ESPON 2006 PROGRAMME

"Territorial trends of energy services and networks and territorial impact of EU energy policy".

THIRD INTERIM REPORT

Espon Project 2.1.4.
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COMPOSITION OF CONSORTIUM:

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1 .EXECUTIVE SUMMARY

The ESPON project 2.1.4 so far

According to the terms of reference, this research project must address five main issues:

1. Analyse the territorial trends of energy supply & demand and their spatial pattern, while identifying indicators and mapping methods for quantifying and representing them, taking in account the progress and results of projects currently developed in the framework of ESPON;
2. Design and carry out a territory impact analysis of the energy policy, seeking to quantify impacts from energy-related spatial development policies and identify a set of parameters that may apply to policy decision-making;
3. Define a typology of regions in terms of infrastructures and energy services, with reference to the database and processing techniques. Such typology should clearly define the relationship between energy and polycentric development and identify the regions that are seriously affected by the spatial trends in the field of energy;
4. Identify ESDP options relevant to the energy policy and submit proposals to make them operational and ensure their territorial diversification;
5. Identify the infrastructures and energy services required to provide development conditions to the most backward regions and to those regions marked by specific handicaps (i.e. islands, mountains).

Data gathering in order to develop a primary database, covering the country sample required (15 EU + 10 N + 2 CC + 2)[1] allowing indicator production and mapping methods was the obvious starting point. Unfortunately it has proven to be a very difficult task. Even when the aim was to obtain data at a level bellow country level (NUTS 2) the results were almost unfruitful.

This reports aims to give some provisional answers for the following items:

a) Outline of the energy sector in an enlarged Europe (27 countries) as well as neighbouring countries (Norway and Switzerland), and the energy policy at Community and national level, this will be provided under a focusing methodology, providing EU wide policies and national policy issues small files;

b) Diagnosis of the existing territorial imbalances and regional disparities in energy services and networks on the basis of available territorial indicators, as far as possible related to the degree of polycentrism, areas facing problems of lagging behind and the accessibility to different parts and types of territories within Europe;

c) Application of the methodology, analysis of the hypothesis previously developed.

These items will be developed under the form of a working report on interim results of the research undertaken, providing outline analysis/diagnosis and including databases, indicators and Europe-wide maps.

The results presented in this report can only be seen as provisional, either in the sense of the data provided, or the conclusions reached.

In fact, project schedule and abnormal difficulties in data gathering have conditioned our work far beyond expectations.

[1] Austria (AT), Belgium (BE), Denmark (DK), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), Luxembourg (LU), Nederland (NL), Portugal (PT), Sweden (SE), United Kingdom (UK), Bulgaria (BG), Czech Republic (CZ), Cyprus (CY), Estonia (EE), Hungary (HU), Lithuania (LT) , Latvia (LV) , Malta (MT) , Poland (PL), Romania (RO), Slovenia (SI), Slovakia (SK), Norway (NO), Switzerland (CH).

Main preliminary results of the research undertaken

- There is a severe lack of statistical data on energy sector: systematic energy data gathering at regional level (NUTS 2) is scarce and in many countries no recent regional data is available; in some cases only recently was established the need for sub-national data on energy consumption.
- The absence of reliable and consistent statistical data under NUTS 0 level is a key issue in this research project. It is strongly recommended that the national and European authorities coordinate serious efforts in the development of data production for the energy sector (resources, production, consumption and prices) in order to render viable future research in this key area.
- There is little evidence and research of the effects of energy on development. Mainstream models assume an adaptation of energy supply to energy demand which is determined by economic growth: energy is assumed, at most, as a limiting factor not as a leading location factor.
- Anyway energy achievements represent key phenomena in economic development. Industrial revolutions are closely linked with new energy sources and natural energy endowments can represent key issues in regional or national development patterns.
- Regions that "export" energy may have in this activity an important source of income, although in most cases, mainly in cases of nuclear, oil, hydro-electricity or wind or solar energy, the revenue for producing regions may be extremely weak in as much as these facilities are owned by non-residents in the region.
- An exception must be emphasized for biomass renewable energy sources. In these cases strong impacts can be noted, in direct employment and specially in indirect agriculture and like employments.
- Fiscal policy can be used as a way to provide producing regions of a share of the generated income, avoiding the "*off-shore*" effect that energy infrastructures seem to have regarding the neighboring territories.
- In average, energy has not an important weight in production costs of industry: as there is access to energy, only very important differences in price and access conditions will have a significant impact on the spatial pattern of economic activities.
- Large disparities exist on energy consumption between European countries with a major contrast between EU 15 countries (0.13 toe per 1000 € of GDP) and New Member States (0.42 toe per 1000 € of GDP).
- Economic development has associated a decrease in energy intensity: increasing energy efficiency is embedded in economic development and, if we exclude some extreme country situations, in Europe it seems to be an inverse relation between development levels and the intensity of economic uses of energy.
- Energy intensity shows a clear decreasing trend. Transport shows the most significant growth of energy consumption between 1995 and 2000.
- Most countries have reduced their dependence on fossil fuels since 1995. Oil is the most significant energy source in EU 15, while in the New Member States the energy consumption is more differentiated among sources.
- There is no clear relation between energy self–sufficiency and development. European countries were able to answer their energy needs through energy imports: no statistical relation exists between energetic self-sufficiency and GDP per capita. This result seems to hold at regional level where it seems there to be a non-coincidence between energy production and energy consumption.
- Households' energy consumption seems to have a major determinant: wealth level. Although climatic conditions have a visible influence, there is a clear and linear relation between domestic and tertiary per capita energy consumption and GDP per capita (ppp).

- In Europe, there are heavy differences on energy prices between industry and household uses. There are, also, strong disparities of conditions (namely price) of access to energy between different EU countries and between energy sources. Price differences between countries are much higher in what concerns households consumption than industrial consumption.
- Prices seem not discriminate between levels of energy consumption. Smooth prices variations seem not to have any impact on households' energy consumption.
- Industry electricity consumption seems to be more responsive to energy prices: figures point to an inverse relation between prices growth and growth of energy consumption by industry. But, here, we can expect some effect of substitution among energy sources.
- Energy market opening is a major component of European energy policy but it is far from being completed.
- Energy market opening has associated a decrease in energy prices either for households or for industry.
- It seems that a trend for increased energy prices disparities among countries in what concerns industrial sector do exist, although in a context of price decrease.
- Most of the energy policy measures will impact territorial development through energy prices variation.
- Studies found a significant but small impact of energy prices on economic growth: the studies analysed point to an elasticity of GDP to energy prices of about 0.02 or 0.03.
- We found no conclusive evidence of the impact of energy prices disparities on location of industrial activities even in the case of energy-intensive industries.

Energy policy in the EU

Energy is a key factor for the EU competitiveness and economic development strategy. The main aim of the EU energy policy, as stated in the November 2000 Green Paper [com(2000)769] is to ensure security of supply at competitive prices while respecting the environment.

Energy import dependence is about 50% but if nothing is done the dependence will increase in the long term.

As instruments to deal with the security of energy supply, energy efficiency in the consuming sectors and the increase role of renewable sources in energy supply are being promoted. ALTENER and SAVE programmes have been important instruments to promote technologies, good practices and institutional reforms in the energy fields. These programs have also had important impacts at local and transnational level by the support to the creation of energy agencies and multinational co-operation projects.

Renewables and distributed generation are energy supply technologies that are expected to have a high contribution to local development, by promoting endogenous resources and creating opportunities for new economic activities. The White Paper "Renewable energy: White Paper laying down a Community strategy and action plan" has as objective to attain, by 2010, a minimum penetration of 12% of renewable energy sources in the European Union. A Directive on the "Promotion of production of electricity from renewable energy sources" (Directive 2001/77/EC) confirmed the target of 12% of renewables in the EU energy systems while fixing a target of 22,1% of electricity produced from renewable sources. This target will impact positively on security of supply, environment and social and economic cohesion. This directive also constitutes an important item of the package of measures needed to comply with the commitments made by EU under the Kyoto Protocol.

The creation of a single market for energy is also a part of the EU energy policy. Directives adopting common rules for electricity (Council Directive 90/547/EEC of 29 October 1990) and gas (Council Directive 91/296/EEC of 31 May 1991) aiming to the free transit and market transparency are nowadays part of the *acquis-communautaire*.

The development of trans-European networks is also part of the strategy to accomplish the internal market for energy. The Council Decision 96/391/EC of 28 March 1996 lays down a series of measures aimed at creating a more favourable context for the development of trans-European networks in the energy sector, thus creating the conditions for the development of co-operation projects within regions in different continents (mainly Europe, Africa and Asia). In this context some 74 projects of common interest have been identified.

The transport sector has a key role in the interface with the energy sector. About 40% of the final energy demand is consumed in the transport sector of which 98% are oil products. Future developments of the sector will consider diversification to other less polluting sources like electricity, natural gas and biofuels. To encourage diversification, directives are being prepared dealing with fiscal measures and biofuel targets. Biofuel development is expected to have a high impact on regional development, mainly in agriculture regions where the negative impacts of the Common Agriculture Policy can be reversed.

Nuclear energy is nowadays a very sensitive aspect in the energy debate. It is a clean technology in what greenhouse gases are concerned but security, deposits of radioactive residues and power stations dismantlement are still important barriers to the development of this energy carrier.

Comparing the European Union countries with the adhesion countries the main energy systems differences come as follows:

- EU countries rely less on solid fuels (4% against 18%) and more on natural gas;
- Coal is still very important in the adhesion countries because of the important endogenous proven reserves. Some capacity has been closed, because of the huge environmental problems (CO_2 emissions and acid rains) while the productivity has been improved in the coal mines of certain countries;
- There is a substitution movement from coal to natural gas for electricity production;
- Industry as a energy consuming sector has lost importance because of the structural political and economic reforms experienced in these countries during the nineties;
- The nuclear power stations in some countries have severe security problems and negotiations are or have been done with EU in order to close some of the most sensitive reactors;
- Renewable energy sources other than hydro have some important barriers in the adhesion countries. Excess electricity generation capacity in some countries, still subsidized prices and lack of financial incentives are among some of the most relevant barriers.
- The energy market reforms are still being conducted and will approach the *acquis communautaire* in a near future. The public ownership of energy utilities is still very important in some countries.
- Huge investments in the energy sector are necessary to increase competitiveness and improve the energy services quality.

Energy data at country and regional level

The data collected and used to construct the ESPON energy database and to calculate the energy indicators comes from different sources where definitions and measure units are not always homogeneous, thus delivering, sometimes, different results for the same items.

Systematic energy data gathering at the regional level is still scarce and in many countries no recent data regarding the intended territorial desegregation is available. For example, the

Department of Trade and Industry in United Kingdom had established the need for sub-national information on energy consumption and only recently is studying how to compile such estimates including, in particular, how to collect such information on electricity use.

In the case of New Member States the problems are even more relevant due to the fact that some data is not produced and many of the energy indicators even do not exist (or at least are not available). This concerns either the country level, NUTS 2 or NUTS 3 level.

The Statistical Energy Yearbooks and Statistics of the New Member States are considerably affected by the transition in the past ten years. There are also changes year by year in the way how they are drawn up. In the newest statistics some data for NUTS 2 level is included, but this is only for the last year or the last two years.

Another significant difficulty in the research is related to the quality of several sources. The energy data accessible from the Internet is also scarce and incomplete. Other sources like EUROSTAT do not provide sufficient information, sometimes even for the country level and the same happens at regional level.

At the present moment, the information collected by NUTS 2 level comes mainly from the EUROSTAT Newcronos database, which has data only for electricity production and consumption. However, this database has a problem of data availability. It must be emphasized that for a large number of the NUTS 2 regions supposedly covered the data is not disclosed, thus making data availability much more narrow than that theoretically possible.

Energy and development

The story of industrialization is, most of the times, told as the story of the energy sources. Industry developed, from the XVIII to the XX Centuries, at the pace of energy revolutions from water mills to electric engines.

The impact of energy in development is frequently seen has a sort of “energy ladder”[2] where energy supply and energy availability clearly act as determinants of economic development.

This idea means that relations among economic development and energy change as economies progress through different development thresholds, so pointing to the advantages of regional and national typologies as a mean to identify and understand policy needs.

Most of the literature on the energy subject is based on a relation where economic development takes the lead and energy development is a follower. Exceptions are energy shocks and energy innovations that disrupt market equilibrium and generate new economic structures with profound effects at all levels.

In fact there is surprisingly little evidence and research of the effects of energy development (increased quality and quantity of supply) on economic development.

Energy is fundamental for almost every human activity and access to energy is crucial for economic development. But we cannot expect to find a clear relationship between energy and development. Nowadays, energy is more or less easily transportable and, at least in the long term, countries and regions will be able to find a reasonable answer to their energy needs. Although this doesn’t mean that different conditions of energy supply do not impact on the rhythm and path of economic growth.

Territorial impacts of energy development

Energy’s importance to regional development has not deserved enough attention. The traditional framework of spatial reference – made up of national territories – and the fact that

[2] The expression has been used by BARNES, D. and W.M. Floor (1996), “Rural Energy in Developing Countries: a Challenge for Economic Development”, Annual Review of Energy and Environment 21: 497-530, but a very large number of other works on Economic Development had used the idea before to define the pace of “industrial revolutions”, see for instance FREEMAN, Christopher (1988), Technology Policy and Economic Performance– Lessons from Japan, Pinter Publishers, London, pp.68 to 76.

electricity can be transported at relatively low cost led observers to view energy as something ubiquitous, with no major impact on decisions regarding business location and conditions of competitiveness.

Although, evolution towards a new supra-national framework, the growing importance of new energy sources and the re-structuring of markets - with the presence of new operators - all contributed to clearly evidence the current disparities between European regions in terms of prices and conditions of access to energy, which has thus become a key driver for territorial development.

One can identify five different types of energy territorial impacts:

Direct employment and GDP

As an economic activity energy represents an important parcel of employment and a significant contribution to the added value of national and regional economies. For instance, in France[3] the energy sector corresponds to 3% of GDP and about 230 000 (direct an indirect) jobs.

However, we may encounter examples of investments in energy infrastructures in a certain region that have but a very small impact at regional level. Wind farms are one example: equipment installation and exploitation are not supposed to have very important local effects, unless the municipalities arrive to negotiate some premium with the promoters as a counterpart for the location facilities. The main impacts of this renewable source are the global emission reductions. On the opposite sense, biomass can be an important contribution to employment in some rural areas.

Location and competitiveness factor

As an average, energy is not a very important direct cost for industry. For instance, in Belgian manufacturing, energy accounts only for 2.7% of total cost of acquisitions[4]. But its importance can be much higher, namely in what concerns activities like non-metallic mineral products, chemical industries or manufacture of basic metals.

On the other hand, there are very important differences of energy prices between countries and between energy sources. The 2002 average EU-15 electricity prices for industry was € 5.49 per 100 kWh and the average natural gas prices was € 4.91 per GJ(GCV). Differences between countries were in the order of € 2.62 (S) to € 8.32 (I) in the case of electricity and in the order of € 4.17 (P) and € 7.73 (S) in natural gas[5].

Market liberalization and European energy networks integration will have significant impacts in prices[6] and different impacts on the competitiveness of economic activities in each territory. Such impacts will be stronger in territories with a more energyA-intensive economy.

Persistent market segmentation factors (e.g. taxation), the entry of new operators in the market and uneven conditions of access to different energy sources (e.g. unavailable access to natural gas in some regions) will maintain the existing large price gaps between different regions, impacting on corporate competitiveness and on decisions made in connection with business location.

However the relation between regional development and energy policy vectors is not always obvious.

3 Repères sur l'énergie en France, (www.industrie.gouv.fr/energie/statisti/se_stats.htm)

4 www.statbel.fgov.be

5 Excise taxes included (www.europa.eu.int/comm/energy_transport/etif/list_of_tables.html)

6 Numbers presented on DGTREN site show a down sloping trend in electricity prices (excise taxes included) for industry and no clear trend for natural gas prices. The reduction of energy prices may be the result of liberalisation and of the evolution of fuel costs.

Income transfer

Europe is heavily dependent on imported energy and there is no coincidence of the regions that produce and the places of consumption of the energy. Regions that "export" energy may have in this activity an important source of income, although in most cases, mainly in cases of hydro-electricity or wind or solar energy, the revenue for producing regions may be extremely weak in as much as these facilities are owned by non residents in the region. In some cases the economic advantages for these regions are limited to some kind of redevance paid to territorial communities for the use of natural resources.

Households behaviour and quality of life

Domestic and tertiary consumption accounts for 39% in 2000 of EU final energy consumption and transport for another one third. Energy and transport represent a substantial part of household's expenses. It seems there to be a close relationship between energy consumption and households' wealth.

This means that energy has a strong potential to become an important factor of life cost and of quality of life and a determinant of residential and urban location choices. Namely, energy can be a decisive factor of mobility choices and impact strongly in urban form and in the use of urban space. Fuel prices may have an important impact on modal split between car and public transport. In what concerns transport, there is an evident relationship between physical planning and energy consumption.

Different prices and environmental conditions resulting from energy production and use will impact on location decisions made by households, in contexts marked both by growing mobility and tele-work opportunities.

Environment

In spite of a trend to lower energy intensity, CO_2 emissions will keep growing, along with an international commitment to stabilize, and after reduce, those emissions. This puts a major challenge on the efficient use of energy, on energy saving, on the introduction of clean and renewable energies. If, on the other hand, emissions trading schemes become reality and enterprises are obliged to internalise atmospheric pollution costs, one could expect significant territorial impacts concerning economic activity location.

The final result depends on the combination of energy sources and energy uses. Transport is, perhaps, the instrumental sector to achieve international commitments and transport policy aiming at the development of more energy efficient transport modes (train, maritime and inland water transport) will cause, indirectly, considerable territorial impact.

ESDP states that energy production and transmission may impact on land use, while energy distribution and energy-use technologies may influence territorial development due to the changes induced in users' behaviour.

Although energy does not deserve much attention in the text of ESDP, one could expect an important contribution of energy to the ESDP options as they are approved in the Ministers' meeting of Postdam.

The implications of energy policies to ESDP options will be developed in the context of the work to be carried along the project. However some ideas may put in advance to be discussed and tested.

	ESDP policy guidelines

	Development of a balanced and polycentric urban system and a new urban-rural relationship	Securing parity of access to infrastructure and knowledge	Sustainable development, prudent management and protection of nature and cultural heritage.
- Liberalisation and market opening - Completing internal energy market	▪ Sector restructuring: is there the risk of higher concentration of economic power in major urban areas? ▪ Lower differences in energy prices: it is not clear which regions/countries are winners or losers ▪ Supply more responsive to the market: more advantages for more developed regions?	▪ The risk of reduced interest in supplying less developed and isolated regions is mitigated through the imposition of public service obligations. ▪ Higher benefits for major energy consumers	▪ Lower energy costs may reduce pressure to higher savings and efficient use of energy
- Overcoming bottlenecks - Security of supply - Need for new power plants - Interconnection capacity reinforcement	▪ Small impact on regional employment and regional income during the construction of energy infrastructures ▪ Major impacts on urban centres producing research and equipment	▪ Field for research and innovation	▪ TEN measures in the energy sector influence spatial organization through two main mechanisms: production and transmission of energy ▪ Possible difficulties linked to complex ratification procedures, varied technical and ecological constraints and acceptance on the part of the population.
- Lower dependence on traditional fossil fuels - Reduction of emissions: fulfil the Kyoto commitments	▪ Need for drastic measures in what concerns transport aiming to revitalise rail and inland water transport: towards more polarized development on major network nodes?	▪ Growing relevance of natural gas: disadvantages for activities in less developed and isolated regions, with possible relocation of energy intensive industries	

Energy options	ESDP policy guidelines		
	Development of a balanced and polycentric urban system and a new urban-rural relationship	**Securing parity of access to infrastructure and knowledge**	**Sustainable development, prudent management and protection of nature and cultural heritage.**
- Energy efficiency - Intelligent energy management	▪ Promotion of a wise management of the urban eco-system. ▪ Support for effective methods of reducing uncontrolled urban expansion; reduction of excessive settlement pressure, particularly in coastal regions ▪ Pursue the concept of the "compact city" and concentrate new urban developments around public transport terminals	▪ There are technologies that permit efficient distributed generation.	▪ Internalisation of environmental costs: opportunity for new technologies ▪ Need for new energetic standards in building industry
- Renewable energies	▪ Rural areas have a considerable potential for renewable energy: solar energy; wind energy; hydroelectric power and tidal energy; energy from biomass; and even from urban waste near large towns and cities (methane production). ▪ Renewable energies may support economic diversification of rural regions and create new sources of revenue to agricultural explorations and to local communities (royalties, taxes, commercial income) ▪ Opportunity to introduce new agricultural productions (biofuels) ▪ Renewable energies may create a complementary relationship between cities and rural areas.		▪ Renewable energy sources cause very little pollution ▪ The objective is to duplicate the weight of renewable energies from 6% to 12% in 2010, and electricity from renewable sources from 14% to 22%

In what spatial development and cohesion are concerned energy can be seen from different angles:

- energy as an economic activity, which asks for investments and can have an interesting impact in terms of job creation at local level;

- energy as a production factor for the economy, and as such its price, quality and diversity can influence location of activities and have a strong impact on competitiveness;

- energy as a source of gas emissions that is responsible for global warming, acidification, eutrophication and ground-level ozone.

Among the main **challenges facing the European Union countries**, we must point out:

- Kyoto targets for greenhouse gas emissions and ceilings for the acidification gases (Gothenburg agreements), implying strong actions on rational use of energy, renewables development, changing the energy mix towards less oil products and coal and more natural gas;

- Renewables development for electricity generation, in line with the directive for electricity from renewables energy sources;

- Liberalization of the energy markets with free access to suppliers as a condition to achieve a successful internal market for energy;

- Trans European networks for energy (oil, natural gas and electricity) enabling access to energy at competitive prices to consumers of the enlarged Europe and making possible decentralized electricity production to deliver directly to the grid.

Some of the challenges are interrelated and others will create some tension between agents (political and economic) in countries where additional measures will have to be implemented in order to comply with the targets. The development of renewables and of the distributed energy production in general, mainly in what electricity production is concerned, asks for networks covering the most promising regions with greater renewables potential. Encouraging competitiveness by liberalization of the energy markets and implementing policies to reduce emissions may have opposite effects.

With the enlargement new advantages will emerge in terms of new markets and new opportunities for investment. The Energy Charter Treaty[7] has opened an opportunity window for political commitment in East-West energy co-operation. The enlarged market will create additional needs for interconnection in order to solve some critical interconnection weaknesses in free energy transit which are identified in EURELECTRIC & UCTE (2002)[8] for the European grid. In fact the European Directive 96/920EC has contributed to important improvements in the transnational networks. However we are still far from a single market and even for EU15 the demand is much higher than the offer, which implies some congestion management. The situation will be much worse if we consider EU25.

Links between energy policy and territory have three basic drivers: investment, prices and income transfer. Impacts of energy policy can then be measured in terms of industry development, welfare and environment.

Investment means in this context all energy infra-structure development, leaded by public or private financing. These could be related among others to the commissioning of energy production facilities and grid construction or improvement. There are in a larger or lesser extent exploitation expenses and revenues associated to every energy investment. This will be considered in our assessment associated under the same heading.

Investment effects are, *per se*, positives in principle, the better if they are applied in less developed or remote regions, either from the infra-structure development itself, or from the exploitation effects. It must be emphasized anyway, that a minimum level of socio-economic fabric density is required to allow those regions to capture significant shares of potential benefits.

Prices reflect changes in the costs of energy either in production, distribution or consumption that may change the behaviour of producers, distributors or consumers. These can derive from taxation or energy sector (production, distribution and consumption) factors.

We assume that price changes have two levels of impact. One, that we may call for simplicity an *income effect*, where price level changes have direct impact on the economy pushing on the opposite direction of the price movement (an increase in prices pressing for a reduction on total economic activity, and a decrease acting in the reverse direction). Ahead in this report we provide evidence that these forces can be considered important, at least on the short run. A second effect, that we may call the *structural effect* can induce technological changes to accommodate price increases (or delay it if energy prices are reduced) or at a limit situation force relocation of industrial facilities. As it is also said ahead, relocation would hardly be derived from energy price effects alone.

Income transfer effects aim to capture the effects associated with the fiscal redistribution, changes on the location of energy production facilities or redistribution of energy production ownership.

Under this heading we are then considering existing possibilities of taxation revenue derived from energy policies as the more obvious effect. If a tax is levied (or raised) on energy

[7] The Energy Charter Treaty of 17 December 1994 OJ N° L 69 of 9 March 1998
[8] European Interconnection: State of the Art 2002

products its revenue can be used to improve the living conditions or the economic infra-structures of less developed regions, thus improving competitiveness for the benefited territories.

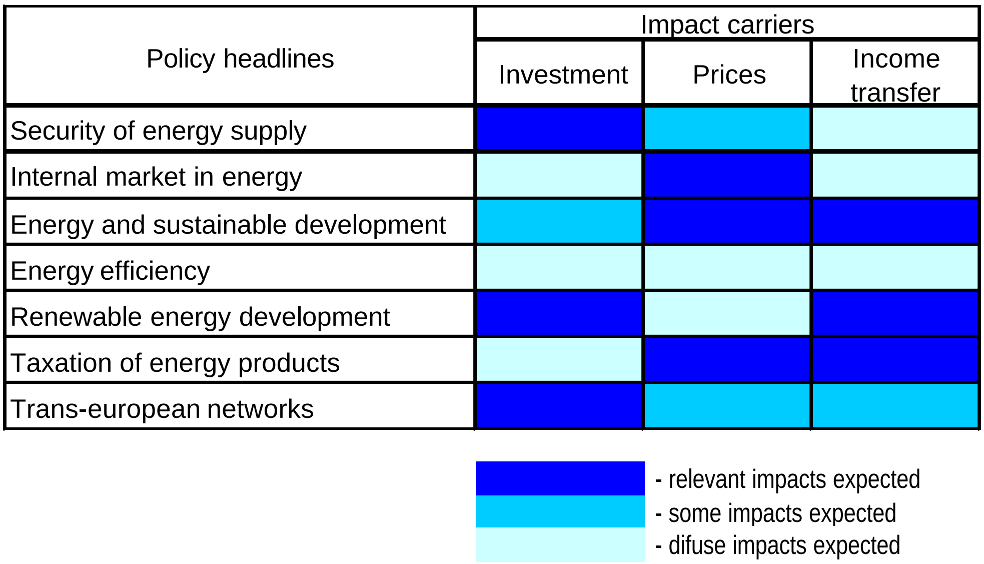
But energy policy can also provide changes in the balance of the energy producing regions. Renewables are much likely to be established in less developed or remote regions, thus transforming a traditionally depleted area in an energy exporter. This could mean that income is transferred from consuming areas towards the new producing areas.

But this reasoning is not fully achieved unless the ownership of producing facilities and distribution companies is considered. The internal market (and privatization) can mean, in the end, that the ownership of energy companies and producing facilities are located outside production or consuming territories, thus inducing income transfers hard to trace.

A third line of potential income transfers can be obtained via emission rights market.

Assuming the aforementioned potential territorial impact factors we may assume an impact chart like follows.

Potential territorial impacts of energy policies



Some comments are required on the chart to make clear our assumptions.

We must accept that there are interconnections among the proposed policy headlines, on the one hand, and that carriers themselves do not act independently. So some simplification is required in order to identify impacts.

Investment effects are more likely to be originated by security of supply (and associated TEN measures) and renewable development policies. All assessments of these policies seem to point out to important effects on less developed regions.

The *price effects* are markedly framed by two opposed development vectors. On the one hand, internal market and liberalization are aimed to reduce energy prices by increased competition. This would mean a push towards an increase on economic activity and an increase on the welfare of the families (either by availability of income for an extra expenditure on energy as a mean for household comfort, or by freeing resources for other forms of consumption and savings). At the same time that could mean a pull towards slower technological development, at least towards less energy efficient equipments and buildings.

But on the other hand consideration of environmental externalities on prices and the cost of emissions rights may push prices upwards, inducing a negative income effect and as positive incentive for more efficient equipments and buildings.

Income transfer effects may be harder to evaluate and, even the potential seems clear, we may not be able to see much of these out of a case study framework. Fiscal effects are subject to national macroeconomic and regional development policies. Private sector transfers could hardly be statistically measured.

Energy intensity and the energy ladder

Excluding Norway, Finland and Luxemburg, it seems there to be an inverse relation between development and the intensity of economic uses of energy (industry and transport energy consumption divided by GDP (ppp)). Higher levels of development mean a higher proportion of services and higher energy efficiency.

Increased energy efficiency is embedded in economic development, so leading to lower energy intensity of GDP. Besides that the intensity patterns seem to have a turning point that has become evident at lower stages of the development ladder.

These efficiency gains, which are recognized by all the available research data, place the issue the energy/capital trade off, raising the always difficult question of technological change.

The existence of evidence of the reach of the energy intensity turning point, as a part of the possible classification of regions regarding the energy development, could be a part of our research path.

Do prices matter?

Energy prices will be the core variable through which territorial energy impacts will occur. But in spite of some weak statistical relations that can be estimated, energy prices seem not relevant to explain either energy consumption or development differences between countries. Energy sector has been a strongly regulated sector and energy prices include several components that are not determined by market forces. A very important parcel of energy prices are taxes and excise duties. Until now, we were not able to find any significant statistical relation between energy prices, energy consumption or rhythm of economic growth. Perhaps, there is here a problem of time lag that needs time series or more sophisticated econometric relations. We will continue to investigate in this direction.

Data presented in the report provides a picture of price trends of electricity in EU countries from 1990 to 2000.

A number of features can be highlighted from data. First the heavy differences on prices from industry to domestic at country level, the different trends in prices and much more closeness of prices for industrial sector than for domestic uses.

Note that, on average, the EU domestic prices are one and half times higher for households than for industrial facilities and cross country differences go from two and a half times to one and a half higher. This evidence exposes that energy price policies strongly vary among EU countries.

But no evidence can, again, be found of structural relation between electricity consumption and price level[9].

If we consider the dynamics of prices and consumptions the outcome is also not very clear.

From 1990 to 1995 electricity prices and consumptions of EU households show that most variations are positive, so consumptions and prices grow. The statistical relation is very weak, and it can be said little more that, in a number of countries, larger price increases may have lead to lower consumption growths.

Taking the period 1995-2000, the statistical relation does not hold either, even if the overall environment is one of price reduction for every surveyed country.

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9 Data is referred to 1999 and weighted prices are based on average prices per sector and relative share on total electricity consumption.

Countries with higher price reductions have experienced stagnant consumption (Germany and Spain) while others with price reductions above 25% have experienced significant increases (France, Greece, Ireland and Portugal).

Even if we experiment regression with a set of countries that excludes those with more deviant performance (in this case Luxemburg, which associates to price reduction a strong consumption reduction) the outcome is not clear at all.

If we try to access similar relations with industry data (electricity prices and consumptions) the outcome is not clear either.

In the period 1995-2000 overall price trend is towards a general price reduction, but performances by industries are also mixed, even though an increase in consumption is more frequent.

Anyway, it must be acknowledge that substitution of energy sources could have played a role here.

Available data points to an inverse relation between prices growth and electricity consumption growth by industry. If we take a narrower set of EU countries (Italy Belgium, Denmark, Spain, Finland, Greece, Netherlands, Portugal and UK[10]) we get a solid statistical relation among price variation and consumption variation.

The provisional conclusion is that national data do not establish an empirical support to put in evidence econometric relations between energy and the development level.

When we go to the regional level, what we can expect is that all the possible relations are weakened. Energy flows inside a given country are much easier and the normal situation is a small differentiation (if any) of energy prices among regions of the same country. Regional database is yet under construction, but we have tried relations at regional level for French regions[11] with data referred to 1998. For the moment, we found that:

(i) Final energy consumption is much lesser concentrated in Ile-de-France than economic activity: Ile-de-France represents 29% of GDP but only 15% of FEC. Other regions represent a higher share of FEC than the respective share of GDP. (ii) There is no statistical relation between energy production and energy consumption, although the first region in primary energy production corresponds to the second economic region. (iii) Development level (GDP per capita) does not discriminate among regions in what concerns the structure of consumer sectors. (iv) Even when Ile-de-France is excluded from the regression, only a weak relation exists between GDP per capita and FEC per capita.

What we can conclude is that the complexity of determinants of energy consumption and of relations between energy and economic growth and the severe lack of time series data on energy at regional level will make very difficult to identify significant spatial relations concerning the energy territorial impact. As regional database is constructed we will continue to test this kind of relations and to define regional typologies that are suitable to clarify the impact of energy on territorial development.

When we research the relation between prices and consumption, a number of hypotheses and research conclusions are identifiable in the literature:

a) that electricity consumption is inelastic in the short run;

b) that industries and households use fixed energy budgets given the GDP level;

c) that energy costs are negligible for the major part of the industries.

In this context the efficiency of using price mechanisms to adjust energy markets are yet to be evaluated.

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[10] Thus excluding France, Germany, Ireland and Italy, for which data is available.

[11] Source: Observatoire de l' Énergie

Using the fixed energy budget hypothesis[12], the one that is more stringent towards the efficiency of price mechanisms on energy markets, points to two main effects:

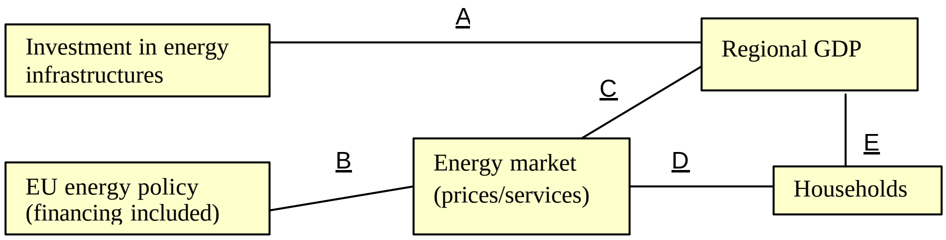
i) in the short run, price changes have some effect on growth, price increases implying lower levels of economic activities, and price decreases leading to enlarged aggregate supply, but with much larger elasticity to price increases;

ii) in the long run on technological change and possible delocalisation of more energy intensive industries.

But as it is presented this hypothesis hardly holds considering recent data for European countries.

A framework for territorial impact assessment

The aim is to clarify the differentiated territorial effects of energy policy and to quantify its effects on the economy and environment of the different European regions. The question is to find five sets of regional parameters A, B, C, D and E that permit the following transformations:



Besides investments in energy facilities, the impacts of energy policy will be mediated by energy prices. It is why we consider as our main concern to find a suitable operator C that can evaluate the effects of energy prices on regional GDP.

Given the above-mentioned difficulties that impede the calculus of direct energy impact on a region, the procedure we used consists in the distribution of the impact calculated at a national level among the different regions of a specific country.

For that, in a first step, we calculated the impact of a decrease[13] in the price of final energy on gross value added of each national branch and, in a second moment, we distributed the impact of each branch among the different regions of that country. This corresponds to assume that:

- The energy price is the same in every region of a specific country: this is not a too much restrictive hypothesis given the small spatial variations, and even uniformity, of energy prices at national level.
- We can find a suitable key to distribute the impact on a specific branch among regions. Here we may have an important weakness of our procedure because we were obliged, as a consequence of the lack of other pertinent data, to use employment, frequently at a high aggregation level. Doing so, we implicit assume that not only internal structure of a particular branch and technology do not vary between

[12] BOURDAIRE, J.M. (2000), "Le lien entre consommation d'énergie et développement économique", Revue de l'Energie, nº 15, mars-avril 2000.

[13] The option by a price decrease is explained by the fact that, at the end, this is the aim of Community energy policy, either by an effective price decrease or by improvements in energy quality and efficiency.

regions as the labour productivity of that branch is the same in every region. A greater disaggregation of activities means a small impact of these hypotheses[14.]

The last assumption may affect significantly the results obtained, but an improvement is only possible with better regional data.

Our procedure has been a two step programming where we firstly calculate the impact of a final energy price variation on gross value added of different national branch and secondly distribute the impact on each branch among regions

For the assessment of the national (branch) impact of a variation in energy price a framework that corresponds to the first generation of impact assessment methods seems the most adequate in the actual circumstances.

We can think energy price variation as an exogenous one that doesn't affect the gross value added per unit of product of each branch. This may occur if price variation is the result, for instance, of cheaper energy imports or it results from a greater efficiency of energy distribution (e.g. reduction of losses in the network), from State subsidies, etc. and each branch passes on the reduction of costs completely to lower prices supported by customers. In this case, an energy price decrease would imply: (i) the maintenance of GVA per product (physical) unit in all branches (including the energy sector); and (ii) a reduction in the price of different products in response of a decrease in the energy price.

Price reduction has an *income effect* and a *substitution effect*. Income effect means that one can buy more of all the goods and services, as if he had benefited from a income increase. So, at this stage, we think that an input-output framework will be the most suitable method for analysing this type of impacts.

Input-output models are accounting apparatus identifying inter-industry linkages, usually used to quantify the global impact of increases or decreases in spending. The standard model is X = AX+Q, where Q is a *nx1* vector of the final demand of products from different productive sectors, X is a nx1 vector of total output from each sector and A is a *nxn* matrix of coefficients a_{ij} of the intermediary consumption of products of sector i necessary to obtain an unity of product j[15]. As investment is a component of final demand, the standard model can be used to evaluate the impact of energy investments or of an increase in energy demand.

Although input-output models were not constructed to evaluate the impact of cost variations, we can use the input-output framework to calculate the impact of a energy price variation in the set of prices of all the production branches.

In an input-output framework the following relation can be verified B´P+V=P, where P is a nx1 vector of sectoral prices; B is a *nxn* matrix of coefficients b_{ij} of physical quantities of product i needed to the production of a (physical) unit of j; V is a *nx1* vector of the value of primary inputs needed to an unity of different sectoral productions; and B' is the transpose of matrix B. The above equality comes from $p_j=b_{1j}p_1+b_{2j}p_2+\ldots+b_{nj}p_n+v_j$. Solving, we obtain $P=(I-B´)^{-1}V$. Although formally b_{ij} is measured in physical units, if we are interested only in the relative variation of prices we can make $b_{ij}= a_{ij}$ and, then ?P=(I-A´)-1?V.

In an input-output framework the following relation can be verified B´P+V=P, where P is a *nx1* vector of sectoral prices; B is a *nxn* matrix of coefficients b_{ij} of physical quantities of product *i* needed to the production of a (physical) unit of *j*; V is a *nx1* vector of the value of primary inputs needed to an unity of different sectoral productions; and B' is the transpose of matrix B. The above equality comes from $p_j=b_{1j}p_1+b_{2j}p_2+\ldots+b_{nj}p_n+v_j$. Solving, we obtain $P=(I-B´)^{-1}V$. Although formally b_{ij} is measured in physical units, if we are interested only in the relative variation of prices we can make $b_{ij}= a_{ij}$ and, then $?P=(I-A´)^{-1}?V$.

[14] In practice, we considered a variation of branch productivity among regions assuming that $q_{ij}/q_j=q_i/q$, were *q* is productivity of the economy, *i* denotes region and *j* denotes the branch

[15] Normally a_{ij} is the monetary amount of product i that is necessary to obtain a monetary unit of product j. The total output (including imports) of a product X_i is used to intermediary consumption ($S_ja_{ij}X_j$) and to final consumption (Q_i), that is, $X_i = S_ja_{ij}X_j+ Q_i$

This procedure presupposes that a variation in energy prices does not imply any input substitution, so that (technical) input coefficients remain constants. This could be a strong hypothesis, regarding the long-term trends to diminishing energy intensity. However, the most important impacts on GDP, obtained by other methods, seem to be short-term or medium-term impacts, pointing to a main influence of demand variations.

We used the last equation to calculate the impact (in relative terms) on different prices of an exogenous reduction of energy price. For calculation effects only, this fall of energy prices was assumed as a reduction in primary inputs[16].

Input-output table is not useful to pass from price variation to GDP variation. Here, we need some additional hypothesis about the way demand reacts to a price variation:

a) First, we assume that final consumers will not change their budgets, so we hypothesize that the entire price savings will be transferred to final demand. This corresponds to *income effect*, but maybe it overestimates the demand growth, as it is possible that some consumers transfer the "additional" real income to additional savings. It is a restrictive hypothesis that could be improved if we could obtain information on price-elasticity and on demand functions.

b) Second, we must take into account the *substitution effect*, what was done by distributing the "additional" demand among different branches proportionally to the weight in total final demand and to the relative price variation of each branch.

These are two very restrictive hypotheses, which were necessary in the absence of information on price elasticities and on demand functions. However, the aim of finding an indicator of the territorial pattern of energy impact is not put in risk if these hypotheses are applied to all countries.

With this two hypothesis we calculate de increase of final demand of products of each branch as $?Q_i = y^*(z_i/z)$, where $y=S_i(1-p_i)^*Q_i$, $z_i=Q_i/p_i$, $z= S_iz_i$ and p_i is the proportional variation of prices (initial prices=1).

Now we can estimate the growth of total uses of each branch through the known relation $?X=(I-A)^{-1}?Q$. If we hypothesise a constant relation between "total uses" and the gross added value, we can calculate the impact on Gross Added Value of each sector[17].

Finally, we must have a distribution key of the increase in the value added of a given sector between different regions. This can be done assuming the initial regional location of different sectors.

Ideally, the initial spatial pattern of the branch production would be the best key of territorial distribution of the increase of the value added. Unfortunately there is no such data for the set of NUTS 2. The best key we could find is employment by industrial sector, but frequently the branch classification of regional employment doesn't coincide with the branch classification of input-output matrix. Perhaps this is the main practical weakness: at a greater level of aggregation it is difficult to assume the any relation concerning the behaviour of branch productivity among regions. What we did was to assume that in a given region all the branches maintained a constant relation with the corresponding national productivity. Following our results, inside the same country, generally more developed regions would be the more benefited from a energy price decrease. This in part may be due to a overestimation of the share of this regions in the increase of added value.

The calculation procedure is, by construction, a linear application. This means that impacts will be proportional to the percentage variation of energy price. And it is symmetric in the sense that energy price increases or price decreases will have symmetric results. This is another result that do not match empirical results that point to a stronger effect of energy price increases.

[16] There are other equivalent procedures to obtain the numerical solution of the system. We used the Solver tool of Microsoft Excel

[17] We hypothesized that added value per physical unit would not change following a variation of energy price. Although all this calculations are done in monetary terms, at the end this hypothesis is respected, taking into account that $a_{ij}= b_{ij}.p_i/p_j$

Given linearity, we choose an arbitrary percentage decrease of 10% in the price of final energy. In practice, that corresponds to a decrease of 10% in the price of the products of NACE classes referred in the last column of the table presented. In some cases a complete isolation of energy branches was not possible.

Results by regions NUTS 2 are presented in tables and map. It must be stressed that regional results are dependent on the regional pattern of employment of branches more impacted by energy prices and are distributed around the national value.

The impacts vary significantly among countries: in 3 countries the impact would be less than 0,5%; in 9 between 0,5% and 0,7%, in another 9 between 0,7% and 1% and in 4 countries impact could be more than 1%.

Several factors may determine the intensity of the impact.

First, the industrial structure and the degree of integration of productive fabric determine how the variation of energy price spreads over the different economic branches. The share of energy going to intermediary inputs and to final consumption is also relevant for the total impact.

Second, the energy intensity of the economy determines the amount of the percentage impact. Next chart shows the relation between energy intensity of GDP and the impact of the energy price increase.

Third, differences in energy prices imply that energy has an economic weight different of that indicated by energy intensity. From input-output tables we calculate that the percentage of final energy in “total uses” vary in a relation of 1:4 and the correlation between this weight and the calculated energy price impact is about 0,87.

Having in mind the severe difficulties of gathering pertinent data to establish econometric relations between spatial patterns of energy and development, it seems that achieving an impact indicator in the way above mentioned is a great advance in understanding the territorial impact of energy policy.

We are perfectly aware of the meaning of the restrictive hypothesis and of the weakness of the model, although our main objective has been to construct an indicator of territorial impact, and, for an indicator, correct proportionality is the more important feature.

When we go to regional level, comes clear that this methodological framework does not take into account the potential impacts on location of different firms and assumes a constant regional pattern of a given sector. But, change in regional pattern is a question of long term and energy impacts seem to be small and to vanish in the long term. Changes in location caused by energy can occur at a small territorial level (where may be relevant to have or not to have access to cheaper energy source) but will be insignificant at a macro-regional scale, even for energy-intensive industries where other location factors will be more relevant. In addition, market liberalisation will tend to reduce (regional) disparities in energy prices for a given kind of consumers and make the price less dependent on consumers’ location. Also, it does not consider the impacts on interregional trade. As it is presented, the model assumes some impact derived from national exports. But it is not symmetrical as there are no corresponding imports in any other country.

2. INTRODUCTION

According to the terms of reference, this research project must address five main issues:

1. Analyse the territorial trends of energy supply & demand and their spatial pattern, while identifying indicators and mapping methods for quantifying and representing them, taking in account the progress and results of projects currently developed in the framework of ESPON;
2. Design and carry out a territory impact analysis of the energy policy, seeking to quantify impacts from energy-related spatial development policies and identify a set of parameters that may apply to policy decision-making;
3. Define a typology of regions in terms of infrastructures and energy services, with reference to the database and processing techniques. Such typology should clearly define the relationship between energy and polycentric development and identify the regions that are seriously affected by the spatial trends in the field of energy;
4. Identify ESDP options relevant to the energy policy and submit proposals to make them operational and ensure their territorial diversification;
5. Identify the infrastructures and energy services required to provide development conditions to the most backward regions and to those regions marked by specific handicaps (i.e. islands, mountains).

Data gathering in order to develop a primary database, covering the country sample required (15 EU + 12 + 2)[18] allowing indicator production and mapping methods was the obvious starting point. Unfortunately it has proven to be a very difficult task. Even when the aim was to obtain data at a level bellow country level (NUTS 2) the efforts were almost unfruitful.

This reports aims to give some provisional answers for the following items:

a) Outline of the energy sector in an enlarged Europe (27 countries) as well as neighbouring countries (Norway and Switzerland), and the energy policy at Community and national level, this will be provided under a focusing methodology, providing EU wide policies and national policy issues small files;

b) Diagnosis of the existing territorial imbalances and regional disparities in energy services and networks on the basis of available territorial indicators, as far as possible related to the degree of polycentrism, areas facing problems of lagging behind and the accessibility to different parts and types of territories within Europe;

c) Application of the methodology, analysis of the hypothesis previously developed.

These items will be developed under the form of a working report on interim results of the research undertaken, providing outline analysis/diagnosis and including databases, indicators and Europe-wide maps.

The results presented in this report can only be seen as provisional, either in the sense of the data provided, or the conclusions reached.

In fact, project schedule and abnormal difficulties in data gathering have conditioned our work far beyond expectations.

[18] Austria (AT), Belgium (BE), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), Luxembourg (LU), Nederland (NL), Portugal (PT), Sweden (SE), United Kingdom (UK), Bulgaria (BG), Czech Republic (CZ), Cyprus (CY), Estonia (EE), Hungary (HU), Lithuania (LT) , Latvia (LV) , Malta (MT) , Poland (PL), Romania (RO), Slovenia (SI), Slovakia (SK), Norway (NO), Switzerland (CH).

Challenges for the future

Owing to severe lack of formal statistical information at regional level an extensive research activity has been done in order to fill the statistical gaps. The construction of databases of energy production, energy consumption and infrastructures available is assumed as the major instrumental task of the work.

Infrastructures are an important asset for the understanding of the importance and potentiality of the energy systems of the regions in terms of regional development. Maps with the location of the main power stations, of the oil refineries and of the electric grids and gas and oil pipelines have been prepared. Refining analysis based on the gathered data is one of the key issues regarding the Final Report preparation.

A foremost important piece of the energy sector development is energy infrastructure investment and especially energy Transeuropean Networks. This is a missing part of our research effort that is yet to be covered to the Final Report.

3. EUROPEAN UNION ENERGY POLICY AND SPATIAL DEVELOPMENT

SECTION I - EU Energy policy and indicators

EU energy policy is still directed towards the long-term energy objectives set out in 1995 in the 'White Paper on Energy Policy for the European Union"[19]. According to the White Paper, "*energy policy must form part of the general aims of the Community's economic policy based on market integration, deregulation, public intervention limited to what is strictly necessary in order to safeguard the public interest and welfare, sustainable development, consumer protection and economic and social cohesion. However, beyond those general aims energy policy must pursue particular aims (in the energy sector) that reconcile competitiveness, security of supply and protection of the environment …*"

The EU countries are heavily dependent of oil. Energy import dependence is about 50% and active policies have to be adopted in the near future in order to reduce the importance of imports.

As instruments to deal with the security of energy supply, energy efficiency in the consuming sectors and the increase role of renewable sources in energy supply some programmes are being promoted. ALTENER and SAVE programmes have been important instruments to promote technologies, good practices and institutional reforms in the energy fields. These programs have also had important impacts at local and transnational level by the support to the creation of energy agencies and multinational co-operation projects.

Renewables and distributed generation are energy supply technologies that are expected to have a high contribution to local development, by promoting endogenous resources and creating opportunities for new economic activities. The White Paper "Renewable energy: White Paper laying down a Community strategy and action plan" has as objective to attain, by 2010, a minimum penetration of 12% of renewable energy sources in the European Union. A Directive on the "Promotion of production of electricity from renewable energy sources" (Directive 2001/77/EC) confirmed the target of 12% of renewables in the EU energy systems while fixing a target of 22,1% of electricity produced from renewable sources. This target will impact positively on security of supply, environment and social and economic cohesion. This directive also constitutes an important item of the package of measures needed to comply with the commitments made by EU under the Kyoto Protocol.

The creation of a single market for energy is also a part of the EU energy policy. Directives adopting common rules for electricity (Council Directive 90/547/EEC of 29 October 1990) and gas (Council Directive 91/296/EEC of 31 May 1991) aiming to the free transit and market transparency are nowadays part of the *acquis-communautaire*.

The development of trans-European networks is also part of the strategy to accomplish the internal market for energy. The Council Decision 96/391/EC of 28 March 1996 lays down a series of measures aimed at creating a more favourable context for the development of trans-European networks in the energy sector, thus creating the conditions for the development of co-operation projects within regions in different continents (mainly Europe, Africa and Asia). In this context some 74 projects of common interest have been identified.

The transport sector has a key role in the interface with the energy sector. About 40% of the final energy demand is consumed in the transport sector of which 98% are oil products. Future developments of the sector will consider diversification to other less polluting sources like electricity, gas and biofuels. To encourage diversification, directives are being prepared dealing with fiscal measures and biofuel targets. Biofuel development is expected to have a

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[19] (COM (95)682) http://www.europarl.eu.int/factsheets/4_12_0_en.htm - note1#note1

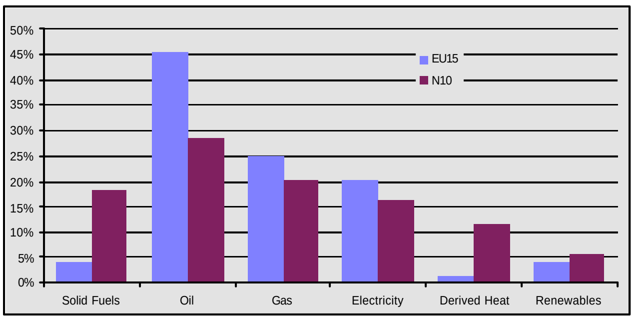
high impact on regional development, mainly in agricultural regions where the negative impacts of the Common Agriculture Policy can be reversed by the new opportunities created for energy crops.

Nuclear energy is nowadays a very sensitive aspect in the energy debate. It is a clean technology in what greenhouse gases are concerned but security, deposits of radioactive residues and power stations dismantlement are still important barriers to the development of this energy carrier.

Comparing the European Union countries with the adhesion countries in terms of total final energy demand the main energy systems differences come as follows:

- EU countries rely less on solid fuels and more on natural gas;
- Coal is still very important in the adhesion countries because of the important endogenous proven reserves. Some capacity has been closed, because of the huge environmental problems (CO2 emissions and acid rains) while the productivity has been improved in the coal mines of certain countries;
- There is a substitution movement from coal to natural gas for electricity production;
- Industry as an energy consuming sector has lost importance because of the structural political and economic reforms experienced in these countries during the nineties;
- The nuclear power stations in some countries have severe security problems and negotiations are or have been done with EU along the negotiations process in order to close some of the most sensitive reactors;
- Renewable energy sources other than hydro have some important barriers in the adhesion countries. Excess electricity generation capacity in some countries, still subsidized prices and lack of financial incentives are among some of the most relevant barriers.
- The energy market reforms are still being conducted and will approach the *acquis communautaire* in a near future. The public ownership of energy utilities is still very important in some countries.
- Huge investments in the energy sector are necessary to increase competitiveness and improve the energy services quality.

Figure 1 - Total final energy demand by type of energy in 2000



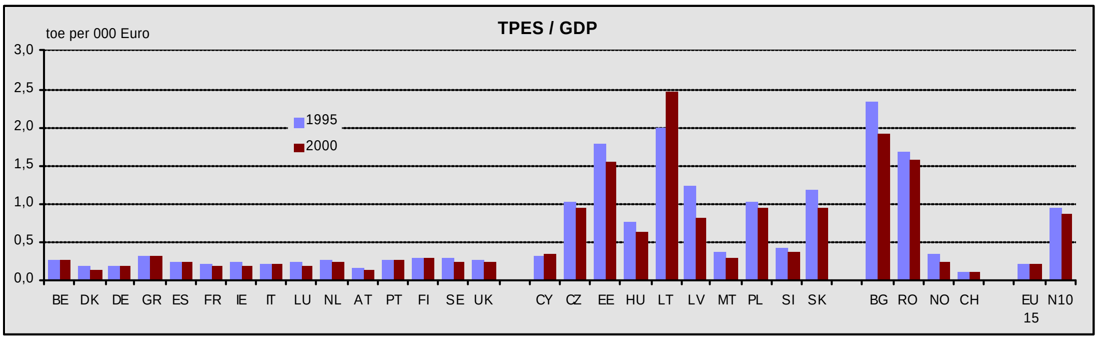
Source: Eurostat.

Four main pillars of the European Union energy strategy have been outlined in the European Commission Green Paper on Energy Security (November 2000): (i) security of supply, (ii) completion of the internal market, (iii) environmental challenge and (iv) promotion of renewable energy and demand management.

The enlargement of EU with the accession of a number of Central and Eastern European states will confirm the current trends that can be observed in the EU15: increasing energy demand, relying mainly on imported fossil fuels, which will ask for new investments in gas, oil and electricity networks.

The accession countries will induce more pressure on security of supply, because of the dependence on oil, of the low energy efficiency, of the different legal and regulatory frameworks. These countries must also conduct energy market reforms which can induce increasing energy prices necessary to finance modernization investments (in renewables and in rational use of energy across the economy).

Figure 2 - Energy intensity for the enlarged Europe between 1995/2000

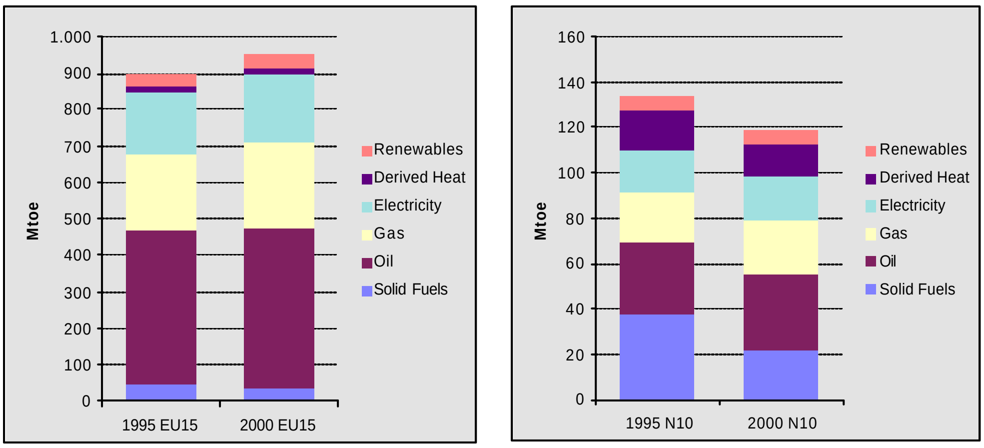


Source: Eurostat
Note: 1999 data for Malta, Norway and Switzerland.

The energy intensity measured as total energy demand per unit of GDP shows clearly the huge investments that have to be done in the adhesion countries in energy efficiency. If we take into account the tendency for increasing prices in the candidate countries, as a consequence of liberalization of the markets and elimination of subsidizes prices, we can imagine how important rational use of energy is for competitiveness.

In the candidate countries energy at local level has an important role as a source of heat for space heating. District heating infrastructures have in general to be refurbished for efficiency reasons. Small installations for distributed generation of electricity and heat are appropriate and in the rural areas there is a market to be developed for biomass as a fuel for district heating.

Figure 3 - Final energy consumption in EU15 and N10 countries between 1995/2000



Source: Eurostat

Among the main challenges facing the European Union countries we must point out Kyoto targets for greenhouse gas emissions and ceilings for the acidification gases (Gothenburg agreements), implying strong actions on rational use of energy, renewables development, changing the energy mix towards less oil products and coal and more natural gas.

In the framework of the Kyoto protocol there is space for project co-operation among countries. Joint Implementation projects can be an efficient instrument for the transfer of technology for the candidate countries. Renewable sources development is among the more promising fields for investment, with a huge impact in local development. Wind and biomass for energy production are natural candidates.

Figures 4 and 5 illustrate clearly the potential for emissions trading benefits in the adhesion countries and for business co-operation, including foreign investment in the energy intensive industries owing to weaker restrictions in what greenhouse gases are concerned.

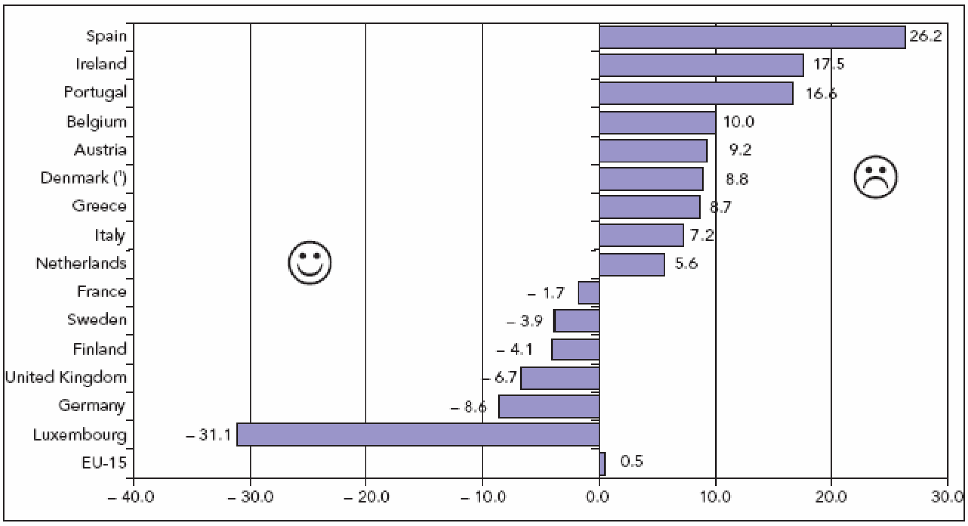
With the enlargement new advantages will emerge in terms of new markets and new opportunities for investment. The Energy Charter Treaty[20] has opened an opportunity window for political commitment in East-West energy co-operation. The enlarged market will create additional needs for interconnection in order to solve some critical interconnection weaknesses in free energy transit which are identified in EURELECTRIC & UCTE (2002)[21] for the European grid. In fact the European Directive 96/920EC has contributed to important improvements in the transnational networks. However we are still far from a single market and even for EU15 the demand is much higher than the offer, which implies some congestion management. The situation will be much worse if we consider EU25.

[20] The Energy Charter Treaty of 17 December 1994 OJ N° L 69 of 9 March 1998

[21] European Interconnection: State of the Art 2002

Figure 4 - Distance to target indicators for the Kyoto Protocol

Distance-to-target indicators (DTI in index points) for the Kyoto Protocol and EC burden sharing targets of EC Member States



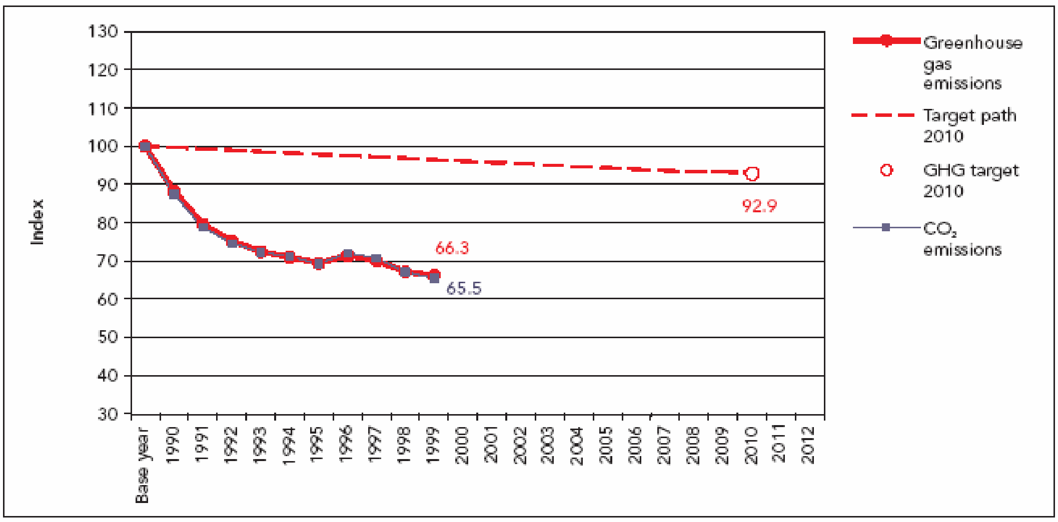
¹) The Danish DTI is + 0.7 index points, if Danish greenhouse gas emissions are adjusted for electricity trade in 1990.

Note: The distance-to-target indicator (DTI) measures the deviation of actual emissions in 2000 from the (hypothetical) linear target path between 1990 and 2010. The DTI gives an indication on progress towards the Kyoto and Member States' sharing targets. It assumes that the Member States meet their target entirely on the basis of domestic measures. See Section 1.2 for an explanation of the DTI.

