3 The significance of northern Europe's raw material assets and industries for the EU

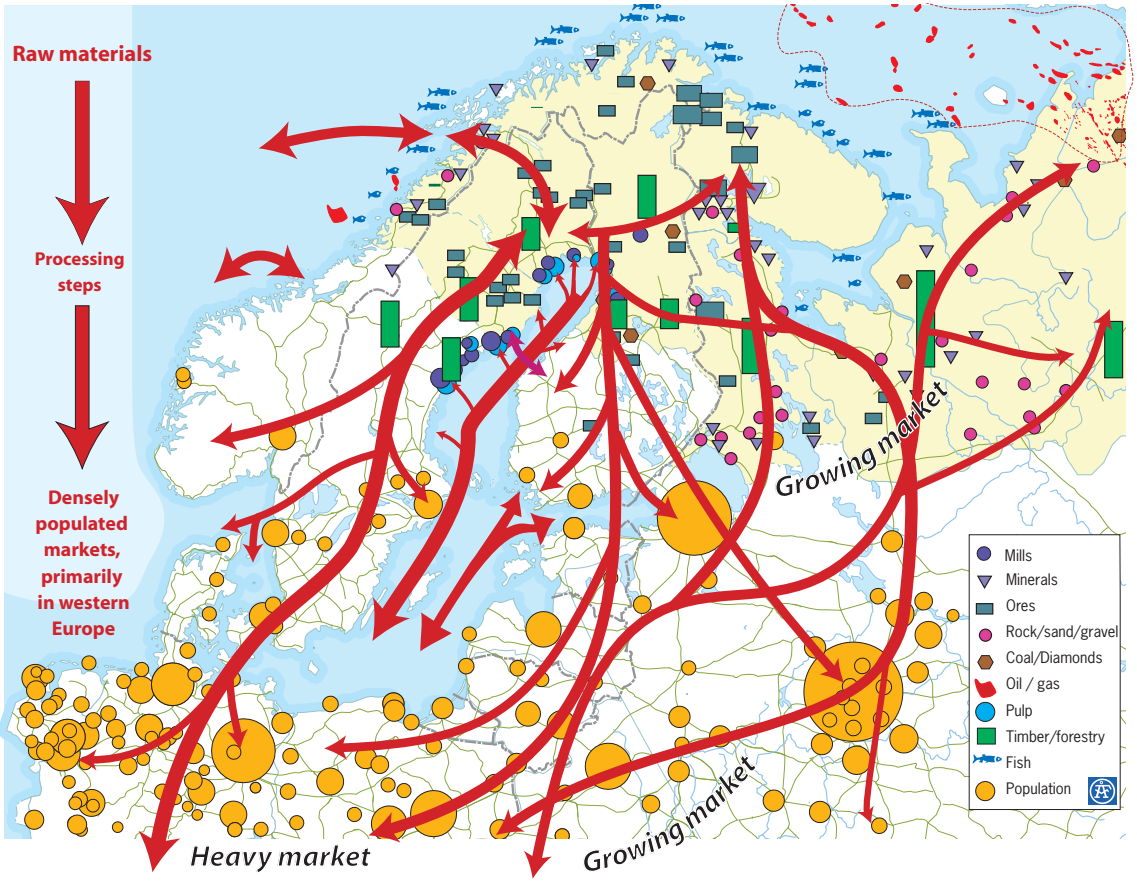
3.1 An overview

Northern Europe is rich in natural resources. Large deposits of minerals and forests; great potentials for the production of hydro and wind power and the extraction of oil and gas. Along with a beautiful natural landscape and interesting places to visit, this makes the region an important source of natural resources. As an example, the Swedish part of the Barents region accounts for nearly 90 percent of EU's iron ore production. Based on the iron ore, a wide range of manufacturing is carried out in the EU, ranging from basic metals to motor vehicles and machinery and equipment (figure 3.1.1 illustrates the raw material supply in the Barents region and its related transport flows to processing and market consumption).

Within the Nordic part of the Barents region extensive investments are made in renewable energy, particularly in wind, hydro and wave power. Bioenergy is also undergoing rapid development. Similar investments can in a longer term also be expected in the Russian part of the Barents region.

Opportunities for processing of raw materials within the Barents region itself are favoured by the relatively good accessibility to tertiary education and skilled labour.

In particular, the northernmost parts of Sweden and northwestern Russia, have extensive mining with concentration to Kiruna/Gällivare, the Kola Peninsula and the Republic of Karelia. Northern Sweden and northern Finland also have extensive establishments of new mines (Pajala, Kolari, Svappavaara, etc.), which will have a significant impact on freight flows, transports and for the industrial system.



Figur 3.1:1 *Northern Europe is very rich in natural resources of forests, ore, minerals, fish, gas, oil and other energy sources. The demand for these natural resources is high on the global market and particularly in the densely populated areas in western Europe.*
Source: *ÅF Infraplan*

3.2 Ore and mineral goods

Accounting for only a small share of the world production of mineral ores, the EU is highly dependent on the import of mineral raw materials. A major part of the EU's domestic supply is extracted in the Barents region. Furthermore, there are great potential for the development of new mines in the region.

Increased demand for mineral goods on the world market, driven by fast growing countries in Asia and Africa, entail an increased potential for the development of industry centred on natural resources in the Barents region. For the EU, the supply of natural resources from the Barents region is important in order to reduce the dependence on raw material imports. The EU's consumption of iron ore products in 2007 was 177 million tonnes, while the iron ore production was only 28 million tonnes.[12]

12 SGU 2008.

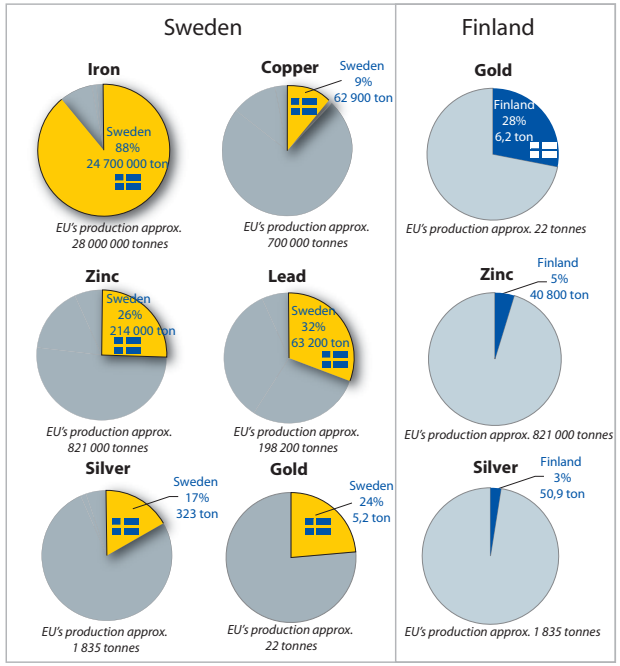


Figure 3.2:1 *Sweden's and Finland's contribution to the EU supply of ore and mineral goods, 2007.*
Sources: *SGU and GTK,*

Mining and quarrying

The Nordic parts of the Barents region

Sweden and Finland, along with Poland, together constitute the EU's main mining region, with high value added in subsequent processing steps. Nearly 90 percent of the EU's iron ore mining takes place in northern Sweden. Northern Sweden and Finland also contribute to significant parts of the EU's production of gold, silver, zinc and copper (figure 3.2:1). Furthermore, chrome production in Kemi in northern Finland has great significance for the production of stainless steel.

