Europe

Growing concern over climate change and energy security dominated the political agenda in Europe in 2006. Urban air quality has much improved in the region, but air pollution continues to have serious adverse health effects.

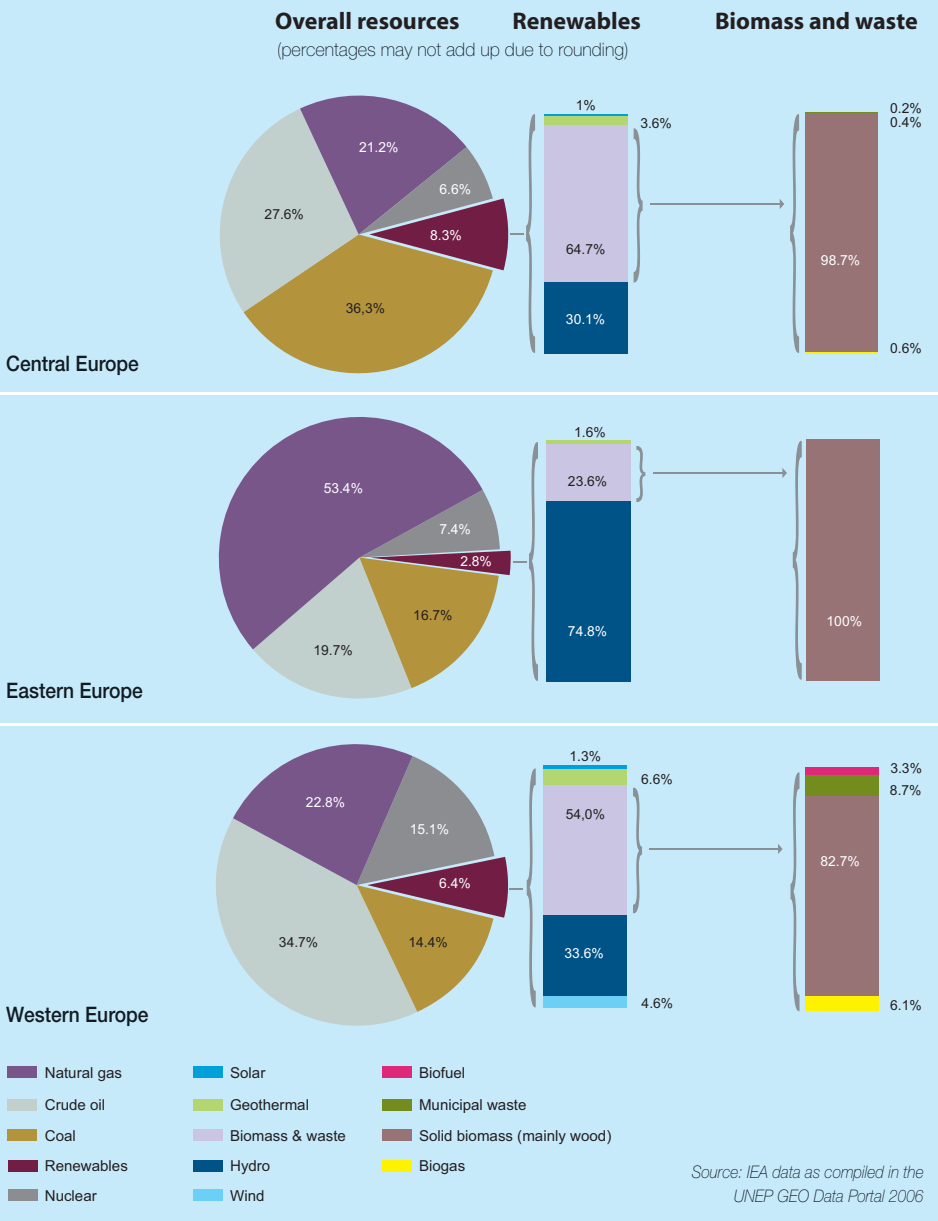
ENERGY SECURITY

Despite clear energy efficiency improvements, the whole of Europe continues to release increasing amounts of greenhouse gases (GHGs) and air pollutants, putting serious pressure on Europe's environment, economies, and human health (EEA 2006a, EEA 2006b, Kowalski 2006). Nearly 80 per cent of the energy consumed in the European Union comes from fossil fuels, as does over 85 per cent in Central Europe and 90 per cent in Eastern Europe **(Figure 1)**. These fuels are expected to dominate Europe's energy sources in coming decades (EC 2006a, IEA 2006a, Kowalski 2006). Fossil fuel dependence is a growing concern in Europe—perceived as reponsible for problems with energy security; climate change effects such as extreme weather events and sea level rise; and other problems such as generation, oil spills, and health problems from air pollution (EEA 2006a, EEA 2006b, Kowalski 2006, WHO 2006a).