(Source: EEA (2002) European Topic Centre on Air and Climate Change, "Greenhouse gas emission trends in Europe", 1990–2000)

Figure 5 - Greenhouse gas emissions of 10 candidate countries compared with their Kyoto Protocol

Greenhouse gas emissions of 10 candidate countries compared with their Kyoto targets for 2008–12 (excl. fluorinated gases and LUCF)



Note: Lithuania 1998, Romania 1994, Slovenia 1996 did not report the complete time series, for missing years the values were interpolated (in the middle of series) or data from the last submitted year were used.

Renewable Energy Sources can play a major role in contributing to a wide range of EU policy goals. The development of a successful EU renewables sector would make a useful long-term contribution to diversity, security and self-sufficiency of energy supply, both at national and local level. As low environmental impacts is one of their main benefits, RES could play a leading role in mitigating the environmental negative effects of energy use, since almost all the RES technologies offer major reductions in harmful emissions when compared with fossil fuels. Furthermore, exploitation of RES would create employment (particularly amongst SME), increase exportations if technology development is pursued, and promote social and economic cohesion, particularly in remote and rural regions.

Many of the RES technologies are well suited for application in remote rural areas (e.g. solar, wind power and biomass, including biofuels production) and have the additional benefit that they create local employment. It is therefore clear that an increase in the deployment of RES technologies would provide new opportunities for the populations of the less developed regions. The higher availability of some RES such as wind, solar and geothermal in such regions is also likely to encourage the larger industries to create local jobs and thus to build closer working relationships and strengthen cohesion across the EU.

A study[22] calculating the effects of renewable energy on EU employment shows that:

- An increase in energy provided from RES can result in the creation of over 900,000 new jobs by 2020, 385,000 jobs are predicted to be created by 2020 from provision of renewable energy, and a further 515,000 jobs from biomass fuel production. This increase takes account of the direct, indirect and subsidy effects on employment and jobs displaced from conventional energy technologies.
- Jobs gains are greatest from biomass technologies - both in the biomass energy industry and in fuel supply - however all technologies show long-term net job creation.
- Renewable energy technologies are in general more labour intensive than conventional energy technologies, in delivering the same amount of energy output.
- Jobs displaced as a result of subsidies to support renewable energy deployment are significantly less than corresponding job gains (both direct and indirect impacts) elsewhere in the economy.
- Job gains are greatest in the agriculture and manufacturing industrial sectors. The conventional energy supply industry is predicted to lose less than 2% of its work force by 2020 as a consequence of the shift to a greater use of energy from renewable sources.
- Employment creation occurs in all Member States.

[22] The impact of renewables on employment and economic growth (1999). Internet site: http://www.eufores.org/Employment.htm

SECTION II - Major EU Energy policy headlines and its territorial impact factors.

As discussed in the previous reports, energy's importance to regional development has not deserved enough attention. The traditional framework of spatial reference – made up of national territories – and the fact that electricity can be transported at relatively low cost - and its prices should not show significant differences - led observers to view energy as something ubiquitous, with no major impact on decisions regarding business location and conditions of competitiveness.

One can identify different types of energy territorial impacts: employment and GDP, location as a competitiveness factor, income transfer, household behaviour and quality of life and environment as discussed before.

In the following section it is done a more focused analysis on the main headline energy policies on the current EU Agenda and its territorial impact. An assessment of the major headlines based on its objectives and supporting documents and their potential territorial impact is shown.

Following this overview of the EU energy policy it is done a survey on each country's energy policy and developments.

MAJOR POLICY HEADLINE

1. SECURITY OF ENERGY SUPPLY

SUPPORTING DOCUMENTS AND ISSUES	OBJECTIVES
• Green Paper; • Minimum stock levels of crude oil and/or petroleum products; • Security of supply of natural gas; • Security of supply for petroleum products.	To ensure, for the well-being of its citizens and for the proper functioning of the economy, the uninterrupted physical availability of energy products on the market at an affordable price for all consumers, whilst respecting environmental concerns and looking towards sustainable development. Rebalance its supply policy by clear action in favour of a demand policy. Undertake an analysis of the contribution of nuclear energy in the middle term. Provide a stronger mechanism to build up strategic stocks and to foresee new import routes for increasing amounts of oil and gas. POTENTIAL TERRITORIAL IMPACT FACTORS Environmental concerns influencing energy choices - the action to combat against climate change will promote the use of local energy sources as well as energy efficient technologies. Technological development, job creation and reinforcement of other infra-structures: telecommunications, transports, health and education. Possible new infrastructure on electricity generation: both centralized and decentralized and corresponding further income for local authorities. Reduction of environmental impacts: air quality, water quality and resource management, soils conservation, noise reduction, biodiversity protection, etc. Renewable energy projects normally bring further income to local authorities. Major concern on security of supply either by the use of decentralized generation (renewables and CHP), as well as further energy reserves improves the avoidance of blackout happenings with its known consequences as well as major effects of terrorist attacks. Development of the internal market has given both a new place and role to energy demand which could lead to political tension, e.g. the fall in prices could thwart the action to combat climate change. It is up to the societies themselves to find satisfactory compromises.

2. INTERNAL MARKET IN ENERGY

SUPPORTING DOCUMENTS AND ISSUES	OBJECTIVES
• Price transparency; • Transit of electricity through transmission grids; • Transit of natural gas through transmission grids; • Coordination of procurement procedures of entities operating in the water, energy, transport and telecommunications sectors; • Common rules for the internal market in electricity; • Common rules for the internal market in natural gas; • Conditions for granting and using authorizations for the prospection, exploration and production of hydrocarbons; • Completing the internal energy market; • Completing the internal energy market: revision of the Directives concerning common rules for the internal market in electricity and natural gas; • Completing the internal energy market: cross-border exchanges in electricity.	Creation of one truly integrated single market for energy which would provide the European Union with a competitive market and a secure energy supply. Appropriate rules with respect to the pricing of cross-border trade; rules for allocation and management of scarce interconnection capacity; and where economically justified, the increase of existing physical interconnection capacity. POTENTIAL TERRITORIAL IMPACT FACTORS Changes in taxes for cross-border trade. Development of actions for congestion management. New industry placements by the expansion of the natural gas and electricity grids. Lower price disparities and reduction of the weight of energy in location decisions. Supply more responsive to the market: risk of minor interest in supplying less developed and isolated regions. Creation of a local R&D technology base. Development of physical infrastructure both in energy and other satellite sectors. Expansion of multi-product companies (e.g. metallurgy), better competition conditions and creation of alternative markets. Creation of regional utilities (gas and electricity). Public service objectives right of households to receive an electricity supply on reasonable terms, the protection of vulnerable consumers and environmental protection. Positive influence on both quantitative and qualitative aspects of employment.

3. ENERGY AND SUSTAINABLE DEVELOPMENT

SUPPORTING DOCUMENTS AND ISSUES	OBJECTIVES
* Global partnership for sustainable development; * Strategy for sustainable development; * Integrating of environmental considerations in Community energy policy; * The energy dimension of climate change.	Incorporate the environmental dimension into its objectives and actions while developing a sustainable energy policy. POTENTIAL TERRITORIAL IMPACT FACTORS On large combustion plants there might be possible discommissions (e.g. old coal power plants or the disposal of disused offshore oil and gas installations). Combined heat and power production and renewable energies development. Soil occupation by these investment projects might bring further income to local authorities. These additional incomes might allow local authorities to invest in further basic infrastructures: telecommunications, health, transport, education, etc. In addition, new legislative measures had been proposed concerning the taxation of energy products representing further income to local authorities. Waste incineration and polluting emissions from motor vehicles controlled and local environment benefits. Improvements in the industrial tissue, by the use of more efficient and less consuming technologies. Possibilities of new agricultural (energy) productions and renewed opportunities for rural areas.

4. ENERGY EFFICIENCY

SUPPORTING DOCUMENTS AND ISSUES	OBJECTIVES

• Towards a strategy for the rational use of energy
• **Energy efficiency requirements:**
  • Energy performance of buildings;
  • Energy certification of buildings;
  • Ballasts for fluorescent lighting;
  • Energy efficiency for refrigerators;
  • Energy efficiency for hot-water boilers.
 	
• **Labelling of energy efficient products:**
  • Household appliances;
  • Office appliances: Energy Star programme;
  • Cogeneration.
	To prepare the ground for common policies and actions in line with the Kyoto commitments.
	
	POTENTIAL TERRITORIAL IMPACT FACTORS
	
	Energy efficient buildings;
	
	Limit carbon dioxide emissions;
	
	Energy-efficient household appliances and other end-use equipment;
	
	Wider use of negotiated and long-term agreements on minimum efficiency requirements;
	
	Energy efficiency in the electricity and gas sectors and combined heat and power (CHP);
	
	Energy management and public and cooperative technology procurement.
	
	Better living conditions (air quality, lighting and thermal comfort in buildings accompanied by general economic savings.
	
	Development of decentralised generation and blackout and terrorist avoidance.
	
	Creation of a local R&D technological basis.
	
	Wise management of mobility systems and new concepts for urban development.

5. RENEWABLE ENERGY SOURCES

SUPPORTING DOCUMENTS AND ISSUES	OBJECTIVES
*White Paper laying down a Community strategy and action plan; * Promotion of electricity from renewable energy sources; * Promotion of biofuels use in transport; * Programme "Intelligent Energy – Europe" (2003-2006); * 6th Framework Programme on Research, Technology Development and Demonstration (2002-2006).	The Directive aims to give a boost to stepping up the contribution of these energies while respecting the principles of the internal market. POTENTIAL TERRITORIAL IMPACT FACTORS Make greater use of the potential available; * Help further cut CO_2 levels; * Reduce energy dependence; * Develop the national industry; • Create jobs. • Development of agriculture through expansion of energy for pumping and irrigation; • Better regulation of hydrological flows (small and micro hydro power; • Better use of local agricultural and animal breeding residues, implying less soil contamination, and additional energy sources (biogas and other agricultural residues); • Economic savings, • creation of additional green areas, • creation of new factories: e.g biofuels production, and other local activities (alternative agricultural use of soils, collection and distribution of materials) • Alternative to agriculture – biofuels • By the use of forest residues, improvement of forest cleaning and reduction of potential forest fires, • Improvement of local environment: quality of soil, water, air and noise…

6. TAXATION OF ENERGY PRODUCTS

SUPPORTING DOCUMENTS AND ISSUES	OBJECTIVES
• Community framework for the taxation of energy products • Tax on carbon dioxide emissions and energy	To determine an overall tax system for the taxation of energy products, with a view to improving the functioning of the internal market, encouraging behaviour conducive to protection of the environment and promoting the greater use of the factor labour. To limit the emission of greenhouse gases and promote efficient use of energy by introducing in the Member States, an additional harmonized tax on carbon dioxide emissions and energy content. POTENTIAL TERRITORIAL IMPACT FACTORS Agricultural, horticultural or fish farming works, and forestry; Improvements in: • **stationary motors;** • plant and machinery used in construction, civil engineering and public works; • vehicles intended for use off the public roadway; • passenger transport and captive fleets which provide services to public bodies. Improvement in traffic at city centres and improvement of conditions for tourism and other tertiary sector activities. The situation of energy-intensive firms by including additional provisions (reductions and exemptions) in order to safeguard the competitiveness of industry. The need to save energy and reduce carbon gas emissions by allowing Member States to introduce, subject to Community competition rules, tax incentives for new investment in this field.

7. NUCLEAR ENERGY

SUPPORTING DOCUMENTS AND ISSUES	OBJECTIVES
SURE programme: nuclear safety. * Nuclear safety in the Newly Independent States and Central and Eastern Europe; * Dangers arising from ionising radiation; * **Waste** : * Shipments of radioactive substances between Member States; * Transfer of radioactive waste: supervision and control.	To improve the safe transport of radioactive materials in the European Union and the safety of nuclear installations in countries participating in the TACIS programme by means of increased cooperation in the field of safeguards and industrial cooperation. POTENTIAL TERRITORIAL IMPACT FACTORS Reduction of incidents which have occurred during transport; Cooperating with the TACIS countries on safe transport: Improvements of nuclear safeguards; The development of modern logistical, evaluation and control equipment and the relevant training; Development and transfer of European technologies by means of cooperation in industry and between regulatory bodies; Promoting cooperation between partners from the Community and the TACIS countries (e.g. in the form of joint industrial projects).

8. TRANS-EUROPEAN NETWORKS

SUPPORTING DOCUMENTS AND ISSUES	OBJECTIVES
• Declaration of interest concerning the transmission of electricity and natural gas; • General rules for the granting of Community financial aid in the field of trans-European networks; • Guidelines on trans-European energy networks; • Set of actions relating to trans-European networks in the energy sector; • The external dimension of trans-European energy networks.	Granting to facilitate private financing of the projects POTENTIAL TERRITORIAL IMPACT FACTORS Promote cross-border projects; Promotion of employment creation; Development of international cooperation and local development; Reinforce the security of the Community's energy supplies. Connection of isolated electricity networks to the interconnected European networks; Improvement of the reliability and security of the Community's electricity supply networks or to supplying the Community with electricity. Introduction of natural gas into new regions; Increase the transmission, reception and storage capacities (needed to satisfy demand) and diversification of supply sources and routes for natural gas

9. COOPERATION WITH THIRD COUNTRIES

SUPPORTING DOCUMENTS AND ISSUES	OBJECTIVES
European Energy Charter * The Northern Dimension of the European energy policy * Euro-Mediterranean Cooperation * Cooperation between the United States and Euratom in the field of fusion energy	The promotion of energy efficiency policies consistent with sustainable development; POTENTIAL TERRITORIAL IMPACT FACTORS The creation of conditions which induce producers and consumers to use energy as economically, efficiently and environmentally soundly as possible; The fostering of cooperation in the field of energy efficiency.

NOTE: Please see annex 1 - EU Energy policy documents for further details on the EU Energy Policy.

Potential policy territorial impacts

Links between energy policy and territory have three basic drivers: investment, prices and income transfer. Impacts of energy policy can then be measured in terms of industry development, welfare and environment.

In this section our aim is to briefly discuss potential impacts of European energy policy headlines on territorial development.

Firstly we will set out what we meant by each of the impact carriers quoted above.

Investment means in this context all energy infra-structure development, leaded by public or private financing. These could be related to the commissioning of energy production facilities, grid construction or improvement, etc. There are in a larger or lesser extent exploitation expenses and revenues associated to every energy investment. This will be considered in our assessment associated under the same heading.

Investment effects are, per se, positives in principle, the better if they are applied in less developed or remote regions, either from the infra-structure development itself, or from the exploitation effects. It must be emphasized anyway, that a minimum level of socio-economic fabric density is required to allow those regions to capture significant shares of potential benefits.

Prices reflect changes in the costs of energy either in production, distribution or consumption that may change the behaviour of producers, distributors or consumers. These can derive from taxation or energy sector (production, distribution and consumption) factors.

We assume that price changes have two levels of impact. One, that we may call for simplicity an income effect, where price level changes have direct impact on the economy pushing on the opposite direction of the price movement (an increase in prices pressing for a reduction on total economic activity, and a decrease acting in the reverse direction). Ahead in this report we provide evidence that these forces can be considered important, at least on the short run. A second effect, that we may call the structural effect can induce technological changes to accommodate price increases (or delay it if energy prices are reduced) or at a limit situation force relocation of industrial facilities. As it is also said ahead, relocation would hardly be derived from energy price effects alone.

Income transfer effects aim to capture the effects associated with the fiscal redistribution, changes on the location of energy production facilities or redistribution of energy production ownership.

Under this heading we are then considering existing possibilities of taxation revenue derived from energy policies as the more obvious effect. If a tax is levied (ort raised) on energy products its revenue can be used to improve the living conditions or the economic infra-structures of less developed regions, thus improving competitiveness for the benefited territories.

But energy policy can also provide a change in the balance of the energy producing regions. Renewables are much likely to be established in less developed or remote regions, thus transforming a traditionally depleted area in an energy exporter. This could mean that income is transferred from consuming areas towards the new producing areas.

But this reasoning is not fully achieved unless the ownership of producing facilities and distribution companies is considered. The internal market (and privatization) can mean, in the end, that the ownership of energy companies and producing facilities are located outside production or consuming territories, thus inducing income transfers hard to trace.

A third line of potential income transfers can be obtained via emission rights market.

Assuming the aforementioned potential territorial impact factors we may assume an impact chart like follows.

Table 1 – Potential territorial impacts of energy policies

Policy headlines	Impact carriers		
	Investment	Prices	Income transfer
Security of energy supply	relevant	some	difuse
Internal market in energy	difuse	relevant	difuse
Energy and sustainable development	some	relevant	relevant
Energy efficiency	difuse	difuse	difuse
Renewable energy development	relevant	difuse	relevant
Taxation of energy products	difuse	relevant	relevant
Trans-european networks	relevant	some	some

- relevant impacts expected
- some impacts expected
- difuse impacts expected

Some comments are required on the chart to make clear our assumptions.

We must accept that there are interconnections among the proposed policy headlines, on the one hand, and that carriers themselves, do not act independently. So some simplification is required in order to identify impacts.

Investment effects are more likely to be originated by security of supply (and associated TEN measures) and renewable development policies. All assessments of these policies seem to point out to important effects on less developed regions.

The *price effects* are markedly framed by two opposed development vectors. On the one hand, internal market and liberalization are aimed to reduce energy prices by increased competition. This would mean a push towards an increase on economic activity and an increase on the welfare of the families (either by availability of income for an extra expenditure on energy as a mean for household comfort, or by freeing resources for other forms of consumption and savings). At the same time that could mean a pull towards slower technological development, at least towards less energy efficient equipments and buildings.

But on the other hand consideration of environmental externalities on prices and the cost of emissions rights may push prices upwards, inducing a negative income effect and as positive incentive for more efficient equipments and buildings.

Income transfer effects may be harder to evaluate and, even if the potential seems clear, we may not be able to see much of these out of a case study framework. Fiscal effects are subject to national macroeconomic and regional development policies. Private sector transfers could hardly be statistically measured.

SECTION III – Country's energy policy guidelines

The following analysis was based, among other sources, on the IEA annual country reviews produced recently.

AUSTRIA

MAIN HIGHLIGHTS

- Most important latest developments: liberalization of the electricity and natural gas markets and the commitment to meet the emissions reduction targets under the Kyoto Protocol (to reduce emissions by 13% below 1990 levels by 2008-2012) – Climate Change Mitigation Programme.
- The emissions of greenhouse gases per inhabitant in Austria amounting to 9,86 tones are about average within the EU, but considerably bellow the level of extra-European industrialized countries.
- Austria is a net importer of energy - of approximately 65% of its total primary energy supply in 2000.
- Austria faces no security of supply problem as Austria is in between strong electricity producing countries. Has also taken steps to ensure supply security through gas storage capabilities, comprehensive measures for oil and sizeable reserve margin for capacity for electricity.
- In April 2002 was defined a strategy to reduce energy intensity (0.107 toe/$1000 GDP in 2003) at a rate of 1% per year.

MAIN CONCERNS

NATURAL GAS

- Major European hub in Baumgarten with main pipelines for Western and Southern Europe. Only 20% of the gas going through Austria is for national consumption.
- Austria has domestic natural gas resources providing 23% of the countries' demand.
- Together with the oil fields, natural gas production fields has declined over the last 20 years and is expected to continue to decline as the sources are exempted.
- Austria imports almost 80% of its natural gas needs, from Russia (80%), Norway and Germany.
- On 1st October 2002, all natural gas customers were given the right to choose their own supplier.
- The Austrian Gas Act opened 50% of the natural gas market (by volume) in August 2000.

OIL

- Austria has domestic oil resources, providing 9% of countries' demand.
- The country imports over 90% of its crude oil needs and nearly 60% of its desel needs.

RENEWABLES

- Austria has substantial hydropower resources which provides approximately 70% of its electricity needs.
- Small hydropower facilities (<10 MW) provided 1,3% of the countries' total primary energy supply and biomass around 10,9% in 2000.
- Other renewable energy technologies: solar, wind, geothermal, biomass electricity generation and landfill gas generation accounted in total for less than 0,5%.
- Small renewable energy technologies (i.e. excluding large hydropower and biomass) benefit from two separate support schemes. The first one is a feed-in tariff. The second one is system of green certificate trading. Electricity suppliers based in Austria must include 8% of small-scale hydro (<10 MW) and 1% (increasing to 4% by 2007) from other renewable energy technologies in the electricity sold to final consumer.
- The Green Electricity Law has a biding provision of the rise of new renewable energies to reach 4% of electricity supply by 2008; small hydro shall account for at least 9%.
- The target is to raise the total share of renewable sources in the overall generation of electric power from currently 70% to 78% (including large hydro).

CHP

- CHP provides 27% of the Austrian electricity supply. These plants are supported by regulations requiring local utilities to pay above-market rates for electricity coming from those plants.

ELECTRICITY

- Austria is a net exporter of electricity but trade balances vary seasonally as Austria's hydropower capability fluctuates through the year.
- On 1st October 2001, all electricity customers were given the right to choose their supplier.
- While larger consumers have enjoyed reduced power prices, smaller customers have seen little or no change to their overall bills. Less than 1% of domestic customers have switched suppliers while 20% of large consumers have done so.
- Access charges to the Austrian system, which account for approximately 35% of the average residential bill, are between 60% and 70% higher than the average of other European countries.
- The role of Austrian utilities in the liberalized Central European electricity market is evolving

SPECIFIC FEATURES

- Climate change is the main priority within the framework of the Environment fund of the Federal Government. Climate Change related subsidies increased from 40 million Euros in 2001 to 57 million in 2002.
- Austria is a carrier of substantial international energy trade.

- Emissions reduction measures were placed into six different categories, with space heating and transport measures accounting for more than one half of the total projected emission cuts.
- Austrian energy intensity is low given in part to the fact to low energy intensity in the transport sector (resulting largely from a high share of diesel fueled vehicles in the Austrian fleet), an economy dominated by services rather than large energy intensive industry and efforts to reduce public energy use such as public lighting.
- Austria makes substantial use of district heating, providing 12% of the countries heating supply.
- The energy related standards for buildings established by the Federal Provinces are permanently improved and thus the energy demand is reduced.
- Starting in 2001, the motor vehicles tax for trucks has been raised by 50% on average and this tax will be applicable until the introduction of a mileage based road pricing.

CLIMATE CHANGE

- National Allocation Plan (NAP) has been accepted by European Commission with technical changes required on "ex-post adjustment" (Austria intends to re-allocate allowances from plants that close down during the 2005-2007 period). If Austria implement this changes by 30 September 2004, all companies qualify automatically for trading. NAP allows 98.2 millions tones of CO2 for 205 installations.
- In December 2003 Austria launched a CDM/JI programme, which aims to make a contribution to achieving the Austrian reduction commitments under the Kyoto protocol through the application of the project related to JI and CDM.
- The goals of this programme are on the one hand to purchase emission reduction credits from Kyoto projects. Two calls for projects (4 December 2003 for JI and 10 December 2003 for CDM) are opened until September 2004. On the other hand it will help financing of particular immaterial services, such as baselines studies, etc…
- Austria already signed Memorandum of Understanding (MoU) on Kyoto projects mechanisms with Bulgaria, China, Czech Republic, Hungary, Latvia, Morocco, Romania and Slovakia.

POLICY RECOMMENDATIONS

The Government of Austria should:

- Continue the liberalization of the electricity and natural gas markets.
- Review energy tax policies to prevent possible market distortion and send the right signals to consumers, taking into account the tax harmonization efforts at the EU level.
- Conduct regular monitoring of the implementation of the emissions reduction programme.
- Examine the transport sector to ensure its optimal contribution to overall GHG emission reduction strategy.
- Ensure an appropriate mix of domestic policies and flexible mechanisms with a view towards minimizing the economic cost of climate change mitigation policies for the whole economy.
- Review the support scheme for CHP plants, including its continuation after 2004. Maximize CHPs cost-effective contribution to meeting environmental goals through

such measures as a gradual lowering of the support levels in accordance with a benchmarking system which includes minimum efficiency standards.

- Explore the most cost-effective measures to achieve the countries targets for contributions from renewable energies
- Monitor the oil market in order not to impede competition nor market distortion and discouragement of new entrants.
- Continue to lower system access charges to the electricity market and consider the option of further unbundling.
- Further clarify if the objectives of the R&D programmes are designed to meet in order to accomplish particular energy and environmental policy objectives.

Source: IEA; Energy Policies of IEA Countries – Austria – 2002 Review, IEA, 2002.
Federal Ministry of Agriculture, Forestry, Environment and Water Management; Climate Strategy – Austria's Responsibility in Mitigating climate Change, October 2002.
IEA; Round Table Reports on Notable Energy Developments in Member Countries – Austria – June 2004
MINEFI – DREE/TRÉSOR ; Le marché du Gaz Naturel en Autriche ; juin 2004
MINEFI – DREE/TRÉSOR ; Le secteur de l'électricité en Autriche ; mars 2004
Austrian regulator, Austrian Energy Agency and Austrian CDM/JI programme

BELGIUM

MAIN HIGHLIGHTS

- Being an highly decentralized country, in Belgium energy policy involve many different players, the regions and federal governments, making the decisions inevitably complex. The CREG is the regulator at the federal level while the VREG, the IBGE and the CWAPE assure the compliance of energy decrees respectively in Flanders, Brussels and Wallonia.
- Because of the county's geographical location, cross-border trade of electricity and gas as well as the energy policies of the neighboring countries affect Belgium's energy policy.
- Belgium's role as a transit country will become more important in the future in what concerns security of supply, competition in energy market as well as the battle on climate change and sustainable energy issues.
- Belgium's energy supply has been diversified, competition in both electricity and gas markets has been introduced and has accepted to meet the Kyoto commitment.
- The theoretical degree of market opening in 2004 is around 80% for electricity and 83% for gas.
- In 1999 energy consumption was 20 to 30% above the level of 1990.

MAIN CONCERNS

OIL

- Belgian government sets price ceilings on oil products. These reflect the market price but also avoid sharp price increases caused by speculation.

NUCLEAR

- Belgium has committed to phase out nuclear power. The declared nuclear plants shut-down is planned to begin after 2014, therefore not creating difficulties for reaching national Kyoto target.

ELECTRICITY & NATURAL GAS

- The federal government is responsible for generation, transmission and pricing, while the regional governments are in charge of distribution, energy efficiency, CHP and renewables promotion.
- Both electricity and gas markets are dominated by single companies there are no clear prospects for new entrants. International competition is the only apparent path to real competition in Belgium.

ELECTRICITY

- The liberalization process is different regarding the regions
- In Flanders, the market is 100% opened since 1st July 2003.
- In Wallonia, clients at high voltage (13000 clients) are eligible from 1st July 2004. Before 1st February 2005, the government will decide on the eligibility for final client (1.4 millions clients) on the 1st July 2005.
- In Brussels, the market is opened since January 2003 for clients with an annual consumption above 10GWh. The market will be completely opened on the 1st January 2007.
- The theoretical opening degree of the electricity market is 80%.

GAS

- The liberalization process is different regarding the regions
- In Flanders, the market is 100% opened since 1st July 2003.
- In Wallonia, the market is opened since January 2004 for clients with an annual consumption above 0.12Gwh per site. Before 1st December 2004, the government will decide on the eligibility for final client before the 1st July 2007.
- In Brussels, the market is opened since 1st July 2004 for professional clients. The market will be completely opened on date neither anterior to the 1st January 2007 nor posterior to the 1st July 2007.
- The theoretical opening degree of the gas market is 83%.

RENEWABLES & CHP

- Belgium aims to reach 6% of electricity consumption from renewable energies by 2010.
- The regions developed a system of Green Certificates (GC) for renewable energy, in which electricity suppliers are committed to render a certain amount of GC every year to the regional regulator. In Flanders, the system works since 1st January 2002 while in Wallonia it has been implemented in 1st January 2003. To stimulate the market, the levels of GC will be increased every year. In 2005, the quotas should represent 5% of electricity supply in Wallonia and 2% in Flanders. In 2010 they should represent respectively 12% and 6%. In Brussels, the quotas will be of 2% in 2004, 2.25% in 2005 and 2.6% in 2006.
- In Flanders, a specific Green Certificate mechanism for cogeneration should be approved by 2004, leading to a double market of GC.
- The federal government started negotiations with the sector to have biofuels, at a more favorable price than traditional fuels, on the market at the beginning of 2005
- On 13 February 2004, the council of ministers decided to create the “federal investment company” which will promote energy saving in government buildings through the third party financing mechanism.

SPECIFIC FEATURES

- Energy related green-house gas emissions continued to grow significantly during the 1990’s, and the Kyoto commitment is to achieve a 7,5% reduction of emissions by 2008-2012 compared to 1990.
- It is believed that significant improvements in energy efficiency can be made in Belgium. The federal plan for sustainable development calls for reducing consumption 7% in 2010 compared to 1990. But energy intensity grew in the 1990’s.

POLICY RECOMMENDATIONS

The Government of Belgium should:

- Consider giving further support to the introduction of CHP, rational use of energy and and renewables in the Belgium market and revise the actual incentives.
- Consider eliminating the remaining price ceiling mechanism to achieve full liberalization of oil prices.
- Develop policies to promoting renewables that are cost-effective, market-oriented, and consistent with the policies of neighboring countries.
- Ensure that the environmental costs of energy are adequately reflected in final costs.
- Study the use of biomass as a supplementary fuel in CHP.

Source: IEA; Energy Policies of IEA Countries – Belgium – 2001 Review, IEA, 2001.
IEA; Round Table: Recent National Developments – Belgium – February 2004
MINEFI – DREE/TRÉSOR ; Le marché énergétique belge ; juin 2004
MINEFI – DREE/TRÉSOR ; Le secteur du gaz en belgique; juin 2003
Energy ministry and Environment ministry.

www.climat.be

DENMARK

MAIN HIGHLIGHTS

- Over the last decades the Danish energy policy has been strongly influenced by environmental policy objectives.
- Denmark has many policy goals that are inspired by both energy and environmental considerations.
- Security of supply has been one of the main priorities since the oil crisis in 1973.
- Government will continue its efforts for energy savings and lower energy consumption.
- It was registered a raise of 8% of energy consumption between 1990 and 1999.
- A number of concrete initiatives are being done in order to promote the energy efficient products and buildings.
- Energy consumption in transports constitutes a rising share of energy consumption, 24% in 1999.

MAIN CONCERNS

NATURAL GAS

- Since 2000, 30% of the market has been open to competition. This is expected to increase up to 38% in 2003 and 43% in 2008.
- The Danish Government is using the derogation of the Gas Directive to limit the access to some potential competitors to the national gas pipeline company – DONG, which now controls 95% of the Danish gas market.
- From 2003 onwards, network operation and gas trading activities will have to be separated.
- The Government has decided that the gas market should be fully competitive by 2004 and that DONG should be privatized at a time to be determined in the future.
- Nearly 25% of the electricity produced is from Natural Gas.

OIL

- The rising trend on oil and gas production is continuing, contributing to an improvement of the balance of payments.
- It is expected that the North Sea oil and gas fields are still to be exploited for many years to come, although it is expected that the maximum production will be reached in 2011 after which it is most likely to decrease.

COAL

- Electricity production stills rely largely on coal with 46% but is in constant decrease over the last years.

ELECTRICITY

- On 29th March 2004, the parliament decided new orientations for long-term electricity policies based on 3 agreements.
- The option of renewable or green energies was confirmed.
- All electricity should be produced at market conditions, supports systems will be revised and the financial structure of producers will be opened.
- The transmission network will be nationalized in order to assure grid access conditions independent from commercial interests.

- Electricity market reform in Denmark goes beyond the requirements of the EU directive.
- The transmission network is divided in two separated and totally independent systems. The western part is connected to Norway and to the continental UCTE grid via Germany. The eastern part is linked to the northern grid Nordel. The two grids should soon be interconnected.
- The eastern part participates in the Nord Pool power exchange since 2000.
- Since 1 January 2003, all final costumers are eligible to choose their electricity supplier in the market.
- District heating is one of the pillars of Danish energy policy. Hence cogeneration is mandatory for every new power plant construction.

RENEWABLES

- Denmark is already producing 21% of its electricity from renewables (15% from wind energy, 3% from waste and 3% from biomass).
- By 2010, wind energy could reach 25% of the national electricity production.
- The biomass agreement promotes the supplementary firing of straw in some power plants. Moreover a final decision is to be made on a capacity to burn further 150 000 tons of straw, to be established before the end of 2004.
- On 9th June 2004 a new support mechanism for renewables was voted.
- It will be possible to implement the offshore wind farm development without more costs involved for consumers than a similar land-base development.

CHP

- Denmark has the world's highest share of electricity generated in combined heat and power, as well as one of the largest district heating systems which covers around 50% of the total heating demand.
- CHP and wind are given priority in dispatching, but control strategies are being developed to match problems with electricity overflow production during windy periods in the winter.

CLIMATE CHANGE

- The Danish National Allocation Plan has been accepted on conditions by the European Commission. 362 companies will qualify for trading on 1st January 2005 with a total allowance of 100,5 millions tonnes of CO_2.

o On 29 September 2003, seven countries of the Baltic Sea Region - Denmark, Finland, Germany, Iceland, Lithuania, Norway and Sweden signed the Regional Testing Ground Agreement for Flexible Mechanisms of the Kyoto Protocol. The Testing Ground Agreement is open to other parties which have adhered to the Kyoto Protocol. The countries will ensure issuance and transfer of greenhouse gas credits related to or accruing from Joint Implementation projects, facilitate generation, minimise transaction costs, especially regarding small and medium scale JI projects.

R&D

- Subsidies to energy R&D initiatives are to create the best possible development basis for energy policy, including development of new energy saving technologies.
- A subsidy to study the geothermal energy potential of the Copenhagen area for heating purposes has been given now leading to a pilot plant being constructed.
- Funds are also being placed on wave energy, solar cells and hydrogen fuel cells.

SPECIFIC FEATURES

- Denmark has the Kyoto target of reducing the greenhouse emissions (six gases) by 21%in the first budget period 2008-2012. The Kyoto protocol was ratified in 2001.
- There is also a national commitment to reduce CO_2 emissions by 20% by 2005, compared to 1998.
- CHP and wind are given priority in dispatching; therefore only about 60 to 65% of the power market is governed by competitive price signals – in Jutland only 35-40%.
- This priority dispatch requirement causes excess generation during certain periods.

POLICY ISSUES

Among others, Danish energy policy issues to be addressed are:

- Review the existing policy measures with a view to developing more cost-effective policies.
- Take steps to move to market based policies as soon as possible, including the introduction of green certificates programme, or some other instrument to off-set the costs of current subsidies for renewable energies.

Source: IEA; Energy Policies of IEA Countries – Denmark – 2002 Review, IEA, 2002.
Statement of the Minister for the Environment and Energy pursuant to the Act on Energy Policy Measures. Energy Policy Review 2001. April 2001.
MINEFI – DREE/TRÉSOR ; ”Le marché danois de l’électricité en 2003”, juillet 2004
MINEFI – DREE/TRÉSOR ; ”L’énergie éolienne au Danemark”, juin 2003

FINLAND

MAIN HIGHLIGHTS

- Finnish Energy markets have undergone a period of restructuring which started in 1995. (oil, wood, district heating has been under competition a long time ago before 1995). It was then opened to the market of competition as well as the integration with the Nordic electricity market.
- It also brought competition to the natural gas market in full compliance with the EU Directive.
- The most important domestic/ energy sources are wood, peat and hydropower.
- The main source of electrical energy is nuclear power.

MAIN CONCERNS

NUCLEAR ENERGY

- One fourth of the electricity is produced by nuclear power (in 2003 it was 26 % and after the 5'th NP unit it will be about 30 %).
- The Government's favourable decision-in-principle on the new nuclear power plant ratified in May 2002 is based on the view that the nuclear power is the most cost-effective base-load power alternative within the Kyoto Protocol.

NATURAL GAS

- Until 1999 Finland was not interconnected to the European Union's natural gas network.
- It is expected that the greater use of natural gas, especially in electricity and heat production could be a means for CO_2 reduction.
- Natural gas accounts for about 11% of the Finnish primary energy supply (4 Mtoe in 2003).

COAL

- Coal accounts for about 15% of the Finnish electricity production.
- 17 % of Finnish primary energy supply (5,8 Mtoe in 2003, when the total use was 35,3 Mtoe).

RENEWABLES

- Renewables account for about 20% of primary energy supply.

CHP

- Finland has one of the highest shares of combined heat and power production in the world.
- One third of the electricity production (34 % in 2003) comes from CHP and 50% (37 % of total volume of the building stock is connected to the district heating network).

ELECTRICITY

- Finland as well as the other Nordic countries is still relatively concentrated.
- More than one third of the electricity is produced by domestic sources and out of that almost half is produced by hydropower.

- Finland is one of the countries more advanced in electricity liberalization.
- Electricity imports from the other Nordic countries as well as the eastern countries have been done for long time already.

After liberalization and releasing the electricity market, the price of electricity was decreasing, depending on the pools and how good the customers could negotiate with companies. By the same time there was a new deal in the market - small local companies were sold to big companies. The price of electricity was decreasing to 2000, after that the prices seem to increase because the big companies needs higher interests of their investments. The industry and SME, creating pools, can maybe negotiate the electrical power with better conditions in the future.

SPECIFIC FEATURES

- The country has already exploited much of its energy efficiency potential, partly because of its cold climate and the scarcity of indigenous resources and the strong industrial development.
- Finland also has energy intensive export industries.
- About half of the target emission reduction, 14 million CO_2 tons, can be met by implementation of the energy conservation programme (3-4 million CO_2 tons) and action plan for renewable energy sources (4-5 million CO_2 tons).
- The most important decision was the realization of new nuclear power unit.
- The state also support the use of domestic fuel (peat, wood chips).

POLICY ISSUES

Among others, Finnish energy policy issues to be addressed are:

- Work towards extending and strengthening the cross-border links in grid-bound industries as soon as economically feasible.
- Ensure that during the privatization of energy companies, ownership is spread among a large number of players and that cross-ownership is reduced.
- Continue efforts to create alternative routes to diversify the supply of natural gas.

Source: IEA; Energy Policies of IEA Countries – Finland – 1999 Review, IEA, 1999.
www.motiva.fi & www.energia.fi

FRANCE

MAIN HIGHLIGHTS

- France is poor in energy resources on its national territory and depends to a large degree on energy imports.
- The French energy sector includes 13 refineries, 58 nuclear power groups over 20 sites. The exploitation of coal ended on the 23rd April 2004 with the closure of the site of La Houvre.
- France has three main objectives: security of supply, French economy competitiveness and environment care; and two main worries: employment and public service.
- France has the lowest per-GDP carbon emissions and electricity is one of the cheapest within the OCDE, as the country's vast nuclear programme has contributed to this.

MAIN CONCERNS

OIL

- Over the last 15 years France has gradually liberalized its energy markets, beginning with deregulation and privatization the oil industry. France has two major oil companies: Total Fina and Elf merged in 2000, creating one of the largest oil companies of the world.
- In 2000, France imported 90,4% (85,6Mt) of its oil consumption, mainly from the North Sea (37%), Saudi Arabia and Gulf area (37%) and Africa (16%). National production (1,4Mt) is concentrated in the Parisian and Aquitanian basins.
- The French economy is very vulnerable to the oil, namely in the transport sector.

COAL

- In 2003, France imported 11,4 Mtep of coal, mainly from Australia (25%), South Africa (22%), Columbia (13%) and USA (11%).

NATURAL GAS

- In 2003, France imported 496,7TWh of natural gas, mainly from Norway (30%), Russia (24%), Algeria (22%) and Netherlands (16%).
- The natural gas use has been growing rapidly over the last three decades. Its usages are mostly on electricity generation.
- All professional clients are allowed to choose their gas supplier since the 1st July 2004. The market will be completely opened on the 1st July 2007.
- A number of potential competitors of the State-owned natural gas supply company Gaz de France (GDF) exist, but GDF has a vastly dominant position in the downstream gas industry and enjoys a significant incumbent advantage.

NUCLEAR

- France has the highest share of nuclear power in the world (77,6% of its electricity needs; 420TWh in 2003) and the second biggest production capacity (after the USA).
- The management of the nuclear fuel cycle is one of the main concerns of the French energy policy.
- France wants to maintain its high competences and invested 445 millions euros per year between 1992 and 2001 for R&D in nuclear fission technologies.

- Framatome, Cogéma and CEA-Industries merged in September 2001 to form the new company Areva, which become one of the largest operators in the nuclear industry worldwide. Areva recently sold a 1,6GW power generator with technology EPR (European Pressurized water Reactor) that should be operational in 2009.

ELECTRICITY

- In 2003, 77% of the electricity production in France was from nuclear, 12% from hydro and 10% from coal.
- France exports about 2% of its electricity production.
- EDF produces about 90% (500,3 TWh) of French electricity production, and is responsible for distributing 92,9% (401 TWh) of the consumption. Its status changed from EPIC (Public) to Anonymous Society in June 2004.
- All professional clients are allowed to choose their electricity supplier since the 1st July 2004. The market will be completely opened on the 1st July 2007.
- Under its obligation to guarantee energy safety, the government decides a long-term investment programme for electricity production. It fixes ranges of capacity for different technologies that it would like to develop within a certain date. To reach its goals, the government is then allowed to refuse building permits or at the contrary make calls for tenders.

CLIMATE CHANGE

- France is committed under the Kyoto protocol to maintain CO_2 emissions at their level of the year 1990. Though in 2001, the total emissions of greenhouse gases approximated their 1990 level, the CO2 emissions from the energy sector raised by 9,1% between 1990 and 2001 and should continue to rise, due to a continuous increase in the transport and residential sectors.
- The first strategy published in 2000 won't be sufficient to reach the Kyoto target. Another climate plan should be published by the year 2004.
- The government already announced its will to maintain the energy final consumption at its 2003 level in 2015 (especially by introducing a system of white certificates), have up to 10 000MW from wind energy installed by 2010 and reduce CO_2 emissions by 75% in 2050.

RENEWABLES

- About 6% of the total French primary energy production comes from renewables.
- Apart from hydro energy, biomass has strong importance in the French energy balance.
- France needs to reach a target of 21% of renewable electricity by 2010.
- In 2004, France had 280 MW of wind installed capacity.
- France has a heading in its energy policy of providing more support to renewables and find a way to better integrate them in the regional energy generation.

POLICY RECOMMENDATIONS

The Government of France should:

- Continue to reform its legislation, procedures and institutions to adapt French energy policy to the challenges of the future, namely competition, energy security and climate change.
- Avoid further concentration of the French energy market.
- Determine the conditions under which the State and the local collectivities could promote the rational use of energy actions as well as renewable energies after studying the respective energy needs.

- Be prepared to go beyond the minimum provisions of the EU Gas Directive in terms of eligibility and market opening.
- Care about having more renewable energy developments and management of the renewable energies fuel cycles.
- Proceed with diversification of energy sources as well as technologies, opening the energy markets and energy taxation reform.
- Implement the spirit of the Electricity Directive as quickly as possible by putting in place practical arrangements to ensure that suppliers can compete with EDF on fair terms.
- Control emissions at local level (including nuclear residues).
- Push forward the liberalization of the electricity and gas markets.

Sources:

Direction Générale de L'Énergie et des Matières Premières – Observatoire de l'Énergie; La Politique Énergétique Française; Ministère de L'Économie des Finances et de L'Industrie, 2002.

ADEME; Pour une Politique Ambitieuse de Maitrise des Consomations d'Énergie – Les perspectives énergétiques nationals à 2010.

IEA; Energy Policies of IEA Countries – France – 2000 Review, IEA, 2000.

IEA; France – Standard Review 2002, IEA, 2002

IEA; Country Statement on Recent energy Policy Development (Standing Group on Long-Term Cooperation June 2004) – France, IEA, 2004

Direction Générale de L'Énergie et des Matières Premières – Observatoire de l'Énergie; Le charbon en France: les principaux résultats 2003; Ministère de L'Économie des Finances et de L'Industrie, 2004.

Direction Générale de L'Énergie et des Matières Premières – Observatoire de l'Énergie; Le pétrole en France: les principaux résultats 2003; Ministère de L'Économie des Finances et de L'Industrie, 2004.

Direction Générale de L'Énergie et des Matières Premières – Observatoire de l'Énergie; Le gaz naturel en France: les principaux résultats 2003; Ministère de L'Économie des Finances et de L'Industrie, 2004.

Direction Générale de L'Énergie et des Matières Premières – Observatoire de l'Énergie; L'électricité en France: les principaux résultats 2003; Ministère de L'Économie des Finances et de L'Industrie, 2004.

Direction Générale de L'Énergie et des Matières Premières – Observatoire de l'Énergie; Les énergies renouvelables en France: les principaux résultats 2003; Ministère de L'Économie des Finances et de L'Industrie, 2004.

www.industrie.gouv.fr/cgi-bin/industrie/frame0.pl?url=/energie/sommaire.htm

www.suivi-eolien.com

GERMANY

MAIN HIGHLIGHTS

- Germany has ambitious targets to reduce green house gas emissions.
- Phase out nuclear power plants by 2025;
- Energy efficiency, conservation, cogeneration and renewables, as well as fossil fuels will play a role in replacing the nuclear plants being discommissioned.
- Germany is the largest electricity market in Europe.
- Energy security is an important issue for Germany as the country has limited indigenous energy resources.

MAIN CONCERNS

NUCLEAR ENERGY

- Germany will gradually phase out nuclear power plants until 2025, without direct costs to the Government.
- Nuclear power now covers 30% of electricity generation and 13% of total primary energy supply.
- Nuclear phase-out policy will not relieve Government and industry in the near future of the responsibilities they now carry for the ongoing nuclear programme. Competence will be needed to maintain for decades safe management of radioactive waste disposal.

NATURAL GAS

- Germany is the second largest European natural gas market after the UK, and one of the countries that have fully liberalized their gas markets.
- The gas supply base is diverse, with domestic production accounting for 22%. Currently there are about 750 companies operating in the German gas sector; however there is a trend for consolidation of electricity and gas markets.

OIL

- Gasoline consumption has decreased somewhat in the transport sector in the past years.
- Oil accounts for almost 39% of the primary energy supply in Germany.
- Almost all oil is imported, from diversified sources (25% from Russia).

COAL

- The German Government wishes to maintain a significant coal-based electricity generation capacity to avoid over-dependence, and associated supply and price risks, on imported energies.
- The policy for hard coal is also closely related to social, regional and employment policies. Because of its poor competitiveness, domestic hard coal receives a significant, but declining, amount of subsidies.
- Lignite production does not receive subsidies. Lignite power plants, however, are currently protected by legislation prohibiting new entries in the New Laender.

RENEWABLES

- In 2000, the share of renewable energies in primary energy supply was 3,4% and in electricity generation 7,3%.

- The Renewable Energies Act of April 2000 aims at doubling the share of renewables in total energy supply by 2010 compared to 2000 level. Germany should generate 12,5% of its electricity from renewable energy by 2010.
- During the 90's, wind power was greatly developed and Germany has become the world leader in this area, with 14 609 MW of installed capacity by the end of 2003.
- Germany has also ambitious targets for off-shore wind power.
- Renewables are both supported by subsidies and feed-in tariffs.

CHP

- Electricity produced in combined heat and power plants (CHP) accounts for 12% of total electricity supply.
- The last cogeneration act of April 2001 allows CHP operators, who are feeding in electricity into the transmission network to receive bonus payments in addition to the revenue at market prices, provided that requirements for the power-to-heat ratios are fulfilled.
- No direct subsidies are given to CHP.
- Possibilities for connecting more consumers to existing district heating networks should be explored to improve their competitiveness.

ELECTRICITY

- Germany is the largest electricity market in Europe
- The electricity market has been fully liberalized since 1998
- There is no sectoral regulator for electricity.
- One concern is the lack of unbundling of the retailing and distribution functions of companies operating at the lower voltage networks as this can permit abusive behaviour.

R&D

- The primary objective of R&D is to support energy policy, and the secondary one is to support industrial development and economic growth.
- Many different aspects of energy policy will demand technological innovation: phase-out nuclear plants, large scale use of renewable energies, climate change goals…

SPECIFIC FEATURES

- In the industrial sector the emphasis is on voluntary measures, such as voluntary agreements and third party financing. However, all new buildings > 12 °C, industry buildings, too, have to comply with the EnEV.
- The housing sector relies mainly on regulatory measures. The one key challenge in this sector is to reduce energy consumption in existing buildings as there are only one regulatory measure at the moment concerning the efficiency of the boiler. However, a considerable number of new home-owners are interested to go further than what the regulatory measures requires. Low-energy houses, passive houses or 3-litre houses are sold because of this interest (supported by funding by the government).

POLICY ISSUES

Among others, German energy policy issues to be addressed are:

- Evaluate the cost-effectiveness of the measures used to achieve all the energy and environment policy objectives.
- Put in place a long-term stable energy policy framework giving a higher priority to energy security through the market mechanism.

- Develop strategies for managing the evolution of GHG emissions beyond Kyoto target years
- Analyze the possibilities of supplementing domestic measures with Kyoto Flexible Mechanisms
- Review and reform energy taxes and eco-tax system to better reflect the externalities of each source of energy.
- Ensure energy intensity continues to decrease and energy efficiency continues to improve
- Enhance measures to address energy efficiency in buildings
- Develop national energy efficiency strategy for the transport sector
- Continue to reduce coal subsidies
- Ensure non-discriminatory, transparent and simple arrangements for access to gas transmission and distribution networks
- Reinforce the resources and power of the Federal Cartel Office and the task force for network access to ensure anti-competitive practices.
- Facilitate access to supply by promoting the liquidity of the gas market
- Continue to monitor concentration in the gas market to avoid further dominance of major players
- Monitor the cost impact of policies that indirectly subsidize renewables
- Reinforce efforts to make the rules for network access fair
- Consider options for separating network operation from other activities
- Avoid dominance of market players in the electricity sector
- Ensure no cross-subsidization and discrimination between distribution and retailing business of electricity
- Facilitate cross-border trade and interconnection
- Promote CHP
- Clarify the role of R&D in light of nuclear phase-out
- Develop R&D for clean coal technologies.

Source: IEA; Energy Policies of IEA Countries – Germany – 2002 Review, IEA, 2002.

GREECE

MAIN HIGHLIGHTS

- Greece depends heavily on imported energy, especially oil.
- Lignite is the only major domestic fuel, is extensively used for power generation and is a major responsible for CO2 emissions and air pollutants.
- Electricity is expected to be just tight to respond to demand over the next years.
- The Greek Government is intending to diversify the supply sources through the increase of gas, oil and electricity connections with neighbouring countries.
- Gas to power generation and to other activities is being promoted.
- Well-designed markets need to be created in the electricity and gas markets.
- There is a strong potential for energy efficiency and energy saving measures in all sectors.

MAIN CONCERNS

NATURAL GAS

- Greece successfully introduced natural gas in its energy mix in 1996.
- In 2000, natural gas accounted for 6,1% of primary energy supply and with an increasing trend.
- Natural gas has already some use in power generation and replaced some oil-use in industry.
- The most of the growth demand for natural gas is expected to come from power generation and residential and services sector.
- The current gas infrastructure is sufficient to meet next years demand, however, it would be wise to increase the LNG regasification capacity, storage capacity and to improve the supply links through Italy and Turkey.
- The natural gas market is still in a very early stage of liberalization, under the derogation clause of an emerging market until 2006 of the EU gas Directive.
- The gas-fired power plants that are planned will not be commissioned by 2005-2006.

COAL

- Low quality lignite accounts for 82% of Greece's indigenous energy production and 64% of its electricity supply.
- While lignite use contributes positively to energy security of supply, it is also an environmental threat.
- Retrofit plans are in place to restore the lignite mines.
- Investments are being made to use state-o-the-art lignite technologies in new power generation plants.
- The Greek State owns all the lignite deposits and the Public Power Corporation had the exclusive rights to mine lignite.

OIL

- Greek oil demand is forecast to grow about 40% between 2000 and 2010.
- Although proceeding slowly, the project of an oil pipeline between Greece and Bulgaria is advancing.
- Although the oil market has been largely liberalized, products may only be imported by refineries, oil marketing companies and few large oil users, for stockholding obligations.

- In a way to respond to the increasing oil demand, Greece will be obliged in future to stock larger oil quantities.
- To avoid market distortion and to stimulate competition, direct imports of crude oil and oil products should be allowed and non-discriminatory access to oil storage facilities should be ensured.

RENEWABLES

- The 1995 Climate Action Plan established a target for increasing the share of renewable energy in primary energy supply to 10% by 2000.
- The target was not achieved, and the actual renewables share was 5,2% in 2000.
- The new indicative target is to generate 20,1% of electricity by renewables in 2010.
- The licenses procedures for renewables are still too complex.
- The most significant renewable potential in Greece is solar and wind energy.
- Currently renewables are promoted through financial incentives: tax breaks, direct subsidies and a feed-in tariff system.
- The exploitation of geothermal energy is an exclusive right of the state though it can assign this role to private investors

ELECTRICITY

- The consumption per inhabitant is around 76% of the UE average, hence the increase in electricity demand should continue. Even if the production capacity had increased of 30% since 1985, the supply is tight considering the expected evolution of demand, especially in dry years. The regulator (RAE) predicts an annual rhythm of peak demand of 5% between 1995 and 2005.
- The electricity is produced from coal (64%), hydro (7%), imported oil (15%) and natural gas (13%). The former monopoly, DEH, stills owing 98% of the installed power capacity in Greece and controls 49% of the electricity transporter (DESMHE SA; the state controls the other 51%).
- Since transmission lines are also capacity limited, trade with neighbouring countries can have only a very limited impact.
- It is urgently needed to reform the electricity market and new investments made by new entrants.
- An electricity tariff adjustment could be a possibility in abating these problems.
- About 34% of the Greek electricity market was opened to competition in February 2001 – the minimum requirements of the EU electricity Directive.
- Not many new entrants are expected in the near future.
- Greece expects to establish a south-east European Electricity pool that could increase competition in the long-term.

SPECIFIC FEATURES

- The institutional framework for market liberalization is already in progress and there is a Regulatory Authority for Energy established since 2000, as an independent agency with a mixed advisory and decision-making role.
- The Regulatory Authority for Energy gives an opinion in the definition of codes, regulations, end-user tariffs and licensing for generation.
- The energy markets in Greece are dominated by highly integrated state-owned enterprises.
- In 1995 Greece introduced the "Hellenic action plan for the abatement of CO2 and other green house gas emissions". It was set a target for the year 2000 of between 12% and 18% emissions (CO2, N2O and CH4) above the 1990 level.
- Under the agreement to meet the Kyoto Protocol target for 2000-2012, Greece's greenhouse gas emissions are expected to be at most 25% above the 1990 level.
- Energy intensity in Greece is a serious matter as it exceeds the European average and with an increasing trend.

- Significant potential for energy saving is available and some measures are self-financing and might not need to rely on subsidies.
- Third party financing and voluntary agreements in industry form a great potential for energy efficiency interventions and demand side measures.
- In the residential sector there is a large potential for energy saving, namely through the introduction of tighter energy building codes, building energy certificates and information campaigns.
- There is a potential in changing electricity tariffs either to influence the promotion of renewable energies and strengthen the competition.

R&D

- Greece actively participates in the EU research programmes but there is still room for further developments.

POLICY RECOMMENDATIONS

The following actions are recommended for the Greek Government:

- Continue to diversify energy supply and energy sources through reinforcement of connections and renewable energies.
- Enhance efforts to promote real competition in energy markets.
- Pursue social objectives through energy taxation and pricing.
- Complete the implementation of the National programme for Green house gas emissions.
- Place more focus on demand side measures
- Ensure that environmental costs are reflected in energy prices.
- Continue the efforts to reduce the environmental impact of lignite use and mining.
- Create an energy efficiency policy framework.
- Continue to diversify the oil sources of import
- Encourage the development of natural gas infrastructures
- Advance its commitment to liberalize the gas markets and encourage private investment.
- Exploit the cost-effective potential of renewables, namely in islands.
- Simplify the licensing process of renewables.
- Continue efforts to develop the south-east electricity market.
- Continue to encourage the participation of industry in R&D.

Source: IEA; Energy Policies of IEA Countries – Greece – 2002 Review, IEA, 2002.
IEA; Report on Notable Energy Development in Greece, IEA, February 2004
MINEFI – DREE/TRÉSOR; “Electricité (production, transport et distribution)”, February 2004
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www.minenv.gr

IRELAND

MAIN HIGHLIGHTS

- Appart from Luxembourg the Irish energy market is the smallest in the EU.
- Ireland spends 7 billion Euro per year in energy, most of which is imported.
- Ireland has a lack of substantial domestic energy resources and a high level of imports.
- Ireland has initiated the reform of both electricity and gas markets and a regulatory body has been put in place.
- A rapid increase in energy demand has been shown as a consequence of an impressive level of economic growth over the last years.
- This high demand has occasionally strained the country's energy infrastructure and has increased Ireland's energy security of supply concerns.
- In 2000 only 15% of the country's energy came from indigenous resources.
- The lack of extensive international energy connections also exacerbate Ireland's vulnerability to supply disruptions and/or price spikes.
- Irish National Allocation Plan for CO2 had been accepted unconditionally by the European Commission. It allows 67 millions tones of CO2 for 143 companies qualified for trading on the 1st January 2005.

MAIN CONCERNS

COAL

- Coal and peat play an important role in the country's energy mix. Together they account for 18% of total primary energy supply and over 36% of electricity generation.
- Both peat and coal are of high carbon content with the corresponding CO_2 emissions when used but they provide some security of supply as peat is domestically borne and Government subsidised.
- The largest single measure is to shut down or fuel switch the coal-fired power station. This measure would account for 22% of the total GHG emission reduction expected.

NATURAL GAS

- The reform of the natural gas is also moving in the right direction. From 1st January 2003, 85% of the market (in volume) can now choose their own gas supplier.
- The production from a new domestic gas field has been sold to a new entrant who will use this gas to compete in the Irish market. Another gas field is scheduled to come in line in 2005, creating further possibilities for competition.
- Ireland could use natural gas to generate up to 80% of all its electricity by 2010.
- The construction and commissioning of a new sub-sea natural gas pipeline from UK shows not only the ways in which energy security can be enhanced but the costs involved in such measures.
- Gas demand has not however been growing as expected and new gas pipeline (the second from UK) might only be needed by 2005.

RENEWABLES

- While renewables do not currently make a substantial contribution to the country's energy mix, there is a large potential, particularly in the form of wind power.
- Ireland has taken steps to encourage renewables use, primarily through an auction process which offers long term power purchase agreements to buy electricity from renewable sources.

- The Irish national Development Plan has an objective of achieving further 500 MW of additional renewable energies capacity until 2010.

CHP

- Historically Ireland always had low levels of CHP use, but Government is now trying to increase its use.
- The absence of any heat distribution infrastructure as well as the limitations to the existing natural gas grid, low population density and difficulties in financing have contributed to this lack of CHP use.
- The NDP has a budget of 5 million Euro in a programme aiming to build greater awareness of the impacts and benefits of CHP.

ELECTRICITY

- The market reform of the electricity sector began with the Electricity Regulation Act. Ireland envisages 100% of market opening by 2005.
- A number of obstacles remain before Ireland can fully benefit from the reform of the electricity sector. One has been the lack of interest from viable committed new entrants, and another the small size of the market.
- ESB is still the most powerful influence towards the transmission system planning and currently owns 85 to 90% of the total Irish generating capacity.
- The current arrangement for separation of grid operation and ownership should be carefully monitored.
- New electricity generation is needed in the short term – possibly in 2004 or 2005. Given the long lead times for developing and building large power stations, it is unlikely that a fully independent power plant will be on line in time to address this comming need.
- A budget of 67 million Euro is being allocated to a grid upgrade development plan with a target of 260 MW of additional clustered connection capacity.

SPECIFIC FEATURES

- Demand side management is being looked at as it would reduce the need for new capacity.
- Passage of the country's National Climate Change Strategy in November 2000 was an important step towards addressing the country's climate change challenges.
- Ireland must limit the net increase of its greenhouse gases emissions to 13% above 1990 level by 2008-2012.
- It is believed that Kyoto Flexible Mechanisms will be needed to reach the country's target.
- Ireland has improved significantly its energy efficiency over the last years with energy intensity falling one-third from 1989 to 2000.
- Transport may provide the best opportunity to improve energy intensity, since an increase in energy use in this sector coincides with the need for a new transportation infrastructure.
- The residential sector accounts for almost 30% of Ireland's related CO_2 emissions. There is a specific plan stimulating the uptake of sustainable energy practices in buildings, accompanied by a "fuel poverty" campaign.

POLICY RECOMMENDATIONS

The Governement of Ireland should:

- Develop a long-term strategy for optimal energy supply mix striking an appropriate balance between energy security and climate change mitigation, noting a rapid share of the natural gas in the electricity sector.
- Review ESB's role in the liberalized electricity sector to address the impression that the company could unfairly influence the market to the disadvantage of new entrant competitors.
- Facilitate the penetration of wind energy into the electricity system by making examining the issues of system frequency stabilization and back-up power that arise with substantial wind power use.
- All support schemes to renewables are market-based and include proper incentives to reduce costs.
- Ensure that greenhouse gas mitigation measures cover all energy and non-energy sectors and reflect the externalities for each source.
- Continue to explore cost-effective mechanisms to promote CHP.
- Continue the process of strengthening the transmission grid.
- Invest in new generating capacity or through an independent power producer.
- Evaluate the role of coal in the energy mix, striking a balance between energy security and greenhouse gas mitigation.

Source: IEA; Energy Policies of IEA Countries – Ireland – 2002 Review, IEA, 2002.

Sustainable Energy Ireland; Five Year Strategy; National Development Plan, 2002.

ITALY

MAIN HIGHLIGHTS

- The public sector has a large role in the Italian energy industry. ENI and ENEL still have a dominant position in the energy industry.
- The Government is implementing numerous measures to liberalize and to increase the efficiency of the energy sector.
- High energy prices, a mild climate and Italy's small number of energy intensive industries contribute to the low level of energy consumption and CO_2 emissions in comparison with GDP.
- The Government has issued a plan to reducing CO_2 emissions in order to comply with the Kyoto commitments.
- Over the past decade energy's dependence of Italy has raged between 80 and 85%.
- Electricity consumption per GDP is much lower in the south than in the north.
- Italy is the member of the EU, which received the largest amount of loans from the European Bank for investments in the energy sector between 1995 and 2000. The total amount reaches 3.3 billions euros, a quarter of the loans conceded. They were used mostly for modernization of the petroleum installations, especially for environmental matters.
- Since the petroleum crisis, Italy promotes a policy of rational use of energy. In 2004, the authorities target to reduce the energy consumption by 2,9Mtep before 2006 (1,6Mtep in the electrical sector) using a system of White Certificates.

MAIN CONCERNS

NUCLEAR ENERGY

- In 1987, by referendum, nuclear energy was phased out in Italy.

