European Environment Agency

Kiev report:

Final Draft Chapter:
2.1 Developments in Socio-economic Sectors - Energy

Kongens Nytorv 6
DK-1050 Copenhagen K
Denmark

Tel. +45 33 36 71 00
Fax. +45 33 36 71 99

E-mail eea@eea.eu.int
Homepage www.eea.eu.int

2.1. Developments in Socio-economic Sectors - Energy

Energy use contributes to a range of environmental pressures and is the major source of greenhouse and acid gas emissions in Europe. Options for reducing environmental pressures include using less energy, using energy more efficiently and using less-polluting energy sources.

Total energy consumption fell over the review period (1992-1999). This was due mainly to reductions in the Newly Independent States, which are linked to their economic difficulties and restructuring.

Energy use continues to be dominated by fossil fuels, but the proportion of both total energy and electricity supplied from renewable sources increased in all three regions between 1992 and 1999. Fastest growth occurred in Western Europe due to successful support programmes in a number of countries. Output also increased in Central and Eastern Europe countries, while the decline in the Newly Independent States was less than for other energy sources.

Energy efficiency improved, but in Western Europe this was not enough to prevent further growth in total energy consumption. Energy efficiency in Central and Eastern Europe improved as a result of a combination of positive measures and economic restructuring, but there was little improvement in the Newly Independent States. Energy consumption per unit of GDP remains considerably higher in Central and Eastern Europe and the Newly Independent States than in Western Europe, indicating a substantial potential for further efficiency improvements.

Overall, energy-related greenhouse gas emissions fell substantially , mainly as a result of economic difficulties and restructuring that led to reduced energy use in Central and Eastern Europe and the Newly Independent States. This improvement may be lost as these economies recover, unless stronger action is taken to improve energy efficiency and switch to low-carbon energy sources.

Energy-related acid gas emissions decreased substantially, helping put all three regions on track to achieve their 2010 emission targets.

Nuclear power raises concerns over safety and the long-term management of radioactive wastes.

2.1.1. Introduction

Energy is vital to social and economic well-being. It provides personal comfort and mobility, and is essential to most industrial and commercial activities. However, today's energy production and consumption practices place considerable pressures on the environment, including contributing to climate change, damaging natural eco-systems, agriculture and the built environment, and adversely affecting human health.

The main determinant of these pressures is the source of the energy. Generally, coal use exerts the greatest pressures because of the high levels of greenhouse gas, acid gas (unless end-of-pipe clean up or advanced technology is used) and particulate emissions associated with its use. Coal use also produces considerable solid and liquid pollution due to its extraction and the disposal of ash. Oil typically exerts less pressure on the environment than coal due to its lower carbon content and reduced solid waste combustion products. Natural gas is the cleanest of the fossil fuels due to its even lower carbon content and lower propensity to cause acid emissions. Nonetheless, natural gas is still a major source of carbon dioxide emissions and natural gas production facilities and pipelines leak methane, a potent greenhouse gas. Nuclear and renewable energy sources exert the least pressure in terms of greenhouse gas emissions and air pollution. With nuclear sources, however, there is a risk of radioactive releases in the event of an accident, and highly radioactive wastes are accumulating for which no generally acceptable disposal route has yet been established. Renewable energy sources offer the cleanest source of energy, but they can have some adverse impacts on the environment such as loss of natural amenities, loss of habitat, visual intrusion and noise.

Certain European countries and the EU have adopted policies to reduce the environmental pressures associated with energy. These include support for energy-saving measures, increased efficiency measures in energy conversion and consumption, switching to less-polluting fuels, removal of subsidies that favour more-polluting fuels, the promotion of renewable energy sources and price structures that are more representative of the full cost to society of the energy being used.

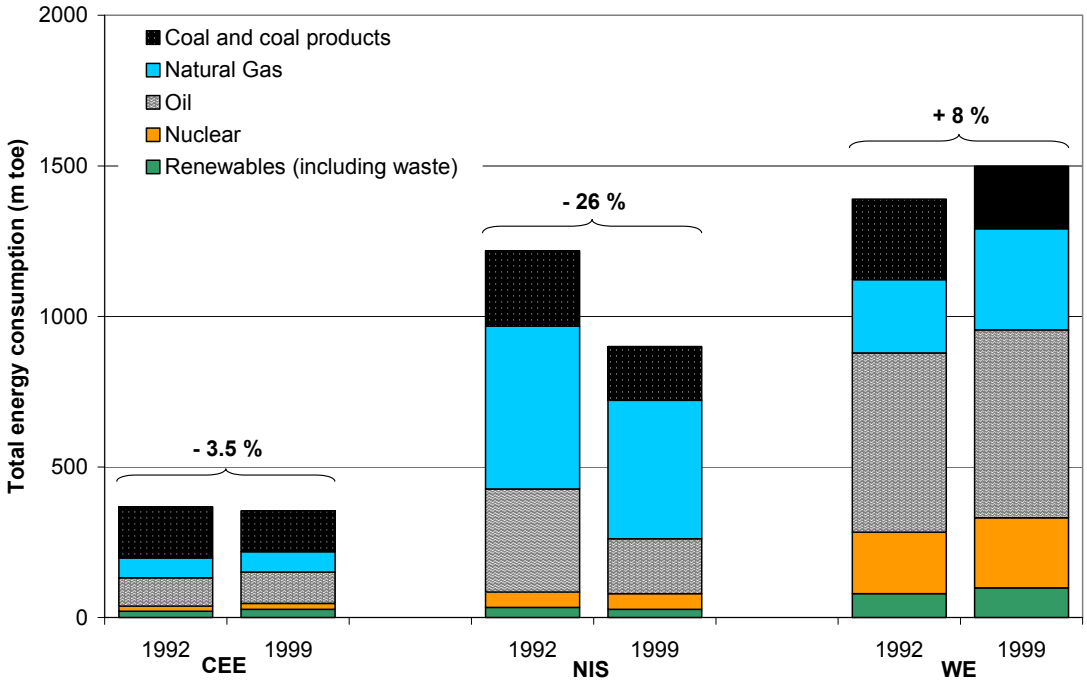
But environmental pressures are not the only factors that affect international and national energy policies, which are also concerned with security of supply, competitive energy prices, market liberalisation, social factors and job creation (EEA, 2002). In some cases these concerns move in harmony with the environment, for example increased energy efficiency is beneficial to most, if not all, energy policy goals. But there are also conflicts. For example concerns over job creation and security of supply may prompt financial support for indigenous energy production, acting as a disincentive towards energy saving through lower prices, and preventing the import of cleaner alternatives. Energy prices may also be kept low to support economic recovery and reduce social impacts. Market liberalisation, which can help attract international investment to modernise energy systems, can deliver lower energy costs in the long run, which, in the absence of appropriate policies to internalise the external costs of energy and improve energy demand management, may lead to reduced energy prices and even increased energy consumption.

