Status Review of Sustainable Development in the Energy Sector

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Executive Summary

The key objective of this report is to assess the progress that Europe has made in working towards the development of sustainable internal energy markets. It is expected that this report will be periodically updated and could provide a vehicle through which the progress of Europe, towards its various sustainability goals, could be monitored.

This report focuses on an assessment of sustainable development, within the gas and electricity sectors, and adopts a definition of sustainable development, used by various European and international institutions, which encompasses economic, environmental and social perspectives. As such, the report is structured along three themes which are discussed in turn below.

With this report, regulators are now considering future steps on the issue of sustainable development and views from interested parties would be welcome in this regard. In particular, Section 2 invites comments from stakeholders regarding the indicators used and the structure of the report.

Managing the transition to a low carbon economy in the energy sector

The 2020 targets on carbon abatement, renewable deployment and energy efficiency are one way in which Member States, with the backing of the European Commission, have committed to address these issues. This section measures progress to date against these challenging targets.

Since 1990, total greenhouse gas (GHG) emissions have declined in the EU-27 area. However, emissions from the gas and electricity sectors have remained fairly stable.

In 2006, the EU-27 sourced nearly 15% of its electricity from renewables, with a target to source 21% by 2010. It is expected that to meet the overall EU target of 20% of energy from renewables, the EU-27 will need to source 34% of electricity from renewables by 2020.

Final energy consumption in the EU-27 grew progressively between 1995 and 2006 Notably, the growth in final electricity consumption during the same period was even faster, mainly due to greater use of electrical appliances in the service and household sectors.

Monitoring gas and electricity prices, customer choice and access to affordable energy

This section focuses on social issues. To monitor customer choice, the report uses electricity and gas switching rates as a proxy for the level of choice available. Higher switching rates are taken to indicate a higher level of consumer choice. The data reveals that switching rates vary considerably among countries, with the United Kingdom having the highest rate for both gas and electricity. To monitor access to affordable energy, the report examines fuel poverty in a selection of Member States where data is available (Belgium, Spain, France, Italy and United Kingdom).

Finally, the section monitors gas and electricity prices and compares these to household income in the EU-15 area. The data shows that electricity prices gradually decreased from 1997 and then began an upward trend from 2004 onwards. Gas prices were more volatile over the same period but also experienced an upward trend, with a steep rise between 2005 and 2007. Excepting this two year period, household income in the EU-15 area experienced larger percentage increases than gas and electricity prices, maintaining disposable income until 2005. Although gas prices increased from 2005 onwards, it may not have had a significant impact on disposable income, as electricity represents a greater share of disposable income than gas. However, electricity prices have gradually begun an upward trend and are catching up to gas prices.

Ensuring a secure and reliable gas and electricity supply

The final section of the report examines issues relating to security and reliability of energy supply. In terms of energy dependency, in 2006 the EU-27 imported a little over 50% of the energy it consumes.

Regarding electricity security of supply, the EU-27 had a generation margin of over 20% in 2007 and imported almost 7,000 GWh of electricity in 2007.

Furthermore, the contribution of wind power generation in the EU-27's generation mix has increased from 0.17% in 1995 to 2.9% in 2006. The amount of oil generation halved and the amount of gas-fired generation has more than doubled between 1995 and 2006.

In terms of gas security of supply, the majority of gas consumed in the EU is imported from two non-EU countries. This should not be a major issue as long as infrastructure is in place to enable sufficient imports, and the legal framework is in place to ensure that contracted gas is delivered. However, the Russia-Ukraine dispute in winter 2008-09 has shown that these conditions do not always hold. Finally, in 2007 European gas storage capacity was about 16% of demand.

1 Introduction

1.1 What is sustainable development?

There are many interpretations of sustainable development and therefore what indicators should be used to monitor progress on these issues. A commonly accepted definition of 'sustainable development' was derived from the 1987 Report of the World Commission on Environment and Development (the Brundtland Commission[1]). The Brundtland Commission defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". In adopting this definition, the Brundtland Commission made clear that sustainable development encompasses environmental, social and economic aspects, but emphasised that the achievement of equity between social groups, as well as different generations (i.e. social aims) should be placed as a priority objective of such development.

The UN Division for Sustainable Development has adopted the definition of sustainable development put forward by the Brundtland Commission, with one of its key objectives being the integration of the social, economic and environmental dimensions of sustainable development in policy-making at international, regional and national levels. In a similar vein, referring to sustainability, the World Bank states that "By promoting economic growth strategies based on expanded infrastructure, which are environmentally responsible and socially acceptable, we are bringing a sustainable future closer to today's reality." With specific reference to the transport sector, the World Bank suggests that sustainable development is comprised of three important elements:

- Environmental sustainability: involves reducing adverse external effects in determining future development;
- Economic sustainability**:** refers to the need to ensure that resources are used efficiently; and
- Social sustainability: involves ensuring access for all to the benefits of development.

In developing an EU Sustainable Development Strategy, the European Commission has also adopted the definition of sustainable development set out by the Brundtland Commission and this strategy was implemented by the European Council in June 2006. In line with the Brundtland Commission definition, the European Commission had regard to the need to deal, in an integrated way, with economic, environmental and social issues when constructing the EU Sustainable Development strategy.

To reflect the position taken by various European and international institutions, this report by the Council of European Energy Regulators (CEER) focuses on an assessment of sustainable development, within the gas and electricity sectors, which examines economic, environmental and social perspectives. This approach is not only consistent with the approach of various other institutions but will also ensure that a rounded position is taken in terms of sustainable development.

[1] http://www.un-documents.net/wced-ocf.htm

1.1.1 Trends in sustainable development for energy

The shift in European focus on sustainable energy markets, particularly in terms of environmental and economic sustainable development, has been especially notable and demonstrated by the development of the Green Package of legislation, published by the European Commission in January 2008[2]. This package includes proposals to deliver on the EU's ambitious commitments to fight climate change and promote renewable energy. In December 2008, the Green Package was formally agreed between the European Parliament and the Council and has been officially approved by the Council and is being translated into the EU official languages before entering into force. Member States have committed to achieve the following targets:

- A reduction in greenhouse gas (GHG)[3] emissions of 20%, compared with 1990 levels, by 2020;
- An increase in the share of renewable generation in the overall fuel mix to 20% by 2020; and
- An improvement in energy efficiency of 20% by 2020.

Furthermore, the European Commission recently published a Communication with the aim of facilitating a global climate change agreement at the Copenhagen UN climate conference in December 2009[4]. One of the proposals is that developed countries should commit to cutting their GHG emissions, as a group, to an average of 30% below 1990 levels by 2020 under the Copenhagen agreement. As such, the EU's target to reduce GHG emissions by 20% by 2020 could potentially be increased following the climate conference. In addition, the European Parliament has recently called for the EU and other industrialised nations to set, as a group, a medium-term target of a 25 to 40% reduction in GHG emissions by 2020 and a long-term GHG emissions reduction target of at least 80% by 2050, compared to 1990[5].

1.2 Objective of the report

The objective of the CEER report is to facilitate the creation of a single competitive, efficient and **sustainable** internal market for gas and electricity in Europe.

The key objective of this report is to assess the progress that Europe has made, primarily as a group, in working towards the development of sustainable internal energy markets.

[2] http://ec.europa.eu/environment/climat/climate_action.htm

[3] Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Hydrofluorocarbons (HFC's), Perfluorocarbons (PFC's) and Sulfur Hexafluoride (SF_6)

[4] EC Communication: Towards a comprehensive climate change agreement in Copenhagen (COM(2009)39). http://ec.europa.eu/environment/climat/future_action.htm

[5] European Parliament resolution of 4 February 2009 on "2050: The future begins today – Recommendations for the EU's future integrated policy on climate change" (2008/2105(INI)). http://www.europarl.europa.eu/news/expert/infopress_page/064-48340-033-02-06-911-20090204IPR48324-02-02-2009-2009-false/default_en.htm

This report is expected to be periodically updated which could provide a vehicle through which the progress of Europe towards its sustainability goals could be monitored.

1.3 Structure of the report

This report is the first of a series of reviews on sustainability that CEER will conduct. Therefore, we would be interested in hearing your views on it, particularly relating to the structure and indicators as well as how often it should be updated.

The remainder of this report is divided into three main themes which reflect closely the key elements that make up sustainable development in the context of the gas and electricity sectors, including environmental, social and economic sustainability.

Section 3: Managing the transition to a low carbon economy in the energy sector;
Section 4: Monitoring gas and electricity prices, customer choice and access to affordable energy; and
Section 5: Ensuring a secure and reliable gas and electricity supply.

2 Feedback

This is the first review of sustainable development to be undertaken by CEER and we would like to periodically update it to reflect the progression of Member States towards its environmental goals. If you have any comments on this report or on related issues of regulatory interest, please send them to the CEER Secretariat at brussels@ceer.eu, by the end of the 2nd quarter of 2009. In particular, CEER would welcome any comments on:

- the structure of the report,
- whether the themes and indicators are useful and
- whether other indicators should be included.

The report does not describe all of the activities that CEER has been undertaking in this area. These include The Green Package – Proposed EU ETS and Renewables Directives: A CEER Position Paper (C08-SDE-02-06), published in May 2008; the Status Review of Renewable and Energy Efficiency Support Schemes in EU (C08-SDE-05-03), published in December 2008; and ongoing work on the impact and integration of wind power. CEER would also welcome views on what further activities it could usefully undertake to support the sustainable development of the European energy sector.

3 Managing the transition to a low carbon economy in the energy sector

3.1 Introduction

It is evident that human activity is having an adverse effect on the environment and the use of energy is one of the key contributors to increasing carbon emissions. The 2020 targets on carbon abatement, renewable deployment and energy efficiency are one way in which Member States, with the backing of the European Commission, have committed to address these issues. This section will measure progress to date against these challenging targets using indicators relating to carbon abatement, renewables and air quality.

3.2 Carbon abatement

This sub-section looks at how the EU has performed in terms of reducing GHG emissions in the gas and electricity sectors, at both the absolute level and on a per capita basis. It also discusses the evolution of the carbon price as part of the EU Emissions Trading Scheme (ETS).

3.2.1 Indicator 1: Greenhouse gas emissions from gas and electricity sectors

Figure 1 illustrates the contributions of the gas and electricity sectors[6] to total GHG emissions, at the EU-27 level, over time. Since 1990, total GHG emissions have declined, hovering just above 5,000 million tonnes of carbon dioxide equivalent (MtCO2e) between 2000 and 2006. Emissions from the gas and electricity sectors have been fairly stable over the period shown – in 1990, they were about 1,461 MtCO2e and in 2006 they were about 1,393 MtCO2e. This implies a contribution of about 27% to total EU GHG emissions from gas and electricity sectors over the period in question.

Figure 1 also shows the European Commission's target of reducing total EU GHG emissions by 20% compared to 1990 levels by 2020. The method for delivery of this target is flexible as it can be achieved through a reduction in GHG emissions in all sectors or just a few. However, there is a case for arguing that a reduction in the electricity and heat sectors looks more promising than, say, the transport sector.

[6] Since no data is available for GHG emissions from the gas sector per se, 'public electricity and heat production' is used as a proxy for 'the gas and electricity sectors'. This is defined by EEA as emissions from main activity producers of electricity generation, combined heat and power generation and heat plants. Main activity producers (i.e. public utilities) are defined as those undertakings whose primary activity is to supply the public. They may be in public or private ownership. Emissions from own on-site use of fuel should be included.

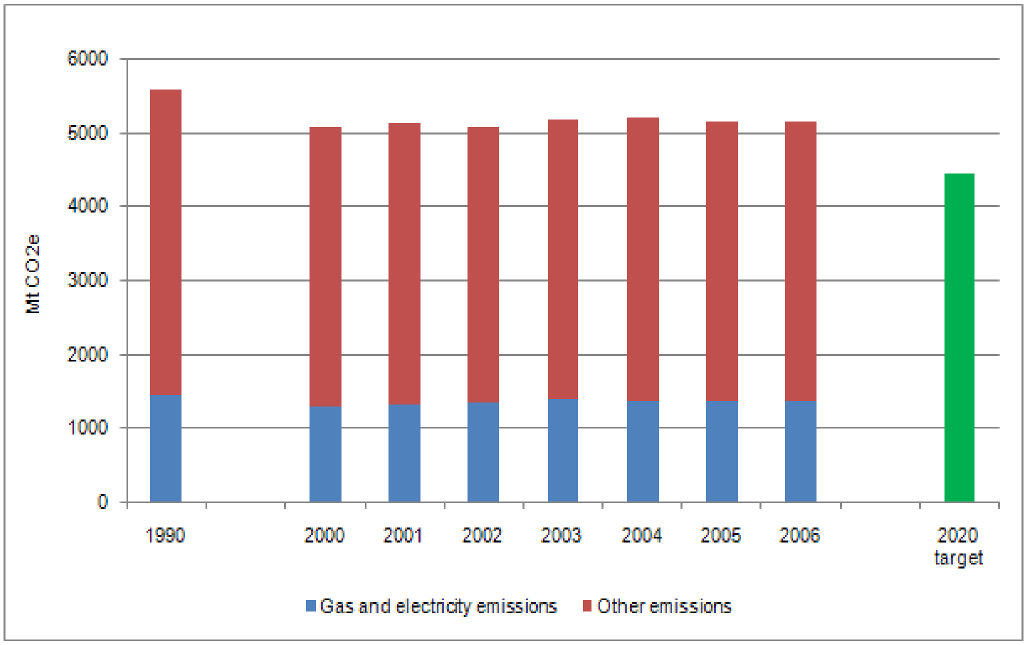

Figure 1 – Contribution of gas and electricity sectors to total GHG emissions, EU-27 level, 1990-2006

Source: European Environment Agency (EEA)

Figure 2 below illustrates the GHG emissions from the gas and electricity sectors across Member States as well as the EU-15 and EU-27 averages. The figure reveals that over half of the EU-27 Member States had higher levels of emissions in 2006 compared to 1990. The average gas and electricity emissions from the EU-15 have increased a little since 1990. However, emissions from the EU-27 have decreased slightly, implying that Member States from the EU-15 did not reduce emissions from the gas and electricity sectors to the same extent as other Member States. However, many of the countries that experienced a fall in emissions did so as a result of either economic contraction or restructuring rather than active emissions controlling. In 1990, the EU-15 was responsible for about 66% of the EU-27's total GHG emissions from the gas and electricity sectors. In 2006, this figure rose to 74%.

Some of the key characteristics of Member States that have high levels of GHG emissions from the gas and electricity sectors include relatively large populations and/or a large proportion of coal and/or oil in their electricity generation mix. One or both of these characteristics holds true for Germany, Poland and the United Kingdom, which have the highest levels of emissions from the gas and electricity sectors among the EU-27. Emissions in these Member States are lower in 2006 compared to 1990. In Germany, this is mainly attributed to increasing efficiency in power and heating plants. In the United Kingdom, this is primarily the result of the liberalisation of energy markets and the subsequent fuel switches from oil and coal to gas in electricity production[7]. The decrease in gas and electricity emissions in Poland can be attributed to the decline of energy inefficient heavy industry and

[7] http://www.eea.europa.eu/publications/technical_report_2008_6/Annual-European-Community-greenhouse-gas-inventory-1990-2006-and-inventory-report-2008 ; page 17

the overall restructuring of the economy[8].

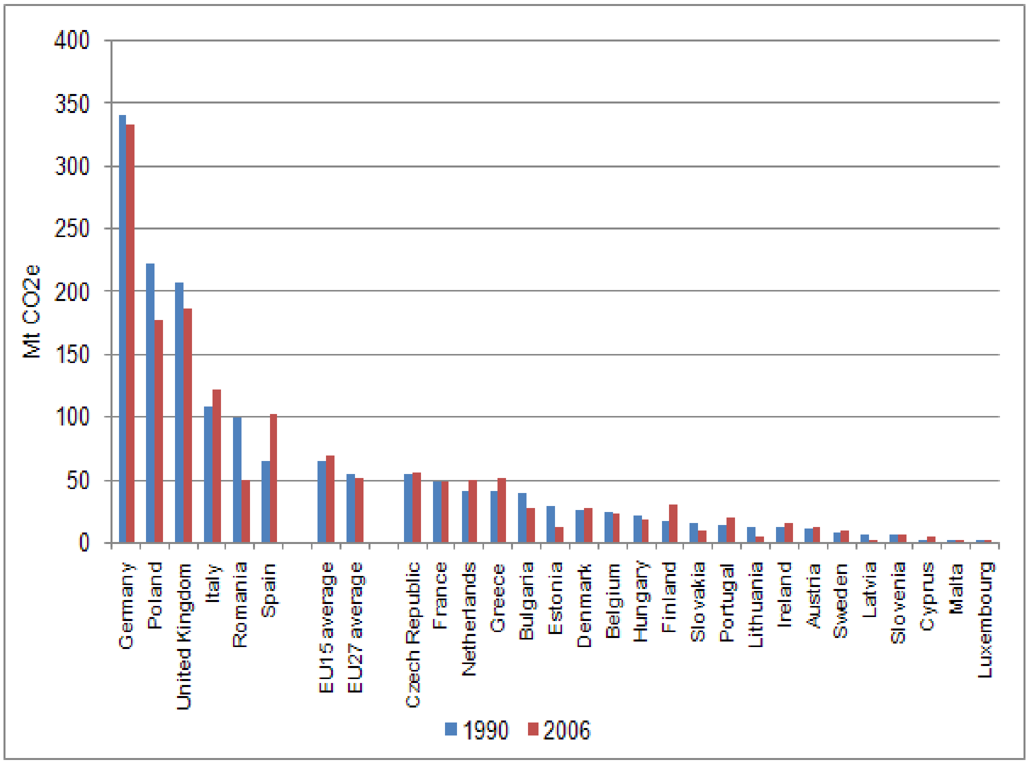

Figure 2 –GHG emissions from gas and electricity sectors across Member States

Source: EEA

Figure 3 shows gas and electricity emissions[9] per capita across Member States as well as at the EU-15 and EU-27 levels in 2006. There are a number of driving factors that explain emissions per capita, including levels of income and wealth which help to determine overall levels of energy demand, differences in the energy intensity of industry, overall levels of energy efficiency, differences in weather conditions and differences in the structure of the energy supply system as well as the electricity generation mix[10]. Estonia's emissions per capita are significantly higher than the other Member States. In contrast, France has the lowest emissions per capita which can be attributed to the very large proportion of nuclear in its electricity generation mix (see Figure 36).

[8] See Footnote 7; page 17

[9] Data on public electricity and heat emissions have been used as a substitute due to lack of data on gas and electricity emissions.