NATURAL GAS

- Italy produces oil and natural gas, though both only cover 9% of its energy needs (in 2001). The removal of unnecessary barriers to oil and gas exploration and production would increase domestic production and enhance security of supply.
- Natural gas consumption has increased rapidly and import sources are being rationalized.
- Natural gas has been replacing oil and coal in the final consumption.

OIL

- Oil still remains the most important fuel in Italy's energy supply, corresponding to 48% of its energy total consumption. This proportion should decrease to reach 45% in 2005, 41% in 2010 and 39% in 2015, oil being replace by alternative energies especially natural gas.
- In the domestic oil sector, competition should enhance security of supply.
- The Government has taken steps to rationalize the downstream oil sector and should continue to ensure the development of effective competition.

COAL

- Coal production is actually negligible

ELECTRICITY

- The prices are particularly high and Italian consumers pay their electricity 30% above the European average.

- Since the 1st july 2004, all non-residential users are free to chose their supplier. The opening rate of the market is consequently around 78%.
- The liberalization process put an antitrust limit (50% of the national offer), hence obliging the historical operator Enel to cede parts of its production capacity. Though, in 2002, the market is still dominated by Enel (46,5% of the production). Edison and its partners represent 17,6% of the production, EndesaItalia 7%, Acea and Interpower 2,9%.
- The sector suffers from important difficulties in organizing the market. Due to dissensions on decision repartition between central and regional authorities, the rules are unstable and sometimes contradictory.
- This incertitude for investment, combined with strong local oppositions, leads to a situation of low capacity for production and transport. The general blackout on the 28th September 2003 pointed out the weakness of the electrical system.
- Italy is the world biggest electricity importer. Indeed, due to the mostly old and costly production structure, imported electricity is cheaper, especially for industrial consumers in the North. Importations come mostly from France (70%) and represent nearly 16% of the total electricity consumption.
- The Italian power exchange, Ipex, had been launched in April 2004. But due to the insufficient supply compare to demand, Enel keeps its place of price maker and prices are much higher than the European average. They reached 67,84€/Mwh in June 2004, while by comparison the average price on the French Powernext for the year 2003 was 29.35€/MWh.

RENEWABLES

- Energies from renewable sources have increased significantly since 1990, mostly because of high buy-back tariffs for electricity.
- The government has set ambitious targets for energy production from renewables as one of its measures to reduce CO_2 emissions. On the 31st January 2004, a decree implementing the European directive 2001/77/CE sets a national reference framework for the promotion of renewable energy sources particularly for their use in micro-generation plants.
- Italy implemented a system of Green Certificates. Producers have to include 2% of renewables in the electricity emitted to the grid. This rate increases by 0.35% per year for the period 2004-2007.

SPECIFIC FEATURES

- Energy efficiency can be improved in many sectors and measures should concentrate on being cost-effective.
- Specific measures are needed to improve the use of public transportation.
- Most of the energy-related CO_2 emissions come from oil combustion. Emissions from natural gas use have been increasing while from coal have been decreasing.

POLICY RECOMMENDATIONS

The Government of Italy should:

- Continue to monitor the evolution of the gas market to ensure security of supply.
- Continue to increase the competition in the oil, natural gas and electricity sectors.
- Promote the increase the share of public transportation.
- Continue to implement EU directives on electricity, gas, buildings, electrical appliances, etc.
- Reduce the losses in the electricity and gas transmission and distribution grids.
- Continue to seek the most cost-effective ways of promoting renewable energies and avoid distortions in competition.

- Integrate the policies of energy – environment – employment, etc.
- Strengthen the role of communes, provinces and regions in energy policy.
- Promote training and information on energy efficiency and renewable energies.
- Improve the energy research field.

Source: IEA; Energy Policies of IEA Countries – Italy – 1999 Review, IEA, 1999.
IEA; New Energy Developments in Italy, IEA, 2004
MINEFI – DREE/TRESOR; Le secteur électrique en Italie, MINEFI, July 2004
MINEFI – DREE/TRESOR; Le pétrole en Italie, MINEFI, July 2003

LUXEMBOURG

MAIN HIGHLIGHTS

- Luxembourg is one of the smallest EU-25 countries.
- Energy consumption per inhabitant is high because of country's iron and steel industry, the large sales of transport fuel and the overall wealth of the country.
- Domestic energy resources are limited to renewable energies and the country has a dependence of over 99% on imported energy.
- Luxembourg's energy markets are greatly influenced by the energy policies and energy markets of surrounding countries.
- The Kyoto target is of 28% reduction in greenhouse gases emissions to Luxembourg, to 1990 levels by 2008-2012.

MAIN CONCERNS

OIL

- Luxembourg is totally dependent on oil products imports. The oil market consists only on retailing.
- Oil arrives mainly via Belgium (82%) and Netherlands (7%).
- Final energy consumption in the transport sector grew by 87% between 1990-2000. One of the key factors in this growth was the gap in excise taxes on oil products between Luxembourg and its neighboring countries, leading to increased purchases of car fuel by foreigners. The ECOFIN agreement on the 21st march 2003, harmonizing taxation on energy within the EU before 1st January 2012, should put an end to this tendency.
- The government sets price ceilings to avoid inflation.

NATURAL GAS

- Luxembourg is totally dependent on natural gas imports.
- Natural Gas supply increased by 56% in 1990-2000. It increased by 36% between 2001 and 2002, substantially because of the starting of a new CCGT plant in Esch-sur-Alzette in may 2002.
- Since 1st October 2003 the market is opened for customers over 5 millions m^3 per year, (74% of the market in volume).
- Imports are being diversified in order to increase Luxembourg's security of supply.

ELECTRICITY

- 90% of the electricity consumed in Luxembourg is imported until 2002 when a combined cycle power plant came into operation.
- Since 1st July 2004 all clients with an annual consumption over 1GWh (approximately 30000 clients) are allowed to choose their supplier. This means a market opening of about 85%. The market should be completely liberalized on the 1st July 2007.

RENEWABLES &CHP

- Electricity generation from renewables and cogeneration expanded rapidly because of generous buy-back tariffs and direct subsidies.
- The directive 2001/77/CE says that Luxembourg should cover 5,7% of its electricity needs from renewables by 2010. It currently reaches 2,6%.
- With installations on the two main rivers in the country, the Moselle and the Sûre, the potential for hydraulic energy reached its maximum.

- Solar thermal energy is being used on swimming pools and sports centres.
- A few applications of solar photovoltaic exist namely for vehicles re-charging.
- A wind energy map is already completed. The ministry of environment gives subsidy for wind energy since 1st January 2001.
- Domestic users can decide of the share of *Green Current* (produced: 10% from gas cogeneration, 1% from photovoltaic, 1% from wind energy, 2% from biomass and 86% from hydro) that he wants to consume, for which he will have to pay 2,5 €c/kWh.

SPECIFIC FEATURES

- Some municipalities are directly engaged in electricity and natural gas distribution activities.
- Energy efficiency has been seriously taken since 1993 supported by a series of decrees and energy taxes.
- The restructuring of iron and steel industry led to a sharp reduction in CO_2 emissions and other pollutant emissions in Luxemburg.

POLICY RECOMMENDATIONS

The Government of Luxembourg should:

- Continue to cooperate with neighboring countries on energy issues namely in electricity and gas liberalization.
- Follow closely the programmes on promotion of energy efficiency in buildings.
- Develop and implement a concrete climate change mitigation plan towards Kyoto Commitments.
- Continue to seek solutions in regional level (with neighboring countries) to reduce energy consumption in the transport sector.

Source: IEA; Energy Policies of IEA Countries – Luxembourg – 2000 Review, IEA, 2000.
IEA; Luxembourg – Standard Review, IEA, 2002.
MINEFI – DREE/TRÉSOR; “L’électricité au Luxembourg”, MINEFI, August 2003
MINEFI – DREE/TRÉSOR; “Le pétrole au Luxembourg”, MINEFI, August 2003
MINEFI – DREE/TRÉSOR; “Le gaz naturel au Luxembourg”, MINEFI, August 2003

THE NETHERLANDS

MAIN HIGHLIGHTS

- The potential tension between the search for low energy prices through competition and environmental imperatives is quite visible.
- The Dutch are generally very environmentally minded and the government is setting very ambitious targets for carbon dioxide emissions, energy efficiency improvements and the share of renewables in the energy mix.
- Competition is being introduced both in power and gas industries and it is expected full introduction by July 2004.
- The power generation in the Netherlands is almost dominated by the use of fossil fuels.

MAIN CONCERNS

NUCLEAR ENERGY

- There is a small amount of nuclear (only 450 MW) and there is a strong public resistance to the use of nuclear.
- There is a government intention to shut down this reactor by 2004. But there are some "forces" trying to keep this plant, in the province of Zeeland (Borsele), open.

NATURAL GAS

- The Netherlands has one of the major gas fields in EU – 15 (field Slochteren).
- The Dutch government has the challenge to preserve the small field's policy in the potentially highly competitive new gas market. The preservation of nature (Waddenzee) is hereby a difficult political issue.
- The Netherlands also imports gas from Russia.
- Natural gas has one of the highest penetrations in the market among the world countries.

OIL

- There are very small oil fields in the Netherlands.
- Rotterdam and Amsterdam are two large harbours that receive the oil and coal products for the whole Europe.

COAL

- Dutch prices for the imported coal are among the lowest in Europe.

RENEWABLES

- The country aims to increase the share of renewables from 1 per cent in 1995 to 5% in 2010 and 10% in 2020.
- There is a target of 12 PJ of solar thermal energy supply by 2020 and 10 PJ of solar photovoltaic by the same year.
- Since the opening of the Dutch retail market for renewable electricity in July 2001, the number of its customers has increased from about 250,000 to approximately 1,4 million in January 2003, mainly due the favourable fiscal incentives for renewable electricity production and consumption and further stimulated by the growth of the European green certificate market.

- Under the EU Renewable Electricity Directive, the Netherlands was allocated an indicative renewable electricity target of 9% in 2010.
- Because of the country's geography, the use of hydropower for electricity generation is almost impossible.

CHP

- Flower and plant growers account for a significant amount of CHP production using natural gas.
- There are some ten large municipal district-heating plants (Rotterdam, Utrecht, Amsterdam, Almere and others).
- It is foreseen a total capacity of 15 000 MW by 2010. At 1997 already 7 800 MW was in place.

ELECTRICITY

- Competition was introduced in 1998 for big consumers (market full open by July 2004).
- There is strong trade as well as foreign direct investment.
- Although the existence of overcapacity of power generating in the Dutch market, the demand for imports is such that interconnected capacity is oversubscribed.

SPECIFIC FEATURES

- To meet its climate change commitments, the country must reduce its greenhouse gas emissions from 1990 levels by 6% until 2008-2012.

POLICY ISSUES

Among others, Netherlands's energy policy issues to be addressed are:

- Maintain the current balance between economic efficiency goals and environmental considerations.
- Continue to closely monitor the energy market and emissions trends and continue to respond to them in a flexible way.
- Maintain its policy in liberalizing the gas market and encourage the gas companies to continue their adaptation to competition.
- Work towards a solution to long-term security of supply and awareness of protection of the small consumers.
- Ensure that no further concentration occurs in the electricity generation market.
- Closely monitor competition in the generation market.
- Closely monitor the expansion of CHP.
- Ensure that grid development allows a fully open market, in particular with respect to cross-border trade.
- Maintain its research and development policy according to its overall energy policy objectives.

Source: IEA; Energy Policies of IEA Countries – The Netherlands – 2000 Review, IEA, 2000.
Water, A. F. J. van de; Bosselaar, L.; Lysen, E. H.; The Netherlands Policy on Solar Energy, Recent Progress and the Role of Utilities. NOVEM.
Sambeek, E. J. W. van; Thuijil, E. van; The Dutch Renewable Electricity Market in 2003. Energy Research Centre of the Netherlands, 2003.

PORTUGAL

MAIN HIGHLIGHTS

- Portugal has an imported energy dependence of over 85%.
- Portugal has been implementing a policy of liberalization of the energy markets, ensuring security of energy supply and further introduction of renewable energies.
- Portuguese energy companies are being restructured and privatized.
- An Iberian electricity market is under preparation.

MAIN CONCERNS

NATURAL GAS

- Portugal is doing efforts to diversify the energy sources namely by the introduction of natural gas.
- From 2003, Portugal will receive gas both by pipeline and by a LNG terminal.
- Gas was first used for electricity generation (in a combined cycle power plant), being since then expanded to industry and the tertiary sectors.
- Because Portugal is an emergent gas market, European legislation permits the introduction of competition to be delayed for ten years after the beginning of gas supplies. Therefore, Portugal has until 2008 to introduce competition in the gas market.

OIL

- In the early 1990's the Portuguese oil sector experienced major changes: competition was introduced in a short time frame, in parallel with the privatization of Petrogal.
- Price ceilings protect consumers from abuses.

RENEWABLES

- All of Portugal's energy production is from renewable energy.
- Currently there is a target of implementing up to 7 000 MW of renewable energy projects until 2010. Most of this capacity will be sought by the use of wind energy.
- Hydro is the most important among the renewable energies, however varying year by year for climatic reasons.

ELECTRICITY

- Portugal has taken a cautious approach towards the liberalization of the electricity sector.
- Because of Portugal's mild climate energy, little energy is used in space heating, however, electricity demand has been growing with the increased use of domestic appliances.
- On 20th January 2004 was signed the agreement for creation of the electricity Iberian Market (MIBEL) between Spain and Portugal. This will involve the creation of the Iberian Market Operator (OMI) that will merge the two current operators (OMEL in Spain will deal with the daily market, OMIP in Portugal will deal with futures and options) and an Iberian regulator. This market should be implemented by the year 2004. In this new market Endesa, Iberdrola, Union Fenosa and EDP will owe 75% of production capacity and 93% of distribution.

SPECIFIC FEATURES

- Improving energy efficiency is an important measure giving the sharp increase in energy demand, as well as to lower the increase in greenhouse gas emissions and to help the Portuguese companies to be competitive.
- To achieve the Kyoto target of limiting the increase in greenhouse gas emissions to 27% over 1990 levels between 2008-2012, further efforts on energy efficiency, renewable energies and cogeneration should be implemented.

POLICY RECOMMENDATIONS

The Government of Portugal should:

- Take further measures to stimulate competition in the energy sector.
- Continue to work for the development of effective, competitive Iberian natural gas and electricity markets.
- Reform the tax system to better internalize external costs of using energy.
- Start implementing the new programmes for the energy efficiency in the different sectors.
- Increase the information to energy consumers on energy efficiency measures.
- Continue to enhance and develop modern public transport in major towns.
- Ensure maximum compliance with EU Directives on labeling, buildings, etc.
- Continue to take steps in the competition in the oil sector.
- Take measures to clarify the rules for handling of bottlenecks and reinforcement of the grid when new generation/ consumption or trading requires it.
- Develop a national energy R&D strategy that is coherent with Portuguese energy policy and that encourages private companies to undertake R&D.

Source: IEA; Energy Policies of IEA Countries – Portugal – 2000 Review, IEA, 2000.
DGE, Energia Portugal 2001; Ministério da Economia, Direcção Geral de Energia, 2001.
IEA; Roundtable Report on Notable Energy Developments, IEA, February 2004

SPAIN

MAIN HIGHLIGHTS

- The Spanish energy sector changed fundamentally during the 90's. Energy demand grew rapidly with the economy.
- Internal energy resources cover about 25% of total primary energy supply and security of supply is an important issue of the Spanish energy policy.
- The electricity oil and gas markets have been liberalized.
- The main challenges are to satisfy the growing energy demand as well as to curb CO_2 emissions to meet the country's Kyoto target as well as to introduce the full liberalization of the electricity, oil and gas markets.

MAIN CONCERNS

NUCLEAR ENERGY

- Nuclear power is an important energy source. It covers about 30% of total electricity generation and 13% of country's total primary energy supply.
- The last nuclear power plant was constructed in 1988. Nuclear energy is subject to a moratorium: there shouldn't be any construction of new power plants before 2010. Though, Spain has not ruled out nuclear power as an option to future capacity needs.
- The energy plan for 2002-2011 indicates that nuclear should represent 19,4% of electricity produced in Spain by 2011.

NATURAL GAS

- The development of Natural Gas in Spain is recent and has a strong dynamism. In 2011, it should represent 22,5% of the total energy consumption (12,2% in 2000). The energy plan for 2002-2011 indicates that Natural Gas should represent 33,1% of electricity produced in Spain by 2011.
- Numerous combined cycle plants are under construction and should provide 12000MWe before 2010.
- A transmission system operator has been established and the arrangements to separating the vertically integrated incumbent are in process.
- Spain depends nearly entirely on importations (97%) and the Spanish government is making continuous effort to diversify the sources of natural gas supply, including the expansion of connections to EU grids and construction of regasification plants.
- Natural gas is subject to lower taxes than other oil products.

OIL

- There is a tax distortion between gasoline and diesel giving favor to diesel over gasoline, although the environmental externalities do not favor this option.

COAL

- There has been a steady process in restructuring domestic coal mines.
- Subsidies are still paid to domestic coal producers

RENEWABLES & CHP

- The government has strongly promoted combined heat and power and renewable energy sources. It has created a special status for electricity production from CHP, renewables, and waste under 50MW of installed power.

- The energy plan for 2002-2011 indicates that renewables should represent 28,4% of electricity produced in Spain by 2011.
- Wind energy has had a tremendous development over the last years supported on the strong technological content and the progressive reduction of unit costs. Spain has the world third largest wind capacity with 6411MW installed in 2003. Spain is considered the world most attractive country for on-shore wind energy by Ernst & Young.
- Solar photovoltaic has had a strong growth (25% per year since 1999, with an installed power of 22,2MW in 2002) and a wide application area.

ELECTRICITY

- The private company REE (Red Eléctrica de España) rules the transport, while OMEL (Companía Operadora del Mercado Español de Electricidad) is the unique pool manager. Independent from other participants, OMEL is in charge of adjusting supply with demand. The CNE (Comisión Nacional de Energía) is the regulator.
- The electrical sector still concentrated around 6 national actors, the 4 historical actors (Endesa, Iberdrola, Union Fenosa and Hidrocantabrico) and 2 newcomers (Viesgo and Gas Natural).
- Two different markets are given to the choice of the client: one regulated with a tariff fixed by law, the other one liberalized. The clients that have chosen liberalized market can come back to regulated tariff after one year.
- In 2003, the unregulated market represents 30,6% of electricity sells in Spain. From the clients entered in this liberalized market, 21% changed supplier, which represents 6,4% of the total market.
- On 20th January 2004 was signed the agreement for creation of the electricity Iberian Market (MIBEL) between Spain and Portugal. This will involve the creation of the Iberian Market Operator (OMI) that will merge the two current operators (OMEL in Spain will deal with the daily market, OMIP in Portugal will deal with futures and options) and an Iberian regulator. This market should be implemented by the year 2004. In this new market Endesa, Iberdrola, Union Fenosa and EDP will owe 75% of production capacity and 93% of distribution.

SPECIFIC FEATURES

- Spain's greenhouse gas emissions objective is set at 15% above 1990, but Spain's CO_2 emission in 1998 were already 21% above than in 1990.
- The government sees a real potential in energy efficiency measures, however the country's energy intensity slightly increased in the last years.

POLICY RECOMMENDATIONS

Spanish Government should

- Study the feasibility of emissions trading scheme.
- Continue to review supply-demand projections, especially in light of the sharp growth of demand and progress in liberalization.
- Consider how to increase the number of energy market players to stimulate competition further.
- Speed up the implementation of the national Kyoto implementation plan.
- Establish a new, coherent and comprehensive energy efficiency programme to help slow the growth in energy demand in all sectors.
- Regularly verify compliance with building codes in both new and retrofitted buildings.
- Encourage efforts to build new interconnections with neighboring countries and increase the capacity of existing ones.

- Assist in defining technical details for opening the market for small consumers and help them prepare for full market liberalization.
- Set a clear time frame for implementing legislation for increasing competition.
- Continue restructuring the coal industry, cutting subsidies and eliminate other distortions.
- Study the benefits of implementing a nation-wide green-certificate system.
- Continue support for development and demonstration of clean coal technologies.

Source: IEA; Energy Policies of IEA Countries – Spain – 2001 Review, IEA, 2001.
IDAE – Ministerio de Economia; Plan de Fomento de las Energías Renovables, IDAE, 1999.
IEA; Spain Round Table, IEA, February 2004
MINEFI – DREE/TRÉSOR; Le marché de l'électricité en Espagne, MINEFI, April 2004
MINEFI – DREE/TRÉSOR; Production et Transport d'électricité en Espagne, MINEFI, June 2003
MINEFI – DREE/TRÉSOR; L'énergie éolienne en Espagne, MINEFI, April 2004
MINEFI – DREE/TRÉSOR; Les infrastructures d'approvisionnement gazier en Espagne, MINEFI, January 2003

SWEDEN

MAIN HIGHLIGHTS

- Sweden is focusing on the development of an international market in electricity, in cooperation with the Baltic countries.
- Sweden is intending to phase out all nuclear power.
- About two thirds of Sweden energy supply comes from oil and nuclear power.
- Coal gas and peat give minor contribution to the power system.
- Under the Kyoto protocol Sweden has made a commitment to reduce greenhouse gases to 8% bellow their 1990 level by 2008-2012.
- The energy policy bill of March 2002 underline the following objectives:
    - Create the conditions for efficient energy use and cost efficient Swedish energy supply with low adverse impact on the health, environment and climate.
    - Facilitate the transformation into an ecologically sustainable society, promoting sound economic and social development in Sweden
    - Contribute to the creation of stable conditions for a competitive business sector, and to renewal and development of Swedish industry
    - Contribute to broadening the co-operation within the Baltic region with regard to energy, the environment and the climate.

MAIN CONCERNS

NUCLEAR ENERGY

- The electricity supply industry expects major reductions in nuclear capacity over the next 20 years because of competitive pressures.
- A nuclear phase out framework has been proposed by the government following a German model.

NATURAL GAS

- Natural gas is being considered a competitive alternative to nuclear power. However the natural gas grid is not largely developed in Sweden.

OIL

- Sweden imports about 35% of its energy supply, mostly oil.
- Oil accounts for about 40% of final energy consumption.

RENEWABLES

- Combustible renewables and wastes (biomass=principally woods and forest wastes) account for 17.5% and hydro 14.3% in year 2000.
- Renewables and CHP are the means to replace nuclear power capacity.
- Measures to increase the participation of renewables are being focused primarily on the use of biofuels.
- Sweden has currently a support scheme of environmental bonus tax exemptions for electricity coming from wind power, small scale hydro (<1.5 MW) or bio-fuel-fired CHP plants.

ELECTRICITY

- Low electricity prices have reduced the interest in investment in new generating capacity.
- Electricity intensity in Sweden is among the highest in the world.
- Taxes on electricity are already quite high and have been raised sharply during the last couple of years.
- Currently, electricity production accounts for 5% of the total CO_2 emissions.
- The electricity market in Sweden has been liberated since 1996 for all costumers. Since then wholesale electricity prices have fallen. However, retail level prices have gone up for residential use and down for industrial use.

SPECIFIC FEATURES

- Sweden has developed important studies on using Kyoto Flexible Mechanisms, namely in the Baltic Sea region.
- Development of alternative transport fuels to replace oil is a priority, and closer attention should be given to ethanol.
- It is planned that future reactor closures will be compensated, in part, by decreased electricity consumption – namely through replacement of electrical building heating.
- The largest proportion of the CO_2 emissions comes from the transport sector.

POLICY ISSUES

Among others, Swedish energy policy issues to be addressed are:

- Simplify the tax regime in Sweden, the balance between revenue, environmental and energy policy goals need to be clarified, and the tax regime stabilized over time.
- Implement the EU gas Directive with a view to opening the market as soon as possible.
- Address the influence of major suppliers in the gas and electricity markets on the development of the gas market.
- Facilitate the access to the system network and the development of gas infrastructure by interested parties.
- Existing nuclear capacity should be used productively pending any definitive policy on its future. A sufficient level of support should be maintained to ensure the continuing safe operation of reactors, the disposal of waste, and the attractiveness of the industry for competent new personnel.
- Harmonize cross-border transmission tariffs;
- Address domestic transmission tariff issues, including congestion;
- Address generation capacity constraints;
- Address ownership issues in the gas and electricity markets;
- Address independence of regulation.

Source: IEA; Energy Policies of IEA Countries – Sweden – 2000 Review, IEA, 2000.

UNITED KINGDOM

MAIN HIGHLIGHTS

- The UK has been liberalizing the energy sector over the last years.
- Since 1998 and 1999 all natural gas and electricity consumers are free to choose their supplier, respectively.
- The restructuring has resulted in closer integration of the gas and electricity markets, as well as other utility services: water, telecommunications and financial services.
- Under the Kyoto Protocol, UK has a target of a 12,5% reduction in greenhouse gas emissions by 2008-2012, but has also an autonomous national target of cutting its CO_2 emissions by 20% by 2010.
- The two main elements of UK policy regarding climate changes are the *Climate Change Levy* (not applicable to residential sector) and the *Domestic Emission Trading scheme*.
- The UK's Energy White paper states that distributed energy sources (micro-CHP and fuell cells) will make UK less vulnerable to security threats.
- Since 1970, overall energy consumption in the UK has increased by around 15% while the size of the economy has doubled. It future this trend should be maintained.

MAIN CONCERNS

NUCLEAR ENERGY

- Nuclear power is currently an important source of carbon-free electricity but, its current economics make it an unattractive option for new generating capacity.
- There are currently no proposals for building new nuclear power plants, but they might be necessary to meet the carbon targets.
- The report of the House of Lords recommends that the UK maintain its present ability to produce less than 20% of domestic electricity demand from nuclear.

NATURAL GAS

- There are eight major gas suppliers in the UK.
- Bottlenecks are felt as it was fetched very high bid prices in recent years.
- New pipeline constructions are needed.
- North Sea part of the UK continental shelf is now a mature province, characterized by a large number of small discoveries and undeveloped finds close to existing pipeline infrastructure.
- UK might be a net gas importer by 2005 and Norway might be the major source of gas.
- Additional gas connections are needed both pipelines and LNG terminals.

OIL

- It is expected that by 2010 UK will be a net importer of oil.

COAL

- Domestic coal production is likely to continue to decline as existing pits reach the end of their geological and economic lives.
- UK almost imports half of the coal it uses and most of the economically viable deep mined coal is likely to be exhausted in ten years.

- The government will proceed with supporting relevant research on clean coal technologies.

CLIMATE CHANGE

- UK emissions reduction target under the Kyoto Protocol is to reduce emissions by 12,5% below 1990 levels by 2008-2012. But UK government also set a national reduction goal for CO_2 of 20% before 2010.
- The *Climate Change Levy* entered in force on the 1st April 2001 and taxes energy consumption of industrial consumers, commercial and public sector.
- A domestic GHG emission trading scheme was launched in April 2002.

RENEWABLES

- The Government has implemented the Renewables Obligation that will raise the contribution of renewable energy sources to England and Wales electricity supply to 10% by 2010. It corresponds approximately to the installation of 10 000 MW of renewable energies capacity by 2010.
- It was introduced in 2002 the Renewables Obligation which requires suppliers in England and Wales to obtain an increasing proportion of electricity from renewables year on year. The share of renewables should be of 10% in 2010, with an intermediate step of 5% by 2003.
- Renewable energy generation is exempted from Climate Change Levy.
- Funding for renewables capital grants 60 million GBP, additional to the 38 million GBP of extra-funding announced in 2002 Spending Review.
- It is expected a voluntary green certificates market to emerge on the basis of this obligation.
- Developers have entered into agreements for leases wind farm sites around UK coast with a total capacity of at last 1400 MW.
- Off-shore wind industry considers a further 3000-4000 MW can be built by 2010. The current installed capacity is of about 250MW.

CHP

- The UK has 5 GW of CHP installed capacity, mainly on an industrial scale.
- The UK has a target of 10 GWe of good quality CHP by 2010. This target could save about 1,25MtC per year.
- It is expected to see a lot of micro CHP for heating and electricity generation in homes as well as businesses. Field trials will be supported to evaluate the benefits of micro CHP.

ELECTRICITY

- England and Wales have 38 major power producers and 7 large power supplier companies.
- New Electricity Trading Arrangements (NETA) replaced the Electricity Pool, which represented the decisive breakthrough towards the fully liberalized market. It has led to a decline in electricity wholesale prices of 20-25%.
- Massive construction of gas fired plants are replacing coal plants.

SPECIFIC FEATURES

- There is an intention to raise energy efficiency of buildings and businesses (by 2005 Buildings Regulation to be issued).
- There is an energy efficiency programme of fuel poverty that applies to low-income households in old poorly insulated buildings.

- A 3,2 millions GBP grant from the DTI will be used to develop fuel cell technology in a bid to make it a more efficient and economically viable energy source.

POLICY RECOMMENDATIONS

The Governement of the UK should:

- Ensure secure, diverse and sustainable energy supplies at competitive prices.
- Consider carbon taxation for households.
- Modify the Climate Change levy to accommodate the carbon content of fuels.
- Consider extending voluntary agreements to cover all larger industries and consider including small and medium-sized industries.
- Review the practical potential of energy efficiency policies to curb energy consumption and CO2 emissions with special emphasis on transport sector.
- Implement the reforms relating to renewables .
- Revise the upstream taxation system to ensure an optimal exploitation of the North Sea resources and standardize off-shore regulation.
- Give incentives to eliminating bottlenecks of gas transportation.
- Encourage full participation of demand side in the balancing market.
- Seek consistency in the regulation of gas and electricity networks
- Take pro-active attitude in the design and implementation of national policy for the decommission of nuclear power plants and fuel cycle facilities and disposal of radioactive waste.

Source: IEA; Energy Policies of IEA Countries – United Kingdom – 2002 Review, IEA, 2002.
DTI - UK; Energy White Paper: Our Energy Future – creating a low carbon economy; 2003.
IEA; Country Statement on recent Energy Policy Development (Standing Group on Long-Term Co-operation June 2004) – United Kingdom, IEA, 2004
MINEFI – DREE/TRÉSOR; Politique environnementale du Royaume-Uni, MINEFI, 2002
MINEFI – DREE/TRÉSOR; Le Marché de l'électricité au Royaume-Uni, MINEFI, 2004

BULGARIA

Energy summary

- Dependency on imports for 70% of the energy supply.
- The domestic resourses of fossil fuels account for small proven reserves of gas and large deposits of low-quality brown coal.
- The electricity supply relies mainly on nuclear power and coal. The country remains a net importer of coal because metallurgical industries need high quality hard coal.
- Heavy dependence on nuclear power (6 x 400 MWe at the Kozloduy nuclear power plant), of which two groups have been shut down on 2002 under some EU pressure and two others are expected to be closed by 2006.
- The hydroelectric resourses are modest (1800 MWe installed, against 3760 Nuclear and 6330 conventional thermal).
- There are plans for a new nuclear power plant (600 MWe Belene facility) to be built till 2010, for 1500 MWe of coal-fired generating capacity and 430 MWe of hydroelectric power.
- The independent producers have 1606 MWe of thermal capacity for cogeneration and they generate 14% of the electricity. There are also small heating power plants in 21 cities and towns, providing 22% of the total public and residential district heating.
- The electric grid is interconnected with the neighbouring countries, which enables international transit. Bulgaria is an exporter of electricity, suppying power to Turkey, Greece, Yugoslavia, Macedonia and Albania.
- There are no crude oil pipelines in Bulgaria but a a 178 mile underground pipeline is projected to enable Russia to export oil through the Bulgarian Sea port of Burgas.
- The natural gas pipelines from Russia enable the gas transit to Turkey, Greece and Macedonia and supply to the national big consuming industries and some big towns. There are projects to expand the network to medium-sized towns.
- Hydro is the most important renewable energy resource available in the country. The availability of nuclear power and the excess capacity will not encourage renewable resources development in the near future.
- Huge investments are necessary to improve the functioning of the energy system. For the electric power sector and until 2005 the investment is expected to attain 4 438 million US dollars.
- Bulgaria is following the recommendations set by the EU directives in what the reform of the energy sector is concerned.

Energy Policy – main highlights

- There are plans to sell the majority of the state-owned energy companies.
- The electricity sector is being reformed according to the unbundling principles. There is now a single buyer and a single supplier to the electricity distribution companies.
- The natural gas market has been partially deregulated in 2001. The big consumers are allowed to negotiate directly with suppliers of imported gas.
- Inefficient coal mines have been closed recently and other privatised. Bulk coal and coal briquettes are still subsidized but there is a strategy to eliminate subsidies and approach market prices as a means to encourage investment in coal mining.

Main concerns

- The security in the nuclear power plant.
- The inefficiency of the supply energy system.
- The restructuring of the Bulgarian state-owned electricity company.
- The dimension of the state-owned energy sector.
- The level of price support through subsidies.
- The inefficiency of the coal mining sector.

Source: http://www.fe.doe.gov/international/bulgover.html.

HUNGARY

Energy summary

- Dependency on imports for 50% of the energy supply.
- Hungary has important domestic energy resources which meet approximately 50% of the energy requirements. Those resources are: oil, gas, nuclear power, low caloric coal and lignite.
- In the primary energy balance natural gas and oil account for about 70% and renewables about 4%.
- The country oil reserves are expected to decrease 6-9% annually and at the same time oil products demand (mainly light petroleum products) is expected to encrease, which obliges the oil company to look for new supply sources.
- The natural gas reserves could last still 20 years at the current production rate. About 75% of the total consumption of natural gas is imported from Russia. There has been important price increases in the last years in order to eliminate subsidies.
- The coal reserves, mainly lignite, are also important but the quality is not so good (high sulphur and ash content). The power plants using the coal are adjacent to the mines. Small mines supply coal for home heating.
- Hungary has one nuclear power plant (Paks power plant) which is working in safe conditions, according to the EU judgement.
- Hungary has only limited hydroelectric potential because it is not a mountainous region. Only three small sites are in operation amounting to a capacity of 43,8 MWe.
- The Hungarian system is integrated with the West-European UCPTE system.
- There are currently about 65 000 km of pipelines in Hungary, in line with the importance of this fuel in the energy system.
- The oil imports come from the Russian Federation and the infrastructure is being used to export oil to other countries.
- The electricity generation capacity in 2001 was 8 310 MWe (6 410 conventional thermal and 1850 nuclear). Hungary is a net importer of electricity (about 9% of electricity demand in 2000), mainly from Slovakia and Ukraine.
- The generating companies have been privatised in the early 1990s, some of them with the adjacent mines.
- For the expansion of the electric generation capacity Hungary is relying on combined cycle gas turbines.
- The electricity prices have increased significantly over the last years, with removal of subsidies.

Energy Policy – main highlights

The major concerns of the country's energy policy come as follows:

- Develop diverse energy supplies and eliminate dependency on imports from the Former Soviet Union;
- Improve environmental protection;
- Increase energy efficiency through modernization of supply structures and better management of electricity consumption;
- Attract foreign capital for investment in capital-intensive energy projects;

The EU directives in terms of market building, removal of subsidies and third party access to the grids are being considered by the Hungarian energy policy. Large electricity consumers can choose their supplier and the same will happen with large natural gas consumers in a near future.

Main concerns

- The importance of coal, mainly lignite, in electricity generation and the social impact of phasing out coal production.
- The air pollution caused by the burning of coal both in thermal power plants and in the residential sector for heat production.

Source: http://www.fe.doe.gov/international/hungover.html

ROMANIA

Energy summary

- Dependency on imports for 50% of the energy supply.
- Romania has abundant fossil fuels and hydroelectric resources. Primary energy production represented in 2001 74% of the energy consumption.
- Crude oil production represents more that 50% of total consumption and explains why the refining system is the largest in Central and Eastern Europe. The refining system has to be reduced and large sums have to be invested to upgrade the system. There is actually an excess capacity.
- Proven reserves of natural gas are enough for 25% at the current consumption level. Production covers about 80% of consumption.
- Both the oil and the natural gas sectors are expected to develop in the coming years owing to World Bank and western countries companies interest.
- Coal reserves are also very important and production almost covers demand. However some mines are uneconomic and have to be closed or modernised.
- The hydroelectric potential amounts to 14 800 MWe and only a fraction is still developed (representing about 35% of the potential in terms of production). Small hydro power plants have an interesting potential (about 5 000 locations).
- In what other renewable energy sources are concerned only small amounts of electricity is being produced using biomass and waste residues.
- Gas pipelines transport gas from Greece and Bulgaria. Some of the distribution pipelines need to be replaced because of security reasons. The most of the imported natural gas comes from Russia, via a pipeline from Ukraine.
- The electricity power network is interconnected and strong links exist with Ukraine, Bulgaria and the former Yugoslavia. Negotiations to become more fully integrated into UCPTE system are being carried out.
- Romania is a net exporter of electricity and its export capacity is being increased.

Energy Policy – main highlights

- The reorganization of the energy sector passed in 1990 maintained state holding companies for sectors considered as strategic. This includes electric power, oil, natural gas, lignite and coal. In the future it is expected an evolution towards a competitive electricity market.
- Romania is opening up its electricity market to follow the EU directives. With 15% of the electricity market liberalized, meaning that some large consumers can choose their suppliers, the regulatory authority plans to go deep in the reform.
- For electricity production Romania accounts with one nuclear power station (750 MWe), responsible for 10% of the Romania electricity production and a second group (700 MWe) is 40% complete.
- The government intends to launch a new program for increasing the use of renewable energy.

Main concerns

- The low level of energy prices when compared to other European countries.
- The excess refining capacity (522 000 b/d from the 10 refineries), which has already been reduced in the past (9 million tons have been closed).
- The mining activity is important and part of the capacity has to be dismantled which poses severe social problems in the mining regions.
- Romania has some industrial zones with severe environmental problems. Land, water and air pollution are among the most severe problems that have to be dealt with by the government.

Source: http://www.fe.doe.gov/international/romnover.html

SLOVENIA

Energy summary

- Electricity generation counts with a nuclear power plant (638 MWe) exploited jointly with Croatia is responsible for 25% of the electricity produced. The remaining comes from hydroelectricity (31%) and conventional thermal sources – coal and oil - (43%). Total capacity installed amounts to 2 660 MWe.
- New capacity relying on gas is being installed (286 MEe).
- The country is a net exporter of electricity.
- Hydroelectricity has an interesting potential even for small scale units. There are about 40 small units that are very old and need to be refurbished. The large-scale units can also be improved with additional capacity.
- The most of commercial heat produced comes from municipal and self-production CHP units.
- Slovenia produces only 45% of the primary energy consumed.
- The country has minor oil and natural gas resources and relies heavily on imports. There was in the past only a small refinery that has been closed down for economic reasons.
- Domestic coal accounted in 2001 for almost 90% of consumption.
- Other renewables have a negligible role in the energy supply system. Biomass from wood waste from the wood processing industry has an interesting potential and there are some district heating installations using it. Firewood for rural households is also extensively used.
- Large gas consumers and distributors are allowed to access the gas grid.
- The electricity network is part UCPTE grid.

Energy Policy – main highlights

- The main lines of the energy strategy adopted by the government come as follow: sustainable electricity production to meet the demand, with increase in cogeneration, decommissioning nuclear power production, increasing natural gas use by commercial and residential users, maintaining the rate of domestic coal use, and increasing the share of renewable energy sources (hydropower, biomass, geothermal, solar and waste residues). Tax incentives are offered as a means to promote renewable energy.
- The energy markets have also been liberalized and prices had to increase.
- Hydropower is one of the main concerns in terms of energy policy because of the interesting potential available.

Main concerns

- The investments needed to refurbish small-scale hydropower units and to increase capacity in the larger ones.
- Lack of storage capacity for oil which increases the possibility of supply shortages.

Source: http://www.fe.doe.gov/international/slvnover.html

CZECH REPUBLIC

Energy summary

- 70% of the TPEC is domestically produced.
- A high priority to build nuclear energy units is part of the energy policy.
- Coal represented about 50% in the TPES registered in 1998, oil and gas about 19,9ans 19,2% and nuclear about 8,1%.
- The Czech Republic has minor oil and gas reserves and the imports of oil come from Russian and Germany.
- Two important refineries already privatised exist in the country. A small one with a processing capacity of 20 000 b/d is operated by a public company.
- Important investments are necessary to improve the refineries as well as oil production.
- Natural gas is used for electricity and heat production which puts a high pressure on the pipelines capacity during the winter months.
- The coal and lignite reserves are moderate but the conditions for an economic exploitation of mining are not met. There are some marginal exports for Slovakia, Germany and Austria. Some of the mines have been closed because of stricter regulations put in place and following UE recommendations. About 64 000 jobs have been destroyed in northern Moravia.
- Two nuclear power plants are in operation: Dukovany with 1760 MWe providing 19% of the electricity produced and Tamelin with 981 MWe which began operation in May 2003 and is expected to produce 20% of the electricity demand.
- The total electricity capacity installed was 15180 MWe in 2001 of which 11 470 conventional thermal, 2 760 nuclear and 950 hydroelectric.
- Hydro is also relevant, mainly because of the pumping capacity.
- The country has a sophisticated electricity system and supplies electricity to other countries.
- Other renewables are negligible.
- There is a high degree of interconnection with other grids. The gas network provides natural gas from Russia to Western Europe.

Energy Policy – main highlights

- The energy policy is based on the following ideas: energy prices determined by the market, privatisation of the energy companies, energy efficiency, environmental concerns, connection to international networks, and efficiency of the domestic supply energy sector.
- The recommendations of the EU are being considered by the authorities.
- Open gradually the third party access to the grids.
- Mandatory energy audits for the government facilities with energy use greater than 1 500 Gj per year and for the non-government energy users consuming more than 35 000 Gj per year.

Main concerns

- The investments needed to improve energy efficiency and improve the environmental conditions as well as productivities and upgrading in quality in the existing refineries.

Source: http://www.fe.doe.gov/international/czekover.html.

LATVIA

Energy summary

- Latvia has no fossil fuel reserves with the exception of peat, which is extracted by a large number of privatized companies. Some of the peat is exported. Wood is also used as an energy resource. Domestic production accounted only 14% of TPEC.
- There are possibilities of offshore oil reserves.
- There is a dependency of 100% on oil products imports to meet the demand. The country has no refining capacity.
- The natural gas is imported from Russia and stored in summer for consumption in winter. The storage facilities are important for the modulation of exports by the Russian company Gazprom. District heat and electricity production are the major clients for natural gas.
- Coal and coke are imported from Poland and other neighbouring countries.
- About 75% of the electricity generating capacity is hydroelectric. Latvia is a net importer of electricity from Lithuania and Estonia (about 25% of the electricity consumed).
- Latvia is an important transhipment location for oil products.

Energy Policy – main highlights

- As an adhesion country Latvia has passed a number of reforms of the energy sector in order to follow the main practices of EU.
- Competition, transparent pricing, development of renewables are among some of the main principles of the reform.
- Cogeneration is also encouraged.

Main concerns

- Energy for households is still subsidized.
- The efficiency of the district heating systems has to be improved and loans have been negotiated with the World Bank.

Source: http://www.fe.doe.gov/international/latvover.html

ESTONIA

Energy summary

- Natural gas and petroleum products are imported. Peat and wood waste are being used in small heating plants. The peat reserves are important and small hydro power plants deliver electricity to some villages in isolated grids.
- Shale oil is a major energy resource in Estonia (in 1997 it represented 76% of TPES). It is the main source of fuel for the thermal power plants and has been used also by the cement manufacturing company and to produce oil distillates. About 9 mines are in operation. EU has been pressing the government to reduce the use of shale oil because of the environment impact but in the final negotiations EU accepted to trial shale oil as coal.
- There are neither imports nor refining of crude oil.
- Natural gas is imported from Russia and is the primary fuel for a cogeneration plant supplying electricity and heat to Tallin.
- The consumption of imported coal is declining and has been substituted by natural gas.
- The hydro resources are not important. Very small hydroelectric power plants exist but the overall capacity is approximately 1 MWe. There are still a potential to exploit but only for very small projects.
- Estonia has two ports for transhipment of oil exports
- Thermal production of electricity uses oil shale as the main fuel. The capacity of the electric power plants is 3 210 MWe. Some electricity is being exported.

Energy Policy – main highlights

- Security of supply at lower prices is the driving force of the energy policy for the country in the reform procedure.
- The electricity and gas sector are being liberalized according to EU directives.

Main concerns

- High dependence on shale oil and its environmental impact.

Source: http://www.fe.doe.gov/international/estnover.html

LITHUANIA

Energy summary

- TPEP represents about 30% of the TPEC.
- Nuclear power is the main source of the electricity generated.
- The country imports crude oil and natural gas and exports gasoline and electricity.
- There are some proven oil reserves that are being exploited but production is almost negligible regarding consumption (7%).
- The refinery although using less capacity than available is supplying refined products to the Baltic republics.
- There is no natural gas production. All the imports are done from Russia. If agreement is reached with Gazprom for the building of a transit pipeline to carry gas to Russian Kalingrad and Poland Lithuania would become an important transit centre for natural gas.
- All the coal is imported as there are no significant coal reserves.
- In terms of electricity the nuclear power plant of Ignalina with 3 000 MWe is the main source of electricity (about 78% in 2001). UE is pressing the government to close the unit but its importance in the energy panorama of the country will raise difficult negotiations.
- The hydroelectric resources are not important. Three hydroelectric facilities have been counted with 909 MWe. Conventional thermal has a capacity of 2 600 MWe.
- The country is exporting important quantities of electricity (about 43% of net generation in 2001).
- Besides the CHP plants there are also some companies that only provide district heating.
- Pipelines and electric transmission lines are being expanded.
- As a renewable source, geothermal energy will be used to produce electricity.

Energy Policy – main highlights

- Privatization of the electric grid and of the gas and oil business has been conducted.
- The gas distribution network, additional storage facilities and diversification of sources of supply for natural gas are among the main guidelines for the energy policy.

Main concerns

- The safety of Ignalina nuclear power plant.
- Restructuring of the electricity industry according to the separation of functions (unbundling).
- Modernization of the cogeneration units.

Source: http://www.fe.doe.gov/international/lithover.html

SLOVAK REPUBLIC

Energy summary

- TPEP covers 36% of total primary energy consumption.
- Solid and liquid fuels are being substituted by natural gas. In the demand side household and services consumptions are growing and industry and agriculture consumptions are decreasing.
- 97% of the oil needs are met by imports from Russia. Domestic extraction of crude oil covers about 1,5% of domestic consumption.
- Natural gas resources are also almost negligible. Slovakia is a transit centre for natural gas coming from Russia to Western countries.
- The coal resources are not important and the existing reserves are of a low quality. Domestic production accounted about 35% of total consumption of coal in 2001.
- Two nuclear power station with six reactors are now in operation.
- Slovakia has approximately 2 500 MWe of installed hydroelectric capacity and there are still additional potential to exploit. 2 600 MWe of nuclear capacity and 2 400 of thermal capacity complete the generation system. The country is a net exporter of electricity but import-export movements exist with the neighbour countries.
- The electricity grid is interconnected with the UCPTE system. The north-south transmission grids are requiring improvement.

Energy Policy – main highlights

- The Law on Energy of 1998 stated the need to stimulate competitiveness, protect consumers and ensure reliable energy supply.
- The electricity and natural gas markets are opened for large consumers to choose their suppliers.

Main concerns

- Diversification of the crude oil suppliers.
- The safety of the nuclear power reactors.

Source: http://www.fe.doe.gov/international/slvkover.html

POLAND

Energy summary

- Poland is heavy dependent on coal (66.3% of primary energy supply in 1998, followed by oil and natural gas with 20,9 and 11,4%).
- TPEP accounts for 87% of TPEC.
- Poland has proven oil reserves and some oil is exploited. But 98% of the consumption is covered by imports.
- Poland has several refineries but is not an exporter of refined products.
- Natural gas reserves are an important asset for Poland. But domestic production meets only 39% of the consumption.
- Poland has important coal resources and is an important exporter.
- Hydroelectricity is not very important (2 180 MWe are installed). Coal accounts for 97% of the electricity produced and hydro for 3%. Poland is a net exporter of electricity.

Energy Policy – main highlights

- Regulation of the energy sector and third party access to the electricity and gas transmission grids.
- Increase the penetration of oil and natural gas.
- Privatization of the energy companies.

Main concerns

- Modernization of the crude oil refining system.
- The age of the electricity generation capacity.

Source: http://www.fe.doe.gov/international/plndover.html

CYPRUS

Energy summary

- Cyprus has no conventional energy resources.
- Renewable energy, mainly solar, wind power and biomass is the only indigenous resource, accounting to 4,5% of the total energy requirements. By far solar is the most important renewable energy used. About 90% of the individual homes, 80 % of the apartments and 50% of hotels are equipped with solar heating systems.
- Presently, Cyprus imports annually about 1 million toe of oil products and 1.3 million toe of crude oil, which is processed in the national refinery. Power generation is oil-based and uses about a third of oil imports.
- Coal is imported for cement production.

Energy Policy – main highlights

- Security of supply, meeting demand, energy conservation.
- Development of energy renewable sources, mitigation of energy consumption on the environment.
- Harmonization of the energy sector with the Acquis Communautaire.

Main concerns

- The financial burden on the economy of energy imports, which represented in 1999 about 70% of the exports value.
- Development of renewable energy.

Source: Ioannis, Chryssis, “Policy Initiatives Regarding RES in the Republic of Cyprus”

MALTA

Energy summary

- The main energy requirement of the Maltese Islands is electricity generation.
- Electricity is generated by two power stations, relying solely on the importation of residual fuel oil and gas oil (formerly also coal).
- Solar energy represents less than 0,5% of the energy supply.

Energy Policy – main highlights

- Fuel switch from coal to oil.

Source: http://www.fe.doe.gov/international/bulgover.html

NORWAY

MAIN HIGHLIGHTS

- Norway is a major producer and exporter of energy.
- Government involvement in the energy sector continues to be prominent in Norway.
- The Norwegian commitment under the Kyoto Protocol is to limit the increase in greenhouse gas emissions to 1% above 1990 levels in the first commitment period, 2008-2012.
- Greenhouse gas emissions fell between 1999 and 2000 (by 1%), mainly because of unusually mild weather resulting in lower consumption of heating oil and heating kerosene and the shut-down of several air services, reducing sales of aviation fuel.
- Some agreements have been made with OPEC in order to defende the oil prices.
- New expansion of electricity generation capacity is being made with natural gas power plants.
- The Government has announced the intention to stop the development of new big hydro power plants.
- Air pollution and acid rains are of big concern.

MAIN CONCERNS

ELECTRICITY

- Norway has the highest electricity consumption per capita in the world, reflecting its large hydro power resource endowment, substantial energy-intensive industries, and its cold climate.
- 99% of its electricity generation comes from hydroelectricity. In wet years it is a net exporter of electricity and an importer in drier years.
- Competition has developed in the electricity market, although public involvement is still strong.
- Expansion of Nord Pool should provide more flexibility in responding to growing electricity demand.
- Investment in transmission has been declining over the past decade as efficiency gains have improved the capability of the system to meet growing demand.

OIL AND GAS

- Norway is a major non-OPEC oil producer and exporter. Natural gas reserves are also very important accounting for 60%of its offshore hydrocarbon reserves. It is the second larger exporter of natural gas in Europe.
- Partial privatisation of Statoil and the restructuring of the State Direct Financial Interest (SDFI).

COAL

- Norway is producing coal at Svalbard Islands where the only coal-fired power plant is located. However it is a coal net importer country.

POLICY ISSUES

- Review the impact of environmental policies on the development of energy projects.
- Evaluate the efficiency and effectiveness of existing policies and measures, in particular the carbon dioxide tax.
- In developing new policies and measures, give particular attention to the petroleum and transport sectors, which are both key emitters in Norway.

- Proactively encourage the private marketing of gas as a means of assisting the closer integration of the Norwegian gas industry with the European market.
- Continue to work towards harmonisation of taxation and other factors influencing the operation of the Nordic electricity market.
- Review the influence of the hydro concession on the level of private and foreign investment in hydro-based generation.
- Review the impact of small-scale and municipal ownership on efficiency and investment in the electricity sector.
- The exhaustion of hydrocarbon reserves. To account for the decrease in future export revenues and to control inflation part of the export revenues of the country are directed to an Investment Fund.

Source: IEA; Energy policies of IEA Countries – Norway – 2001 Review, IEA, 2001. EIA – Country Analysis Brief (http://www.eia.doe.gov/emeu/cabs/norway.html).

SWITZERLAND

MAIN HIGHLIGHTS

- Switzerland carries out energy policy in a federal system with very decentralised decision-making.
- The current energy policy of Switzerland is defined in the Swiss Energy Action Plan ("SwissEnergy"), which was launched by the federal government in 2001 and replaced the Energy 2000 Action Plan.
- Targets: reduce consumption of fossil fuels by 10% and limit the increase of electricity consumption at 5% between 2000 and 2010. The share of non-hydro renewables in electricity generation is planned to increase from 2.2% in 1999 to 3.2% in 2010.
- Between 1990 and 1997, the slowing-down of fossil fuel use and electricity demand and the stabilisation of CO2 emissions were achieved as a result of economic stagnation and the Energy 2000 Action Plan.
- The Swiss Government and the cantons have put strong emphasis on promoting non-hydro renewables.
- Switzerland has a robust, comprehensive and well-managed research and development programme in the energy field.
- Ambitious goal accepted in Kyoto: an 8% cut in greenhouse gas emissions from those of 1990 by the period 2008-2012.

MAIN CONCERNS

NUCLEAR ENERGY

- In 1999 five nuclear units were in operation representing nearly 20% of the total generation capacity in the country.
- The Swiss nuclear power plants are efficiently run and contribute significantly to Swiss electricity supply. It provides 40% of electricity supply.
- Together with hydroelectricity nuclear contributes to 98% carbon-free electricity production.

RENEWABLES

- In 1999, the contribution of all renewables, including hydropower, to primary energy supply was 18.9%.
- SwissEnergy is continuing to implement the measures to promote renewables of the Energy 2000 Action Plan.

NATURAL GAS

- Switzerland no longer has domestic gas production and has been totally dependent on imports since 1994.
- About 100 companies are currently active in the transmission and distribution of gas. Most of them belong to the public sector (communes and cantons).
- The gas industry expects to expand in the area of co-generation, possibly by replacing nuclear energy.

ELECTRICITY AND NATURAL GAS

- Only 2% of Swiss electricity production comes from fossil fuels, 40% is based on nuclear energy and 58% on hydro energy.
- A large number of companies are present in the electricity and natural gas sectors. Suppliers have monopoly rights in their areas and set prices for final consumers.
- Strong involvement of local authorities in both ownership and regulation, e.g. price controls.

- High average electricity and gas prices, in particular for industrial customers.
- Initiative to introduce competition in the electricity and natural gas sectors.

OIL

- Switzerland has no domestic production of fossil fuels and thus is totally dependent on imports.
- Oil consumption has stabilised since the beginning of the 1990s.
- Competition in the retail market is increasing although oil supply is still mainly concentrated in the hands of four large suppliers.

COAL

- Coal is not used for electricity generation and is mostly consumed in the cement industry. This industry has committed itself to replace coal by waste-derived fuels for 75% of its energy consumption.

POLICY ISSUES

- Strengthen public information on energy policy measures. Make sure that trade-offs between various policy options are well understood.
- Improve the review of the cantons' energy policies. Promote co-operation among cantons.
- Further enhance co-operation with the cantons on energy policy, especially on the Energy 2000 Action Plan and on the introduction of competition in the energy markets to ensure successful implementation of energy policy measures.
- Focus on the most cost-effective measures to promote non-hydro renewables and ensure that these measures are designed to increase their competitiveness.
- Ensure that the public receives accurate information about renewable energy available on the market.
- Seriously consider the future of electricity supply, taking into account probable future developments (i.e. introduction of competition, CO_2 emissions reduction) and the merits of the different production options from the point of view of economy and environment.
- Implement an energy tax reform based on ecological considerations.

Source: IEA; Energy policies of IEA Countries – Switzerland – 1999 Review, IEA, 1999; Energy Policies of IEA Countries 2001 Review.

SECTION IV – Summary

The following table presents a summary of main energy features on our sample.

Table 1 - Summary of main energy features

Country	Energy market opening (electricity + gas)[23]	Main energy investments planned	Kyoto commitment by 2008-2012[24]	Renewables target Directive 2010[25]	Obs.
Austria	100%	Gas storage facilities; Renewables	-13%	78,1%	Austria is a carrier of substantial international energy trade.
Belgium	Not yet completed	Renewables & CHP	-8%	6%	Belgium is committed to phase out nuclear power. Importance of electricity & gas cross-border trade.
Denmark	Not yet completed (gas)	Renewables: geothermal, wind & biomass; Energy efficiency	-21%	29%	Introduction of "green certificates" system
Finland	100%	New nuclear energy power. Extend cross-border grids and networks.	0	31,5%	There is much electricity trade between other Nordic countries and eastern countries.
France	Not yet completed	Renewables	0	21%	Highest nuclear share in electricity production. Reduction of coal use.
Germany	100%	Renewables, CHP & Energy efficiency	-21%	12,5%	Phase out nuclear by 2005. Largest electricity market in Europe. Declining coal subsidies.
Greece	Not yet completed	Natural gas for power generation; Energy saving & efficiency & renewables	25%	20,1%	Expansion of natural gas use: power generation & other.
Ireland	Not yet completed	Strengthen transmission grids; new sub-sea natural gas pipeline to UK; renewables, fuel switch on coal power plants.	13%	13,2%	Small market. Coal & peat play important role on energy mix but are high CO2 emitters. Shut down of fuel switch coal plants.
Italy	Not yet completed	Fuel switch from coal and oil to natural gas. Renewables.	-7%	25%	Strong differences between the north and south of the country.
Luxembourg	Not yet completed	Renewables & CHP	-28%	5,7%	Strong importance of iron & steel industry -> high energy consumption per inhabitant. Very small market.
Netherlands	Not yet completed	Grid reinforcement. Renewables	-6%	9%	Nuclear to be phased out.
Portugal	Not yet completed	Natural gas grid expansion LNG terminal; reinforcement of electricity grid; renewables, energy efficiency & CHP	27%	39%	In process of creation of an Iberian Electricity Market.
Spain	Not yet completed	Expansion of connections to EU natural and electricity grids. Renewables & CHP, energy efficiency.	15%	29,4%	One of the most important European wind energy markets.
Sweden	Gas not yet completed. Electricity completed	Natural gas, renewables & CHP.	4%	60%	Electricity market in cooperation with Baltic countries under study. Phase out all nuclear plants.
UK	100% completed	New gas pipelines; Renewables, energy efficiency and CHP	-13%	10%	One of the largest energy markets in Europe.

[23] According to the level of implementation of the Directives of Electricity and Gas.
[24] Negative means reduction of emissions and positive means maximum threshold allowed.
[25] Amount of electricity generated by renewable energy sources by 2010, according to the Renewable Energies Directive.

4. ENERGY POLICY INDICATORS

SECTION I - Short presentation on concepts, methodologies and typologies used and developed

<u>The methodology</u>

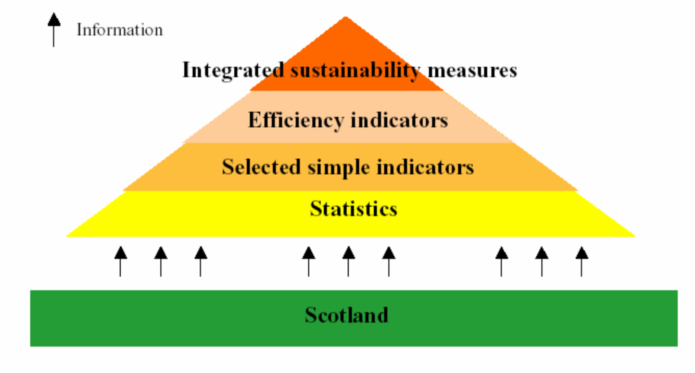
Energy indicators are estimated from basic data on the structure of economic and human activity, combined with measurements of the energy use for those activities. Indicators link energy use to economic and human activity.

Our goal in the framework of the ESPON project is to use disaggregated indicators to show how energy infrastructures and energy production and consumption is linked with economic and human activity and to understand how spatial development depend or is influenced by the energy sector development and/or by energy availability.

The raw material for indicators estimation is the statistical information on chosen variables. The criteria for choosing variables are, among others, data availability and connection with the project subject.

With the set of indicators proposed we must be able to measure, namely, the degree of regional development among the 29 countries of the study, the strong and weak points of the energy sector, including infrastructures, the potential for regional development, and the bottlenecks for spatial development. Some common links among subsets of indicators were established, according to the types of answers and/or problems to be studied and the type of information embodied in each subset.

Figure 6 - From raw statistics to summary indicators



Source: Sustainability indicators for waste, energy and travel for Scotland - Scottish Executive Central Research Unit 2001

The final set of indicators to obtain is the result of the following process:

i) at a first stage where data availability is not completely assessed it is proposed a first and complete set of variables and indicators, an ambitious proposal as we were in an ideal world in terms of information availability;

ii) in a second step the assessment on the possibility to estimate the indicators proposed is done taking into account data availability and quality. A second stage set of indicators is proposed, trying to take into consideration the possibility to answer the main questions concerned with the aims of the ESPON project;

iii) In a final step the quality of the indicators estimated is assessed, based on the criteria of information content, adequacy to answer the main policy questions, possibility of interregional comparisons.

The raw statistical data

As a starting point we accessed to the energy balances of all the countries considered, which is a good statistical base for regional data validation. We produced some indicators at country level considering primary and final energy consumption, energy imports, and energy sources and consuming sectors.

For data collection of raw statistical information a set of core indicators and variables has been defined taking in mind the proposed set of indicators presented ahead. Some adjustments were made since our second interim report taking into account data availability and quality.

Core Indicators proposed

CI1	**Electricity production by power source** (hydroelectric, nuclear and thermal power)	
CI2	**Final energy consumption by energy type and consumption sector** *We must retain the classifications available in statistical sources, in order to have flexibility for other aggregation.*	
	Energy type: . Solid Fuels . Oil . Gas . Electricity . Derived Heat . Renewable	Consumption sector: . Industry . Transport . Domestic and Tertiary
CI3	**Energy prices for industry (tax included)**	

Variables

Besides the core indicators the following variables were proposed to be collected in order to construct the indicators proposed in our second interim report:

V1	**Location of natural gas supply infrastructures**
V2	**Location of high voltage electricity networks**
V3	**Primary energy supply by energy product** (oil, solids, nuclear, hydro, natural gas, other renewable)
V4	**Location of Power Plants** (hydro, thermal, nuclear)
V5	**Refineries capacity**
V6	**Employment in the energy sector**
V7	**Energy prices for the residential sector** (electricity, natural gas)
V8	**Energy prices for the transport sector** (unleaded gasoline, automotive diesel)
V9	**Duration (minutes) of electricity supply disruption**

The indicators

The contribution of the energy sector for regional and social development can be assessed using a set of indicators covering the different aspects of the countries and regions concerned. The main limitation in designing such a battery of indicators is the availability of data at country and regional level enabling consistent comparisons.