2.1.2. Consumption and sources of energy

2.1.2.1. Total energy consumption

Total energy consumption[1] fell (by 7.5 %) in Europe between 1992 and 1999 (Figure 2.1.1.). This was mainly the result of reduced energy consumption in the NIS, attributed to economic decline rather than increased energy efficiency. Energy consumption in CEE also fell due to a combination of economic restructuring and the implementation of energy efficiency measures). Turkey, a major energy consumer within the CEE region, increased its energy consumption substantially over the period as a result of high economic growth and only limited measures to improve energy efficiency. Energy consumption in WE increased, roughly in line with economic growth, a trend that is expected to be followed by CEE and the NIS as economies in these regions complete their transition to market based economies. The environmental impacts associated with energy use in Europe therefore seem destined to increase unless there is a substantial switch to less polluting energy sources and large improvements in energy efficiency (see section 3).

Figure 2.1.1. Total energy consumption



Note: Waste includes wood wastes, other biodegradable solid wastes, and industrial and municipal wastes which contain both biodegradable and non-biodegradable components. Only biodegradable waste is considered to be a renewable energy source.
Source: IEA, 2001

☹ Total energy consumption fell but remains dominated by fossil fuels.

[1] Total energy consumption is also known as total primary energy supply or gross inland energy consumption. It is a measure of the energy inputs to an economy and can be calculated by adding total indigenous energy production, energy imports minus exports and net withdrawals from existing stocks.

2.1.2.2. Sources of energy

There have been overall reductions in coal and oil consumption with a growth in natural gas use. The reduction in coal use in the CEE countries and NIS is linked to the reduction of government support and the closure of a number of uneconomic mines. However, there is a risk of renewed growth in coal consumption if Russia turns to coal for electricity production to free up more natural gas and oil for export (European Commission, 2002). In WE the reduction in coal use is mainly the result of one-off fuel switching in favour of natural gas. European oil consumption fell entirely as a result of reduced consumption in NIS. Oil consumption increased in WE and CEE countries, mainly as a result of growth in transport demand, particularly road transport.

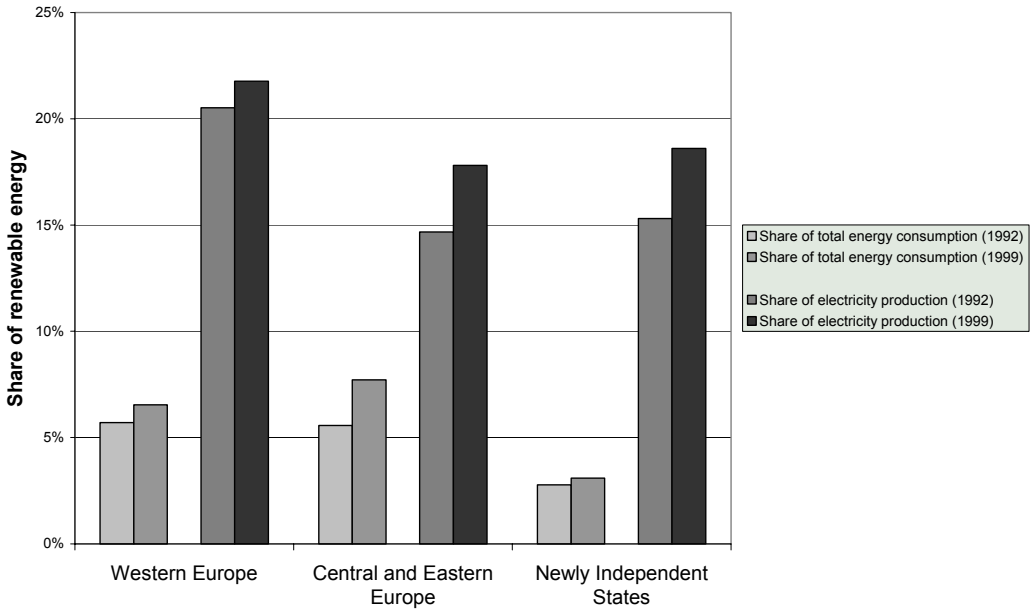
Nuclear power production increased in CEE and WE, and to a much lesser extent in NIS. This trend is not expected to continue as nuclear plant starts to be decommissioned throughout Europe and few new plants are in preparation. This is expected to result in a further growth in combustion-related emissions in the long-term, including carbon dioxide, if the shortfall in capacity is replaced by fossil-fuelled plant. This highlights the importance of policies and measures to stimulate the development and deployment of renewable energy sources.

Renewable energy production increased in WE, where positive measures have been taken to encourage its deployment, and in CEE, while it decreased in the NIS. For further explanation of the trends, see the renewable energy sources box.