[10] Energy and Environment Report 2008, European Environment Agency, page18. http://www.eea.europa.eu/publications/eea_report_2008_6

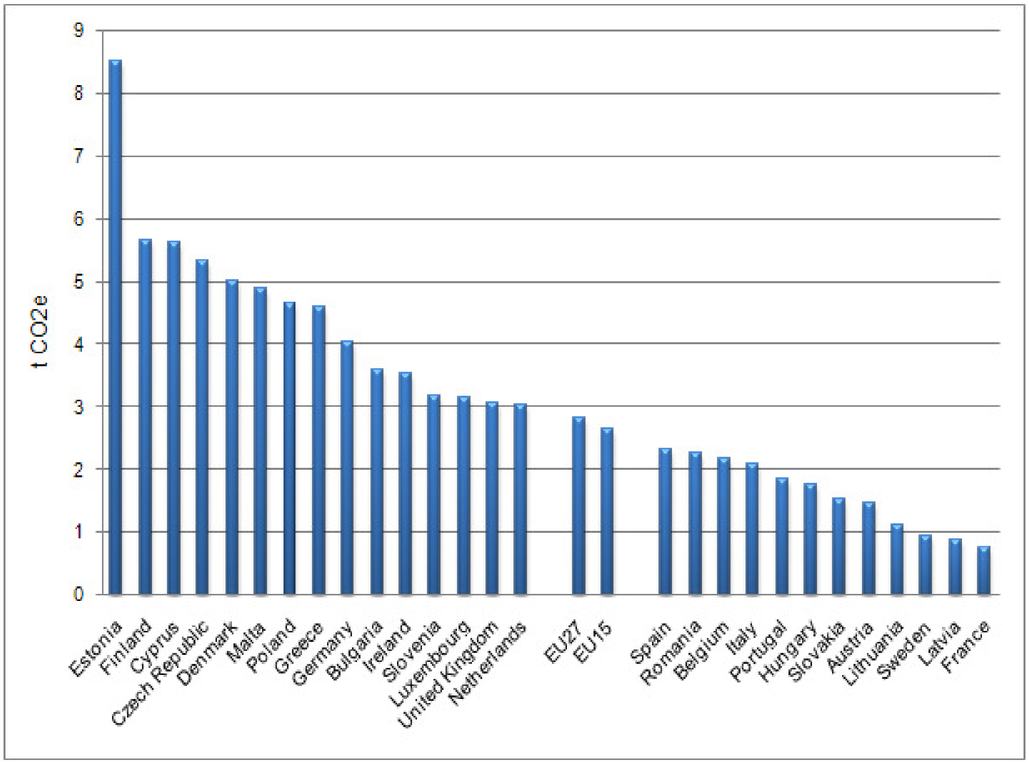

Figure 3 –Gas and electricity emissions per capita, 2006

Source: EEA

3.2.2 Indicator 2: Carbon price

Figure 4 depicts the evolution of the carbon price through the EU ETS (the Scheme). As part of the Scheme, there is a cap on the total emissions allowed from heavy polluting industries across Europe, including the power sector. The Scheme facilitates trading of the 'right to emit' permits among participants; one allowance is equivalent to 1 tonne of CO2. Allowances are allocated and/or auctioned to participants. The aim of both the cap on emissions and the trading system for allowances is to establish a carbon price in order to internalise the environmental costs associated with emissions created by industry during productive activity.

The period between 2005 and 2007 marked the first phase of the Scheme. As shown in Figure 4, the carbon price collapsed in 2007 because the cap set on emissions was too low (resulting in a surplus of allowances) to support a price high enough to induce participants to abate CO2. The second phase of the Scheme is well underway and the emissions ceiling is more ambitious, with fewer allowances available in the carbon market. As a result, the price has remained above €20/tCO2. However, more recently, recessionary pressures on the global economy have resulted in participants cutting production in response to decreasing demand. This has led to an abundance of allowances being sold, contributing to a decline in the carbon price.

Figure 4 – Evolution of EU ETS forward prices

Source: European Climate Exchange

3.2.3 CASE STUDY: Carbon Capture and Storage

Using Carbon Capture and Storage (CCS) to reduce carbon emissions has the potential to play an important role in European and global efforts to mitigate climate change. While renewable energy will be vital to this effort, gas, oil and coal will remain key components of the global energy mix during this century. Unless we find a way to reduce the emissions associated with fossil fuels, we risk failing to meet our carbon abatement targets - CCS is one of the proposed solutions.

No commercial scale CCS plants have been built in the electricity generation industry; however successful projects have captured emissions associated with the extraction of oil and gas. For example, British Petroleum (BP) captures 1 million tonnes of CO_2 annually at the In Salah production site in Algeria, and is participating in a CCS project in the Sleipner offshore field in Norway[11].

3.2.3.1 Carbon capture and storage in Norway

The Norwegian government is currently assessing two possible CCS projects in Norway at Kårstø and Mongstad. The aim of the Kårstø project is to demonstrate full-scale CCS using current technology. The CCS project at Kårstø will capture and store about 1 million tonnes of CO_2 emitted from the Naturkrafts gas-powered power plant.

The CCS project at Mongstad is a joint project between the Norwegian government and StatoilHydro. The first step is to establish a power plant and a CO_2 test plant with the capacity to capture at least 100 000 tonnes of CO_2 per year. The second step is a full-scale CCS plant at Mongstad[12].

The Norwegian government has been given permission to support the CCS project at the Kårstø gas-fired power plant without breaking EU competition rules. EU competition rules do not allow state aid, but an exception can be applied when it protects the environment. EFTA Surveillance Authority (ESA) applies EU laws to the non-EU member Norway in the same way as the European Commission does toward EU Member States.

According to the ESA, the state aid provided for Kårstø can last for ten years and be given directly to state-owned Gassnova SF, which will own and manage the plant. It is expected that the Norwegian government will make an investment decision on the CCS plant in 2009. The experience of Kårstø will be used to improve CCS technology. The ESA hopes that this use of state investment will assist in making other CCS projects more accessible at a reasonable cost and encourage private sector investment[13].

[11] http://www.bp.com/sectiongenericarticle.do?categoryId=9022291&contentId=7042499

[12] http://www.statoil.com/statoilcom/svg00990.nsf/Attachments/EVM+Norsk+og+engelsk/$FILE/EVMokt2006_eng.pdf

[13] http://www.eftasurv.int/information/pressreleases/2009pr/dbaFile15995.html

3.2.3.2 Other CCS proposals

There are a number of other CCS projects currently in progress in the EU. The following is a list of some of the projects:

- The UK Government is running a competition to demonstrate the first full scale CCS power plant in the UK. The demonstration project aims to be operational by 2014[14];
- Vattenfall is to build a CCS demonstration plant in Germany to be operational by 2015[15];
- Bellona (a non-profit organisation based in Norway) has suggested that annual fee paid by Norway for membership of the European Economic Area[16] Norway's (240 million Euro) could be ring-fenced to help finance a CCS project in Poland[17];
- Enel (Italy's main generator) has plans to run two CCS demonstration projects based on post-combustion (by 2015) and oxy-coal combustion technologies (by 2016); and
- There are plans to build pilot plants in the EU by 2015 with a view to making CCS commercially viable by 2020. These plants are expected to be funded by revenues from the EU ETS auctions.

3.3 Air quality

The gas and electricity sectors have an impact on local environments in addition to the global environment.

Monitoring air pollutants is one way to assess the effect of both the gas and electricity sectors on the local environment. Electricity generation from burning fossil fuels is one of the main sources of air quality pollutants.

3.3.1 Indicator 3: NOX and SO2 from gas and electricity sectors

Figure 5 illustrates the change in both sulphur dioxide (SO_2) and nitrogen oxide (NO_X) emissions between 1990 and 2006 across Member States. SO_2 and NO_X are released into the atmosphere through the combustion of fossil fuels. These pollutants can affect air quality (and therefore human respiratory health), and the ecosystem through acidification, which also causes water pollution[18].

The majority of Member States experienced declines in both SO_2 and NO_X between 1990 and 2006; Figure 5 shows negative changes for them. This can be attributed to a combination of factors, including the increased use of abatement technologies, improvements in efficiency, fuel switching from coal and oil to natural gas, closure of inefficient coal plants and installation of abatement equipment (Large Combustion Plant Directive, 2001/80/EC) and the overall improvement in generation technology (in particular,

[14] http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/css/css.aspx
[15] http://cleantech.com/news/2900/vattenfall-to-build-ccs-demonstration-plant-in-germany
[16] http://www.efta.int/content/legal-texts/eea/EEAtext/EEAagreement/at_download/file
[17] http://www.bellona.org/articles/articles_2008/poland_ccs
[18] http://www.scotland.gov.uk/Topics/Statistics/Browse/Environment/TrendAir

through the use of combined cycle gas turbines)[19]. However, there are a few Member States where at least one of the pollutants has increased. For example, Luxembourg experienced an increase of over 300% in $NO_{X;}$ however this should be interpreted with caution as this represents a change from 0.30 kilotonnes to 1.22 kilotonnes which is a fairly low level.

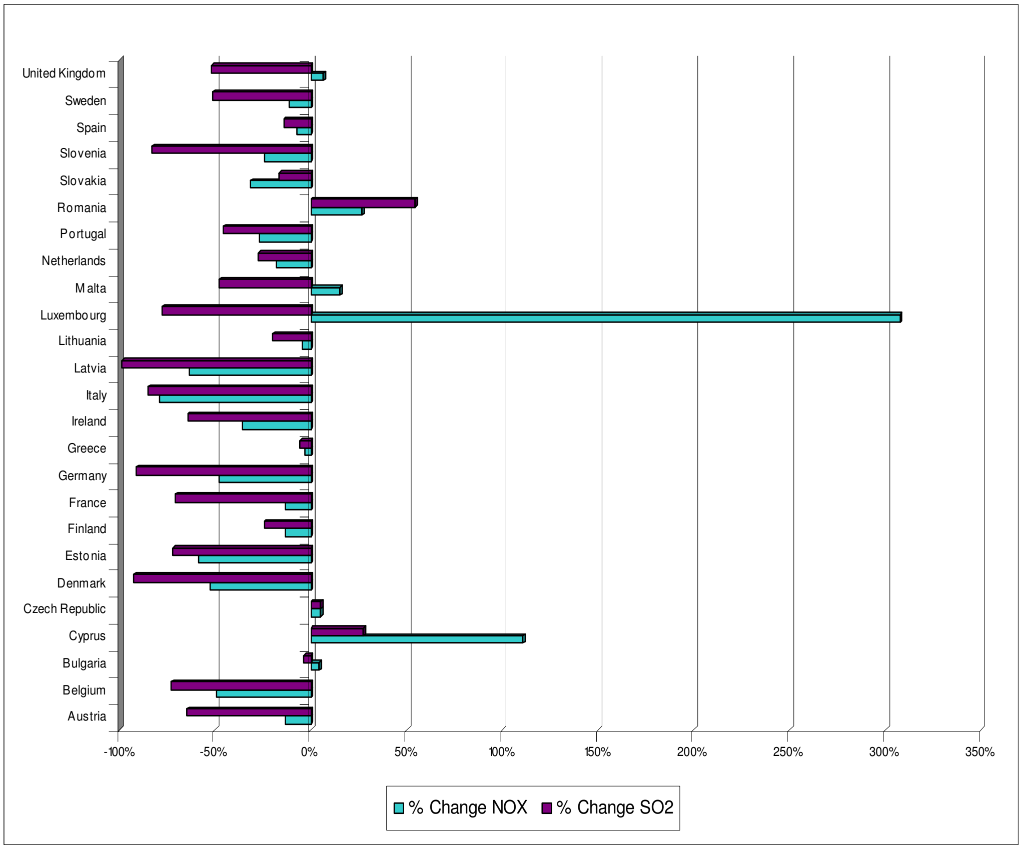

Figure 5 – Changes in NOX and SO2 in gas and electricity sectors, 1990-2006 unless stated otherwise[20]

Source: EEA

[19] See footnote 10, page 19

[20] Bulgaria 2005-06; Czech Republic 2004-06; Finland 2003-06; Greece 2004-06; Lithuania 2004-06; Malta 2000-06; Netherlands 2003-06; Romania 2005-06; Slovakia 2002-06; Slovenia 2002-06; Spain 2000-06; and, United Kingdom 2001-06.

3.4 Renewables

Increasing the share of renewables in energy will play a vital role in the EU's commitment to combat climate change. As discussed above, the share of energy from renewables must increase to 20% by 2020. This section examines the proportion of electricity generated from renewables across the EU.

3.4.1 Indicator 4: Electricity generation from renewables

Figure 6 shows the proportion of electricity sourced from renewables in 2006 compared to the existing national 2010 targets for renewable electricity deployment.

The proportion of electricity from renewables varies considerably across Member States. Some of the factors contributing to this variability include indigenous sources of energy as well as policies in place, such as those that support the deployment of renewables in electricity production. For example, the United Kingdom has been richly endowed with large oil and gas reserves, although reserves have now peaked and are in decline. Thus, historically, there has not been much of a drive to use alternative sources of energy. However, the Renewables Obligation (RO) came into force in 2002 in England and Scotland and in 2005 in Northern Ireland. The RO places an obligation on suppliers to source an annually increasing percentage of their electricity from renewables. Since the RO began, the share of electricity from renewables has increased from 2.9% in 2002 to 4.6% in 2006.

Austria has the highest proportion of electricity from renewables, sourced primarily from hydro. Feed-in tariffs are available for electricity sourced from renewables with an obligatory purchase by the responsible authority, and investment grants are available for hydro and solid biomass plants[21]. Sweden's share of electricity from renewables is the second largest after Austria's. Renewable sources in Sweden primarily include hydro and, to a lesser extent, biomass, reflecting Sweden's geography. The support schemes in place in Sweden include tradable green certificates and quota obligations on electricity suppliers as well as premium tariffs for wind[22]. In December 2008, the CEER published a Status Review of Renewable and Energy Efficiency Support Schemes in the EU which describes the support schemes in place in each Member State[23].

Luxembourg has the smallest proportion of renewable electricity, mainly consisting of small scale hydro. Although Luxembourg has a range of support schemes in place to encourage renewables as well as a stable investment climate, according to the European Commission, it has not made much progress towards its targets due to limitations on eligibility and budget[24].

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[21] CEER Status Review of Renewable and Energy Efficiency Support Schemes in EU, C08-SDE-05-03, page 18 http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_ERGEG_PAPERS/Electricity/2008/C08-SDE-05-03_RES%20and%20EE%20support_10-Dec-2008.pdf

[22] Sweden Renewable Energy Factsheet: http://www.energy.eu/renewables/factsheets/2008_res_sheet_sweden_en.pdf

[23] See footnote 21.

[24] Luxembourg Renewable Energy Factsheet: http://www.energy.eu/renewables/factsheets/2008_res_sheet_luxembourg_en.pdf

Furthermore, in Spain there has been a rapid increase in the installed capacity of renewable generation, reflecting the success of its support scheme, including feed-in tariffs. However, an increase in electricity demand has meant partly that the *proportion* of electricity generated from renewables in Spain has not increased.

The EU target of increasing the share of renewables in the overall fuel mix to 20% by 2020 includes the heat, transport and electricity sectors – national targets have been set for energy but not for electricity. To meet this overall EU target, the European Commission expects that 34% of electricity will need to come from renewables[25]. Even if the EU-27 meets its overall 2010 target, as illustrated in Figure 6, it will still have some way to go to achieve a generation mix comprised of 34% of renewables.

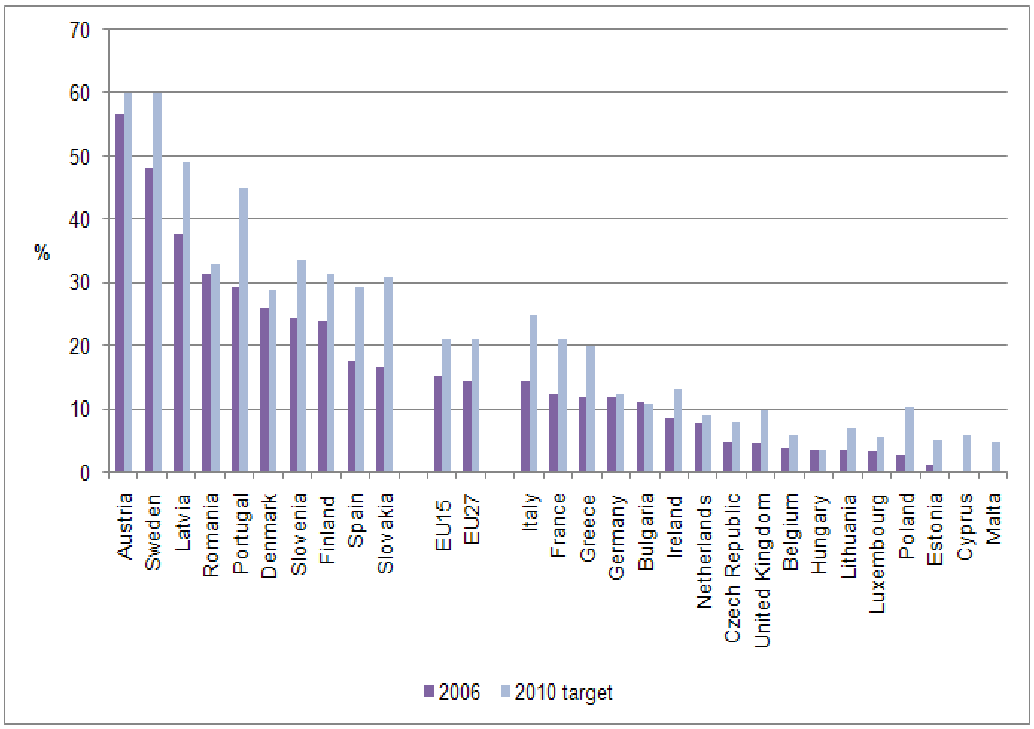

Figure 6 – Proportion of electricity from renewables in each Member State, 2006 versus 2010 target

Source: Eurostat

[25] Renewable Energy Roadmap, COM(2006)848 final, European Commission, http://ec.europa.eu/energy/energy_policy/doc/03_renewable_energy_roadmap_en.pdf

3.4.2 Indicator 5: Electricity generation from wind

Wind power represents the most promising renewable technology option available to meet the target of sourcing 20% of energy from renewables by 2020, .Figure 7 illustrates the proportion of electricity generated from wind in the EU in 2006. As a group, in 2006 the EU-27 sourced 3% of electricity from wind. To put this into context, the European Commission considers that wind could contribute 12% of EU electricity by 2020[26].

Comparing individual Member States, Denmark generates the largest proportion of electricity from wind which stands at 15%. Estonia and Spain are second at 8% each. The next section highlights Denmark's and Spain's successes in deploying wind generation.