The main characteristics of the reality to be studied are supposed to emerge with the indicators. To be reliable the indicators battery must also enable decision makers and researchers to follow and measure the adequacy and impact of energy policies both at country and region level. The energy policies at EU and country levels have nowadays some common goals: security of supply, competitive energy markets, environment sustainability.

We propose a range of indicators to measure and compare the different aspects of the energy sector in the countries and regions concerned.

We have to take into account that some indicators were estimated only at national level because they don't have any meaning at regional or local level. Primary energy supply, for instance, has no sense at regional level because their level and composition depends mainly on national policies, resources location and technologies.

The indicators have been grouped into 4 domains covering different aspects of the energy sector:

1 Economy, society and energy *(indicators A)*
2 Reliable supplies of energy *(indicators B)*
3 Competitive energy markets *(indicators C)*
4 Environmental objectives *(indicators D)*

A detailed analysis is presented forward. The results of these indicators are presented in Annex and the respective analysis in section III.

Detailed analysis of the proposed indicators

A. Economy, society and energy

Indicator	Description	Why is this indicator important?	What are the links with other indicators?	Scope, information source and reporting frequency
A.1 TPES / Population (toe per capita)	Total primary energy supply per capita	Primary energy supply to the economy depends on final energy demand, on the endogenous resources, on the energy carriers to transform energy. Primary energy relies on fossil fuels for most countries. This ratio and the messages embodied deserve a complementary analysis because it can translate welfare of the population, the way energy is used (degree of efficiency), the importance and structure of the industrial sector versus service sector.	As a high level indicator there are direct or indirect links between energy supply and virtually all the other indicators in this set. Direct links are with indicators on emissions of GHG, Eco-efficiency indicators and uptake of energy efficiency measures. Indirectly the energy efficiency of the economy is linked closely to total material requirement, distance travelled (and therefore ability to achieve access without using cars).	**NUTS 0**: Energy balances (time series), ESPON database

Indicator	Description	Why is this indicator important?	What are the links with other indicators?	Scope, information source and reporting frequency
A.2 **FEC/ Population** (toe per capita)	Final energy consumption per capita	Final energy represents the energy consumed in the last stage, meaning that there are no more transformations into other energy forms. It is independent of the efficiency of technology conversions from primary to final energy. It reflects the efficiency of the end use equipments, the welfare of the population and the structure of the economy in terms of sectors.	As a high level indicator there are direct or indirect links between energy supply and virtually all the other indicators in this set. Direct links are with indicators on emissions of GHG, Eco-efficiency indicators and uptake of energy efficiency measures.	**NUTS 0**: energy balances (time series), ESPON database **NUTS 2**: estimation for specific years (when possible), Eurostat Newcronos
A.3 **FEC service and residential sector / FEC total** (%)	% of the service and residential sector final energy consumption (FEC) in the total FEC	Developed economies have usually a strong service sector (high percentage in the ratio). This indicator is a good proxy to classify countries according to their development level.	It is expected that the evolution of this ratio goes in line with the importance of the service sector in terms of GDP.	**NUTS 0**: energy balances (time series) **NUTS 2**: estimation for specific years (when possible), Eurostat Newcronos
A.4 **Electricity consumption / Population** (kWh per capita)	Electricity consumption per capita	It is a good proxy to measure the welfare of the population.	The evolution of this indicator follows the evolution of A.3.	**NUTS 0**: energy balances (time series), ESPON database **NUTS 2**: estimation for specific years (when possible), Eurostat Newcronos
A.5 **TPES / GDP** (toe per 000 Euro)	Total primary energy supply per thousand Euro of GDP	It shows the efficiency in using energy when comparing countries with the same sector structure. However the magnitude depends on the structure of the economic activity and also of the efficiency in using energy.	As a high level indicator there are direct or indirect links between energy supply and virtually all the other indicators in this set. Direct links are with indicators on emissions of GHG, Eco-efficiency indicators and uptake of energy efficiency measures. Indirectly the energy efficiency of the economy is linked closely to total material requirement, distance travelled (and therefore ability to achieve access without using cars).	**NUTS 0**: energy balances and national accounts (time series), ESPON database, Eurostat Newcronos
A.6 **FEC / GDP** (toe per 000 Euro)	Final energy consumption per thousand Euro of GDP	Final energy represents the energy consumed in the last stage, meaning that there are no more transformations into other energy forms. It is independent of the efficiency of technology conversions from primary to final energy. It reflects the efficiency of the equipments in the economy and the structure of the economy.	It is the inverse of the energy productivity in terms of value added (see A7)	**NUTS 0**: energy balances and national accounts (time series), ESPON database **NUTS 2**: estimation for specific years (when possible), Eurostat Newcronos

Indicator	Description	Why is this indicator important?	What are the links with other indicators?	Scope, information source and reporting frequency
A.7 **GDP / FEC** (000 Euro per toe)	Energy productivity in terms of value added	When comparing countries it shows those w hich are more or less dependent in final energy in the productive process. We must have in mind that the indicator can be influenced by the relative weight of the economic sectors (for instance, service sectors are in general terms less intensive than manufacturing sectors).	It is the inverse of A6.	**NUTS 0**: energy balances and national accounts (time series), ESPON database **NUTS 2**: estimation for specific years (when possible), Eurostat Newcronos
A.8 **Electricity consumption / GDP** (kWh per 000 Euro)	Electricity consumption per thousand of GDP	It measures the degree of dependence of the economy from electricity.	The inverse (see A.9) measures the productivity of electricity in terms of GDP.	**NUTS 0**: energy balances and national accounts (time series), ESPON database **NUTS 2**: estimation for specific years (when possible), Eurostat Newcronos
A.9 **GDP / Electricity consumption** (Euro per kWh)	Electricity productivity in terms of GDP.	It measures the relative efficiency in using electricity.	The inverse (see A.8) measures intensity of electricity in GDP.	**NUTS 0**: energy balances and national accounts (time series), ESPON database **NUTS 2**: estimation for specific years (when possible), Eurostat Newcronos
A.10 **Households energy use** (toe per capita)	Final household energy consumption per capita	It enables the comparison of countries in terms of welfare of the population.	It gives the same information of A.2	**NUTS 0**: energy balances (time series) **NUTS 2**: estimation for specific years (when possible)

B. Reliable supplies of energy

Indicator	Description	Why is this indicator important?	What are the links with other indicators?	Scope, information source and reporting frequency
B.1 **Average load factor** (%)	The average percentage of generating capacity used	It is a measure of the demand pressure under the electric sector and of the failures risk.		**NUTS 0**: information from the utilities (time series)
B.2 **Proportion of electricity generated by renewables** (%)	Share of renewables in electricity production.	It enables the assessment of the weight of renewables in electricity generation and to which degree the country is achieving the indicative target of the Directive on electricity production from energy sources.	It is complementary of the B.3, B.4 and B.5 ratios	**NUTS 0**: energy balances (time series)
B.3 **Proportion of electricity generated by liquid fossil fuels** (%)	Share of liquid fossil fuels in electricity generation.	It enables the assessment of the weight of liquid fossil fuels in electricity generation.	It is complementary of the B.2, B.4 and B.5 ratios	**NUTS 0**: energy balances (time series)

Indicator	Description	Why is this indicator important?	What are the links with other indicators?	Scope, information source and reporting frequency
B.4 Proportion of electricity generated by solid fossil fuels (%)	Share of solid fossil fuels in electricity production.	It enables the assessment of the weight of solid fossil fuels in electricity generation.	It is complementary of the B.2, B.3 and B.5 ratios	**NUTS 0**: energy balances (time series)
B.5 Proportion of electricity generated by natural gas (%)	Share of natural gas in electricity production.	It enables the assessment of the weigh of natural gas in electricity generation.	It is complementary of the B.2, B.3 and B.4 ratios	**NUTS 0**: energy balances (time series)
B.6 Shares and diversity of fuels used for electricity generation	Diversity measure. The smaller the measure the more dependent is the energy system of a reduced number of fuels.	It enables the classification of the countries and regions energy systems according to the more or less dependence on a reduced number of energy products. *(Shannon-Weiner measure[26])*	As a summary measure it sums up information given by indicators B.2 to B.5.	**NUTS 0**: energy balances (time series)
B.7 Gas capacity (kWh/day)	Capacity for natural gas supply	It measures the available capacity for supplying natural gas. Knowing the demand over or underestimation of the capacity can be estimated.		**NUTS 0**: reports from sector entity (time series) **NUTS 2**: estimation for specific years (when possible)
B.8 Ratio of energy production to primary energy consumption	This indicator measures the primary energy self sufficiency. The complement is a measure on dependence of imports.	It gives a good measure of security of supply in terms of primary energy consumption.		**NUTS 0**: energy balances (time series) **NUTS 2**: estimation for specific years (when possible)
B.9 Fossil fuels dependency (%)	It shows fossil fuels as a percentage of primary consumption.	It is an indicator which can be used to compare countries in terms of greenhouse gases emissions.		**NUTS 0**: energy balances (time series) **NUTS 2**: estimation for specific years (when possible)
B.10 Annual electricity failures (minutes/year)	This indicator shows the number of electricity disrupted supply minutes per year.	It is a measure of the quality of the service of the electricity distribution utilities.		**NUTS 0**: reports from the regulators and electric utilities associations. **NUTS 2**: estimation for specific years (when possible)
B.11 Crude oil refined/fossil fuels primary consumption (%)		Importance of refinery in fossil fuels primary consumption		**NUTS 0**: Energy Information Administration annual reports
B.12 Grid density (high and medium voltage) (km/km^2)	Number of km of high and medium voltage grids per km2	It informs about more or less rarefaction of electricity supply in terms of the grid.		**NUTS 0**: information from the transmission utilities and from the regulators. **NUTS 2**: estimation for specific years (when possible)

[26] Shannon-Weiner measure = $-\sum p_i \ln p_i$ over all i
where pi represents the proportion of the total supplied by fuel i.

C. Competitive energy markets

Indicator	Description	Why is this indicator important?	What are the links with other indicators?	Scope, information source and reporting frequency
C.1 Fuel price indices for the industrial sector (natural gas, electricity)	It enables the visualization of the evolution of relative price indices of energy used by industry. As a basis for comparison the German price will be considered (it is the larger consumer of the countries considered).	It enables the assessment of relative competitiveness among countries.		**NUTS 0**: price information published by national and international authorities.
C.2 Fuel price indices for the domestic sector (natural gas, electricity)	It enables the visualization of the evolution of relative price indices of gas and electricity as the main energy sources used by the residential sector. As a basis for comparison the German price will be considered (it is the larger consumer of the countries considered).	It enables the assessment of relative competitiveness and welfare of the population among countries.		**NUTS 0**: price information published by national and international authorities.
C.3 Fuel price indices for the transport sector (gasoline and diesel)	It enables the visualization of the evolution of relative price indices of petrol and gasoil sources used by the transport sector. As a basis for comparison the German price will be considered (it is the larger consumer of the countries considered).	It enables the assessment of relative competitiveness and welfare of the population among countries.		**NUTS 0**: price information published by national and international authorities.
C.4 Competition in electricity generation	Measures the degree of concentration in the electricity generation. *(The Herfindahl-Herschmann measure[27])*	A better understanding of the behaviour of agents acting in the sector will be achieved		**NUTS 0**: information from dispersed sources.

D. Environmental objectives

Indicator	Description	Why is this indicator important?	What are the links with other indicators?	Scope, information source and reporting frequency
D.1 Greenhouse gas emissions (Mio tonnes CO2 equivalent)	The amount of CO2 equivalent released to the atmosphere.	This indicator will help to monitor the Kyoto targets or the burden sharing targets.		**NUTS 0**: Inventories supplied yearly to the IFCCC.
D.2 Acidification gas emissions (Acidifying Potential (kt))	The amount of acidification gases released to the atmosphere.	This indicator will help to monitor the existing targets for acidification gases.		**NUTS 0**: Inventories supplied yearly to the IFCCC.

[27] Herfindahl-Herschmann measure = The square of each participant's market share added together across all participants in the market. Values vary between zero, which signifies a perfectly competitive industry, and ten thousand, for a pure monopoly.

SECTION II - Main difficulties related to data collection

The main difficulty related to data collection is the severe lack of statistical information. This has limited the scope of analysis making impossible, in some cases, to calculate the proposed energy indicators at regional level and therefore hindering the elaboration of a detailed and complete assessment of the energy sector in a global regional perspective.

The data collected and used to construct the energy database and to calculate the energy indicators comes from different sources where definitions and measure units are not always homogeneous, thus delivering different results for the same items.

Additionally, establishing contact with the appropriate persons in each country was often an unfruitful and time consuming activity. Frequently the received data was incomplete for the country level and in other cases there were no answers at all. Moreover, the data from different sources vary and it is hard (if possible at all) to verify its quality.

Systematic energy data at the regional level is still scarce and in many countries no recent data regarding the intended territorial desegregation is available. For instance, in United Kingdom the Department of Trade and Industry had established the need for sub-national information on energy consumption and only recently is studying how to compile such estimates including, in particular, how to collect such information on electricity use.

In the case of the New Member States the problems are even more relevant due to the fact that some data is not produced and many of the energy indicators even do not exist (or at least are not available). This concerns either NUTS 2 or country level.

The Statistics of the New Member States are considerably affected by the transition in the past ten years. There are also changes year by year in the way how they are drawn up. In the newest statistics some data for NUTS 2 level is included, but this is only for the last year or the last two years.

At the present moment, the information collected by NUTS 2 level mainly comes from the database Eurostat Newcronos (updated in July 2004) with data referring only electricity. However, the database has a problem of data availability at this regional level desegregation. It must be emphasized that for a large number of the NUTS 2 regions supposedly covered the data is not disclosed, thus making data availability much narrower than that theoretically possible.

In fact data availability is a constraint for the work development and too much time consuming. Some specific data is very hard or almost impossible to obtain, namely with the intended desegregation (NUT 2 and 3) required by the ESPON-CU. Also some information is considered as classified by the utilities. For the New Member States the lack of data is still more sensitive.

The relevance of the present analysis depends on the quality of the data collection and calculation of indicators. This is why the way in which the data is collected and interpreted is of fundamental importance. We will then concentrate the analysis on country level, through the application of the proposed indicators.

To measure and compare the different aspects of the energy sector in the countries and regions concerned in this study, we established two core indicators and nine variables in order to construct the indicators proposed at that time. In our second interim report we already present results for some of the indicators. However some data was updated since then and other were collected through new sources.

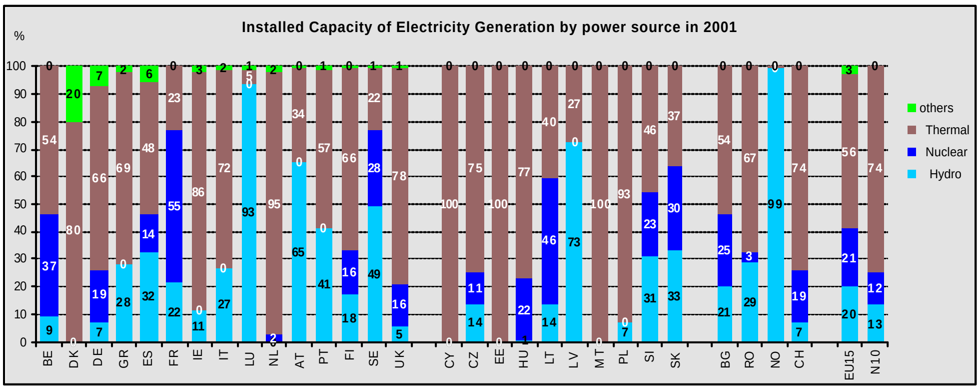
Now we made a synthesis of available data situation and present the results that were possible to have for a better understanding of the energy sector at regional level in Europe.

Core Indicator 1 - Electricity production by power source

Installed capacity production of electricity generation plants is a close proxy of the size of the economies. But the structure of the production by source strongly varies among countries reflecting different energy policy options in the past and availability of energy resources.

Regarding data for 2001 at country level we observe that thermal power plants provided the majority of capacity, representing 74% of total installed capacity in the N10 and 56% in EU15.

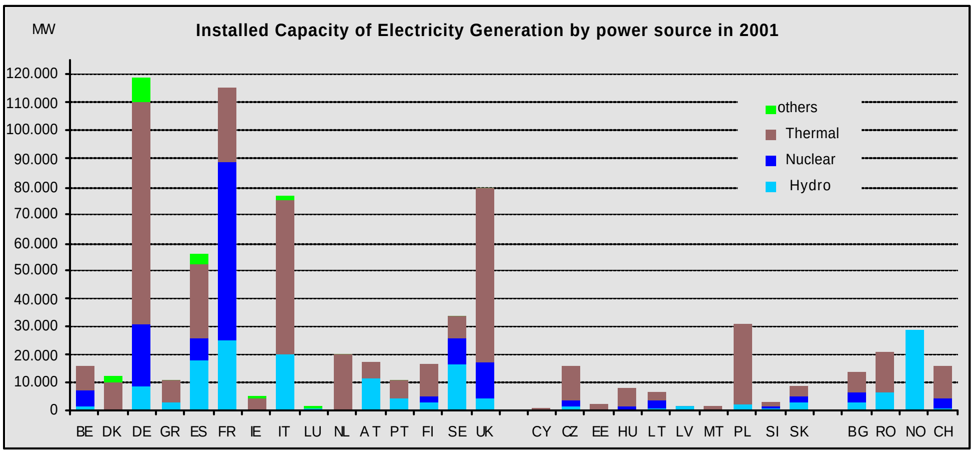
Figure 7 - Core Indicator 1 by NUTS 0 in 2001 (%)



Source: “Energy, transport and environment indicators 1991-2001” and “2001 Annual Energy Review” for CH (1999 data), Eurostat

Germany and France have the greatest installed capacity although with a different contribution of power sources in each country. In Germany thermal power is the main source representing 66% and in France nuclear power represents 55% of total installed capacity.

Figure 8 - Core Indicator 1 by NUTS 0 in 2001 (MW)



Source: “Energy, transport and environment indicators 1991-2001” and “2001 Annual Energy Review” for CH (1999 data), Eurostat

At regional level the data collected for Core Indicator 1 comes from Eurostat Newcronos database recent output (updated in July of 2004) and refers to *installed net capacity production by power source* between 1990 and 2000.

For some cases there is no data for all power sources at the same year, and other cases the information it is not available at all. The analysis reports to 21 countries with NUTS 2 but only for 13 countries it is possible to have comparable data. Besides that, for example Germany has only 8 regions with available data in a total of 40 regions. So, the comparative analysis is strongly limited.

In Czech Republic the hydro and thermal electricity production capacity are not collected at regional level, according to the Eurostat[28]. In Hungary the electric production capacity is the annual average of net production capacity. For Slovakia it is considered the installed energy production capacity.

Next table shows a summary of data available by NUTS 2 level collected for Core Indicator 1 between 1990 and 2000 (all data is presented in Annex).

Table 2 - Situation of data collection for Core Indicator 1 by NUTS 2 (1990-2000)

Core Indicator 1 - Electricity Production by power source

(installed net capacity production by hydroelectric, nuclear, and thermal power)

NUTS 2	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990
BE	t	t	t	t		n	n	n			
DE											
GR											
ES									n		
FR											
IE											
IT	h,th	h									
NL						n,th	n,th	n	n	n,th	n,th
AT											
PT											
FI											
SE											
UK							n	n	n	n	n
CZ											
HU											
PL	t,h,th	t,h,th	t,h,th	t,h,th	t,h,th	t,h,th					
SK											
BG											
RO											
NO											
CH											

Source: Eurostat Newcronos
Notes: Some regions have only: t - total; n - nuclear; h - hydroelectric; th - thermal
other cases it means there is data for all power sources

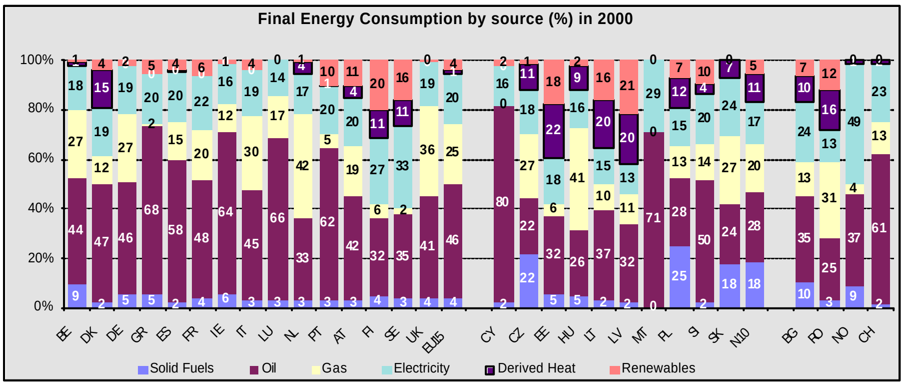
[28] European Regional Statistics, Reference Guide, 2003, Eurostat.

Core Indicator 2 - Final Energy Consumption by energy type and consumption sector

Analysing final energy consumption by source is only possible at country level European Union countries (EU15) have a different structure then that from New Member States (N10) in 2000.

The most significant energy source consumed in EU15 countries was oil, representing about 46%, followed by gas with 25% and electricity with 20% of total average final consumption. In the N10 countries the final energy consumption is more proportional among sources, although there are great disparities among countries as we can see in the figure below.

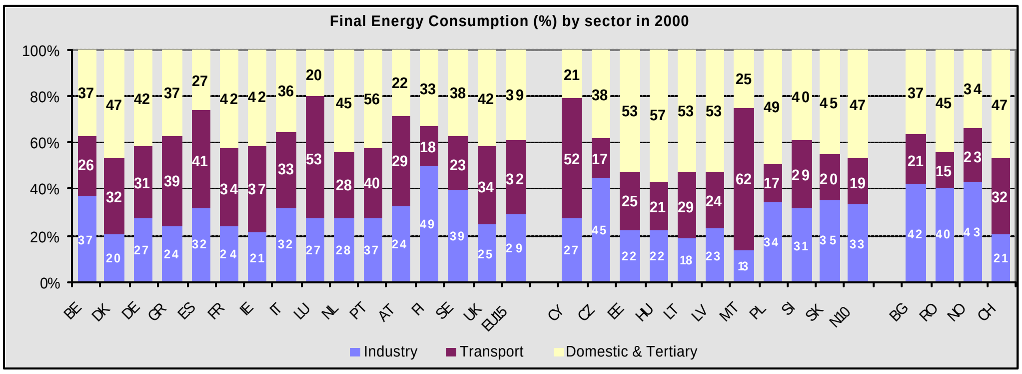
Figure 9 - Final Energy Consumption by energy type in 2000



Source: "Energy &Transport in Figures", Eurostat; 2001 IEA Energy Statistics (for Norway and Switzerland).

Regarding final energy consumption by sector, the domestic and services sectors in EU15 were responsible for nearly 40% of final energy consumption in 2000 and for 47% in N10 countries, making it the largest energy consuming sectors, ahead of the industrial sector and transport sector, in average terms.

Figure 10 - Final Energy Consumption by sector in 2000 (%)



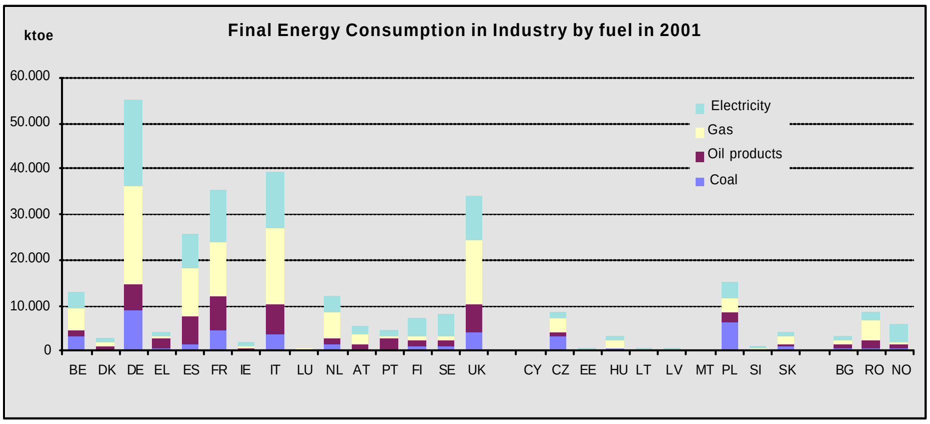
Source: "Energy &Transport in Figures", Eurostat; 2001 IEA Energy Statistics (for Norway and Switzerland).

Analysing the energy consumption of all industrial sectors by energy type in 2001, in EU15 the share of gas was 37%, followed by electricity 33%. In the case of N10 countries the share of coal was 34% and natural gas 32%.

The figure below show that in almost EU15 countries gases were the main source of energy for industrial sector, with exception of two groups of countries: Sweden, Finland and Denmark, where electricity share is greater, and Portugal, Ireland and Greece where oil represents the first source of industrial energy consumption.

In the New Member States, the gases are the main source for industry with the exception of Poland and Czech Republic industry sector which consume mainly coal.

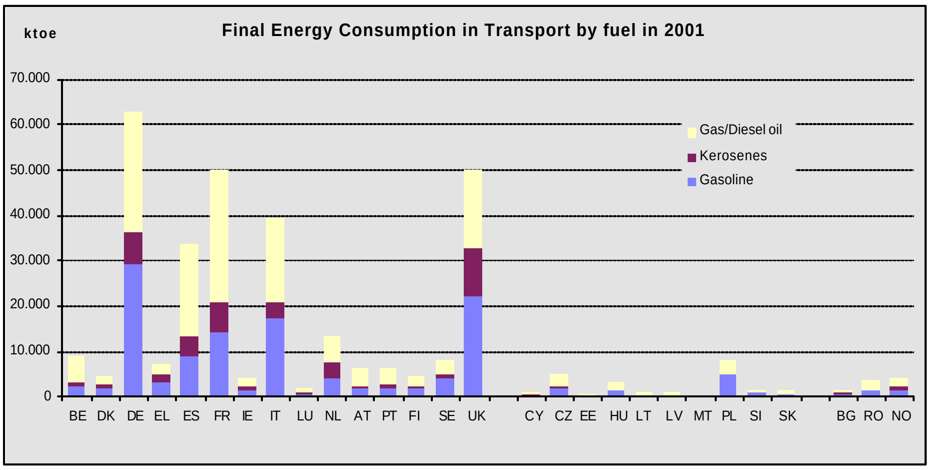
Figure 11 - Final Energy Consumption in Industry by fuel in 2001



Source: "Energy, transport and environment indicators 1991-2001", Eurostat. No available data for Switzerland.

In the case of transport sector, the share of gas/diesel oil consumed in almost countries is significant, with few exceptions.

Figure 12 - Final Energy Consumption in Transport by fuel in 2001



Source: "Energy, transport and environment indicators 1991-2001", Eurostat No available data for Switzerland.

At regional level data collection for final energy consumption was not possible for each type of energy. It was available only *for electricity by sector* between 1990 and 2000*.* Once again the problem of data availability is very significant, compromising any comparative analysis. Figure below demonstrates a summary of data collected by NUTS 2 for this core indicator (all data is presented in Annex).

Table 3 - Situation of data collection for Core Indicator 2 by NUTS 2 (1990-2000)

Core Indicator 2 - Final Energy Consumption by source and sector

(only final electricity consumption by sector)

NUTS 2	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990
BE	t	t	t	t	t	t	t	t			
DE											
GR											
ES											
FR											
IE											
IT											
NL											
AT					t	t	t				
PT											
FI											
SE											
UK											
CZ				h	h						
HU											
PL											
SK											
BG											
RO											
NO											
CH											

Sources: Eurostat Newcronos, IEA, DGE (for Portugal) CNE (for Spain)
Notes: t - only total; h - only households

Core Indicator 3 - Energy prices for industry (tax included)

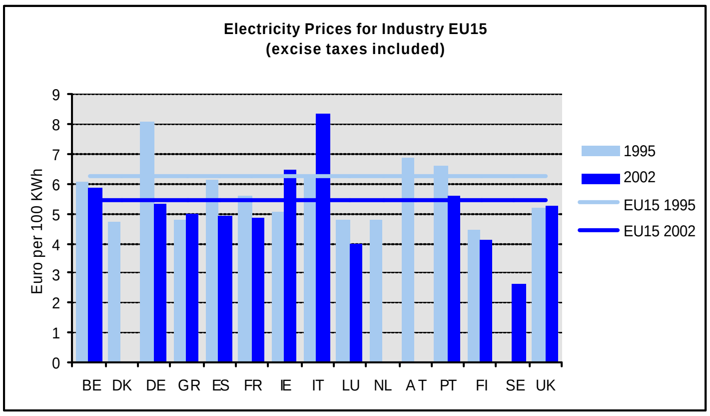
This core indicator has little sense at regional level because price level and composition depend mainly on national policies, resources location and technologies.

Among the countries under review, the prices for industrial electricity consumption (excise taxes included) are only higher than the average in Belgium, Ireland, Italy and Portugal in 2002. The industrial electricity prices are declining by 12% in EU15 between 1995 and 2002. They are strongly related to the structure of production and the price of the input transformation.

The greatest decrease in electricity price for industry was in Germany, the largest consumer country and for that reason it was chosen as reference in the price indices (see the analysis of competitive energy markets - indicators C in section IIII).

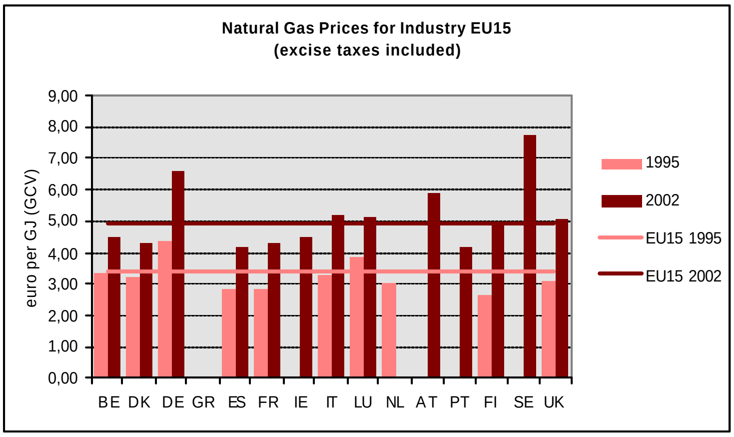
In the same period the natural gas prices for industry rose by 43%. It is important to refer that natural gas prices are directly influenced by the international oil prices. Some countries may benefit from the strategic location in the middle of a natural gas transport network.

Figure 13 - Electricity Prices for Industry (excise taxes included) in EU15 (1995-2002)



Source: "Energy &Transport in Figures 2003", Eurostat.

Figure 14 - Natural Gas Prices for Industry (excise taxes included) in EU15 (1995-2002)



Source: "Energy &Transport in Figures 2003", Eurostat.

Regarding the variables proposed the following data were collected in order to construct the indicators proposed. Only for variables 1, 2, 4, 6 and 9 it was possible to have information at the regional level pretended.

		NUTS 0	NUTS 2
V1	**Location of natural gas supply infrastructures**		✓
V2	**Location of high voltage electricity networks**		✓
V3	**Primary energy supply by energy product** (oil, solids, nuclear, hydro, natural gas, other renewable)	✓	
V4	**Location of Power Plants** (hydro, thermal, nuclear)		✓
V5	**Refineries capacity**	✓	
V6	**Employment in the energy sector**		✓
V7	**Energy prices for the residential sector** (electricity, natural gas)	✓	
V8	**Energy prices for the transport sector** (unleaded gasoline, automotive diesel)	✓	
V9	**Duration (minutes) of electricity supply disruption**	✓	✓

Variable 1, 2 and 4

For variables 1, 2 and 4 (location of natural gas supply infrastructures, high voltage electricity networks and power plants) it was possible to have a regional representation for our country sample.

The respective maps can be seen in the Annex. Some remarks have to be made concerning the map designing:

1. For mapping *high voltage electricity networks* and *hydro and thermal power plants location* we used the UCTE[29] map of 2003. It should be underlined that the data for Northern parts of Finland, Sweden and Norway, as for Malta and Cyprus do not appear.
2. For mapping the location of *nuclear power plants* we based on 2003 data of Nuke database system[30] used by 1.3.1 ESPON project.
3. For mapping *European natural gas network* we used the GTE[31] map for 2003.

The following commentaries refer to analysis of this variables map representation at regional level for 2003:

[29] (UCTE) Union for the Co-ordination of Transmission of Electricity is an association of transmission system operators in continental Europe.

[30] NUKE database system covers nuclear power plants all over the world and was created by Nuclear Training Centre in Ljubljana (Slovenia).

[31] (GTE) Gas Transmission Europe is an association representing the gas transmission companies in Europe.

- *Power Stations - General observations*

The maps represent only large power stations and don't take into account small-scale distributed energy. Nor do they represent renewable energies apart from large hydro. The hypothesis of dominance among countries of large centralized power generation system is valid in almost all the countries studied. However it should be moderated in countries like the Netherlands, where distributed energy (mostly by cogeneration) represents more than a third of the electricity market and in countries like Denmark which produce 20% of its electricity from wind energy.

Independent to the technology employed, it can already be pointed out that power stations are in most cases near to high population density areas, especially country's capitals. In the cases of thermal or nuclear power plants, water in large quantity is needed for cooling the reactors. Hence, most power stations are also near to big rivers or by the sea.

- *Hydro-electric Power Stations*

There are two different ways of exploiting hydro potential for electricity production: by creating a retention pool in altitude and using the difference of potential energy of water hence created, or by using the flow debit of water along a river. Consequently large hydroelectric power plants are concentrated around mountainous areas and large rivers.

They are especially concentrated in regions around the Alps, where countries like Austria and Switzerland produce most of their electricity from hydro (70% for Austria, 56% for Switzerland). Regions with lower relief but high precipitation levels, like northern western Iberian Peninsula, Scotland and Norway also produce centralized hydro energy. Norway even produces 99% of its electricity needs from hydro. The potential in the Carpathian Mountains in Romania is largely exploited while there could possibly be more power stations in the Tatra Mountains between Slovakia and Poland. On the other hand, flat regions in the Netherlands, Belgium and Poland for example have nearly no potential for large hydro. Large rivers like especially the Rhone, the Danube and to a smaller extent the Rhine are largely used for electricity generation.

The maximum potential for large hydro-electric power stations is nearly reached, especially in western European countries, but there still exists a good potential for smaller hydro power plants along the rivers, which is much better distributed around Europe. Those small power stations are not represented on the map.

- *Thermal Power Stations*

The repartition of thermal power stations is quite homogeneous around Europe, though they are still near to high population density areas. Norway, which produces all of its electricity from hydro, is a notable exception with no thermal power plants installed.

- *Nuclear Power Stations*

National policies regarding nuclear power generation are different among European countries, thus leading to disequilibrium in power capacity distribution around Europe. While France produces 80% of its electricity from nuclear energy, Italy decided by referendum in 1987 to phase out its reactors.

Power Capacities are mostly installed in western countries and especially in France (especially along the Loire, the Rhone and by the Northern Coast). In Eastern countries, nuclear power stations are installed near to the country's capitals. Though Poland is the more populated of EU new countries, Poland doesn't have nuclear power plants.

➢ *Electricity network*

Six synchronous grids coexist in Europe. The most important is the UCTE grid (Union for the Coordination of Transmission of Electricity), which is divided in two areas, one for most EU and the other one for Romania, Bulgaria, the Balkans and Greece. Several AC connections are currently under construction to interconnect UCTE 1 and UCTE 2 grids. United Kingdom has a synchronous grid of its own, excluding Northern Ireland which is connected to the autonomous Irish grid. Norway, Sweden, Finland and the eastern part of Denmark form the Nordel grid. Baltic countries are connected to the Russian grid.

Due to the liberalisation of electricity markets, interconnections between the different areas and within a specific zone have taken crucial importance. Formerly, zones were nearly self balanced and ensured high system security but due to the heavy increase of cross border transports, systems are operated more often very close to their limits.

It's technically difficult and economically not interesting to burry AC Very High Voltage lines. Hence for sea-cross interconnections it's mandatory to switch to DC lines. This mainly explains the existence of several synchronous grids in Europe. In liberalized electricity markets, some of these connections have taken high importance. Among them we can mention the DC connection between France and England, allowing the continental countries to sell electricity in the UK, the connections between Denmark, Germany and Poland with the Nordel, allowing trading with the Norpool and the connection between Greece and Italy, reinforcing the security of the Italian power system. A DC connection between Finland and Estonia is currently under construction.

It can also be mentioned that some of the former members of the Warsaw pact, namely Poland, Hungary, Romania and Bulgaria are connected to the Ukrainian nuclear power plants by Very High Voltage (750kV) lines.

The European grids are mostly mature and most regions of Europe are connected to Very High Voltage. They will be reinforced within the next years (especially in Italy, Greece and the Iberian Peninsula) and interconnections will be multiplied in order to facilitate electricity exchanges and hence reinforce the security of supply. However construction of new Very High Voltage lines, which are too expensive to burry, is often very problematic due to public protest, as is faced now in south Italy.

➢ *Gas Network*

Europe has diversified its gas supply in order to increase security. Consequently gas comes from different sources.

It is a local resource in the Netherlands and in the North Sea between Norway and Scotland. It is transported by gas pipeline mostly to Benelux countries, Germany and the UK. It's also a national resource in Poland, Hungary and Romania where the gas is more auto-consumed than exported to the rest of Europe.

The main foreign supplier of gas for EU is Russia. Gas comes by pipelines. Due to the geography, the main routes are across Poland and between the Carpathian and the Tatra mountains in Slovakia and Hungary. This situation made the gas hubs of Baumgarten (Austria) and Poland of major importance in Europe (only 20% of the gas going through Austria is for national consumption). Large gas transport pipelines do not cross mountainous regions like the Alps and the Tatra.

The two major gas resources for Europe, the North Sea and Russia, interconnect in Germany and the Netherlands. In this zone, pipelines are of major size. This is also the zone where major interconnections are made. The gas transport pipelines are then going thinner when they reach the furthest regions of Europe.

One pipeline is going from Turkey through Bulgaria to Greece and Romania. It is connected to the gas resources of the Caspian Sea. While Romania has a good gas transport network using mostly national resources and Russian gas, Greece has quite a poor connection to gas. This could change when the large gas reserves of the Middle East will be more widely exploited, making the route through Turkey of major importance.

The pipelines between Morocco and Spain and between Tunisia and Italy secure the gas supply from Algeria, though connection through the Pyrenees has to be reinforced.

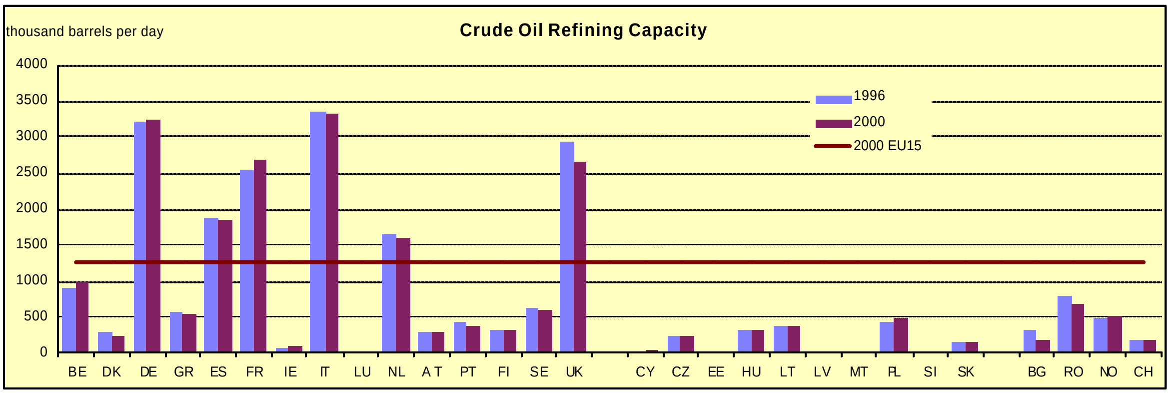
Another way of reinforcing connection to Algerian gas resources is by developing LNG (Liquid Natural Gas) terminals. Spain is not a gas producer but has clearly decided to switch large part of its electricity production to gas. Apart from the pipeline going through the strait of Gibraltar, it already has 4 LNG terminals and plans to construct 2 more. Portugal also recently opened one LNG terminal. Those terminals are important as the Iberian Peninsula miss gas storage capacities to modulate gas supply.

Most gas storage capacities can be found in France, Northern Germany and in Central Europe.

Variable 5 – Refinaries Capacity

Approximately 55% of crude oil refining capacity in the EU29 is located in Germany, France, Italy and United Kingdom. In the period 1996-2000 the crude oil refining capacity reduced in average by 1,4% in EU15 and it grew by 3,6% in N10.

Figure 15 - Crude Oil Refining Capacity in 1996 and 2000

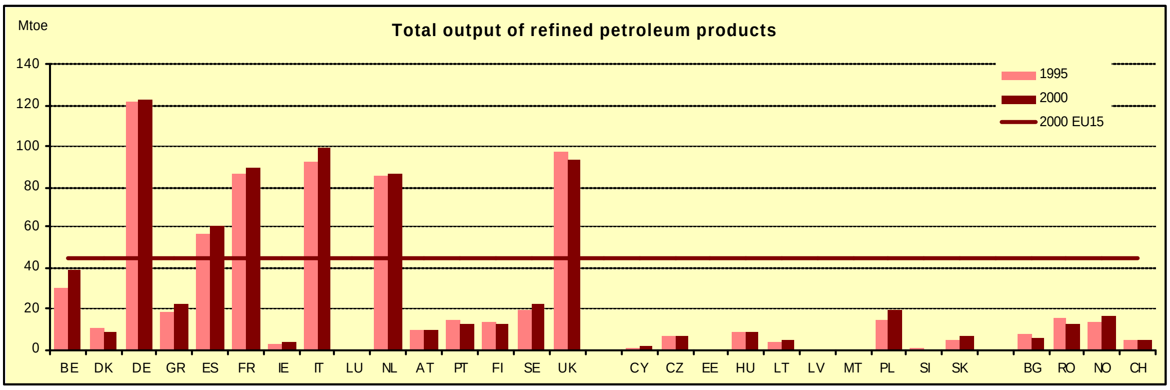


Source: EIA, International Energy Annual.

To access the importance of refinery in fossil fuels primary consumption we use the proportion of crude oil refined in fossil fuels primary consumption (see analysis of indicator B11 presented in Section III). For the analysis we used the total output of refined petroleum products in million tonnes to compare with fossil fuels primary consumption.

The figure below shows that Germany, France, Italy and United Kingdom represent 50% of total output of refined petroleum products in EU29 countries in 2000.

Figure 16 - Total output of refined petroleum products



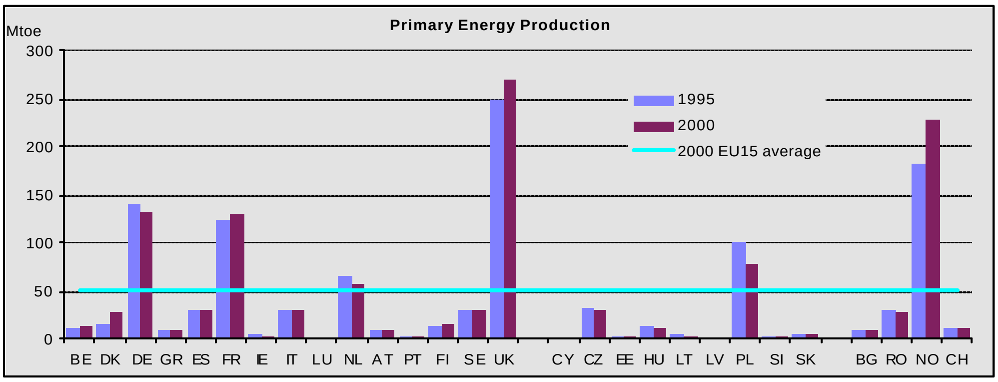
Source: EIA, International Energy Annual.

Variable 3 - Primary energy supply by energy product

Primary energy products are forms of energy obtained directly from nature, including non-renewable fuels such as coal, natural gas and crude oil, and renewable fuels such as wood, hydro-electricity and solar energy. There are few countries self sufficient in primary energy production and most countries are highly dependent on fossil fuels, especially imported oil.

In 2000, United Kingdom was the most important producer of primary energy supply in our country sample, followed by Norway. In average primary energy production in EU15 increased 3% between 1995 and 2000, and decreased 13% in N10.

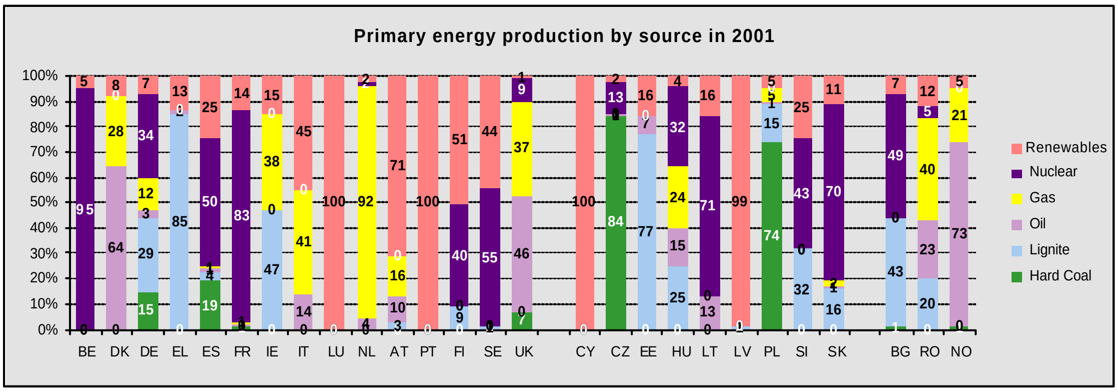
Figure 17 - Primary Energy Production in 1995 and 2000



Source: Eurostat, 2001 data for Norway and 1999 data for Switzerland. No available data for Malta.

The structure of primary energy production depends on the natural resources available in a country, which means great disparities between our country sample. For example, the proportion of nuclear energy on primary energy production is dominating in Belgium, France and in Lithuania, for example, with 95%, 83% and 71% respectively. In the Netherlands the production of natural gas is very important (92% of the primary energy production). The proportion of hydro energy is rather low in the countries referred. Although the hydropower energy potential is highly exploited for example in Belgium, it remains negligible due to the topography.

Figure 18 - Primary Energy Production by source in 2001



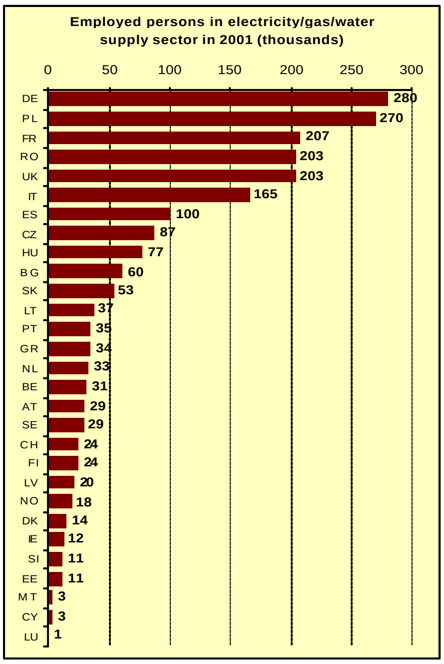
Source: "Energy, transport and environment indicators 1991-2001", Eurostat (no available data for Malta and Switzerland)

In general, European energy production is based on gas and petroleum deposits in the North Sea, which belong to the UK and Netherlands, while German potential is based on coal deposits and France on its nuclear production.

Variable 6 - Employment in the energy sector

In 2001 around two million people were directly employed in the energy sector in the EU29 countries. About a quarter of the total employment in energy sector are in Germany (14%) and Poland (13%).

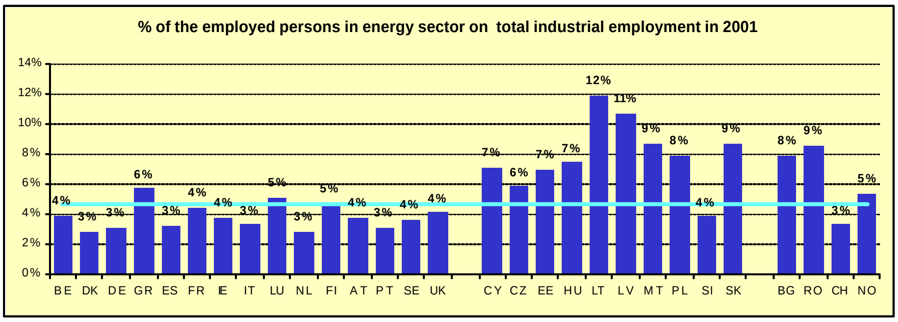
Figure 19 - Employed persons in energy sector in 2001



Source: Eurostat, National Statistics for Switzerland (2001) and Malta (2000)

Once again the absolute size of the sector reflects the size of the countries. But if we take the weight of energy sector employment towards total industrial employment (see the figure below) efficiency differences became evident.

Figure 20 - Percentage of the employed persons in energy sector on total industrial employment in 2001



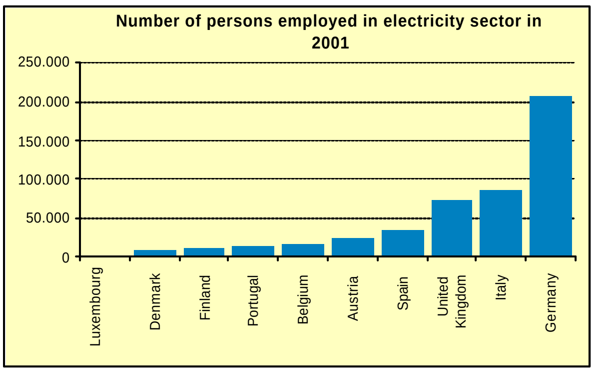
Source: Eurostat, National Statistics for Switzerland (2001) and Malta (2000)

In 2001 employment in energy sector represented in average five per cent of total industrial employment[32] with more significant importance in N10 countries (the greatest weights were in Lithuania and Latvia with 12% and 11% respectively).

At regional level NUTS 2 the differences are greater with a range of weight between regions from 1% to 22% of total industrial employment.

Regarding the electricity sector, information about employed persons by countries it was more difficult to collect in some cases because of confidentiality and other cases data was not available at all, according to Eurostat source (data from structural business statistics).

Figure 21 - Number of persons employed in electricity sector in 2001.



Source: "Competition indicators in the electricity market, 1999-2001", Eurostat, 2003

Note: provisional data for Germany and Luxembourg; no available data for Greece, Ireland, Netherlands and Norway; confidential data for France and Sweden.

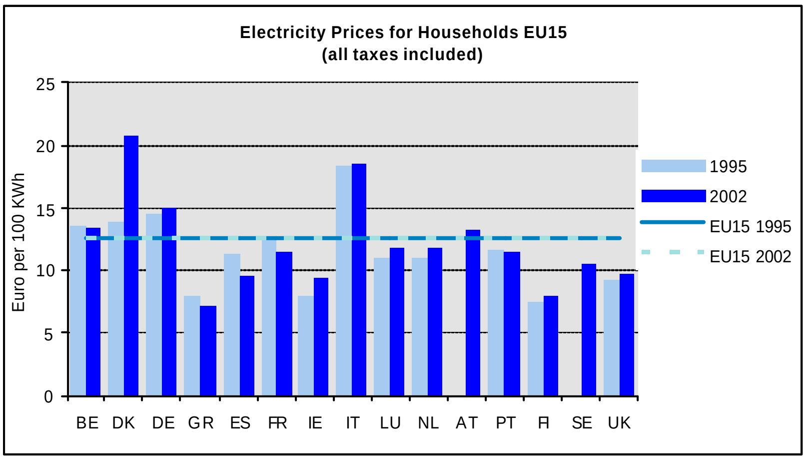
32 Accordingly to statistical classification of economic activities of the European communities industrial sector is represented by NACE C+D+E (C is mining and quarrying, D is manufacturing and E is electricity/gas/water supply).

Variable 7- Energy prices for the residential sector

Unlike industrial fuel prices, household fuel prices are affected by weather conditions with extreme temperatures pushing up or down demand and prices.

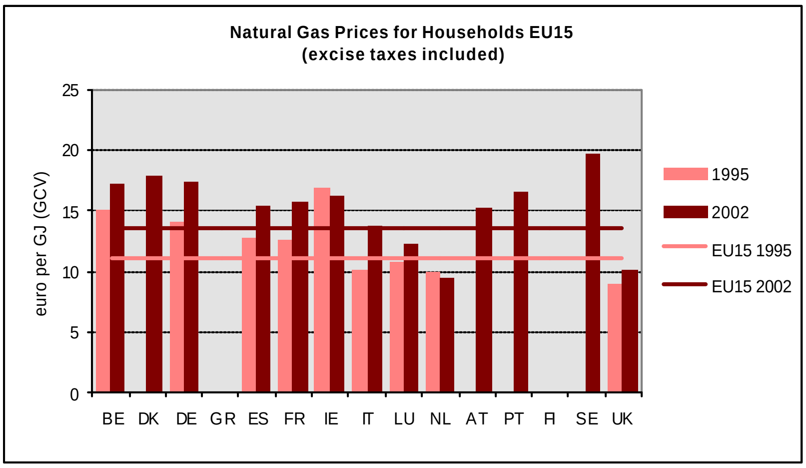
Over the observation period (1995-2002), domestic electricity price decreased 0,1%. On the other hand natural gas experienced 22% increase in the same period.

Figure 22 - Electricity Prices for households (all taxes included) in EU15 (1995-2002)



Source: “Energy &Transport in Figures 2003”, Eurostat

Figure 23 - Natural Gas Prices for households (all taxes included) in EU15 (1995-2002)

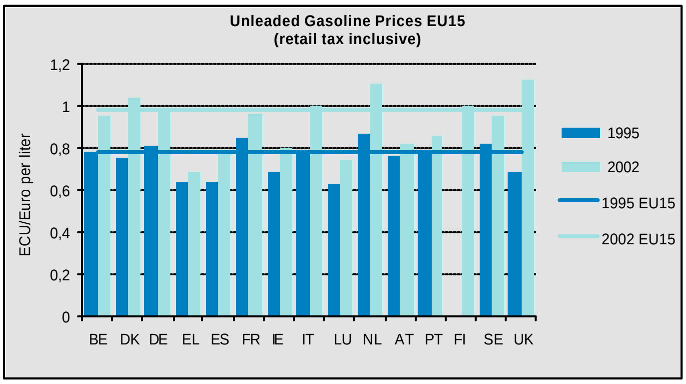


Source: “Energy &Transport in Figures 2003”, Eurostat

Variable 8 - Energy prices for the transport sector

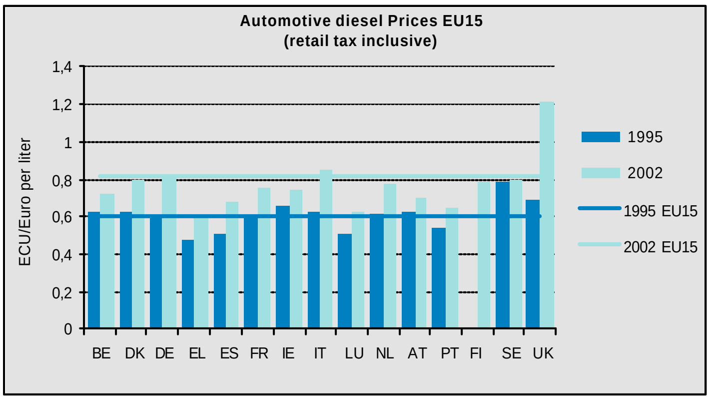
At current prices, during the period 1995-2002 the retail price (tax inclusive) of unleaded gasoline rose by 26% while automotive diesel increased by 35%. Both types of fuel exhibited related trends with similar volatility reflecting global oil market price developments. However on average diesel remained cheaper than unleaded gasoline.

Figure 24 - Unleaded Gasoline Retail Prices (tax-Inclusive) for Transport Sector (1995-2002)



Source: "Energy, transport and environment indicators 1991-2001", Eurostat, 2003

Figure 25 - Automotive Diesel Retail Prices (tax-Inclusive) for Transport Sector (1995-2002)



Source: "Energy, transport and environment indicators 1991-2001", Eurostat, 2003

Variable 9 – Duration (minutes) of electricity supply disruption

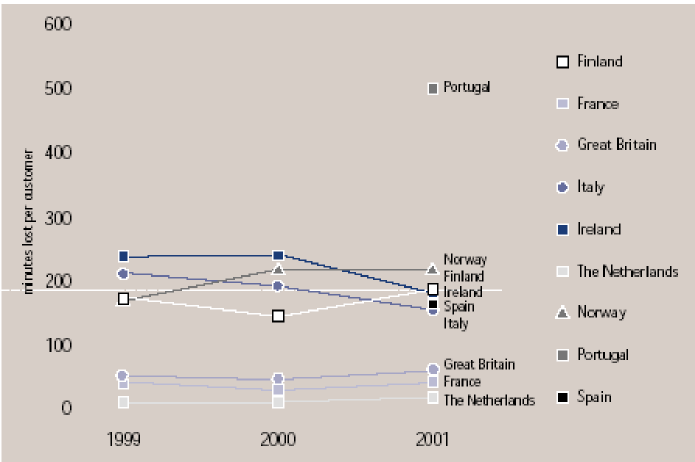
Electricity black outs remind us of the central importance of energy in our every day lives as well as the importance of a European energy policy.

In a recent study[33] about quality of electricity supply in nine European countries the minutes of electricity supply disruption are measured trough CML (customer minutes lost).

According to that study the *unplanned electricity interruptions* for the period 1999-2001 observed the following trends:

- Great Britain, France and the Netherlands, have an average annual CML consistently below 100 minutes lost per customer for each of the three years.
- Norway, Ireland, Italy and Finland have an average annual CML within a161/256 minutes range for each of the three years. Spain also lies within this range for the year 2001, the only year for which it has available data.
- For the year 2001, Portugal report high national averages for minutes lost, of 531. Natural hazards like storms could explain this outlayer behaviour, but in absence of data for other years the explanation can only be considered sufficient.

Figure 26 - Unplanned electricity interruptions minutes lost per customer per year (1999-2001)



Source: "Second Benchmarking report on quality of electricity supply", Council of European Energy Regulators, September 2003.

In seven countries some data is available at a regional or district (province) level but the number of regions vary across countries (see Annex). The disaggregated data shows sharp differences among regions and among districts in all countries where it is available. In Italy and Spain the geographical classifications can help to explain differences which arise for geographical reasons.

Using regional data for 2001, it is possible to see a positive correlation between CMLs and number of interruptions[34]. The regression results show (with an R2 of 0.82) an intercept of 3.5 minutes (which is in keeping with the definition of long term interruptions) and a slope of 64.321 minutes.

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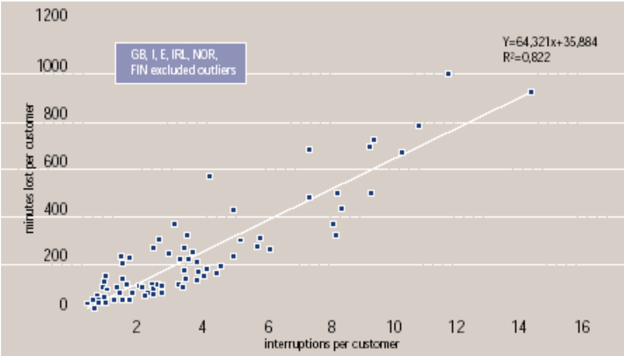
33 "Second Benchmarking report on quality of electricity supply", Council of European Energy Regulators, September 2003.

34 Customer Minutes Lost should equate to the multiple of the average duration of the interruption (minutes per interruption) times the number of Interruptions per customer plus approximately 3 minutes per customer (for so-called long interruptions).

Figure 27 - Regression analysis of the duration and frequency of unplanned electricity interruption (2001)

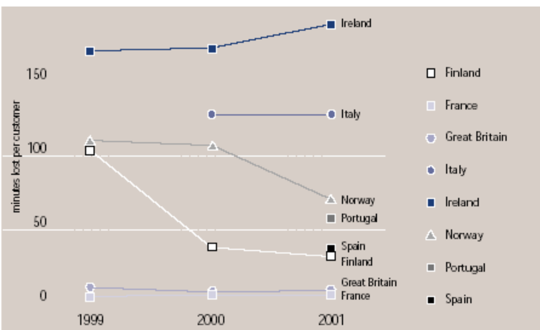


Source: "Second Benchmarking report on quality of electricity supply", Council of European Energy Regulators, September 2003.

Regarding *planned electricity interruptions* in 2001, five countries reported data for each of the three years, 1999-2001. Data for planned interruptions is not available for the Netherlands. Partial data is also available for a further three countries, Italy for the latter two years, and year 2001 data for Portugal and Spain. The following trends are observed:

- France has an average CML of 6 minutes or less for each of the three years. Great Britain too has a relatively low and consistent level of annual average CML value (of between 8.12 and 10.95) for each of the three years.
- The data shows that Finland experienced a significant drop in the average number of customer minutes lost from a high of 103 minutes in 1999 to 38 in the year 2000. This levelled off to an average of 32 minutes in 2001, which is comparable to the average in Spain (in 2001) of 36.6 minutes lost.
- Norway also experienced a fall in planned interruptions, but with the fall occurring over the course of the latter two years (from 106 minutes lost in 2000 to 70 minutes lost in 2001). Portugal has a lower average CML of 57.37 minutes for 2001.
- Data for Italy is available for 2000 and 2001. Accordingly, Italy ranks relatively high both in terms of the average number of interruptions (126.57 and 127.4 respectively) and the average customer minutes lost (0.83 and 0.79 respectively) for both of these years.
- In terms of the duration of outages, Ireland ranks highest for each of the three years, with average CML of 170 minutes in 1999 and 172 in year 2000 rising to 188 minutes lost on average per customer in 2001.

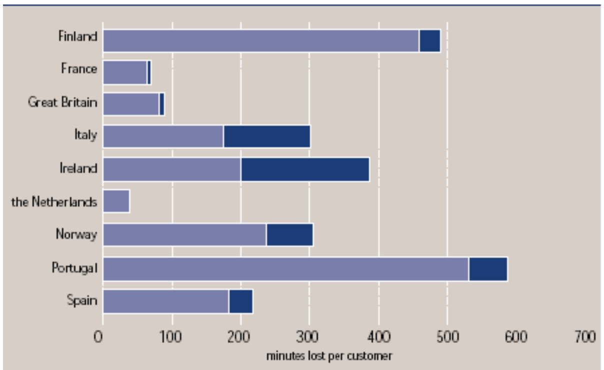
Figure 28 - Planned electricity interruptions minutes lost per customer (1999-2001)



Source: "Second Benchmarking report on quality of electricity supply", Council of European Energy Regulators, September 2003.

