Ivteks.

The light industry mainly produces fabrics, non-woven materials of fabric type, knitted goods, and clothing.

THE LUMBER SECTOR

THE METALLURGIC SECTOR

The development of the metallurgic industry is directed by three large enterprises that are listed below.

- OAO Glinozyom Pikalyovo Plant;
- OAO Volkhov Aluminum;
- OAO Boksitogorsky Glinozyom.

Small Business Development

There are almost 13 thousand small enterprises on the territory of the Leningrad Region. 128.7 thousand people are employed by this thriving sector of the regional economy (in 2003 - 121.6 thousand people). According to the Tax Ministry of the Russian Federation, by January 1, 2005 the number of individual small businessmen registered on the tax account of the Leningrad Region was 51,343 people. The Leningrad Region is second only to Saint Petersburg among the subjects of Northwest federal district in the number of small enterprises and people employed in their operation. In total, 23% of the working age population of the region is employed in small business (including the registered farms - 6032 units).

FOREST SECTOR etc

http://syas.ru/eng/ Sjasski pehmopaperi
Pikalevo Al factory
Kingisepp
Olhava Al-sulatto, kemia-, rakennustarvike- ja elintarviketeollisuutta
Svetogorsk
Viipurin sellutehdas, Johannes; pellettitehdas 1M t /yr pellett plant
Kamenogorsk
Lesogorsk; Jääski, yhdistetty ENSOON 2010, Sveto
Läskelän sellu- ja paperi
Kommunar sama
Ilim pulp konserni: Pietarin kartonkitehdas, omistaa pietarin sellu

Table 2.20 Aerial emissions (t) from industrial enterprises at Volkhov, Russia

Year	Dust	SO_2	CO	NO_x	HF
1971	–	8,750	–	–	730
1972	–	8,750	–	–	730
1973	–	10,950	–	–	730
1974	–	10,950	–	–	730
1975	–	10,950	–	–	730
1978	9,300	4,600	–	300	240
1979	9,300	4,600	2,300	800	330
1980	9,400	2,600	2,800	900	280
1981	8,900	2,500	2,500	800	222
1982	8,100	2,500	2,800	900	400
1983	9,400	2,900	3,200	1,100	369
1984	7,500	3,000	3,900	900	410
1985	6,700	2,900	2,400	800	320
1986	6,000	3,800	2,300	1,100	360
1987	5,000	3,600	2,100	1,200	250
1988	6,200	3,600	2,100	1,200	–
1989	4,900	3,000	2,000	1,100	378
1990	4,100	2,700	1,200	800	375
	1,816[a]	1,818[a]	1,318[a]	296[a]	162[a]
1991	2,800	2,900	1,900	900	238
1992	2,856[b]	2,388[b]	1,644[b]	–	253[b]
1993	2,300	2,600	1,500	600	133
1994	1,700	1,400	1,400	400	22
1995	1,400	2,900	1,100	300	7
1996	300	1,300	1,200	200	18
1997	200	1,300	900	100	22
1998	200	1,500	1,200	300	16
1999	200	1,600	1,300	300	16
2000	700	1,300	1,500	300	19
2001	719[b]	556[b]	1,600	200	16
	800	600			
2002	2,308[b]	938[b]	1,400	400	16
	2,400	1,500			
2003	2,400	1,500	1,400	400	15
2004	2,600	1,100	1,800	300	26
2005	2,000	1,000	3,100	300	24

Non-referenced values were extracted from Emissions of Pollutants in Russia (1966–2006).

Other data sources:

[a]Ministry of the Environment of Finland (1991a), data refer to the aluminium plant only.

[b]HELCOM (2004), data refer to the aluminium plant only.

Kozlov e.a., 2009

ENERGY SECTOR

TGC-1 production capacities as of 31 December 2012

Name	Installed electric capacity, MW	Installed heat capacity, GCal/h	Available capacity, MW	ICUF (for electric capacity)*, %	Fuel (main / reserve)
Nevsky Branch					
Central CHPP	75.5	1,340.0	75.5	61.3	Gas/Fuel oil
Pravoberezhnaya CHPP	180.0	1,120.0	180.0	67.0	Gas/Fuel oil
Vasileostrovskaya CHPP	135.0	1 213.0	135.0	61.6	Gas/Fuel oil
Dubrovskaya CHPP	142.0	185.0	140.0	14.5	Gas/Fuel Oil, Coal, Peat
Pervomayskaya CHPP	524.0	1,477.0	460.0	46.6	Gas/Fuel oil
Avtovskaya CHPP	321.0	1,849.0	321.0	49.2	Gas/Fuel oil
Vyborgskaya CHPP	278.0	1,110.0	278.0	35.0	Gas/Fuel oil
Severnaya CHPP	500.0	1,188.0	500.0	51.0	Gas/Fuel oil
Yuzhnaya CHPP	1,175.0	2,480.0	1,200.0	56.7	Gas/Fuel oil
Ladoga HPPs Cascade	345.0	-	260.4	54.8	-
Narvskaya HPP	124.8	-	124.8	58.7	-
Vuoksa HPPs Cascade	226.8	-	226.8	63.5	-
Total for Nevsky Branch	**4,027.1**	**11,962.0**	**3,901.5**	**51.9**	-
Karelsky Branch					
Petrozavodskaya CHPP	280.0	689.0	251.0	49.1	Gas/Fuel oil
Vyg HPPs Cascade	240.0	-	164.2	54.8	-
Kem HPPs Cascade	330.0	-	160.6	54.3	-
Suna HPPs Cascade	50.6	-	39.7	69.9	-
Smaller HPPs group	13.1	-	10.8	74.2	-
Total for Karelsky Branch	**913.7**	**689.0**	**626.3**	**54.0**	-
Kolsky Branch					
Apatitskaya CHPP	323.0	735.0	239.0	13.7	Coal
Niva HPPs Cascade	569.5	-	564.3	63.2	-
Paz HPPs Cascade	187.6	-	187.6	66.3	-
Tuloma HPPs Cascade	324.0	-	324.0	43.4	-
Serebryansky HPPs Cascade	513.5	-	511.5	29.7	-
Total for Kolsky Branch	**1,917.6**	**735.0**	**1,826.4**	**42.8**	-
Total for TGC-1	**6,858.4**	**13,386.0**	**6,354.2**	**49.7**	-
Murmanskaya CHPP	12.0	1,111.0	12.0	16.1	Fuel oil
Total for TGC-1 with Murmanskaya CHPP	**6,870.4**	**14,497.0**	**6,366.2**	**49.6**	

http://www.tgc1.ru/fileadmin/ir/Reports/Annual/2012/tgc_annual_en_2012.pdf

Installed capacity in 2012:

- decreased at the Dubrovskaya CHPP due to the decommissioning of turbine unit no. 1 with an installed capacity of 50 MW;
- changed at the Pervomayskaya CHPP due to the decommissioning of turbine units no. 1, 2, and 7 with a total installed capacity of 110 MW and the commissioning of a CCGT-180 unit with a capacity of 180 MW;
- increased at the Lesogorskaya HPP of the Vuoksa HPPs Cascade by 6 MW due to the remarking of hydroelectric unit no. 3 following modernization;
- increased at the Svetogorskaya HPP of the Vuoksa HPPs Cascade by 7.25 MW due to the remarking of hydroelectric unit no. 4 following modernization.

Available capacity in 2012:

- decreased at the Dubrovskaya CHPP due to the decommissioning of turbine unit no.1;
- increased at the Volkhovskaya HPP of the Ladoga HPPs Cascade due to the decrease in seasonal restrictions;
- increased at the Lesogorskaya HPP of the Vuoksa HPPs Cascade due to the remarking of hydroelectric unit no. 3 following modernization

Installed electric capacity utilization factor in 2012, %

	CHPPs	HPPs	HPPs+CHPPs
Nevsky Branch	50.6	58.3	51.9
Karelsky Branch	49.1	56.2	54.0
Kolsky Branch	13.7	48.7	42.8
TGC-1	**47.5**	**52.6**	**49.7**
Murmanskaya CHPP	16.1	-	16.1

Electricity generation by TGC-1 power plants in 2011 – 2012, thousand kWh

	2011	2012
Karelsky Branch		
Petrozavodskaya CHPP	1,059,924	1,207,749
Vyg HPPs Cascade	1,026,717	1,155,407
Kem HPPs Cascade	940,249	1,575,201
Suna HPPs Cascade	179,182	310,879
Smaller HPPs group	66,046	85,344
Total for Karelsky Branch	**3,272,118**	**4,334,579**
Kolsky Branch		
Apatitskaya CHPP	393,530	387,930
Niva HPPs Cascade	2,898,392	3,160,256
Paz HPPs Cascade	1,002,319	1,092,544
Tuloma HPPs Cascade	1,267,059	1,235,248
Serebryansky HPPs Cascade	1,454,926	1,339,538
Total for Kolsky Branch	**7,016,225**	**7,215,516**
Total for TGC-1	**28,332,251**	**30,371,359**
Murmanskaya CHPP	29,844	16,963
Total for TGC-1 with Murmanskaya CHPP	**28,362,094**	**30,388,322**
Total for CHPPs	**16,339,366**	**16,889,454**
Total for HPPs	**12,022,728**	**13,498,868**

Heating output by TGC-1 power plants in 2011 – 2012, GCal

	2011	2012
Nevsky Branch		
Central CHPP	2,486,876	2,595,966
Pravoberezhnaya CHPP	2,305,220	2,242,261
Vasileostrovskaya CHPP	1,998,112	2,020,799
Dubrovskaya CHPP	245,781	259,219
Pervomayskaya CHPP	1,957,773	1,947,166
Avtovskaya CHPP	3,604,737	3,703,624
Vyborgskaya CHPP	1,315,678	1,326,752
Severnaya CHPP	3,094,715	3,066,578
Yuzhnaya CHPP	4,045,176	4,155,522
Boiler facilities	4,741	4,314
Total for Nevsky Branch	**21,058,809**	**21,322,201**
Karelsky Branch		
Petrozavodskaya CHPP	1,645,174	1,784,658
Total for Karelsky Branch	**1,645,174**	**1,784,658**
Kolsky Branch		
Apatitskaya CHPP	1,157,719	1,170,772
Electrical boiler houses	11,794	3,287
Total for Kolsky Branch	**1,169,513**	**1,174,059**
Total for TGC-1	**23,873,496**	**24,280,918**
Murmanskaya CHPP	2,179,450	2,156,616
Total for TGC-1 with Murmanskaya CHPP	**26,052,946**	**26,437,534**