Box 2.1. Renewable energy sources

Renewable energy sources are seen as an increasingly important option for reducing the pressures placed on the environment by energy production and consumption. They can also contribute to the security of energy supply by replacing imported fossil fuels. The significance of renewable energy sources was recognised at the Johannesburg UN World Summit on Sustainable Development (UN, 2002) and in a number of EU policy documents, notably a renewable energies White Paper (European Commission, 1997) and a Directive on the promotion of electricity from renewable energy sources (European Parliament and Council, 2001). The EU documents set overall targets to derive 12 % of the EU's total energy consumption and 22.1 % of the EU's electricity from renewable sources by 2010. This should also encourage the development of renewable energy sources in countries that have applied for EU membership. Some CEE and NIS countries have also developed energy and environment policies that include the development of renewable sources, but experience suggests that this has had a low priority, the necessary investment resources are lacking and the strong institutional structures needed to drive the process have not yet been established.

Contribution of renewable energy sources, including waste, to total energy consumption and electricity production



Note: Waste includes wood wastes, other biodegradable solid wastes and industrial and municipal wastes which contain both biodegradable and non-biodegradable components. Only biodegradable waste is considered to be a renewable energy source.
Source: IEA

Box to be continued on next page

Box continued from previous page

Total renewable energy consumption in Europe (both electricity and heat) increased by 15 % between 1992 and 1999, increasing its share of total energy consumption from 4.5 to 5.6 %. Electricity production from renewable sources increased by 15 %, bringing its share of total production from 18 to 20 %.

Renewable energy consumption in WE grew by 24 % between 1992 and 1999. However, because of overall growth in total energy consumption, the share of renewables increased only slightly. This growth has been supported by a range of policy interventions mainly

aimed at stimulating the growth of new renewable technologies for electricity production. Renewable energy consumption in CEE increased also by 24 % and the share of renewables in total energy consumption increased over this period, from 6 % to 8 % of the total. Most of the growth came from an expansion of biomass/waste combustion and hydro-power and does not appear to be linked to any co-ordinated policy initiatives. The NIS saw a decrease in renewable energy consumption of 18 %, due to a decrease in production from combustible renewable sources and hydro-power. Nonetheless renewable sources maintained their share of total energy consumption due to falling overall consumption.

Renewable electricity production grew between 1992 and 1999 in both WE (20%) and CEE (36%). Almost all of the growth in CEE can be attributed to electricity produced from hydro power that is believed to be due to the refurbishment and completion of plant. The increase in renewable electricity production for WE was driven by increases in production from biomass, hydro and wind power. In 1999 renewables contributed 21.8 % of total electricity production in Western Europe. This is close to the EU target of 22.1 %, but includes Iceland, Norway and Switzerland, three non-EU countries with very high proportions of renewables. The NIS trend in renewable electricity production fell slightly as a result of a decline in hydro-power.

Electricity produced from large hydro-power continues to dominate renewable electricity in all regions. In particular, it accounts for about 90% of production for both the NIS and CEE. This source is unlikely to increase in WE since most of the best sites have already been exploited and also because of the impacts on the environment through loss of land and the resultant destructions of natural habitats and ecosystems. There are a number of sites that are still suitable for development in CEE and NIS.

The role of 'new renewable sources' such as wind and solar remains small for countries outside WE. WE made some headway in wind power increasing its share to 2.4 % of total renewable electricity production in 1999. This growth was greatly helped by the "feed-in" arrangement implemented during that period by Denmark, Germany and Spain, according to which the utilities were obliged to purchase electricity from renewable electricity producers at a fixed, commercially favourable price. The share of electricity production from wind for the NIS and CEE was still below 0.1 % of total renewable electricity production in 1999. Solar electricity production is recorded only in WE where it represented just 0.01 % of total renewable electricity production in 1999, with Germany and Spain driving its growth with the help of feed-in arrangements and state financial support (EEA, 2001).

2.1.3. Energy efficiency

One way of reducing environmental measures from energy use is to reduce the demand for energy-consuming services or by delivering these services with more efficient devices. The importance of using energy efficiently is recognised in a number of policy agreements and measures including the Energy Charter Treaty and Protocol on Energy Efficiency and Related Environmental Aspects (ECS, 2002). The EU has developed an action plan which aims to deliver a 1 % per year reduction in energy intensity[2], over and above "that which would have otherwise been attained" (Council of the European Union, 1998). The measures contained in this plan should also encourage development in countries that have applied for EU membership and will apply to these countries as soon as they become members of the EU, as well as to current Member States.

[2] In this case the Energy Intensity of a country is defined as its final energy consumption divided by its Gross Domestic Product.