The production value of mining and quarrying in the Swedish part of the Barents region was more than 2.9 billion Euros (2007).[13] This is equivalent to 64 percent of Sweden's total production in mining and quarrying. In northern Finland, the production value amounts to 0.45 billion Euros (2007), equivalent to almost half of the Finnish production in mining and quarrying.[14]

13 Statistics Sweden.
14 Statistics Finland.

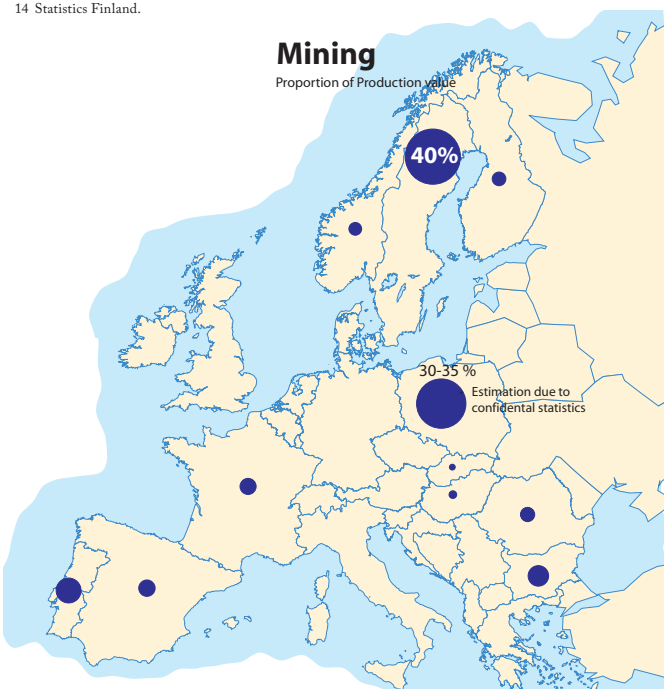


Figure 3.2:2 *Share of the EU's production.*
Source: *SGU/ÅF Infraplan.*

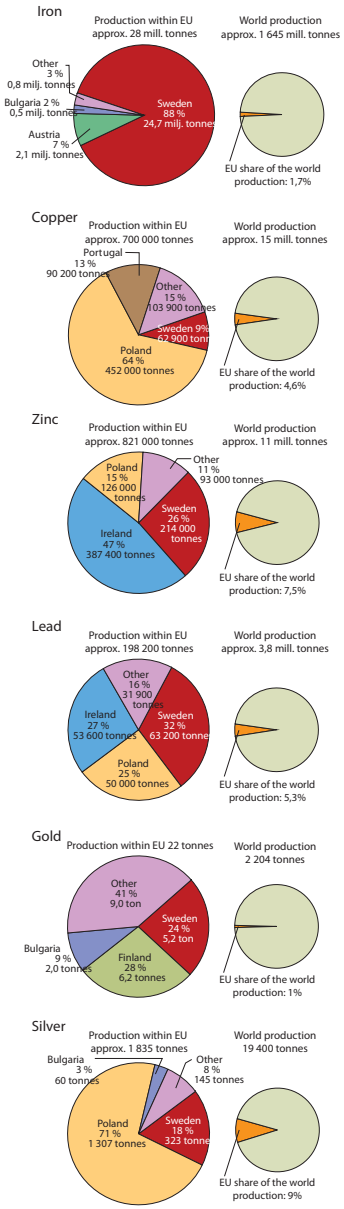


Figure 3.2:3 *Mining production in EU27 and the EU's share of the world production.*
Source: *SGU, 2007.*

Examples from Russian mining industry

The Russian territories of the Barents region together account for significant shares of the Russian Federation's total mining production; 100 percent of the apatite concentrate, 99 percent of the ceramic pegmatites, 88 percent of the phosphates, 78 percent of the micas, and a significant share of copper, nickel, cobalt, rare metals and earth elements.[15]

Large mining regions predominate, especially in Murmansk Oblast and in the Republic of Karelia. The Murmansk Oblast has over 200 deposits of 40 types of minerals. The Murmansk Oblast also has 35 percent phospate, 30 percent non-ferrous metals, 80 percent of rare metals, 75 percent phlogopite, 93 percent kyanite, 37 percent feldspar and pegmatite, and 4 percent of iron ores reserves of the whole of CIS.[16] Large reserves of nickel-copper ores, alumina, rare metals, titanium, construction materials, and semi-precious stones are also found in the region. The Murmansk Oblast is the largest producer of phosphate fertilizers in the world.

The Republic of Karelia has 203 deposits of 23 types of minerals; 45 percent pegmatite raw material, 13.8 percent facing stones, 7.7 percent muscovites, and 4.3 percent building stones reserves of the whole Russian Federation are situated in the Republic of Karelia. Significant iron ore deposits are found in the Kostomuksha area, where JSC Karelsky Okatysh extract iron ore and process it into iron pellets. Small deposits of granite, marble, quartzite, and rare metals are also found in the Republic of Karelia.

The Arkhangelsk Oblast has total bauxite reserves of 120 million tonnes and the North Onezhsky bauxite mine is the largest in Europe. The total fluorite reserves are 60 million tonnes. Diamond deposits are found on the Kuloy-Belomorean plateau, and the best quality diamonds have been found in the Lomonosov deposit. The estimated total reserves of diamonds in the Arkhangelsk Oblast are 130 million carats. Large limestone, clay, and gypsum deposits are also located in the region.

The Republic of Komi has deposits of various minerals which are almost as rich as in the Murmansk Oblast. Large deposits of salt, shale, bauxite, titanium, chronium, iron ore, barium, manganese, as well as precious metals and stones have been found.

15 http://arcticcentre.ulapland.fi/barentsinfo/economic/02/01.html

16 The Commonwealth of Independent States (CIS), is a regional organization whose participating countries are former Soviet Republics, formed during the breakup of the Soviet Union.

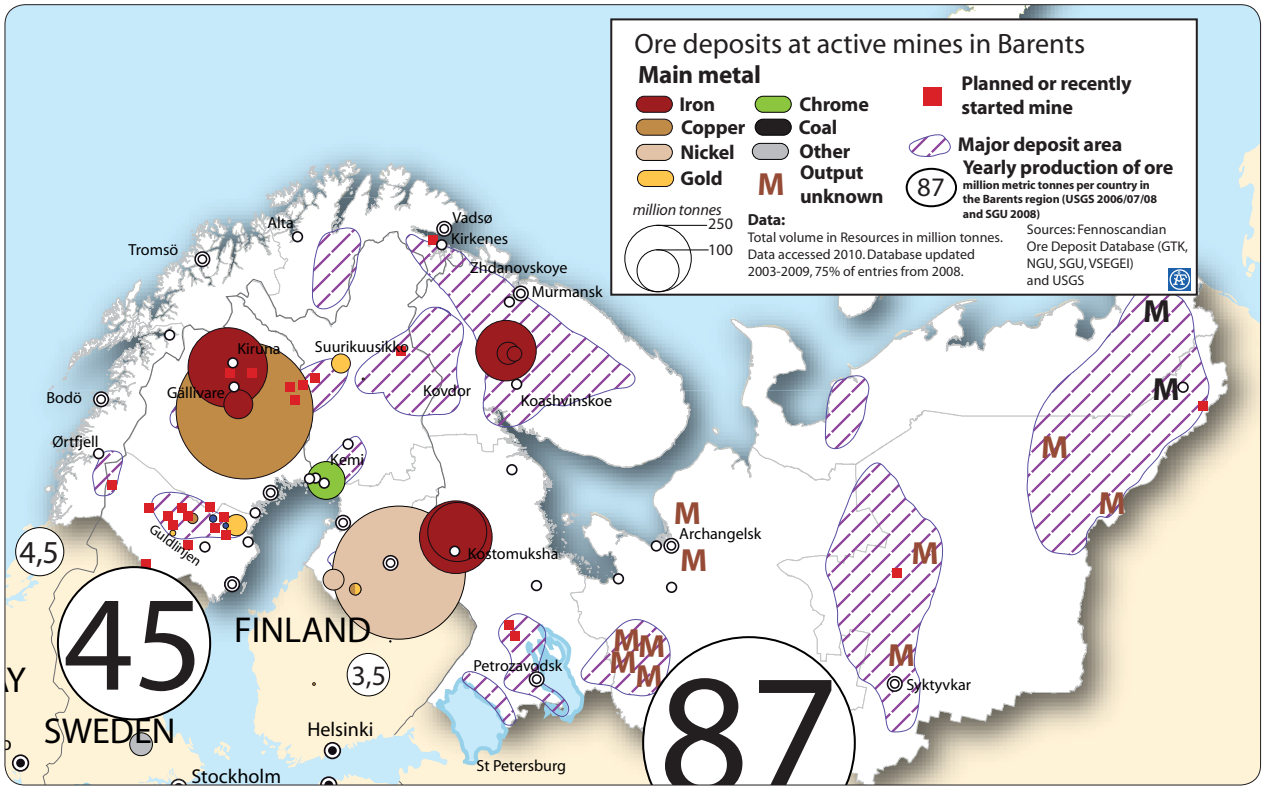


Figure 3.2:4 *Ore deposits in active mines in the Barents region*
Source: *Fennoscandian ore deposits database.*

Rock waste

Rock waste from mining is a voluminous rest product of future importance, but adequate transport links, preferably railway or railway combined with sea transports, are required to tap this potential.