Breakdown of specific reference fuel consumption by TGC-1 CHPPs in 2011 – 2012

	2011		2012	
	for electricity, g/kWh	for heat, kg/GCal	for electricity, g/kWh	for heat, kg/GCal
Nevsky Branch				
Central CHPP	400.8	159.9	407.0	160.4
Pravoberezhnaya CHPP	280.6	151.4	268.2	145.6
Vasileostrovskaya CHPP	300.8	133.4	300.0	141.3
Dubrovskaya CHPP	478.7	159.0	470.3	157.6
Pervomayskaya CHPP	292.9	147.8	266.3	147.7
Avtovskaya CHPP	340.6	129.9	339.6	131.4
Vyborgskaya CHPP	310.2	133.7	316.5	138.4
Severnaya CHPP	286.4	125.3	280.9	127.1
Yuzhnaya CHPP	265.4	136.0	263.5	138.1
Average for Nevsky Branch	**291.6**	**138.9**	**283.6**	**140.3**
Karelsky Branch				
Petrozavodskaya CHPP	281.2	133.1	280.0	131.2
Average for Karelsky Branch	**281.2**	**133.1**	**280.0**	**131.2**
Kolsky Branch				
Apatitskaya CHPP	320.6	143.1	321.0	143.6
Average for Kolsky Branch	**320.6**	**143.1**	**321.0**	**143.6**
Average for TGC-1	**291.6**	**138.7**	**284.1**	**139.8**
Murmanskaya CHPP	445.9	172.8	-	174.2

Fuel mix in 2012, %

	Gas	Fuel oil	Coal
Nevsky Branch	98.71	1.26	0.04
Karelsky Branch	98.52	1.48	-
Kolsky Branch	-	0.25	99.75
Total for TGC-1	**95.26**	**1.24**	**3.50**
Murmanskaya CHPP	-	100	-
Total for TGC-1 with Murmanskaya CHPP	**91.00**	**5.65**	**3.35**

In 2012, electric power plants of TGC-1, excluding the Murmanskaya CHPP, consumed 6,397.9 million m³ of gas for heat and electricity output, as well as 69.7 thousand tons of fuel oil and 365.6 thousand tons of coal. The share of gas in the fuel balance was 95.3 %, fuel oil 1.2 %, and coal 3.5 %.

The main type of fuel used at TGC-1 power stations is:

– natural gas and dry stripped gas at the Nevsky Branch CHPPs;
– natural gas at the Petrozavodskaya CHPP of the Karelsky Branch;
– coal of energy types D and G at the Apatitskaya CHPP of the Kolsky Branch.

Reserve types of fuel are:

– fuel oil and coal of energy mark G at the Nevsky Branch CHPPs;
– fuel oil at the Petrozavodskaya CHPP of the Karelsky Branch;

Emergency burning fuel types are:

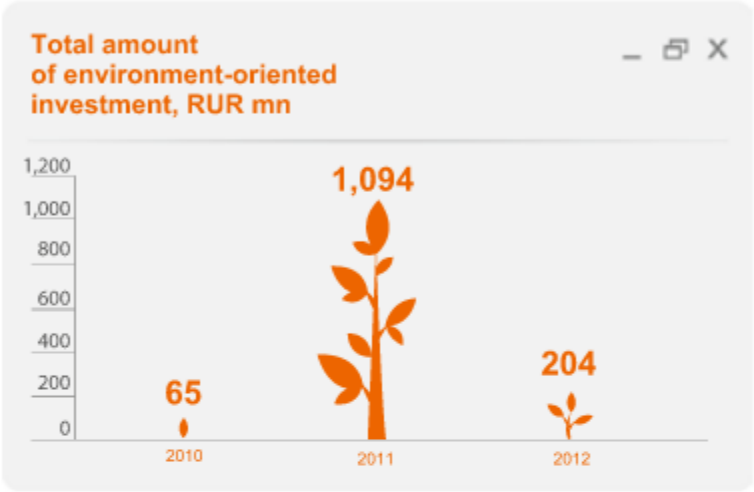
– fuel oil at the Apatitskaya CHPP of the Kolsky Branch.

The main fuel used at the Murmanskaya CHPP is fuel oil

http://www.tgc1.ru/fileadmin/ir/Reports/Annual/2012/tgc_annual_en_2012.pdf

Environmental Protection

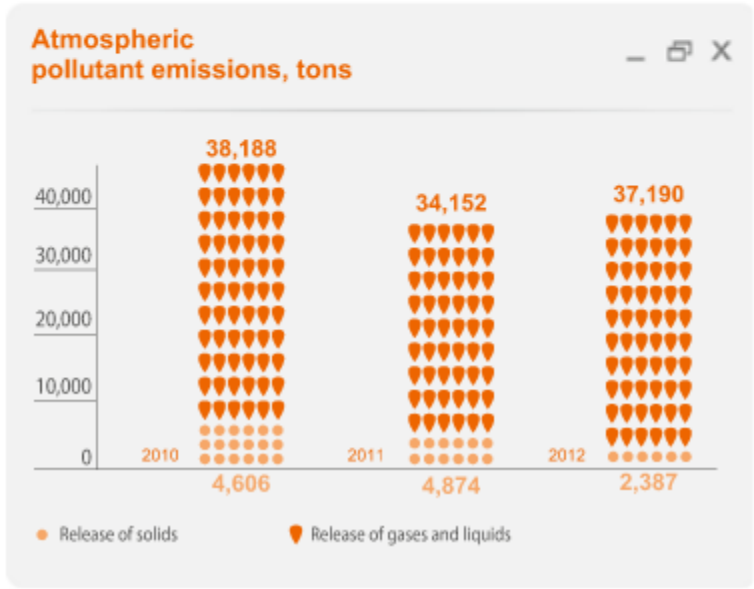
In 2012, various measures for environmental protection were applied in the structural divisions of TGC-1.

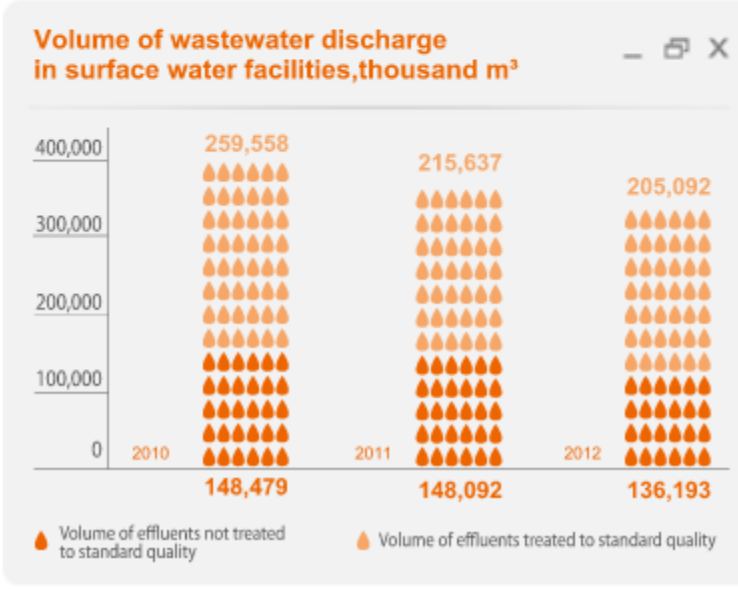


In 2012, TGC-1's pollutant emissions increased by 525 tons (1.3 %) compared to 2011, which was mainly due to the power production increase.

Compared to previous years, the amount of disposed water reduced by 11.9 million m³ (8 %) due to the operation of new 180 MW CCGT units no. 1 and 2 with a recycling process water supply system and phasing out of some obsolete and outdated machinery at the Pervomayskaya CHPP of the Nevsky Branch.

http://www.tgc1.ru/fileadmin/ir/Reports/Annual/2012/tgc_annual_en_2012.pdf





Saint Petersburg

Currently, the main producers of heat in Saint Petersburg are as follows:

- TGC-1;
- GUP TEC of St. Petersburg;
- Peterburgteploenergo LLC;
- Severo-Zapadnaya TPP Branch of INTER RAO-Electrogeneratsiya JSC.

http://www.tgc1.ru/fileadmin/ir/Reports/Annual/2012/tgc_annual_en_2012.pdf

Structure of Saint Petersburg heat market*

Name of organization	Installed heat capacity, GCal/h	Connected heat capacity, GCal/h	Heat output for consumers, thousand GCal	Market share,%
TGC-1	11,890	9,674	20,814	47
GUP TEC of St. Petersburg	8,998	8,480	19,260	43
Peterburgteploenergo LLC	2,113	1,464	2,987	7
North-West CHPP	700	240	1,210	3

* – Organizations with an energy output of more than 1,000 thousand GCal (indicated by data recorded during the formation of heat tariffs in 2012)

In addition, there are a number of heat producers in Saint Petersburg with an annual output of less than 1,000 thousand GCal per year, the total share of which does not exceed 5 % of useful output.

http://www.tgc1.ru/fileadmin/ir/Reports/Annual/2012/tgc_annual_en_2012.pdf

Leningrad Oblast

In Leningrad Oblast, TGC-1 sells heat in the Kirov, Vsyevolozhk and Lodeynopolsky Districts.

The Dubrovskaya CHPP of TGC-1's Nevsky Branch is the sole source of heat providing to Kirovsk city in Leningrad Oblast.

In the Lodeynopolsky District, all heat produced by electric boilers belonging to TGC-1 is sold to wholesale buyer-resellers Lodeynopolskaya Teploset LLC for providing heating to consumers in the town of Svirstroy.