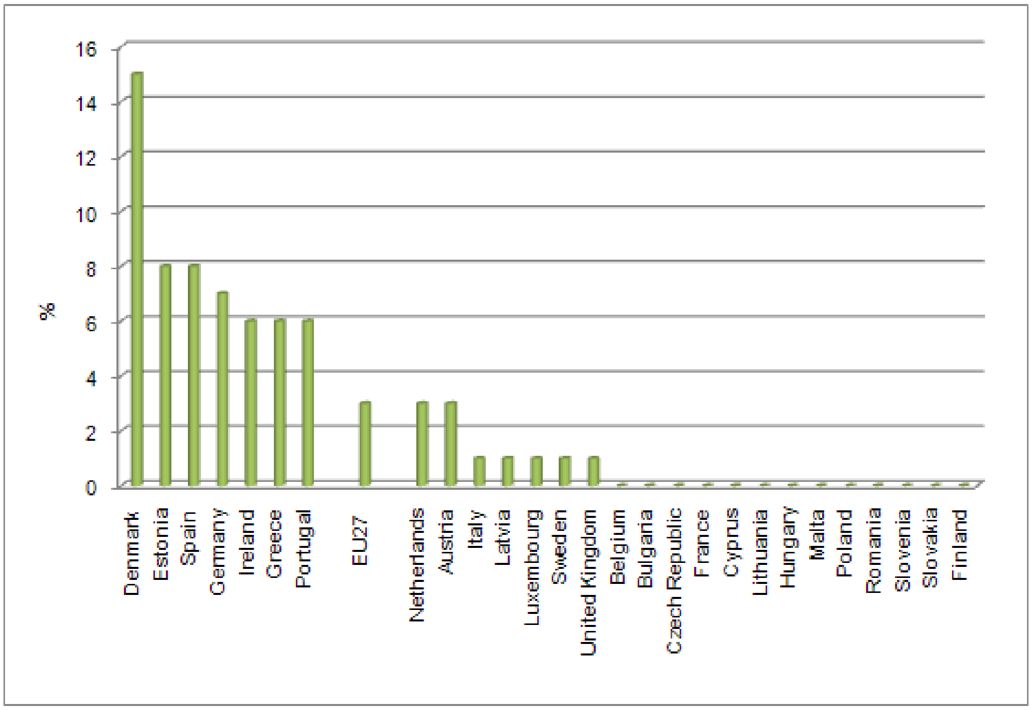

Figure 7 – Proportion of electricity from wind in each Member State, 2006

Source: Eurostat

[26] See footnote 25.

3.4.3 CASE STUDY: Wind power in Denmark and Spain

3.4.3.1 Wind power in Denmark

In 1980, the Danish Parliament introduced incentives for wind cooperatives to encourage individual action toward meeting the country's energy and environmental policy objectives. This programme enabled households to generate electricity from wind without installing a wind turbine themselves. The three key components to the Danish wind initiative were:

1. Giving wind power developments the right to connect to the electricity network;
2. Obliging utilities to purchase their electricity; and
3. A guaranteed price for the power produced.

Under the scheme, the co-operative pays for the cost of connection up to the point of connection to the network and the network operator pays for any upstream upgrades and other improvements. This arrangement resulted in significant uptake of wind generation in Denmark, and the model has been reproduced in Germany and the Netherlands.

Danish law encouraged mutual ownership of wind turbines by exempting the owners from taxes on the portion of the electricity produced which offsets their household's domestic electricity consumption. A wind co-operative would purchase a wind turbine, select the site, sell electricity to the electricity utility under favourable terms, and share the revenues among its members. This enabled the group to buy the most cost-effective turbine available, even though it may have generated far more electricity than individual co-operative members needed for themselves. However, this additional electricity could then be sold to the electricity utilities at a guaranteed price.

A well known example of a Danish wind cooperative is Middelgrunden. In March 2001, it was the world's largest offshore wind farm and is still one of the largest that is cooperatively owned. It is located two kilometres outside of Copenhagen harbour, and comprises twenty 2 MW wind turbines. Half of the turbines are owned by the Middelgrunden Wind Co-operative, and the other half are owned by Copenhagen Energy, the local municipal electricity company. The joint project between the co-operative and the electric company worked well throughout the planning, approval, and construction phases of the project.

Against the above success, it is important to note that these positives need to be balanced against the potential negative impact of these initiatives on the network and the market. In particular, system concerns and associated cost implications.

3.4.3.2 Wind power in Spain

Spain is not a natural location for wind generation. However, a stable and predictable framework as well as technological developments has attracted investment and resulted in the success of wind power in Spain. Wind generation capacity has increased ten-fold in the last ten years. The current capacity is 15,187 MW as shown in Figure 8.

Furthermore, technological refinements in system operation and wind generation have made it possible for the Spanish transmission system operator to transmit a significant share of power from wind into the grid. In 2008, 11% of electricity consumption in Spain was sourced from wind, which has surpassed hydro generation. During some periods in the day, more than a quarter of electricity production comes from wind, particularly at night when demand is low.

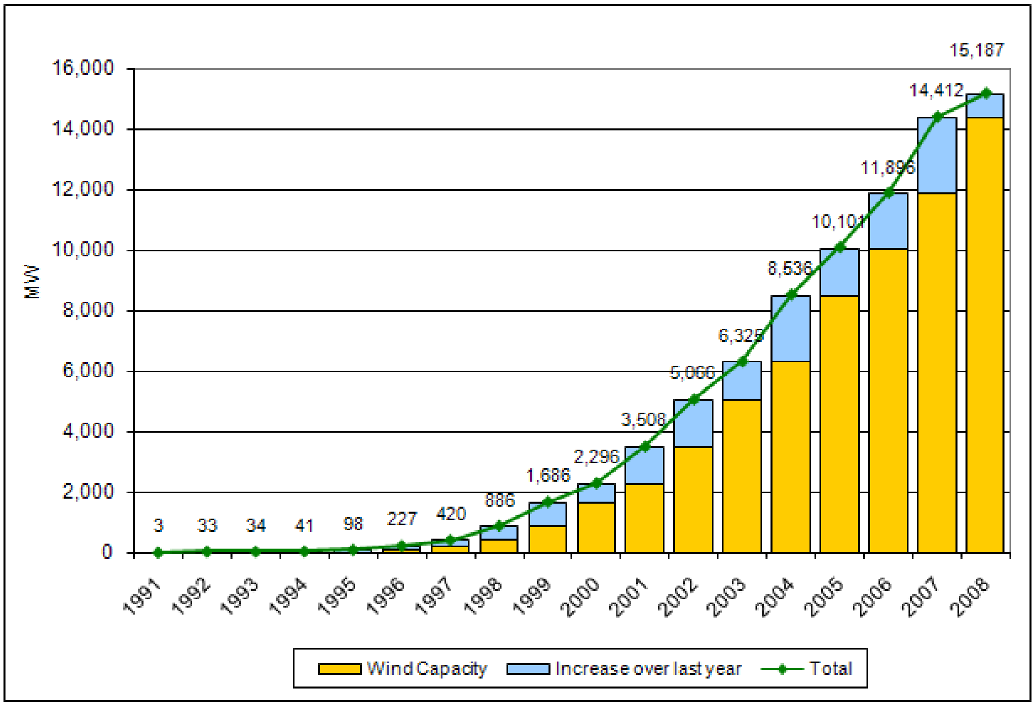

Figure 8 – Installed capacity of wind power in Spain, MW, 1991-2008

Source: Spanish National Regulator, CNE

3.5 Energy efficiency

Energy efficiency is one of the most cost-effective ways to reduce GHG emissions. It can also improve security of energy supply by lowering dependence on fossil fuels. Furthermore, improvements in energy efficiency can contribute to industry competitiveness by reducing the burden of energy costs per unit of output and the need for investments in new energy infrastructure.

3.5.1 Indicator 6: Final energy and electricity consumption[27]

An increase in energy demand reflects more pressure on the environment due to human activities. Because of this, a core objective of the European strategy for energy is to promote savings in every type of energy production and use.

Figure 9 shows the evolution of final energy and electricity consumption between 1995 and 2006 in the EU-27 area. Final energy consumption in the EU-27 increased progressively over the period in question, growing from 1.07 Gigatons of Oil Equivalent (Gtoe) in 1995 to 1.18 Gtoe in 2006, corresponding to an annual average growth of approximately 0.9%. An even more rapid increase occurred in final electricity consumption[28], mainly due to greater use of existing or new electrical appliances in the service sector and, to a lesser extent, in the household sector.

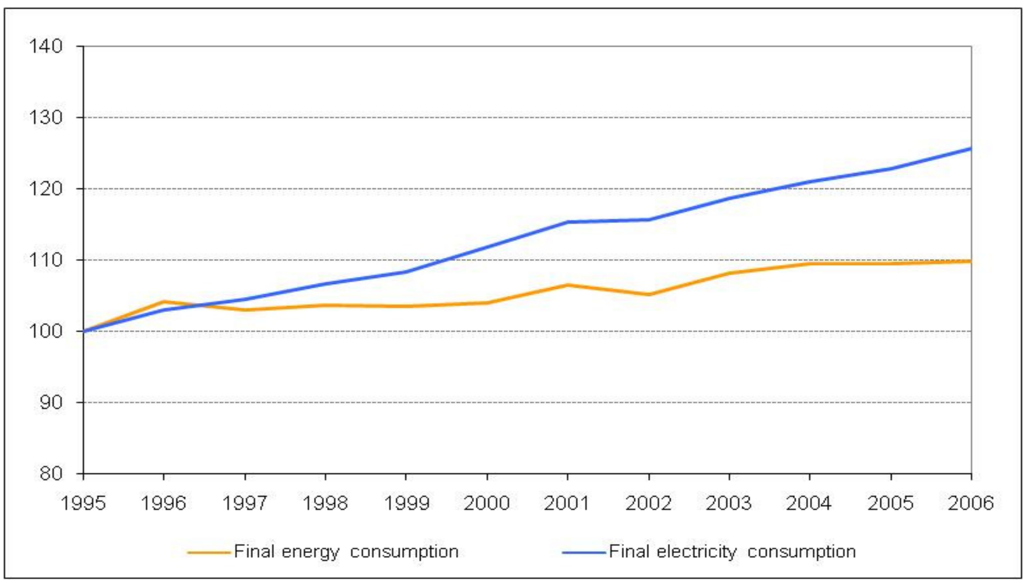

Figure 9 – Final Energy and Electricity Consumption, EU-27 (1995-2006, Index 1995=100)

Source: Eurostat

[27] Final energy consumption includes all energy delivered to the final consumer's door (in the industry, transport, households and other sectors) for all energy uses. It excludes deliveries for transformation and/or own use of the energy producing industries, as well as network losses.

[28] Final electricity consumption covers the electricity delivered to the final consumer's door (in the industry, transport, households and other sectors) for all energy uses. It excludes deliveries for transformation and/or own use of the energy producing industries, as well as network losses.

Figure 10 below illustrates the performance of individual Member States in final energy and electricity consumptions. It shows that the annual average change in electricity consumption from 1995 to 2006 has been larger than the average annual change in final energy consumption in many countries; few Member States showed the opposite trend. Sweden and three eastern European Countries (Bulgaria, Poland and Romania) decreased their total energy demand over the past decade, while they increased their final demand for electricity. Overall, the breakdown by Member State highlights significant differences among Member States in their efforts to contain energy consumption growth.

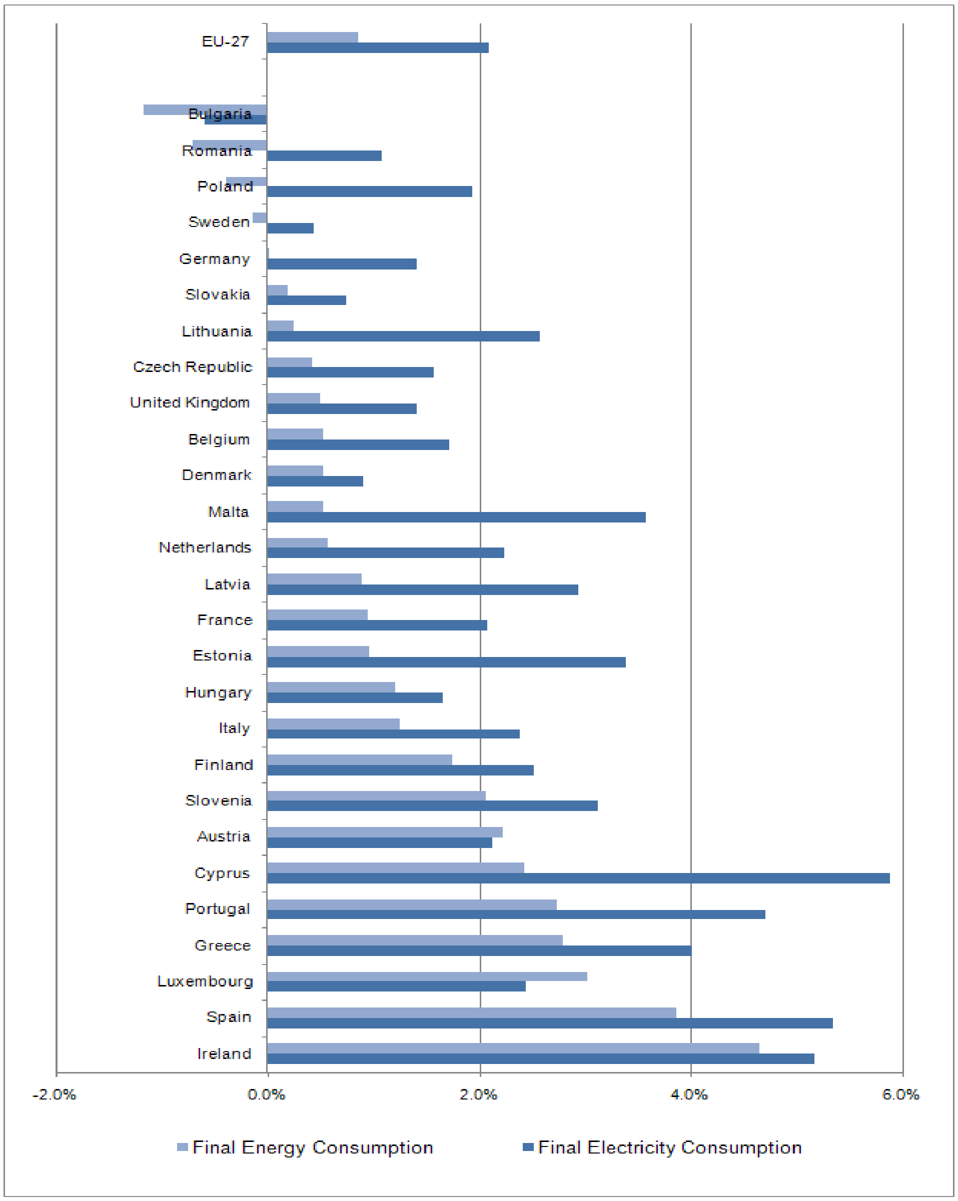

Figure 10 – Average Annual Change in Final Energy and Electricity Consumption, 1995-2006

Source: Eurostat

3.5.2 CASE STUDY: Italy's Experience with White Certificates

The White Certificate scheme is an instrument, based on a market approach, designed to achieve significant and measurable improvements in energy efficiency. This scheme has been in force since 2001 and white certificates have been tradable since 2005. Electricity and gas distributors, serving more than 50,000 end-user customers for at least two years, are required to achieve annual energy savings targets using appropriate measures. This obligation can be met by undertaking energy efficiency measures directly or by outsourcing them out to Energy Service Companies (ESCOs). Alternatively, when targets cannot be met, distributors can buy white certificates on the market to meet their obligations. Certificates are issued annually by the Electric Market Operator (EMO) to each distributor after verifying their energy efficiency results. Certificates are used by distributors as proof of target compliance or sold to other parties when in surplus. They can also be provided to ESCOs for projects carried out on behalf of distributors.

Three years after its introduction, the white certificate mechanism seems to have worked effectively, allowing many companies to exceed their energy saving commitments. By mid-2008, the EMO issued white certificates for 1.8 Mtoe, corresponding to 163% of the total target established by the Italian Government. Figure 11 compares the energy savings commitment against the white certificates issued between 2005 and 2008.

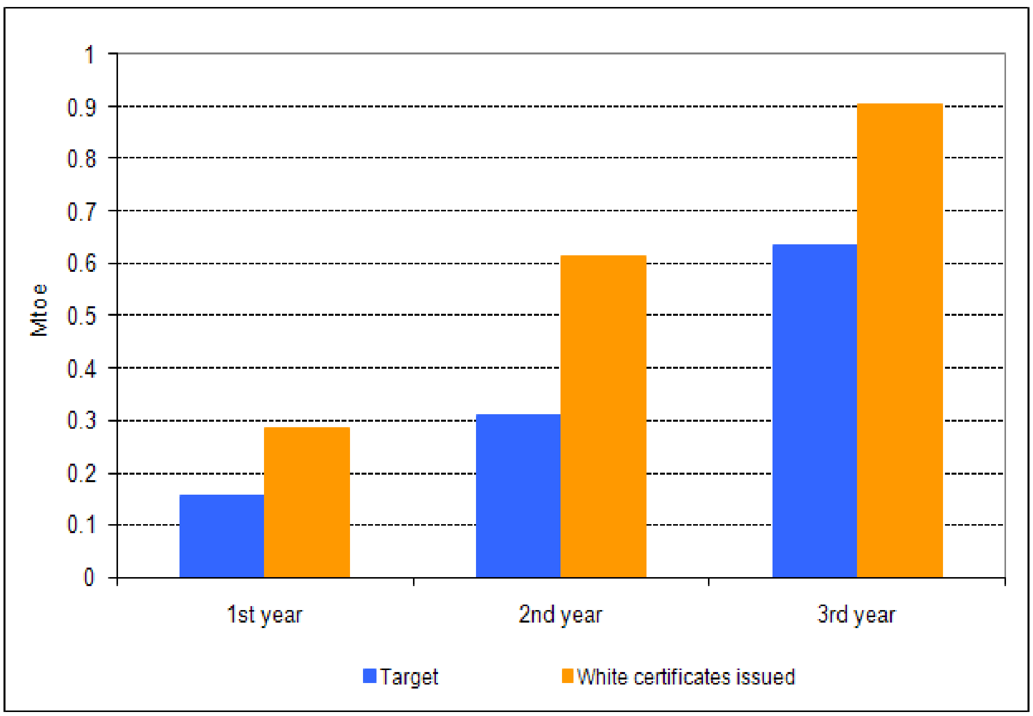

Figure 11 – Energy saving commitments and white certificates issued, Mtoe, 2005-2008

Source: Italian National Regulator, AEEG

As illustrated in Figure 12, most of the energy savings have come from a reduction in electricity consumption (77%). The breakdown by sector is as follows: electricity consumption in the domestic sector (63%); domestic heating fuel savings (21%); public lighting (7%); CHP in the domestic sector (5%); and industrial sector savings (4%).