Rock waste can be used for road and railway construction, for concrete etc. There is a major demand of rock waste, in particular in large, dynamic city regions and in regions with poor rock quality, for example in the Baltic countries. The use of rock waste from mining saves land and reduces impacts from quarries in large city regions.

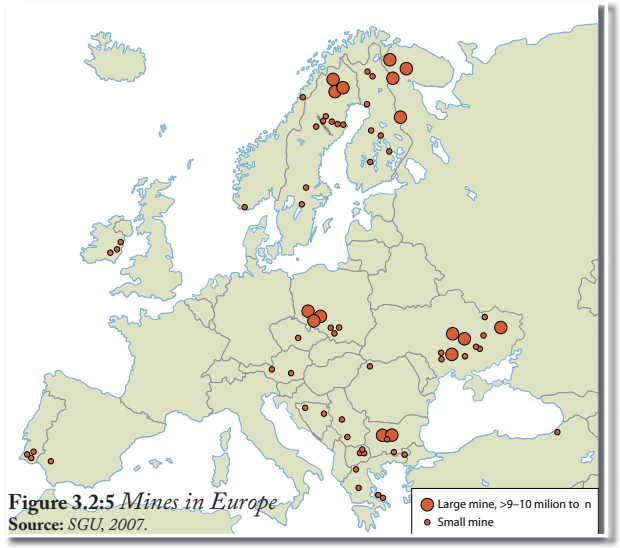


Figure 3.2:5 *Mines in Europe*
Source: *SGU, 2007.*

Examples from Nordic mining industry

Increased capacity and new mines

In the next few years, LKAB (Europe's largest producer of iron ore) plan on opening three new iron ore mines in the Svappavaara area, 60 kilometres south east of Kiruna. The new mines in Svappavaara will increase LKAB's capacity to respond to increased demand for iron ore products. LKAB has expanded the capacity above ground for the past five years, with two new pelletizing plant and upgraded logistics structure, and thus has capacity for increased production. The goal is an annual production of 37 million tonnes per year, an increase of 10 million tonnes. The three new deposits together contain about 300 million tonnes of iron ore, and has an iron content of 40 to 55 percent.

Boliden´s Aitik is one of Europe´s largest copper mines. The operation is currently being expanded with the aim of doubling the annual production from 18 million tonnes to 36 million tonnes. A spur line from Malmbanan railway has been built in order both to improve logistics and to benefit the environment.

New iron ore deposits have been found in the vicinity of Kaunisvaara in Swedish Pajala and in Kolari on the Finnish side. The identified mine deposits may together have an equivalent volume of the ore deposits in Malmberget, that is approximately 340 million tonnes. The mining of iron ore in the deposits in Pajala/Kolari is planned to start in 2012 with a production of 2 million tonnes per year. Production is expected to increase to 5 million tonnes per year in 2014.[17]

A number of mining projects, which are significant by international standards, are under way also in Finland. The Suurikuusikko gold deposit, boasting proven economic gold content of about 120 tonnes, may eventually be Europe's largest operating gold mine.

The Talvivaara nickel deposit is the largest in western Europe. The deposit also has significant amounts of copper, cobalt and zink. Based on proven reserves, the mine has the capacity to produce nearly 3 percent of the world's nickel over its scheduled 25-year operating life. However, potential reserves indicate that the mine may ultimately operate many years longer. A second important nickel mining project is the Kevitsa mine near Sodankylä. The nickel-PGE ore body is nearly as extensive as that of Talvivaara. Production at the Kevitsa mine is planned to start in 2010.

Ore findings and innovative concentration methods will be creating a solid foundation for sustained mining investment. Due to studies carried out by the research institute Ruralia the mining development will create jobs, promote entrepreneurship and development of skills[18]. Finland's mining industry in the medium-term may provide a considerable economic boost to regional economies by bringing large investment to remote

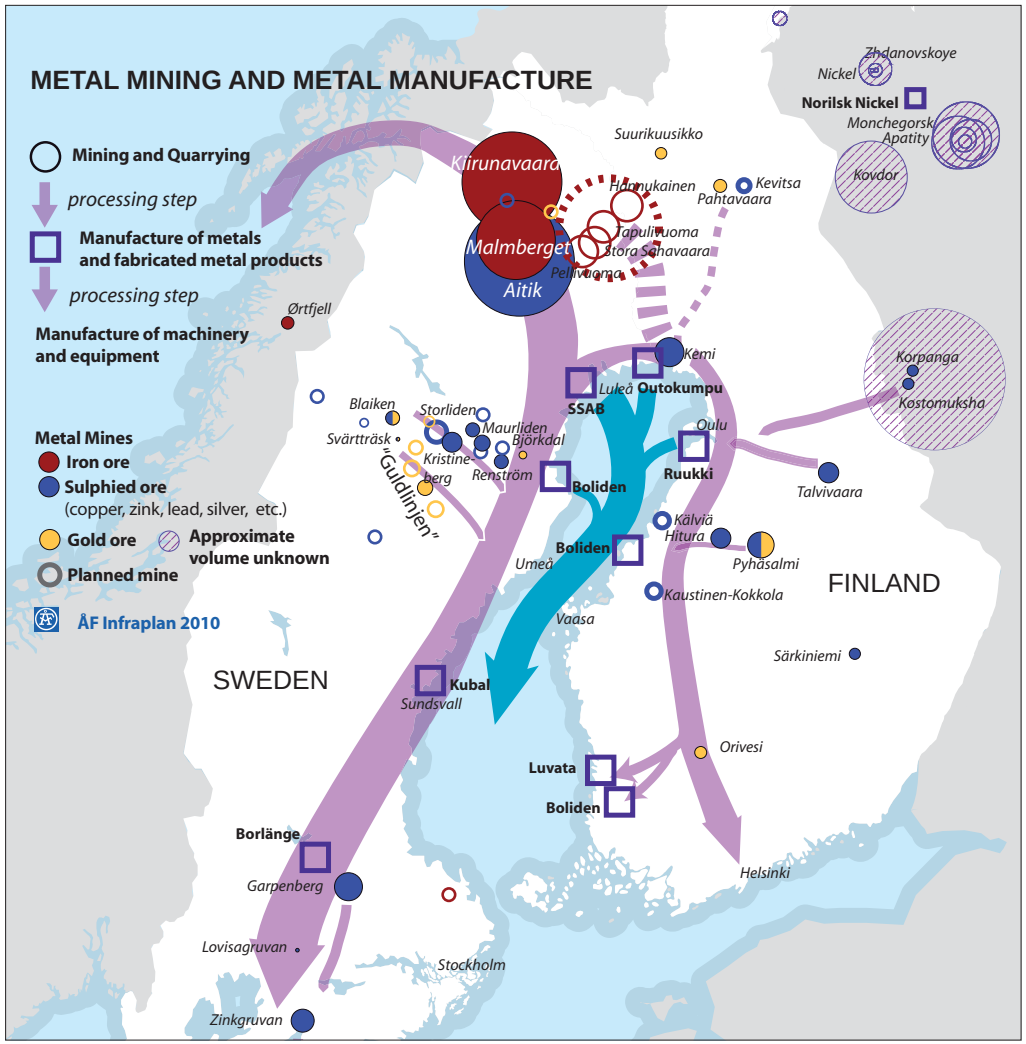


Figure 3.2:5 *Metal mining and metal manufacture in Sweden and Finland and principle goods flows. Based on mineral ore from northern Europe, a wide range of manufacturing is carried out in the EU, ranging from basic metals to motor vehicles and machinery and equipment. Large volumes of metal goods are transported to the European market primarily by sea and rail.*
Source: *ÅF Infraplan, 2010.*