The Severnaya CHPP of TGC-1's Nevsky Branch is the sole source of heat providing heating to consumers in the village of Novoe Devyatkino in Leningrad Oblast.

In summary, one can say that TGC-1 currently has no competitors in providing heat in Leningrad Oblast.

Electricity generation by TGC-1 power plants in 2011 – 2012, thousand kWh

	2011	2012
Nevsky Branch		
Central CHPP	438,263	406,435
Pravoberezhnaya CHPP	869,721	1,244,348
Vasileostrovskaya CHPP	768,765	730,933
Dubrovskaya CHPP	264,198	196,670
Pervomayskaya CHPP	1,900,199	2,367,057
Avtovskaya CHPP	1,463,357	1,388,243
Vyborgskaya CHPP	985,755	854,450
Severnaya CHPP	2,317,602	2,237,793
Yuzhnaya CHPP	5,848,209	5,850,885
Narvskaya HPP	754,537	643,192
Vuoksa HPPs Cascade	999,035	1,239,077
Ladoga HPPs Cascade	1,434,267	1,662,182
Total for Nevsky Branch	**18,043,907**	**18,821,263**

http://www.tgc1.ru/fileadmin/ir/Reports/Annual/2012/tgc_annual_en_2012.pdf

St. Petersburg Heating Grid

Creation of St. Petersburg Heating Grid was provided for under a tripartite agreement among the Administration of Saint Petersburg, TGC-1, and GUP TEC of St. Petersburg to unify the heating grids within the territory of TGC-1 CHPPs.

The operations of Saint Petersburg Heating Grid began on 1 May 1 2010. Agency sales of heat in the areas of heat supply by TGC-1 CHPPs under the right of lease of TGC-1's heating mains and local grids of GUP TEC Saint Petersburg began on 1 July 1 2010.

In December 2010, FFMS of Russia registered an additional issue of shares of Saint Petersburg Heating Grid, to which TGC-1 and GUP TEC St. Petersburg subscribed. On 31 December 2010, TGC-1 and Saint Petersburg Heating Grid entered into contract for the purchase by TGC-1 of ordinary shares in Saint Petersburg Heating Grid, with payment by property accounted on the balance of the Heating Grid enterprise of the Nevsky branch of TGC-1.

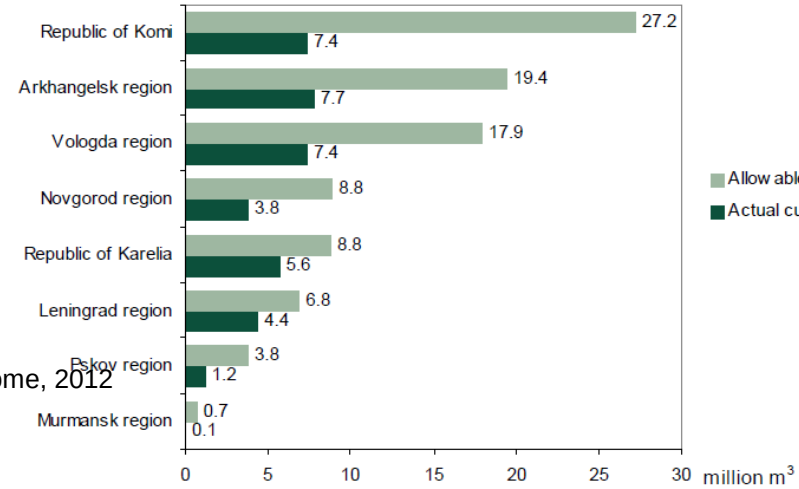
The securities placement was completed in December 2011, and the report on the results of an additional issue of Saint Petersburg Heating Grid shares was approved. The Company placed additional ordinary registered shares totalling 31,304,269,380 shares. As a result of the placement, the structure of the authorized capital of Saint Petersburg Heating Grid has changed: TGC-1 owns 74.9997 %, GUP TEC St. Petersburg 25.0003 % of the Company's issued shares. In January 2012, FFMS of Russia registered the report on the results of the additional issue of shares. As a result of the issue, the authorized capital of the Company increased more than 1,000 times and amounted to RUR 31,334 million

FOREST SECTOR

Table 2.1. Forest resources of Russia and Northwest Russia in 2008

Region	Forest land [1]	Stocked forest land [2]			Exploitable forests [3]		
		Area	Volume	Mean increment [4]	Area	Volume	Mean increment
	1 000 ha	1 000 ha	mil. m³	mil. m³	1 000 ha	mil. m³	mil. m³
Russian federation	838 069	746 310	76 404	947	345 449	40 814	577
European part of Russia[5]	151 127	147 844	19 711	323	103 659	13 645	238
Northwest Russia	82 917	81 352	9 163	121	57 141	6 637	94
Arkhangelsk	22 377	21 994	2 481	29	16 260	1 783	22
Karelia	9 529	9 255	943	14	7 744	744	12
Komi	28 982	28 628	2 849	30	17 771	1 913	22
Leningrad	3 805	3 622	631	10	2 404	400	7
Murmansk	5 186	5 120	226	2	2 108	92	1
Novgorod	3 408	3 333	560	10	2 733	457	8
Pskov	2 090	2 042	322	7	1 784	280	6
Vologda	7 297	7 124	1 104	18	6 154	931	15

Source: Roslesinforg 2008



Source: Roslesinforg 2008a

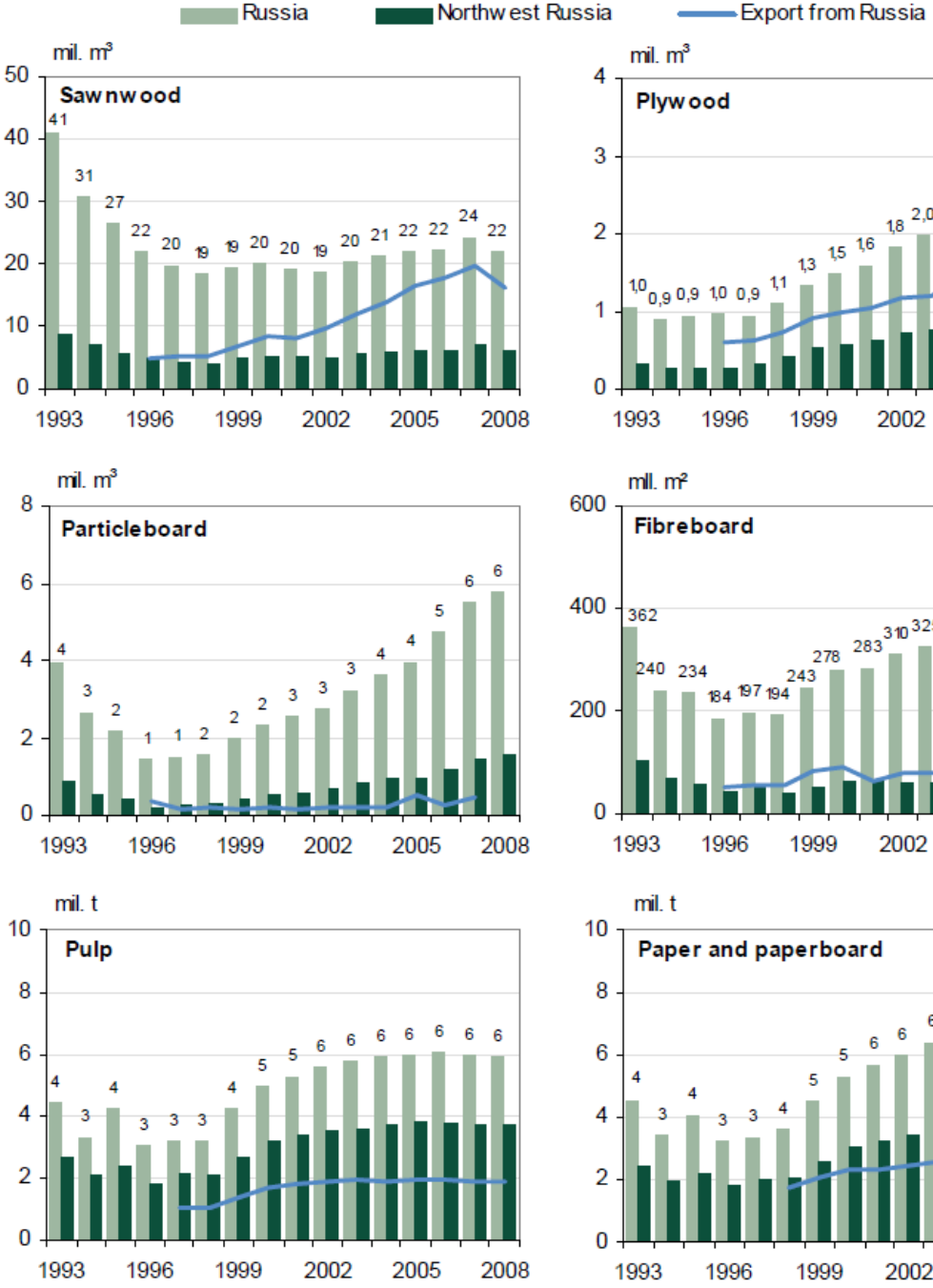
Atlas of the forest sector in Northwest Russia 2009
Yuri Gerasimov, Sari Karvinen and Timo Leinonen
Working Papers of the Finnish Forest Research Institute 131
http://www.metla.fi/julkaisut/workingpapers/2009/mwp131.htm

http://www.lenobl.ru/gov/committee/nature (http://gu.lenobl.ru/)
http://www.gov.karelia.ru/Power/Committee/Forest/index_e.html
http://www.gov-murman.ru/power/comit/forestry/ - http://eng.gov-murman.ru/

THE RUSSIAN FEDERATION FOREST SECTOR OUTLOOK STUDY TO 2030. FAO UN, Rome, 2012

http://helcom.fi/Lists/Publications/Report on the status of HELCOM hot spots in Russia.pdf

http://helcom.fi/Lists/Publications/Report%20on%20the%20status%20of%20HELCOM%20hot%20spots%20in%20Russia.pdf