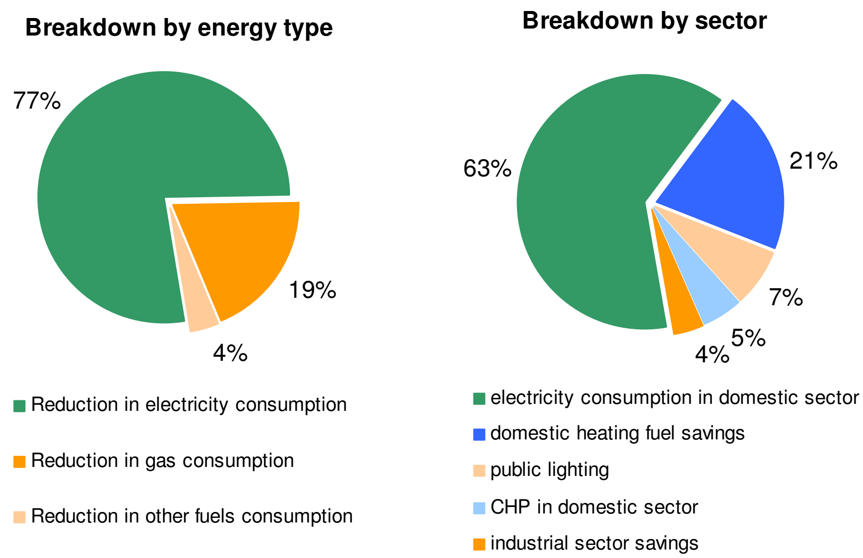

Figure 12 – Breakdown of energy savings due to White Certificate Scheme

Source: Italian National Regulator, AEEG

A central feature of the white certificate scheme is the implementation of a market mechanism (both spot market and bilateral negotiations) which allows energy saving objectives to be met in a cost-effective way. Although the majority of certificates are still traded on a bilateral basis (65% of the total in 2007), transactions established in the spot market are progressively increasing (17% in 2005, 24% in 2006 and 35% in 2007). With respect to market functioning, however, there has been a decrease in prices, mainly due to excess supply.

In order to solve existing technical and economic problems (i.e. excess supply, fall in prices, difficulties in the allocation of individual obligations, and complexity of the penalty system) and to account for the promising results already achieved, the white certificate scheme has been recently revised and new energy efficiency targets have been established for the next three years. By the end of the first eight years of application (2005-2012), annual energy savings are expected to reach 6 Mtoe, with a total amount of energy saved ranging between 22 and 34 Mtoe.

3.5.3 Indicator 7: Energy intensity

Energy intensity is the ratio between total energy consumption and GDP and it provides an overall measure of the energy efficiency in an economy[29]. Figure 13 shows that the energy

[29] Energy Intensity is measured as the ratio between the gross inland consumption of energy and the gross domestic product (GDP) for a given calendar year. It measures the energy consumption of an economy and its overall energy efficiency. The gross inland consumption of energy is calculated as the sum of the gross inland consumption of five energy types: coal, electricity, oil, natural gas and renewable energy sources. The

intensity in the EU-27, measured as kilograms of oil equivalent per 1,000 euro of output, fell over the period between 1995 and 2006 (-14%), mainly due to efficiency improvements and technological changes in the industry and service sectors.

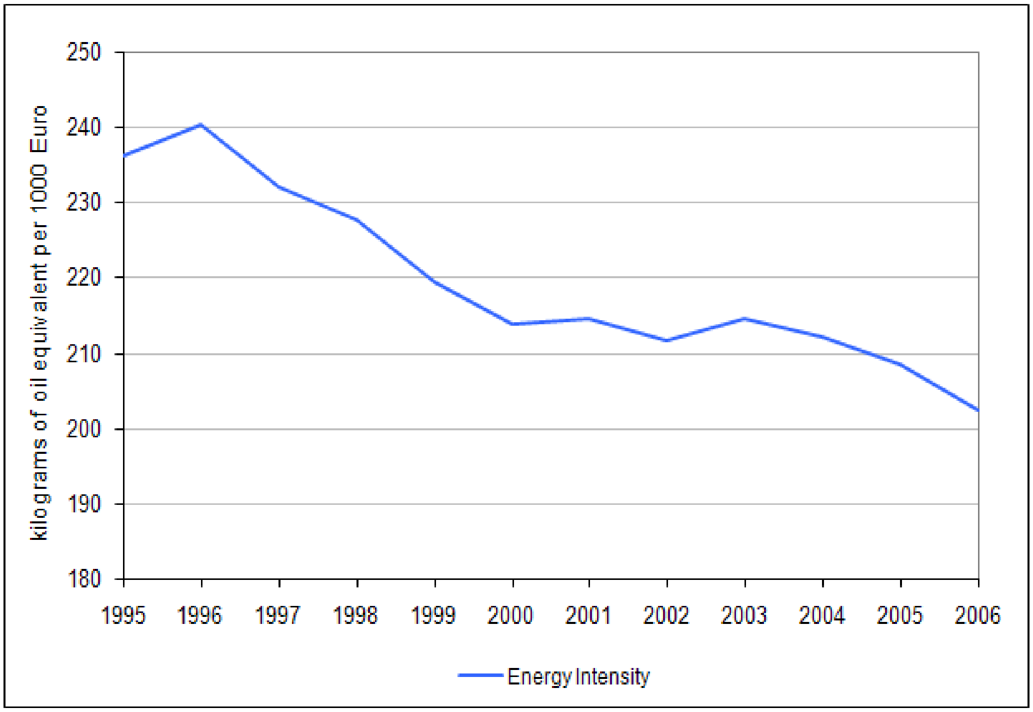

Figure 13 – Energy Intensity, EU-27, 1995-2006

Source: Eurostat

Figure 14 shows the change in energy intensity of individual Member States from 1995 to 2006, which varies considerably. In the eastern European countries (Estonia, Lithuania, Latvia, Poland, Romania, Bulgaria Slovakia, Hungary), the overall reduction in energy intensity between 1995 and 2006 has been generally larger than in other countries, reflecting structural changes in those economies. Several central and northern countries, including Sweden, Slovenia, United Kingdom, Denmark, Netherlands and, to a lesser extent, Germany and Finland have also performed well. Other Member States, including Italy, Spain, and Portugal, decreased energy intensity to a lesser extent over 1995 and 2006 but may have exploited energy efficiency opportunities earlier than other countries.

GDP figures are taken at constant prices to avoid the impact of the inflation, base year 1995. The energy intensity ratio is determined by dividing the gross inland consumption by the GDP. Since gross inland consumption is measured in kgoe (kilogram of oil equivalent) and GDP in 1 000 EUR, this ratio is measured in kgoe per 1 000 EUR.

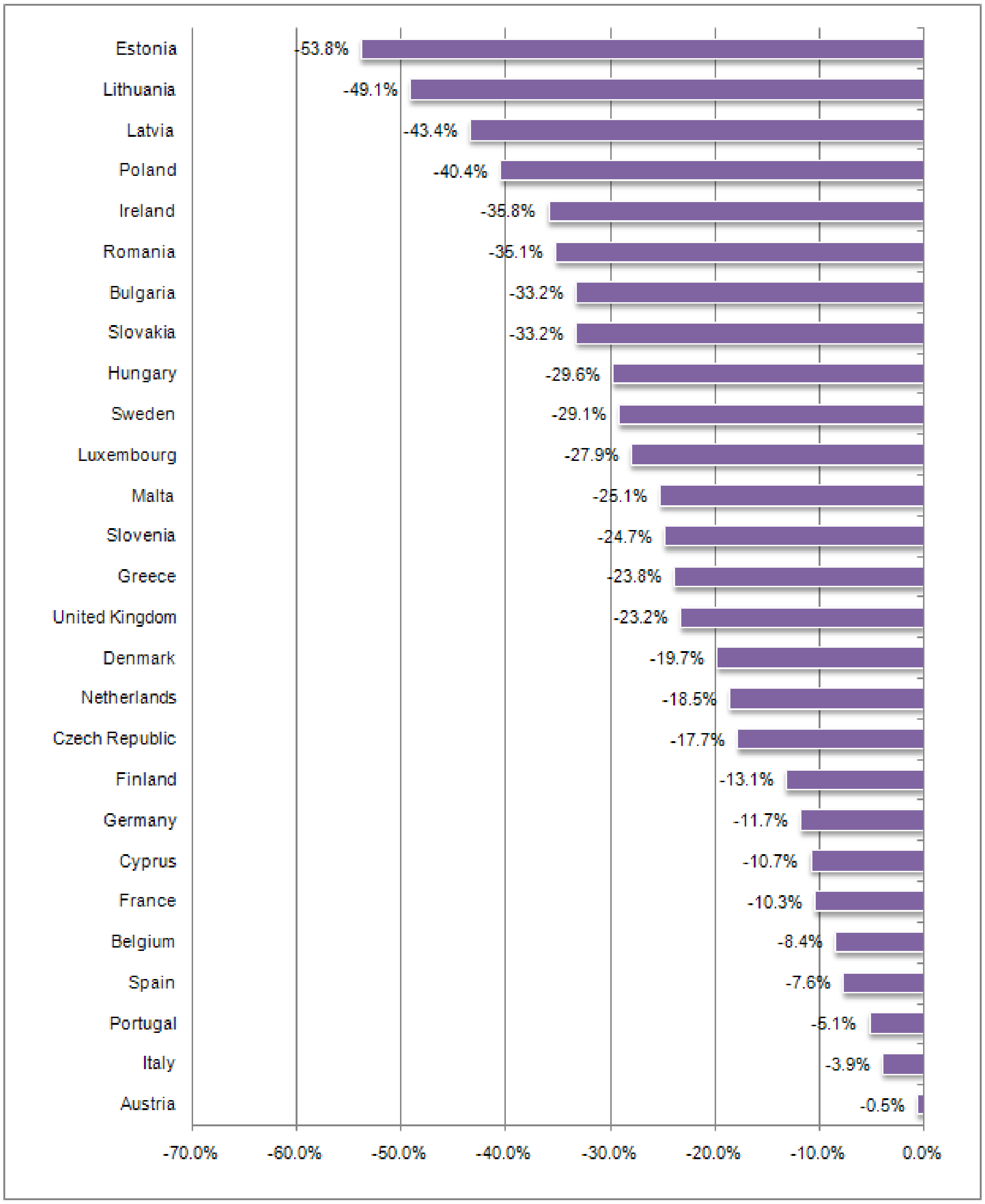

Figure 14 – Change in energy intensity in Member States between 1995 and 2006

Source: Eurostat

3.5.4 Indicator 8: Electricity generation from combined heat and power

Combined heat and power (CHP) or cogeneration is a technology used to improve energy efficiency through the simultaneous generation of heat and power in the same plant[30]. CHP reduces the need for additional fuel combustion for the generation of heat resulting in energy savings and lower GHG emissions.

Figure 15 illustrates the 2006 share of CHP in gross electricity generation in each Member State as well as in the EU-15 and EU-27 areas. It measures the penetration of CHP in the electricity market.

As a group, the penetration of CHP is a little over 10% in the EU. There exists an EU-15 indicative target of 18% of CHP electricity in gross electricity production by 2010. The CHP Directive on the promotion of high-efficiency cogeneration (2004/8/EC) is expected to start having an effect from 2006; it encourages Member States to promote CHP up-take and help to overcome the current barriers hindering progress. It does not set targets but instead requires Member States to carry out analysis of their potential for high efficiency cogeneration[31]. It is important to note that the potential for a country to generate CHP depends on its share of electricity generated from fossil fuels.

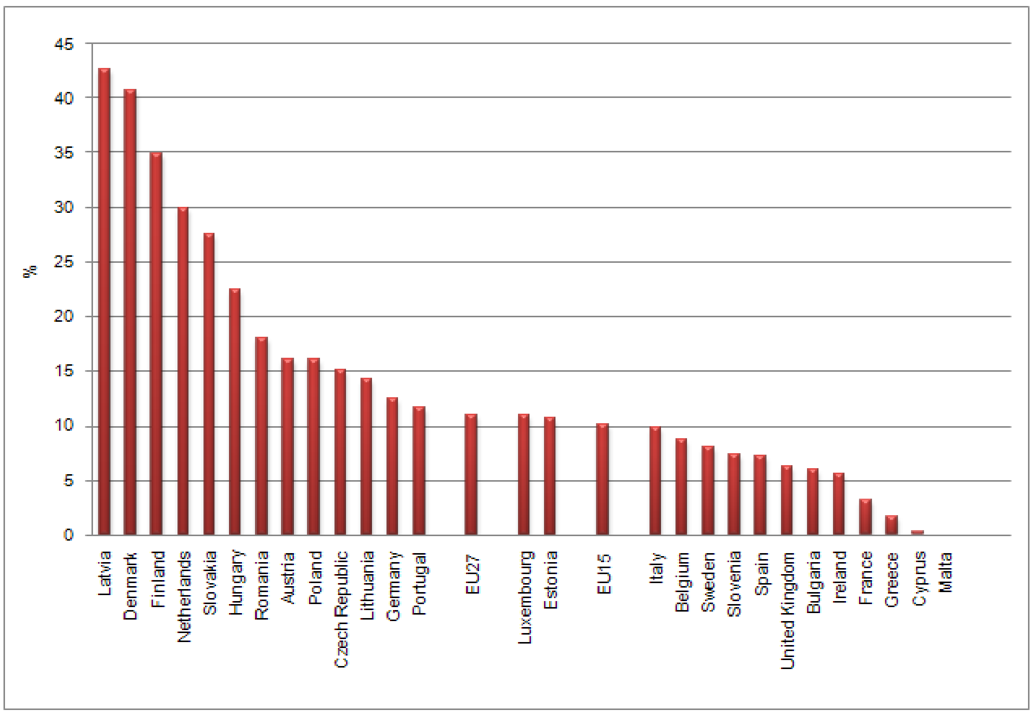

Figure 15 – Proportion of electricity from CHP in each Member State, 2006

Source: Eurostat

[30] Eurostat

[31] http://themes.eea.europa.eu/Sectors_and_activities/energy/indicators/EN20,2007.04

3.5.5 Indicator 9: Efficiency of conventional electricity generation

Figure 16 presents the efficiency of conventional electricity generation, measured as gross electricity output from thermal power plants divided by total fuel consumption. Between 2001 and 2006, production of electricity from thermal power stations became more efficient in most Member States, as a consequence of refurbishment of power plants, new investments, adoption of more efficient technologies and exploitation of economies of scale.

Over the same period, the efficiency of conventional electricity generation increased in the EU-27 from 37.4% to 38.6%. There were eight countries which experienced declines in efficiency (Czech Republic, Lithuania, Finland, Malta, Portugal, Belgium, Italy and Austria), but the majority of them started from a level higher than the EU average. Despite some improvements in Eastern Europe, most of the new EU participants still show lower electricity efficiency than other Member States.

A similar trend can be observed with respect to the efficiency of all thermal power stations, computed as the ratio between electricity and heat from power and CHP plants and the fuel consumption used for their generation. Figure 17 shows that the efficiency of thermal power stations including heat in the EU-27 increased from 45.8% to 46.8% between 2001 and 2006. The majority of Member States improved their performance over the last five years. A few countries exhibit very high efficiency levels, mainly due to the widespread deployment of CHP plants.