17 www.northlandresourcesinc.com/s/Projects.asp
18 Törmä H & Reini, 2009, Ruralia Institute

areas traditionally lacking high-paying industrial jobs.[19]

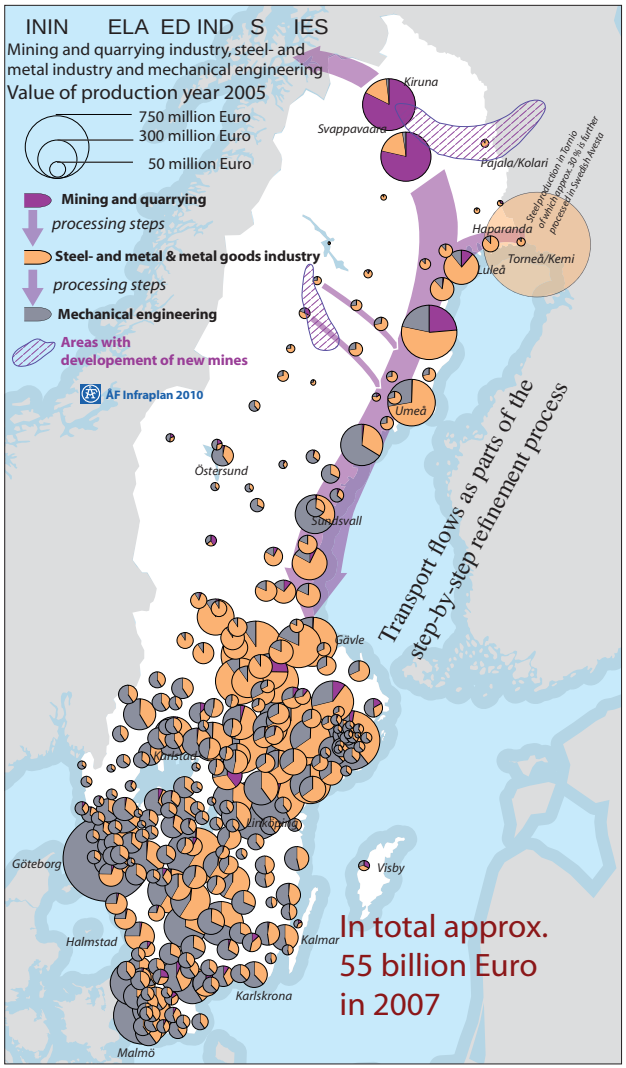


Figure 3.2:6 *The example is from the Swedish mining industry as statistics from the Barents region as a whole is lacking. Raw material production in the north is the main basis for the processing industry in other parts of Sweden and in the EU. Based on Swedish ore and metals, approximately 55 billion Euro is produced in the Swedish industrial system and even relatively more within the rest of EU.*
Source: *ÅF Infraplan, 2009, based on Statistics Sweden.*

Figure 3.2:7 *Example of processing flows for the Swedish steel company SSAB.*
Source: *ÅF Infraplan, 2010.*

19 GTK Annual report 2007, Geological Survey of Finland.

Main basis for a competitive processing industry

Mineral ore is the basis of production in a value chain including many industries.

Consumers of mineral raw material include:

- basic metals
- non-metallic mineral products
- construction
- chemicals
- other mining and quarrying

Consumers of processed mineral materials include:

- construction
- chemicals
- basic metals
- metal products
- motor vehicles
- machinery and equipment
- non-metallic mineral products
- electrical machinery

The production value of the EU's domestic mineral raw material from mining equals 45 billion Euro (2005). The EU's net import of mineral raw materials amounts to 14.1 billion Euro.[20]

Based on the mineral raw material, a wide range of manufacturing is carried out in the EU. The total production value for consumers of mineral raw materials in EU27 amounts to 2 551 billion Euro, corresponding to 18.4 million persons employed. Consumers of processed mineral material produce a value added equivalent to 1 325 billion Euro, creating employment for 29.7 million persons.[21]

20 Commission of the European Communities, SEC (2008) 2741
21 Commission of the European Communities, SEC (2008) 2741

Region	Forest land (1000 ha)	Productive forest land (1000 ha)	Growing stock on forest land (mill. m³ standing volume)	Annual increment under bark (mill. m³ per year)
Murmansk Oblast	*9,364*	*5,198*	*212*	*2,0*
Republic of Karelia	*14,930*	*9,102*	*859*	*11,9*
Arkhangelsk Oblast	*29,258*	*21,631*	*2,393*	*20,5*
Republic of Komi	*29,145*	*19,554**	*2,660*	*28,0*
Lapland	*4,946*	*4,699***	*360*	*11,6*
Kainuu	*1,710*	*1,625***	*159*	*6,5*
Oulu/N. Ostrobothnia	*2,410*	*2,290***	*212*	*9,6*
Norrbotten	*5,285*	*3,609*	*288*	*9,4*
Västerbotten	*4,149*	*3,104*	*302*	*10,0*
Nordland and Troms	*1,456*	*1,001*	*57*	*1,5*
Finnmark	*data not available*	*data not available*	*data not available*	*data not available*
Barents region	***102,653***	***71,813***	***7,501***	

** Statistics on productive forest land is not available for the Republic of Komi. An assumption has been made that the share of productive forest land as part of total forest land is the same as for the other 3 oblasts of the Barents region, i.e. 67 % (FAWS/Forest land for Russia as a whole equals 64%).*
*** Statistics on productive forest land is not available on a regional level in Finland. An assumption has been made that the share of productive forest land as part of total forest land is the same as i Finland as a whole, i.e. 95 %.*

Figure 3.3:2 *Forest resources in the Barents region.*
Sources: *Swedish Forest Agency 2004–2008, Statistics Norway, The National Forest Inventory 2000–2004, Finnish Statistical Yearbook of Forestry, 2004–2007, arcticcentre.ulapland.fi.*

3.3 Wood resources and forest based industry

Wood resources

Northern Europe in an EU27 perspective

Sweden and Finland together account for 34 percent of the EU27 countries' forest land and 33 percent of the forest available for wood supply. Norway has only a limited amount of forest land, around 8 000 hectares.

With over 800 million hectares or forest land, the Russian Federation has about 22 percent of the world's total forest area and 21 percent of the world's standing timber volume. Approximately 20 percent of the forest land of the Russian Federation is located in the European part of Russia, while the remaining part is located in Siberia and the Russian Far East.[22]

22 http://arcticcentre.ulapland.fi/barentsinfo/economic/02/02.html

The average annual change of forest land is relatively small; +0,04 percent in Finland, +0,004 percent in Sweden, +0,4 percent in Norway and -0,1 percent in Russia.[23]

	Forest land (1000 ha)	Share of EU27	FAWS* (1000 ha)	Share of EU27
EU15	*113,567*		*95,525*	
EU27	*146,951*		*123,534*	
Sweden	*27,264*	*19 %*	*21,236*	*17 %*
Finland	*21,883*	*15 %*	*20,675*	*16 %*
Norway	*8,710*			
Russia	*816,538*			

*Forests available for wood supply.