Year 2008 preliminary data

http://www.metla.fi/julkaisut/workingpapers/2009/mwp131.htm

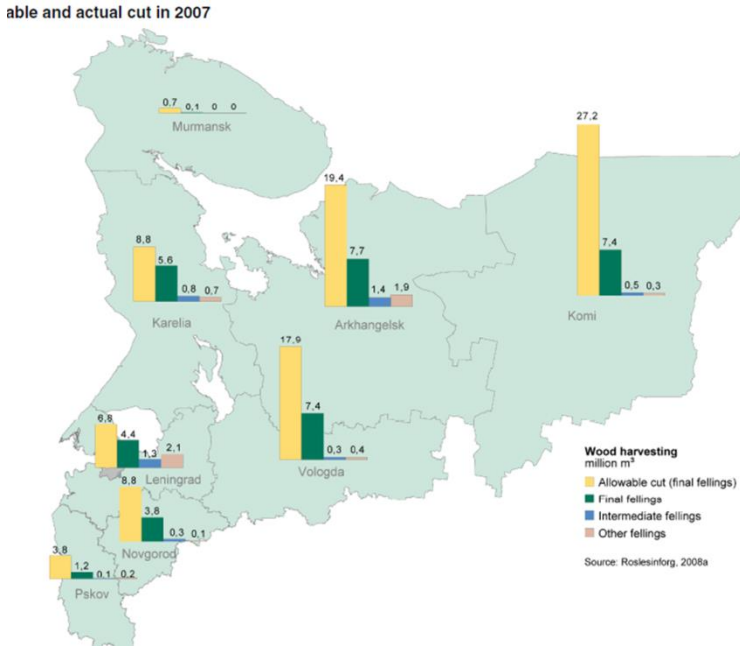
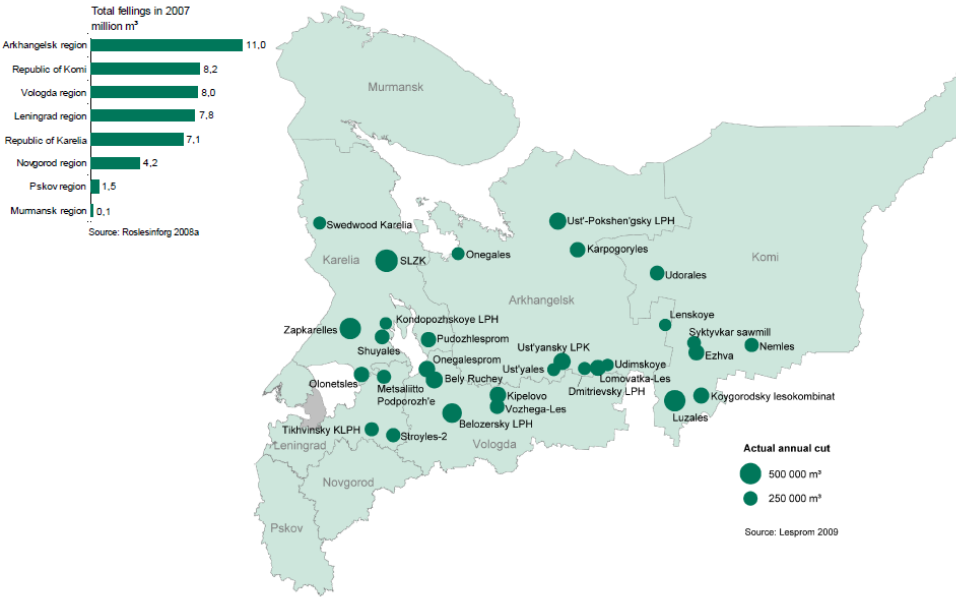


Table 4.1. Share of the forest industry in total industrial production in Northwest R

Region	Forest industry total (incl. printing)	Wood products industry	Pulp and paper industry, printing*
	%		
Northwest Russia	12	4	8
Arkhangelsk	62	19	43
Karelia	56	14	42
Komi	33	12	21
Leningrad	14	3	11
Murmansk	1	0	1
Novgorod	19	13	6
Pskov	4	2	2
St. Petersburg	5	2	3
Vologda	5	4	1

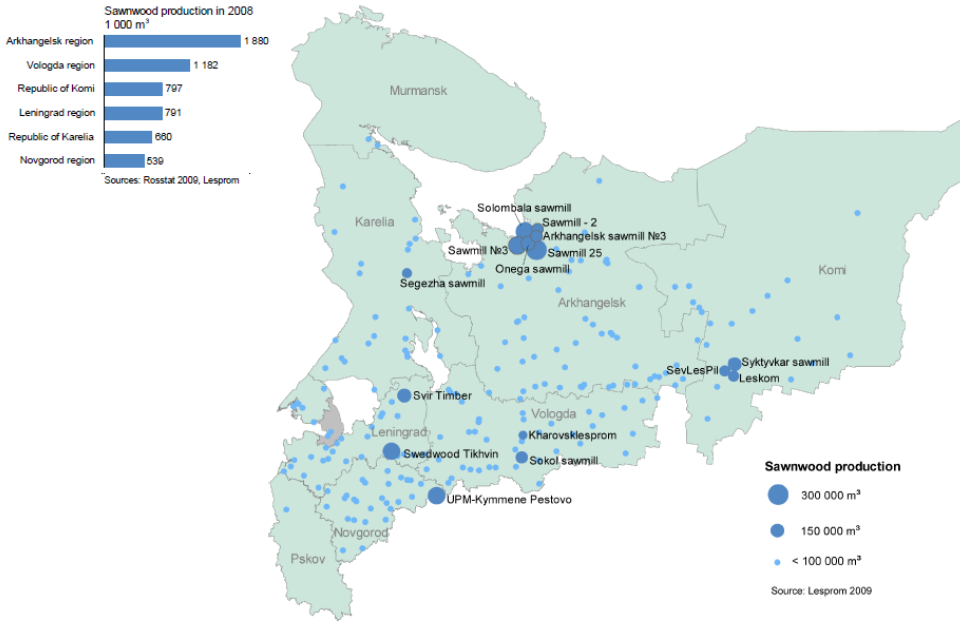
Source: Rosstat 2008a.

5.11 Fellings and the biggest logging companies



Working Papers of the Finnish Forest Research Institute 131
http://www.metla.fi/julkaisut/workingpapers/2009/mwp131.htm

5.12 Sawnwood production and sawmills



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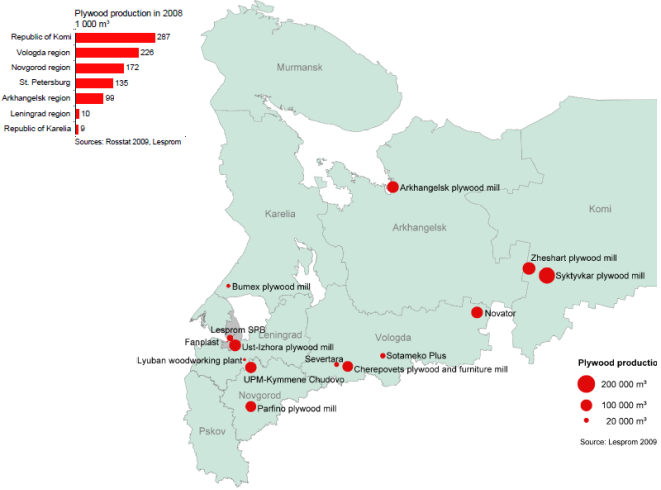
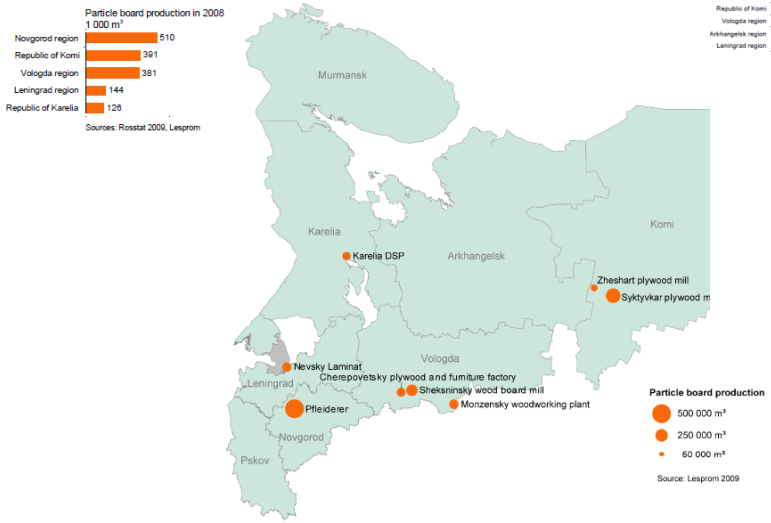
http://www.metla.fi/julkaisut/workingpapers/2009/mwp131.htm

5.13 Plywood production and producers



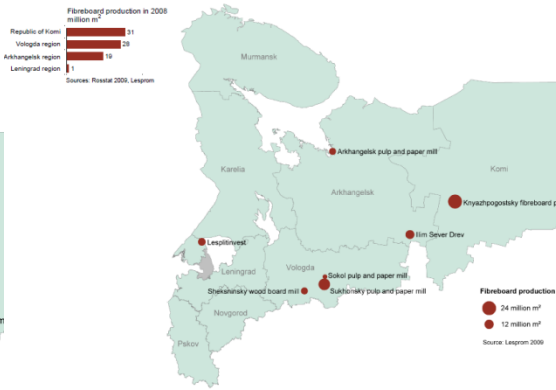
Working Papers of the Finnish Forest Research Institute 131
http://www.metla.fi/julkaisut/workingpapers/2009/mwp131.htm