The energy security context varies considerably within Europe. The European Union (EU-25) imports 50 per cent of its energy requirements, while Russia is the world's second largest exporter of oil and the world's largest exporter of natural gas (EEA 2006b, IEA 2006b). The potential for energy resource scarcities over the long term causes some concern among analysts—more so for oil and natural gas, less so for coal and uranium. Other major concerns are soaring energy prices, power disruptions due to extreme weather events, effects of climate change and air pollution on environment and human health, and potential threats to supply—a concern heightened by Russia's early 2006 interruption of gas supplies to the Ukraine pipeline network, which also supplies several Western European countries **(Box 1)**.

Although changes in Europe's fuel mix have slightly reduced emissions of GHGs per unit of energy produced, total GHG emissions are rising again. This is mainly caused by increasing use of coal for electricity production—a reaction to rising gas prices (EEA 2006b, EEA 2006c, Kowalski 2006). In addition, energy efficiency gains are largely offset by the continuous growth in total energy consumption, particularly in the EU-25, but also in Southeastern and Eastern Europe where consumption is rising (GEO Data Portal 2006). Energy production and consumption are major sources of GHG emissions and air pollution, but they are key to economic growth. Therefore, many European governments are in the process of revising their energy policies to better balance energy security, economic efficiency and competitiveness, and environmental acceptability by seeking to diversify the energy mix and energy supply routes among other options **(Box 2)**.

Figure 1: Energy consumption in Europe



Source: IEA data as compiled in the UNEP GEO Data Portal 2006

Box 1: European energy security issues, objectives, and policy priorities

This box summarizes some of the major issues involved in the energy security debate and lists various objectives and policy priorities proposed by authors and institutions.

Issues
- Continually increasing energy consumption
- Environmental degradation
- Unreliable energy supply and fluctuating prices
- Disruptions and uncertainties due to terrorism, social unrest, price disputes, and natural disasters.

Objectives
- More efficiency in energy production and consumption
- More environmentally sound technologies
- More diversity in energy mix and supply
- Reduced vulnerability through safer energy infrastructure (pipelines, refineries, electricity networks) and better emergency preparedness
- Sufficient levels of environmental and human health protection
- Long term reliability and availability of energy at reasonable prices
- Reliable access for producers to resources, markets, and consumers to justify future investment.

Policy priorities
- Stimulate technological innovation in energy efficiency and low carbon energy
- Promote a radical change in public attitudes towards drastic energy savings
- Tighten free credits, include more sectors in the EU Emission Trading Scheme, and expand UNFCCC projects under the Clean Development Mechanism
- Foster partnerships among energy-producing and energy-consuming countries so that supply sources and routes can be diversified and procedures agreed for sharing strategic emergency reserves
- Enable stable investment regimes through liberalized markets.

Sources: Yergin 2006, EC 2006a, EC 2006b, Howell of Guildford 2006, IEA 2006c , MNP 2006, NEA 2005, Kowalski 2006

Europe's coal reserves are abundant, readily accessible, and prices are stable, so coal remains an important fuel for electricity generation and heavy industries, despite the high levels of GHG emissions and air pollutants resulting from its use (EC 2006a, EC 2006b, Kowalski 2006). Capturing and sequestering carbon instead of emitting it to the atmosphere is seen by many as a promising technology to reduce GHG emissions and air pollution.

Opinions about the use of nuclear energy are shifting. Electricity is generated from 204 nuclear units in 19 European countries spread across the region, and uranium resources are considered adequate and widespread. Since the energy generated is carbon free and stockpiles can be maintained at reasonable costs, some countries such as the United Kingdom are reconsidering nuclear energy as a potential measure to reduce GHG emissions (NEA 2005 and 2006). Other countries such as Germany and Sweden are still phasing out nuclear energy, while others are building new units—ten are under construction in Bulgaria, Finland, Romania, Russia, and Ukraine (IAEA 2006). However, there are still serious public concerns and political debate about nuclear energy, especially over the disposal of nuclear wastes and the potential for accidents. These concerns, along with the problems of ageing of most European nuclear units, high investment costs, and long construction times, have prompted recent energy outlooks to project a slight nuclear reduction in Europe (EC 2006a, IEA 2006a).