For a global picture, the Figure below chart the total interruptions (planned and unplanned) in 2001 on the basis of Customer Minutes Lost for the nine countries.

Figure 29 - Unplanned and Planned electricity interruptions minutes lost per customer (2001)



Source: "Second Benchmarking report on quality of electricity supply", Council of European Energy Regulators, September 2003.

The following observations can be made:

- All countries (except Ireland and Italy) show proportionately higher averages for unplanned than planned electricity interruptions.
- Significant differences are evident across countries.
- Countries can be grouped into three groups according to performance. The best performers, with the shortest average duration are Great Britain, France and the Netherlands. Second group is Portugal and Finland which show very high averages for unplanned interruptions in 2001. Finally, Spain, Norway, Ireland and Italy are on a par for the average duration of unplanned interruptions.
- For Ireland and Italy, the relatively high average duration for planned outages skews their averages for total duration of interruptions in 2001 upwards.

Section III - Energy sector overview

After presenting the difficulties of data collection and the results of core indicators and variables, it is possible to measure and compare the different aspects of the energy sector at country level and present an analysis based on the indicators proposed. These indicators have been grouped into 4 domains covering different aspects of the energy sector.

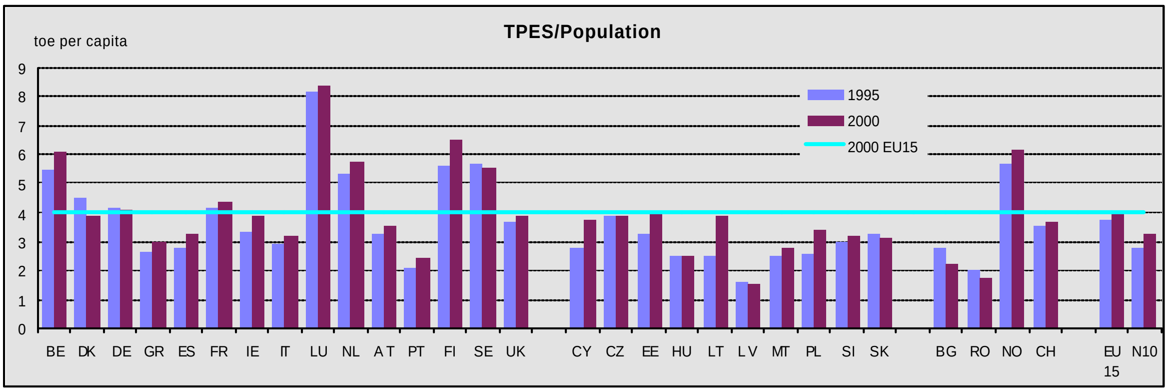
- Economy, society and energy *(indicators A)*
- Reliable supplies of energy *(indicators B)*
- Competitive energy markets *(indicators C)*
- Environmental objectives *(indicators D)*

The set of indicators proposed were calculated for the 29 countries of the study, although sometimes it was not possible to find the necessary information for all the countries for parts of the considered period (1995 to 2000). Indicators results are presented along the text and maps representation are presented in Annex.

Economy, society and energy *(indicators A)*

In 2000 *total primary energy supply per capita (A1)* was higher in the EU15 average countries than in N10 countries. This indicator can translate for example differences in welfare of population.

Figure 30 - (A1) Total Primary Energy Supply[35] per capita in 1995 and 2000



Source: Eurostat
Note: 1999 data for Malta, Norway and Switzerland.

[35] Total Primary Energy Supply (TPES) is the energy content of different energy sources as they are offered by nature before they are transformed for use. TPES is made up of domestic production plus imports and minus exports, international marine bunkers, and stock changes.

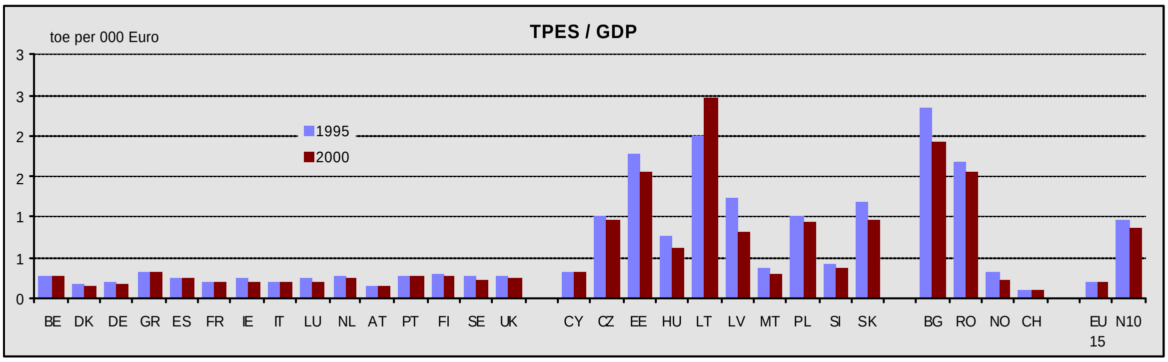
In 2000 the EU15 average energy supply per inhabitant was 3.97 toe. Countries such as Luxembourg, Finland, Sweden and Belgium are way above that average, due mainly to their small population (especially Luxembourg) and their extreme climatic conditions. In Germany and France the indicator, which is above the European average, is directly influenced by industrial development, which always requires high levels of energy consumption. Countries like Spain, Greece, Portugal and Italy have a level of consumption that is relatively lower than the average, which is directly determined by the more favourable weather conditions, which significantly reduce the amount of energy consumed.

Analysing the evolution of this indicator over 1995 to 2000, it is important to refer that total primary energy supply per capita increased by 18% in N10 and 6% in EU15. Only in four countries this indicator decreased in that period (Denmark, Latvia, Bulgaria and Romania).

The ratio TPE/GDP, *total primary energy supply per thousand Euro of GDP (A5)* gives us an idea of the energy intensity. Figure below shows considerable differences where most of N10 countries have a higher level in comparison to EU15.

However in average this ratio has been reduced by 6% in EU15 and 9% in N10 in the period 1995-2000 (exceptions are Spain, Italy, Cyprus and Lithuania).

Figure 31 - (A5) Total primary energy supply per thousand Euro of GDP in 1995 and 2000



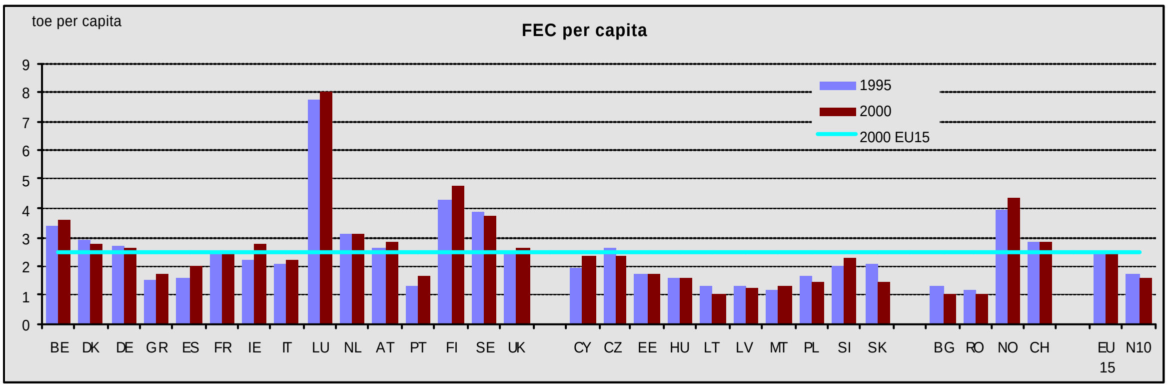
Source: Eurostat
Note: 1999 data for Malta, Norway and Switzerland.

Given that countries exhibit a range of climate, industrial structures, geographical features and economic development, changes in the aggregate energy intensity ratio are an inadequate basis for measuring and comparing energy efficiency among countries. Using only the ratio of energy use to GDP as an energy performance indicator for cross-country comparison would be misleading. However, aggregate energy intensity can be broken down to identify the factors which have contributed to the net aggregate effect. These factors may be due to the level of economic activity (the production effect); the sectoral composition of the economy (the structural effect); and energy intensities of activity within the various energy-using sectors (the real intensity effect).

Considering that *final energy consumption per capita (A2)* reflects for example the structure of the economy and the energetic efficiency of the industrial equipment and buildings, in 2000 the Scandinavian countries, as well as Luxembourg, have the highest per capita energy consumptions on our country sample, as can be seen in the figure below.

Total final energy consumption per capita in the more developed countries is about twice as high as in the New Member States, which is mainly due to higher consumption in the industry and transport sectors. It is important to note that between 1995 and 2000, Portugal, Spain, Ireland and Cyprus were the countries with more significant growth in this indicator.

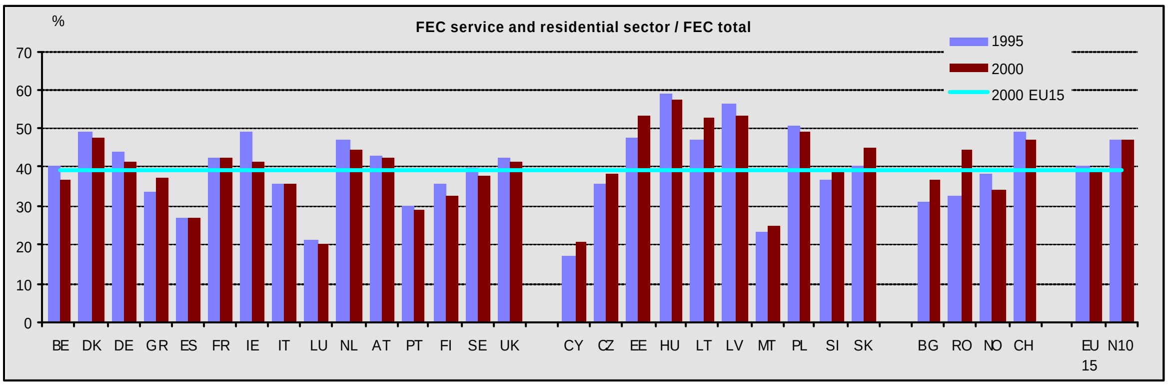
Figure 32 - (A2) Final Energy Consumption per capita in 1995 and 2000



Source: Eurostat and IEA Energy Statistics.

Observing the importance of *final energy consumption in service and residential sector (A3)* in total energy consumption, we see a more significant weight in N10 countries (see analysis of core indicator 2). In the period 1995-2000, from the EU15 countries only Greece have seen this indicator increase.

Figure 33 - (A3) Final energy consumption of service and residential sectors in final energy consumption in 1995 and 2000



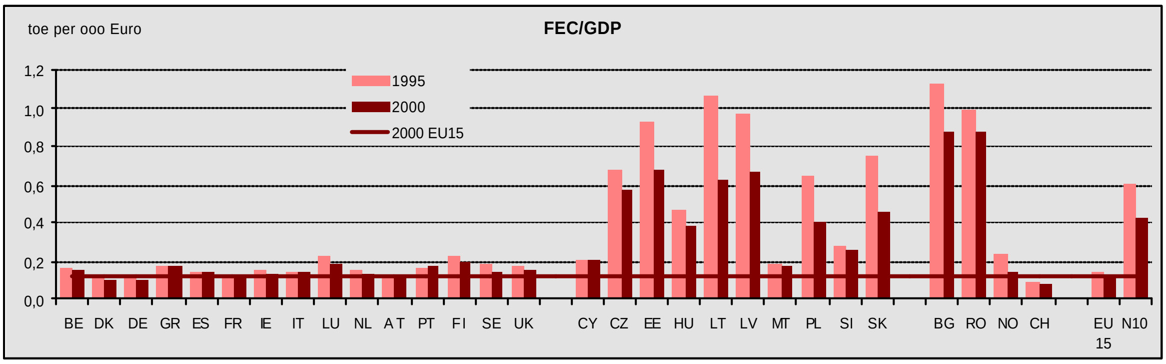
Source: Eurostat and IEA Energy Statistics.

In 2000, the average of *final energy consumption* is around 0,13 toe per thousand Euros in EU15 and 0,42 toe per thousand Euros in the N10 *(A6)*.

Large differences exist between countries ranging from 0,09 toe per thousand Euros in Denmark to 0,9 toe per thousand Euro in Romania. Besides economic inequality between countries, the difference in this indicator may also reflect differences in energy consumption patterns as well as inefficiency within energy transformation.

In the period 1995-2000 energy intensity decreased with a particularly pronounced way in N10 countries. In Eu15 energy intensity decreased also except in Spain and Portugal, which showed a higher increase than the average of their economic activity.

Figure 34 - (A6) Final Energy Consumption per thousand Euro of GDP in 1995 and 2000

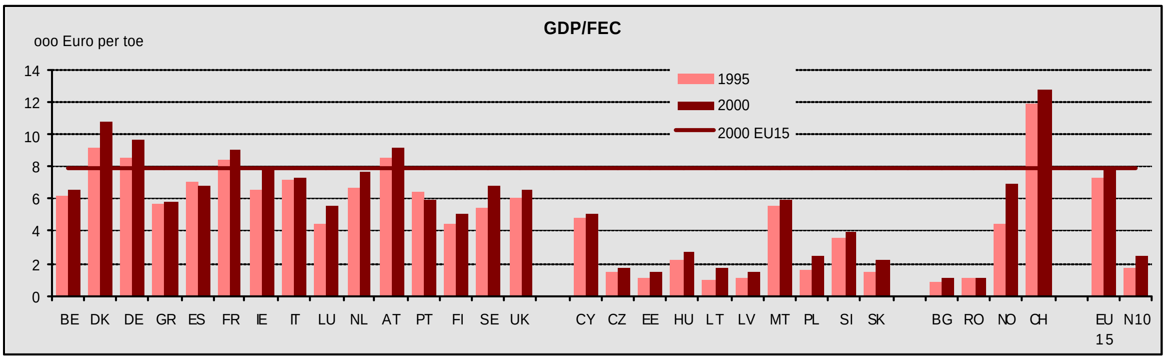


Source: Eurostat and IEA Energy Statistics.

The inverse of this indicator, *GDP/FEC (A7)*, gives the energy productivity in terms of value added. This indicator measures each country progress in terms of obtaining more economic activity per unit of energy consumed. The N10 countries are more dependent of final energy in the productive process. Only in Spain and Portugal this indicator decreased between 1995 and 2000.

We must have in mind that the indicator can be influenced by relative weight of the economic sectors.

Figure 35 - (A7) GDP / FEC in 1995 and 2000



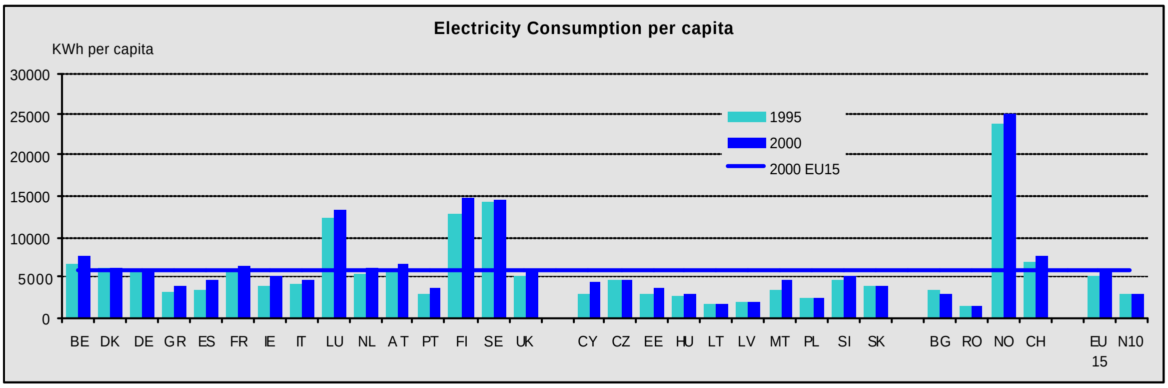
Source: Eurostat and IEA Energy Statistics.

In terms of electricity sector, it is necessary to use indicators such as electricity consumption per capita (indicator A4) and average consumption in terms of GDP (indicator A8).

In the figure below we can see the evolution of *electricity consumption per capita (A4)* with a general trend of growth in the period 1995 to 2000, with exception of Lithuania, Bulgaria and Romania.

There are great differences between countries. Although the European average is 5.895 kWh per person, the Nordic countries exceed largely that value. Luxembourg also have high values because of its very small population and because much of its industry is electricity intensive.

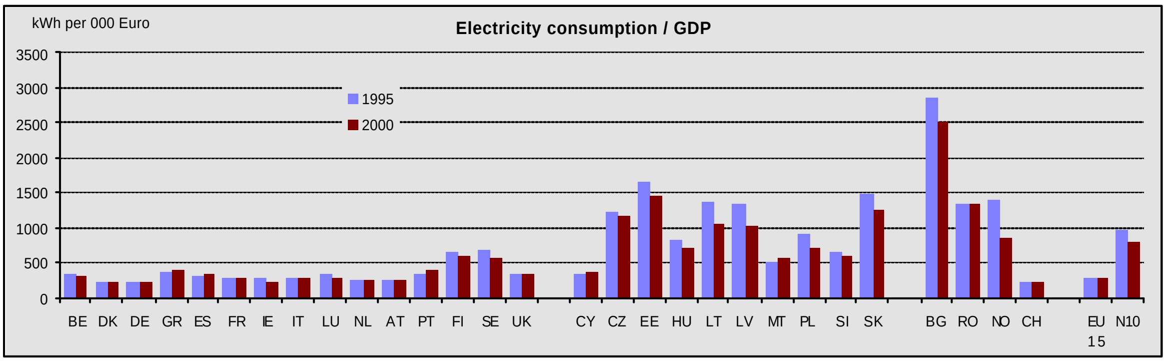
Figure 36 - (A4) Electricity Consumption per capita in 1995 and 2000



Source: Eurostat and IEA Energy Statistics.

Differences between E15 and N10 are also evident regarding *electricity consumption per thousand Euro of GDP (A8)*. The biggest consumers of electric energy, in terms of GDP consumption, are the Nordic countries in EU15 and Slovakia and Estonia in N10. Although great part of New Member States and candidate countries have a higher degree of dependence of economies from electricity, the trend is reducing this dependence to European average.

Figure 37 - (A8) Electricity consumption per thousand Euro of GDP in 1995 and 2000



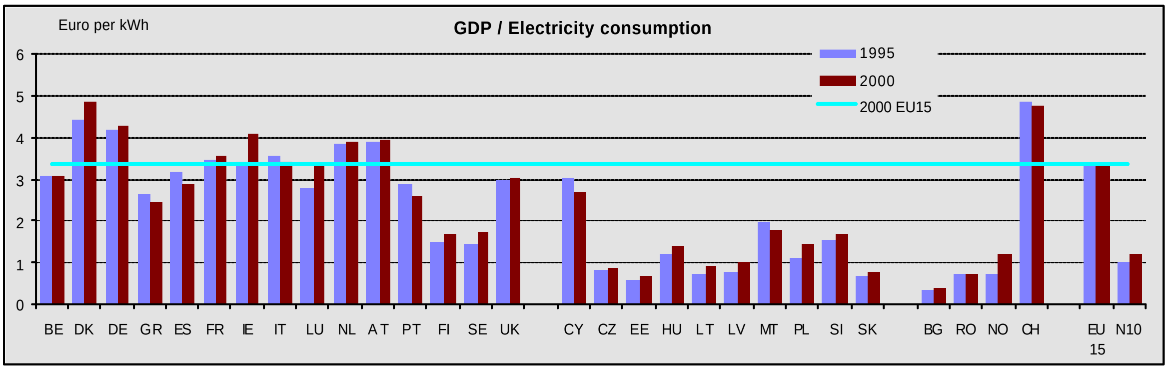
Source: Eurostat and IEA Energy Statistics.

In cases of high electricity consumption in relation to GDP and low electricity consumption per capita, the explanation lies partly in electricity intensive industries, plus a lower GDP and a level of energy efficiency of industries which is below the other European countries.

We must notice the influence of certain key factors, which affect, to a greater or lesser degree, the level of consumption of electric energy: factors such as climatic conditions, the economic structure of the country, energy consumption habits with regard to certain energy sources, plus efficiency in the use of energy.

The inverse of this indicator is *GDP/electricity consumption (A9)* which measures the relative efficiency in using electricity.

Figure 38 - (A9) Electricity productivity in terms of GDP in 1995 and 2000

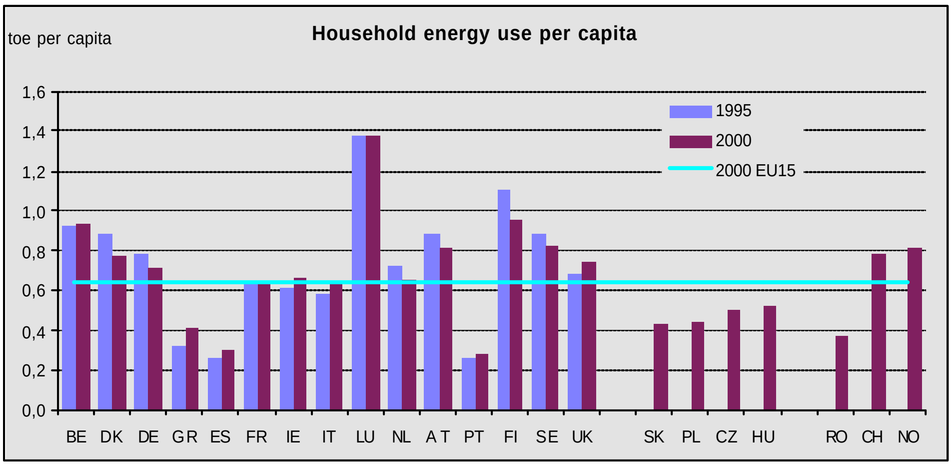


Source: Eurostat and IEA Energy Statistics.

Analysing the amount of *household energy use (A10)* there are great differences between countries. This variation is a combination of many factors, such as climate, comfort levels, energy efficiency and energy prices.

Within the EU15, northern countries generally have higher levels of household energy use per capita than southern countries, reflecting the fact that much household energy is used for heating The countries with the lowest levels of such as Greece, Portugal and Spain, have experienced increases in this indicator between 1995 and 2000.

Figure 39 - (A10) Household Energy use per capita in 2000



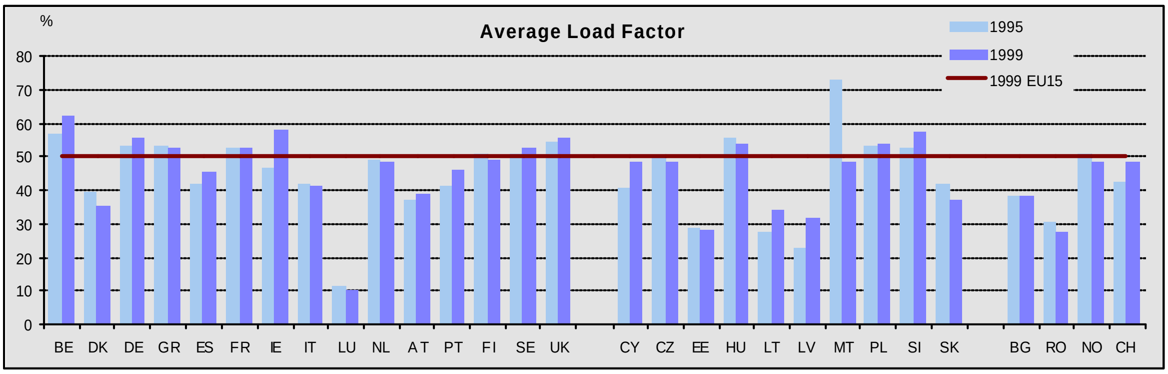
Source: Eurostat, IEA Energy Statistics and The Department of Trade and Industry of United Kingdom data for N10, Romania, Switzerland and Norway.

Reliable supplies of energy *(indicators B)*

Rely on secure supplies of energy is fundamental to the economy as a whole and to sustainable development, which requires the right infrastructure and liberalised energy markets in Europe.

The average percentage of generating capacity used, reflected in *average load factor (B1)*, is quite different among countries, as well the respective evolutions in the period 1995-1999 in the case of EU15 and 1995-1998 in the rest of the countries. Luxembourg is an exceptional case with a low value for this indicator.

Figure 40 - (B1) Average load factor in 1995 and 1999

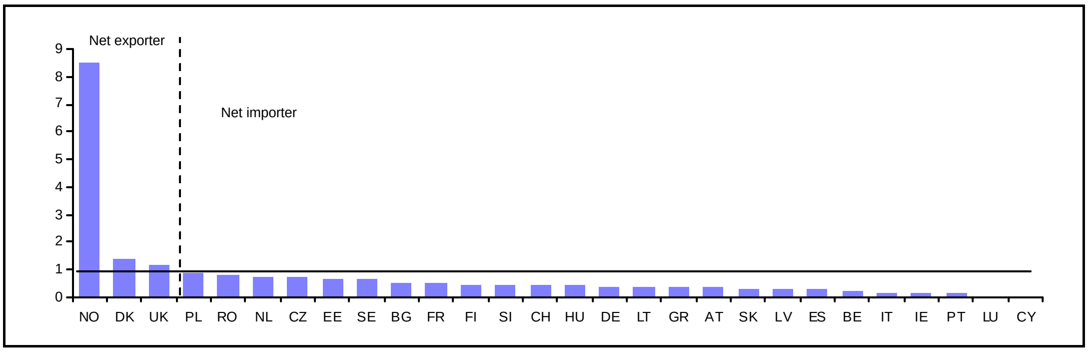


Source: "2001 - Annual Energy Review", 1998 data for New Member States, Bulgaria and Romania

To measure the primary energy self sufficiency we use indicator *B8*, giving the picture of security of supply in terms of primary energy consumption. In the next figure it is possible to see that Norway's position is exceptional in producing 8 times as much energy as it consumes in 2000. Besides Norway only two countries, United Kingdom and Denmark, had a surplus of energy over their own requirements.

It is important to refer that N10 countries have a high level of self-sufficiency. Poland is the most outstanding case, with around 90%, due mainly to its important coal deposits, while the Czech Republic has reached 75%.

Figure 41 - (B8) Ratio of energy production to primary energy consumption in 2000



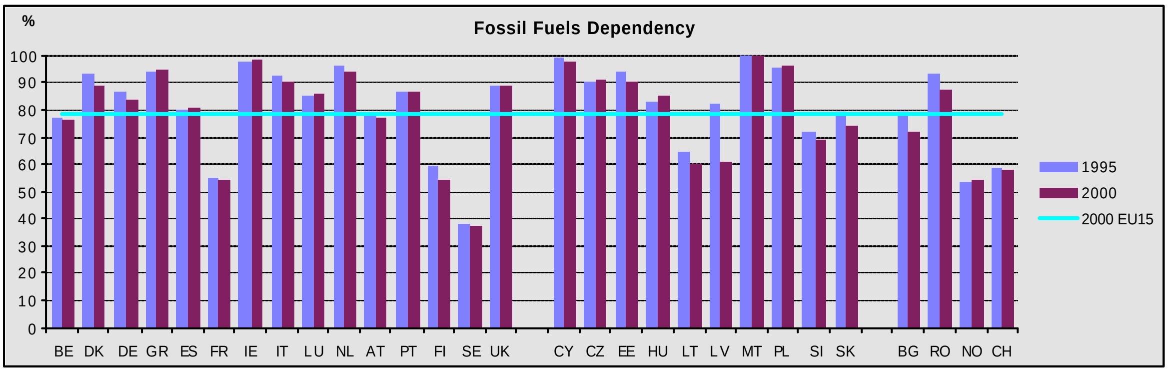
Source: Eurostat. 2001 data for N10 and Norway

Between 1995-2000 energy dependency was reduced in average. A lower result of this indicator means high dependence from energy imports.

The proportion of primary energy consumption met by coal, oil and gas gives a measure of a country's *dependence on fossil fuels (B9).* In 2000, the countries least dependent on fossil fuels, such as Sweden, Norway, or France, have well developed sources of nuclear or hydro electricity.

Most countries have reduced their dependence on fossil fuels since 1995 by developing alternative sources. In average EU15 reduced by 1,7% and N10 by 1,1%.

Figure 42 - (B9) Fossil Fuels Dependency in 1995 and 2000



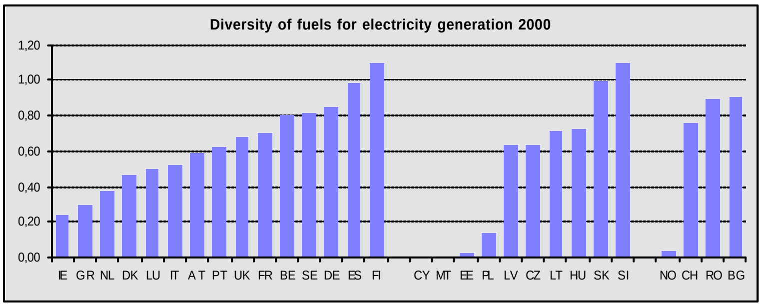
Source: Eurostat, 2001 data for N10 and Norway

Energy investments are costly, risky and require long-term commitments. For that reason energy security policies should emphasizing the expansion and diversification of energy supplies. The mix of primary fuels consumed for energy purposes has become increasingly diverse in the last years.

Diversification contributes to security of supply carrying out benefits for individual consumers and for the national economy. Is one of the major objectives of national energy policies, thereby contributing to reduce the dependence on one source of energy and seeking to increase the level of self-supply through the use of one's own resources in order to lessen the vulnerability of energy and the level of dependence on outside sources.

In the case of fuels used for electricity generation, *diversity of supply (B6)*, the *Shannon-Weiner measure of diversity* (described in the detailed analysis in section I) increased between 1995 and 2000 for a great part of the 29 countries (exceptions were Austria, Greece, Luxembourg, Sweden, Czech Republic, Hungary and Slovakia).

Figure 43 - (B6) Diversity of fuels used for electricity generation in 2000

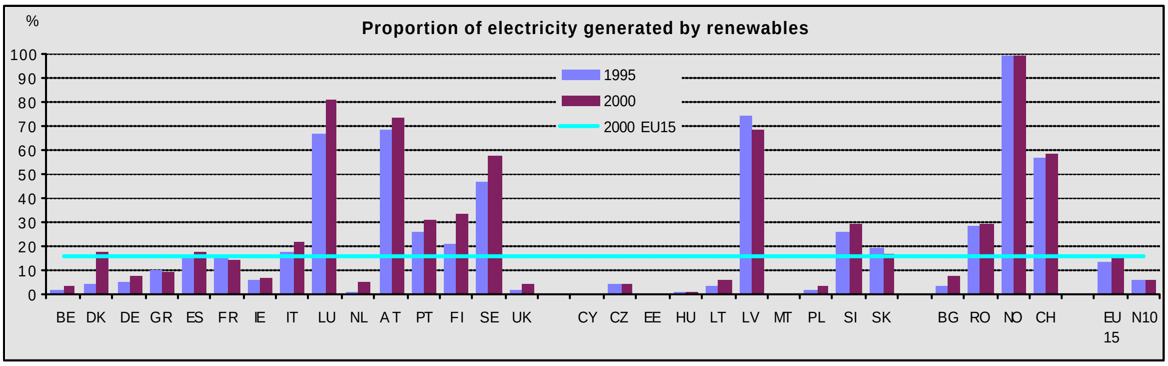


Source: "Energy and Transport in Figures", Eurostat

In 2000 countries such as Finland and Slovenia, with higher values of the Shannon-Weiner measure, have energy systems less dependent of a reduced number of fuels.

In 2000, the *proportion of electricity generated by renewables (B5)* is significant in countries such as Norway and Luxembourg for example, although it must be understood that the nature of renewable in this context is very different among countries.

Figure 44 - (B2) Proportion of electricity generated by renewable in 1995 and 2000



Source: "Energy and Transport in Figures", Eurostat

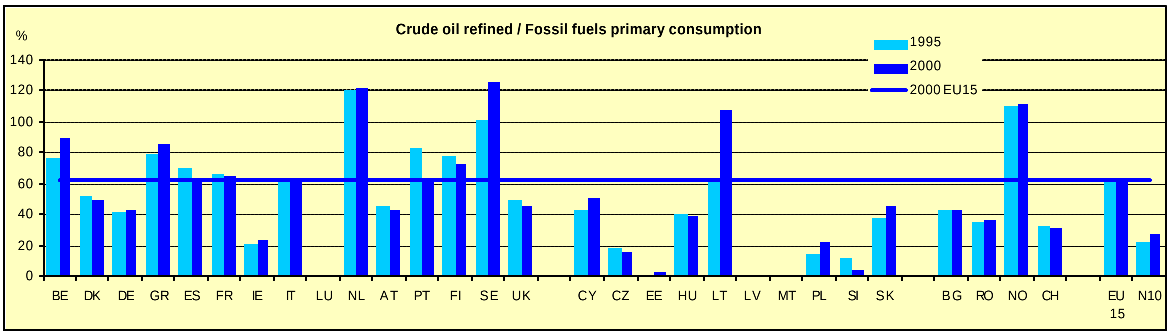
Evolution of *proportions of electricity generated liquid and solid fossil fuels, as well as natural gas* in each country can be seen trough indicators *B3, B4 and B5* in the Annex.

For indicators like *Gas Capacity (B7), and Grid density high and medium voltage (B12)* it was not possible to collect consistent data until now besides the maps presented in Annex.

For the construction of indicator *crude oil refined / fossil fuels primary consumption (B11)* we collected data for output of refined petroleum products (see variable 5). In the case of N10 countries, Bulgaria, Romania and Norway fossil fuels primary consumption refers to the year 2001.

In the figure below we can see that the proportion is higher than EU15 average in countries like Belgium, Greece, Netherlands, Finland, Sweden and Norway in 2000.

Figure 45 - (B11) Proportion of Crude Oil refined in Fossil Fuels Primary Consumption in 1995 and 2000



Source: "International Energy Annual", EIA; Eurostat; Eurosgas
Note: Crude Oil refined refers to Output of Refined Petroleum Products. For N10, Bulgaria, Romania and Norway fossil fuel primary consumption refers to 2001.

<u>Competitive energy markets</u> *(indicators C)*

In energy markets competition does not guarantee lower prices and may be based on other factors such as quality of service. Prices paid by final consumers are influenced by several factors including: international prices of key raw materials such as crude oil; the balance of supply and demand; taxes; and the costs of extracting, manufacturing (i.e. refining or generation), distribution, retailing and marketing individual fuels.

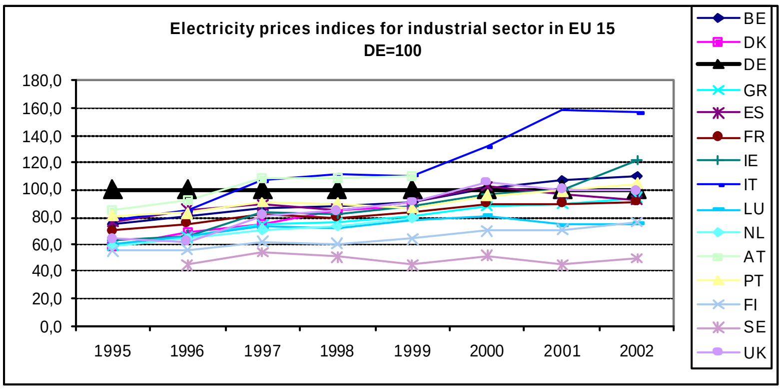
In an exercise of assessing the relative competitiveness among countries it should be underlined that comparing prices across countries involves many questions such as the relative levels of inflation and exchange rates, taxes and individual market structures.

Therefore, we analyze the evolution of relative price indices of electricity and natural gas prices used by industry sector (C1). These indicators shows the trends in electricity and natural gas prices indexed to Germany prices (considered the largest consumer country in this study).

With Germany electricity prices as basis for comparison and considering that those prices decreased there much more then anywhere else (see core indicator 3), we realize that EU15 haven't been able to follow up this trend, improving their competitiveness.

As we can see in the figure below the situation in 2002 is quite different from 1995, reflecting a trend of larger disparities between electricity prices for industry.

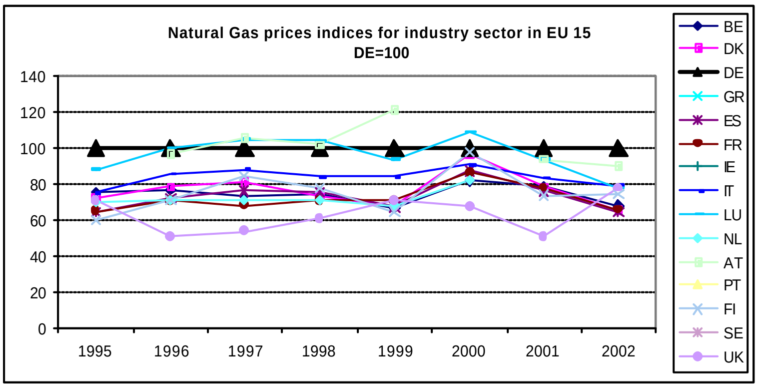
Figure 46 - (C1) Electricity Prices Indices for industrial sector (Germany=100)



Source: "Energy &Transport in Figures 2003", Eurostat

Regarding natural gas prices trend for industry, after a period of some instability in 2002 the situation became similar to the year of 1995.

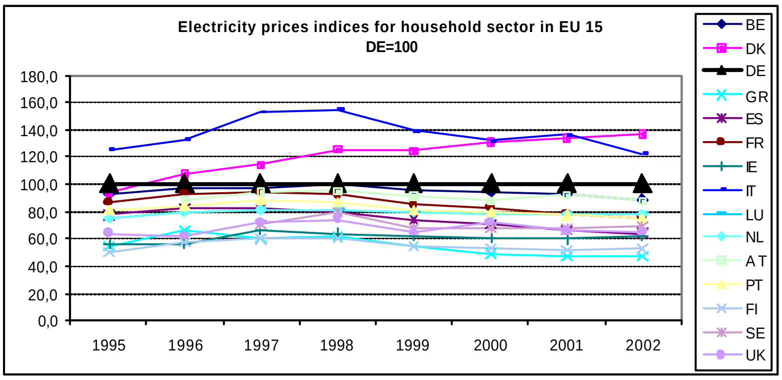
Figure 47 - (C1) Natural Gas Prices Indices for industrial sector (Germany=100)



Source: "Energy &Transport in Figures 2003", Eurostat

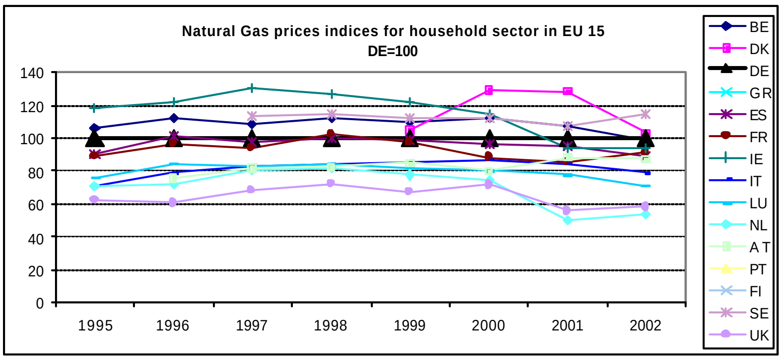
For *price indices of electricity* and *natural gas prices used by the household sector* (C2) the disparities among countries are larger when comparing to Germany prices. Comparing the situation in 1995 to 2002 the differences are not significant.

Figure 48 - (C2) Electricity Prices Indices for household sector (Germany=100)



Source: "Energy &Transport in Figures 2003", Eurostat

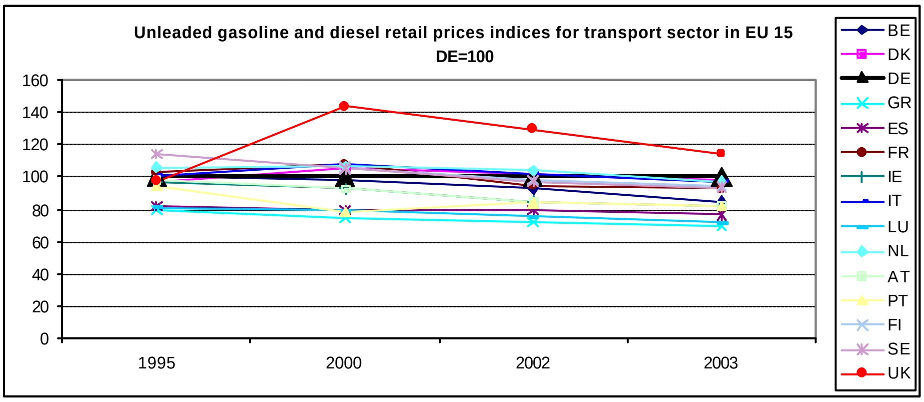
Figure 49 - (C2) Natural Gas Prices Indices for household sector (Germany=100)



Source: "Energy &Transport in Figures 2003", Eurostat

Observing the *price indices of fuel prices used by the transport sector* (C3) the disparities among countries are smaller when comparing to Germany prices. Only in United Kingdom there was a more significant divergence between 2000 and 2002 when comparing with Germany prices.

Figure 50 - (C3) Fuel price indices for the transport sector (Germany=100)

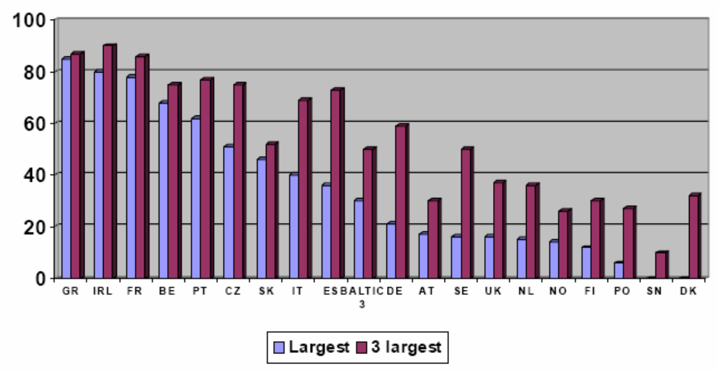


Source: "Energy, transport and environment indicators, 1991-2001", Eurostat.

To measure of the degree of concentration in the electricity generation market using the indicator *competition in electricity generation (C4)* (Herfindahl-Herschmann measure) was a difficult task because of availability of data. Therefore we opted to use the data presented in the European Commission Communication about the degree of concentration in each generation market, in terms of the share of the largest, and the three largest companies.

The graph below has been adjusted (i.e. lowered) by taking into account the amount of import capacity, recognising that this is also a source of competition.

Figure 51 - Concentration of largest companies in electricity generation market



Source: "Energy Infrastructure and security of supply", COM(2003) 743 final, December 2003

(http://europa.eu.int/comm/energy/electricity/infrastructure/doc/2003/com_2003_743_en.pdf)

In that document it is referred an unsatisfactory position in a number of the 25 Member States with the following striking examples:

- Greece, where the "Public Power Company" (PPC) controls the domestic generation market and connection with Balkan neighbours is not well developed,

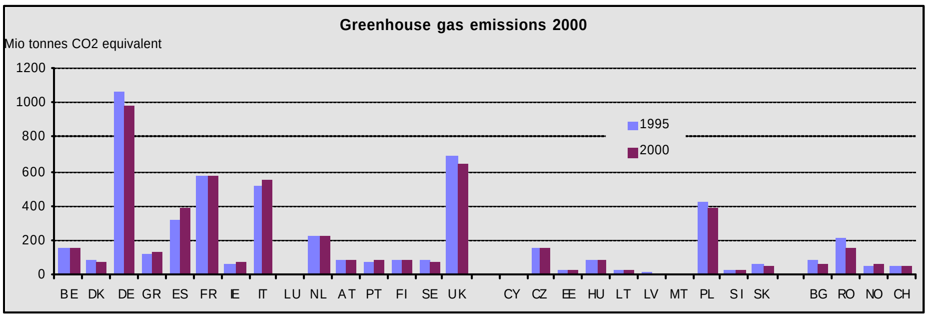
- Ireland, where Electricity Supply Board's (ESB) position continues to be isolated from potential competitive pressures and where there is insufficient interconnection with Northern Ireland and the wider EU market
- France, where Electricité de France's (EDF) position can only be challenged to a limited extent through imports,
- Belgium, where the dominant position of Electrabel is compounded by insufficient import capacity,
- A number of the new Member States (e.g Czech Republic, Slovakia), where transmission grids need to be reinforced and\or further upgraded to allow competition between former incumbents,
- Austria, where reinforcement of the national network is needed to ensure sufficient cross border competition with the newly merged "Energie Austria",
- Italy where reinforcement of connections with neighbouring countries, especially, Austria and Slovenia would increase reliability and provide greater diversity,
- Finally, in Spain and Portugal, the slow progress in developing interconnectors and the completion of an integrated market still means that the largest companies retain a significant degree of control.

Environmental objectives *(indicators D)*

The objective of energy efficiency activities is to ensure rational use of energy resources and reduce adverse environmental effects of energy use. Reducing greenhouse gas emissions is getting the main reason for efficient use of energy.

The following indicator shows a positive evolution on the reduction of amounts of CO_2 equivalent released to the atmosphere between 1995 and 2000. Emissions have declined substantially in almost all of the New Member States and candidate countries, mainly due to the introduction of market economies and the consequent restructuring or closure of heavily polluting and energy-intensive industries. However there were exceptions like Slovenia, Cyprus and Malta. In EU15 the exceptions were Italy, Spain, Greece, Portugal, Austria and Ireland.

Figure 52 - (D1) Greenhouse gas emissions in 2000

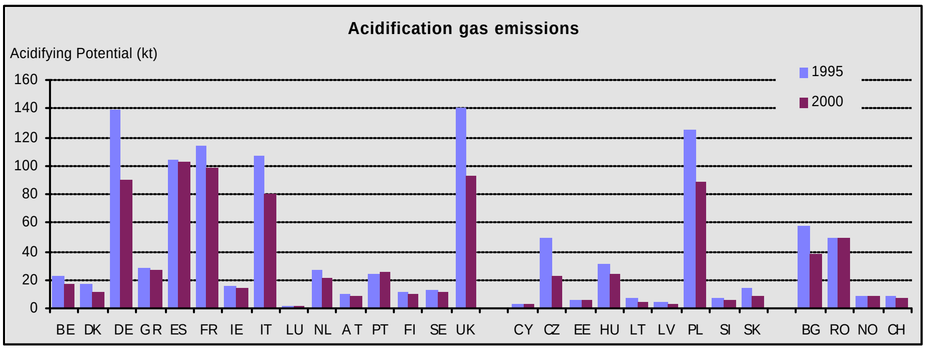


Source: "Energy, transport and environment indicators 1991-2001", Eurostat

The reduction in energy intensity (see indicator A5) between 1995-2000 in almost EU29 countries is a positive factor for controlling overall GHG emissions. For example in the United Kingdom the reduction of greenhouse gas emissions was partly a result of the liberalisation of the energy market and subsequent changes in the choice of fuel used in electricity production from oil and coal to gas.

Regarding the *emissions of acidifying substances (D2)* in the EU15 have decreased by 21% between 1995 and 2000, and by 34% in the 10 new Member States. In EU15 the biggest reductions have been in Germany and United Kingdom, in N10 was in Czech Republic and Latvia.

Figure 53 - (D2) Acidification gas emissions in 1995 and 2000



Source: "Energy, transport and environment indicators 1991-2001", Eurostat. No available data for Malta.

Note: The acidifying substances considered in this publication are sulphur dioxide (SO2), nitrogen oxides (NOx) and ammonia (NH3). Emissions of these gases are associated with the formation of acid rain.

Synthesis

In this energy sector overview of our country sample it were evident the complexities and differences between energy statistics. The key energy indicators used can give us a global picture of strong and weak points of the energy sector, as well the potential for regional development and the bottlenecks for spatial development.

However, along this chapter it was clear that geographical features as well as the social and economic conditions of each country have a direct bearing on the overall picture. Therefore, the structure of that overall picture depends on the energy resources of the country, the organisation and productive structure, as well as the level of experience in the use and exploitation of certain energy sources.

The major trends observed in the country sample of our study were the following:

In the New Member States:

- Primary energy production and energy consumption declined;
- Final energy consumption decline, despite GDP growth;
- The share of transport sector in final energy consumption increased while industry declined;
- Increasing share of electricity in final energy consumption but below EU15 average;
- Significant contribution of solid fuels in electricity generation;
- Energy intensity improvement;
- GHG emissions reduction more significant than in EU15.

In the European Countries:

- Renewable energy production increased;
- Slow growth of overall energy consumption, with fuel mix changing in favour of gas;
- Gas prices rose significantly;
- Electricity prices decreased in industrial and domestic sectors as a result of increasing competition between producers and technological improvements;
- Energy intensity improved;
- GHG slightly reduced.

Of the range of indicators set out, some are more closely linked to energy policy objectives than others. In our next final interim report we intend to bring up to date respective data.

5. METHODOLOGY FOR TERRITORIAL IMPACT ASSESSMENT

The development of methodologies for territorial impact assessment is heavily dependent on the availability of relevant data and, until now, we have not been able to overcome the severe lack of energy data at a regional level.

In this section we present:

a) Some results of the analysis at country level and at regional level for a country (France) in view of identifying relevant relations between energy and development. The conclusion is that econometric models will be of little help to put in evidence the impact of energy on territorial development, mainly on account of the severe lack of data.

b) A brief reference to the methodologies most frequently used to assess the economic impact of energy shocks, with a particular emphasis on the general equilibrium models. The most important references will be OECD Interlink model, IMF multimode model and GEM-E3 model. This will highlight the results we obtained by a much less sophisticated method.

   These references will be made in the context of a theoretical reasoning on what we can expect about energy territorial impact and of the presentation of results of some studies that aim to quantify the economic impact of changing the conditions of energy supply, namely recent studies on the impact of increasing oil prices. The conclusion of these studies point to a significant but small impact. The results we obtained are coherent with the conclusions of these studies.

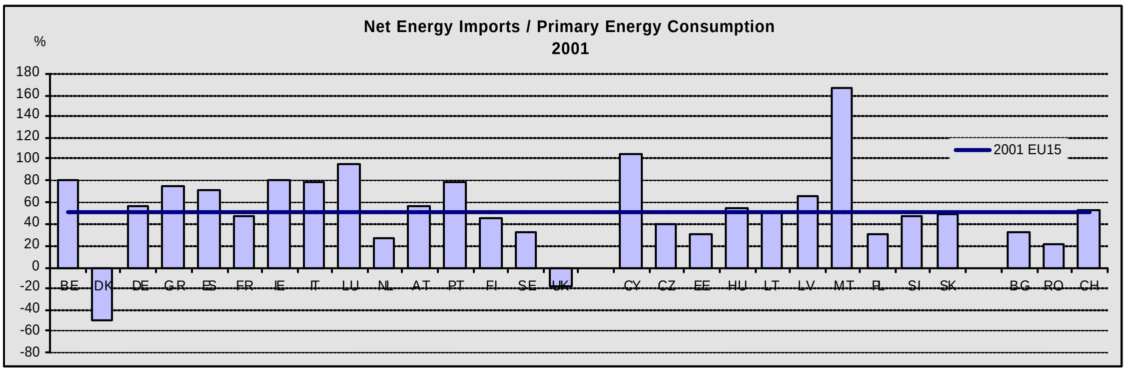
c) The framework we developed to assess energy territorial impact and the results obtained for different European countries and regions. Although this methodology presents several weaknesses, it seems feasible and able to reach a pertinent indicator.

A. Energy and Development: some results of a cross-country analysis

With the exception of Norway, United Kingdom and, more recently, Denmark, European countries are net importers of energy. European Union imports about 50% of its primary energy consumption and the dependence rate increased from 51.6% in 2000 to 52.4% in 2001[36]. New members and candidate countries, as a whole, have a much lesser dependence rate, due to the low dependence level of Poland, Romania and Czech Republic, but several countries do not cover 50% of its energy needs. Europe is the largest net energy importer in the world.

[36] Eurostat, Statistics in Focus, Theme 8- 19/2002

Figure 54 - Net energy imports and primary energy consumption in 2001



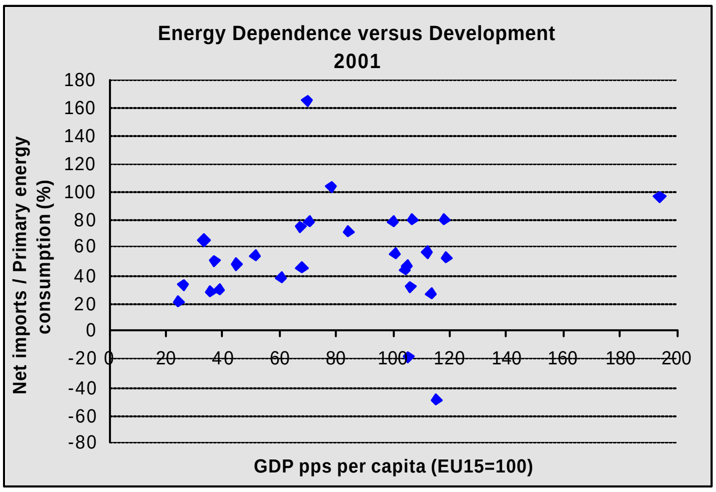
Source: Eurostat.

Note: For sake of legibility, Norway is not represented on this chart.

Energy is fundamental for almost every human activity and access to energy is crucial for economic development. But we cannot expect to find a clear relationship between development and energy. Nowadays, energy is more or less easily transportable and, at least in the long term, countries and regions will be able to find a reasonable answer to their energy needs.

Although this doesn't mean that different conditions of energy supply do not impact on the rhythm and path of economic growth, the fact is that there is no relation between the level of energetic self-sufficiency and economic development when measured by the GDP per capita (pps).

Figure 55 - Energy Dependence and Economic Development, 2001



Source: Eurostat.

Note: For sake of legibility, Norway is not represented on this chart.

But, it must be stressed that the story of industrialization is, most of the times, told as the story of the energy sources. Industry developed, from the XVIII to the XX Centuries, at the pace of energy revolutions from water mills to electric engines.

The impact of energy in development is frequently seen as a sort of "energy ladder"[37] where energy supply and energy availability clearly acts as a determinant of economic development.

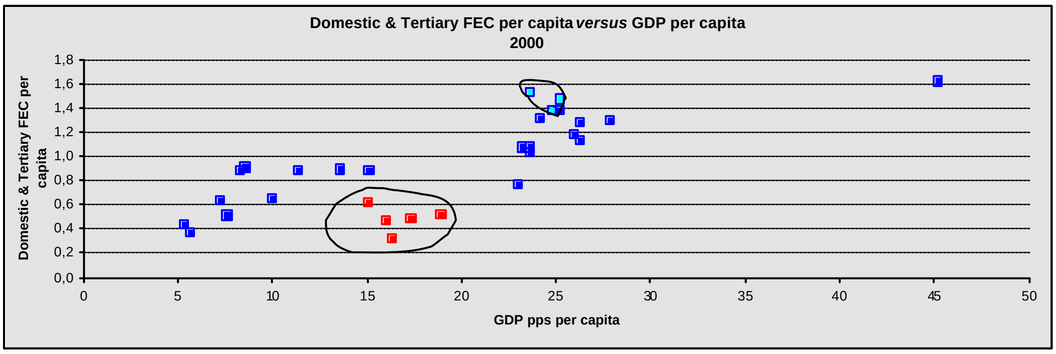
Energy availability here means its existence (whether or not there are sources of energy that can be mobilized and used by industries and households), its cost (whether or not its cost allows industries and households to make affordable use of it) and its quality (whether or not industries and households can rely on energy supply without the heavy burden of long and frequent disruptions or stream variations).

This idea means that relations among economic development and energy change as economies progress through different development thresholds, so pointing to the advantages of regional and national typologies as a mean to identify and understand policy needs.

Nevertheless, in most energy models, is energy that responds to economic growth and this seems apparent in Europe. The result of the technological progress has been a decrease in energy intensity. In EU-15 energy intensity (GIC/GDP) per 1000 Euro was in 2001 almost 20 kgoe less than in 1992.

Climate variations are a relevant factor of different rates of energy consumption and may blur relations with other pertinent variables.

Figure 56 - Domestic and tertiary energy consumption and GDP per capita, 2000



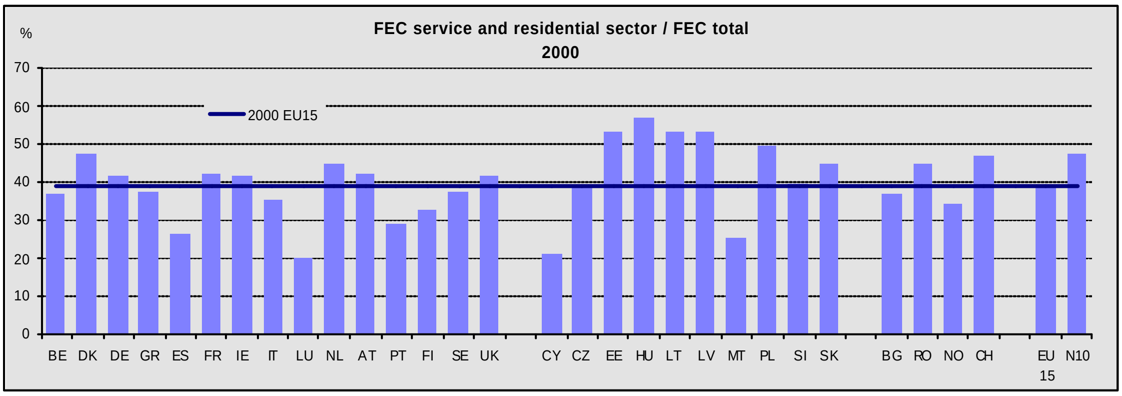
Source: Eurostat.

In Figure 3, the Mediterranean and Nordic countries are identified, but it is clear that, in what concerns households, the most important factor seem to be differences in wealth. There is a clear and linear relation between domestic and tertiary per capita energy consumption and GDP per capita (correlation = 0.77). This relation is even stronger (r=0,88) when only EU-15 countries and households' consumption are considered.

Another important relation, inasmuch as domestic and services consumption is concerned, could reflect economic structure and building efficiency. This is shown in data provided in figure above.

37 The expression has been used by BARNES, D. and W.M. Floor (1996), "Rural Energy in Developing Countries: a Challenge for Economic Development", Annual Review of Energy and Environment 21: 497-530, but a very large number of other works on Economic Development had used the idea before to define the pace of "industrial revolutions", see for instance FREEMAN, Christopher (1988), Technology Policy and Economic Performance – Lessons from Japan, Pinter Publishers, London, pp.68 to 76.

Figure 57 - Share of service and residential energy consumption in Final Energy Consumption

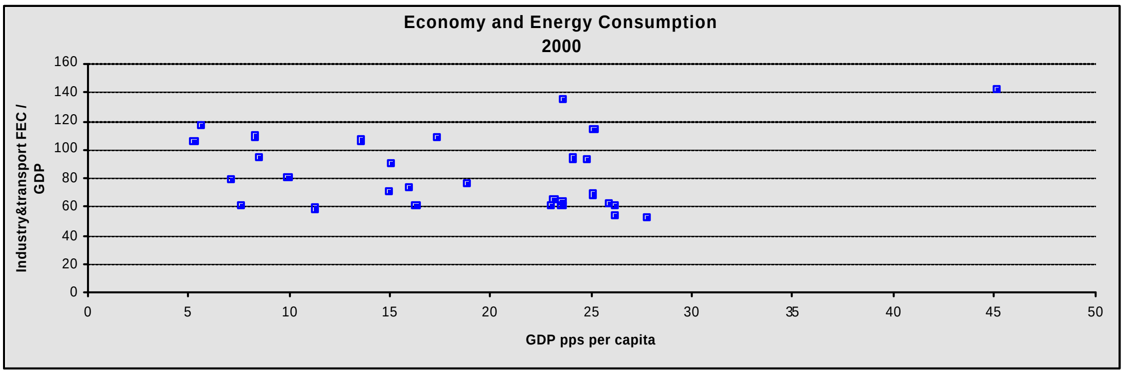


Source: Eurostat and IEA Energy Statistics.

Note that New Member States and candidate countries, although having lower levels of service sector development and lower levels of electric domestic utilities, use a larger share of its electric consumption in services and residential sectors than EU average. This can only be explained by a lower development of industrial sector, industrial energy supply relying in other energy sources and lower building energy efficiency.

Excluding Norway, Finland and Luxemburg, it seems there to be an inverse relation between development and the intensity of economic uses of energy (industry and transport energy consumption divided by GDP (pps)). Higher levels of development mean a higher proportion of services and higher energy efficiency.

Figure 58 - Economic development and energy consumption, 2000

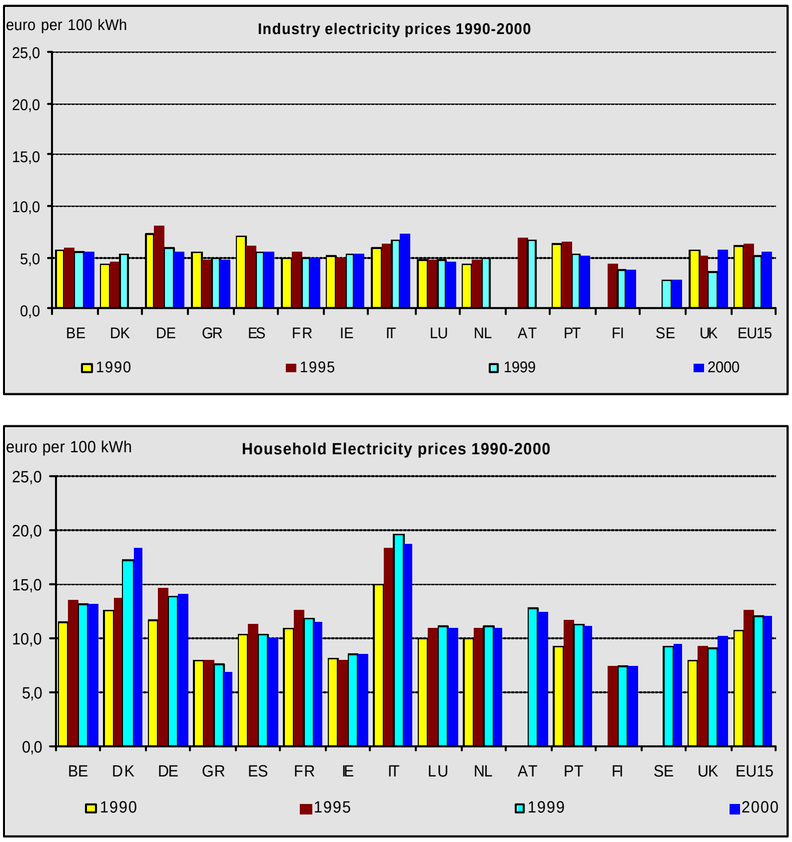


Source: Eurostat.