5.14 Particle board production and producers



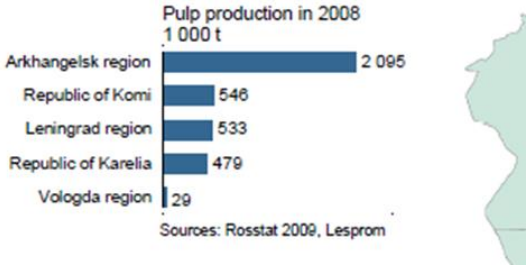
Working Papers of the Finnish Forest Research Institute 131
http://www.metla.fi/julkaisut/workingpapers/2009/mwp131.htm

5.15 Fibreboard production and producers

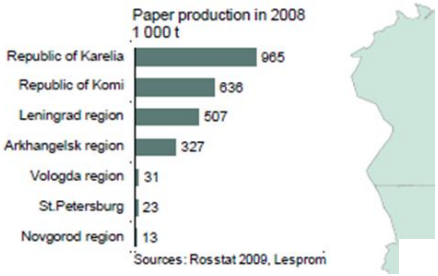


http://www.metla.fi/julkaisut/workingpapers/2009/mwp131.htm

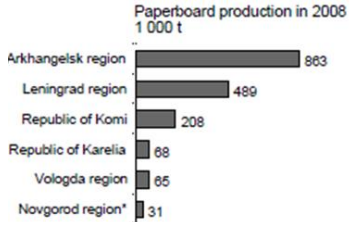
5.16 Pulp production and pulp mills

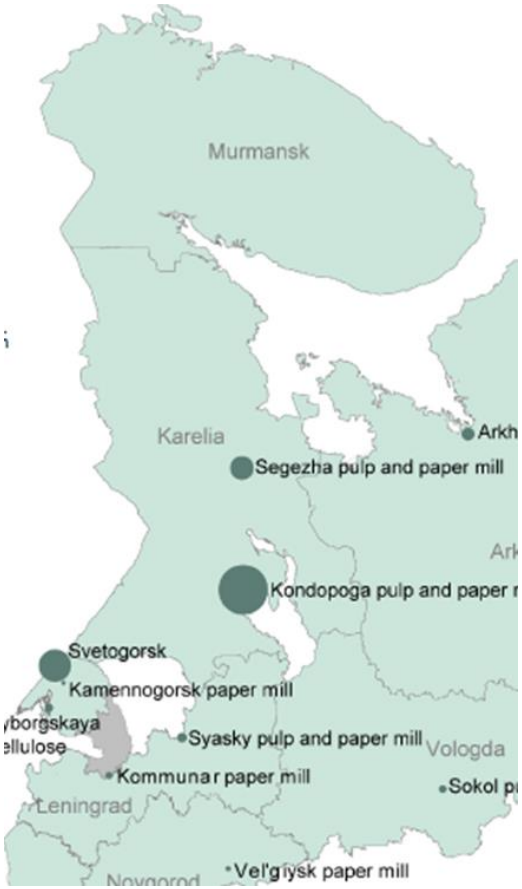


5.17 Paper production and paper mills



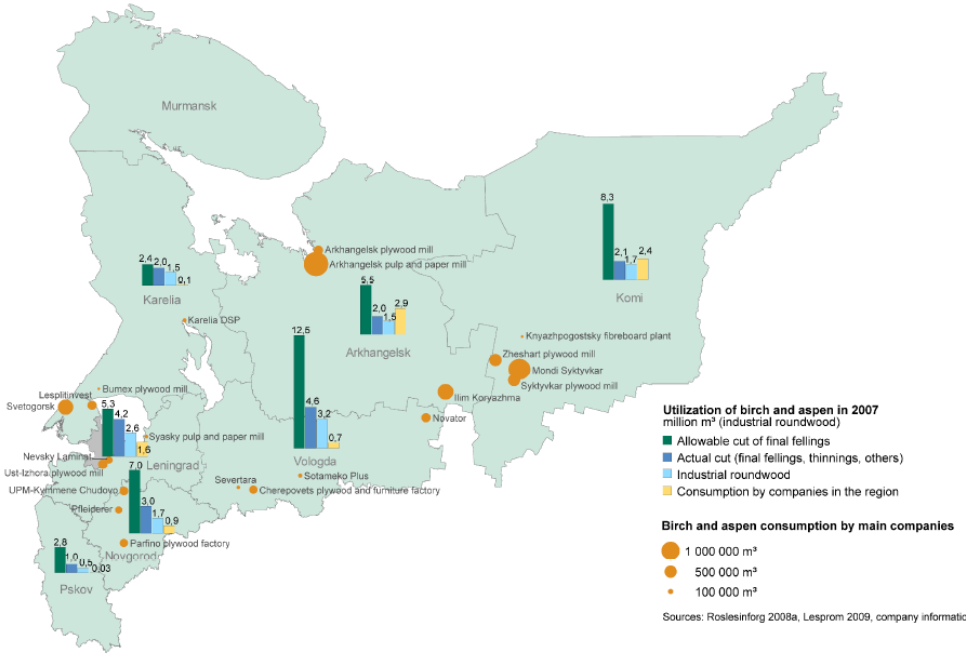
5.18 Paperboard production and paperboard mills



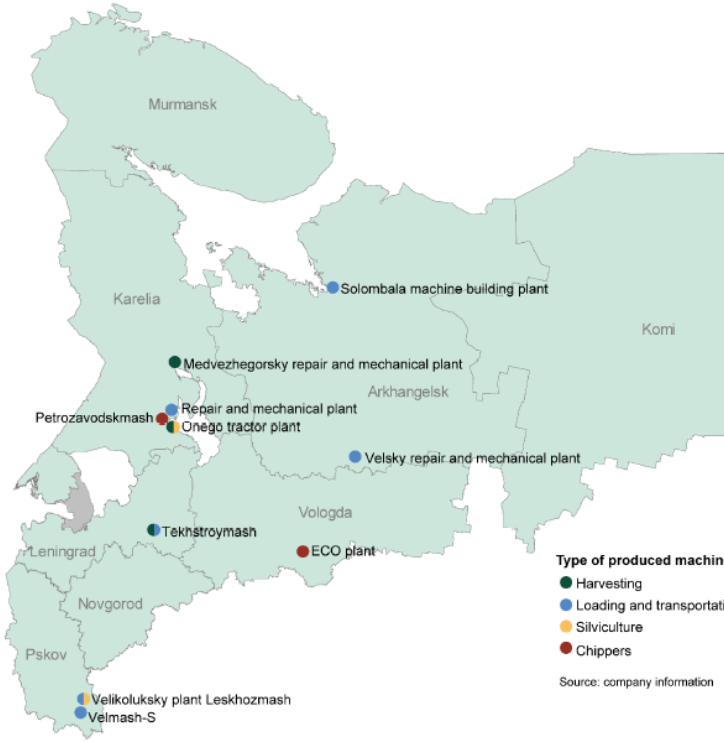


http://www.metla.fi/julkaisut/workingpapers/2009/mwp131.htm

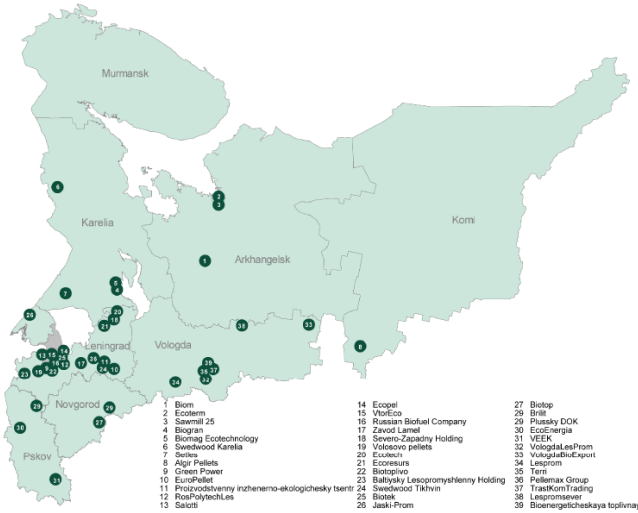
5.19 Utilization of birch and aspen



5.20 Machine manufacturers in the forest sector



5.21 Wood pellet and bricket producers



http://www.metla.fi/julkaisut/workingpapers/2009/mwp131.htm

Annex 1 Companies on the maps

Logging companies	Name in Russian	Region	Internet
Belozersky LPH (lespromkhoz)	Белозерский леспромхоз (ЛПХ), ОАО	Vologda	www.cherles.com
Bely Ruchey	Белый ручей, ЗАО	Vologda	
Dmitrievsky LPH (lespromkhoz)	Дмитриевский леспромхоз (ЛПХ), ОАО	Arkhangelsk	www.titangroup.ru
Ezhva	Эжва, ООО	Komi	
Karpogoryles	Карпогорылес, ООО	Arkhangelsk	www.titangroup.ru
Kipelovo	Лесопромышленный концерн (ЛПК) Кипелово, ОАО	Vologda	www.nationaltimber.com www.investlesprom.ru
Kondopozhskoye LPH (lespromkhoz)	Кондопожское лесопромышленное хозяйство (ЛПХ), ОАО	Karelia	
Koygorodsky lesokombinat	Койгородский лесокомбинат, ООО	Komi	
Lenskoye (Lenskoye LP KTsBK*)	Ленское лесное предприятие Котласского ЦБК (ЛП КЦБК), ООО	Arkhangelsk	
Lomovatka-Les	Ломоватка-Лес, ООО	Arkhangelsk Vologda	www.volwood.ru
Luzales	Лузалес, ООО	Komi	www.luzales.ru
Metsäliitto Podporozh'e	Метсялиитто Подпорожье, ООО	Leningrad	www.metsaliitto.com
Nemles	Немлес, ООО	Komi	
Olonetsles	Олонецлес, ОАО	Karelia	
Onegales	Производственно-лесозаготовительное объединение (ПЛО) Онегалес, ЗАО	Arkhangelsk	www.investlesprom.ru
Onegalesprom	Онегалеспром, ЗАО	Vologda	www.volwood.ru
Pudozhlesprom	Пудожлеспром, ООО	Karelia	
Shuyales	Шуялес, ЗАО	Karelia	www.shujales.ru
SLZK (Severnaya lesozagotovitelnaya kompaniya)	Северная лесозаготовительная компания (СЛЗК), ООО	Karelia	www.investlesprom.ru
Stroyles-2	Стройлес-2, ООО	Leningrad	
SwedwoodKarelia	Сведвуд Карелия, ООО	Karelia	www.ikea.com
Syktyvkar sawmill	Сыктывкарский лесопильно-деревообрабатывающий комбинат (ЛДК),ОАО	Komi	
Tikhvinsky KLPH (kompleksny lespromkhoz)	Тихвинский комплексный леспромхоз (КЛПХ), ЗАО	Leningrad	www.upm-kymmene.com
Udimskoye (Udimskoye LP KTsBK*)	Удимское лесное предприятие Котласского ЦБК (ЛП КЦБК), ОАО	Arkhangelsk	www.ilimpulp.ru
Udorales	Удоралес, ООО	Komi	
Ust'-Pokshen'gsky LPH (lespromkhoz)	Усть-Покшеньгский ЛПХ, ОАО	Arkhangelsk	www.titangroup.ru
Ust'yales	Устьялес, ОАО	Arkhangelsk	www.nationaltimber.com www.investlesprom.ru
Ust'yansky LPK (lesopromyshlenny kompleks)	Устьянский лесопромышленный комплекс (ЛПК), ООО	Arkhangelsk	
Vozhega-les	Вожега-лес, ООО	Vologda	
Zapkarelles	Запкареллес, АО	Karelia	www.zapkarelles.ru