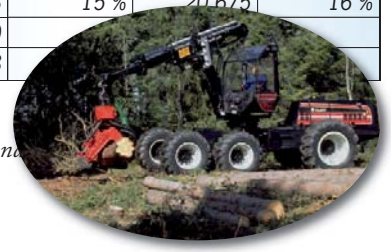


Figure 3.3:1 *Forest land an*
Source: *Eurostat/TBFRA, 2000.*

23 Eurostat, Subdivision and development of wooded area, 2000 (Source: TBFRA 2000).

Forest resources in northern Europe

The forest area in the Barents region amounts to more than 100 million hectares, which equals 70 percent of the forest area of EU27. With 20 million hectares of forest area, the Finnish, Swedish and Norwegian part of the Barents region accounts for approximately 14 percent of the total forest area of the EU.

The forest area in the Swedish parts of the Barents region amounts to about 10 million hectares, which corresponds to a third of the Swedish forest area. Growing stock on forest area accounts for 590 million m^3, which is 20 percent of the Swedish total. The forestry industry has opportunities to increase wood production significantly by the use of fertilization.

The Finnish part of the Barents region accounts for 730 million m^3 of the forest resources, corresponding to a third of Finland's total forest resource. Finnish forest industry has previously imported a relatively large share of raw materials from Russia.

The total forest resources of the Murmansk and Arkhangelsk Oblasts, and the Republics of Karelia and Komi amount to over 6 billion m^3, corresponding to around 7,5 percent of the Russian Federation's total wood volume. The Republic of Komi has the largest timber resources of the regions of Northwest Russia. Altogether, a significant potential for expansion and development of both mechanical and chemical wood industries exists in northwest Russia.[24]

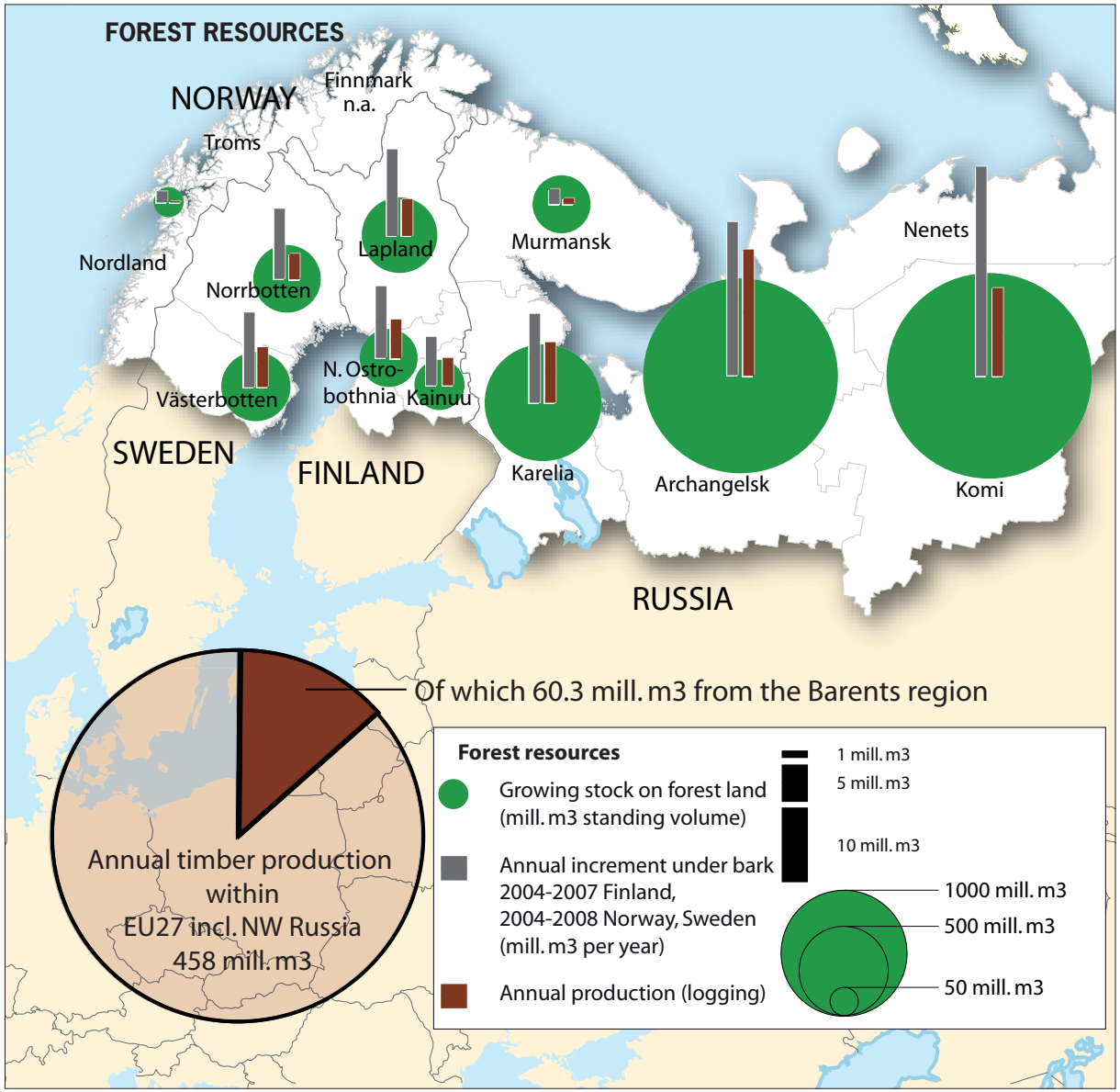


Figure 3.3:3 *Forest resources, annual increment and annual production in the Barents region.*
Sources: *Swedish Forest Agency 2004–2008, Statistics Norway, The National Forest Inventory 2000–2004, Finnish Statistical Yearbook of Forestry, 2004–2007, arcticcentre.ulapland.fi. Eurostat, Roundwood removals total under bark, 2008.*

24 http://arcticcentre.ulapland.fi/barentsinfo/economic/

Figure 3.3:3 illustrates the vast forest resources in northern Europe. The annual increment in the region is higher than annual logging, which entails that forest resources, especially in the northernmost parts of Finland and Sweden and in the Komi Republic, are growing. In the Komi Republic, limited access to wooded areas is restricting the timber production. Protected nature areas also play a part in the continous growth of forest resources in the Barents region. These protected areas are particularly large in northern Finland and northern Sweden. In 2008, the Finnish part of the Barents region counted for 85 percent of the total Finnish protected forest area.[25] The Swedish part of the Barents region held 64 percent of Sweden's total area of nature reserves (2007).[26]

25 Statistical yearbook of forestry. Finland
26 Swedish Forest Agency.

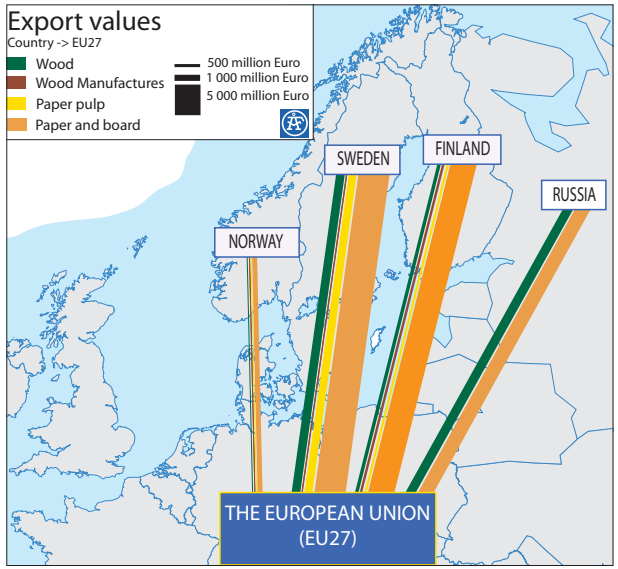


Figure 3.3:4 *Sweden, Finland and Russia are the world's second, third and forth largest exporters of pulp, paper and sawn timber. Large export shares go to the EU market. Significant shares of these exports are generated in the northernmost parts of the respective countries.*
Sources: *Statistics Norway 2008, Federal State Statistical Service Russia 2008, Eurostat 2008.*