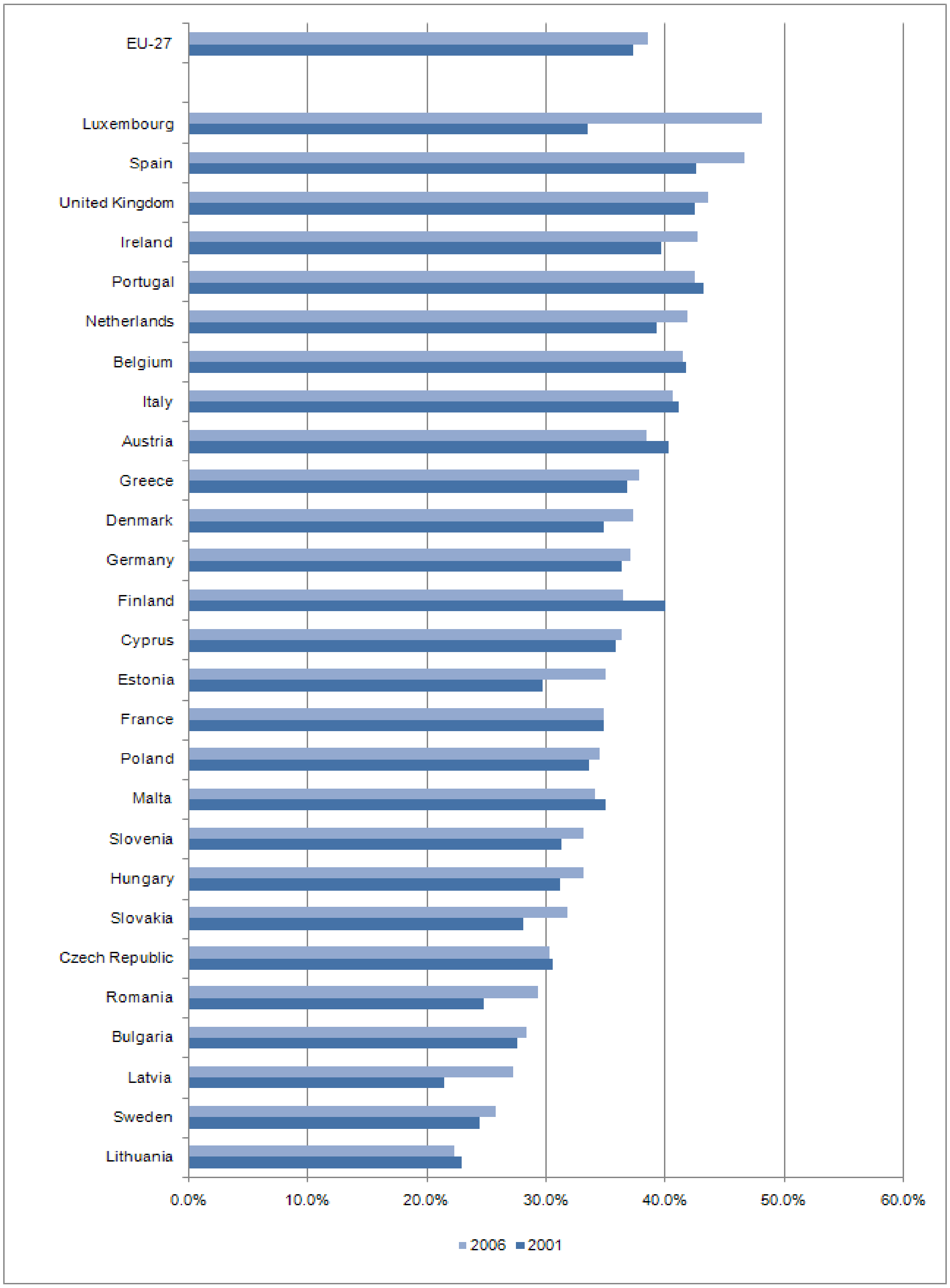

Figure 16 - Efficiency of Conventional Electricity Generation, 2001 versus 2006

Source: Eurostat

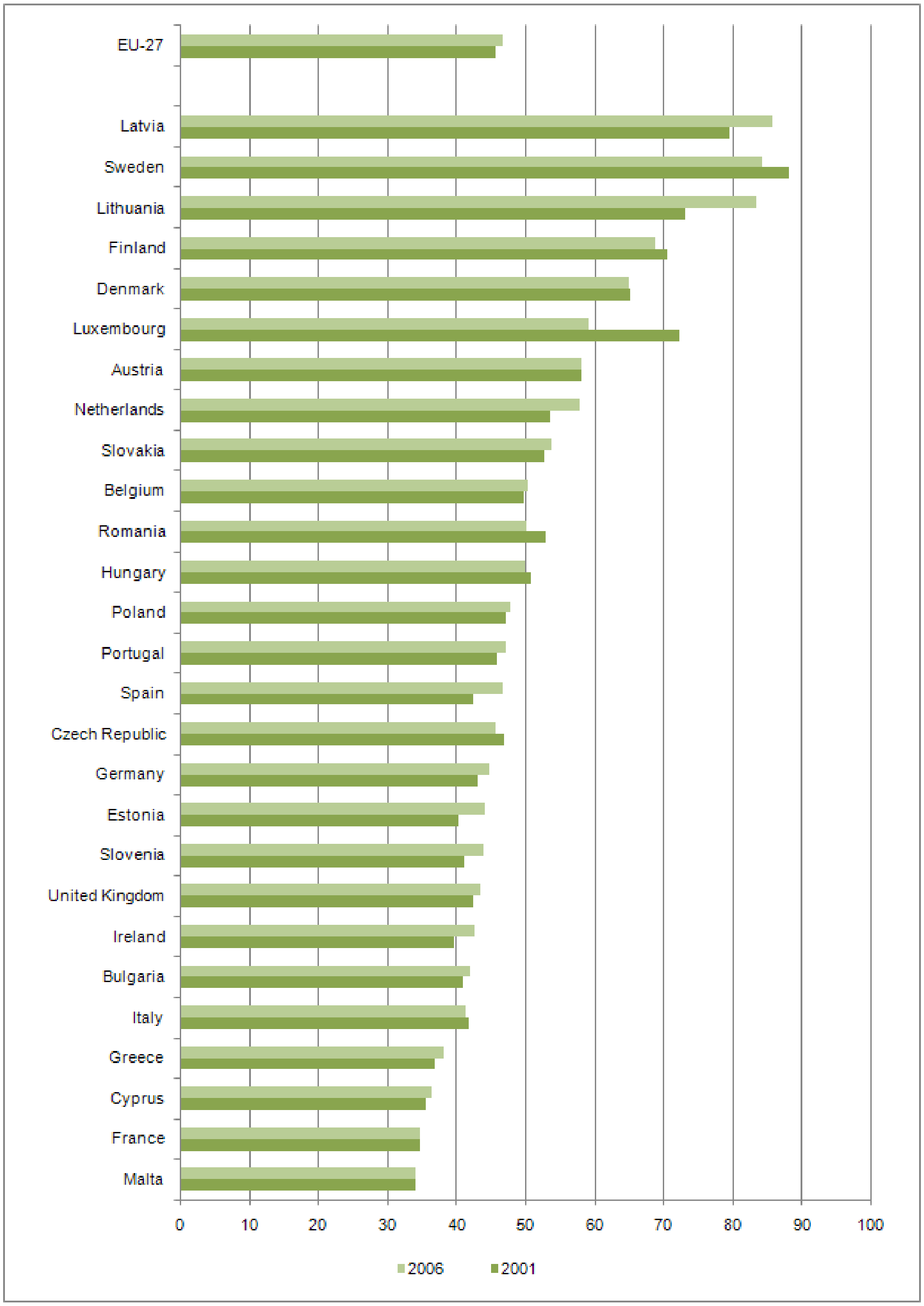

Figure 17 – Comparison of Efficiency of Thermal Power Station including Heat, 2001 versus 2006

Source: Eurostat

3.5.6 Indicator 10: Gas and electricity losses

Losses in electricity and gas networks represent a considerable share of the available energy which could be minimised by adopting the appropriate regulation for network efficiency.

Figure 18 demonstrates that over the period between 2001 and 2006, electricity network losses[32] in the EU-27 declined from 7.2% to 6.8% of total electricity demand[33]. Eastern European countries provided the main contribution to the EU reduction, although their network dispersions remain higher than the European average. Northern countries, including Luxembourg, Finland, Netherlands, Denmark and Belgium, exhibit a particularly high network efficiency. Despite the improvements achieved in most Member States, electricity losses are still significant. Solutions to mitigate losses include, among other things, the introduction of more efficient distribution transformers in the grid, in view of the fact that they are currently responsible for about one third of total network dispersions. However, these solutions are constrained by the length of electricity networks in each Member State which influences the amount of loss.

A shown in Figure 19, leakage in gas from the distribution networks are significantly lower than in the electricity sector due to differences in the physical properties of the two energy sources and in the corresponding transmission networks. However, gas is principally composed of methane which is far more potent than other GHG emissions and so has a greater environmental impact than the indirect emissions associated with electricity generation. Again, gas leakage also depends on the length of the network in each Member State. Losses from the transmission network could account for a significant amount of total losses however data was not available to illustrate this.

Gas distribution losses in the EU-27 have increased slightly over the past five years, from 0.8% of gross inland consumption in 2001 to 0.9% in 2006. Figure 19 shows that performance is highly variable among Member States. Some countries such as Portugal and Romania have seen their losses increase considerably, while others such as Poland, Bulgaria and Lithuania have seen their losses decrease by more than half. However, many countries appear to have effectively managed network losses.

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[32] ERGEG wrote a position paper (E08-ENM-04-03) on the treatment of losses by network operators in 2008 which can be found at: http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_CONSULT/CLOSED%20PUBLIC%20CONSULTATIONS/ELECTRICITY/Treatment%20of%20Losses/CD/E08-ENM-04-03_Treatment-of-Losses_PC_2008-07-15.pdf

[33] Electricity demand is measured as follows: total net generation – consumption for pumped-storage + total imports – total exports

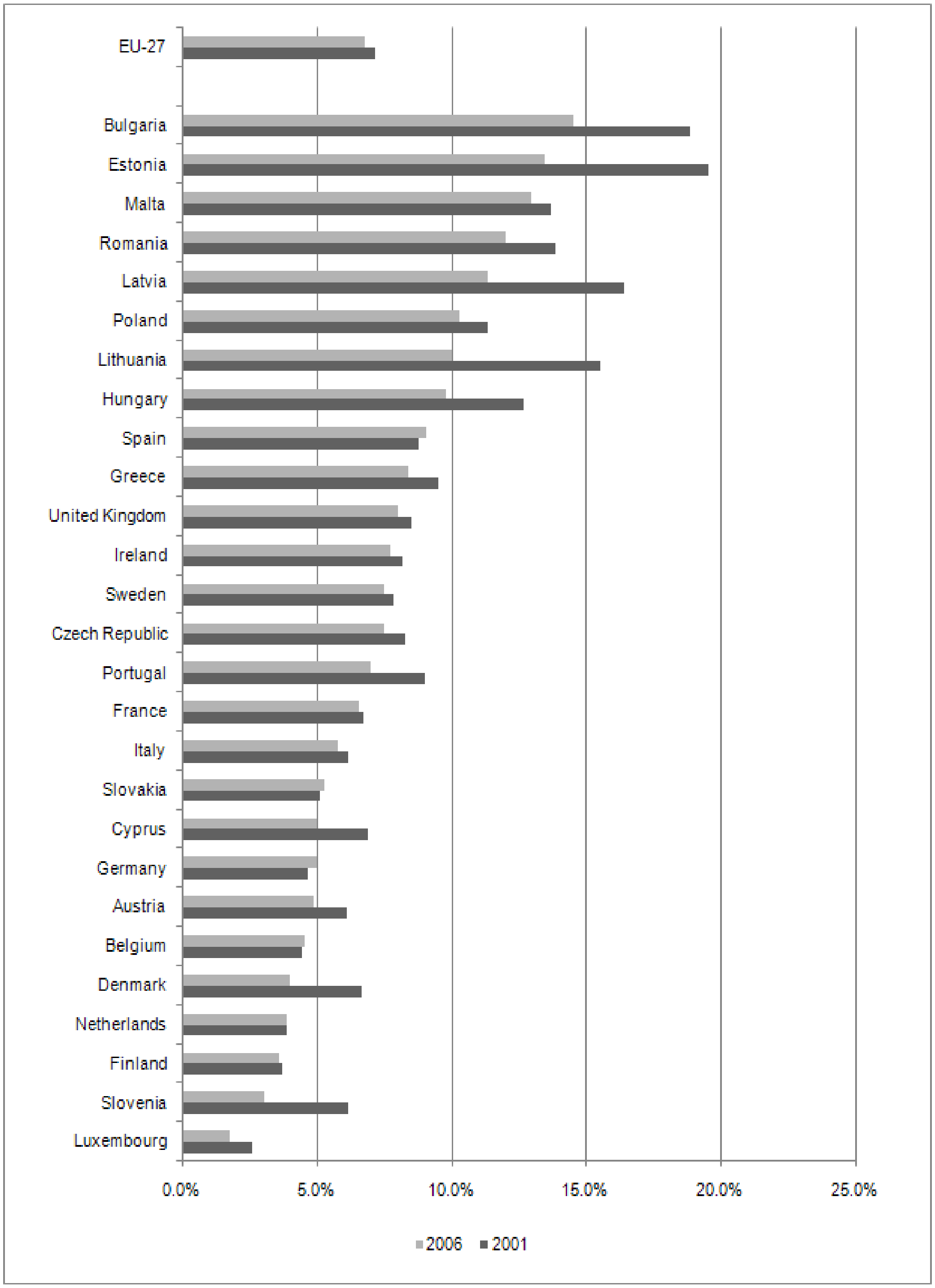


Figure 18 –Electricity network losses as % of total electricity demand, 2001 versus 2006

Source: Eurostat

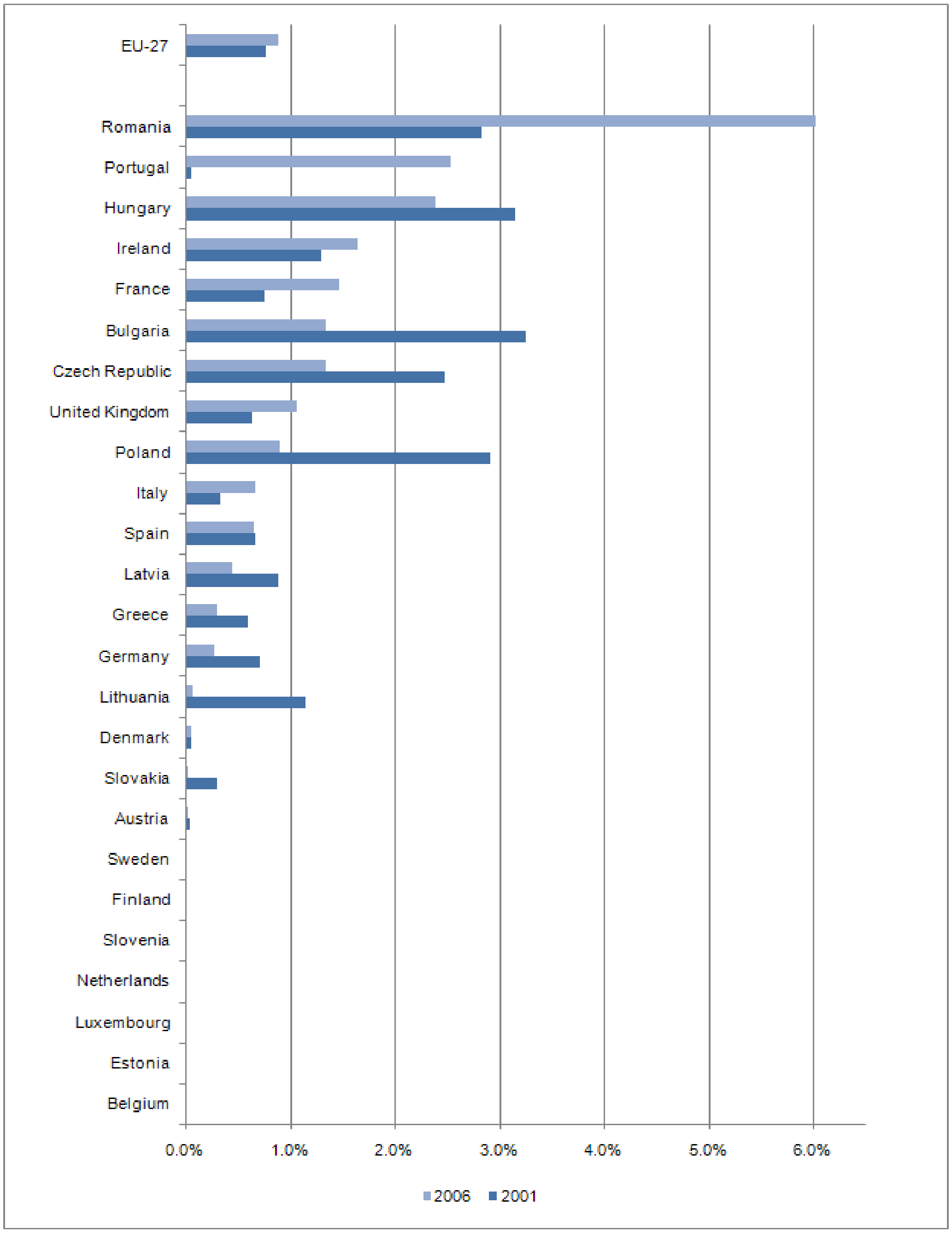


Figure 19 – Gas distribution losses as % of gross Inland consumption, 2001 versus 2006[34]

Source: Eurostat

[34] Data not available for Cyprus and Malta

4 Monitoring gas and electricity, customer choice and access to affordable energy

This section focuses on social issues by monitoring customer choice, using customer switching rates as a proxy, and access to affordable energy, using fuel poverty numbers as an indicator. It also examines gas and electricity prices and compares it to disposable income in the EU.

4.1 Indicator 11: Gas and electricity prices

As depicted in Figure 20 below, the EU has experienced significant price increases of 14% and 33% for electricity and gas, respectively, between 2005 and 2007. With the exception of Latvia's electricity price, gas and electricity prices (inclusive of taxes) have risen in all Member States. The largest increases in gas prices have taken place in Romania, United Kingdom, Latvia and Ireland - all greater than 60%. In terms of electricity prices, the largest increase has been in the United Kingdom equalling 50%. Electricity prices also increased significantly (i.e. greater than 20%) in the Czech Republic, Cyprus, Malta, Romania and Sweden. In comparison to gas prices, electricity prices did not increase as much because other input fuels to electricity generation can be substituted to a certain extent as gas prices rise[35].

[35] See footnote 10.

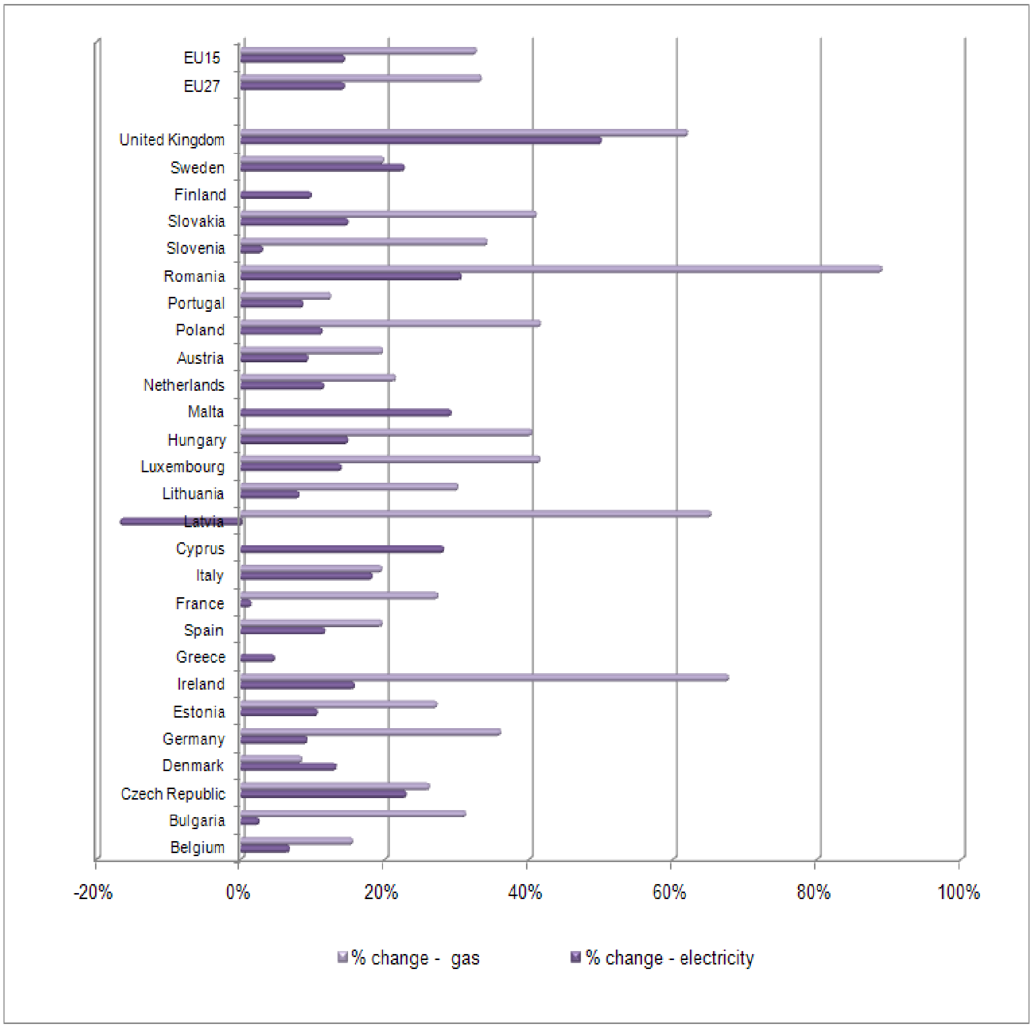


Figure 20 – Changes in Household Gas[36] and Electricity[37] Prices (with taxes) (2005-2007)

Source: Eurostat

Figure 21 and Figure 22 illustrate the share of taxes in household electricity and gas prices across Member States as well as in the EU-15 and EU-27 areas. The shares vary considerably across Member States. According to the EEA's Energy and environment report 2008, the wide variations in taxes in this sector reflect different policy priorities. For example, high taxes in Denmark are a deliberate policy to encourage energy efficiency, and low taxes in the United Kingdom reflect the Government's priority to ensure affordable supplies of energy for all consumers.