* LP KTsBK=forestry enterprise of the Kotlas pulp and paper mill

Sawmills	http://www.metla.fi/julkaisut/workingpapers/2009/mwp131.htm		
Arkhangelsk sawmill № 3	Архангельский лесопильно-деревообрабатывающий комбинат (ЛДК) № 3, ОАО	Arkhangelsk	
Kharovsklesprom	Харовсклеспром, ООО	Vologda	www.volwood.ru
Leskom	Леском, ЗАО	Komi	
Onega sawmill	Онежский лесопильно-дерево-обрабатывающий комбинат, ОАО	Arkhangelsk	www.investlesprom.ru
Sawmill - 2	Лесозавод-2, ОАО	Arkhangelsk	www.lesozavod2.ru
Sawmill 25	Лесозавод 25, ЗАО	Arkhangelsk	www.sawmill25.ru
Sawmill № 3	Лесозавод № 3, ОАО	Arkhangelsk	www.sawmill3.ru
Segezha sawmill	Лесопильно-дерево-обрабатывающий комбинат (ЛДК) Сегежский, ОАО	Karelia	www.scbk.ru/sldk www.investlesprom.ru
SevLesPil	СевЛесПил, ООО	Komi	
Sokol sawmill	Сокольский дерево-обрабатывающий комбинат (ДОК), ОАО	Vologda	www.sokoldok.ru www.nationaltimber.com www.investlesprom.ru
Solombala sawmill	Соломбальский лесопильно-деревообрабатывающий комбинат (ЛДК), ОАО	Arkhangelsk	www.solombala.com
Svir Timber	СвирьТимбер, ООО	Leningrad	www.metsabotnia.com
Swedwood Tikhvin	Сведвуд Тихвин, ООО	Leningrad	www.ikea.com
Syktyvkar sawmill	Сыктывкарский лесопильно-деревообрабатывающий комбинат (ЛДК), ОАО	Komi	
UPM-Kymmene Pestovo	ЮПМ-Кюммене Пестово, ООО	Novgorod	www.upm-kymmene.com
Plywood producers			
Arkhangelsk plywood mill	Архангельский фанерный завод, ЗАО	Arkhangelsk	www.arkpf.ru
Bumex plywood mill	Лахденпохский фанерный комбинат "Бумэкс", ООО	Karelia	www.bumex.ru
Cherepovets plywood and furniture factory	Череповецкий фанерно-мебельный комбинат, ЗАО	Vologda	
Fanplast	Фанпласт, ОАО (фанерный завод)	St. Petersburg	www.fanplast.sp.ru
Lesprom SPB	Леспром СПб, ОАО	St. Petersburg	
Lyuban woodworking plant	Любанский лесодеревообраба-тывающий комбинат (ЛДОК), ОАО	Leningrad	www.rosstro-group.ru
Novator, plywood mill in Velikiy Ustyug	Великоустюгский Фанерный Комбинат "Новатор", ОАО	Vologda	www.sveza.ru
Parfino plywood factory	Парфинский фанерный комбинат, ОАО	Novgorod	www.parfinofk.ru
Severtara	Севертара, ОАО	Vologda	www.severtara.ru
Sotameko Plus	Сотамеко Плюс, ООО	Vologda	www.fancom.ru
Syktyvkar plywood mill	Сыктывкарский фанерный завод, ООО	Komi	www.plypan.com
UPM-Kymmene Chudovo	ЮПМ-Кюммене Чудово, ООО	Novgorod	www.upm-kymmene.com
Ust-Izhora plywood mill	Усть-Ижорский фанерный комбинат,	St. Petersburg	www.sveza.ru

Particle board producers			
Cherepovetsky plywood and furniture factory	Череповецкий фанерно-мебельный комбинат, ЗАО	Vologda	
Karelia DSP	Карелия ДСП, ООО	Karelia	
Monzensky woodworking plant	Монзенский деревообрабатывающий комбинат, ООО	Vologda	
Nevsky Laminat	Завод Невский Ламинат, ООО	Leningrad	www.dspnd.ru
Pfleiderer	Флайдерер, ООО	Novgorod	www.pfleiderer.de
Sheksninsky wood board mill	Шекснинский комбинат древесных плит, ООО	Vologda	www.skdp.ru
Syktyvkar plywood mill	Сыктывкарский фанерный завод, ООО	Komi	www.plypan.com
Zheshart plywood mill	Жешартский фанерный комбинат, ЗАО	Komi	www.upgweb.ru
Fibreboard producers			
Arkhangelsk pulp and paper mill	Архангельский целлюлозно-бумажный комбинат, ОАО	Arkhangelsk	www.appm.ru
IlimSeverDrev	Илимсевердрев, ООО	Arkhangelsk	
Knyazhpogostsky fibreboard plant	Княжпогостский завод ДВП, ООО	Komi	www.wood-way.ru
Lesplitinvest	Лесплитинвест, ОАО	Leningrad	www.plit.ru
Sheksninsky wood board mill	Шекснинский комбинат древесных плит, ООО	Vologda	www.skdp.ru
Sokol pulp and paper mill	Сокольский целлюлозно-бумажный комбинат, ОАО	Vologda	www.sokolmill.ru
Sukhonsky pulp and paper mill	Сухонский целлюлозно-бумажный комбинат, ОАО	Vologda	
Pulp producers			
Arkhangelsk pulp and paper mill	Архангельский целлюлозно-бумажный комбинат, ОАО	Arkhangelsk	www.appm.ru
Ilim Koryazhma	Группа Илим, филиал в Коряжме	Arkhangelsk	www.ilimgroup.ru
Kondopoga pulp and paper mill	Кондопога, ОАО	Karelia	home.onego.ru/~avangard
Mondi Syktyvkar	Монди Сыктывкарский ЛПК, ОАО	Komi	www.mondigroup.com
Pitkaranta pulp mill	Целлюлозный завод Питкяранта, ОАО	Karelia	www.pitzavod.ru
Segezha pulp and paper mill	Сегежский целлюлозно-бумажный комбинат, ОАО	Karelia	www.scbk.ru www.investlesprom.ru
Sokol pulp and paper mill	Сокольский целлюлозно-бумажный комбинат, ОАО	Vologda	www.sokolmill.ru
Solombala pulp and paper mill	Соломбальский целлюлозно-бумажный комбинат, ОАО	Arkhangelsk	www.solombala.com
Svetogorsk	Светогорск, ОАО	Leningrad	www.internationalpaper.com
Syasky pulp and paper mill	Сясьский целлюлозно-бумажный комбинат, ОАО	Leningrad	www.syas.ru
Vyborgskaya Cellulose	Выборгская целлюлоза, ОАО	Leningrad	www.vybcell.ru

Paper producers			
Arkhangelsk pulp and paper mill	Архангельский целлюлозно-бумажный комбинат, ОАО	Arkhangelsk	www.appm.ru
Ilim Koryazhma	Группа Илим, филиал в Коряжме	Arkhangelsk	www.ilimgroup.ru
Kamennogorsk paper mill	Каменногорская фабрика офсетных бумаг, ЗАО	Leningrad	
Kommunar paper mill	Бумажная фабрика Коммунар, ОАО	Leningrad	www.kommunar.ru
Kondopoga pulp and paper mill	Кондопога, ОАО	Karelia	home.onego.ru/~avangard
Mondi Syktyvkar	Монди Сыктывкарский ЛПК, ОАО	Komi	www.mondigroup.com
Segezha pulp and paper mill	Сегежский целлюлозно-бумажный комбинат, ОАО	Karelia	www.scbk.ru www.investlesprom.ru
Sokol pulp and paper mill	Сокольский целлюлозно-бумажный комбинат, ОАО	Vologda	www.sokolmill.ru
Svetogorsk	Светогорск, ОАО	Leningrad	www.internationalpaper.com
Syasky pulp and paper mill	Сясьский целлюлозно-бумажный комбинат, ОАО	Leningrad	www.syas.ru
Vel'giysk paper mill	Вельгийская бумажная фабрика, ОАО	Novgorod	www.bvbf.natm.ru
Vyborgskaya Cellulose	Выборгская целлюлоза, ОАО	Leningrad	www.vybcell.ru
Paperboard producers			
Arkhangelsk pulp and paper mill	Архангельский целлюлозно-бумажный комбинат, ОАО	Arkhangelsk	www.appm.ru
Ilim Koryazhma	Группа Илим, филиал в Коряжме	Arkhangelsk	www.ilimgroup.ru
Mondi Syktyvkar	Монди Сыктывкарский ЛПК, ОАО	Komi	www.mondigroup.com
Segezha pulp and paper mill	Сегежский целлюлозно-бумажный комбинат, ОАО	Karelia	www.scbk.ru www.investlesprom.ru
Smurfit Kappa St.Petersburg	Смерфит Каппа Санкт-Петербург	Leningrad	www.smurfitkappa.ru
St.Petersburg paperboard and printing mill	Санкт-Петербургский картонно-полиграфический комбинат, ОАО	Leningrad	www.ilimgroup.ru
Sukhonsky pulp and paper mill	Сухонский целлюлозно-бумажный комбинат, ООО	Vologda	www.ukobf.ru
Suoyarvskaya paperboard mill	Суоярвская картонная фабрика, ООО	Karelia	
Svetogorsk	Светогорск, ОАО	Leningrad	www.internationalpaper.com
Syasky pulp and paper mill	Сясьский целлюлозно-бумажный комбинат, ОАО	Leningrad	www.syas.ru
Vyborgskaya Cellulose	Выборгская целлюлоза, ОАО	Leningrad	www.vybcell.ru