Energy prices will be the core variable through which territorial energy impacts will occur. But in spite of some weak statistical relations that can be estimated, energy prices seem not relevant to explain either energy consumption or development differences between countries. Energy sector has been a strongly regulated sector and energy prices include several components that are not determined by market forces. A very important parcel of energy prices are taxes and excise duties. Until now, we were not able to find any significant statistical relation between energy prices, energy consumption or rhythm of economic growth. Perhaps, there is here a problem of time lag that needs time series or more sophisticated econometric relations.

Next figures provides a picture of price trends of electricity in EU countries from 1990 to 2000.

Figure 59 - Industry and household electricity price trends 1990-2000

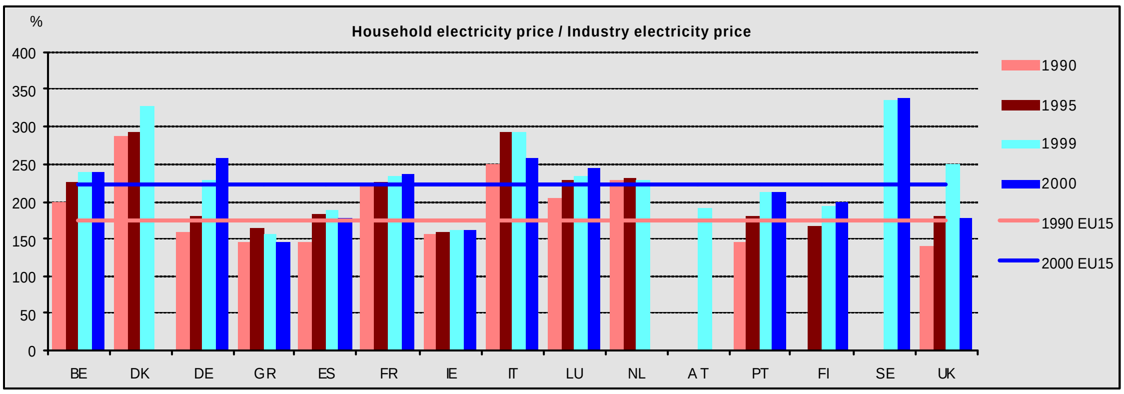


Source: Eurostat.

A number of features can be highlighted from this data. First the heavy differences on prices from industry to domestic at country level, the different trends in prices and much more closeliness of prices for industrial sector than for domestic uses.

Next figure pictures the average differences between industrial and residential prices on EU countries in 1999.

Figure 60 - Relation between household and industry electricity final prices

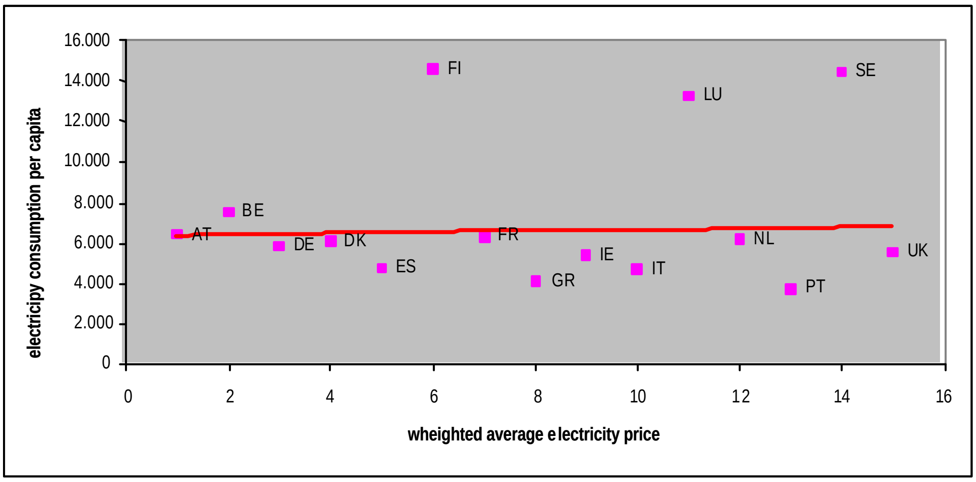


Source: Eurostat.

Note that, on average, the EU domestic prices are one and half times higher for households than for industrial facilities and cross-country differences go from three and a half times to one and a half higher. This evidence exposes that energy price policies strongly vary among EU countries.

But no evidence can, again, be found of structural relation between electricity consumption and price level, as it is pictured in the next figure[38].

Figure 61 - Electricity consumption and electricity prices in EU countries in 1999

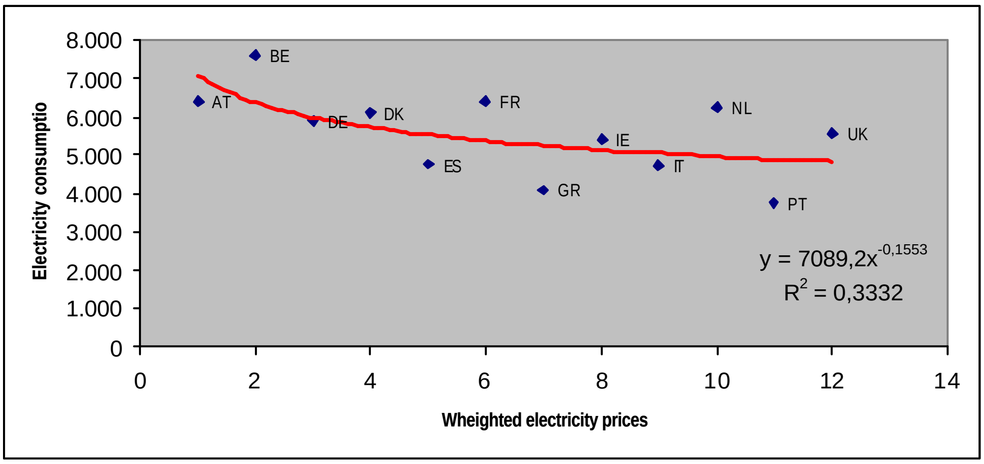


Source: Eurostat.

The picture clearly shows that EU countries have a distribution of electric consumption per capita that has no relation with price level.

But if we exclude from the analysis the countries that are shown out of the flock (Finland, Luxemburg and Sweden)[39], a relation among prices and consumptions seems to appear, as it is shown in the next figure.

Figure 62 - Electricity consumption and electricity prices in some EU countries in 1999



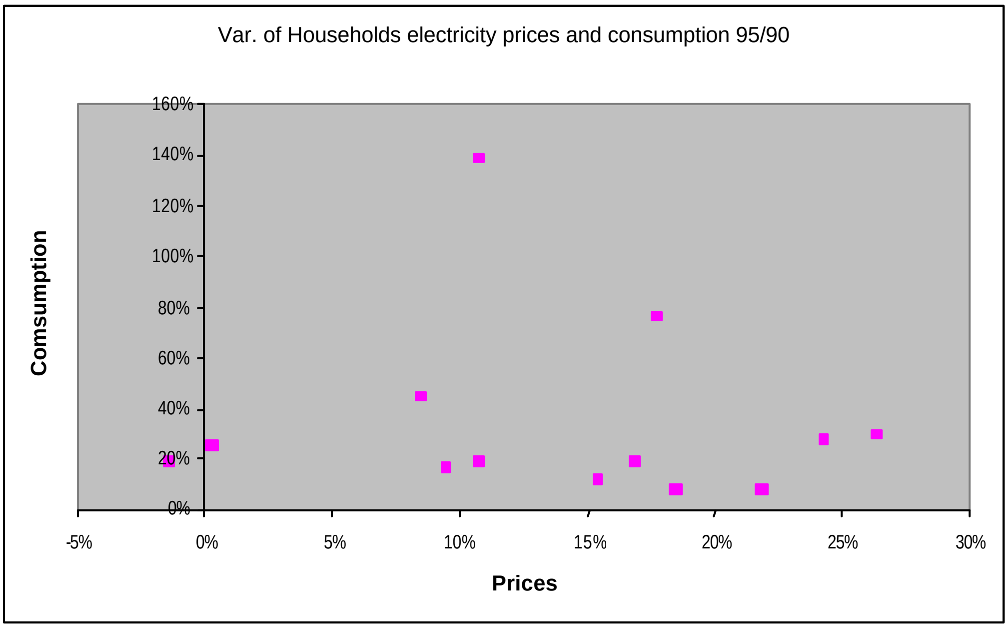
Source: Eurostat.

[38] Data is referred to 1999 and weighted prices are based on average prices per sector and relative share on total electricity consumption.

[39] This is acceptable because in Finland and Sweden climate generates different household consumption patterns and in the case of Luxembourg the urban agglomeration also implies a different analysis.

Obviously, no cause-effect relation can be deduced from that relation and if we consider the dynamics of prices and consumptions the outcome is also not very clear as it is portrayed in the next figure.

Figure 63 - Variation of electricity prices and consumptions of EU households from 1990 to 1995



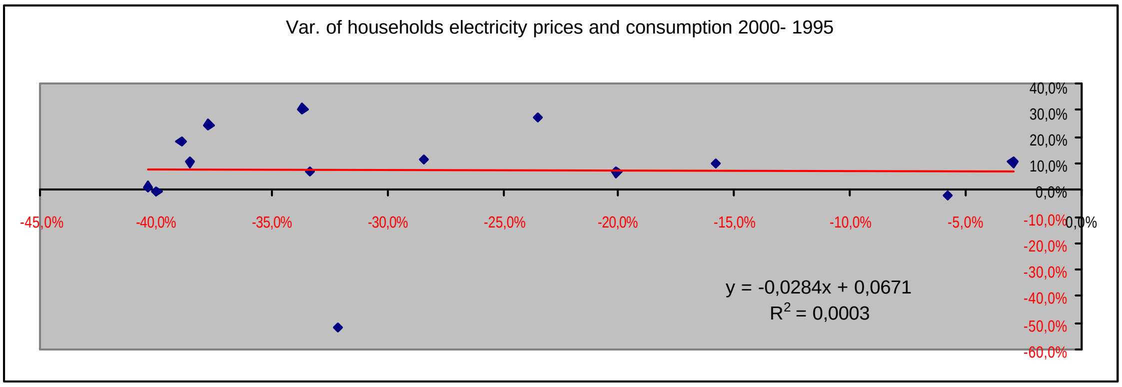
Source: Eurostat.

Note that most variations are positive, so consumptions and prices grow. The statistical relation is very weak, and it can be said little more that in a number of countries larger price increases may have lead to lower consumption growths. Differences in households' wealth and in the rate of changing the consumption patterns will be more relevant than electricity price variations.

If, again, we excluded from the regression countries that show different performance, in this case Belgium and Luxembourg for having abnormal consumption growth rates, statistical relation doesn't improve.

Taking the period 1995-2000, the statistical relation does not hold either, even if the overall environment is one of price reduction for every surveyed country.

Figure 64 - Variation of electricity prices and consumptions on EU households from 1995 to 2000

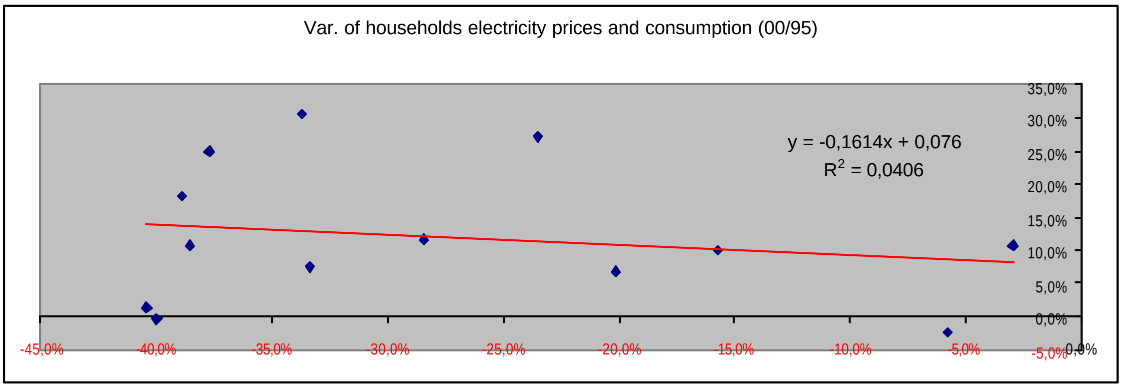


Source: Eurostat.

Countries with higher price reductions have experienced stagnant consumption (Germany and Spain) while others with price reductions above 25% have experienced significant increases (France, Greece, Ireland and Portugal).

Even if we experiment regression with a set of countries that excludes those with more deviant performance (in this case Luxemburg, which associates to price reduction a strong consumption reduction) the outcome is not clear at all.

Figure 65 - Var. of households electricity prices and consumption (00/95) in selected EU country sample

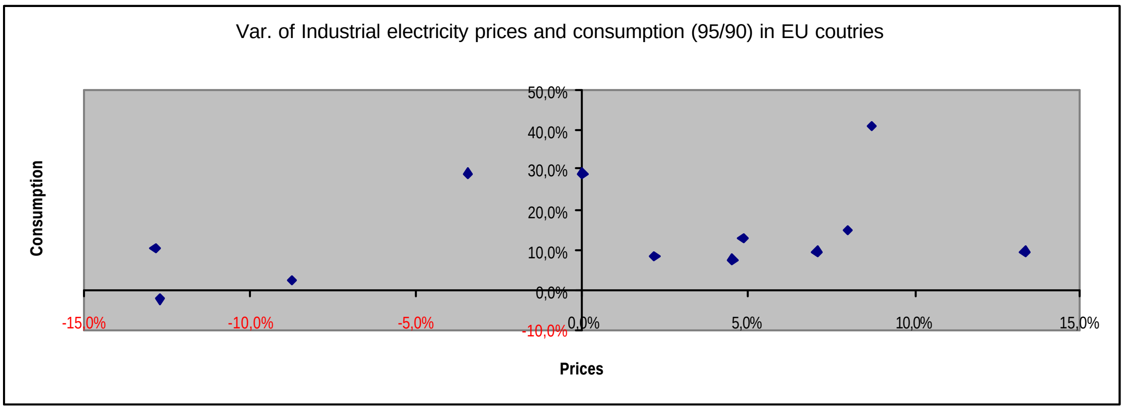


Source: Eurostat.

If we try to access similar relations with industry data (electricity prices and consumptions) the outcome is not clear either.

In the 1990-1995 period a mix of policies can be portrayed with an overall outcome of consumption growth.

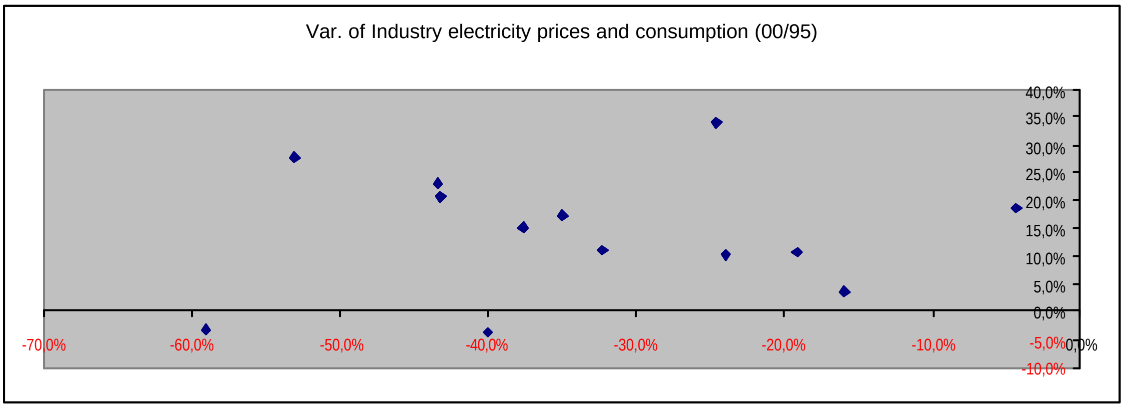
Figure 66 - Variation of industrial electricity prices and consumption (95/90) in EU countries



Source: Eurostat.

In the period 1995-2000 overall price trend is towards a general price reduction, but performances by industries are also mixed, even though an increase in consumption is more frequent.

Figure 67 - Variation of industry electricity prices and consumption (00/95)

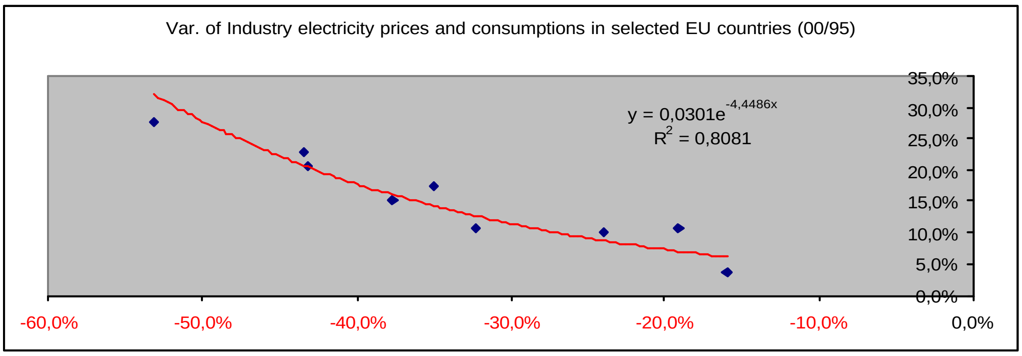


Source: Eurostat.

Anyway, it must be acknowledge that substitution of energy sources could have played a role here.

Figures point to an inverse relation between prices growth and growth of electricity consumption by industry. If we take a narrower set of EU countries (Italy Belgium, Denmark, Spain, Finland, Greece, Netherlands, Portugal and UK[40]) we get a solid statistical relation among price variation and consumption variation, which is pictured in the following figure.

Figure 68 - Variation of industry electricity prices and consumptions in selected EU countries (00/95)



Source: Eurostat.

Although this last relation must be more deeply investigated, the provisional conclusion is that national data do not establish an empirical support to put in evidence econometric relations between energy and the development level.

When we go to the regional level, what we can expect is that all the possible relations are weakened. Energy flows inside a given country are much easier and the normal situation is a small differentiation (if any) of energy prices among regions of the same country. We have tried relations at regional level for French regions[41] with data referred to 1998. For the moment, we found that:

40 Thus excluding France, Germany, Ireland and Italy, for which data is available.

41 Source: Observatoire de l' Énergie

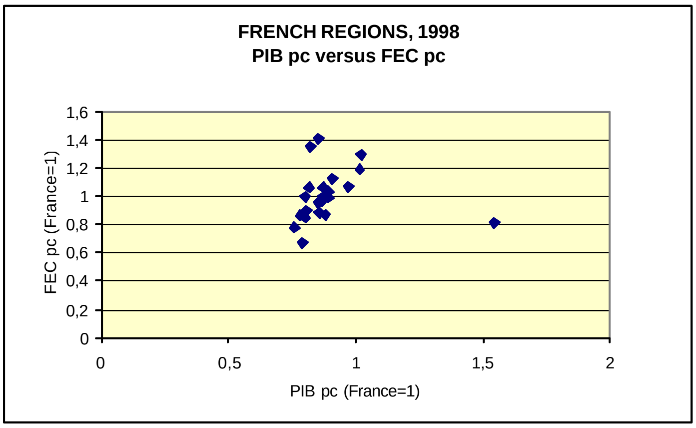
a) Final energy consumption is much lesser concentrated in Ile-de-France than economic activity: Ile-de-France represents 29% of GDP but only 15% of FEC. Other regions represent a higher share of FEC than the respective share of GDP.

b) There is no statistical relation between energy production and energy consumption, although the first region in primary energy production corresponds to the second economic region.

c) Development level (GDP pc) does not discriminate among regions in what concerns the structure of consumer sectors.

d) Even when Ile-de-France is excluded, only a weak relation (r=0.54) exists between GDP per capita and FEC per capita and nothing can be said about the direction of the relation cause-effect.

Figure 69 - GDP and Final Energy consumption in French regions



What we can conclude is that the complexity of determinants of energy consumption and of relations between energy and economic growth and the severe lack of time series data on energy at regional level will make very difficult to identify significant spatial relations concerning the energy territorial impact.

B. Methods for assessment of energy territorial impact

B.1 The nature of territorial impact

One can identify five different types of energy territorial impacts:

a) *Direct employment and GDP*

As an economic activity energy represents an important parcel of employment and a significant contribution to the added value of national and regional economies. For instance, in France[42] the energy sector corresponds to 3% of GDP and about 230 000 (direct an indirect) jobs.

However, we may encounter examples of investments in energy infrastructures in a certain region that have but a very small impact at regional level. Wind farms are one example: equipment installation and exploitation are not supposed to have very important local effects. The main impacts of this renewable source are the global emission reductions. On the opposite sense, bio-mass can be an important contribution to employment in some rural areas.

[42] Repères sur l'énergie en France, (www.industrie.gouv.fr/energie/statisti/se_stats.htm)

b) *Location and competitiveness factor*

As an average, energy is not a very important direct cost for industry. For instance, in Belgian manufacturing, energy accounts only for 2.7% of total cost of acquisitions[43]. But its importance can be much higher, namely in what concerns activities like non-metallic mineral products, chemical industries or manufacture of basic metals.

On the other hand, there are very important differences of energy prices between countries and between energy sources. The 2002 average EU-15 electricity prices for industry was € 5.49 per 100 kWh and the average natural gas prices was €4.91 per GJ(GCV). Differences between countries were in the order of € 2.62 (S) to € 8.32 (I) in the case of electricity and in the order of € 4.17 (P) and € 7.73 (S) in natural gas[44].

Market liberalization and European energy networks integration will have significant impacts in prices[45] and different impacts on the competitiveness of economic activities in each territory. Such impacts will be stronger in territories with a more energy-intensive economy.

Persistent market segmentation factors (e.g. taxation), the entry of new operators in the market and uneven conditions of access to different energy sources (e.g. unavailable access to natural gas in some regions) will maintain the existing large price gaps between different regions, impacting on corporate competitiveness and on decisions made in connection with business location.

However the relation between regional development and energy policy vectors is not always obvious.

c) *Income transfer*

Europe is heavily dependent on imported energy and there is no coincidence of the regions that produce and the places of consumption of the energy. Regions that "export" energy may have in this activity an important source of income, although in most cases, mainly in cases of hydro-electricity or wind or solar energy, the revenue for producing regions may be extremely weak in as much as these facilities are owned by non residents in the region. In some cases the economic advantages for these regions are limited to some kind of redevance paid to territorial communities for the use of natural resources.

d) *Households behaviour and quality of life*

Domestic and tertiary consumption accounts for 39% in 2000 of EU final energy consumption and transport for another one third. Energy and transport represent a substantial part of household's expenses. It seems there to be a close relationship between energy consumption and households' wealth.

This means that energy has a strong potential to become an important factor of life cost and of quality of life and a determinant of residential and urban location choices. Namely, energy can be a decisive factor of mobility choices and impact strongly in urban form and in the use of urban space. Fuel prices may have an important impact on modal split between car and public transport. In what concerns transport, there is an evident relationship between physical planning and energy consumption.

Different prices and environmental conditions resulting from energy production and use will impact on location decisions made by households, in contexts marked both by growing mobility and tele-work opportunities.

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43 www.statbel.fgov.be

44 Excise taxes included (www.europa.eu.int/comm/energy_transport/etif/list_of_tables.html)

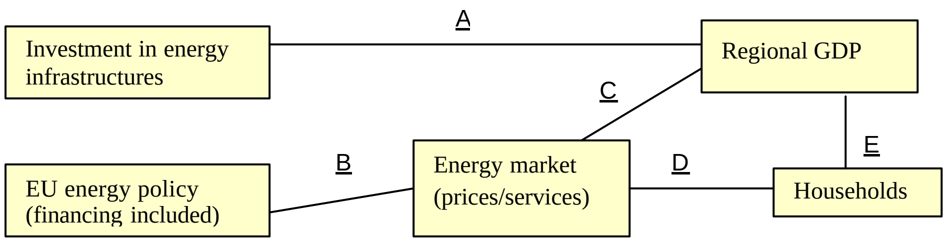
45 Numbers presented on DGTREN site show a down sloping trend in electricity prices (excise taxes included) for industry and no clear trend for natural gas prices. The reduction of energy prices may be the result of liberalisation and of the evolution of fuel costs.

e) Environment

In spite of a trend to lower energy intensity, CO2 emissions will keep growing, along with an international commitment to stabilize, and after reduce, those emissions. This puts a major challenge on the efficient use of energy, on energy saving, on the introduction of clean and renewable energies. If, on the other hand, emissions trading schemes become reality and enterprises are obliged to internalise atmospheric pollution costs, one could expect significant territorial impacts concerning economic activity location.

The final result depends on the combination of energy sources and energy uses. Transport is, perhaps, the instrumental sector to achieve international commitments and transport policy aiming at the development of more energy efficient transport modes (train, maritime and inland water transport) will cause, indirectly, considerable territorial impact.

The aim of a territorial impact assessment should be to clarify the differentiated territorial effects of energy policy and to quantify its effects on the economy and environment of the different European regions. In economic terms, the question is to find five sets of regional parameters A, B, C, D, E that permit the following transformations:



Nonetheless, our attention will be focused on the impacts operating through energy prices, that is, the impact on industry location and territorial competitiveness, since:

- Spatial pattern of energy production in Europe seems stable and new production plants will have a very localised impact. Major changes could be in what concerns renewables, but equipment installation and exploitation are not supposed to have very important local effects[46];
- Changing energy prices or the spatial pattern of energy production may affect income transfer in territorial and social terms. But there is no guarantee that this impact benefits regions where production facilities area located. The exact territorial impact only could be assessed through an analysis of the spatial distribution of the owners of the production facilities;
- Households behaviour is only relevant at the urban level and results would be meaningful only if referred to an urban region in particular.

Besides investments in energy facilities, the impacts of energy policy will be mediated by energy prices. It is why we will concentrate our attention on the relations between energy price and GDP growth, that is, in the search of a suitable operator C that can evaluate the effects of energy prices on regional GDP.

B.2. Energy and industrial location: what we can expect

Energy is fundamental for almost every human activity. So, energy availability is a necessary condition for economic growth and differences on access to energy was an important determinant of spatial patterns and territorial development. But nowadays, in developed

[46] But they may have important environmental impacts.

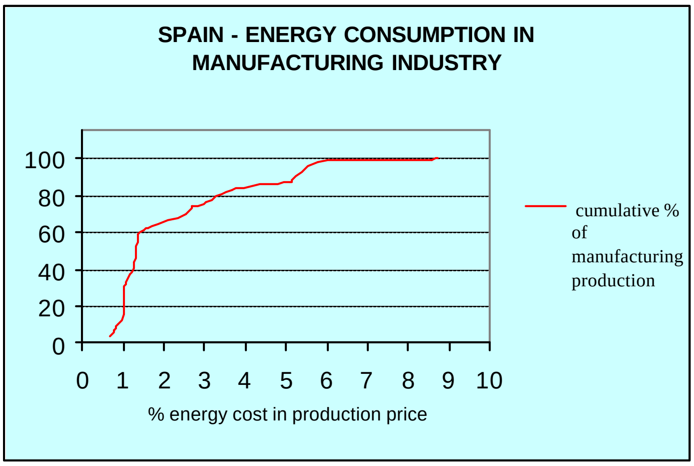
countries the potential of energy to territorial changes seems to be weak and relevant only at a small territorial level.

From location theory we know that the importance of a location factor is defined by the weight of this factor in the objective function (cost for enterprises or utility function for households) and by the spatial variability in the conditions of access to it.

In what concerns energy, its weight in total costs is rather small and only significant to a small number of industries[47]. If we take the case of Spain, for example, for about 2/3 of manufacturing productions the weight of energy in total production costs is less than 2%, and only for 12% of production that weight is higher than 5%. Industries for which energy has a higher weight in production prices are industries whose location faces the burden of transport costs.

Given this small weight, only great spatial variations in energy conditions can have a visible impact on location choices. The fact that those variations are small or inexistent inside the same country, we can expect a small impact of energy in actual transformation of spatial patterns.

Figure 70 - Energy costs in industry production prices, 1998



It is not frequent to find studies that search to quantify the economic impact of changing energy conditions on industrial location, but some light can be thread by a paper from Stephan J. Goetz[48]. In this study the author "examines the location decisions between 1988 and 1994 of a certain class of manufacturing establishments – those that use a relatively large share (more than 5 percent) of electric energy among intermediate inputs - and identifies economic factors systematically associated with new establishment locations. A key question is whether electric-energy-intensive firms will relocate to take advantage of lower electricity rates".

The author analyses separately firms from: *"paper and allied products"; "chemicals and allied products"; "stone, clay and glass products"; and "primary metal industries*". The dependent variable is the "*county-level net change in the number of energy-intensive establishment between 1988 and 1994*" for the more than 3000 continental US counties. The author seeks to explain the dependent variable by a set of near 30 independent variables: market variables, labour force variables, policy variables, agglomeration factors, and other variables. "*Energy prices*" is one of those variables. For that, the author uses the Ordinary Least Square

47 Perhaps, energy costs would be more relevant for households. For instance, in France energy costs represent about 6% of total households' expenses. But a great part of these expenses are transport costs.

48 Stephan J. Goetz - "Location Decisions of Energy-Intensive Manufacturing Firms: Estimating the Potential Impact of Electric Utilities Deregulation", TVA Rural Studies Program/ Contractor Paper 98-3 (www.rural.org/publications)

(OLS) method and two variants of maximum likelihood methods that take account of the fact that explaining increases in the dependent variable may involve factors different from those that explain decreasing behaviours.

When a "short model" (only some few independent variables) is considered, the author concludes that *"…results confirm that electric-energy-intensive firms are sensitive to electric energy costs and that they may react to deregulation by relocating their manufacturing establishments to lower-cost states and counties….".* But the analysis of the numerical results shows that for one of the sectors (paper…) the sign result of energy price is contrary to what would be expected and the statistical significance seems to be low and the weight of energy price too small when compared with remaining independent variables. Results are not better for the "full model": the author recognizes that the responsiveness of firms to energy prices seems dubious in contrast with the other variables, although concluding that *"… it would not be prudent to conclude from this analysis that energy prices do not matter…".* In our opinion, the relevance of the study is just the evidence of the small impact of energy prices when other location factors are considered.

B.3. Results from econometric models

These models seek statistically significant relations between a dependent variable (GDP growth, energy-intensive establishments, etc.) and explaining variables with special relevance to variables concerning conditions of access to energy (prices, quality, etc.). Econometrics has the tools to establish relations of the kind Y= f(X1, X2, ….Xn). The difficulty lies in the correct specification of the relation and, mainly, in the lack of the pertinent data.

Frequently, one uses Vector Auto-Regression (VAR) models[49] that are more useful to identify causal relations among variables than ordinary linear regression. Some tests permit to identify the directions of causality. Despite the sophistication of econometric methods, results are not always consistent.

Stern[50] synthesises results obtained through this methods and says "*Many analysts […] used Granger (1969) causality tests or the related test developed by Sims(1972) to test whether energy use causes economic growth or whether energy use is determined by the level of output in the context of a bivariate vector autoregression. The results have been generally inconclusive. Where significant results were obtained they indicate that causality runs from output to energy use. (…)".* And continues with references to work that conclude in one and another senses. Finally, he refers his own works with some innovations in the model specification supporting the conclusion that energy causes GDP.

In the same sense, a recent working paper by Gaudreault[51] uses this methodology to analyse the impact of the energy price upon the economy of Canada. Following a presentation of several empirical studies on the USA, he uses different specifications of a VAR model to estimate the impact of energy price on GDP in Canada. The main conclusions are:

> *«Pour évaluer la présence d'une relation empirique entre l'activité économique au Canada et le prix de l'énergie, nous utilisons premièrement des tests bivariés et multivariés de causalité à la Granger. Les résultats des tests bivariés montrent la présence d'une relation négative significative entre les hausses de prix du pétrole et l'activité économique au Canada pour la période allant du premier trimestre 1962 au quatrième trimestre 2001. Cette relation est asymétrique puisque les coefficients associés aux variables de baisses de prix du pétrole ne sont pas conjointement significatifs.*

49 The reduced form of a VAR can be $Y_t=\alpha+\sum_1^n \beta_i Y_{t-i}+\sum_1^n \lambda_i X_{t-i}+\varepsilon_t$ (t=time)

50 Stern, David I. (2003)- "Energy and Economic Growth", Rensselaer Polytechnic Institute, NY. A version of this paper can be obtained in www.rpi.edu/~sternd/

51 Gaudreault, Carl, Le Prix de l' énergie et l' activité économique au Canada, Department of Finance, working paper 2003-14 (http://econpapers.hhs.se/paper/fcawpfnca/2003-14.htm)

Les tests multivariés corroborent ce résultat pour certaines spécifications de prix réel du pétrole seulement, notamment le niveau, la volatilité et les chocs normalisés positifs du prix réel du pétrole. De plus, l'inclusion de différentes variables dans les équations ne fait pas apparaître de relation causale significative entre le prix du gaz naturel (ou les indices de prix de l'énergie) et l'activité économique du Canada.» (Gaudreault, 2003, 51)

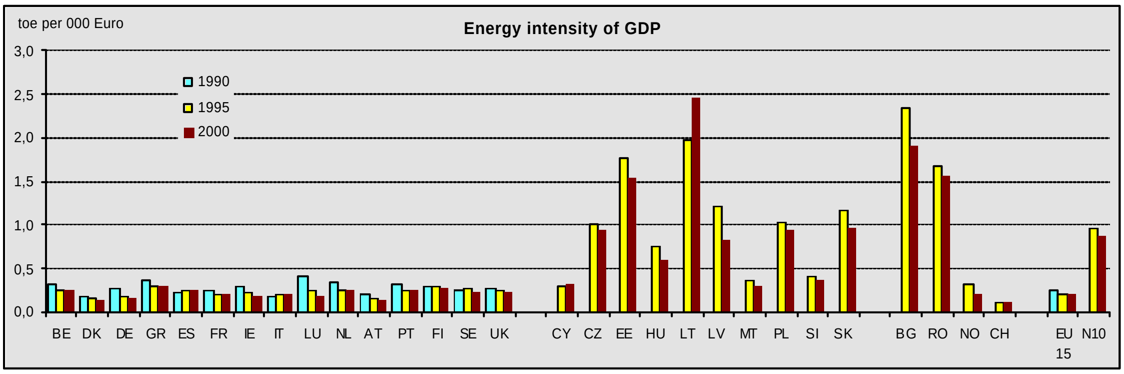
The author carried out a more in-deep analysis that permitted the evaluation of the impact on GDP of a 1% increase in the oil price. The results were sensitive to the specification of the model and to the time period considered. The cumulative impact, at the end of the second year, of 1% increase of the oil price, could be between –0,04% and –0,10% depending of specification of the price variable[52].

The difficulty with this kind of methods comes from the difficulty in isolating the effect of energy price. For instance, the reaction of economic authorities to inflation pressure as a result of growing energy prices may be more relevant than the energy price increase and the consequent normal reaction of enterprises and householders.

At this point one must be aware of the complex factors that can hide the relations between energy and development.

Increased energy efficiency is embedded in economic development, leading to lower energy intensity of GDP. Besides that, the intensity patterns seem to have a turning point that has become evident at lower stages of the development ladder.

Figure 71 - Energy intensity of GDP (toe/ thousand €)



Source: Eurostat. (1999 data for Malta, Norway and Switzerland).

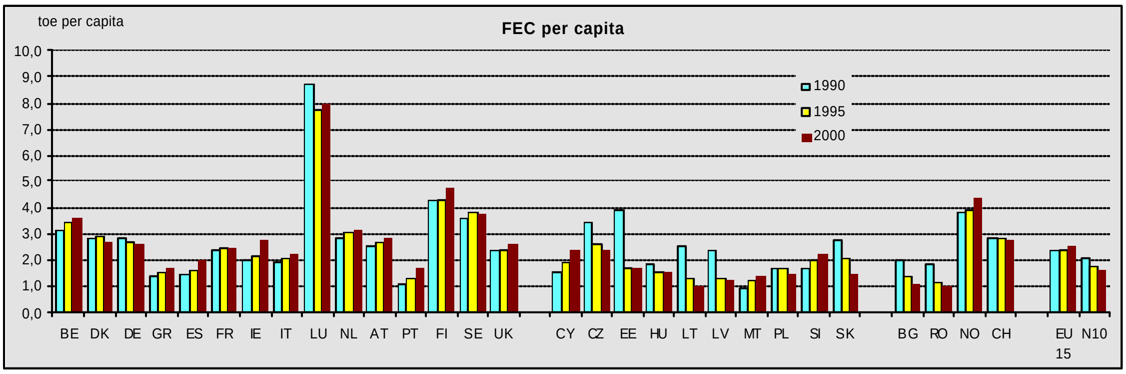
These efficiency gains, which are recognized by all the available research data, place the issue in the energy/capital trade off, raising the always difficult question of technological change.

No matter, practical application of this possible indicator is burdened by a number of factors like impact of climate conditions in the overall energy consumption. Data series shows more than one turning point in several of the sampled countries.

And household consumptions follow a different path, seeming to be much more resilient to decrease, leading to overall increases in energy consumptions.

52 This seems to be a much higher impact than that calculated in recent works to the OECD countries.

Figure 72 - Final Energy Consumption per capita



Source: Eurostat, IEA

This raises the central question of relation between prices and consumption.

A number of hypotheses and research conclusions are identifiable in the literature:

a) that electricity consumption is inelastic in the short run;

b) that industries and households use fixed energy budgets given the GDP level;

c) that energy costs are negligible for the major part of the industries.

In this context the efficiency of using price mechanisms to adjust energy markets are yet to be evaluated.

Using the fixed energy budget hypothesis[53], the one that is more stringent towards the efficiency of price mechanisms on energy markets, points to two main effects:

I. in the short run, price changes have some effect on growth, price increases implying lower levels of economic activities, and price decreases leading to enlarged aggregate supply, but with much larger elasticity to price increases;

II. in the long run we can expect technological change and, eventually, some delocalisation of more energy intensive industries.

In any case, in our research we couldn't make use of this kind of methods on account of a severe lack of energy data (consumption and prices) at regional level.

B.3. Modeling the economy

These are forecast or simulation models of the economy, where energy plays the role of a production factor or, by price mechanisms, affect costs and technology. Example of this kind of models are OECD interlink model, IMF multimod model and GEM-E3 model.

OECD interlink model was used recently by the International Energy Agency to analyze the impact of high oil prices on the global economy[54].

53 BOURDAIRE, J.M. (2000), "Le lien entre consomation d'energie et development economique", Revue de l'Energie, nº 15, mars-avril 2000.

54 IEA, Analysis of the Impact of High Oil Prices on the Global Economy, May 2004 (http://www.iea.org/Textbase/Papers/2004/High_Oil_Prices.pdf)

OECD INTERLINK model

- *INTERLINK follows the tradition of many other macroeconomic models, combining short-term "keynesian" features with long-term neo-classical properties.*
- *The core of each country model consists of: a) a production function determining output in the long term; b) a wage-price block, which in combination with factor demand equations (for capital and labour) essentially determines the speed of adjustment following a shock; c) behavioural equations for private consumption as well as for prices and volumes of imports and exports.*
- *The supply side of most country models is determined by a constant-returns-to-scale Cobb-Douglas production function with capital and labour as production factors. Labour is assumed to be a homogenous production factor and no distinction is made between skilled and unskilled labour. Technological progress is disembodied and specified in terms of a labour efficiency index (which, given the Cobb-Douglas specification, can easily be rewritten as a total factor productivity index)*
- *Prices are determined as a constant mark-up over marginal costs in the long term. In the short run, prices are sensitive to demand pressure and may therefore deviate from unit costs*
- *Private consumption depends on disposable income and wealth, proxied by the real interest rate and the rate of inflation.*
- *The presence of inflation in the consumption equation can be perceived as a proxy for real balance effects (higher inflation reduces real balances and hence consumption).*
- *An **oil price increase** mainly works its way through the system as a terms of trade shock. For net oil importing countries there is an initial loss in real disposable incomes as prices of oil- and energy-related goods and services increase. This simultaneously leads to lower output and higher inflation (i.e. a negative supply shock). The degree of the downturn in demand depends partly on the extent to which consumption responds to lower disposable incomes and higher inflation and investment to lower output. A further effect arises from the net export side, since market growth slows and competitiveness changes (positively if inflation increases by less than among trading partners, otherwise negatively). Second-round effects depend on the response of wages to higher consumer prices. To the extent most wage earners are willing to accept a decline in real wages, unemployment will only increase modestly and inflation will soon be back to around its initial level.*

From:
OECD, Standard Shocks in the OECD INTERLINK model, ECO/WKP (2001) 32

INTERLINK is used mainly for analyzing effects and international spillovers of macroeconomic policy, and in this particular case, was used to test the vulnerability of OECD economy to higher oil prices.

Although the "amount of oil the OECD uses to produce one dollar of real GDP halved between 1973 and 2002", OECD remain vulnerable to oil-price increases and the simulation carried out concluded that:

- *A sustained $10 per barrel increase in oil prices from $25 to $35 (a 40% increase) would result in the OECD as a whole losing 0.4% of GDP in the first and second years of higher prices*
- *These losses start to diminish in the following years as global trade in non-oil goods and services recovers and, throughout the whole five-year projection period, GDP is 0.3% lower on average than in the base case*
- *Euro-zone countries, which are highly dependent on oil imports, would suffer most in the short term, their GDP dropping by 0.5%*
- *The impact of higher oil prices on the rate of inflation is more marked. The consumer price index is on average 0.5% higher than in the base case over the five year projection period.*

The study analyses also the impact on developing countries and transition economies and on the global economy. In some developing countries the impact on GDP may reach more than 1.5% after one year.

IMF MULTIMOD model *«is a dynamic multicountry macro model of the world economy that has been designed to study the transmission of shocks across countries as well as the short-run and medium-run consequences of alternative monetary and fiscal policies»*[55].

The basic structure and properties of MULTIMOD are meant to represent well-established views about how modern industrial economies function and interact with each other. In the construction of the model, theoretical foundations prevailed upon goodness of fit. *« (…) The main criteria for incorporating an estimated equation specification are that the specification should be based to a large extent on underlying theory and should not generate an unrealistic degree of macroeconomic variability when embedded into the MULTIMOD system of equations. Thus, in comparison with models for which short-term forecasting accuracy is a high priority, MULTIMOD has been estimated with a relatively low willingness to sacrifice theoretical foundations in order to obtain better goodness of fit.»* (Laxton et alii, 1998).

A working paper prepared by the IMF Research Department in 2000[56], analyzed the potential impact of a sustained $5/barrel increase in the price of oil on the global economy, over a baseline around $25 (a 20% increase) in 2000-2001. The model can take into account the several channels through which oil prices may affect the economy.

THE TRANSMISSION OF OIL PRICES SHOCKS IN MULTIMOD

An oil price increase can influence macroeconomic behaviour through several channels. Five of these seem particularly relevant in the first few years following the shock. First, the transfer of income from oil-importing countries to oil-exporting countries is expected to reduce global demand as demand in the oil-importing countries is likely to decline more than it will rise in the oil-exporting countries. (…). Second, the increase in the cost of inputs to production can reduce the amount of non-oil (potential) output that can be profitably supplied in the short run, given the existing capital stock and assuming that wages are relatively inflexible in the short-run. Third, workers and producers may resist declines in their real wages and profit margins, putting upward pressure on unit labor costs and prices of finished goods and services. Fourth, the impact of higher energy prices on headline price indexes (e.g., consumer price levels) and the potential pass-through into core inflation may induce central banks to tighten monetary policy. And fifth, the extent that policy reactions seem inconsistent with announced policy objectives, the credibility of the monetary authorities may be eroded, with consequences for inflation expectations and the inflation process.

From:

Hunt, Isard, Laxton, "The Macroeconomic Effects of Higher Oil Prices", IMF, WP/01/14, (http://www.imf.org/external/pubs/ft/wp/2001/wp0114.pdf)

The results of different simulations are consistent with those of INTERLINK models. For industrialised countries the impact on GDP (percent deviation from baseline) would reach a peak of –0,3% in 2001 and 2002 and would decline to –0,1% in 2004. For Euro Area the impact on GDP would be of –0,4% in 2001 and 2002, decreasing to –0,1% in 2004.

Comparing with the results of other models, MULTIMOD seems estimate results substantially higher than OECD INTERLINK model.

GEM-E3 model is an applied general equilibrium model for the European Union member states taken individually or as a whole, which provides details on the macro-economy and its

[55] Douglas Laxton, Peter Isard, Hamid Faruqee, Eswar Prasad, and Bart Turtelboom (1998), MULTIMOD Mark III The Core Dynamic and Steady-State Models, IMF occasional paper 164, present a full description of the model. MULTIMOD is available to the public and can be obtained through www.imf.org/external/np/res/mmod/index.htm. Posterior versions of the model were developed.

[56] IMF, "The Impact of Higher Oil Prices on the Global Economy", Prepared by the Research Department, December 2000. (http://www.imf.org/external/pubs/ft/oil/2000/oilrep.PDF)

interaction with the environment and the energy system[57]. Partly financed by the European Commission, the model is being used to evaluate policy issues for the European Commission.

The model involves the specification of production and consumption functions. Production is modeled through KLEM (capital, labour, energy and materials) production functions involving many factors (all intermediate products and two primary factors –capital and labour). At the same time consumers can also endogenously decide the structure of their demand for goods and services. Their consumption mix is decided through a flexible expenditure system involving durable and non-durable goods. The model includes an environmental module focusing in some pollution variables and distinguishes between productive branches[58].

GEM- E3 was used by Kouvaritakis et alii[59] for analysing the economic impacts of energy tax policies in the EU. The study presents, among other results, the impact on macro economic aggregates and sectoral production. The study concludes that "The energy tax reform imposing minimum taxes (…) has very small effects at macroeconomic level and negligible positive environmental effects, as the rates proposed are not very high and below the existing rates in nearly half of EU countries.". Meaningful is the fact that, even in countries where those taxes may imply a relevant increase in energy price, the impact on GDP is of only a few decimals of percent.

This study makes assumptions about the use of taxes revenue, and does not present the results in a way that permit comparison with the results of other models.

Other studies also concluded by a small impact of energy price changes on GDP.

For instance, a similar result was obtained for Taiwan, where one[60] estimates that the impact of petroleum fund fee of 2,785% on oil prices will be a reduction of GDP of only a negligible 0.08%.

Concerning other energy forms, a study by Barnett et alii[61] analysed the economic impact of retail electric competition in Alabama. This study discusses the potential consequences of retail competition pointing to the possible effect of reducing regional disparities in energy price and, in consequence, to reduce incentive to change location and estimates the potential economic impact of possible reductions in the price of electricity. The study uses the Alabama Econometric Model that is said that "is a simultaneous equation model with over 250 equations describing the state economy. These equations include both behavioural and stochastic equations, as well as numerous identities." The methodology is one of comparing economic scenarios, assuming different policies conducting to different electricity prices.

Here, our interest is not in the structure of the model but on the scale of the estimated impacts. From the results presented we can conclude (our calculations over the table presented) that the study estimates an increase of 0.05% in gross state production (GSP) in consequence of a reduction of 2.8% in the price of electricity. Accordingly, two scenarios where electricity prices differ 5.6% imply a difference in GSP of 0.15%. Some productive sectors will suffer a greater impact but, in general, differences in electricity prices have a very small impact in economic growth.

The objective of the previous references was twofold:

- First, to present alternative methods of evaluating the energy impact on economic activity.

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57 Capros et al., 199, The GEM-E3 model: Reference Manual, http://gem-e3.zew.de

58 For a detailed description, GEM-E3- Computable General Equilibrium Model for studying Economy-Energy-Environment Interactions for Europe and the World (www.gem-e3.net)

59 Nikos Kouvaritakis, Leonidas Parousso and Denise Van Regemorter, 2003 – "The macroeconomic evaluation of energy tax policies within the EU, with the GEM-E3-Euope model", study for the European Commission DG TAXUD, December 2002 (www.europa.eu.int/comm/taxation_customs/taxation/economictaxation_final_report.pdf) .

60 Chi-Yan Liang, "The effect of petroleum Fund Fee on oil prices and the economy of Taiwan", NPF Research Report, July 2002 (www.npf.org.tw)

61 Andy Barnett, Henry Thompson, Samuel Addy, Ahmad Ijaz – Economic Impact of Retail Electric Competition in Alabama, Economic Development Institute, Auburn University (http://web6.duc.auburn.edu/outreach/edi/electricstudy.pdf)

At an earlier phase of our work we put a special focus on econometric models as a privileged tool to assess territorial impact of energy policies. But, we were not aware of the lack of energy data at regional level. When one can't know even the energy consumption at NUTS II level, there is no possibility to use methods that depends on the availability of time series of relevant data for, at least, the most part of territorial unities. The construction of a energy database consistent at the territorial level must be the principal target of future research projects.

The use of a general equilibrium model of the kind of those mentioned was only briefly envisaged. First, the calibration of such a model for the 29 countries is a specific project that one couldn't carry out in the context and conditions of the actual contract. Second, even if that calibration was possible, remained the question of assessing the impacts at a regional level. Finally, and most important, the complexity of feedbacks in a GEM would make very difficult to isolate the impact of the energy shock (for instance, a great part of the impact of oil shocks can be attributed to the reaction of monetary authorities to the consequent price increase).

- Second, to obtain quantitative references for the results we obtained using a much more simplified framework.

All the empirical results point to a very small elasticity of GDP relatively to energy price. For Euro Area, the above results are a decrease of GDP of 0,4% for a 20% increase in oil price (MULTIMOD) or of about 0,5% for a 40% oil price increase (INTERLINK).

Our results do not differ too much from those obtained by INTERLINK model. If we hypothesise a growth of 40% in the price of the products of the branch "oil and gas extraction", or the correspondent imports, we obtain a decrease of GDP of –0,45% in Portugal, -0,53% in Spain, -0,35% in Austria or –0,54% in UK. The impact follows the weight of the branch in the economy. The average for 12 countries of UE15 (except Germany, Netherlands and Luxemburg) would be -0,53%. For this reason, although we use a very simplified framework with very restrictive hypothesis, we think we can use our results as a good indicator of territorial impact of variations in energy price.

C. A simplified framework for territorial impact assessment of energy

Given the above-mentioned difficulties that impede the calculus of direct energy impact on a region, the procedure we used consists in the distribution of the impact calculated at a national level among the different regions of a specific country.

For that, in a first step, we calculated the impact of a decrease[62] in the price of final energy on gross value added of each national branch and, in a second moment, we distributed the impact of each branch among the different regions of that country. This corresponds to assume that:

- The energy price is the same in every region of a specific country: this is not a too much restrictive hypothesis given the small spatial variations, and even uniformity, of energy prices at national level.
- We can find a suitable key to distribute the impact on a specific branch among regions. Here we may have an important weakness of our procedure because we were obliged, as a consequence of the lack of other pertinent data, to use employment, frequently at a high aggregation level. Doing so, we implicit assume that not only internal structure of a particular branch and technology do not vary between

[62] The option by a price decrease is explained by the fact that, at the end, this is the aim of Community energy policy, either by an effective price decrease or by improvements in energy quality and efficiency.

regions as the labour productivity of that branch is the same in every region. A greater disaggregation of activities means a small impact of these hypotheses[63].

The last assumption may affect significantly the results obtained, but an improvement is only possible with better regional data.

THE PROCEDURE

1. Calculate the impact of a final energy price variation on gross value added of different national branch
2. Distribute the impact on each branch among regions

For the assessment of the national (branch) impact of a variation in energy price a framework that corresponds to the first generation of impact assessment methods seems the most adequate in the actual circumstances.

We can think energy price variation as an exogenous one that doesn't affect the gross value added per unit of product of each branch. This may occur if price variation is the result, for instance, of cheaper energy imports or it results from a greater efficiency of energy distribution (e.g. reduction of losses in the network), from State subsidies, etc. and each branch passes on the reduction of costs completely to lower prices supported by customers. In this case, an energy price decrease would imply: (i) the maintenance of GVA per product (physical) unit in all branches (including the energy sector); and (ii) a reduction in the price of different products in response of a decrease in the energy price.

Price reduction has an *income effect* and a *substitution effect*. Income effect means that one can buy more of all the goods and services, as if he had benefited from a income increase. So, at this stage, we think that an input-output framework will be the most suitable method for analysing this type of impacts.

Input-output models are accounting apparatus identifying inter-industry linkages, usually used to quantify the global impact of increases or decreases in spending. The standard model is X = AX+Q, where Q is a *nx1* vector of the final demand of products from different productive sectors, X is a nx1 vector of total output from each sector and A is a *nxn* matrix of coefficients a_{ij} of the intermediary consumption of products of sector i necessary to obtain an unity of product j[64]. As investment is a component of final demand, the standard model can be used to evaluate the impact of energy investments or of an increase in energy demand.

Although input-output models were not constructed to evaluate the impact of cost variations, we can use the input-output framework to calculate the impact of a energy price variation in the set of prices of all the production branches.

In an input-output framework the following relation can be verified B´P+V=P, where P is a nx1 vector of sectoral prices; B is a *nxn* matrix of coefficients b_{ij} of physical quantities of product i needed to the production of a (physical) unit of j; V is a *nx1* vector of the value of primary inputs needed to an unity of different sectoral productions; and B' is the transpose of matrix B. The above equality comes from $p_j=b_{1j}p_1+b_{2j}p_2+\ldots+b_{nj}p_n+v_j$. Solving, we obtain $P=(I-B')^{-1}V$. Although formally b_{ij} is measured in physical units, if we are interested only in the relative variation of prices we can make $b_{ij}= a_{ij}$ and, then ?P=(I-A´)-1?V.

In an input-output framework the following relation can be verified B´P+V=P, where P is a *nx1* vector of sectoral prices; B is a *nxn* matrix of coefficients b_{ij} of physical quantities of product *i*

63 In practice, we considered a variation of branch productivity among regions assuming that $q_{ij}/q_j=q_i/q$, were *q* is productivity of the economy, *i* denotes region and *j* denotes the branch

64 Normally a_{ij} is the monetary amount of product i that is necessary to obtain a monetary unit of product j. The total output (including imports) of a product X_i is used to intermediary consumption ($S_j a_{ij} X_j$) and to final consumption (Q_i), that is, $X_i = S_j a_{ij} X_j + Q_i$

needed to the production of a (physical) unit of *j*; V is a *nx1* vector of the value of primary inputs needed to an unity of different sectoral productions; and B' is the transpose of matrix B. The above equality comes from $p_j=b_{1j}p_1+b_{2j}p_2+\ldots+b_{nj}p_n+v_j$. Solving, we obtain $P=(I-B')^{-1}V$. Although formally b_{ij} is measured in physical units, if we are interested only in the relative variation of prices we can make $b_{ij}= a_{ij}$ and, then $?P=(I-A')^{-1}?V$.

This procedure presupposes that a variation in energy prices does not imply any input substitution, so that (technical) input coefficients remain constants. This could be a strong hypothesis, regarding the long-term trends to diminishing energy intensity. However, the most important impacts on GDP, obtained by other methods, seem to be short-term or medium-term impacts, pointing to a main influence of demand variations.

We used the last equation to calculate the impact (in relative terms) on different prices of an exogenous reduction of energy price. For calculation effects only, this fall of energy prices was assumed as a reduction in primary inputs[65].

Input-output table is not useful to pass from price variation to GDP variation. Here, we need some additional hypothesis about the way demand reacts to a price variation:

c) First, we assume that final consumers will not change their budgets, so we hypothesize that the entire price savings will be transferred to final demand. This corresponds to *income effect*, but maybe it overestimates the demand growth, as it is possible that some consumers transfer the "additional" real income to additional savings. It is a restrictive hypothesis that could be improved if we could obtain information on price-elasticity and on demand functions.

d) Second, we must take into account the *substitution effect*, what was done by distributing the "additional" demand among different branches proportionally to the weight in total final demand and to the relative price variation of each branch.

These are two very restrictive hypotheses, which were necessary in the absence of information on price elasticities and on demand functions. However, the aim of finding an indicator of the territorial pattern of energy impact is not put in risk if these hypotheses are applied to all countries.

With this two hypothesis we calculate de increase of final demand of products of each branch as $?Q_i = y*(z_i/z)$, where $y=S_i(1-p_i)*Q_i$, $z_i=Q_i/p_i$, $z= Sz_i$ and p_i is the proportional variation of prices (initial prices=1).

Now we can estimate the growth of total uses of each branch through the known relation $?X=(I-A)^{-1}?Q$. If we hypothesise a constant relation between "total uses" and the gross added value, we can calculate the impact on Gross Added Value of each sector[66.]

[65] There are other equivalent procedures to obtain the numerical solution of the system. We used the Solver tool of Microsoft Excel

[66] We hypothesized that added value per physical unit would not change following a variation of energy price. Although all this calculations are done in monetary terms, at the end this hypothesis is respected, taking into account that $a_{ij}= b_{ij}.p_i/p_j$

ESTIMATING THE IMPACT BY BRANCH AT NATIONAL LEVEL

1. Estimating the impact on price of the different branches: $?P=(I-A')^{-1}?\,V$
   Critical hypotheses: (i) there is no technical change in sequence of an energy price increase; (ii) firms pass on cost variations completely to customers and the added value per physical unit remains unchanged.
2. Calculating additional demand: $?Q = y^*(z_i/z)$, where $y=S_i(1-p_i)^*Q_i$, $z_i=Q_i/p_i$, $z= S_i z_i$ and p_i is the proportional variation of prices
   Critical hypotheses: (i) the budget of final consumers remains unchanged and the entire price savings goes to additional purchases; (ii) The additional demand is distributed proportionally to initial consumptions and to price variations.
3. Calculating the additional gross value by branch: $?X=(I-A)^{-1}?\,Q$ and $?V_i=ß_i.?X_i$, where $ß_i$ is the relation between the Added Value and Total Uses in branch *i*.
   Critical hypotheses: (i) the added value per physical unit remains constant in each sector; (ii) the proportion between imports and total uses doesn't change.

Finally, we must have a distribution key of the increase in the value added of a given sector between different regions. This can be done assuming the initial regional location of different sectors.

Ideally, the initial spatial pattern of the branch production would be the best key of territorial distribution of the increase of the value added. Unfortunately there is no such data for the set of NUTS II. The best key we could find is employment by industrial sector, but frequently the branch classification of regional employment doesn't coincide with the branch classification of input-output matrix. Perhaps this is the main practical weakness: at a greater level of aggregation it is difficult to assume the any relation concerning the behaviour of branch productivity among regions. What we did was to assume that in a given region all the branches maintained a constant relation with the corresponding national productivity. Following our results, inside the same country, generally more developed regions would be the more benefited from a energy price decrease. This in part may be due to a overestimation of the share of this regions in the increase of added value.

DISTRIBUTING THE IMPACT ON ADDED VALUE AMONG REGIONS

For the regions of a specific country R=MV (M is a *rxn* matrix with m_{ij} = share of region *i* in the production sector *j*). Normally M was obtained on the base of employment data.

Critical hypotheses: (i) interregional flows of goods and services remain proportionally unchanged; (ii) Prices of the products of a given branch do not vary among regions; (iii) the same happens for energy intensity; (iv) a constant relation, among branches of a given region, between regional productivity and global productivity

In the above boxes, we have presented the critical hypothesis in the different steps. These hypotheses configure weaknesses of the methodological framework we used, which will justify an eventual severe criticism. We are aware of those insufficiencies, but we can't say that these hypotheses are more unrealistic than those implicit in more sophisticated models.

In any case, these weaknesses are aggravated by the quality of input-output data we had to use. We could obtain input-output tables for 25 of the 29 countries. But these matrixes are related to different years, in some cases distant enough to make difficult to assume there were no meaningful technological changes. They are also of different branch classification and different nature. In some cases, it is not possible a total separation of energy branches and in this cases the impacts may be overestimated. We were obliged to do some work to assure a minimum consistency. We consider that the faults that may persist do not affect significantly the results obtained.

In the next table, one can see the main characteristics of data we used.

The calculation procedure is, by construction, a linear application. This means that impacts will be proportional to the percentage variation of energy price. And it is symmetric in the sense that energy price increases or price decreases will have symmetric results. This is another result that do not match empirical results that point to a stronger effect of energy price increases.

Given linearity, we choose an arbitrary percentage decrease of 10% in the price of final energy. In practice, that corresponds to a decrease of 10% in the price of the products of NACE classes referred in the last column of the next table. In some cases a complete isolation of energy branches was not possible.

Results by regions NUTS II are presented in next tables and map. It must be stressed that regional results are dependent on the regional pattern of employment of branches more impacted by energy prices and are distributed around the national value.