Total gas and electricity prices (inclusive of taxes) also vary significantly from country to

[36] Based on the standard domestic consumer D3 (83.70 GJ/year) on 1st January of each calendar year.

[37] Based on the standard consumer Dc (3 500 kWh/year) on 1st January of each year, weighted by consumption.

country due to differences in tax rates, fuel input prices, generation mix and efficiency, supply structure and market distortions[38].

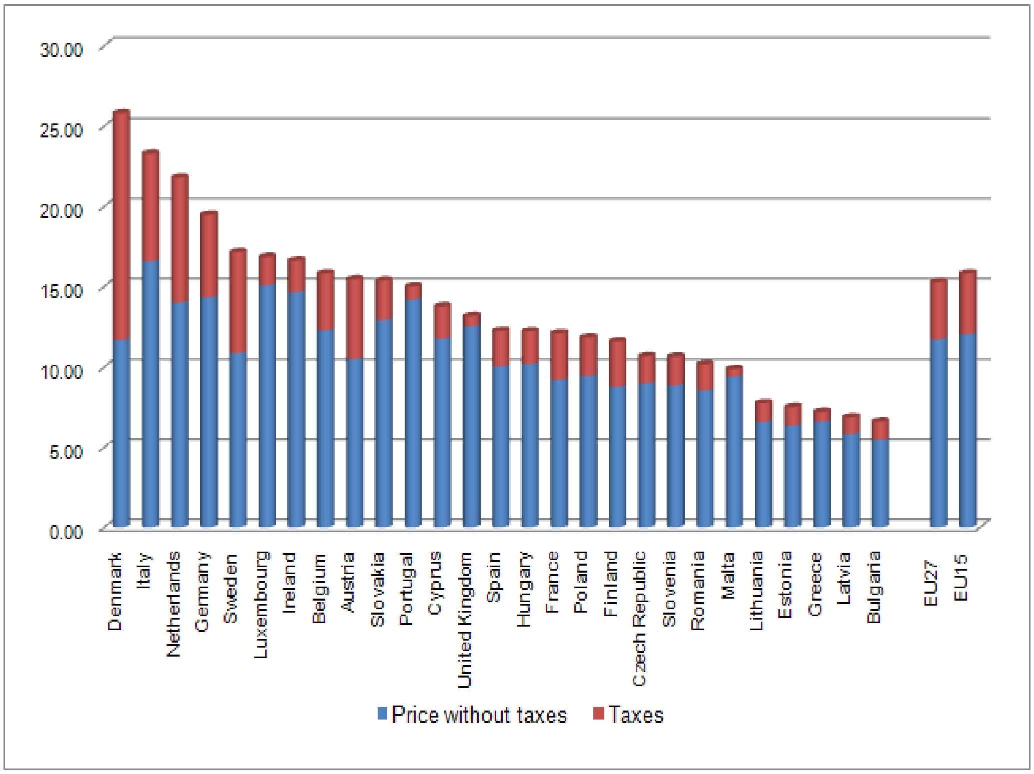


Figure 21 – Price of electricity for households[39], 2007, cents/kWh

Source: Eurostat

[38] See footnote 10.

[39] Based on the standard consumer Dc (3 500 kWh/year) on the 1st of January of each year, weighted by consumption.

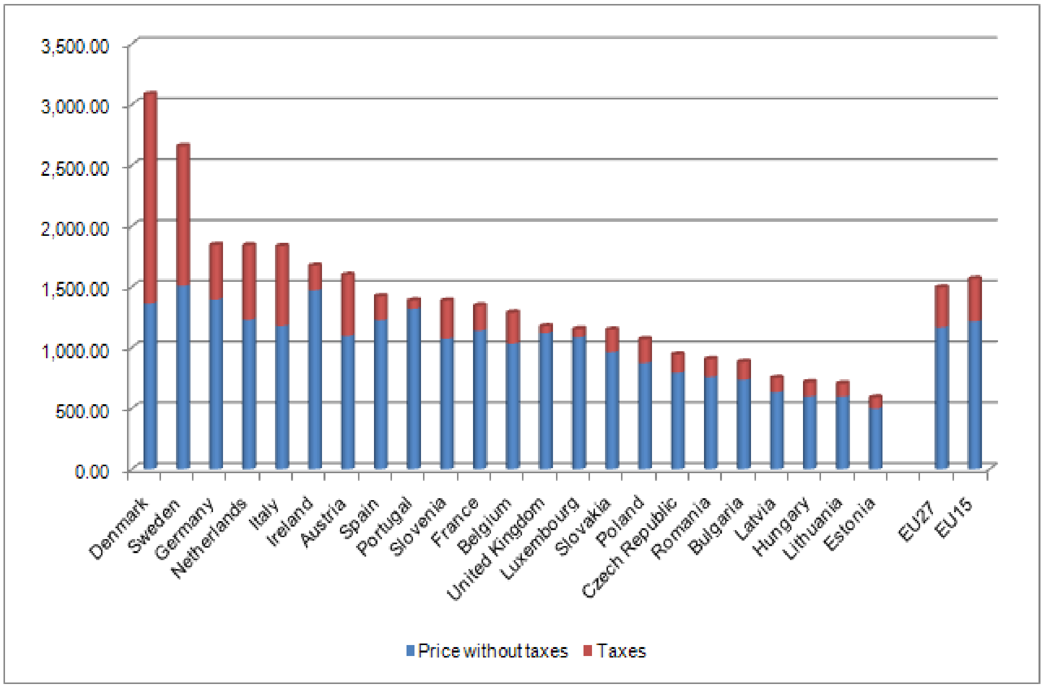


Figure 22 – Price of gas for households[40], 2007, cents/GJ

Source: Eurostat

Figure 23 below depicts household income and gas and electricity prices in the EU-15 Member States between 1997 and 2007. Electricity prices gradually decreased from 1997 and then began an upward trend from 2004 onwards. Gas prices were more volatile over the same period but also experienced an upward trend with a steep rise between 2005 and 2007 – a reflection of rising world energy prices during this period. Household income rose steadily during this period. Except for the rapid increase of gas prices between 2005 and 2007, household income in the EU-15 area experienced larger percentage increases than gas and electricity prices, maintaining disposable income until 2005. Although gas prices increased from 2005 onwards, it may not have had a significant impact on disposable income as electricity represents a greater share of disposable income than gas. However, electricity prices have gradually begun an upward trend and are catching up to gas prices.

It should be noted that the pursuit of low prices is not, in itself, a prudent regulatory objective rather the pursuit of cost reflective prices will lead to greater efficiency in the long term.

[40] Based on the standard domestic consumer D3 (83.70 GJ/year) on the 1st of January of each calendar year.

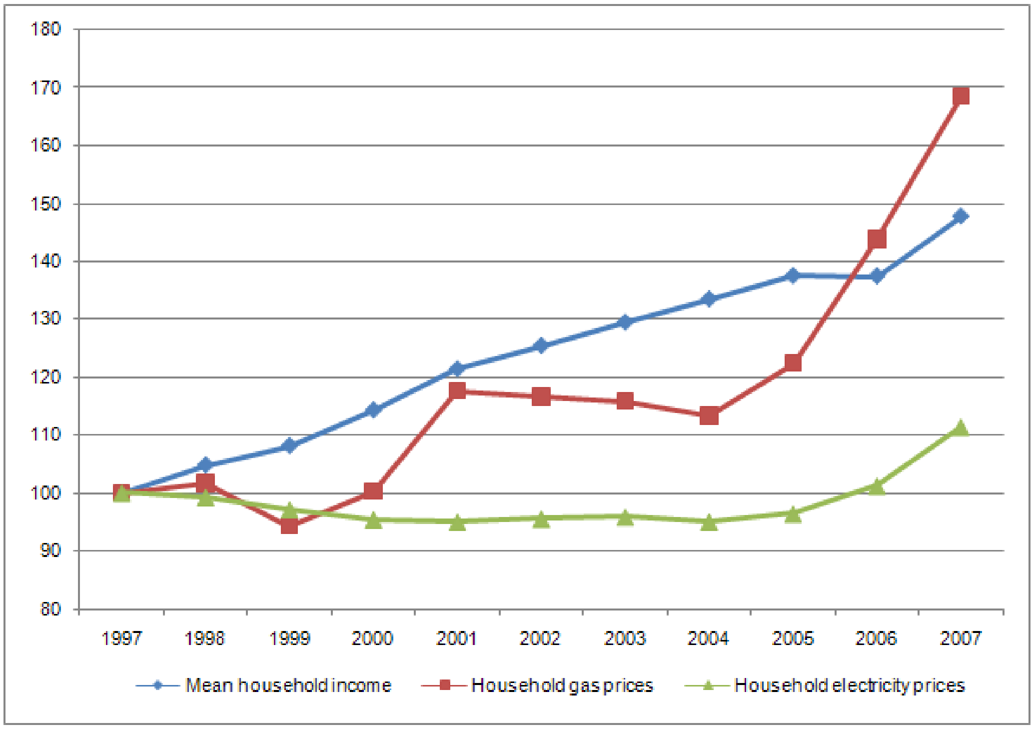


Figure 23 – Household[41] income and prices without taxes, EU-15, 1997-2007, Index: 1997=100

Source: Eurostat

4.2 Indicator 12: Customer switching

Figure 24 and Figure 25 compare electricity and gas switching rates[42] for small industry and households in 2007 across Member States, where data is available. Customer switching promotes competition between suppliers and it gives an indication of the freedom that customers have to choose and switch between suppliers. The highest rates of electricity and gas switching activity occurred in the United Kingdom. Switching rates are a function of market liberalisation and competition, cultural norms, and whether or not there are any barriers to switching such as exit and entry fees, all of which vary considerably across the Member States.

[41] For gas, household is based on the standard domestic consumer D3 (83.70 GJ/year) on 1st January of each calendar year. For electricity, household is based on the standard consumer Dc (3 500 kWh/year) on 1st January of each year, weighted by consumption.

[42] These figures are based upon the number of times a different owner is registered to a meter point, and the total number of meter points. Note that this may include customers who switch more than once in a year.

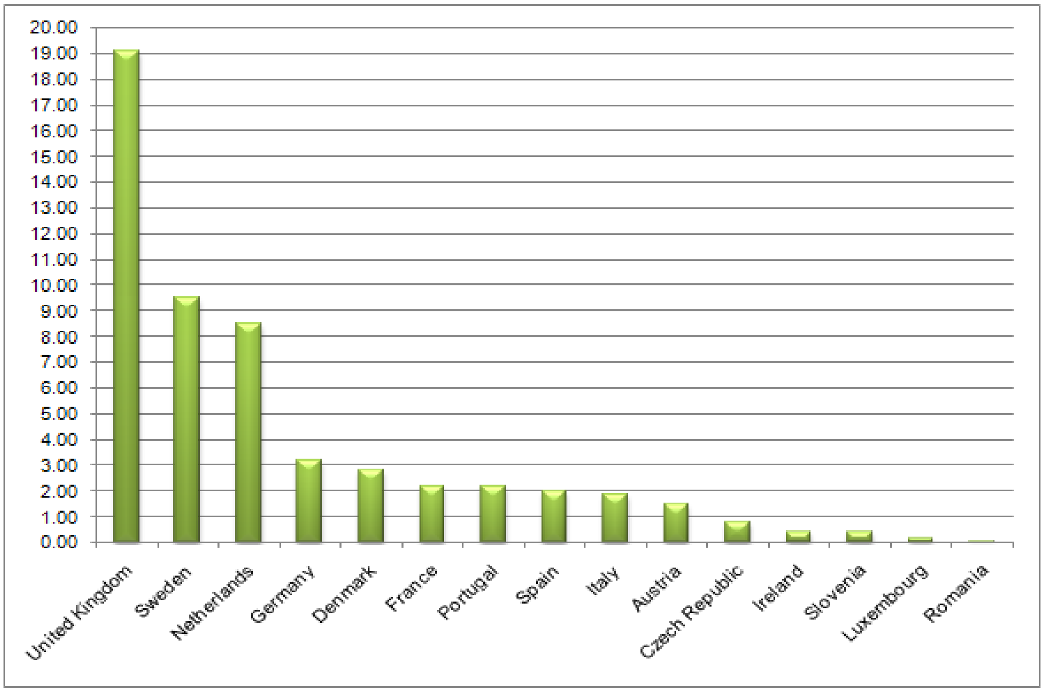


Figure 24 – Annual electricity switching rate (%) in small industry and households, 2007

Source: CEER, National Reports

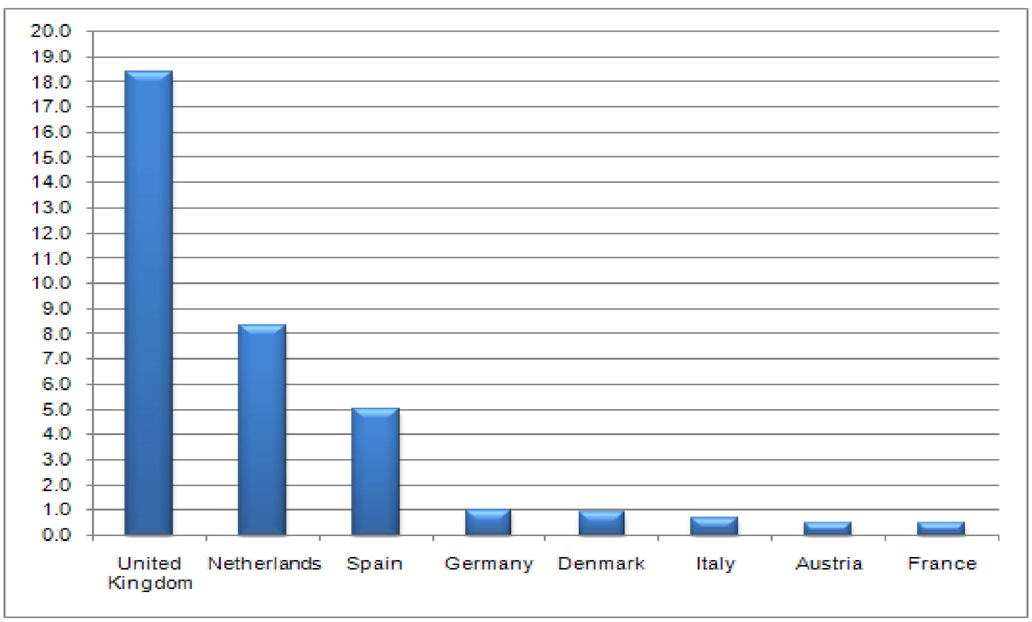


Figure 25 – Annual gas switching rate (%) in small industry and households, 2007

Source: CEER, National Reports

4.3 Indicator 13: Fuel poverty

There is a limited amount of information on fuel poverty in the EU as many countries do not actively measure and report this type of data. However, a study has been conducted by the European Commission Intelligent Energy for Europe Programme entitled the European Fuel Poverty and Energy Efficiency (EPEE) project. The goal of the project is to improve knowledge and understanding of fuel poverty, evaluate the number of fuel poor in the five project partner countries (Belgium, Spain, France, Italy, and United Kingdom) and identify mechanisms to address fuel poverty.

One of the outputs of this study was a report presenting an evaluation of fuel poverty in the five partner countries, based on the EU survey on income and living conditions (SILC). The evaluation analysed three variables in order to get an idea of the number of fuel poor in each country:

- Capability to pay to keep one's home adequately warm;
- Leaking roof, damp walls/floors/foundation, or rot in window frames or floor; and
- Arrears on electricity, water and gas bills.

Figure 26 shows the results of the evaluation in each of the partner countries. Respondents to the survey in all partner countries had most difficulty with the variable related to damp, leaks or mould in their homes. Italy had the largest proportion of respondents saying they had problems with the condition of their home. A possible explanation is that 64% of buildings in Italy were built before 1973. Less than 10% had problems with keeping up with their utility bills and less than 15% were unable to keep their homes warm. The results of the analysis of the three variables gave a range of the number of people in fuel poverty in each partner country which is depicted in Figure 27. The ranges are wide and should therefore be examined with caution.