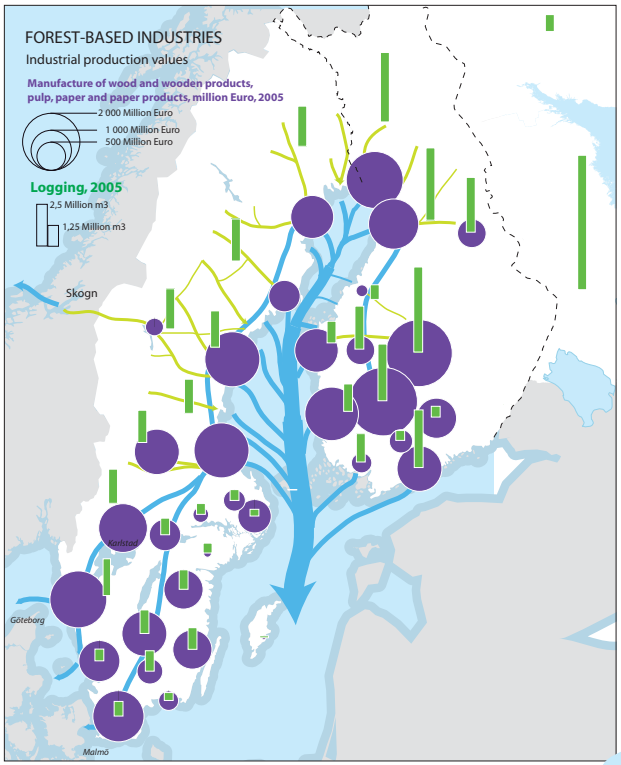


Figure 3.3:5 *Logging and industrial production values based on forest resources. The northern parts of Sweden and Finland have large forest resources, which are used in the rest of the EU in form of pulp and paper, sawn and planed timber.*
Source: *ÅF Infraplan 2010.*

Figure 3.3:6 *An example of flows from forest industry based in northern Sweden.*
Sources: *ÅF Infraplan 2010*

Annual timber production in the Barents region equals around 13 percent of the total timber production in the EU including northwestern Russia.

A common timber market with local variations

Major industries in the area often have larger catchment areas for their wood supply. The forest industry in northern Sweden competes with industries all around the Baltic Sea for the commodity.[27]

The general trend seems to be one of equalization of the wood price in the Baltic region. However, several factors suggest that regional differences in raw material supply will persist also in the future. These factors include supply accuracy, quality aspects

27 Norrbottens läns landsting, 2008.

3.4 Energy resources

Europe is currently depending on imports of energy and the EU is a major importer of oil and gas. Among the countries of northern Europe, Russia and Norway possess the largest reserves of oil and gas.

The emissions of greenhouse gasses is one of the central issues in the energy discussion today. The EU adopted an integrated energy and climate change policy in December 2008, including ambitious targets for the year 2020. The targets are:

- cutting greenhouse gas emissions by 20 percent
- reducing energy consumption by 20 percent through increased energy efficiency
- meeting 20 percent of energy needs with renewable sources

The Barents region has a wealth of renewable energy, with hydro power currently as the main energy source for electricity generation and with great potential for new wind power and bioenergy production.

Hydro power

Hydro power is an energy source of great importance in the Barents region. In 2007 the annual production of the region was around 70 TWh[32] which is as much as 23 percent of the annual production of 310 TWh within the EU27.[33] In the Nordic part of the Barents region, where hydro power accounts for almost all electricity produced, there is limited opportunity for further expansion. Few rivers remain unexploited and they are therefore protected because of their value to the environment. However, output can still be enhanced by around 30 percent[34] mainly by increasing the capacity of the turbines.

In Murmansk and Karelia hydro power plays an important role for electricity supply and further expansion is possible throughout the whole Russian part of the Barents region.

A great advantage of hydro power is the ability to regulate production. Therefore hydro power can complement other renewable energy sources which are more difficult to regulate, in particular wind power.

32 Norwegian Water Resources and Energy Directorate, Swedenergy industry organisation, The Finnish Energy Industry Association and www.barentsinfo.com
33 Energy, transport and environment indicators. 2009 edition, Eurostat.
34 Norwegian Water Resources and Energy Directorate, ERENE-European Community for Renewable Energy. Volume 3, Heinrich-Böll-Stiftung 2008 and The Finnish Energy Industry Association

Figure 3.4:1 *Existing and potential hydro power and wind power production in northern Europe (TWh/year).*
Source: *Regional authorities, compiled by ÅF Infraplan.*

Wave power

Wave power is an unexploited energy source with great potential and in all countries in the Barents region there is ongoing research in this field. The greatest opportunities are along the Norwegian and Russian coasts.

North of Murmansk there is a pilot plant for tidal power in Kislaya Guba with a capacity of 400 kW. Two larger tidal power plants are also being planned, one of them will be situated at Mezen in the Archangelsk Oblast.

Wind power

Countries in southern and central Europe have already installed a large amount of wind power capacity. The expansion in these countries has been facilitated by political action and economic incentives.

The Barents region extends over large unpopulated areas with large wind power opportunities at higher altitudes and along the coasts. For this reason, the region holds great potential for wind power production.

In Norway, Sweden, Finland and Russia the demand for electricity has previously been met by hydro power and nuclear power and electricity from fossil fuels. Only a small part of the potential for wind power production is being used. By the end of 2009 the installed capacity was 430 MW in Norway, 1560 MW in Sweden, 150 MW in Finland and around 20 MW in Russia, altogether around 2200 MW.[35]

However, many wind power projects are under way in the Barents region. See figure 3.4:3 where the planned projects of northern Sweden and Finland are shown. If all of the planned projects are realised then the Barents region can increase wind power production tenfold. The capacity of the planned wind power projects is around 22 000 MW[36], which equals a production of 60 TWh/year. This in turn corresponds to the annual production of hydro power in the Barents region.

This opportunity to increase production of renewable energy substantially in northern Europe is of great importance for sustainable industrial production and sustainable transports.

35 Wind in power: 2009 European statistics. EWEA: The European Wind Energy Association, 2010.
36 Norwegian Water Resources and Energy Directorate, Regional authorities in Sweden, The Finnish wind power association and www.barentsinfo.com

OJ L 140/16, 5.6.2009 (OJ L 140/16, 5.6.2009)

In addition to the planned wind power projects in the Barents region there are further unexploited areas in the Russian part of the region which hold great potential, mainly along the Barents Sea and the White Sea. The planned wind power projects in the Russian part of the Barents region currently amounts to 200 MW and are mainly located in the Murmansk Oblast.[37] Planning of wind power projects in the Russian part of the Barents region is partly limited due to the military restricted areas along parts of the coasts.

The common challenge for wind power throughout the Barents region is the arctic climate which can cause icing of the power plants. Another challenge is the insufficient capacity of the electrical grid which limits the possibility of utilising the energy potential.

Bioenergy

Bioenergy is renewable energy produced from biomass, which if produced in a sustainable manner has a zero carbon footprint. The Barents region holds a wealth of sustainable bioenergy resources mainly in the vast forest areas.

A large share of the more than 60 million m^3 of logged forest (see section 3.3) is already being used for heating purposes. In Sweden, around 45 percent of the roundwood is used as energy shortly after logging, mainly in the pulp and paper industry[38]. If this share would be scaled up to the logging in the entire Barents region, this would mean a potential annual energy yield of 150 TWh of heat (with a conservative calculation of 2,500 kWh per m^3 wood fuel).

Russia is a very large forest nation with enormous resources of biomass. The large distances and sparse infrastructure however make it difficult to achieve profitability in transporting the bulky and low-value (compared to the more abundant fossile fuels) biomass to cities or ports. This has hampered the development of biofuels in Russia.