Another promising option for diversifying Europe's energy mix is commercialization of renewable energy. Total renewable energy supply remains low in Europe, but there is considerable variation among countries. Some countries have achieved real increases and much higher percentages of energy from renewable sources. The share of renewable energy in the EU-25's electricity generation averages at 12.8 per cent, but nine countries including Belgium, Hungary, Poland, and the UK get less than 3 per cent from renewables while Austria, Latvia, Portugal, and Sweden get 35 per cent or more of their energy from renewable sources (Eurostat in EEA 2006b). Wind energy is virtually absent in Central and Eastern Europe, while Western Europe has 69 per cent of the world's total installed capacity of wind energy (REN21 2006). Overall, wind turbines supply only 2.5 per cent of Europe's current electricity demand (IEA 2006d).

Recently, promising renewable energy policies have been established, such as the EU-25 Biomass Action Plan and subsidies in favour of renewables in Denmark, Germany, and Sweden. Some new technologies are also showing promise. Today's wind turbines produce 180 times more electricity than 20 years ago at less than half the cost per unit. The International Energy Agency (IEA) projects that the share of renewable energy sources (excluding hydropower) in the EU will grow from 5 per cent in 2004 to 19 per cent in 2030, or 24 per cent in that same year if policies currently being considered to promote renewable energy are actually and fully implemented (EC 2005, Greenpeace 2006, IEA 2006a).

Progress towards a more energy-sustainable Europe will depend on improved energy efficiency achieved through a wide variety of innovative policies and technologies. Action should focus on replacing or decommissioning ageing coal and nuclear installations and introducing radical innovations in fuel switches, energy efficiency, carbon storage, and low carbon and carbon free technologies. All options need to be considered and large investments will be required to further research, develop, and exploit viable new

Box 2: The Baku-Tbilisi-Ceyhan oil pipeline inaugurated

In May 2006 the Baku-Tbilisi-Ceyhan (BTC) oil pipeline became operational. This 1 770 kilometre pipeline, with a capacity of 1 million barrels per day, runs from Baku, Azerbaijan through Georgia to Ceyhan on the Mediterranean coast of Turkey. The pipeline was commissioned by a consortium of 11 energy companies led by BP (formerly British Petroleum), which has a 30.1 per cent stake and operates the pipeline.

The pipeline will provide Caspian countries, Azerbaijan and Kazakhstan in particular, with adequate infrastructure for their growing oil shipments to international markets. It will advance EU efforts to diversify sources and routes of energy supplies and it will also eliminate some 350 tanker cargoes per year through the sensitive Bosphorus and Dardanelles straits that are dangerously congested by oil traffic. However, environmental concerns range from the threats to watersheds of the Borjomi National Park in Georgia (an area of mineral water springs that are a major export commodity) to the dangers posed by frequent and strong seismic activity throughout the region. The pipeline management is convinced that the environment of the three nations will be maintained through adherence to three separate environment and social impact assessments, very careful construction procedures, and community and environmental investment programmes (BP 2006).

Sources: EU 2006, BP 2006.

In Europe, woody biomass is by far the largest renewable energy source.

Source: Oed / Still Pictures

The full potential of wind energy is yet to be realized.

Source: Mike Schroeder / Still Pictures

technologies (EEA 2006b, IEA 2006a, MNP 2006). The new EU Emissions Trading Scheme (ETS) is expected to stimulate investment in emission reduction technologies **(Box 3)**. In addition, regulatory policy tools need to be considered, such as stricter ETS credits, licensing, information campaigns, energy-efficient labelling, and improved insulation standards for buildings.

Box 3: EU's Emissions Trading Scheme

The Emissions Trading Scheme (ETS) of the EU, launched in 2005, is the world's first market for buying and selling the right to emit CO_2. The scheme is the EU's key instrument to fight climate change and meet its Kyoto targets; it is seen as a more business-friendly way to reduce production of GHGs than taxes. Under the scheme, EU countries have set mandatory limits on how much CO_2 power plants and heavy industries may emit at country level. Companies receive a quota of free carbon credits allowing them to emit CO_2 up to that limit. If they emit less they can sell their credit surplus, but if they exceed it they have to buy credits from others.