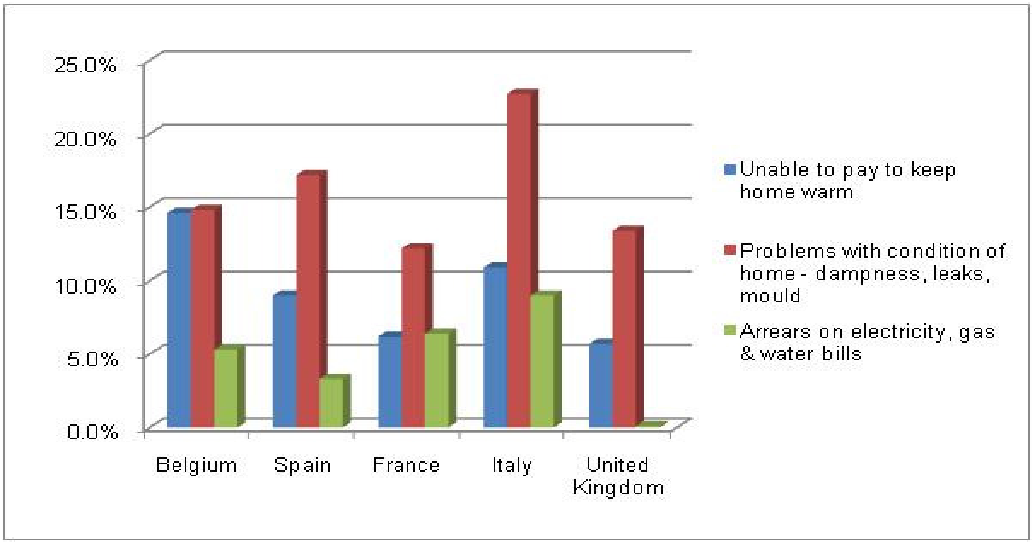
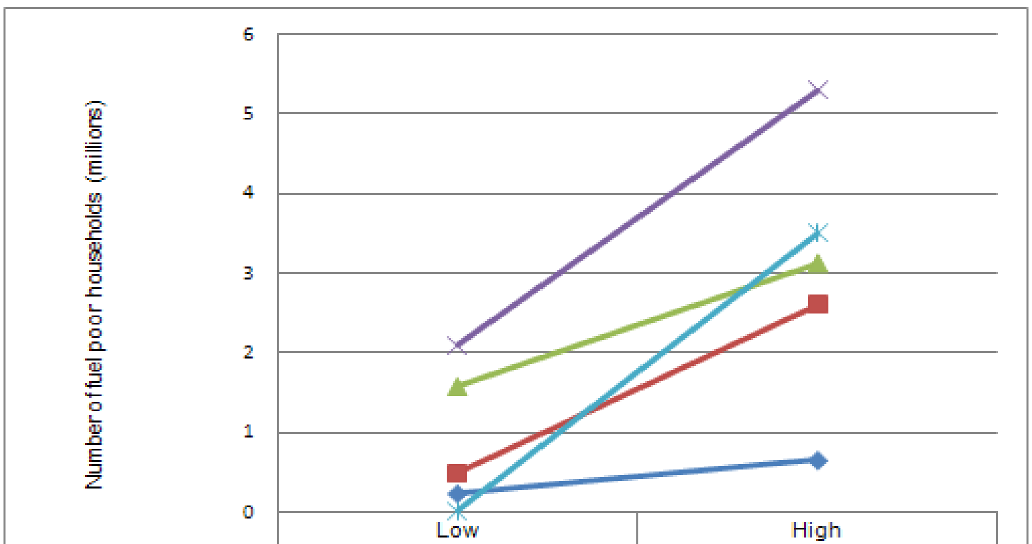


Figure 26 – Evaluation of fuel poverty in selected Member States, 2005

Source: European Fuel poverty and Energy Efficiency, Intelligent Energy Europe



	Low	High
Belgium	0.24	0.66
Spain	0.5	2.6
France	1.59	3.13
Italy	2.1	5.3
United Kingdom	0.03	3.5

Figure 27 – Range of fuel poor households in selected Member States, 2005

Source: European Fuel poverty and Energy Efficiency, Intelligent Energy Europe

4.4 CASE STUDY: Fuel poverty in the UK

In the UK, a household is in fuel poverty if it spends more than 10% of its income on fuel to maintain a satisfactory heating regime.

The UK Government published a fuel poverty strategy in November 2001 which has helped to reduce fuel poverty by about 2.25 million vulnerable households (including children, the elderly or somebody who is disabled) between 1996 and 2006. However, rising prices in recent years has resulted in an increase in the number of households in fuel poverty to 3.5 million in 2006.

There are a number of fuel poverty schemes in the UK with investment totalling over £20 billion since 2000. In 2008, the Government announced the Home Energy Saving Programme which will offer energy efficiency and other measures to households in deprived areas. The Programme will be funded by energy suppliers and electricity generators. The Government publishes annual updates on the progress that the various programmes and measures have made to tackle fuel poverty.

Finally, the UK regulator, Ofgem, held a summit in 2008 to agree a set of actions to improve targeting of existing help to those in fuel poverty and help more vulnerable energy consumers participate more effectively in the energy market. A number of key initiatives were agreed[43].

[43] http://www.ofgem.gov.uk/Sustainability/SocAction/Publications/Documents1/Fuel%20Poverty%20Summit%20Action%20Programme.pdf

5 Ensuring a secure and reliable gas and electricity supply in the EU

It is not easy to define security of supply. In the past, security of supply was often defined simply as risk of a physical disruption of supply. Recent definitions consider the economic and environmental sustainability of security of supply, considering long-term energy security[44].

The importance of a secure European energy supply has again been highlighted by the recent dispute between Russia and Ukraine. In this section, we use indicators to illustrate current and past levels of security and reliability of European energy supplies. The section will also discuss a case study of how Denmark successfully reduced its energy dependency.

[44] "[…]security of supply is a flow of energy supply to meet demand in a manner and at a price level that does not disrupt the course of the economy in an environmentally sustainable manner" Cambridge Energy Research Associates (CERA) Global Energy and Energy Security: A New Agenda 2001. www.cera.com

5.1 Indicator 14: Energy dependency

Figure 28 shows net energy imports[45] as a percentage of energy consumption[46] in 2006. The analysis here focuses on dependency in a single year however dependency can also vary from month to month.

The more a country relies on imports to meet its energy demand, the greater its degree of susceptibility to external supply disruptions. Figure 28 shows that the EU, as a group, imports a little over 50% of the energy it consumes. Cyprus, Luxembourg and Malta are most reliant on imports, importing about 100% of the energy they consume. In contrast, Denmark is least dependent as it exports nearly one and a half times as much energy as it consumes.

[45] Net imports are calculated as imports minus exports. Imports represent all entries into the national territory excluding transit quantities (notably via gas and oil pipelines); electrical energy is an exception and its transit is always recorded under foreign trade. Exports similarly cover all quantities exported from the national territory.

[46] Final energy consumption includes all energy delivered to the final consumer's door (in the industry, transport, households and other sectors) for all energy uses. It excludes deliveries for transformation and/or own use of the energy producing industries, as well as network losses.

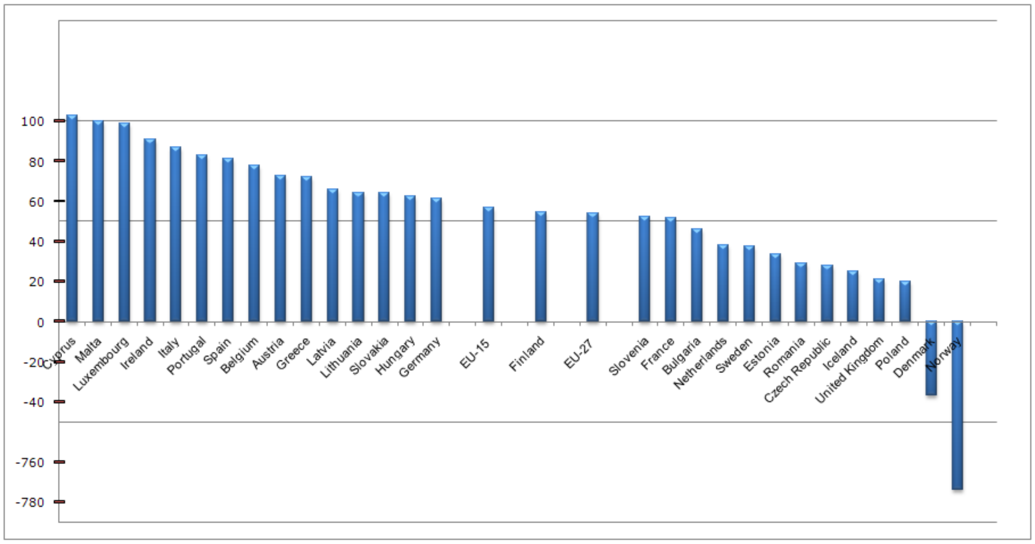


Figure 28 – Net imports as percent of energy consumption, 2006

Source: Eurostat

The case study below highlights that, although energy dependency can be reduced by the exploitation of national energy reserves, equally important are measures to increase efficiency in both energy generation and consumption and measures to increase renewable generation.

It should also be noted that energy dependency should not solely be considered at a national level. In a well functioning single European energy market, if one country depends on a European neighbour for its energy needs this is not necessarily an issue. What is important is that the physical infrastructure is in place to ensure the energy can be delivered and the legal infrastructure is in place to ensure that the energy contracted will be delivered. As with any commodity or service, some Member States may have comparative advantages in energy production due to the resources that it is endowed with. These resources could be fossil fuels, but could also be natural resources such as wind, solar or strong tides or elevated masses of water.

5.2 CASE IN POINT: Energy Dependency in Denmark

Denmark provides an interesting case study because it was 99% dependent on foreign sources of oil in 1973 and is now energy self sufficient. It has achieved this through a combination of managed exploitation of its natural gas resources, the development of renewable energy technologies and a drive for energy efficiency.

Natural gas reserves were discovered in the Danish section of the North Sea in 1979. Currently, natural gas contributes 23% of Denmark's energy consumption and is used for domestic heating, in combined heat and power plants and in industry. Furthermore, a significant quantity is exported to Sweden and Germany.

With respect to renewables, Denmark has implemented policies to encourage the development of wind and biomass generation. Denmark currently produces 15% of its energy from renewable sources and aims to increase this to 30% by 2025.

In order to increase efficiency in electricity generation, Denmark has developed its cogeneration sector. The surplus heat from more than 50% of the electricity generated (excluding that from wind-turbines) is used for district heating or industrial purposes. Just over 80% of district heating is co-generated with power.

Denmark has managed to increase energy efficiency on the demand side. This has been achieved through a variety of government measures and incentives on industry and end-users.

5.3 Indicator 15: Electricity security of supply

The next three figures examine the security of national and overall EU electricity supplies. There are two main causes of physical disruptions of electricity supplies: those caused by insufficient electricity generation and those caused by faults on the transmission or distribution systems. In order to secure the former, a country must have either a comfortable generation margin (defined as the differece between generation capacity and peak demand) or sufficient interconnections with countries with surplus generation which can be exported.

Figure 29 shows generation margins in Member States as well as the EU-15 and EU-27 areas. There is no available data for the Netherlands in 2007 but the corresponding margin in 2006 was 42%. As the graph illustrates, most Member States, including the EU as a group, have generation margins of over 20%. Only four countries have a margin of under 10%: Cyprus; Finland; Hungary; Luxembourg; and Poland. As stated above, the fact that a Member State has a low or negative generation margin does not necessarily imply that there is an issue with security of electricity supply, as long as the generation gap can be met by imported electricity. The next two graphs examine the capacity available to import or export electricity (interconnectedness) and actual net imports. These two figures show, for example, that Luxembourg makes up its negative generation margin by importing the majority of its electricity.

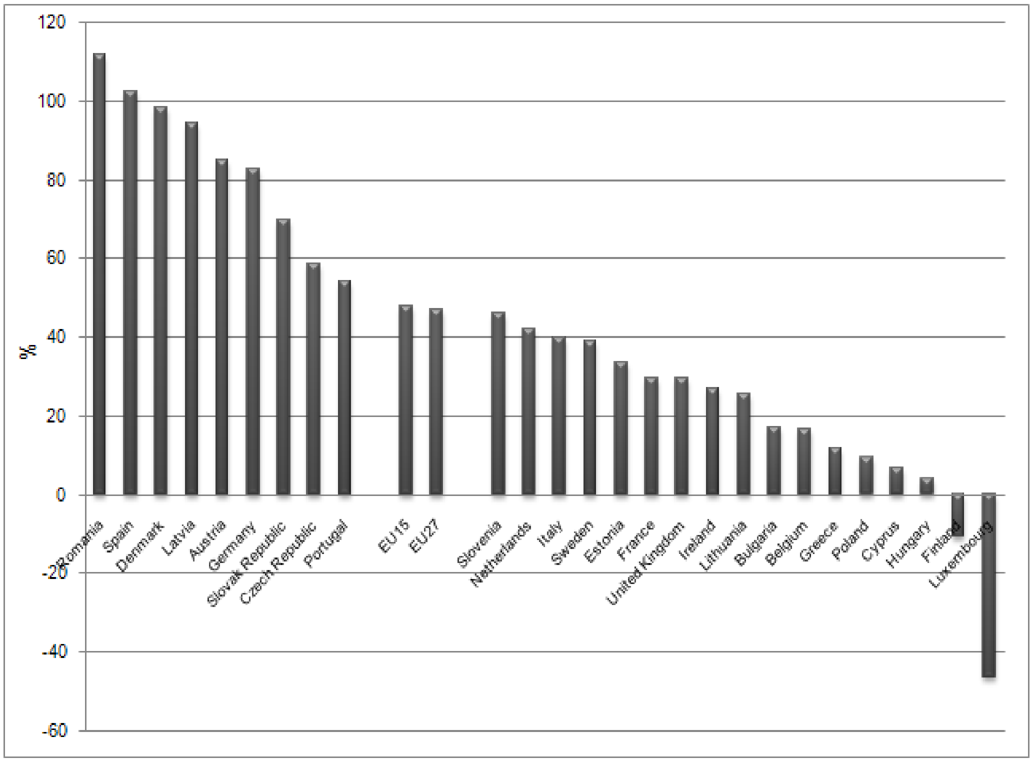


Figure 29 – Generation Margins, 2007[47]

Source: Eurostat

Where data is available, Figure 30 illustrates the level of physical interconnection (active power, MW) with control areas in neighbouring Member States. The figure shows that five countries are below the 10% target (interconnection as a percentage of installed generation capacity) established at the EU summit in Barcelona in 2002. Because Ireland and the United Kingdom are islands, Italy and Spain, in comparison, should be better interconnected to the rest of Europe. Although there is some progress being made in this regard, further interconnection capacity should be an urgent prority for these countries.

[47] No data available for Malta. Most recent available data for the Netherlands is 2006.

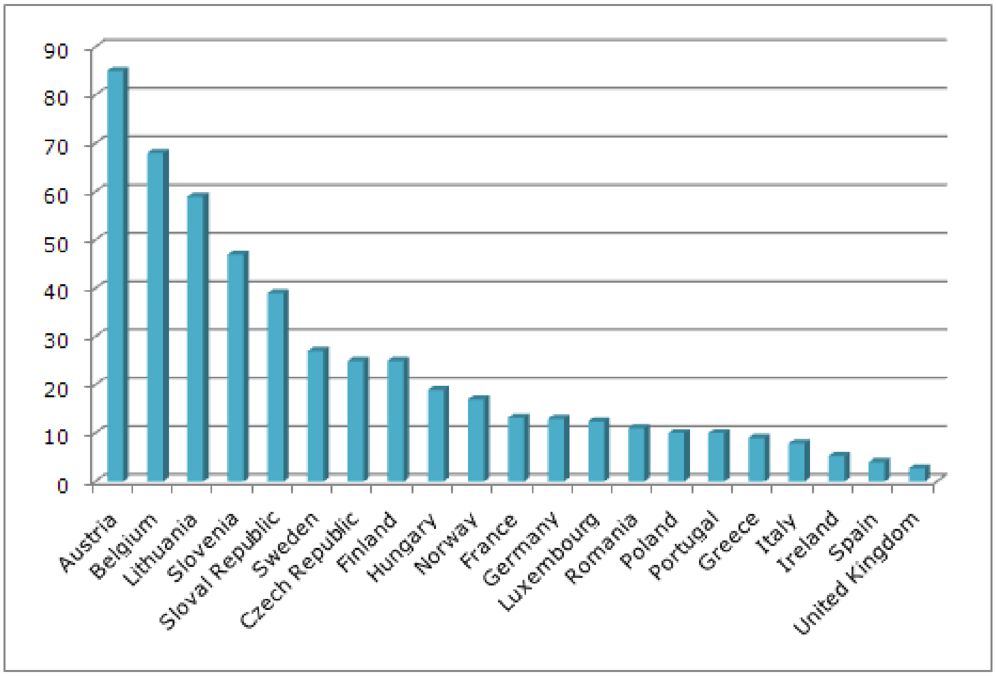


Figure 30 – Interconnection capacity as percentage of total installed generation capacity, 2007[48]

Source: CEER members

Figure 31 shows that France is Europe's major electricity exporter, exporting more than three times as much electricity as any other Member State. Italy imports the most electricity followed by the Netherlands and Portugal.

[48] Data not available for all countries.

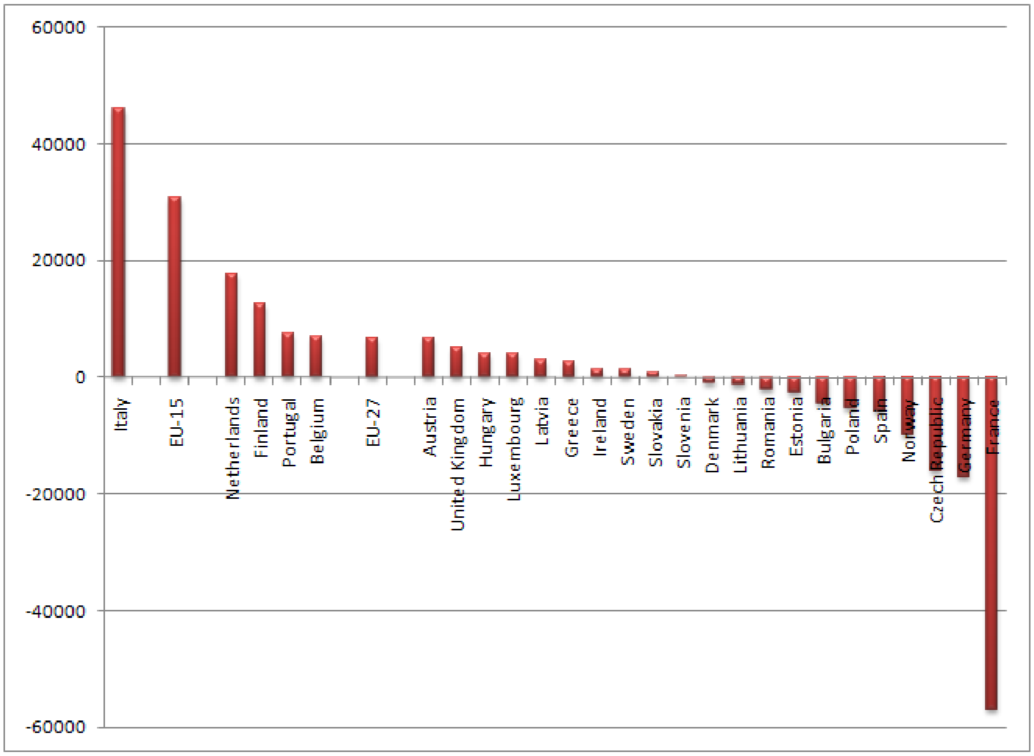


Figure 31 – Net Imports of Electricity, GWh, 2007[49]

Source: Eurostat

Figure 32 and Figure 33 illustrate unplanned and planned interruptions in minutes lost per year between 1999 and 2007. In Figure 32, if we remove data related to exceptional events (e.g. severe weather-related incidents), including the values for Portugal before 2004 as well as the high values for Sweden in 2005, Italy in 2003, Estonia in 2005 and Hungary in 1999, the range of minutes lost per year from unplanned interruptions was between 50 and 250. Some countries experienced improvements in interruptions between 1999 and 2007.

Figure 33 shows the number of minutes lost per year due to planned interruptions. The figure shows a wide range between countries (between less than 10 minutes per year to just over 200). Some countries show a small decrease however the minutes lost due to planned interruptions has been fairly stable during the period in question. The variation between countries may be a result of the way in which the distribution network is designed and/or the amount of maintenance and replacement of the network[50].

[49] No data available for Cyprus or Greece.