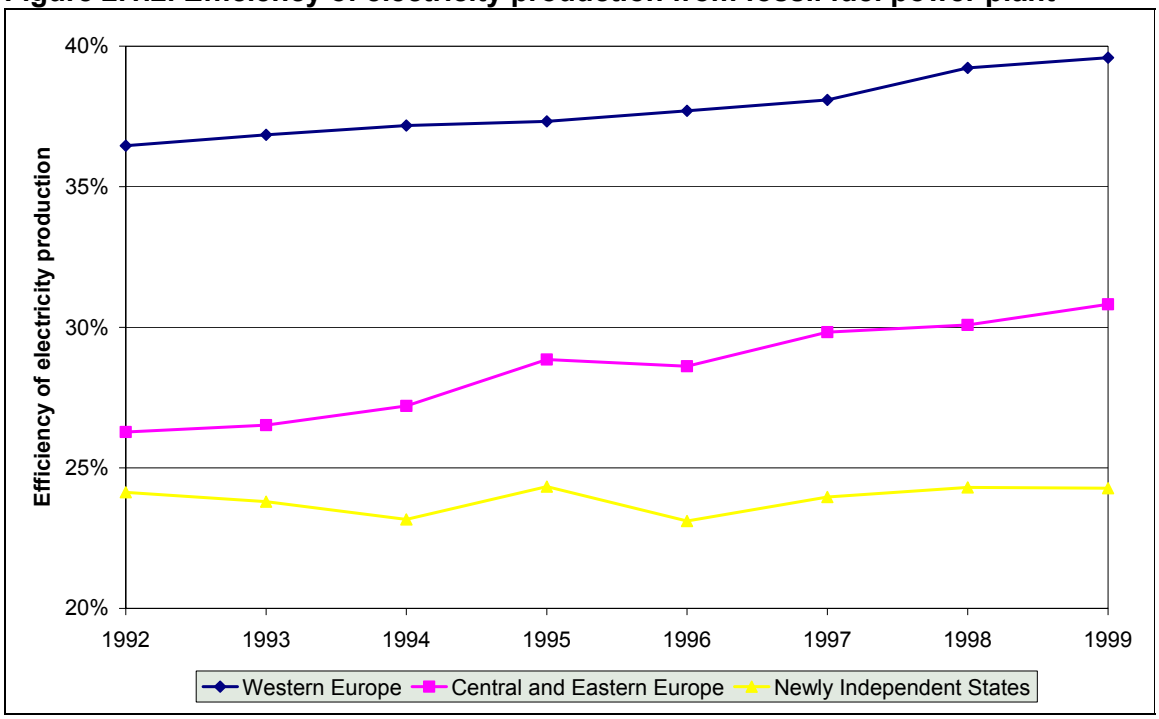
2.1.3.1. Efficiency of electricity production

The electricity production sector is of particular importance. Experience shows that the proportion of electricity in final energy consumption[3] increases as economies develop. This is because greater automation in industrial production is usually associated with a greater use of electricity, while increased wealth results in more electricity use by households and services. Between 1992 and 1999 electricity's share of final demand increased, reaching 21.6 % in WE, 20.9 % in CEE and 17.5 % in the NIS. Since this trend is likely to continue, it is vital to the environment that electricity is produced with maximum efficiency, particularly from fossil-fuelled plant that release substantial quantities of greenhouse gases and other pollutants.

On average, the efficiency of fossil-fuelled electricity production in Europe increased from 29 % to 32 % between 1992 and 1999. This was due mostly to plant replacement in WE (especially switching to inherently more efficient systems such as gas turbines), and technical improvements and refurbishment in CEE (Figure 2.1.2). However, production efficiency in both CEE and the NIS remains substantially below WE levels. In CEE countries this is due to high reliance on coal (74 %, compared with 48 % in WE in 1999), which is intrinsically less efficient, and to the age and low technical specification of much of the plant. In the NIS, 59 % of fossil-fuelled electricity production comes from natural gas, which is capable of higher production efficiencies, but the low efficiency observed in the region indicates the age and poor technical performance of such plant. Significant efficiency improvements in CEE and the NIS will only come from investment in new plant, but few national utilities can afford this. Consequently, many countries are implementing or are planning market liberalisation measures in order to attract private investment.

[3] Final energy consumption is the energy consumption of the transport, industry, other (households and services) and agriculture sectors. It includes the consumption of converted energy (i.e. electricity, publicly supplied heat, refined oil products, coke, etc.) and the direct use of primary fuels such as natural gas or renewables (e.g. solar heat, biomass).

Figure 2.1.2. Efficiency of electricity production from fossil fuel power plant



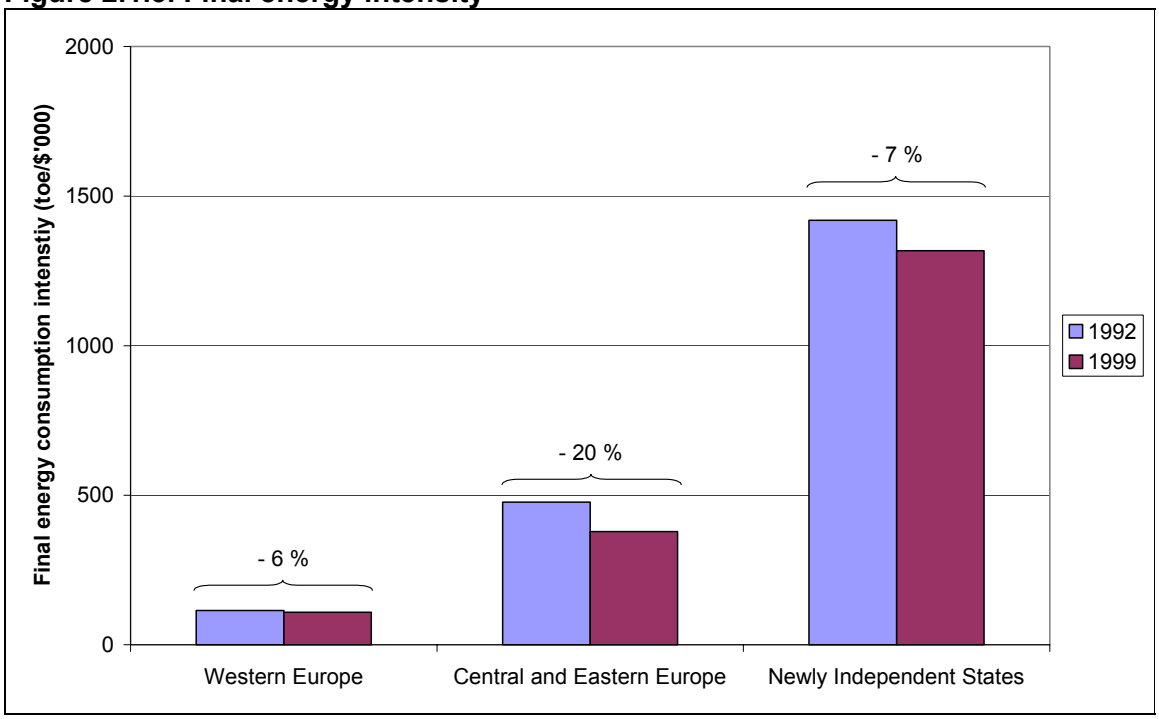
Source IEA, 2001

😐 **The efficiency of electricity production from fossil fuels has improved slightly, but this has been confined to Western Europe and Central and Eastern Europe**