In April this year the carbon credit reached its highest value (around US$40). However, when the first national emission reports were delivered in mid-April, it became clear that the allocation of credits had been too generous in the first phase of the scheme (2005-2007). Most companies had more credits than they needed, leading to a dramatic drop in carbon prices which fell below US$13 per metric ton in May.

To enhance the effectiveness and environmental benefits of the EU Emissions Trading Scheme, the European Commission urged Member States to present tougher credit limits in their National Allocation Plans (NAP) for the second trading period (2008-2012). The Commission is also examining the need for changes in the trading scheme. Legislation has been proposed to include the aviation sector and its implications are under study. The NAPs establish emission totals for different sectors and decide how the total is divided among installations covered by the scheme. Some countries have included more installations or more GHGs, others have not. Many countries have been late in submitting their NAPs.

In August ETS prices recovered to a level nearing US$26. In November the European Commission approved a first set of ten National Allocation Plans for the 2008-2012 trading period, provided that for nine out of the ten plans the emission allowances are reduced (only the emissions proposed by the United Kingdom were accepted). By 10 December 2006 the CO_2 prices had dropped to about US$10.

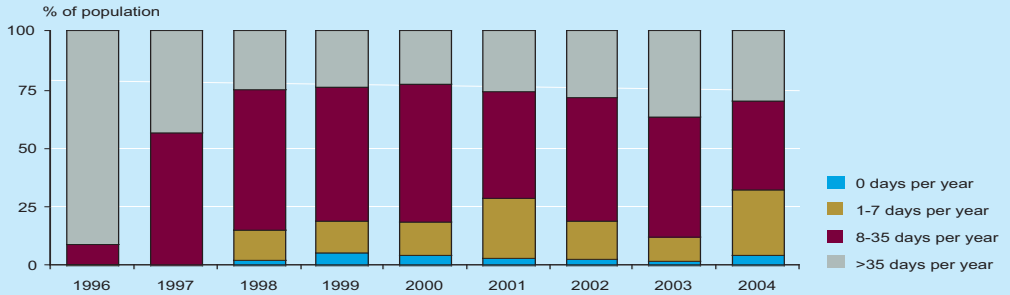
Source: EEA 2006c

URBAN AIR POLLUTION

Air quality has improved significantly in Europe over the last decades, due mainly to drastic policy measures at national and EU levels and the impact of the pan-European UNECE Convention on Long-Range Transboundary Air Pollution (EEA 2006a, EEA 2006e, EMEP 2006, UNEP 2006). In Western Europe and a significant proportion of Central Europe the air quality limit for sulphur dioxide, established by the EU, is now rarely exceeded—attributable to relatively simple measures such as switching to fuel with lower sulphur content or installing equipment in coal power stations to remove sulphur dioxide from stack emissions. However, improvements in emission trends are beginning to plateau. By 2020, sulphur emissions from international shipping on seas surrounding Europe are expected to be larger than the total land-based emissions in the EU-25 (Acidrain.org 2006). And evidence mounts that air pollution, ground-level ozone, and particulate matter (PM) continue to have serious adverse health effects **(Figure 2)**.

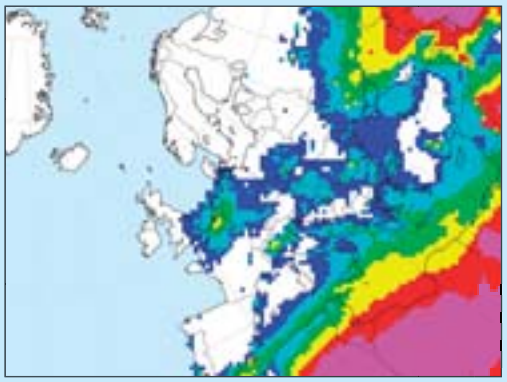
Recent World Health Organization (WHO) calculations show that current levels of PM reduce life expectancy by 8.2 months in the EU-15 and 10.3 months in the 10 new member states. In the EU-25 some 348 000 premature deaths per year are attributed to PM exposure. Effects are three times higher in hot spots polluted by traffic and heating emissions than in the least polluted areas (WHO 2006a). Effects of long term exposure to air pollution on life expectancy are thought to be mostly attributable to fractions of PM smaller than 2.5 micrometres ($PM_{2.5}$) (WHO 2006a). A new modelling report of the Environmental Monitoring, Evaluation, and Protection Programme (EMEP) shows that many major European cities are hotspots with daily and annual mean $PM_{2.5}$ concentrations that far exceed the WHO guidelines for PM, which are more stringent than the EU limits (EMEP 2006). The WHO guidelines are also exceeded in large areas outside Europe's highly populated urban areas, due to long-range transport of small particles **(Figure 3)**. Fine