[50] 4th Benchmarking Report on Quality of Electricity Supply 2008 (C08-EQS-24-04), http://www.energy-regulators.eu/portal/page/portal/EER_HOME/C08-EQS-24-04_4th%20Benchmarking%20Report%20EQS_10-Dec-2008.pdf

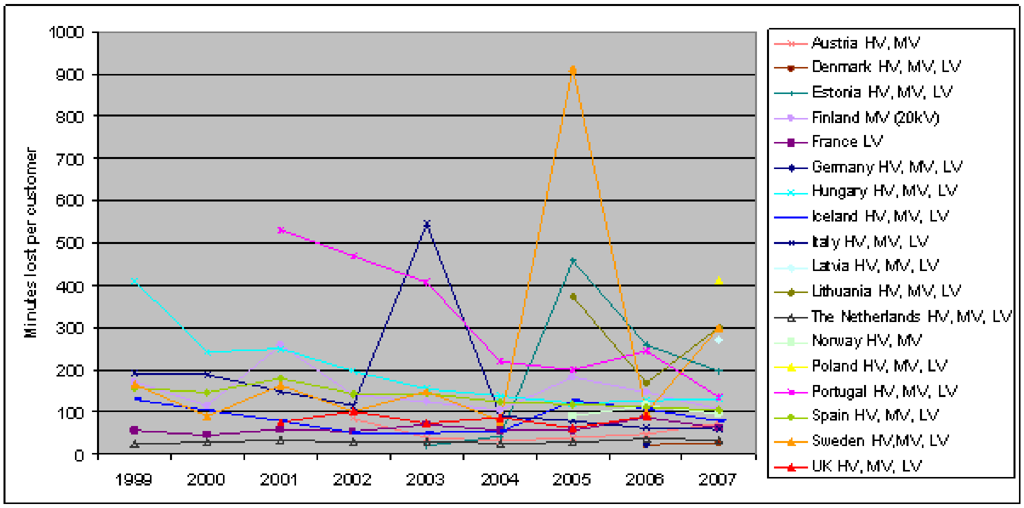


Figure 32 – Unplanned interruptions including all events, minutes lost per year, 1999 – 2007
The voltage level (LV, MV, HV) is related to where the incidents occur.
The French values in the figure are lower than the reality.

Source: CEER, 4th Benchmarking Report on Quality of Electricity Supply 2008[51]

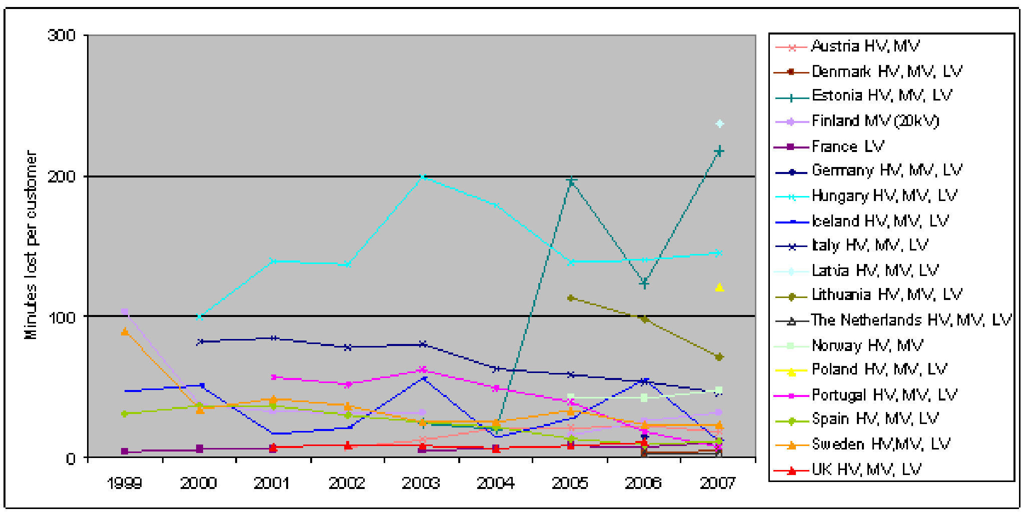


Figure 33 – Planned interruptions, minutes lost per year, 1999-2007
The voltage level (LV, MV, HV) is related to where the incidents occur.
The French values in the figure are lower than the reality.

Source: 4th Benchmarking Report on Quality of Electricity Supply 2008[52]

The next three figures show the breakdown of sources used to generate electricity consumption. Figure 34 shows the generation mix in the EU-27 area between 1995 and

[51] Data not available for all CEER members

[52] Data not available for all CEER members

2006. The contribution from wind increased from just 0.17% in 1995 to 2.9% in 2006. The amount of oil generation has halved while gas fired generation has more than doubled over the same period.

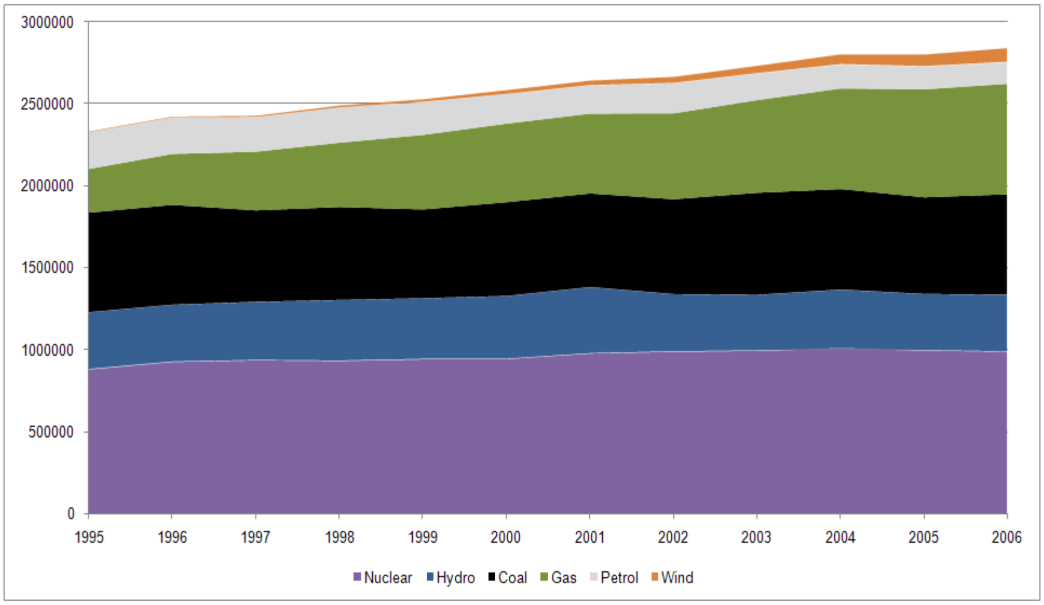


Figure 34 – Generation Mix, GWh, EU-27, 1995-2006

Source: Eurostat

Figure 35 shows that the generation mix varies across the big five European electricity consuming countries. For example, France generates 80% of the electricity it consumes from nuclear power plants and Italy generates none from nuclear.

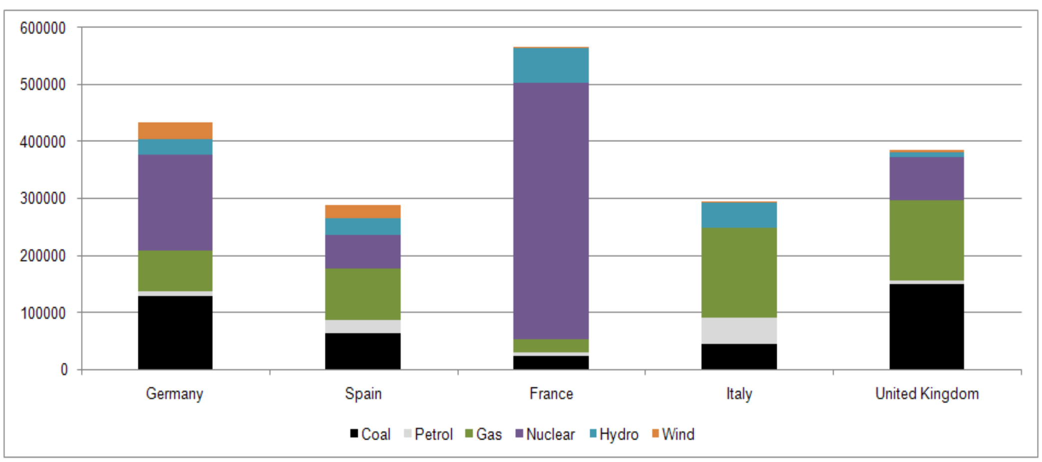


Figure 35 – Generation Mix, GWh, Big Five, 2006

Source: Eurostat

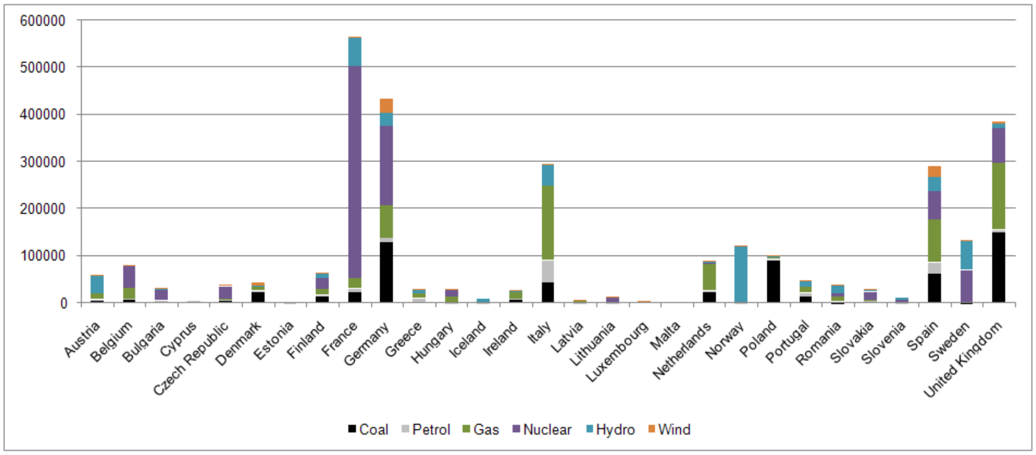


Figure 36 – Generation Mix, GWh, All Countries, 2006

Source: Eurostat

Examining the other European countries (Figure 36), the majority generate electricity from a diverse mix of sources. Of those countries with less diversity, Poland is very reliant on coal generation (which accounted for 91% of generation in 2006) and the Netherlands is very reliant on gas fired generation (64%).

	Coal	Petrol	Gas	Nuclear	Hydro	Wind
EU-27	22	5	24	35	12	3
Austria	11	3	18	0	65	3
Belgium	9	2	29	58	2	0
Bulgaria	15	1	7	62	15	0
Cyprus	0	100	0	0	0	0
Czech Republic	15	1	8	67	8	0
Denmark	59	4	23	0	0	15
Estonia	0	3	87	0	1	8
Finland	26	1	19	36	18	0
France	4	1	4	80	11	0
Germany	30	2	16	39	6	7
Greece	0	34	37	0	23	6
Hungary	1	2	47	49	1	0
Ireland	23	11	55	0	4	6
Italy	15	16	54	0	15	1
Latvia	0	0	43	0	56	1
Lithuania	0	3	20	71	7	0
Luxembourg	0	0	77	0	22	1
Malta	0	100	0	0	0	0
the Netherlands	27	2	64	4	0	3
Poland	91	2	3	0	3	0
Portugal	32	11	26	0	24	6
Romania	2	4	31	15	48	0
Slovakia	12	3	7	63	16	0
Slovenia	5	1	4	55	36	0
Spain	22	8	31	21	10	8
Sweden	1	1	0	50	46	1
United Kingdom	39	1	37	20	2	1

Table 1 – Electricity Generation Mix, %, 2006

Source: Eurostat

5.4 Indicator 16: Gas security of supply

Gas security of supply differs from electricity in two main ways. Firstly, unlike electricity, gas can be stored. Secondly, unlike electricity, the majority of gas consumed in Europe is imported from outside of the EU[53].

Figure 37 shows that the majority of natural gas consumed in Europe is imported from two countries outside of the European Union: Russia and Norway. As mentioned above, this should not be an issue as long as the infrastructure is in place to enable sufficient imports and the legal framework is in place to ensure that contracted gas is delivered. However, the recent Russia-Ukraine dispute has shown that these conditions do not always hold.

Given this uncertainty, security of gas supply can be increased in three ways: EU Member States can develop infrastructure to reduce reliance on a sole exporting country for their gas needs, such as LNG terminals; EU Member States can increase the capacity of storage facilities to ensure supply in the case of external disruption; and market integration and transparency must be developed to ensure the efficient use of existing capacity, to build new capacity and to ensure that price signals following supply disruptions encourage shippers and holders of storage gas to ship gas to areas where it is in short supply. Some countries, such as Spain and Portugal already rely on LNG for the majority of their total gas imports and new LNG facilities are either planned or under construction in a number of European countries.

[53] Due to the increasing use of gas in electricity generation, electricity security of supply is of course indirectly affected by external gas supply disruptions.

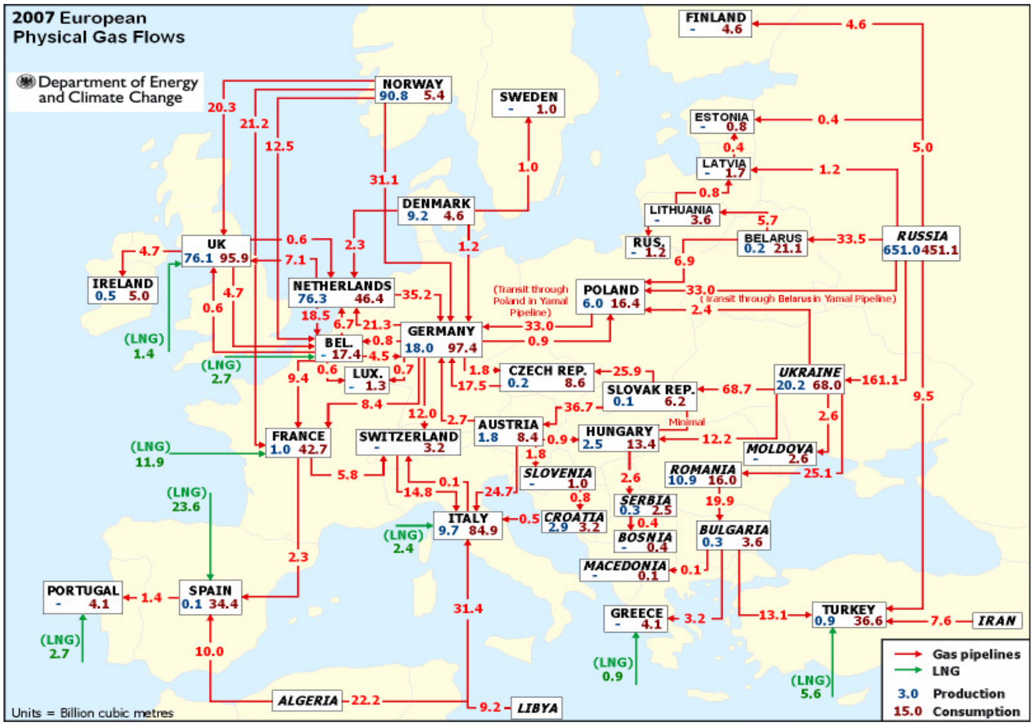


Figure 37 – European Physical Gas Flows (2007)

Source: UK Department of Energy and Climate Change

Figure 38 shows that Latvia, Austria and Slovakia have the most storage capacity relative to their annual demand. From Figure 37, it can be seen that these countries are also dependent on a sole import route for their gas which could explain the emphasis they place on storage. Sweden has virtually no storage capacity while the UK, Spain, Ireland, Belgium and Portugal all have storage facilities with capacity of less than 5% of annual demand.

Taken collectively, European storage capacity equated to around 16% of annual European demand in 2007.

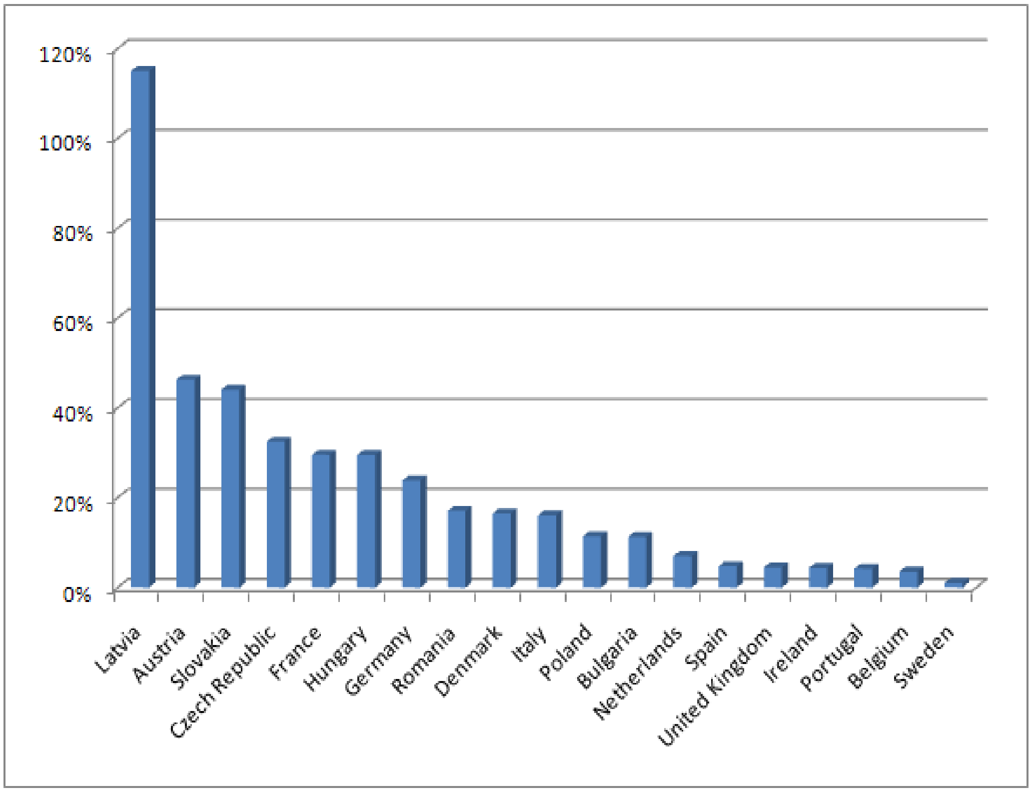


Figure 38 – Storage capacity as a percentage of annual demand, 2007

Source: Global Markets Direct – Europe UGS Industry Report May 2008[54]

[54] Data only available for those countries with storage facilities and release data on capacity levels

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