2.1.3.2. Efficiency of energy use

Improvements in the way end-use sectors use energy can be tracked by measuring final energy intensity (i.e. final energy consumption per unit of GDP). The lower the intensity the less energy is used per unit of wealth created.

Figure 2.1.3. Final energy intensity



Source: IEA, 2001

Energy intensities in CEE and the NIS are substantially higher than in WE (see Figure 2.1.3). This reflects low efficiency in all end-use sectors due to a combination of factors including old, inefficient industrial plant, inadequate maintenance, poorly insulated building stock, a lack of heating controls in buildings combined with comparatively longer and colder winters in some countries, and old/inefficient vehicle fleets. Historically, this position developed because many countries in the region had access to relatively abundant, low-cost energy resources, making them less exposed to the energy price shocks of the 1970s, and providing less incentive to invest in energy efficiency. The situation persisted due to a shortage of investment, especially in the NIS.

☹ **Energy is being used more efficiently, but this was mainly a result of changes in CEE and the NIS, which may not be sustained in the long run without more active support for energy efficiency.**

Most NIS and CEE countries developed policies to encourage and support rational energy saving. This, together with one-off economic restructuring contributed to reduced energy intensities, particularly in the CEE countries aiming for accession to the EU. However, in many countries, the implementation of energy efficiency measures has been weak because priority has been given to economic recovery and social issues, and the institutions needed to drive energy efficiency policies were poorly supported. Consequently in a number of countries, particularly in the NIS, the improvements have largely been due to deprivation rather than rational energy saving, and may therefore be reversed as economies revive, unless stronger measures to support energy efficiency are implemented. The slow pace with which energy intensity decreased in WE is the result of low prioritisation of energy efficiency policies due to abundant energy supplies and low fossil fuel prices.

Table 2.1.1. shows that there is considerable potential for energy savings in all sectors throughout Europe and especially in CEE and the NIS. In CEE, improvements in industrial energy intensity resulted from a combination of closure of some inefficient plant and investment in new production facilities by international companies. Improvements in energy efficiency in households and services resulted from a combination of measures including increased prices, reduced subsidies, metering and billing by consumption, all of which provided a financial incentive to reduce energy consumption. In the NIS, industrial energy intensity actually increased between 1992 and 1999, showing that economic decline and restructuring in these countries has not yielded any overall improvement in efficiency. The improvements in energy intensity in households and services were due mainly to self-deprivation and supply limitations since price and market reforms have proved difficult to introduce at a time of economic recession and high unemployment.

Table 2.1.1 Energy intensities of individual economic sectors (toe/million $)

	Industry		Transport		Households and Services	
	1992	**1999**	**1992**	**1999**	**1992**	**1999**
Western Europe	0.125	0.122	0.033	0.033	0.043	0.040
Central and Eastern Europe	0.654	0.447	0.073	0.073	0.202	0.164
Newly Independent States	0.929	1.437	0.242	0.223	0.751	0.615

Note: Comparisons between energy intensities of different sectors cannot be made. Industrial energy intensity is calculated as the ratio of energy consumption to value added, while the energy intensity of the transport and household and services sectors is calculated as the ratio of energy consumption to gross domestic product. These energy intensities are also not comparable with the final energy intensity of Figure 2.1.3, which is defined as the ratio of final energy consumption to gross domestic product.

Source: IEA, 2001

Case Study - Hospital heating system refurbishment in the Czech Republic

The Bulovka Teaching Hospital in Prague needed a significant upgrade of the central heating system, but the hospital had no available funds. The necessary upgrades were obtained through a performance contract with an energy services company (ESCO). The ESCO provided the finance, which was paid off using the energy savings achieved at the hospital over an eight year contract period.

The ESCO made four energy saving changes:

1. switched the existing central heating system to district heating that provided space heating and hot water in a more efficient way
2. installed a small high-efficiency gas boiler for specific uses (other than heating and hot water) including sterilisation and laundry services. Heat had previously been taken from the hospitals main boiler plant
3. put in place a new computerised energy management system that gave more precise control of indoor temperatures, hot water and space heating. It also facilitates on-line performance monitoring, which together with preventative maintenance, ensures the long-term efficiency of the system
4. installed a new air handler recovery system that was more efficient because it used heat exchangers to preheat intake air by absorbing the heat from vented air.

This project cost US $ 2.7 million and will produce savings of US $ 0.7 million per year, illustrating the high potential for energy savings through innovative financial arrangements. The project was awarded best practice status by the World Energy Efficiency Association.

Source: Energy Charter Secretariat, Brussels

2.1.4 Environmental impacts

2.1.4.1. Greenhouse gas emissions

Note: THIS SECTION IS PRELIMINARY AND WILL BE UPDATED WITH NEW GHG EMISSIONS DATA.