Table 4 - Data used to estimate regional energy impact

Country		Tables	year	number of sectors	Regional Gross Value Added	Regional Employment	NUTS level	NACE code Final Energy
BE	Belgium	Use table	1999	54	1999	2001	2	23, 40
DK	Denmark	Use table	1999	60	1999	-	0	23, 40
DE	Germany	Use table	2000	59	2000	2001	2	23, 40
GR	Greece	Use Table	1999	59	1999	2001	2	23, 40
ES	Spain	Use table	1997	70	1996	2001	2	23, 40
FR	France	Use table	2000	59	2000	2001	2	23, 40
IE	Irelnd	Input-Output	1993	41	1993	2000	2	23, 40+41
IT	Italy	Use table	2000	58	2000	2000	2	23, 40
LU	Luxembourg	n.a.	-	-	-	-	2	-
NL	Nethelands	Use table	2000	25	2000	2001	2	23, 40+41
AT	Austria	Use table	1995	55	2000	2001	2	23, 40
PT	Portugal	Use table	1999	59	1999	1999	2	23, 40
FI	Finland	Use table	2000	59	2000	2001	2	23, 40
SE	Sweden	Use table	1999	59	1999	2001	2	23, 40
UK	United Kingdom	Use table	2001	123	2001	2001	2	23, 40
CY	Cyprus	Input-Output	1986	33	1986	-	0	23+24,40
CZ	Chzech Republic	Use table	1999	30	1999	2001	2	23, 40+41
EE	Estonia	Use table	1997	60	1997	-	0	23, 40
HU	Hungary	Use table	2000	57	2000	2001	2	23, 40
LT	Lithuania	n.a.	-	-	-	-	2	-
LV	Latvia	Use table	1997	58	1997	-	0	23, 40
MT	Malta	n.a.	-	-	-	-	2	-
PL	Poland	Input-Output	1995	58	1995	2001	2	23, 40
SI	Eslovenia	Use table	2000	30	2000	-	0	23, 40+41
SK	Slovakia	Use table	1998	47	1998	2001	2	23+24,40
BG	Bulgaria	Use Table	1997	53	1997	2001	2	23, 40+41
RO	Romenia	Input-Output	2000	105	1999	2000	2	23, 40
NO	Norway	Use table	2000	59	2000	2001	2	23, 40
CH	Switzerland	n.a.	-	-	-	-	2	-

Notes:

n.a. - not available

NACE Rev. 1.1- Statistical Classification of Economic Activities of the European Communities. In sectors 23 and 40 prices reduced 10%.
In some cases it was necessary to aggregate the sectors.

code 23 - Manufacture of coke, refined petroleum products and nuclear fuel;

code 24 - Manufacture of chemicals and chemical products

code 40 - Electricity, gas, steam and hot water supply

code 41 - Collection, purification and distribution of water

IMPACT OF A 10% DECREASE IN ENERGY PRICES ON REGIONAL GDP (provisional values)
(percentage points)

REGION	COUNTRY	GDP GROWTH
	AT	0,70
Burgenland	AT11	0,66
Niederösterreich	AT12	0,67
Wien	AT13	0,77
Kärnten	AT21	0,71
Steiermark	AT22	0,67
Oberösterreich	AT31	0,66
Salzburg	AT32	0,68
Tirol	AT33	0,67
Vorarlberg	AT34	0,69
	BE	0,68
Région Bruxelles-capitale/Brussels hoofdstad gewest	BE10	0,72
Antwerpen	BE21	0,70
Limburg (B)	BE22	0,66
Oost-Vlaanderen	BE23	0,68
Vlaams Brabant	BE24	0,72
West-Vlaanderen	BE25	0,65
Brabant Wallon	BE31	0,72
Hainaut	BE32	0,64
Liège	BE33	0,65
Luxembourg (B)	BE34	0,64
Namur	BE35	0,62
	BG	1,24
Severozapaden	BG01	1,32
Severen Tsentralen	BG02	1,20
Severoiztochen	BG03	1,29
Yugozapaden	BG04	1,20
Yuzhen Tsentralen	BG05	1,23
Yugoiztochen	BG06	1,26
	CH	
Région Lémanique	CH01	
Espace Mittelland	CH02	
Suisse Du Nord-Est	CH03	
Zürich	CH04	
Suisse Orientale	CH05	
Suisse Centrale	CH06	
Ticino	CH07	
	CY	0,71
	CZ	0,73
Praha	CZ01	0,80
Stredni Cechy	CZ02	0,73
Jihozápad	CZ03	0,71
Severozápad	CZ04	0,73
Severovýchod	CZ05	0,70
Jihovýchod	CZ06	0,70
Stredni Morava	CZ07	0,69
Moravskoslezko	CZ08	0,70

REGION	COUNTRY	GDP GROWTH
	DE	0,57
Stuttgart	DE11	0,57
Karlsruhe	DE12	0,61
Freiburg	DE13	0,54
Tübingen	DE14	0,56
Oberbayern	DE21	0,61
Niederbayern	DE22	0,53
Oberpfalz	DE23	0,53
Oberfranken	DE24	0,53
Mittelfranken	DE25	0,57
Unterfranken	DE26	0,55
Schwaben	DE27	0,54
Berlin	DE3	0,63
Brandenburg	DE4	0,53
Bremen	DE5	0,59
Hamburg	DE6	0,63
Darmstadt	DE71	0,61
Gießen	DE72	0,55
Kassel	DE73	0,54
Mecklenburg-Vorpommern	DE8	0,50
Braunschweig	DE91	0,56
Hannover	DE92	0,55
Lüneburg	DE93	0,53
Weser-Ems	DE94	0,52
Düsseldorf	DEA1	0,58
Köln	DEA2	0,57
Münster	DEA3	0,53
Detmold	DEA4	0,54
Arnsberg	DEA5	0,55
Koblenz, Trier,Rheinhessen-Pfalz	DEB0	0,54
Saarland	DEC	0,52
Chemnitz	DED1	0,55
Dresden	DED2	0,58
Leipzig	DED3	0,57
Dessau	DEE1	0,51
Halle	DEE2	0,52
Magdeburg	DEE3	0,51
Schleswig-Holstein	DEF	0,55
Thüringen	DEG	0,51
	DK	0,30
	EE	1,26

IMPACT OF A 10% DECREASE IN ENERGY PRICES ON REGIONAL GDP (provisional values)
(percentage points)

REGION	COUNTRY	GDP GROWTH
	ES	0,49
Galicia	ES11	0,46
Principado de Asturias	ES12	0,48
Cantabria	ES13	0,49
Pais Vasco	ES21	0,50
Comunidad Foral de Navarra	ES22	0,48
La Rioja	ES23	0,48
Aragón	ES24	0,48
Comunidad de Madrid	ES3	0,54
Castilla y León	ES41	0,48
Castilla-la Mancha	ES42	0,46
Extremadura	ES43	0,44
Cataluña	ES51	0,51
Comunidad Valenciana	ES52	0,48
Islas Baleares	ES53	0,50
Andalucia	ES61	0,47
Région de Murcia	ES62	0,47
Ceuta y Melilla (ES)	ES63	0,51
Canarias (ES)	ES7	0,48
	FI	0,61
Itä-Suomi	FI13	0,58
Väli-Suomi	FI14	0,59
Pohjois-Suomi	FI15	0,59
Uusimaa (suuralue)	FI16	0,61
Etelä-Suomi	FI17	0,62
Åland	FI2	0,58
	FR	0,70
Île de France	FR10	0,84
Champagne-Ardenne	FR21	0,65
Picardie	FR22	0,65
Haute-Normandie	FR23	0,68
Centre	FR24	0,66
Basse-Normandie	FR25	0,60
Bourgogne	FR26	0,62
Nord - Pas-de-Calais	FR30	0,68
Lorraine	FR41	0,67
Alsace	FR42	0,68
Franche-Comté	FR43	0,63
Pays de la Loire	FR51	0,66
Bretagne	FR52	0,62
Poitou-Charentes	FR53	0,64
Aquitaine	FR61	0,65
Midi-Pyrénées	FR62	0,66
Limousin	FR63	0,59
Rhône-Alpes	FR71	0,69
Auvergne	FR72	0,61
Languedoc-Roussillon	FR81	0,61
Provence-Alpes-Côte d'Azur	FR82	0,66
Corse	FR83	0,60
Guadeloupe (FR)	FR91	
Martinique (FR)	FR92	
Guyane (FR)	FR93	
Réunion (FR)	FR94	

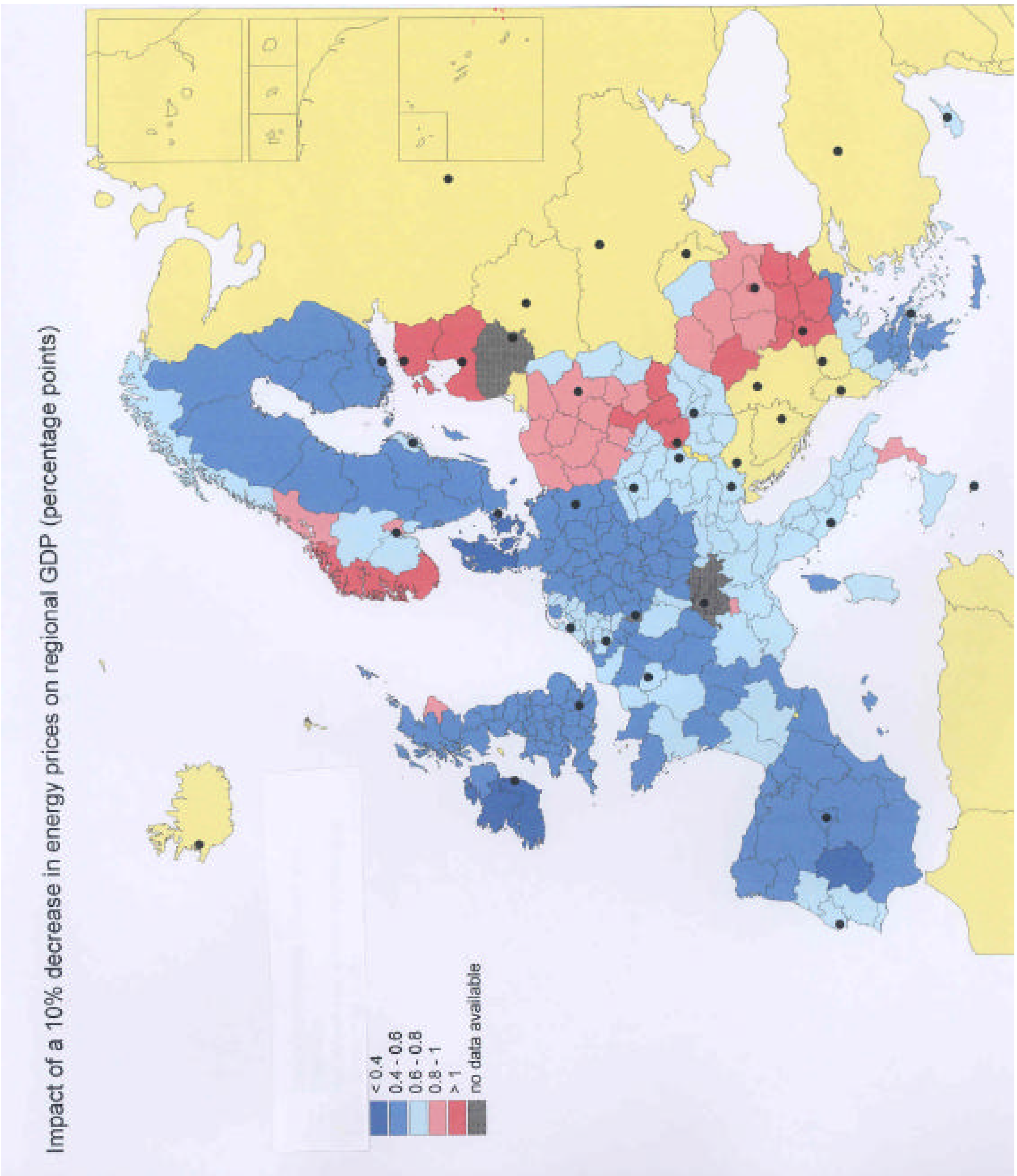
REGION	COUNTRY	GDP GROWTH
	GR	0,69
Anatoliki Makedonia, Thraki	GR11	0,58
Kentriki Makedonia	GR12	0,67
Dytiki Makedonia	GR13	0,70
Thessalia	GR14	0,62
Ipeiros	GR21	0,65
Ionia Nisia	GR22	0,67
Dytiki Ellada	GR23	0,61
Sterea Ellada	GR24	0,62
Peloponnisos	GR25	0,61
Attiki	GR3	0,79
Voreio Aigaio	GR41	0,66
Notio Aigaio	GR42	0,73
Kriti	GR43	0,62
	HU	0,76
Közép-Magyarország	HU01	0,81
Közép-Dunántúl	HU02	0,74
Nyugat-Dunántúl	HU03	0,72
Dél-Dunántúl	HU04	0,73
Észak-Magyarország	HU05	0,73
Észak-Alföld	HU06	0,73
Dél-Alföld	HU07	0,71
	IE	0,39
Border, Midlands and Western	IE01	0,37
Southern and Eastern	IE02	0,39
	IT	0,77
Piemonte	IT11	0,74
Valle d'Aosta	IT12	0,85
Liguria	IT13	0,75
Lombardia	IT2	0,71
Trentino-Alto Adige	IT31	0,81
Veneto	IT32	0,76
Friuli-Venezia Giulia	IT33	0,77
Emilia-Romagna	IT4	0,75
Toscana	IT51	0,77
Umbria	IT52	0,79
Marche	IT53	0,78
Lazio	IT6	0,79
Abruzzo	IT71	0,81
Molise	IT72	0,84
Campania	IT8	0,84
Puglia	IT91	0,82
Basilicata	IT92	0,85
Calabria	IT93	0,85
Sicilia	ITA	0,84
Sardegna	ITB	0,83

IMPACT OF A 10% DECREASE IN ENERGY PRICES ON REGIONAL GDP (provisional values)
(percentage points)

REGION	COUNTRY	GDP GROWTH
	LT	
	LU	
	LV	1,17
	MT	
	NL	0,67
Groningen	NL11	0,68
Friesland	NL12	0,65
Drenthe	NL13	0,77
Overijssel	NL21	0,66
Gelderland	NL22	0,65
Flevoland	NL23	0,65
Utrecht	NL31	0,67
Noord-Holland	NL32	0,69
Zuid-Holland	NL33	0,67
Zeeland	NL34	0,64
Noord-Brabant	NL41	0,66
Limburg (NL)	NL42	0,68
	NO	0,76
Oslo Og Akershus	NO01	0,90
Hedmark Og Oppland	NO02	0,79
Sør-Østlandet	NO03	0,82
Agder Og Rogaland	NO04	1,59
Vestlandet	NO05	1,19
Trøndelag	NO06	0,89
Nord-Norge	NO07	0,83
	PL	0,97
Dolnoslaskie	PL01	1,03
Kujawsko-Pomorskie	PL02	0,92
Lubelskie	PL03	0,80
Lubuskie	PL04	1,01
Lódzkie	PL05	0,97
Malopolskie	PL06	0,91
Mazowieckie	PL07	0,96
Opolskie	PL08	0,95
Podkarpackie	PL09	0,84
Podlaskie	PL0A	0,80
Pomorskie	PL0B	1,02
Slaskie	PL0C	1,12
Swietokrzyskie	PL0D	0,87
Warminsko-Mazurskie	PL0E	0,97
Wielkopolskie	PL0F	0,95
Zachodniopomorskie	PL0G	1,03
	PT	0,71
Norte	PT11	0,63
Centro (PT)	PT12	0,66
Lisboa e Vale do Tejo	PT13	0,79
Alentejo	PT14	0,66
Algarve	PT15	0,71
Açores (PT)	PT2	0,67
Madeira (PT)	PT3	0,65
	RO	0,98
Nord-Est	RO01	0,79
Sud-Est	RO02	0,90
Sud	RO03	0,87
Sud-Vest	RO04	0,86
Vest	RO05	1,00
Nord-Vest	RO06	0,86
Centru	RO07	0,97
Bucuresti	RO08	1,42

REGION	COUNTRY	GDP GROWTH
	SE	0,64
Stockholm	SE01	0,67
Östra Mellansverige	SE02	0,64
Sydsverige	SE04	0,62
Norra Mellansverige	SE06	0,61
Mellersta Norrland	SE07	0,63
Övre Norrland	SE08	0,61
Småland med öarna	SE09	0,63
Västsverige	SE0A	0,63
	SI	0,82
	SK	1,81
Bratislavský	SK01	2,07
Západné Slovensko	SK02	1,73
Stredné Slovensko	SK03	1,71
Východné Slovensko	SK04	1,71
	UK	0,57
Tees Valley and Durham	UKC1	0,53
Northumberland, Tyne and Wear	UKC2	0,56
Cumbria	UKD1	0,55
Cheshire	UKD2	0,58
Greater Manchester	UKD3	0,56
Lancashire	UKD4	0,55
Merseyside	UKD5	0,55
East Riding and North Lincolnshire	UKE1	0,54
North Yorkshire	UKE2	0,55
South Yorkshire	UKE3	0,56
West Yorkshire	UKE4	0,58
Derbyshire and Nottinghamshire	UKF1	0,58
Leicestershire, Rutland and Northants	UKF2	0,58
Lincolnshire	UKF3	0,55
Herefordshire, Worcestershire and Warks	UKG1	0,57
Shropshire and Staffordshire	UKG2	0,56
West Midlands	UKG3	0,56
East Anglia	UKH1	0,57
Bedfordshire, Hertfordshire	UKH2	0,59
Essex	UKH3	0,58
Inner London	UKI1	0,64
Outer London	UKI2	0,61
Berkshire, Bucks and Oxfordshire	UKJ1	0,62
Surrey, East and West Sussex	UKJ2	0,60
Hampshire and Isle of Wight	UKJ3	0,57
Kent	UKJ4	0,56
Gloucestershire, Wiltshire and North Somerset	UKK1	0,57
Dorset and Somerset	UKK2	0,58
Cornwall and Isles of Scilly	UKK3	0,63
Devon	UKK4	0,57
West Wales and The Valleys	UKL1	0,53
East Wales	UKL2	0,54
North Eastern Scotland	UKM1	0,90
Eastern Scotland	UKM2	0,56
South Western Scotland	UKM3	0,56
Highlands and Islands	UKM4	0,59
Northern Ireland	UKN	0,53

Map 1 - Impact of 10% decrease in energy prices on regional GDP (percentage points)



Note: provisional values.

The impacts vary significantly among countries: in 3 countries the impact would be less than 0,5%; in 9 between 0,5% and 0,7%, in another 9 between 0,7% and 1% and in 4 countries impact could be more than 1%.

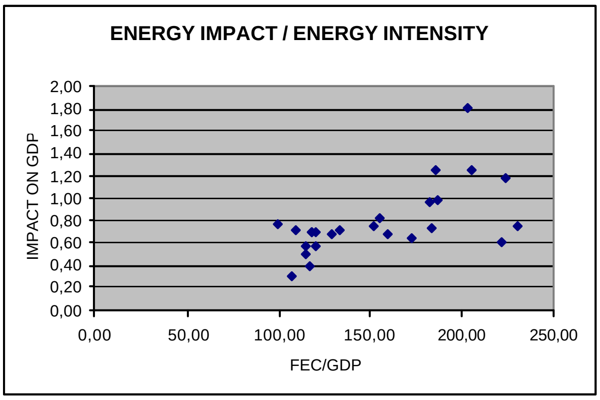
Several factors may determine the intensity of the impact.

First, the industrial structure and the degree of integration of productive fabric determine how the variation of energy price spreads over the different economic branches. The share of energy going to intermediary inputs and to final consumption is also relevant for the total impact.

Second, the energy intensity of the economy determines the amount of the percentage impact. Next chart shows the relation between energy intensity of GDP and the impact of the energy price increase.

Third, differences in energy prices imply that energy has an economic weight different of that indicated by energy intensity. From input-output tables we calculate that the percentage of final energy in "total uses" vary in a relation of 1:4 and the correlation between this weight and the calculated energy price impact is about 0,87.

Figure 73 - Energy impact / Energy intensity



Having in mind the severe difficulties of gathering pertinent data to establish econometric relations between spatial patterns of energy and development, it seems that achieving an impact indicator in the way above mentioned is a great advance in understanding the territorial impact of energy policy.

We are perfectly aware of the meaning of the restrictive hypothesis and of the weakness of the model, although our main objective has been to construct an indicator of territorial impact, and, for an indicator, correct proportionality is the more important feature.

When we go to regional level, comes clear that this methodological framework does not take into account the potential impacts on location of different firms and assumes a constant regional pattern of a given sector. But, change in regional pattern is a question of long term and energy impacts seem to be small and to vanish in the long term. Changes in location caused by energy can occur at a small territorial level (where may be relevant to have or not to have access to cheaper energy source) but will be insignificant at a macro-regional scale, even for energy-intensive industries where other location factors will be more relevant. In addition, market liberalisation will tend to reduce (regional) disparities in energy prices for a given kind of consumers and make the price less dependent on consumers' location. Also, it does not consider the impacts on interregional trade. As it is presented, the model assumes some impact derived from national exports. But it is not symmetrical as there are no corresponding imports in any other country.

The question that remains is the fundamental question of the impact of energy policy on energy prices in each country. A study from ECB[67] points to a downward trend in electricity prices and an upward trend in gas prices. But, for the moment, the impact of energy policy needs to be clarified.

[67] ECB, Price Effects of Regulatory Reform in Selected Network Industries, March 2001.

D. CASE STUDIES ASSESSMENT

The lack of statistical data has not enabled us to go deeper on the study of the relationship between energy policies and measures and its territorial impact analysis. In order to collect further evidence of the impact of energy policies on local development we have launched several case studies covering important aspects of the energy policy:

- solar thermal development (Denmark)
- biomass development for heating purposes (Poland)
- introduction of an autonomous local unit for natural gas distribution in a medium size town (Portugal)
- the local impact of a big coal power plant (640 MW) in a depressed region (Portugal)
- the impact and uncertainties with market integration (Iberian Peninsula)

Some of these case studies are still under review and being finalized.

The decentralized nature and the scale of renewable energy has important consequences in terms of job creation. With the actual technology in the market, solar thermal, biomass for heating and electricity production, wind power and biofuels to substitute petrol and diesel offer a range of cost effective projects. In very limited regions geothermal energy is also being exploited for heating and electricity generation.

All these technologies and the projects associated rely on European or national technology and expertise and endogenous energy resources. The European Union policies on renewables and greenhouse gases have been adopted by the European Union countries and a huge development is expected till 2010 in order to meet the defined targets at country level.

The case studies have different scope in terms of territory covered:

- All the country (Solar thermal in Denmark)
- A specific region (Biomass in Poland and the two Portuguese case studies)
- More than one country (market integration)

In what follows we highlight some relevant aspects of the case studies and expected results after completion.

i) Solar thermal development in Denmark

The majority of EU countries have launched policy programmes in favour of renewable energy sources like solar for thermal purposes. These programs are proposed mainly after the increase in oil prices resulting from the oil crisis. Nowadays global warming is a new argument in favour of renewable energy sources.

Solar energy as a decentralized energy carrier has strong effects in terms of job creation, mainly if there is an industrial project associated. Manufacturers, sellers, architects, installers, researchers, are among some of the direct agents involved.

From 1978 till 2002 Denmark put in place an active policy for thermal solar development. As a result 12 manufacturers have been actively involved in the program, about 1000 installers have been certified and 260 000 m2 of solar collectors have been installed.

Being difficult to assess the impact of a solar program development at territorial level we can conclude however that the multiplier effects of such a program are enormous. We must add also the externalities involved: substitution of fossil fuels, diversification of energy sources, less emissions of greenhouse and acidification gases.

ii) Biomass development for heating purposes in Poland

Poland has very high unemployment rates in rural areas (20%). The unemployment could be partially overcome by an active policy for biomass development. Biomass development could also have important impacts at the level of gaseous emissions, considering that Poland rely mainly on domestic coal as a source of primary energy.

Meanwhile the responsibility for preparing energy plans to secure energy supplies to the local residents and industries were made the responsibility of the lowest administration units (*gminas*), which is favourable to renewables development and use of endogenous resources.

If a biomass policy is successful developed it should be noted that the biomass fuel would be locally produced (mostly auto-produced). This will:

- lower the energy bills of the users
- create local jobs as installation and maintenance is left to local companies
- boost countrywide the SME businesses involved in boiler manufacturing, especially if the "400000 boilers program" is launched successfully.

However some barriers to the development of biomass for heating purposes have to be considered:

- lack of expertise at local level to conduct sustainable energy projects;
- lack of financial resources to upgrade the inefficient heating systems now in place;
- scarcity of financial resources in the municipalities for renewable energy projects support.

With the present administrative structure, the most appropriate level for renewables development seems to be the level of *powiats* (counties) or groups of several neighbouring ones with similar or complementary characteristics. Such a scale of planning of the use of RES would, in particular, facilitate the cost-effective allocation of surplus biomass from the production area to the communes where the demand is higher than the existing potential. Thus the effective solution would be to bring the co-ordination down to the county or NUTS3 level (groups of counties).

At the same time, the arguments that the introduction of the mandatory admixtures of bio-components to fossil fuels for motor vehicles - apart from the global impact - would greatly help the troubled Polish agricultural sector and, by this virtue, Poland's economy at large were played down. Other arguments were overshadowed as well (energy security of the country, improved trade balance, increased volume of Poland's GHG emission credits). Job creation in unemployment-ridden areas would be a significant effect; according to government estimates ca. 100 thousand people would find employment in the biofuel sector by 2005. The same source estimated the farmers' revenues total revenue from rape-for-biodiesel production alone at 46, 126, 219 and 328 mEURO in 2002, 2003, 2005 and 2007, respectively. These are – as it looks now – lost opportunities. No doubt, the cancellation of the Act will benefit the (fossil) oil lobby instead.

iii) Impact of an autonomous local unit for natural gas distribution

In Portugal the main pipeline for natural gas distribution goes from south (Sines) to North, along the territory near the coast. The interior of the country has some small towns with reduced economic activity apart from the services and agriculture. Energy infrastructures and reliable energy supply are an important location factor for economic activities. Small autonomous units using liquefied natural gas can be used where the market exists but it is not cost effective to invest in the connection to the main pipeline. This is the case with Vila Real, an interior town in the North of Portugal, with 50 000 inhabitants. Besides a dynamic university, which has given new life to the region, in itself the region is lacking of a diversified economic tissue.

With the availability of natural gas it is expected that new activities will come and additional arguments for choosing location can be offered to the firms looking for reliable sites in terms of infrastructures availability.

The autonomous unit has been installed in 2000 and in 2001 a duplication if its capacity was already in place, which shows the enormous interest from the consumers for a clean and reliable energy source.

The town is now experiencing a dynamic development process, based on modern communication infrastructures, availability of skilled labour, diversified energy sources.

iv) Impact of a big coal power plant (640 MW) in a depressed region

Moving along the Tejo Valley to the East we enter into more and more depressed areas, with agriculture and forestry being the main economic activity. Sites for coal power plants are not easy to find because of the opposition of populations. Local impacts on the environment are the main argument against such projects (particulates, acidification emissions, among others).

Such a power plant needs water for refrigeration and a location near the Tejo river could be eligible. During the negotiations with the local authorities of the candidate locations the development impact in the regions in terms of job creation, municipal revenues and other policies aiming to improve the welfare of the population are of a crucial importance.

The site selected is located in one of the poorest villages in the Abrantes municipality, implying the transportation by rail of imported coal from Sines harbour, about 320 km Southwest on the Atlantic coast.

Some summary measures of the impact of the installation of the Pego coal power plant (640MW) come as follows:

- The income tax (IRC) is about 20 million euros, which represents 26 percent of the total IRC in Santarém district and 80 percent of total IRC in Abrantes municipality;
- The annual direct labour requirements amount to 284 jobs equivalent per year and the impact in terms of indirect labour requirements is 33.486 jobs equivalent per year;
- The installation of the Pego power station induced an intense demand for construction materials, services (ceramic, hardened, inert, wood, transports, tourism, etc.), and workforce at local level;
- During the construction the number of jobs was increasing until the 3rd year of construction, reaching a maximum that exceeded the 2.000 workers, having in consideration the staff of the contractors and sub-contractors;
- After the power station began its exploration, the public investment in Abrantes municipality increased around 160% in the period 1995-1998 and direct taxes increased by 80%.

Besides the main activity the Pego investors are nowadays important supporters of some social initiatives in the area having as targets the less favoured people (care centers for elder people and children, cooperation with the schools for students visits, among others).

The power station has conducted important initiatives in the environment field, having adopted modern regulations in terms of certification.

v) Impact and uncertainties with market integration (Iberian Peninsula)

Portugal and Spain are in the process of negotiating the implementation of the Iberian Market for Electricity, which is expected to enter into force next year. According to what has happened in similar situations, the completion of the liberalized market will take several years. Meanwhile we will have a mix of competitive and oligopolistic markets, calling for a more or less degree of regulation.

With integration of markets and increased competition it is expected a reduction in the electricity market price, which would be a positive outcome. However the final result of the integration of the two markets is uncertain, depending on the market power of the main producers.

Integration will imply additional investments on high voltage transmission lines in order to eliminate barriers actually in place for the electricity transit.

Besides the expected impact on electricity prices the integration of the two markets will have important consequences at the level of security of supply, thus reducing the probability of shortfalls.

FINAL CONSIDERATIONS

The case studies approach to study the territorial impact of energy policies and measures can help the researcher to understand the main movements and impacts of decisions, investments and energy use that can be registered in some countries and regions, at certain moments. Some of the impacts are qualitative, such as the impact on welfare of the population from energy availability at low prices. Others being quantitative depend on the region where the phenomenon we want to measure happens. For instance, different per capita electricity consumption can depend on the climate of the region, the structure of the economic tissue, the price, the lack of alternative energy sources.

To the complexities mentioned we can add fundamental questions for which the answer is not clear and with unknown or uncertain impacts:

- will the price of oil follow old patterns or are we approaching a non return period of high prices?
- will a new technology be mature in due time to replace oil?
- what will be the role for renewable energy sources?
- from the on going debate will nuclear power emerge as a winner?
- what will be the evolution towards distributed energy (microgeneration of electricity, cogeneration, …)?
- will the Kyoto protocol enter into force?
- what will be the role for biofuels in the transport sector?

The lesson to extract from these questions is that a set of uncertainties exist that will prevent us from extracting definitive conclusions for the medium and long term from historic data. We need to be prepared to react in real time to the important challenges faced by the energy sector and the energy consumers. The evidence collected in this study is of great value to understand the complexities of the energy sector and its connection with the territory and with the consumers.

CONCLUSIONS AND RECOMMENDATIONS

See annex file

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ANNEXES

ANNEX 1 – EU Energy Policy

Source: Energy – http://europa.eu.int/pol/ener/index_en.htm

Presenting its strategic objectives for 2000-2005 [COM (2000) 154 final, "Shaping a new Europe"], the Commission indicated energy to be a key factor for Europe's competitiveness and economic development. The prime aim of the European Community's energy policy, as set out in the November 2000 Green Paper on the security of energy supply, is to ensure a supply of energy to all consumers at affordable prices while respecting the environment and promoting healthy competition on the European energy market. The European Union is facing new energy challenges for which it must have an appropriate energy strategy.

Security of the Union's energy supply and protection of the envi ronment have been highly important in recent years. In particular, the signature of the 1997 Kyoto Protocol on Climate Change boosted the importance of the environment dimension and sustainable development in Community energy policy. The Union's external energy dependence is continuing to grow (it currently meets 50% of its energy requirements through imports). As the Green Paper states, if nothing is done, this rate of dependence will grow to 70% by 2030, which would further weaken the Union's position on the international energy market. Vigilance with regard to diversification of energy sources and supplier areas is one of the ways of ensuring security of supply. The debate on the Green Paper should be concluded at the Barcelona Summit in March 2002, following which the Commission will propose a set of specific measures to improve the EU security of energy supply (Additional information on the Green Paper "Towards a European strategy for the security of energy supply").

Creation of a single market is a part of the energy policy and has long been a priority of the Community. The Commission's aim is to provide the Union with the most effective, safest and competitive energy market. The creation of the single market, which is now well under way, has proceeded in stages. Initially, measures were taken to ensure the transparency of prices to final consumers and to facilitate the transit of gas and electricity between the Community's major grids. The next step was to remove certain restrictions so that companies would enjoy equal access to explore and prospect for hydrocarbons. In 1996 and 1998, in an important move forward in the construction of the single energy market, Directives were adopted on common rules for electricity and gas. These Directives ensured the free movement of electricity and gas within the Community. Liberalisation of the electricity and gas markets, which were opened up to major consumers in 1999 and 2000 respectively, has enjoyed some success, though the degree of liberalisation still varies greatly from one Member State to another.

The call made at the Lisbon European Council of 23 and 24 March 2000 for the energy markets to be opened up more quickly provided a new major impetus in this area. In March 2001 the Commission adopted a set of measures to open up the gas and electricity markets fully by 2005. They include a communication on the completion of the internal market, a draft Directive amending the Directives introducing common rules for the internal market in electricity and gas and a draft regulation on conditions for access to the network for cross-border trade in electricity. These measures provide inter alia for an accelerated timetable, conditions even more conducive to genuine and fair competition, and the creation of a single market which offers guarantees to the public, protects the environment and ensures a safe and affordable supply of energy.

The completion of the internal market for energy is accompanied by measures to strengthen economic and social cohesion, such as the creation of trans-European energy networks. Legislation on Community guidelines in this area and on measures to create a favourable context for the trans-European networks was adopted during 1996. The decisions on the guidelines contain a list of projects of common interest in the trans-European electricity and natural gas networks. Under these guidelines, some 74 projects of common interest have been identified, representing a total investment of EUR 18 000 million. The funding of these projects is largely the responsibility of the operators in this sector. In a number of cases, the Union's financial instruments, consisting essentially of EIB loans and ERDF aid, have been mobilised. In its 1997 annual report on the trans-European networks, the Commission reported major progress in the gas sector. However, the priority projects in the electricity sector are facing administrative, financial and environmental problems which are slowing them down. The guidelines are to be revised to focus on remaining bottlenecks and improve the interoperability of networks.

The introduction of trans-European energy networks also has an impact on relations with third countries. Interconnections have been made with certain Mediterranean countries, the countries of Central and Eastern Europe and Norway. The CENTREL electricity grid, which covers Poland, the Czech Republic, Slovakia and Hungary, was connected to the UCPTE grid (the main European electricity grid) in 1995. The extension of the UCPTE grid to the Balkan States and its interconnection with the countries of the CIS is the subject of studies being funded by the Community, as are gas links between Eastern and Western Europe. Projects on connection with the countries of the Mediterranean basin are also being studied and a Euro-Mediterranean partnership in the energy sector has been set up. At international level, the European Union is likewise endeavouring to establish cooperation in the energy field with almost all the main countries and regions of the world. The Synergy programme is geared to the Community's general energy relations with third countries. Cooperation with Russia in the energy field was given a boost at the EU-Russia Summit in October 2000 thanks to the concept of energy partnership. In addition, the European Community is a signatory to the European Energy Charter, which promotes East-West cooperation on energy. The European Union plays an active role in initiatives in the Baltic Sea region, including the "Northern dimension" action plan. The European Union is also developing major links with other countries such as the Balkan States and China. It is also taking care to maintain its relationships with its industrialised partners in the OECD and with its EEA partners. Finally, its links with the Gulf States are important both in themselves and as part of the dialogue between energy producers and consumers which has recently been revived. The European Union is also represented in a wide range of international forums and organisations such as the International Energy Agency (IEA).

Energy from renewable energy sources (RES) is playing a key role in the diversification and sustainability of energy sources and the campaign to combat climate change. The Altener programme, set up in 1993 and renewed in 1998, promotes RES in the European Union. The 1997 White Paper provided a strategy and a Community action plan for RES. The prime objective set by the White Paper is to double the proportion of renewable energy sources in the EU gross domestic energy consumption from 6% in 1997 to 12% in 2010. Despite some progress in this area, the report published in January 2001 emphasised that much work had yet to be done. Nonetheless, the Commission believes the goal set in the White Paper to be a realistic one. A Council and Parliament Directive on the promotion of production of electricity from renewable energy sources was adopted in September 2001; it aims to increase the percentage of "green" electricity in the Union from 14% in 1997 to 22% in 2010.

A "take-off" campaign to get RES off the ground is an integral part of the action plan and strategy for 2010 and must act as a catalyst for the development of key renewable energy sectors for which quantitative targets have been set for 2003. The take-off campaign also includes the renewable energy partnerships, which is a system of voluntary agreements by public or private partners with the Commission to achieve the objectives of the campaign.

For the first time, the Green Paper on security of energy supply stresses the fundamental importance of influencing demand rather than concentrating solely on energy supply. In order to limit our energy dependence, the growth in our demand has to be limited by legislative means, among others. A series of measures are so presented in the Green Paper.

In the context of the Kyoto Protocol, improved energy efficiency has become even more than before an important element of Community strategy. In April 2000, the Commission adopted an action plan to improve energy efficiency in the European Community. The SAVE programme encourages energy efficiency measures, and will be the main instrument for coordination of the plan. Under the plan, for example, the Commission adopted in May 2001 a proposal for a Directive on energy efficiency in buildings covering: a common methodology for minimum energy performance standards, the application of those standards for new buildings and for major renovations of existing buildings, production of an energy performance certificate in the event of the construction, sale or renting of a building and the checking of heating and air-conditioning systems.

As 40% of energy is consumed in the transport sector which in turn is responsible for 28% of CO2 emissions, the Green Paper stresses the importance of taking transport policy measures to reduce energy consumption. In this connection, the White Paper "European Transport Policy for 2010: time to decide" adopted in September 2001 by the Commission is, with its 60 proposals, a key instrument to change the present modal split. Oil accounts for 98% of energy consumption in the transport sector. An attempt at diversification is therefore essential in this sector. In November 2001, the Commission adopted an action plan and two proposals for directives to encourage the use of alternative fuels in the transport sector, beginning with regulatory and fiscal measures aimed at promoting biofuels. The first directive provides for a minimum percentage of biofuels from 2005 while the second allows the possibility of applying a reduced excise duty for biofuels.

SAVE, ALTENER, SYNERGY, SURE (nuclear safety and transport of radioactive materials) and ETAP (studies, analyses and forecasts) are incorporated in a non-technological energy framework programme which runs until the end of 2002 and is currently being revised.

Alongside legislative measures or measures designed to encourage changes, technological progress is an important mean of achieving the objectives of the Community energy strategy. The Commission supports research, development and demonstration projects in the field of non-nuclear energy under the ENERGY sub-programme of the Fifth Framework Programme for research and technological development. This framework programme runs until the end of 2002 and the Sixth Framework Programme which will lay emphasis on the European Research Area is currently being drawn up.

On what regards nuclear energy, Union policy is responsibility of the European Atomic Energy Community (EURATOM) set up in 1957 on the basis of a separate treaty to that of the European Community. EURATOM has a number of tasks including research into and development of the peaceful use of nuclear energy, the drawing up of uniform safety standards, and the creation of a common market for nuclear energy equipment and an adequate supply of nuclear energy. It is also responsible for ensuring that nuclear materials are not used for unlawful purposes such as the production of nuclear weapons. The institutions common to the European Community (particularly the Council, Commission and European Parliament) and the Supply Agency created by the EURATOM Treaty are responsible for implementing the Treaty. EURATOM plays an active role in international initiatives, having concluded many international agreements with third countries or international organisations, such as the International Atomic Energy Agency (IAEA) with the Convention on Nuclear Safety. The EURATOM Safeguards Office, for its part, is responsible for ensuring that within the European Union nuclear materials are not diverted from their prescribed use and that the safeguards to be applied by the Community under an agreement with a third country or international organisation are observed.

Nuclear safety is of particular concern to certain countries, particularly in Eastern Europe. It has a prominent place in the negotiations underway with candidate countries. The TACIS, PHARE and to some extent SURE programmes are involved in measures to improve safety in third countries.

Lastly, in the tax field, the Commission has presented two proposals on the taxation of energy products. One proposal, presented in 1997, sets out a global tax system for such products; this proposal is however pending in the absence of political agreement between the Member States. As stated above, the Commission also adopted in November 2001 a proposal for a directive allowing the application of reduced rates of excise duty on biofuels. The Green Paper on security of energy supply also stresses that tax measures will be needed to curb the present growth in demand.

ANNEX 2 – Tables and maps

Maps (see word files)

Tables related to energy indicators (see excel files)

Table 5 - Regional Unplanned Electricity Supply Interruptions in 2001

	REGIONS	MINUTES LOST PER CUSTUMER	NUMBER OF INTERRUPT, PER CUST,	DISTRIBUTED ENERGY AT MV & LV (TWH)	LENGTH OF MV CIRCUITS (KM)	NUMBER OF LV USERS (MILLIONS)	AREA (KM2)
E	País Vasco	56,40	0,92	n,a,	11,078	1,049	7,234
E	Navarra	59,40	1,16	n,a,	15,266	0,283	10,391
E	La Rioja	66,00	1,5	n,a,	1,264	0,178	5,045
E	Asturias	91,20	1,37	n,a,	9,015	0,589	10,604
E	Madrid	92,40	2,66	n,a,	33,641	2,531	8,028
E	Cantabria	112,20	2,37	n,a,	6,551	0,311	5,321
E	Aragón	112,20	2,5	n,a,	9,214	0,737	47,720
E	Castilla-León	115,20	2,42	n,a,	20,893	0,165	94,223
E	C, Valenciana	145,80	3,78	n,a,	26,742	2,603	23,255
E	Canarias	171,60	4,4	n,a,	8,827	0,825	7,242
E	Murcia	176,40	3,84	n,a,	4,344	0,597	11,313
E	Cast-La Mancha	186,60	4,08	n.a.	27,081	1,054	79,463
E	Extremadura	202,80	4,54	n.a.	6,777	0,555	41,634
E	Andalucía	215,40	3,78	n.a.	38,686	3,621	87,597
E	Cataluña	229,80	3,54	n.a.	55,466	3,705	32,114
E	Galicia	310,20	5,12	n.a.	29,597	1,444	29,574
FIN	Lappland (northern part of Finland)	81,00	2,20	n,a,	10,937	n,a,	93,004
FIN	Coast	307	2,60	n.a.	37,008	n,a,	n,a,
FIN	Inland	506	9,30	n.a.	59,226	n.a.	n.a.
I	Friuli - Venezia Giulia	62,74	1,66	5,23	7,187	0,7	7,844
I	Valle D'Aosta	84,13	1,80	0,55	1,268	0,11	3,264
I	Liguria	89,08	2,46	4,89	6,565	1,21	5,420
I	Lombardia	89,86	1,79	44,22	35,446	5,07	23,872
I	Umbria	90,61	2,26	2,88	7,622	0,48	8,456
I	Marche	102,17	2,46	5,26	10,289	0,82	9,694
I	Trentino Alto Adige	113,25	3,36	2,47	5,362	0,33	13,607
I	Veneto	115,32	2,69	21,38	23,529	2,49	18,364
I	Emilia-Romagna	115,34	2,09	20,06	27,752	2,51	22,123
I	Piemonte	118,81	2,58	17,71	27,096	2,72	25,399
I	Toscana	119,51	3,30	14,58	23,982	2,19	22,993
I	Lazio	143,02	3,44	17,12	26,766	3,11	17,227
I	Molise	161,88	4,02	1,04	3,480	0,2	4,438
I	Abruzzo	180,50	3,39	4,49	9,115	0,78	10,795
I	Mid-western	205	1,52	n.a.	25,478	0,368593	n.a.
I	Northern	229	1,65	n.a.	26,538	0,362114	n.a.
I	Campania	235,91	4,92	12,85	21,647	2,63	13,595
I	Puglia	258,31	3,62	9,41	24,889	2,2	19,362
I	Sicilia	311,48	5,80	11,7	33,216	2,82	25,707
I	Calabria	327,05	8,19	4,18	15,219	1,19	15,080
I	Basilicata	435,03	4,91	1,82	8,831	0,34	9,992
I	Sardegna	486,32	7,37	4,75	14,230	0,94	24,090
IRL	Dublin	133	0,93	n,a,	3,911	0,463853	n,a,
IRL	Southern	238	1,40	n,a,	24,410	0,391795	n,a,
NOR	Oslo (County in the south-east of Norway)	47,00	0,70	9,2	3,552	0,507	454
NOR	Akershus (County in the south-east of Norway)	270,00	2,40	7,1	5,677	0,47	4,916
NOR	Finnmark (County in the north of Norway)	327,00	3,50	1,4	3,488	0,074	48,649
P	Grande Porto	252,83	2,92	n,a,	9,181	0,592	735
P	Península de Setúbal	271,78	6,11	n.a.	5,200	0,407	1,519
P	Grande Lisboa	276,8	3,42	n.a.	7,212	0,82	567
P	Algarve	284,4	5,7	n.a.	8,871	0,318	4,990

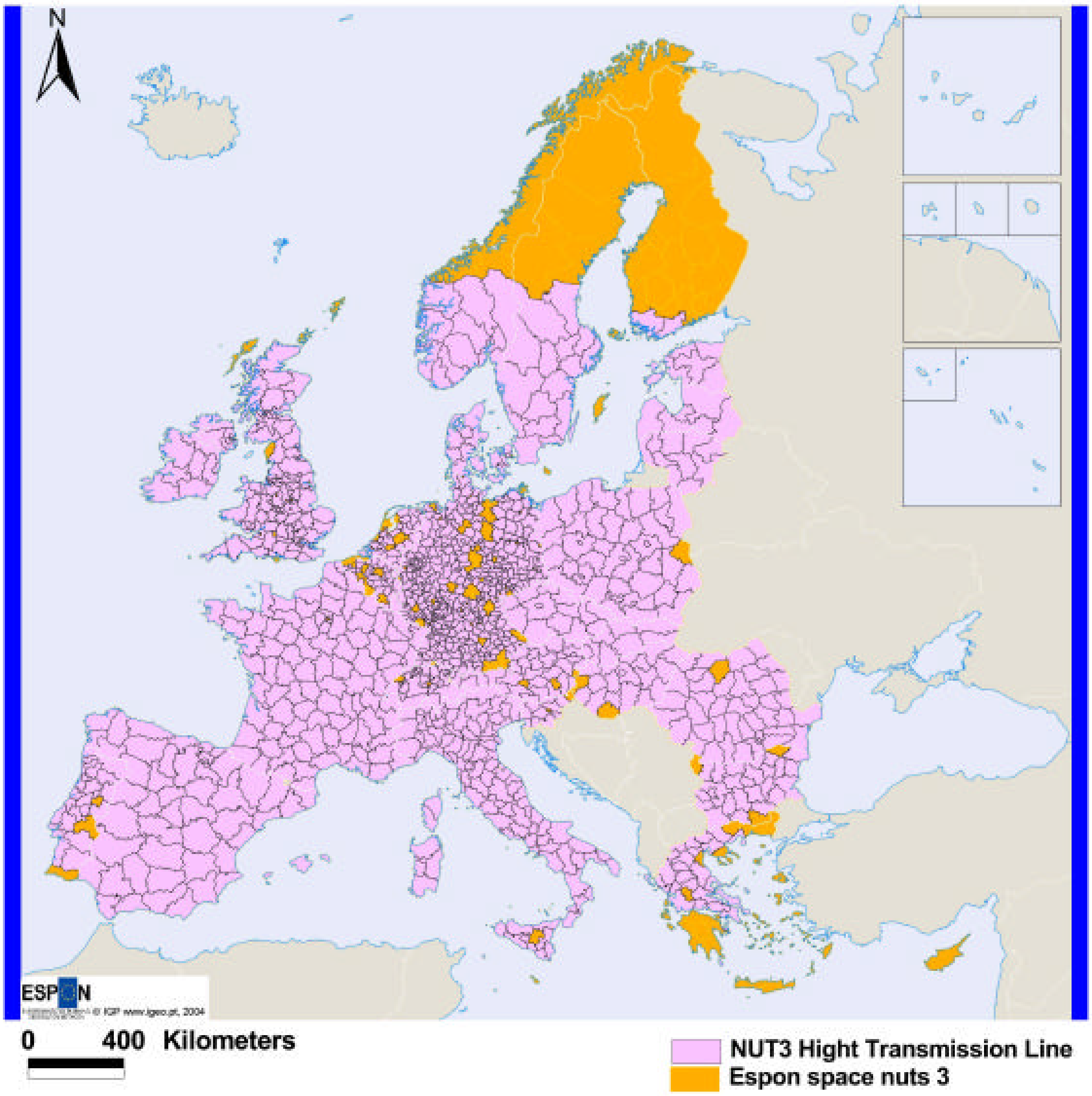
	REGIONS	MINUTES LOST PER CUSTUMER	NUMBER OF INTERRUPT, PER CUST,	DISTRIBUTED ENERGY AT MV & LV (TWH)	LENGTH OF MV CIRCUITS (KM)	NUMBER OF LV USERS (MILLIONS)	AREA (KM2)
P	Beira interior	378,17	8,09	n.a.	8,234	0,269	11,463
P	Trás-os-Montes	440,29	8,34	n.a.	8,980	0,27	11,383
P	Ave-Sousa	507,2	8,18	n.a.	8,124	0,392	3,155
E	Baleares	576,00	4,19	n.a.	8,122	0,533	4,992
P	Alentejo	667,91	10,24	n.a.	7,827	0,227	21,159
P	Minho	685,64	7,36	n.a.	10,491	0,373	3,887
P	Oeste	699,49	9,22	n.a.	3,972	0,347	1,938
P	Litoral Centro	721,21	9,34	n.a.	7,692	0,299	3,833
P	Coimbra	782,3	10,78	n.a.	8,685	0,349	6,121
P	Vale do Tejo	921,19	14,33	n.a.	7,915	0,278	11,987
P	Beira Litoral	1001,24	11,65	n.a.	11,922	0,452	6,072
GB	London Power Networks	43,00	0,40	24,193	9,073	2,07	665
GB	Manweb	55,00	0,53	14,497	19,421	1,44	12,200
GB	Yorkshire Electricity Distribution	56,00	0,70	22,274	20,509	2,07	10,700
GB	NORWEB (Now United Utilities)	60,00	0,54	23,575	19,239	2,26	12,500
GB	Eastern Electricity	66,00	0,69	32,7	36,354	3,35	20,300
GB	Southern Electric Power Distribution	69,00	0,74	29,37	27,500	2,69	16,900
GB	Western Power Distribution (South West)	70,00	0,87	14,245	17,179	0,99	14,400
GB	SEEBOARD Energy	75,00	0,89	19,054	16,555	2,15	8,200
GB	Northern Electric Distribution Limited	110,00	0,98	14,089	20,098	1,50	14,400
GB	Scottish Hydro-Electric Power Distribution	111,00	1,32	n,a,	25,239	0,66	54,390
GB	East Midlands Electricity Distribution	112,00	0,91	27,093	26,736	2,42	16,000
GB	Western Power Distribution (South Wales)	123,00	1,58	9,357	23,486	1,36	14,400
GB	SP Distribution	152,00	0,92	n,a,	32,059	1,91	22,950
UK	GPU Power Networks (Now Aquila)	143,00	1,48	26,073	26,222	2,26	13,300
BG	EDC G, Oriahoviza	59	2,84	1,5	8 585	0,538962	15 017
BG	EDC Pleven	286	2,6	6,93	10 515	0,580549	19 255
BG	EDC Sofia District	n.a.	n.a.	n.a.	8 757	0,533670	19 093
BG	EDC Sofia Capital	150	4,09	2,529	3 875	0,585992	1 311
BG	EDC Varna	86	9,0	4,8	7 678	0,590600	14360
BG	EDC Plovdiv	n.a.	n.a.	n.a.	12 568	0,858432	20 000
BG	EDC St, Zagora	n.a.	n.a.	n.a.	11 048	0,682131	21 000
BG	EDC Zl, Piasaci	n.a.	n.a.	n.a.	25	0,000460	2,17
HU	DÉDÁSZ(Déldunántuli Áramszolgáltató Rt,)	267,6/ 181,2	2, 44/ 2,07	3, 018	11 640	709	18 414
HU	DÉMÁSZ (Délmagyarországi Áramszolgáltató Rt,)	332,4/ 2,95,8	2,66/ 2,72	3,244	9 401	740	18 235
HU	ELMŰ (Budapesti Elektromos Muvek Rt,)	237,6/ 139,8	1,58/ 1,53	5, 813	11 451	917	18 223
HU	ÉDÁSZ (Északldunántuli Áramszolgáltató Rt,)	176,4/ 1,83	1,74/ 1,83	8,148	10 344	1 359	4 050
HU	ÉMÁSZ(Északmagyarországi Áramszolgáltató Rt,)	264,6/ 2,28,6	2,63/ 2,59	3,264	8 802	712	15 501
HU	TITÁSZ(Tiszántúli Áramszolgáltató Rt,)	252,6/ 2,15	2,46/ 2,36	3,531	11 876	748	18 608
LT	Vilniaus ET	60,6	0,48	1,8467	6459		
LT	Kauno ET	29,4	0,40	1,4024	7627		
LT	Klaipedos ET	63	0,49	1,2112	9033		
LT	ŠiauliuET	88,2	0,52	0,7516	8668		
LT	Panevežio ET	99	0,67	0,6851	7112		
LT	Alytaus ET	17,4	0,38	0,6498	5810		
LT	Utenos ET	98,4	0,88	0,3703	7165		

Source:,"Second Benchmarking report on quality of electricity supply", Council of European Energy Regulators, September 2003 and "Quality of electricity supply" ERRA energy regulators regional association, April 2004
Note: for HU data refers to 2002

ANNEX 3 – Case Studies

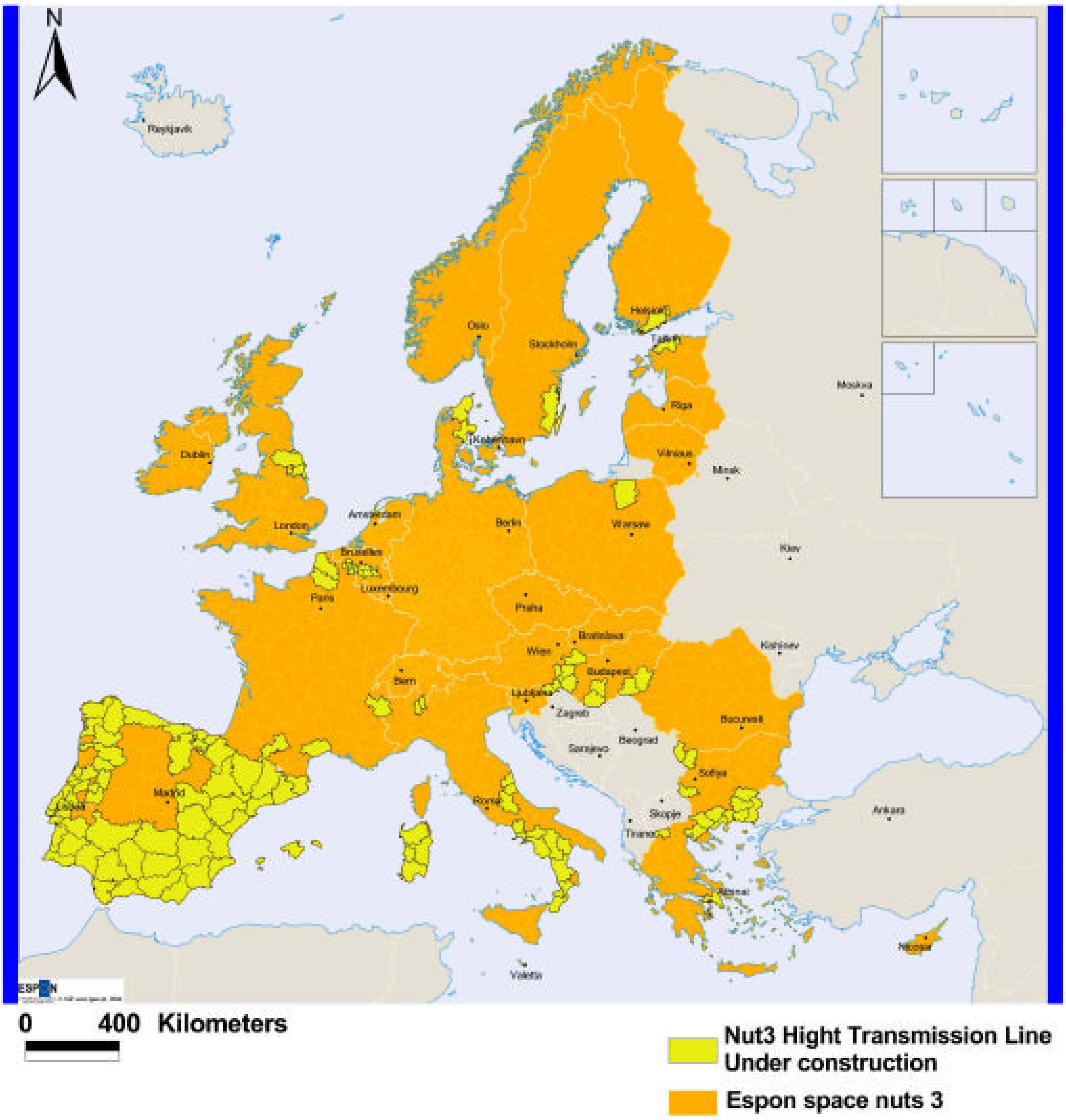
See word files

NUTS 3 with access to Electricity High transmission lines (2003)



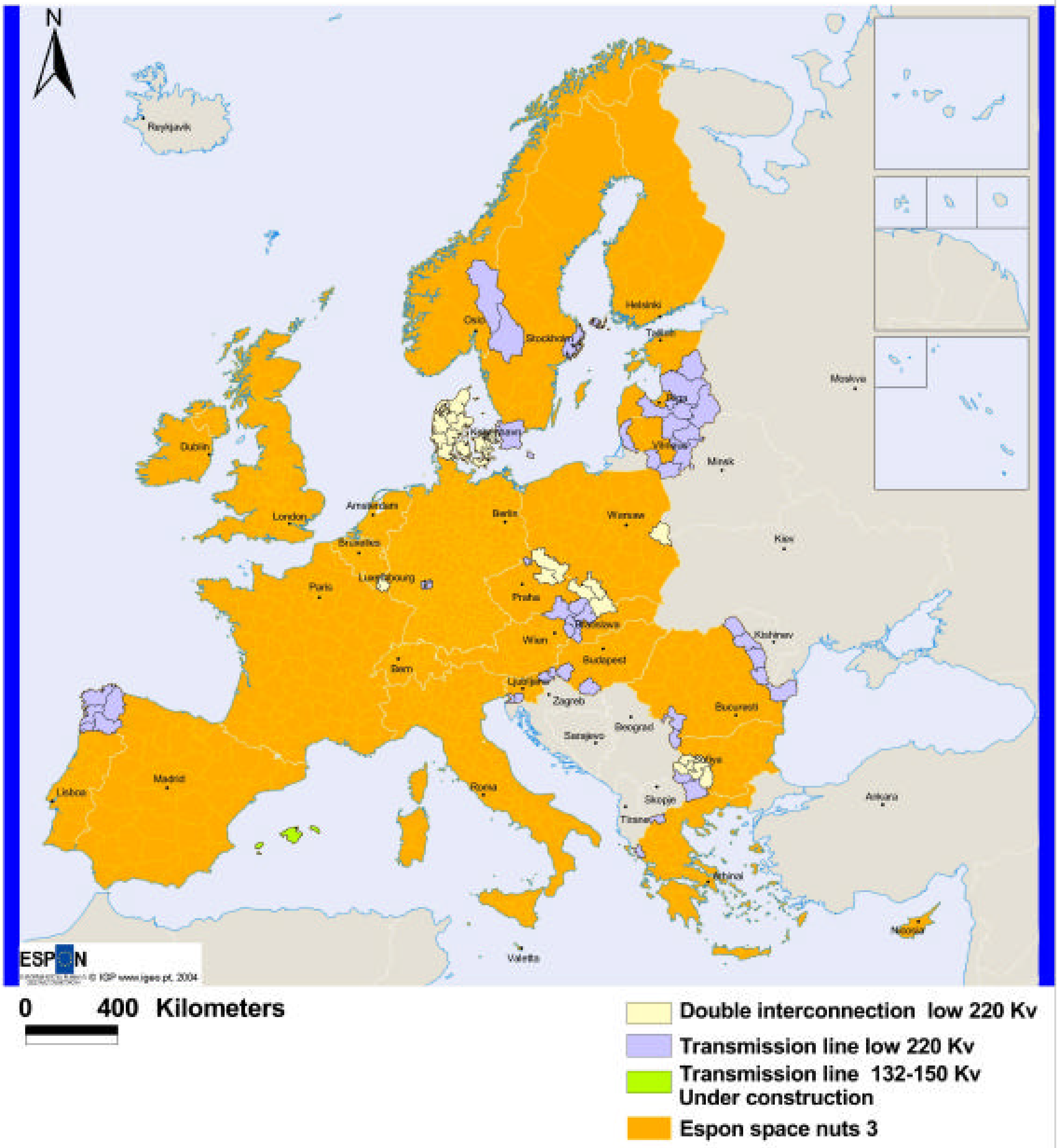
Origin of data: EU29 except Finland, Sweden,Norway, Malta and Cyprus: UCTE, 2003
Source: UCTE, 2003

NUTS 3 with access to Electricity high transmission lines under construction (2003)



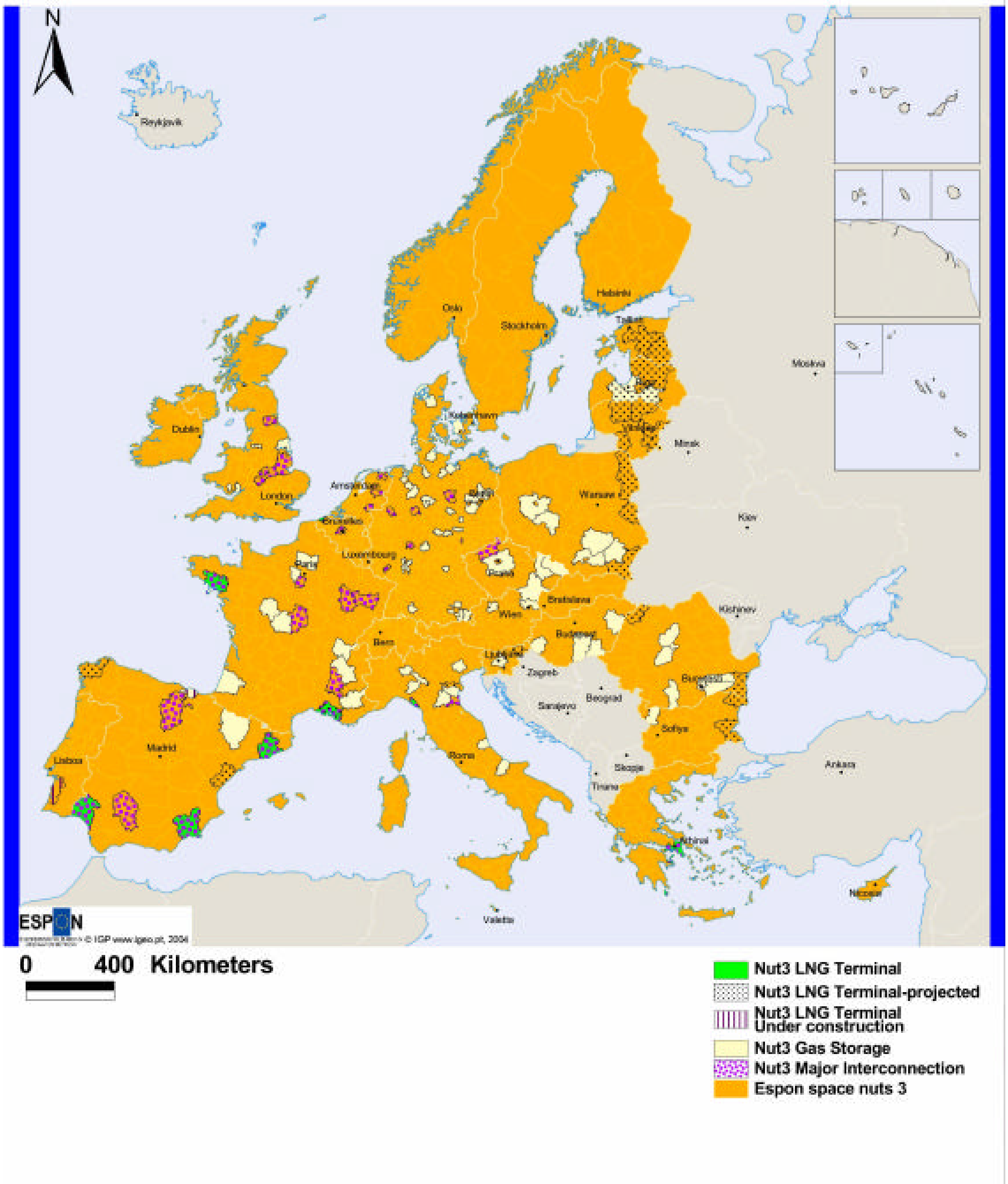
Origin of data: EU29 except Finland, Sweden,Norway, Malta and Cyprus: UCTE, 2003
Source: UCTE, 2003