Figure 2: Population in Western and Central Europe living in urban areas where concentrations of particulate matter under 10 micrometres exceed the daily EU limit



Source: EEA 2006e

Figure 3: Areas exceeding WHO guidelines for particulate matter air pollution

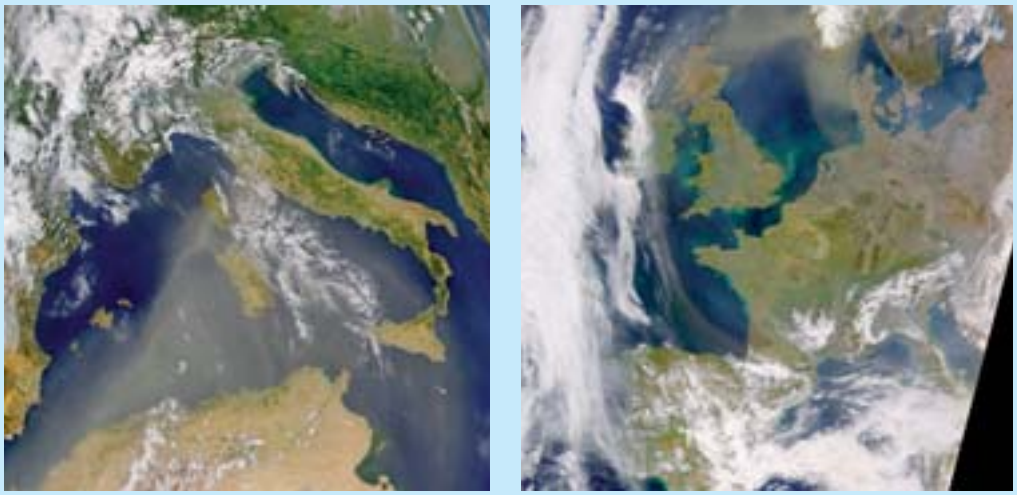


Annual mean concentrations of $PM_{2.5}$ as calculated for 2004. Only grid cells with values higher than the guideline value (10 µg/m³) are shown in colour

> 70 µg/m³
31 – 70 µg/m³
21 - 30 µg/m³
16 - 20 µg/m³
13 – 15 µg/m³
10 - 12 µg/m³
< 10 µg/m³

Source: EMEP 2006

Box 4: Desert dust from Africa travels far into Europe



The left-hand true-colour image from 19 August 2004 shows a large plume of Saharan dust (light brown) blowing northward over the Mediterranean Sea, partially obscuring the islands of Corsica, Sardinia, and Sicily. The right-hand image from 16 April 2003 shows how far north the dust can be transported. Here a long trail of dust from Africa (light brown) can be seen arcing to the northwest over southern France, stretching north over the Atlantic Ocean and across Ireland and Scotland, continuing eastward to Sweden and Norway, and then turning south to Denmark.

Source: SeaWiFS Project, NASA/Goddard Space Flight Centre, and ORBIMAGE

dust and other small particles can be transported over thousands of kilometres and affect people living far from the actual pollution source, as shown in satellite images (Box 4).

Until now, air quality and related health policies have focused mainly on end-of-pipe measures. These will continue to be important, but more action is needed at local, national, and international levels to reduce air pollution at the source, for example through energy savings and low-carbon technologies in the energy and automobile industries (WHO 2006a, MNP 2006, EEA 2006d).

Street-level air pollution is still causing too many health problems

Source: argus/Still Pictures

CHALLENGES

Measures to improve air quality have had significant co-benefits in reducing GHGs, just as efforts to combat climate change can reduce local air pollution. The key environmental policy challenge for Europe is to develop and implement more integrated policy frameworks, in which climate change objectives largely coincide with air quality aims while achieving substantive cost savings (EEA 2006d, MNP 2006). Such integrated policies may receive more public support, as local air quality has so far been more relevant for voters than climate concerns.

More research and technology development is needed on energy supply efficiency, including more environmentally sound energy systems. Innovative technology and stronger corporate responsibility could be stimulated by introducing more stringent vehicle emission standards, raising energy prices so that they reflect the external costs of climate change and air pollution, and information campaigns to promote radical change in public attitudes towards energy consumption.

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