Much research and technical development around biofuels have therefore been concentrated in Sweden and Finland. One example is the regional co-operation *BioFuel Region* (in Västerbotten and Västernorrland in northern Sweden) supporting development and introduction of renewable fuels. In Norrbotten, important research and application are formed around the forestry industry in Piteå, which is developing new fuels from the residual products of the paper industry.

In Finland and Sweden, around 25 percent of total energy supply comes from bioenergy, while Norway and Russia have much smaller shares[39]. In Norway, 5 percent of energy consumption came from bioenergy in 2008[40]

In Sweden and Finland, peat is classified as a *slowly renewing biomass fuel* as opposed to the stance of the European Union and Intergovernmental Panel on Climate Change which classify peat strictly as a fossil fuel. Northwestern Russia, in particular the Arkhangelsk Oblast and the Republic of Karelia, possess large peat reserves, which so far remain practically unexploited. These reserves could be used to improve the energy status of deficit regions, both in Russia and the EU, which today are dependent on fuel imports[41].

There is also some biogas production in the Barents region, connected to waste treatment facilities and dairy production.

37 www.barentsinfo.org

38 Johansson, B. 2007. Bioenergi till vad och hur mycket? Formas Fokuserar.

39 www.finbioenergy.fi and Energiläget i siffror 2009, Energimyndigheten.
40 Norwegian statistics
41 www.barentsinfo.org

Electricity infrastructure

Renewable energy sources like wind power and bioenergy will become increasingly important as a complement to the current electricity production (hydro power, nuclear power, oil, gas and coal) and play an important part in reducing emissions.

There are ongoing projects between the Baltic Sea countries to strengthen and connect the national grids to enable more wind power, both land-based and off-shore. An example is the European Wind Energy Associations (EWEA) Offshore Network Development Plan that is providing a step by step approach to the planning of Europe's offshore grid in the North Sea and the Baltic Sea.

The electrical grid in the Barents region has not enough capacity to distribute the amount of energy that could potentially be produced and the current grid provides few access points to the other European grids. Part of the output can be consumed in the region by heavy industries, but most of the power needs to be transmitted to the more populated southern parts of each country and further to the densely populated parts of the European continent.

Insufficient power grid capacity is a serious limitation to exploite the potential of renewable energy. According to the Swedish transmission system operator Svenska Kraftnät it takes at least five years to build a new 400 kV transmission line which means that the expansion is threatened to be significantly delayed. Only in Sweden three to four 400 kV lines are required to exploit the existing potential and one of the bottlenecks is close to Gävle (150 km north of Stockholm)

In the Russian part of the Barents region, a new grid construction is less urgent since less production is planned so far but the question is likely to grow in importance over the next decade.

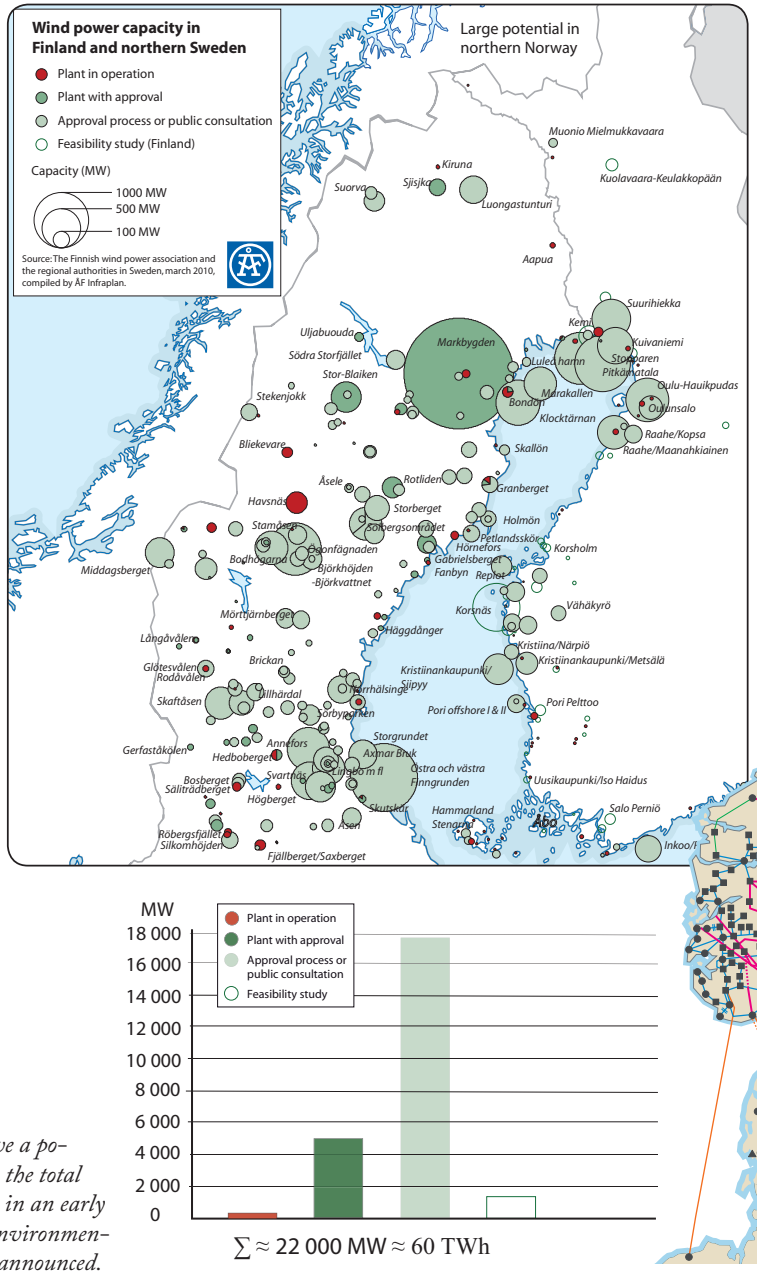


Figure 3.4:2 *The planned wind farms of the Barents region have a potential output of around 60 TWh/year, which is comparable to the total nuclear power production in Sweden. Many of the projects are in an early planning phase and may not be realised due to economical or environmental reasons, but there are also many additional projects still unannounced.*

Figure 3.4:3 *In the northern parts of Sweden and Finland, many wind power projects are under way, but realizing this potential requires an improved transmission grid to the southern parts of each country and to the rest of Europe. The need for improved grid capacity will be intensified by the large potential wind power capacity in northern Norway and on the Kola peninsula.*

Figure 3.4:4 *The grid in Norway, Sweden and Finland.*

Oil

Global oil production is near its peak. Since 2004 production has been between 71 and 75 million barrels (1 barrel = 159 litres) of crude oil per day[42].

Norway was the 12th largest oil producer and 6th largest oil exporter in the world in 2008, see figure 3.4:6. The top importers of Norwegian oil in 2008 were all EU countries, see figure 3.4:7. According to EIA, current crude oil production is about two million barrels per day. Norwegian production peaked in 2001, with 3.4 million barrels per day, and is now in decline.

In 2009 Norway ranked 20th in the world with 6,680 million bbl (barrels) in proved oil reserves which means that the country still has more reserves than the entire EU.

Russia was the world´s second largest producer and exporter of oil in 2009. Current production is about 9.6 million bbl of crude oil per day. Russia, with 79,000 million bbl, is ranked eight in the world in proved oil reserves.