Machine manufacturers			
ECO plant	Завод Эко, АО	Vologda	www.chipping-machine.ru
Medvezhegorsky repair and mechanical plant	Медвежьегорский ремонтно-механический завод, ОАО	Karelia	www.harvy-forester.ru
Onego tractor plant	Онежский тракторный завод, ООО	Karelia	www.tplants.com
Petrozavodskmash	Петрозаводскмаш, ЗАО	Karelia	www.pbm.onego.ru
Repair and mechanical plant	Ремонтно-механический завод, ЗАО	Karelia	www.sampo.ru/~rmz/
Solombala machine building plant	Соломбальский машиностроительный завод, ОАО	Arkhangelsk	www.smz.com.ru www.liftingmachine.ru
Tekhstroymash	Завод Техстроймаш, ООО	Leningrad	www.tsmash.ru
Velikoluksky plant Leskhozmash	Великолукский завод Лесхозмаш, ОАО	Pskov	www.leshozmash.ru
Velmash-S	Великолукский машиностроительный завод (Велмаш-С), ООО	Pskov	www.velmash.com www.liftingmachine.ru
Velsky repair and mechanical plant	Вельский ремонтно-механический завод (РМЗ), ОАО	Arkhangelsk	www.titangroup.ru/issuers/velskrmz.shtml
Wood pellet and bricket producers			
Algir Pellets	Альгир Пеллетс	Komi	
Baltiysky Lesopromyshlenny Holding	Балтийский Лесопромышленный Холдинг, ЗАО	Leningrad	
Bioenergeticheskaya toplivnaya kompaninya	Биоэнергетическая топливная компания, ООО	Vologda	
Biogran	Биогран, ООО	Karelia	www.biogran.ru
Biom	Биом, ООО	Arkhangelsk	
Biomag Ecotechnology	Биомаг Экотехнологии	Karelia	www.biomageco.com
Biotek	Биотек, ООО	Leningrad	
Biotop	Биотоп, ООО	Novgorod	
Biotoplivo	Биотопливо, ООО	Leningrad	
Brilit	Брилит, ООО	Novgorod	
EcoEnergia	ЭкоЭнергия, ООО	Pskov	www.ecology-energy.ru
Ecopel	Экопел, ЗАО	Leningrad	
Ecoresurs	Экоресурс, ООО	Leningrad	
Ecotech	Экотех, ООО	Leningrad	
Ecoterm	Экотерм, ООО	Arkhangelsk	
EuroPellet	Европеллет, ООО	Leningrad	www.europellet.spb.ru
Green Power	Грин Пауэрс, ООО	Leningrad	
Jaski-Prom	Яаски-Пром, ООО	Leningrad	
Lesprom	Леспром, ООО	Vologda	
Lespromsever	Леспромсевер, ООО	Vologda	
Pellemax Group	Пеллемакс Групп	Vologda	
Plussky DOK	Плюсский деревообрабатывающий комбинат (ДОК), ООО	Pskov	
Proizvodstvenny inzhenerno-ekologichesky tsentr	Производственный инженерно-экологический центр, ООО	Leningrad	
RosPolytechLes	РосПолитехЛес, ЗАО	Leningrad	www.rptg.ru
Russian Biofuel Company	Русская биотопливная компания, ООО	Leningrad	www.russianbiofuelcompany.ru
Salotti	Салотти, ООО	Leningrad	www.salotti.spb.ru
Sawmill 25	Лесозавод 25, ZAO	Arkhangelsk	www.sawmill25.ru
Setles	Сетлес, ООО	Karelia	www.storaenso.com
Severo-Zapadny Holding	Северо-Западный холдинг, ООО	Leningrad	
SwedwoodKarelia	Сведвуд Карелия, ООО	Karelia	www.swedwood.com
Swedwood Tikhvin	Сведвуд Тихвин, ООО	Leningrad	www.swedwood.com
Terri	Терри, ООО	Vologda	
TrastKomTrading	ТрастКомТрейдинг, ЗАО	Vologda	
VEEK	ВЭЭК, ООО	Pskov	www.veek.ru
VologdaBioExport	ВологдаБиоЭкспорт, ООО	Vologda	www.vologdabioexport.ru
VologdaLesProm	Корпорация Вологдалеспром, ОАО	Vologda	www.vologdalesprom.ru
Volosovo pellets	Волосово пеллетс, ЗАО	Leningrad	
VtorEco	ВторЭко, ООО	Leningrad	
Zavod Lamel	Завод Ламель, ООО	Leningrad	

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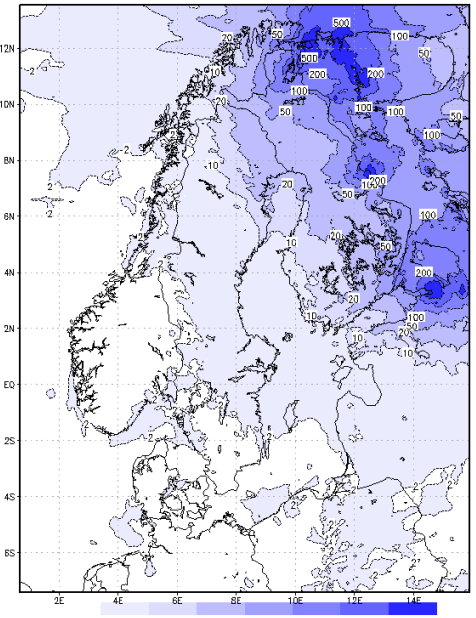
The modelling part of the study

SOURCE-RECEPTOR CALCULATIONS AT THE FINNISH EASTERN BORDER

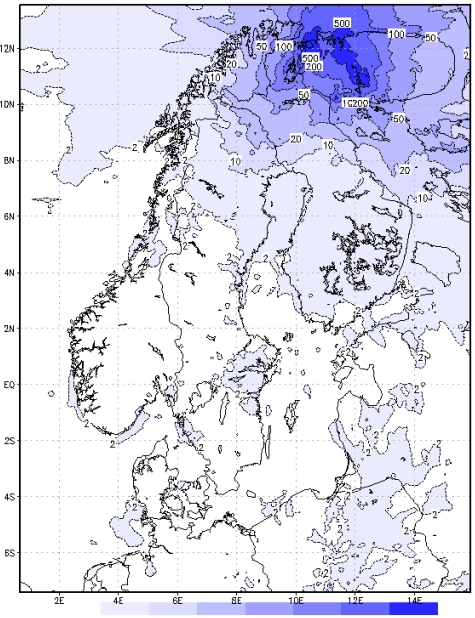
Model

The air pollution fluxes between adjacent countries are very sensitive to emission data used, thus the quality of emission inventories should be high and annually evaluated. The contribution of the Kola Peninsula, Karelia, Leningrad-Oblast (KoKaLO) and Finland sulphur and nitrogen emissions to Finland, Kola Peninsula and Baltic Sea (BS) deposition was calculated with the regional grid model Hilatar (Hongisto, 2003) using the FMI operative HIRLAM (HIgh Resolution Limited Area Model) meteorology and grid. The model has 0.068^{o} horizontal resolution and 21 vertical layers and it is off-line nested with the European Hilatar model with 0.15^{o} resolution. The chemistry module includes acid compounds of oxidized and reduced nitrogen (N) and sulphur (S).

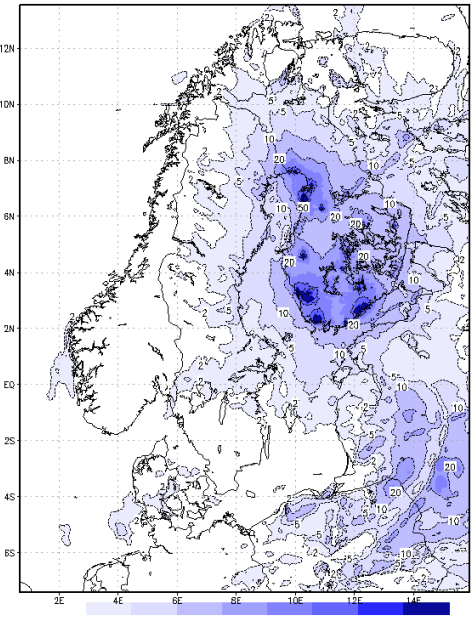
S deposition, Kola,Karelia,LO, 2011, mg(S) m-2