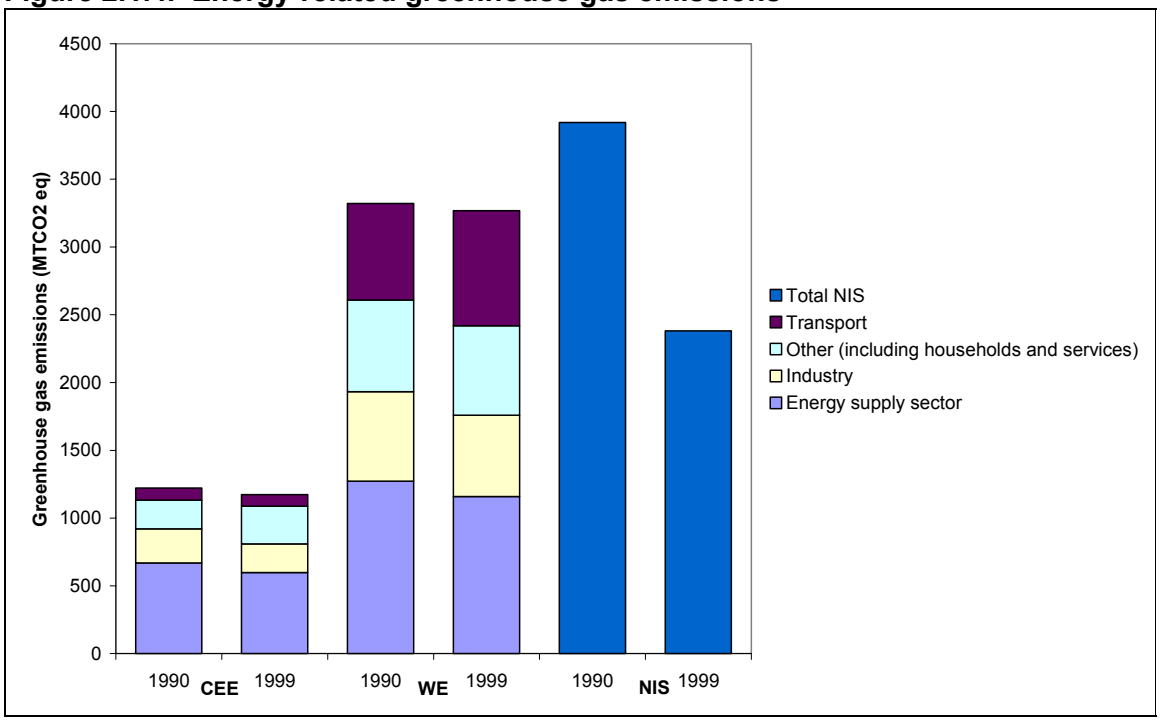
The reduction of global greenhouse gas emissions is a priority action area for industrialised countries, as agreed under the UN Kyoto Protocol (see chapter 3 climate change). The Kyoto Protocol emissions target for EU Member States is a reduction to 8 % below 1990 levels by 2008-12. Several CEE states have Kyoto reduction targets of 5 to 8 %. The target for Russia and the Ukraine, the only NIS countries that have Kyoto targets, and the two largest economies of the NIS, is to stabilise emissions[4] to 1990 levels. There is a clear need for action to reduce emissions arising from energy use since they account for over 80 %[5] of total emissions. Moreover, while the attainment of these targets is important, they only represent a first step, since it is estimated that global emissions need to be reduced by about 70 % in the long term to stabilise GHG concentrations at an acceptable level (IPCC, 2001). It is therefore important for reductions in emissions to be based on lasting measures and actions.

☺ **Total energy-related greenhouse gas emissions fell substantially in Europe between 1990 and 1999, due mainly to economic difficulties and restructuring in the NIS and CEE. This improvement may be lost when economic activity recovers unless economic growth is accompanied by strong energy efficiency measures and the implementaion of low carbon energy supply options.**

[4] Kyoto targets for non-EU Western European countries are 101% (Norway), 110% (Iceland) and 92% (Switzerland) of 1990 (base year) emissions. CEE targets are 92% (Bulgaria), 95% (Croatia), 92% (Czech Republic), 92% (Estonia), 94% (Hungary), 92% (Latvia), 92% (Lithuania), 94% (Poland), 92% (Romania), 92% (Slovakia) and 92% (Slovenia) of base year emissions. Five of these countries have a base year other than 1990: Bulgaria (1988), Hungary (average emissions of the years 1985 to 1987), Poland (1988), Romania (1989), Slovenia (1986).

[5] Data for Russia and Ukraine cover all sources of carbon dioxide, methane and nitrous oxide, but separate estimates indicate that energy use accounts for over 80 % of these emissions.

Figure 2.1.4. Energy-related greenhouse gas emissions



Notes:

1. CEE excludes Albania, Bosnia, Macedonia, Malta, Romania and Yugoslavia due to missing or incomplete data.
2. WE excludes Iceland and Liechtenstein as data are not available.
3. NIS includes Russia and Ukraine only, and data are for all GHG emission sources, not just those from energy-related activities. Russia and Ukraine accounted for over 82% of the greenhouse gas emissions from NIS countries.
4. Energy supply sector emissions include those from coal mining, oil and gas exploration and extraction, public electricity and heat production, oil refining and other industries engaged in converting primary energy into energy products. It also includes fugitive emissions from the exploration, production, storage and transport of fuels.
5. The data are for emissions of carbon dioxide, methane and nitrous oxide, and exclude the fluorinated gases.

Source: EEA / ETC on Air and Climate Change

Overall, energy-related greenhouse gas emissions in Europe fell considerably between 1990 and 1999 (Figure 2.1.4). This was due mainly to Russia and the Ukraine, two of the biggest energy consumers in Europe which reduced their total emissions by 36 % and 50 % respectively over the 1990-99 period. These reductions were mostly the result of economic difficulties and restructuring, which resulted in a substantial reduction in the energy use of these two countries over the same period. CEE countries achieved a reduction of 4 % due to large cuts in most countries, mainly as a result of economic restructuring, which were partly off-set by increased emissions from Turkey (54 %) and Croatia (11.7 %). Energy-related emissions in WE fell by only 1.6 %. Nevertheless, this was achieved against a background of an 18 % increase in economic growth over the same period.