In the Barents region the Timan-Pechora oil and gas region has large estimated oil resources of over 4,800 million tonnes (1 metric ton of crude oil ≈ 7.3 barrels of crude oil), with an estimated ability to extract over 1,400 million tonnes. The Republic of Komi has 520 million tonnes of oil resources. [43]

42 EIA (U.S Energy Information Administration
43 Source: http://arcticcentre.ulapland.fi/barentsinfo

Figure 3.4:5 *Norwegian and Russian oil and gas fields.*
Source: *EIA, Irish Offshore Operators' Association (IOOA) processed by ÅF.*

Country	Million bbl/day	Period
Russia	9.6	nov 2009
Norway	2.0	nov 2009
Denmark	0.25	nov 2009

Figure 3.4:4 *Current crude oil production.*
Source: *EIA (U.S Energy Information Administration)*

Country	Million barrels	Rank	Year
Saudi Arabia	266,700	1	1 jan 2009 est.
Canada	178,100	2	1 jan 2009 est.
Iran	136,200	3	1 jan 2009 est.
Russia	79,000	8	1 jan 2009 est.
Norway	6,680	20	1 jan 2009 est.
EU	5,504	22	1 jan 2008
Denmark	800	41	1 jan 2009 est.

Figure 3.4:6 *Oil - proved reserves.*
Source: *CIA The World Factbook*

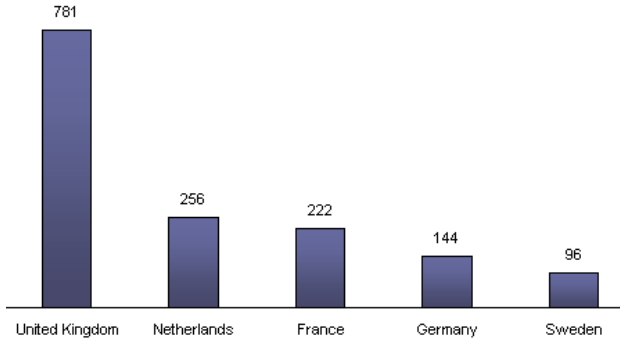


Figure 3.4:7 *Top importers of Norwegian oil 2008 (Thousand barrels per day).*
Source: *Statistics Norway, 2009*

Natural gas

The Barents region is very important for the gas supply of the EU. Russia and Norway are the major suppliers of gas to Europe, and their share of the EU' gas imports in 2006 was 62 percent.

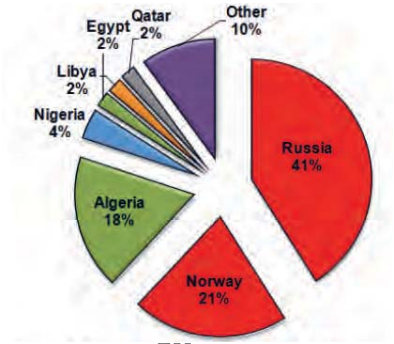


Figure 3.4:8 *EU gas imports in 2006.*
Source: *Production from Giant Gas Fields in Norway and Russia and Subsequent Implications for European Energy Security, Bengt Söderberg 2010 (based on data from the International Energy Agency).*

Norwegian natural gas production and exports have increased rapidly since 1995 (figure 3.4:10). Norway provided 21 percent of the EU imports of natural gas in 2006. Norway, ranked 16th in the world with 2,259,000 million cubic metres in proved reserves, has more natural gas than the entire EU.

In the Barents region new investments are made. Snøhvit plant at Melkøya near Hammerfest in Finnmark, put into operation in September 2007, is the first LNG (liquefied natural gas) production plant in Europe.[44]Norwegian gas production is expected to decline by 2030 and exports to the EU via pipeline may even be 20 percent lower than today. [45]

44 www.statoil.com/en
45 Production from Giant Gas Fields in Norway and Russia and Subsequent Implications for European Energy Security, Bengt Söderberg 2010)

Country	Million CU M	Rank	Year
Russia	43,300,000	1	1 january 2009 est.
Iran	28,080,000	2	1 january 2009 est.
Qatar	25,260,000	3	1 january 2009 est.
Turkmenistan	7,940,000	4	1 january 2009 est.
Norway	2,313,000	16	1 january 2009 est.
EU	2,259,000	17	1 january 2008 est.
Denmark	60,000	62	1 january 2009 est.

Figure 3.4:9 *Natural gas - proved reserves (million cubic metres).*
Source: *CIA The World Factbook*

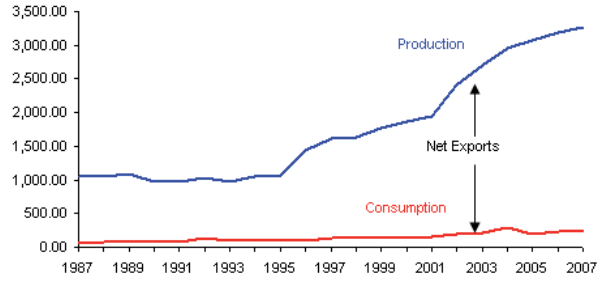


Figure 3.4:10 *Norwegian natural gas production, consumption and net exports (Billion cubic feet per day).*
Source: *EIA*

Russia has the biggest natural gas reserve in the world. The potential Barents Sea natural gas resources are estimated at 10,000 bcm (billion cubic metre; km3), of which the Shtockmanovskoye (Shtokman gasfield) natural gas and condensate field is estimated to hold 3,000 bcm. The estimated recoverable reserves of the Shtockmanovskoye field are 2,500 bcm, and the estimated potential annual production capacity is 100-150 bcm. The Timan-Pechora oil and gas region, which covers parts of the Republic of Komi and the Nenets Autonomous Okrug, has estimated natural gas resources of over 600 bcm. In addition, the Republic of Komi has 30 million tons of estimated gas condensate reserves and 200 bcm of natural gas reserves.[46] A study of the potential production from Russian giant fields finds that exports of Russian gas to the EU could increase by a maximum of 45 percent by 2030. In absolute terms this corresponds to approximately 70 Gm^3/year.[47]

The single most important factor, to increase the current levels in Russian gas exports to the EU, is whether the gas fields on the Arctic Yamal Peninsula (which lie just on the Asian side of the border between Europe and Asia) will be in operation from 2012 onwards. The gas will be distributed to EU countries in the Yamal - Europe pipeline via the Barents region.[48]

46 www.barentsinfo.org
47 Bengt Söderberg, 2010)
48 Bengt Söderberg, 2010)

Coal

With 173 billion short tons (1 short ton = 2,000 pounds = 907 kg) Russia holds the world's second largest recoverable coal reserves. Russia produced 321 million short tons in 2006, making it the fifth largest in the world. The country consumed roughly 260 million short tons, leaving 61 million short tons for exports. According to the government's energy strategy, Russia should produce between 441 and 496 million short tons by 2020.[49]

In the Barents region Komi is important with 30 million tons per year.[50] The Republic of Komi alone has estimated reserves of 8.5 billion tons.[51]

Net exports of energy

Figure 3.4:11 shows the countries' net export values to the European Union (EU27).

49 EIA
50 USGS, US Geological survey, 2006 minerals yearbook
51 http://arcticcentre.ulapland.fi/barentsinfo

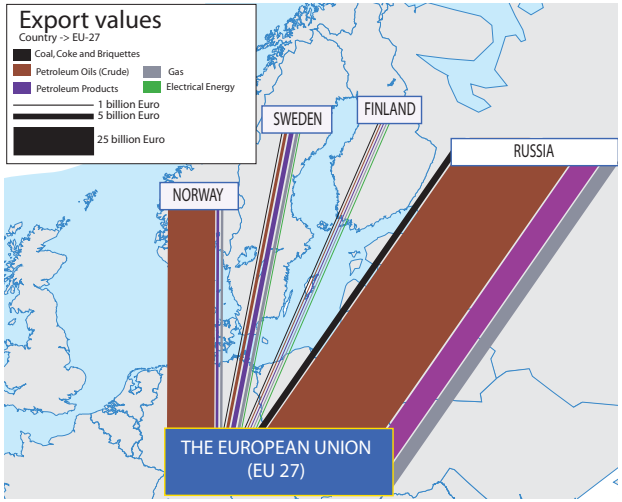


Figure 3.4:11 *Net export values of energy 2008.*
Source: *Statistics Norway, Eurostat, Federal State Statistical Service Russia.*