S deposition, Kola emissions, 2011, mg(S) m-2

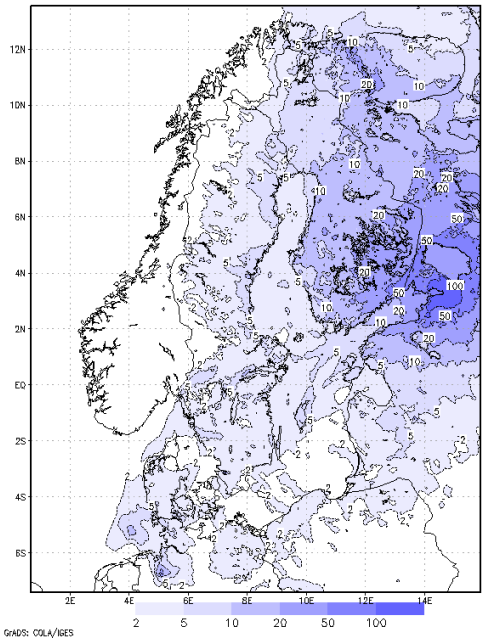


S deposition, Finnish emissions 2011, mg(S) m-2

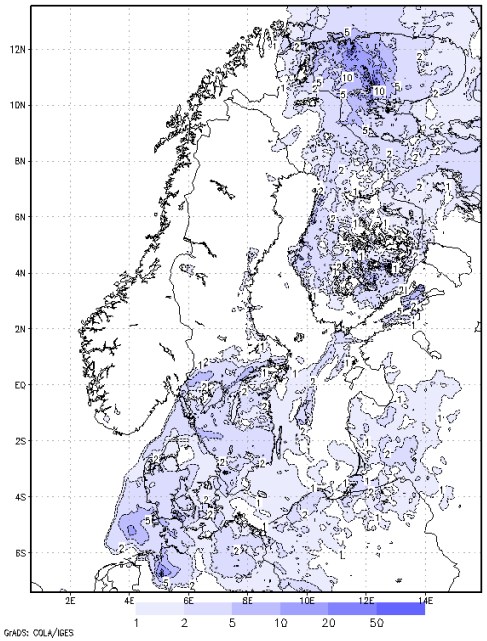


GrA

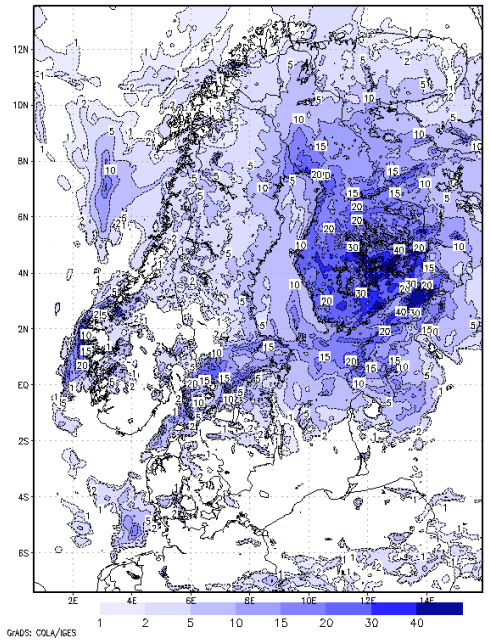
NOX deposition, Kola,Karelia,LO, 2011, mg(N) m-2



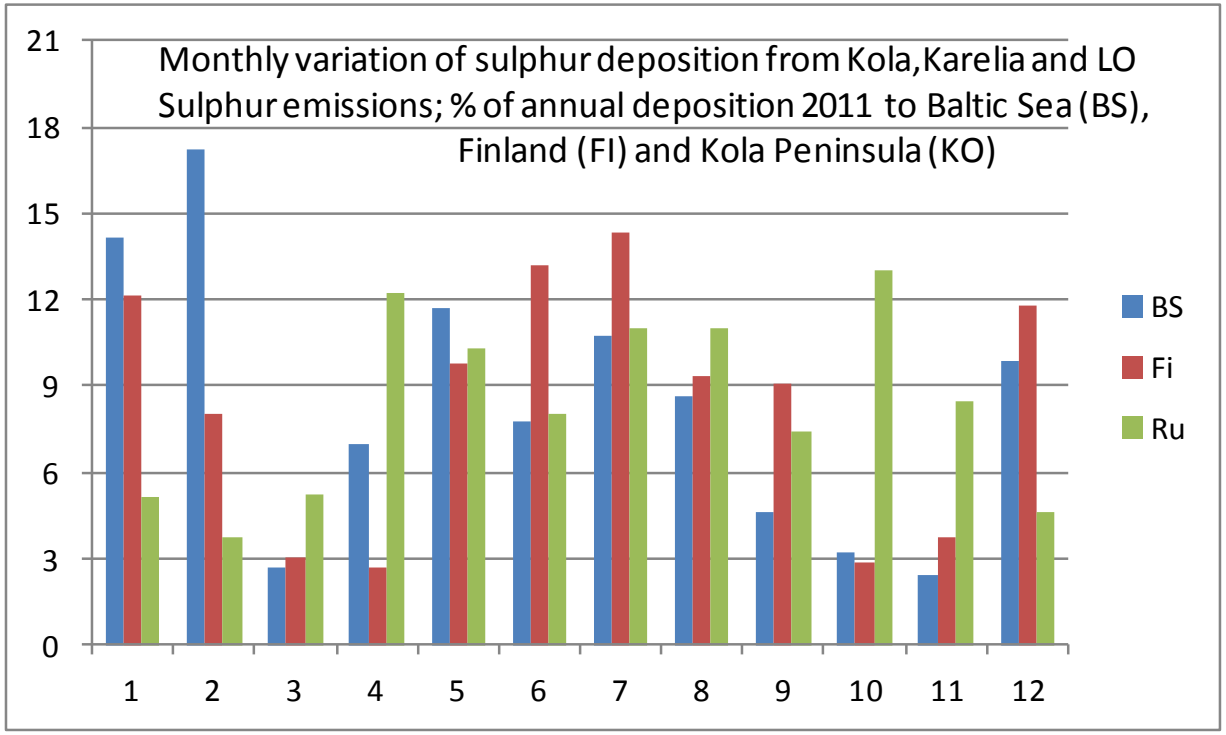
NOX deposition, Kola emissions, 2011, mg(N) m-2

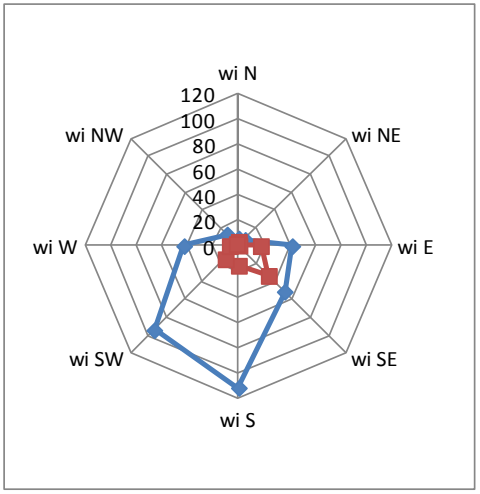


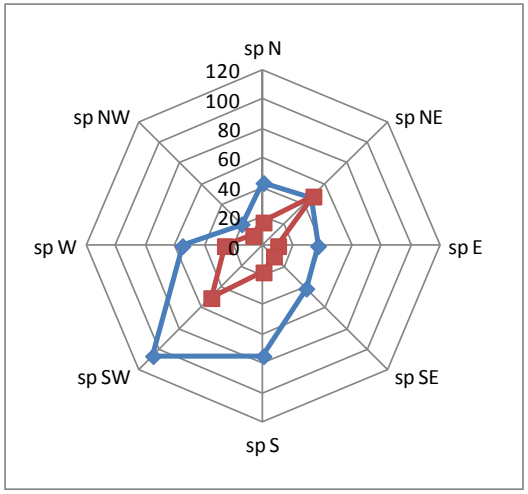
NOX deposition, Finnish emissions 2011, mg(N) m-2

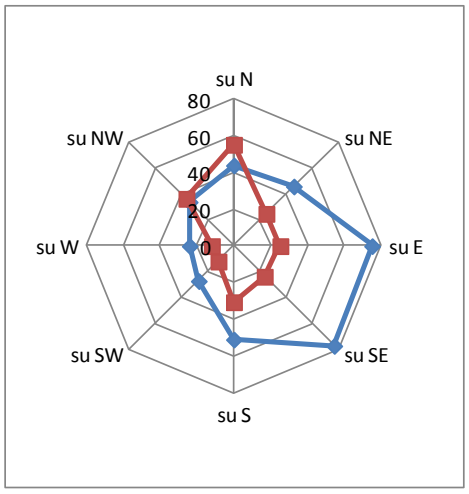


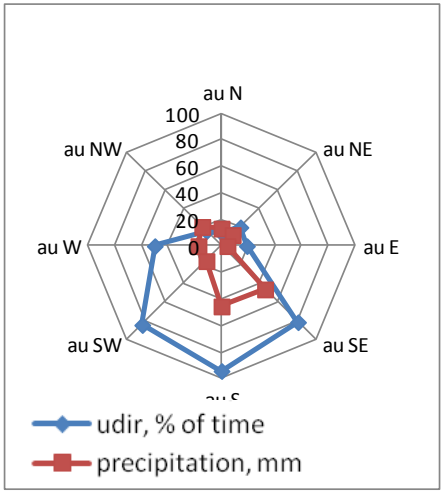
revised		Sox deposition, t S				Nox deposition, t N		
	2011	tot	wet	dry		tot	wet	dry
from KoKaLO	to Baltic S	2644	1658	984		1580	962	616
from KoKaLO	to Finland	15061	9715	5346		4559	2298	2259
from KoKaLO	to Kola	73990	37157	36833		6139	3260	2875
from Finland	to Baltic S	1633	887	746		851	442	408
from Finland	to Finland	7258	3838	3420		5221	2666	2555
from Finland	to Kola	335	241	95		711	477	233
from Kola	to Baltic S	267	112	155		271	106	166
from Kola	to Finland	6303	4139	2164		1564	841	722
from Kola	to Kola	6747	4408	2338		511	77	434











In Lapland the high emissions from Kola industry are detected as high SO_2 concentration peaks, however wet deposition is low because of low precipitation amounts generally and especially during eastern winds, which are also rare in winter. Scavenging of SO_2 with snow is also weak, and the humidity- and temperature-dependent conversion of SO_2 to SO_4 is slow especially in winter. However, modelled dry deposition is rather high, as it should be: in Sevettijärvi, during the Lapland forest damage project, S deposition was three times higher in forest than in open measurement place indicating high dry deposition (Tikkanen 1995).