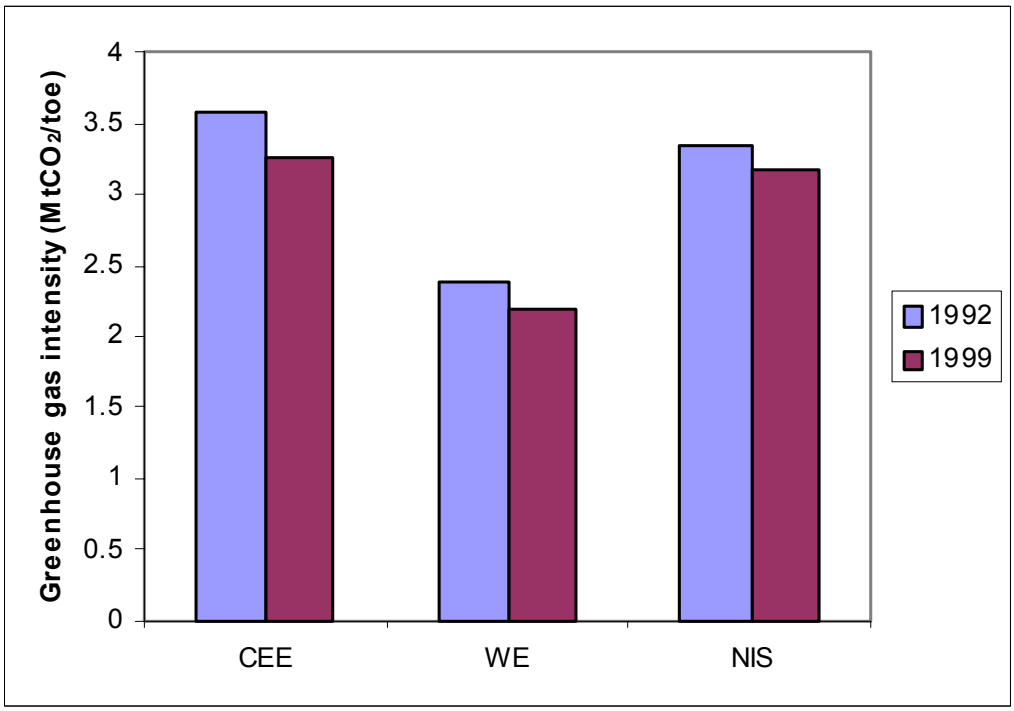
Figure 2.1.4 shows that transport contributes a substantial proportion of greenhouse gas emissions in WE countries but much less in CEE countries. The low energy consumption of the transport sector in the NIS indicates that the contribution of transport emissions in this region is also much less. Transport growth is strongly driven by economic growth and transport emissions are expected to grow substantially in CEE and the NIS as economies recover and the demand for transport increases.

The emissions from the energy supply sector shown in Figure 2.1.4 include fugitive methane emissions from energy production. These amounted to almost 15 % of total greenhouse gas emissions in Russia and Ukraine in 1999 (reflecting their substantial oil

and gas production) compared to almost 2 % to 4 % in WE and CEE. Other significant oil and gas producers such as the UK have much lower fugitive emissions (i.e. about 3 % of total emissions in 1999) which indicates the potential for improvement.

One option for achieving a lasting reduction in energy-related greenhouse gas emissions is to reduce the greenhouse gas intensity[6] of energy use by switching to energy sources that contain less carbon (e.g. from coal to natural gas or renewable energy sources), and / or by reducing the emissions associated with the production and use of these sources. Figure 2.1.5. shows that all three regions achieved reductions in greenhouse gas intensity between 1992 and 1999. In fact, with total energy consumption growing in WE, the reduction in its energy-related GHG emissions observed in Figure 2.1.4. was largely due to this cut in greenhouse gas intensity. However, greenhouse gas intensities in CEE and the NIS remain substantially higher than in WE[7] mainly as a result of a large use of coal in CEE and of substantial fugitive methane emissions in NIS.

Figure 2.1.5 Greenhouse gas intensity of total energy consumption



Source: EEA / ETC on Air and Climate Change

2.1.4.2. Other environmental pressures

In addition to being the most important source of greenhouse gases, the production and consumption of energy places other pressures on the environment. Fossil fuel combustion is a major source of air pollution (see chapter 5 air pollution). Energy production also damages land and water resources through excessive dumping and unplanned discharges of a range of substances such as crude oil, mine tailings, polluted mine waters and coal ash. Nuclear power places a potential threat to the environment as there is a risk of radioactive releases (see also chapter 10 technological and natural hazards).

Note: THE SO_2 AND NO_X TEXT AND GRAPHS ARE PRELIMINARY AND WILL BE UPDATED WITH NEW DATA.

---

[6] Greenhouse gas intensity is defined as the amount of greenhouse gas emissions, expressed in carbon dioxide equivalent that is released per unit of Total Energy Consumption.

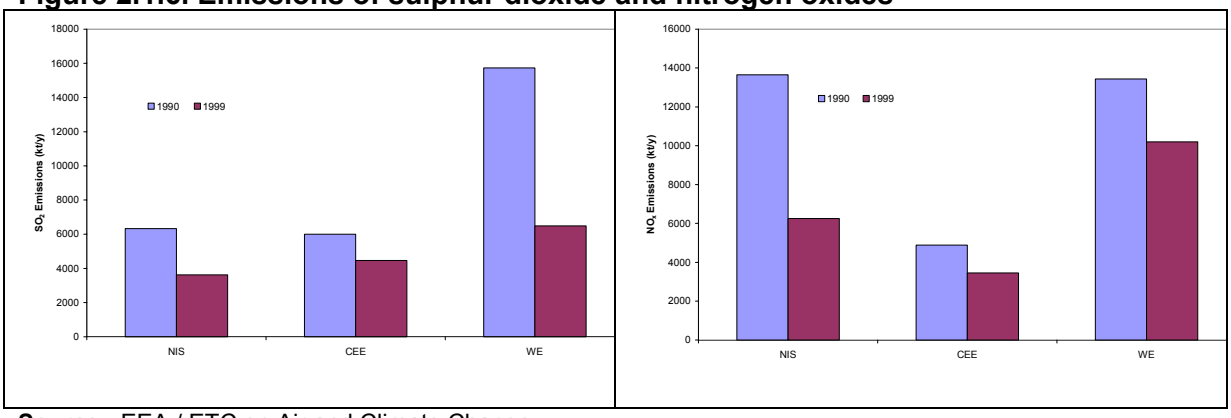
[7] This conclusion for NIS countries is based on total emissions because energy-related emissions data are not available.

Energy use is the major source of SO_2 and NO_X emissions, accounting for over 90 % of both emissions in Europe in 1999. Considerable progress has been made in reducing energy-related emissions and this has greatly helped all three regions to be on track to achieve their aggregate targets under the UNECE Convention on long-range trans-boundary air pollution (see chapter 5 air pollution).

The reductions in acid gas emissions in WE, shown in Figure 2.1.6, were achieved mainly by direct actions including switching to lower sulphur fuels, installing flue gas clean-up systems, introducing catalytic converters in cars and modifying combustion processes. The reductions in CEE were also greatly helped by direct actions. However, the reduction in energy use in CEE, in particular of coal use, played an important role also. Acid emissions data issues with some NIS countries prevent us from drawing precise conclusions for NIS. Judging from the NIS energy consumption data, it is likely however that the reductions in acid gas emissions in the NIS were mostly the result of reduced energy use with direct actions also contributing to the reductions.

The fact that direct actions contributed significantly to the reductions in Europe, particularly in WE and CEE, is encouraging. Nevertheless, on the one hand, there are a number of regions in Europe mostly in CEE and NIS countries that face serious air pollution problems that need to be addressed urgently. On the other hand, the potential for improvement through direct actions in CEE and the NIS is still large while the potential for improvement through energy efficiency measures remains to be further explored by all three regions.

Figure 2.1.6. Emissions of sulphur dioxide and nitrogen oxides



Source: EEA / ETC on Air and Climate Change

Notes:

1. Due to a lack of data, the NIS includes only Belarus, Russia and Ukraine
2. Due to missing or incomplete data, CEE excludes Albania, Cyprus, Malta and Romania.

☺ Energy related acid gas emissions have been reduced substantially, placing all three regions on track to meet the total emissions targets for 2010.

Nuclear power is responsible for a steady accumulation of highly radioactive waste which could release radioactivity into the environment if not carefully managed. Highly radioactive waste will remain radioactive for thousands of years and as yet, no generally acceptable disposal route has been found. There is also a risk of accidents in nuclear installations that will result in large uncontrolled releases of radioactivity into the environment. In both cases, such releases would have serious impacts on human health and ecological systems, as well as contaminating water and land resources such that they could not be used for food production.

The risks need to be balanced against the potential benefits of nuclear power. At the point of electricity production, nuclear power plants do not emit greenhouse or acid gases. The production of electricity from renewable sources is however also greenhouse gas neutral.

Data on the accumulation of radioactive wastes across all three regions is not available, but OECD data for WE show on average an annual discharge of nearly 3000 tonnes of highly radioactive used nuclear fuel for storage during the 1985-2010 period (OECD, 1999).

Experience shows that the greatest impact of nuclear power on human health and the environment is caused by operational accidents, of which Chernobyl is the worst example. The risk of such events on existing plant can be reduced with improved safety systems and management procedures. If these measures are successful this should be indicated by a fall in the number of "unusual events" reported to the Incident Reporting System operated jointly by IAEA and OECD. This shows the number of incidents reported varying from 177 to 76 between 1992 and 2001 with no clear improvement trend. Nevertheless, 2000 and 2001 had the lowest number of incidents. The nuclear plant in the NIS and CEE countries are particular sources of concern due to past performance and the fact they are ageing.

☹ **The risk of nuclear power plant accidents and the continued build up of highly radioactive waste from nuclear power production, for which no generally acceptable disposal route has yet been established, are sources of concern.**

2.1.5. References

Council of the European Union, 1998. Council Resolution (98/C394/01) on energy efficiency in the European Community.

EEA, 2001. Renewable Energies: Success Stories. Environmental issues report No. 27. European Environment Agency, Copenhagen.

EEA, 2002. Energy and Environment in the European Union. Environmental Issues report no. 31. European Environment Agency, Copenhagen.

ECS, 2002. The Energy Charter Treaty - A Readers Guide. Energy Charter Secretariat, Brussels, Belgium.

European Commission, 1997. Energy for the future: Renewable sources of energy. White paper for a Community strategy and action plan. COM(97) 30 final, Brussels, Commission of the European Communities.

European Commission, 2002. 2001 Annual Energy Review, European Commission, Luxembourg, 2002.

European Parliament and Council, 2001. Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the electricity market, September 2001.

IEA, 2001. International Energy Agency, Energy Balances of OECD Countries and Energy Balances of Non-OECD Countries, IEA, Paris.

IPCC, 2001. Intergovernmental Panel on Climate Change – Working group I, Third Assessment Report, Summary for policy makers.

OECD, 1999. Environmental data compendium 1999, Paris, Organisation for Economic Cooperation and Development

UN, 2002. World Summit on Sustainable Development – Plan of Implementation, United Nations, Johannesburg.