NUTS 3 with access to Electricity low transmission lines (2003)



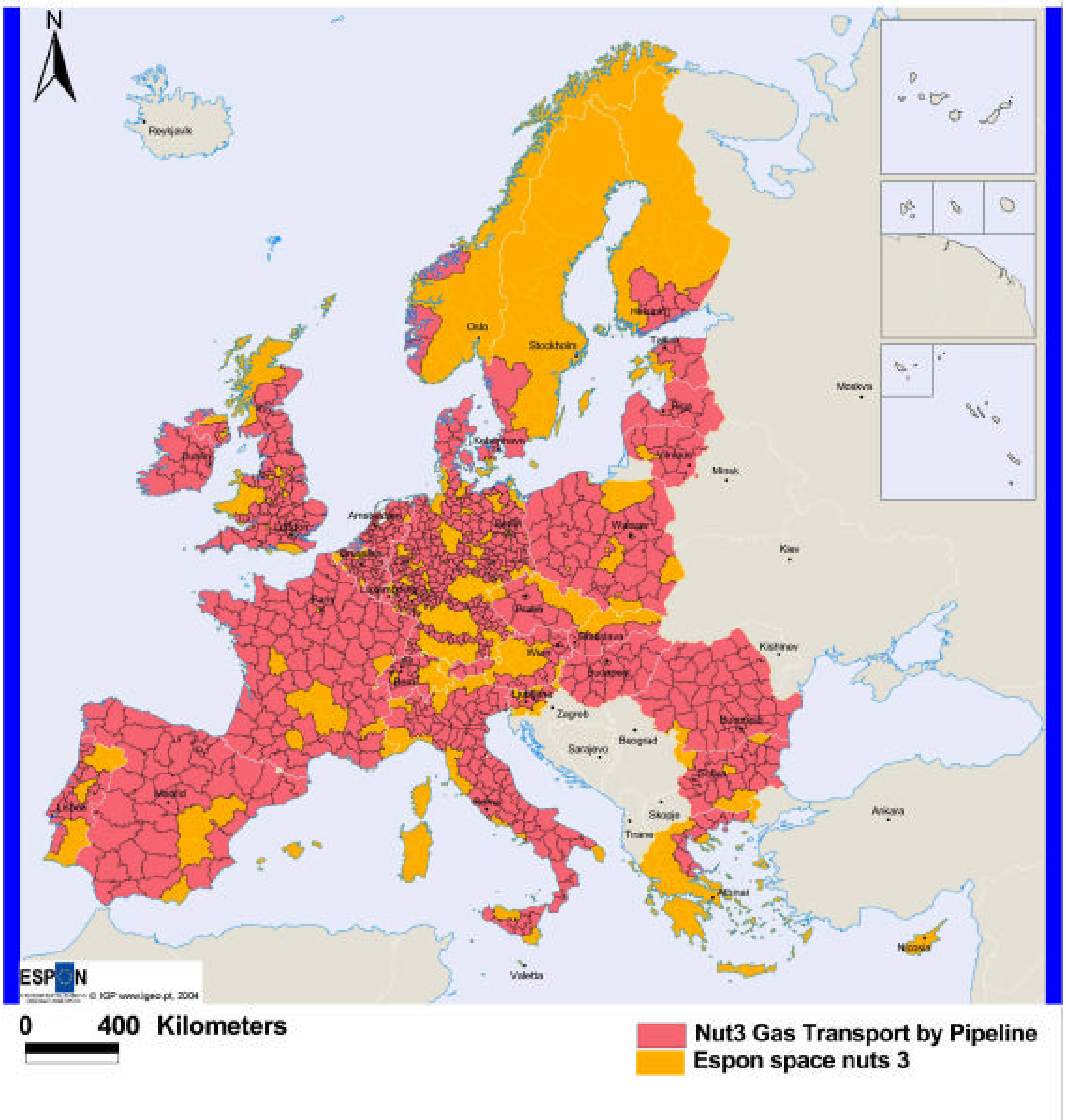
Origin of data: EU29 except Finland, Sweden,Norway, Malta and Cyprus: UCTE, 2003
Source: UCTE, 2003

NUTS 3 with Access to Gas Infrastructures (2003)



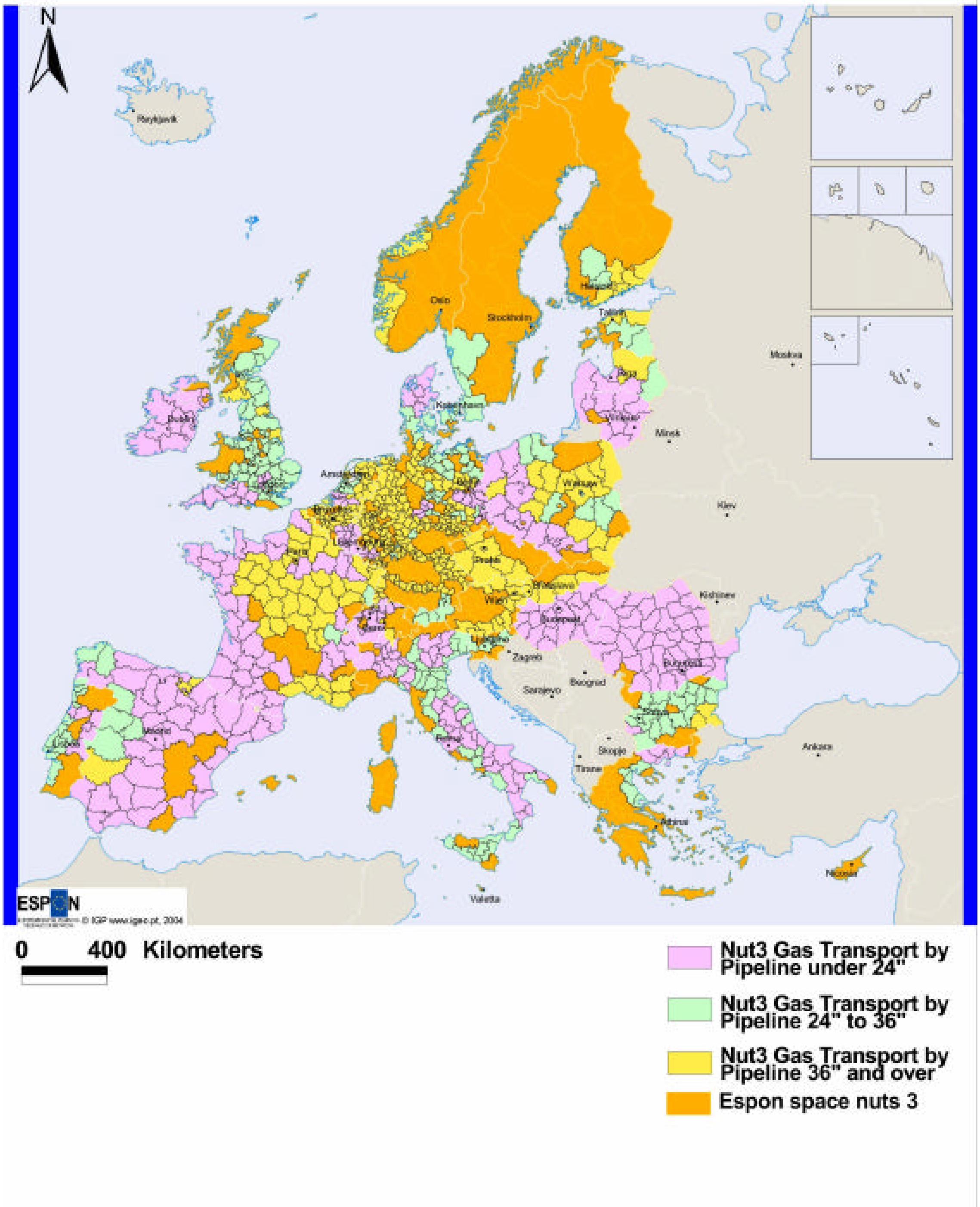
Origin of data: GTE, 2003
Source: GTE, 2003

NUTS 3 with Gas Transport Pipelines (2003)



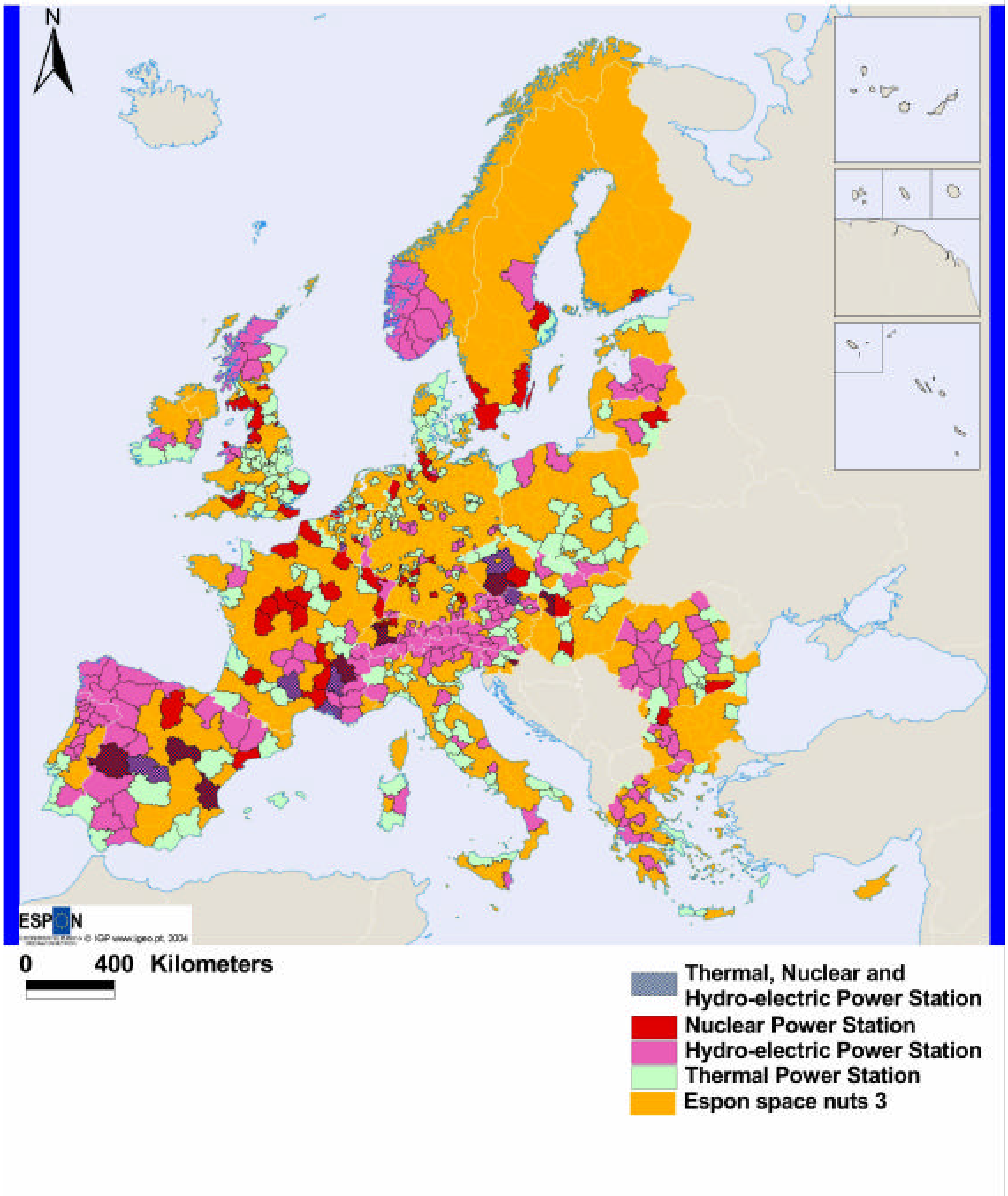
Origin of data: GTE, 2003
Source: GTE, 2003

NUTS 3 with Gas Lines 2v



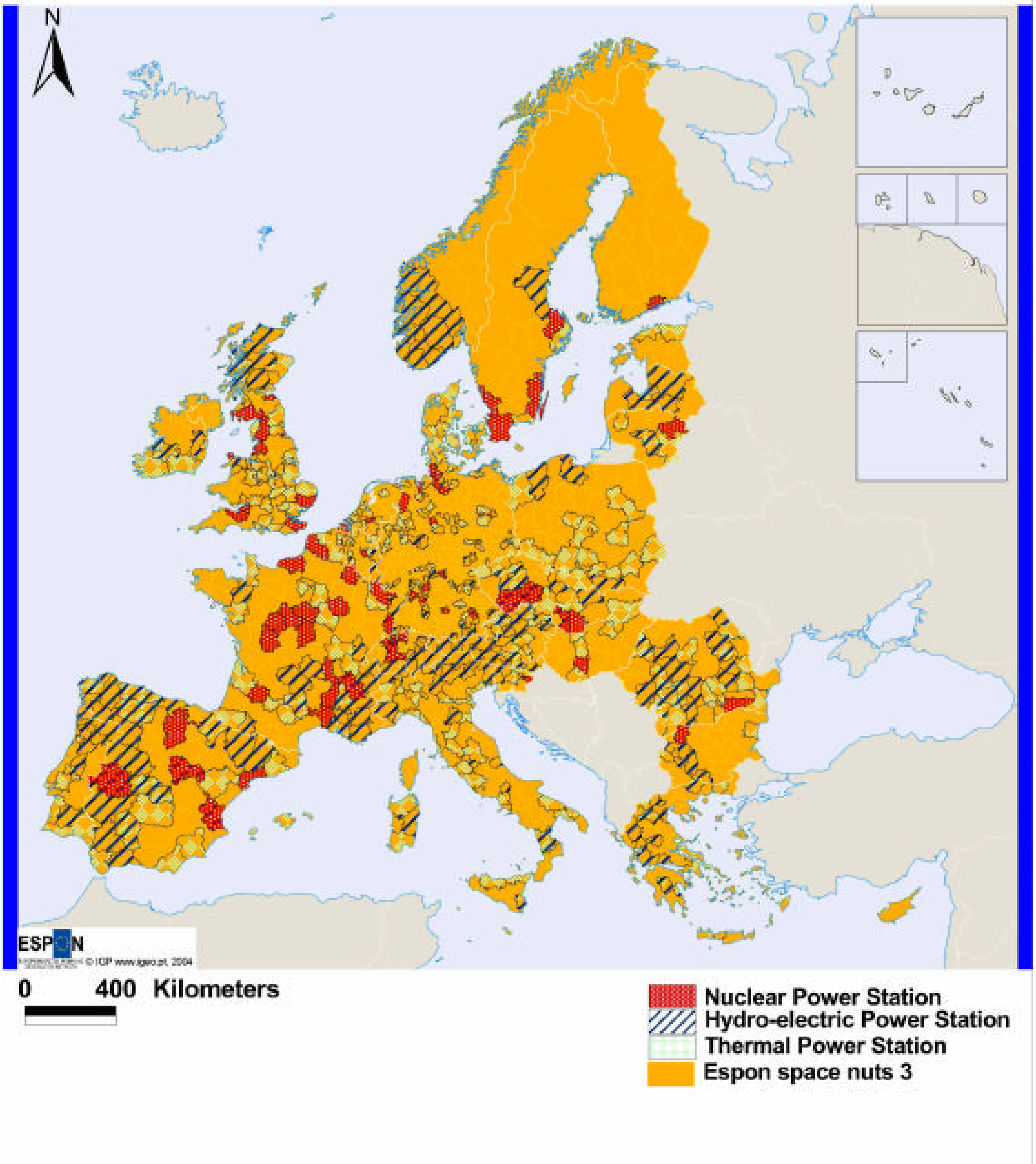
Origin of data: GTE, 2003
Source: GTE, 2003

Location of Thermal, Nuclear and Hydro-electric power stations in 2003



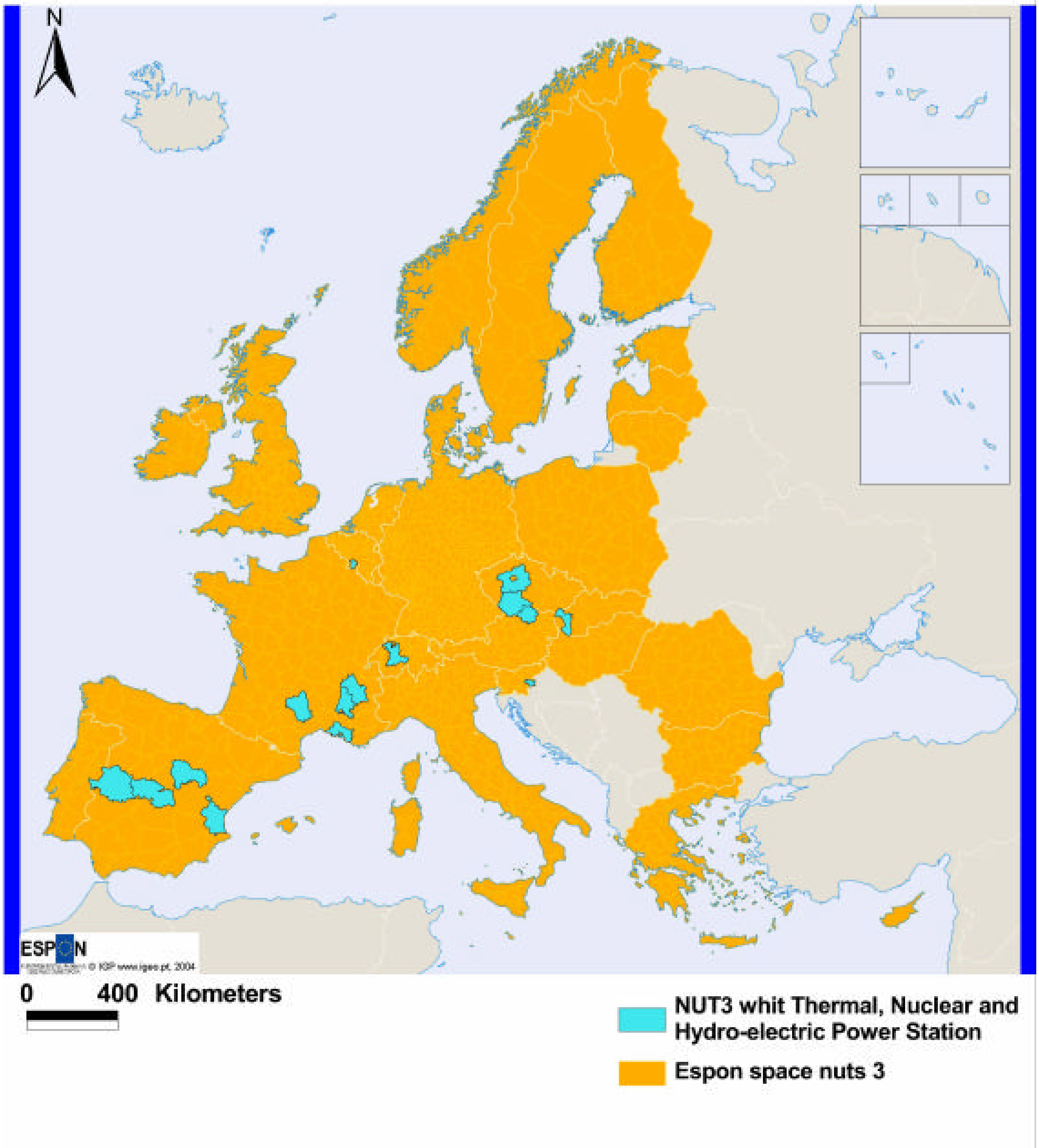
Origin of data: EU29 except Finland, Sweden, Norway, Malta and Cyprus: UCTE, 2003
Source: UCTE, 2003

Location of Thermal, Nuclear and Hydro-electric power stations in 2003



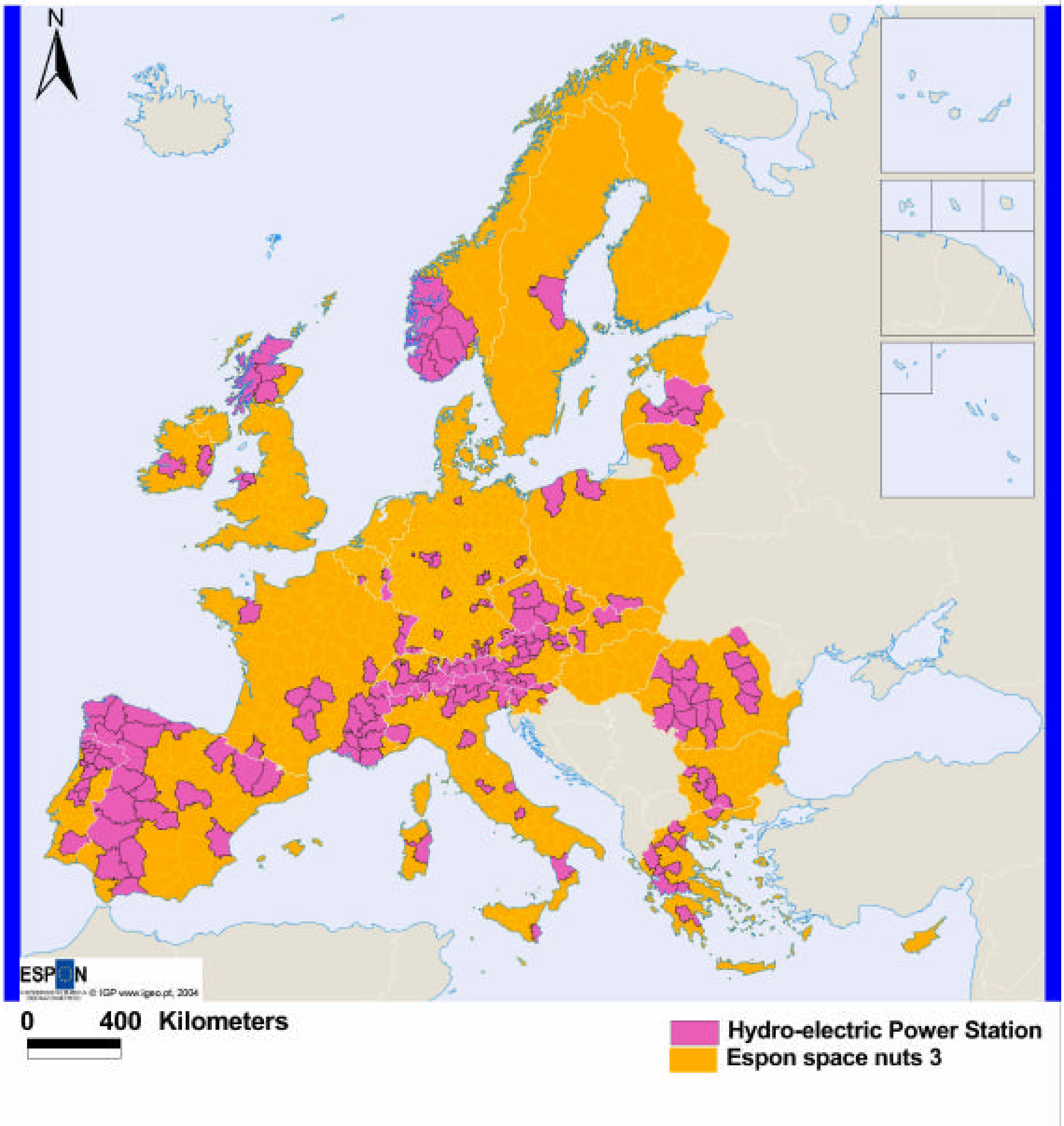
Origin of data: EU29 except Finland, Sweden, Norway, Malta and Cyprus: UCTE, 2003
Source: UCTE, 2003

Location of Thermal, Nuclear and Hydro-electric power stations in 2003



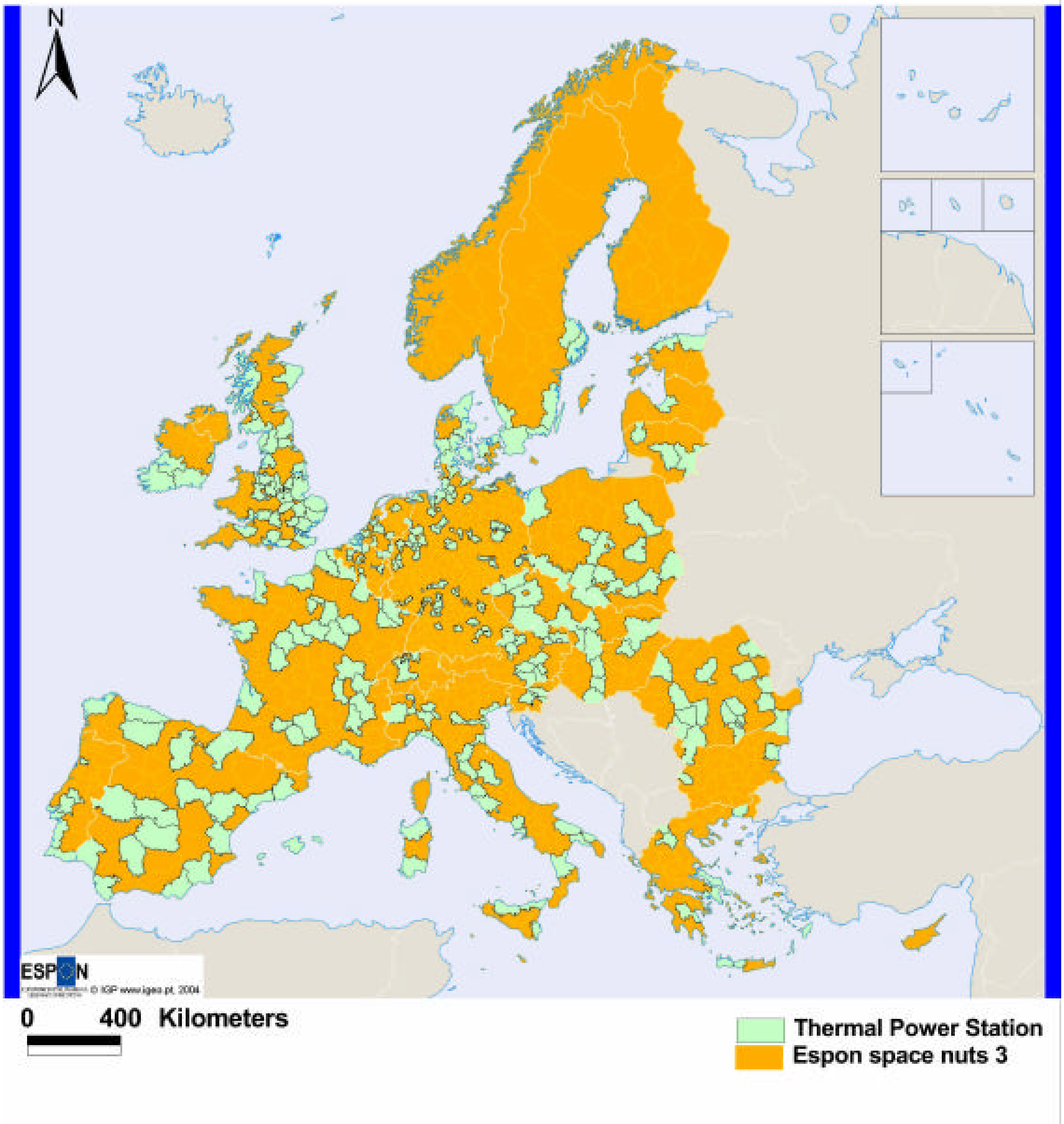
Origin of data: EU29 except Finland, Sweden, Norway, Malta and Cyprus: UCTE, 2003
Source: UCTE, 2003

Location of Hydro electric power stations in 2003



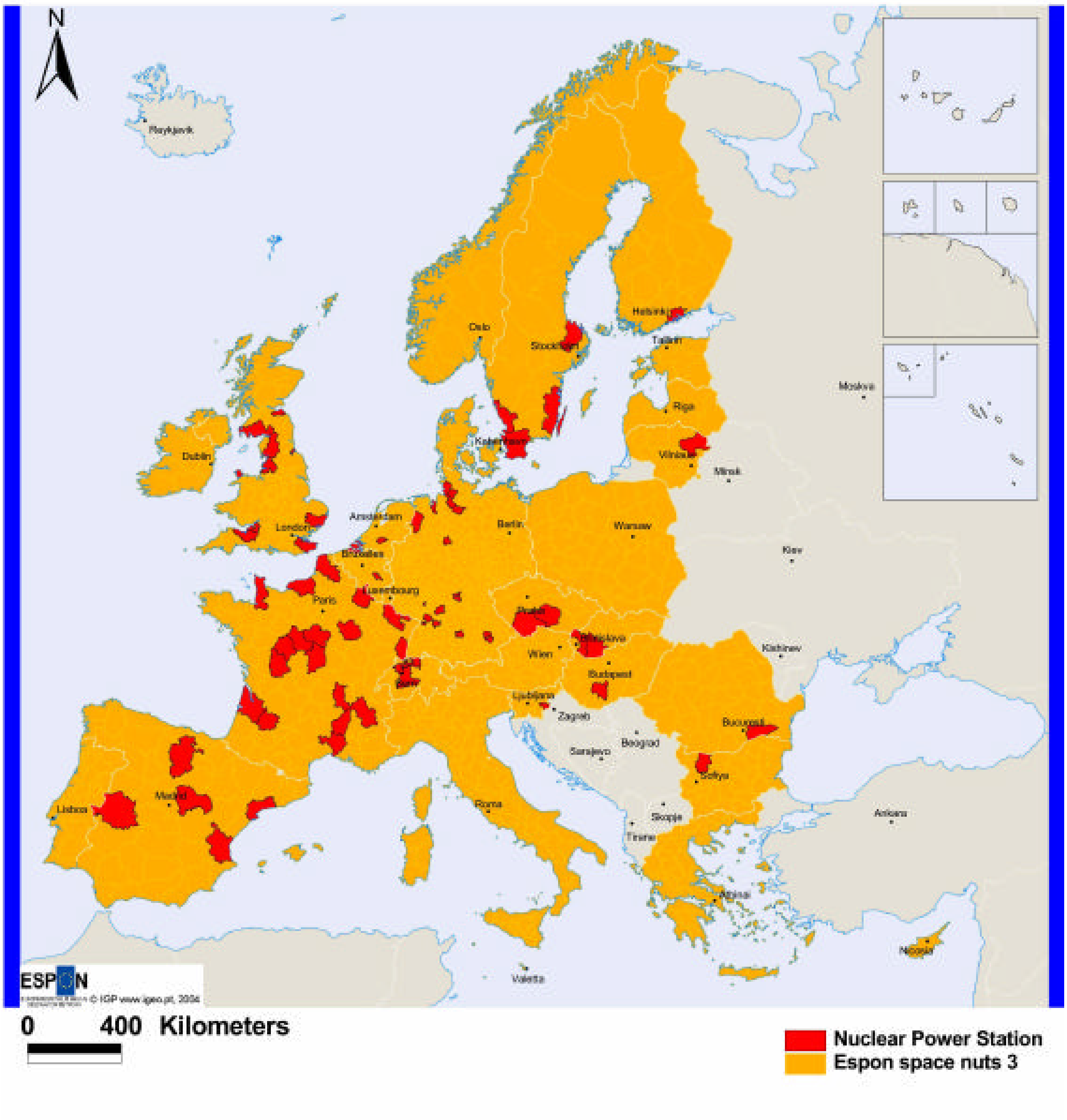
Origin of data: EU29 except Finland, Sweden, Norway, Malta and Cyprus: UCTE, 2003
Source: UCTE, 2003

Location of Thermal power stations in 2003



Origin of data: EU29 except Finland, Sweden, Norway, Malta and Cyprus: UCTE, 2003
Source: UCTE, 2003

Location of Nuclear power stations in 2003



Origin of data: EU29 except Finland, Sweden, Norway, Malta and Cyprus: UCTE, 2003
Source: UCTE, 2003

	1990		BE	DK	DE	GR	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	CY	CZ	EE	HU	LT	LV	MT	PL	SI	SK	BG	RO	NO	CH	EU 15	N10
(1)	Population	Million	10,0	5,1	79,4	10,2	38,9	56,7	3,5	56,7	0,4	15,0	7,7	9,9	5,0	8,6	57,6	0,7	10,4	1,6	10,4	3,7	2,7	0,4	38,1	2,0	5,3	8,7	23,2	4,2	6,7	364,5	75,1
(1)	GDP	bil.€ 1990	154,5	101,6	1 297,4	65,3	398,2	940,0	35,9	861,2	8,5	222,5	125,6	54,3	106,2	180,8	763,1															5 315,0	
(1)	**Primary Energy Production**	Mtoe	12,5	9,9	186,4	9,2	33,4	108,4	3,5	27,4	0,0	60,3	8,7	2,7	11,7	29,6	204,5	0,0	39,0	5,6	14,2	4,8	1,2		101,5	2,7	5,3	9,8	39,8	120,1	9,8	708,3	174,4
	Solids	Mtoe	1,1		125,0	7,1	11,7	7,6	1,4	0,3			0,6	0,1	1,5	0,3	53,1		34,7	5,4	4,1	0,0	0,3		94,5	1,2	1,4	5,4	7,6	0,2		209,9	141,7
	Oil	Mtoe		6,1	3,8	0,8	0,8	3,5		4,7		4,0	1,2			0,0	92,8		0,2		2,3				0,2	0,0	0,1	0,1	7,7	84,4		117,6	2,7
	Natural Gas	Mtoe	0,0	2,7	13,7	0,1	1,3	2,4	1,9	14,0		54,6	1,1				40,9		0,2		3,8				2,4	0,0	0,3	0,0	22,9	24,1	0,0	132,9	6,8
	Nuclear	Mtoe	10,7		37,7		13,7	79,1				0,9			5,0	17,8	16,6		3,3		3,6	4,4				1,2	3,1	3,8			6,2	181,4	15,6
	Hydro & Wind	Mtoe	0,0	0,1	1,4	0,2	2,2	4,6	0,1	2,7	0,01	0,0	2,7	0,8	0,9	6,2	0,4		0,1		0,0	0,0	0,4		0,1	0,3	0,2	0,2	1,0	10,4	2,6	22,3	1,1
	Geothermal	Mtoe	0,0	0,0	0,0	0,0	0,0	0,1		2,1			0,0	0,0			0,0														0,1	2,2	
	Other renewables	Mtoe	0,7	1,1	4,8	1,0	3,8	11,0	0,1	3,5	0,04	0,8	3,1	1,8	4,3	5,3	0,6	0,01	0,5	0,2	0,4	0,3	0,5		4,4		0,2	0,4	0,6	1,0	1,0	41,9	6,5
(1)	**Net Imports**	Mtoe	38,9	9,1	165,3	15,4	59,9	119,8	7,1	132,0	3,5	17,4	17,3	15,2	18,0	17,8	7,3	1,6	7,6	4,5	14,2	11,9	6,5	0,8	2,1	2,5	16,5	17,1	21,6	-96,3	15,2	643,8	68,3
	Solids	Mtoe	9,5	6,2	3,3	1,0	7,0	13,0	2,1	13,8	1,1	9,5	3,1	2,8	4,4	2,3	9,1	0,1	-5,7	0,7	1,6	0,7	0,4	0,2	-18,9	0,1	5,7	3,4	4,3	0,7	0,3	88,3	-15,1
	Oil	Mtoe	21,5	3,2	120,1	14,3	49,2	86,6	5,0	89,9	1,6	30,9	9,7	12,4	10,5	15,1	-9,0	1,6	8,6	3,1	6,4	7,5	3,5	0,6	14,3	1,8	4,7	8,6	10,6	-73,5	13,4	460,9	52,3
	Crude oil	Mtoe	26,1	2,0	88,5	14,7	53,3	76,0	2,0	84,3		48,0	7,8	11,4	8,9	16,9	-3,1	0,6	7,4		6,3	9,6			12,9	0,6	6,2	8,3	15,6	-68,4	3,2	436,7	43,5
	Oil products	Mtoe	-4,6	1,1	31,6	-0,4	-4,1	10,6	3,0	5,6	1,6	-17,1	1,9	1,0	1,6	-1,8	-5,9	1,0	1,2	3,1	0,2	-2,0	3,5	0,6	1,4	1,2	-1,4	0,3	-5,0	-5,1	10,2	24,1	8,7
	Natural gas	Mtoe	8,2	-0,9	41,8		3,7	24,1		25,3	0,4	-23,8	4,5		2,3	0,5	6,2		4,8	1,3	5,2	4,7	2,3		6,8	0,7	5,6	4,9	5,9	-22,2	1,6	92,3	31,2
	Electricity	Mtoe	-0,3	0,6	0,1	0,1	0,0	-3,9		3,0	0,3	0,8	0,0	0,0	0,9	-0,2	1,0		-0,1	-0,6	1,0	-1,0	0,3		-0,1	-0,1	0,4	0,3	0,8	-1,4	-0,2	2,3	-0,2
(1)	**Primary Energy Consumption**	Mtoe	47,3	18,2	354,5	22,2	89,1	223,2	10,3	154,8	3,6	66,8	25,7	16,7	28,5	46,9	211,5	1,5	47,9	10,3	28,5	17,2	7,6	0,8	102,0	5,3	21,4	27,1	61,1	21,5	25,1	1 319,2	242,4
	Solids	Mtoe	10,2	6,1	131,5	8,1	18,9	20,0	3,5	14,6	1,1	9,1	4,2	2,6	5,1	2,7	63,3	0,1	29,8	6,4	6,1	0,8	0,8	0,2	75,4	1,4	7,4	8,8	11,7	0,9	0,4	301,2	128,4
	Oil	Mtoe	17,7	8,6	124,0	12,8	45,5	87,7	4,7	89,8	1,6	24,4	10,5	11,6	9,9	14,5	82,3	1,5	9,0	3,1	8,5	8,0	3,5	0,6	13,2	1,8	4,7	8,8	18,2	8,6	13,5	545,8	53,8
	Natural Gas	Mtoe	8,2	1,8	55,0	0,1	5,0	24,6	1,9	39,0	0,4	30,8	5,2		2,3	0,5	47,2		5,3	1,3	8,9	4,7	2,1		8,9	0,7	5,3	4,9	28,8	2,0	1,6	222,1	37,2
	Other	Mtoe	11,1	1,8	43,9	1,2	19,6	91,0	0,2	11,3	0,4	2,4	5,7	2,5	11,2	29,2	18,7	0,01	3,9	-0,4	4,9	3,8	1,2		4,4	1,4	3,9	4,7	2,4	10,1	9,6	250,2	23,0
(1)	**Final Energy Consumption by source**	Mtoe	31,3	14,3	227,3	14,5	56,5	136,2	7,1	110,6	3,3	42,9	19,9	11,1	21,3	30,4	136,7	1,1	35,3	6,2	19,3	9,5	6,4	0,3	62,3	3,4	14,6	17,5	43,6	16,3	19,1	863,6	158,3
	Solids	Mtoe	3,8	0,5	37,1	1,1	3,5	9,1	1,6	4,3	0,8	1,7	1,8	0,6	1,6	1,2	12,0	0,1	18,7	0,6	2,8	0,7	0,6		19,3	0,3	4,8	1,5	4,2	0,8	0,3	80,5	47,8
	Oil	Mtoe	14,8	7,6	96,8	10,0	33,6	67,6	3,8	54,7	1,6	13,1	8,1	6,7	8,1	12,0	59,2	0,8	6,3	2,6	6,2	3,7	2,2	0,3	9,3	1,5	3,2	5,8	8,2	6,1	12,3	397,6	36,1
	Gas	Mtoe	7,2	1,1	42,7	0,0	4,9	23,7	0,6	29,7	0,6	21,2	3,0	0,1	1,5	0,6	41,2		4,2	0,2	5,6	0,7	0,6		6,0	0,5	3,7	2,3	19,8		1,5	178,2	21,5
	Electricity	Mtoe	5,0	2,5	38,4	2,4	10,8	26,0	1,0	18,4	0,4	6,3	3,7	2,0	5,1	10,3	23,6	0,2	4,1	0,6	2,7	1,0	0,8	0,1	8,3	0,8	2,0	3,0	4,7	8,3	4,0	156,0	20,6
	Heat	Mtoe	0,2	2,1	9,2	0,0	0,0	0,1		0,2		0,3	0,6	0,0	1,9	1,7	0,4		1,5	2,0	1,6	3,1	1,7		15,6	0,2	0,6	4,5	6,2	0,1	0,3	16,7	26,3
	Renewable	Mtoe	0,3	0,5	3,1	1,0	3,7	9,8	0,1	3,4	0,02	0,3	2,8	1,6	3,2	4,6	0,3	0,01	0,5	0,2	0,4	0,3	0,5		3,9		0,2	0,4	0,6	1,0	0,6	34,5	6,0
(1) (5)	**Final Energy Consumption by sector**	Mtoe	31,3	14,3	227,3	14,5	56,5	136,1	7,1	110,4	3,3	42,9	19,9	11,1	21,3	30,4	136,7	1,1	35,3	6,1	19,3	9,5	6,3	0,3	62,3	3,4	14,6	17,5	43,7	16,2	19,1	863,3	158,2
	Industry	Mtoe	11,9	2,9	71,5	3,9	19,8	37,0	1,8	36,9	1,7	13,2	5,8	4,0	9,2	11,8	34,6	0,2	18,1	1,8	6,4	2,9	1,8		25,3	1,4	8,1	10,2	25,5	6,1	3,4	266,0	66,1
	Transport	Mtoe	7,7	4,5	58,8	5,8	22,3	41,9	2,0	33,4	1,0	10,3	5,4	3,7	4,3	7,2	45,5	0,6	2,9	0,6	3,2	1,5	1,2	0,2	7,6	0,9	1,1	2,6	4,5	4,2	6,3	253,8	19,8
	Domestic & Tertiary	Mtoe	11,7	7,0	97,0	4,8	14,4	57,1	3,3	40,1	0,6	19,4	8,8	3,3	7,8	11,4	56,7	0,2	14,3	3,8	9,7	5,1	3,3	0,1	29,4	1,0	5,4	4,7	13,8	5,9	9,4	343,4	72,2
	total		31,3	14,3	227,3	14,5	56,5	136,1	7,1	110,4	3,3	42,9	19,9	11,1	21,3	30,4	136,7															863,3	
	Industry		11,9	2,9	71,5	4,0	19,8	37,0	1,8	36,9	1,7	13,2	5,8	4,0	9,2	11,8	34,6															266,1	
	Transport		7,7	4,5	58,8	5,8	22,3	41,9	2,0	33,4	1,0	10,3	5,4	3,7	4,3	7,2	45,5															253,8	
	Households	Mtoe	8,3	4,1	57,9	3,2	9,3	36,5	2,2	33,2	0,5	9,8	6,8	2,3	5,5	6,8	41,6															228,1	
	Agriculture	Mtoe	0,5	0,6	2,1	1,0	1,7	3,1	0,2	2,9	0,01	3,3	1,1	0,5	0,8	0,5	1,2															19,5	
	Others	Mtoe	2,9	2,2	36,9	0,5	3,5	17,5	0,9	4,1	0,1	6,3	0,9	0,6	1,6	4,0	13,9															95,8	
(3)	**Electricity Consumption by sector**	GWh	59 108	29 538	398 187	28 812	129 161	322 893	11 968	218 700	4 127	75 452	:	23 950	:	:	284 808															1 586 704	
	Industry	GWh	30 619	8 803	199 411	12 511	63 279	128 339	4 477	110 914	2 617	26 175	:	12 219	:	:	100 358															699 722	
	Energy	GWh	1 028	248	:	:	3 371	12 350	108	4 541		:	:	406	:	:	9 974															32 026	
	Transport	GWh	1 249	225	11 312	65	3 669	8 880	16	5 607	53	1 288	:	310	:	:	5 837															38 511	
	Households	GWh	12 555	8 953	99 586	9 074	30 210	96 799	4 572	52 730	650	16 500	:	5 920	:	:	93 793															431 342	
	Agriculture	GWh	:	2 890	7 223	1 558	3 538	2 175	:	4 228	82	:	:	266	:	:	3 875															25 835	
	Services	GWh	13 657	7 974	80 655	5 605	25 094	74 350	2 795	40 680	725	22 381	:	4 829	:	:	70 971															349 716	
	Others	GWh		445									:		:	:																445	
(1)	**Gross Electricity Generation**	TWh	70,8	25,7	548,7	35,0	151,7	420,1	14,5	216,9	1,4	71,8	50,8	28,5	54,4	146,5	318,9	2,0	62,6	17,2	28,4	28,4	6,6	1,1	134,5	12,4	23,4	42,1	64,3	121,6	54,6	2 155,7	316,7
	Nuclear	TWh	42,7		152,4		54,3	314,0				3,5			19,2	68,2	65,7		12,6		13,7	17,0				4,6	12,0	14,7			23,6	720,1	60,0
	Hydro & wind (including pumping)	TWh	0,9	0,6	18,6	2,0	26,2	57,9	1,0	35,1	0,8	0,1	32,9	9,3	10,9	73,0	7,1		1,4		0,2	0,4	4,5		1,4	3,0	1,9	1,9	11,4	121,1	29,8	276,4	12,8
	Thermal	TWh	27,2	25,1	377,6	33,0	71,3	48,1	13,5	181,8	0,6	68,2	17,9	19,2	24,3	5,3	246,1	2,0	48,5	17,2	14,5	11,0	2,1	1,1	133,1	4,9	9,5	25,6	52,9	0,5	1,2	1 159,2	243,9
(1)	**Electricity Production Capacity**	GWh	14,1	9,1	121,2	8,5	43,4	103,4	3,8	56,6	1,2	17,6	16,7	7,4	13,2	34,2	73,0	0,5	15,4	3,5	6,6	5,2	1,7	0,3	30,9	2,7	6,3	11,1	22,5	27,1	15,6	523,5	72,9
	Nuclear	GWh	5,5		24,2		7,0	55,8				0,5			2,4	10,0	11,4		1,8		1,7	2,5				0,6	1,8	2,8			3,0	116,6	8,3
	Hydro & wind (including pumping)	GWh	1,4	0,4	8,8	2,4	16,2	25,0	0,5	18,8	1,1	0,1	10,9	3,3	2,6	16,3	4,2		1,5		0,0	0,1	1,2		1,9	0,8	1,7	2,0	5,7	26,9	11,7	112,1	7,0
	Thermal	GWh	7,2	8,8	88,2	6,1	20,2	22,7	3,3	37,8	0,1	17,0	5,7	4,1	8,2	7,9	57,5	0,5	12,1	3,5	4,9	2,6	0,6	0,3	29,1	1,3	2,9	6,4	16,8	0,3	1,0	294,7	57,6
(4)	**Energy Prices for Industry** (excise taxes included)																																
	Electricity	€ per 100 KWh	5,8	4,4	7,4	5,5	7,1	5,0	5,2	6,0	4,8	4,4	n.a.	6,4	n.a.	n.a.	5,7															6,1	
	Low Sulphur Fuel Oil	€ per tonne	116,2	154,0	128,8	127,0	127,4	120,3	138,2	142,4	121,0	169,2	n.a.	139,5	n.a.	n.a.	119,3															129,8	
	Natural Gas	€ per GJ (GCV)	3,5	n.a.	4,5	n.a.	3,5	3,1	2,3	3,1	3,9	2,8	n.a.	n.a.	n.a.	n.a.	3,4															3,5	
	Steam Coal	€ per toe (NCV)	62,2	134,6	202,3	n.a.	n.a.	105,8	n.a.	65,7	n.a.	70,4	91,5	n.a.	78,5	109,2	99,1																
(4)	**Energy Prices for Households** (All taxes included)																																
	Electricity	€ per 100 KWh	11,5	12,6	11,7	7,9	10,4	10,9	8,2	15,0	9,9	9,9	n.a.	9,3	n.a.	n.a.	7,8															10,8	
	Light Fuel Oil	€ per 1000 litres	194,2	530,2	228,6	197,3	265,3	335,9	270,5	583,0	225,2	304,7	n.a.	n.a.	n.a.	n.a.	212,3															323,4	
	Natural Gas	€ per GJ (GCV)	12,8	n.a.	12,1	n.a.	12,8	12,2	14,3	11,7	11,0	7,9	n.a.	n.a.	n.a.	n.a.	8,0															10,1	

Sources:

(1) "2001 - Annual Energy Review" (energy balances)

(2) ESPON database

(3) Eurostat Newcronos

(4) Energy&Transport in Figures 2002

All available price data has been used in the calculation of EU-wide fuel price averages. The overall EU price is an average of the prices in the individual countries weighted by their consumption.

Electricity

The prices are as of 1 January in the year shown. Prices are collected at a variety of locations in each country.

The standard consumer used for domestic prices corresponds to a standard dwelling of 100 m2 with 4-5 rooms plus kitchen with an annual consumption of 7500 kWh.

For industrial prices, the standard consumer's annual consumption is 24000MWh.

The average price in each country is calculated as the median of the prices in the various locations. These country average prices are weighted by their final consumption (Domestic or Industry) to have the EU-wide price average.

The domestic prices shown here are the final selling prices while industrial prices shown less VAT.

Gas

The same methodology is used for gas price, but the standard used for domestic consumers corresponds to an annual consumption of 16.74 GJ while for industrial consumers this annual consumption is 418000 GJ.

(5) Eurostat SIRENE

	1995		BE	DK	DE	GR	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	CY	CZ	EE	HU	LT	LV	MT	PL	SI	SK	BG	RO	NO	CH	EU 15	N10
																															total	total
(3) (1)	Population	Million	10,1	5,2	81,5	10,4	39,2	58,0	3,6	57,3	0,4	15,4	8,0	10,0	5,1	8,8	58,5	0,7	10,3	1,5	10,2	3,7	2,5	0,4	38,6	2,0	5,4	8,4	22,7	4,4	7,0	371,7	75,4
(2)	GDP	bil.€	211,7	137,8	1 880,2	89,9	446,9	1 188,1	50,9	839,0	13,8	317,3	179,8	82,6	98,9	183,6	867,7	6,8	39,8	2,7	34,1	4,6	3,4	2,5	97,2	14,3	14,6	10,0	27,1	74,8	235,1	6 588,4	220,1
(1)	**Primary Energy Production**	Mtoe	11,4	15,5	141,3	9,7	31,4	123,4	4,3	30,8	0,05	66,0	8,7	2,6	13,2	31,1	250,0	0,01	31,8	3,0	13,3	3,6	0,7		99,5	2,8	4,9	10,1	31,5	182,3	11,0	739,4	159,6
	Solids	Mtoe	0,3		78,8	7,9	10,2	5,4	1,8	0,1			0,3		2,1	0,3	31,0		27,6	2,3	3,1	0,0	0,1		91,1	1,0	1,1	5,1	7,2	0,2		138,0	126,2
	Oil	Mtoe		9,3	3,2	0,5	0,8	3,3		5,3		3,6	1,1			0,0	132,3		0,3	0,3	2,3	0,1			0,4	0,0	0,1	0,0	6,8	142,3		159,2	3,5
	Natural Gas	Mtoe	0,0	4,7	14,8	0,0	0,4	2,8	2,2	16,3		60,5	1,3				63,6		0,2		3,8				3,2	0,0	0,3	0,0	14,4	28,3		166,6	7,4
	Nuclear	Mtoe	10,3		37,3		14,3	94,0				1,0			5,0	18,0	21,2		3,2		3,7	3,1				1,2	3,0	4,5			6,5	201,2	14,2
	Hydro & Wind	Mtoe	0,0	0,1	1,8	0,3	2,0	6,3	0,1	3,2	0,01	0,0	3,2	0,7	1,1	5,9	0,4		0,2		0,0	0,0	0,3		0,2	0,3	0,4	0,1	1,4	10,4	3,0	25,3	1,3
	Geothermal	Mtoe	0,0	0,0	0,0	0,0	0,0	0,1	0,0	2,3			0,0	0,0			0,0														0,1	2,5	
	Other renewables	Mtoe	0,8	1,4	5,3	1,0	3,8	11,5	0,2	3,5	0,04	0,9	2,9	1,9	5,1	6,9	1,4	0,01	0,4	0,3	0,5	0,2	0,4		4,7	0,2	0,1	0,2	1,6	1,1	1,4	46,6	7,0
(1)	**Net Imports**	Mtoe	43,7	7,9	195,2	18,2	75,4	115,3	7,6	134,7	3,3	16,3	17,4	17,9	15,4	19,1	-36,1	2,1	8,6	1,9	12,5	5,6	3,4	0,9	0,0	3,0	12,2	13,4	14,0	-157,6	13,9	651,3	50,1
	Solids	Mtoe	9,3	7,7	11,0	0,9	9,1	9,0	1,8	13,0	0,5	8,9	2,5	3,8	3,8	2,7	10,4	0,02	-5,8	0,3	1,4	0,2	0,1	0,02	-21,2	0,2	3,9	2,3	2,7	0,9	0,2	94,4	-20,9
	Oil	Mtoe	23,6	1,8	130,8	17,2	58,4	85,4	5,7	90,0	1,8	32,8	9,7	14,0	8,2	15,9	-48,5	2,0	7,9	1,0	5,3	3,6	2,1	0,9	15,6	2,3	3,6	6,6	6,5	-133,1	12,2	446,7	44,5
	Crude oil	Mtoe	25,7	0,8	101,2	17,0	55,4	78,8	2,3	82,8		59,3	8,0	13,5	8,5	17,8	-36,4	0,8	6,9		5,7	3,6			14,1	0,6	5,4	8,1	8,4	-127,7	4,8	434,7	37,2
	Oil products	Mtoe	-2,1	1,0	29,6	0,3	3,0	6,6	3,4	7,1	1,8	-26,4	1,6	0,5	-0,3	-1,9	-12,2	1,2	1,0	1,0	-0,4	0,0	2,1	0,9	1,6	1,7	-1,7	-1,5	-1,9	-5,4	7,4	12,0	7,3
	Natural gas	Mtoe	10,4	-1,5	52,9		7,5	26,9	0,1	28,5	0,6	-26,4	5,4		2,8	0,7	0,6		6,4	0,6	5,5	2,0	1,0		5,8	0,7	4,6	4,6	4,8	-24,8	2,2	108,6	26,6
	Electricity	Mtoe	0,4	-0,1	0,4	0,1	0,4	-6,0	0,0	3,2	0,4	1,0	-0,2	0,1	0,6	-0,1	1,4		0,0	-0,1	0,2	-0,2	0,2		-0,2	-0,1	0,1	0,0	0,0	-0,6	-0,6	1,5	-0,1
(1)	**Primary Energy Consumption**	Mtoe	50,5	20,6	337,1	24,1	102,3	235,7	11,0	162,7	3,3	73,3	26,4	19,6	28,8	49,9	218,5	2,0	41,0	4,8	25,6	8,9	4,0	0,8	100,2	5,9	17,3	23,0	45,4	23,5	25,3	1 363,8	210,6
	Solids	Mtoe	8,6	6,4	92,2	8,8	19,5	15,3	2,9	12,3	0,5	9,1	3,2	3,5	5,9	2,9	46,6	0,01	22,6	2,8	4,5	0,3	0,2	0,03	70,3	1,2	5,2	7,4	9,9	1,0	0,2	237,7	107,3
	Oil	Mtoe	19,8	9,6	133,6	14,0	54,6	85,5	5,6	93,4	1,8	27,2	10,9	13,4	8,3	15,7	82,3	2,0	8,0	1,2	7,5	3,4	2,0	0,8	16,2	2,3	3,4	6,3	13,2	8,0	12,5	575,6	46,8
	Natural Gas	Mtoe	10,6	3,1	66,4	0,0	7,7	29,0	2,3	44,7	0,6	34,1	6,3		2,8	0,7	65,0		6,6	0,6	9,2	2,0	1,0		9,0	0,7	5,1	4,6	19,2	3,5	2,2	273,4	34,1
	Other	Mtoe	11,5	1,4	44,9	1,4	20,5	106,0	0,2	12,3	0,5	3,0	5,9	2,7	11,7	30,7	24,5	0,01	3,8	0,3	4,4	3,2	0,7		4,8	1,6	3,6	4,8	3,1	11,0	10,4	277,1	22,4
(1)	**Final Energy Consumption by source**	Mtoe	34,5	15,1	221,3	15,8	63,5	141,5	7,8	116,8	3,1	47,4	21,2	13,0	22,1	33,7	142,4	1,4	27,0	2,5	15,8	4,9	3,3	0,4	63,2	4,0	10,9	11,3	26,7	17,2	19,7	899,3	133,5
	Solids	Mtoe	3,3	0,4	14,9	1,1	2,2	6,9	0,9	4,1	0,4	1,4	1,4	0,5	1,3	1,3	8,9	0,01	8,6	0,2	1,4	0,2	0,1		24,2	0,1	2,9	1,3	2,2	1,0	0,2	49,1	37,7
	Oil	Mtoe	16,3	7,6	104,2	10,8	39,0	68,2	4,7	54,1	1,8	14,7	8,8	8,2	7,7	12,4	61,4	1,2	5,2	0,9	4,2	2,0	1,3	0,3	11,8	2,1	2,0	2,9	5,6	6,1	12,2	419,9	31,1
	Gas	Mtoe	8,5	1,7	51,8	0,0	6,8	27,1	0,7	34,5	0,6	22,5	3,6	0,1	1,5	0,6	46,1		5,2	0,2	6,1	0,4	0,3		6,0	0,4	3,5	1,6	9,5		2,1	206,3	22,1
	Electricity	Mtoe	5,9	2,7	38,9	2,9	12,1	29,5	1,3	20,4	0,4	7,1	4,0	2,5	5,6	10,7	25,3	0,2	4,1	0,4	2,4	0,5	0,4	0,1	7,7	0,8	1,9	2,5	3,1	8,9	4,2	169,4	18,5
	Heat	Mtoe	0,2	2,2	8,7	0,0	0,0	0,1	0,0	0,2		1,4	0,8	0,0	2,1	3,5	0,0		3,5	0,6	1,3	1,6	0,9		8,8	0,2	0,7	2,8	4,7	0,1	0,4	19,5	17,4
	Renewable	Mtoe	0,3	0,6	2,7	1,0	3,3	9,7	0,2	3,4	0,02	0,3	2,6	1,7	3,8	5,1	0,7	0,01	0,3	0,3	0,5	0,2	0,3		4,7	0,3	0,0	0,2	1,6	1,1	0,7	35,3	6,7
(1) (5)	**Final Energy Consumption by sector**	Mtoe	34,5	15,1	221,3	15,8	63,5	141,4	7,8	116,6	3,1	47,4	21,2	13,0	22,1	33,7	142,4	1,4	26,9	2,5	15,8	4,9	3,2	0,4	63,1	4,0	10,9	11,3	26,6	17,1	19,7	898,9	133,2
	Industry	Mtoe	12,1	3,1	62,0	4,1	20,4	37,2	1,8	37,1	1,2	12,7	5,9	4,3	10,0	12,6	34,9	0,4	14,4	0,8	3,8	1,4	0,6	0,04	22,8	1,1	5,1	6,0	14,7	6,2	3,6	259,3	50,5
	Transport	Mtoe	8,5	4,6	62,9	6,4	26,1	44,0	2,2	37,6	1,3	12,4	6,2	4,9	4,1	7,7	46,9	0,8	2,9	0,5	2,7	1,2	0,8	0,3	8,4	1,4	1,4	1,7	3,1	4,4	6,4	275,7	20,4
	Domestic & Tertiary	Mtoe	13,9	7,4	96,5	5,3	17,0	60,2	3,8	41,9	0,7	22,3	9,1	3,9	8,0	13,4	60,6	0,2	9,6	1,2	9,3	2,3	1,8	0,1	31,9	1,5	4,4	3,5	8,7	6,5	9,6	363,9	62,4
	total	Mtoe	34,5	15,1	221,3	15,8	63,5	141,4	7,8	116,6	3,1	47,4	21,2	13,0	22,1	33,7	142,4															899,0	
	Industry	Mtoe	12,1	3,1	62,0	4,1	20,4	37,2	1,8	37,1	1,2	12,7	5,9	4,3	10,0	12,6	34,9															259,4	
	Transport	Mtoe	8,5	4,6	62,9	6,4	26,1	44,0	2,2	37,6	1,3	12,4	6,2	4,9	4,1	7,7	46,9															275,8	
	Households	Mtoe	9,3	4,6	63,0	3,3	10,0	36,3	2,2	32,9	0,6	11,1	7,0	2,6	5,6	7,8	39,7															236,0	
	Agriculture	Mtoe	1,1	1,0	2,6	1,0	2,1	3,0	0,3	3,2	0,0	4,0	1,1	0,5	0,6	0,5	1,2															22,2	
	Others	Mtoe	3,5	1,9	30,9	0,9	4,9	20,9	1,3	5,7	0,1	7,2	1,0	0,9	1,7	5,1	19,7															105,7	
(3)	**Electricity Consumption by sector**	GWh	69 828	31 576	528 332	34 450	172 328	363 217	14 931	243 355	5 004	85 610	46 286	28 851	65 999	:	306 172	:	52 155	6 027	28 919	6 689	4 807	:	:	9 565	27 688	:	:			1 995 940	135 850
	Industry	GWh	34 605	9 651	229 222	12 214	69 650	140 384	5 767	119 472	3 373	36 835	17 812	13 227	36 362	:	102 507	:	18 161	1 751	8 347	2 806	1 716	:	:	5 150	15 105	:	:			831 081	53 036
	Energy	GWh	1 381	341	21 370	:	4 506	12 664	90	5 646	:	2 531	1 049	487	695	:	8 393	:	4 073	1 542	1 478	334	175	:	:	220	:	:	:			59 153	7 822
	Transport	GWh	1 464	239	16 194	67	4 166	9 727	18	7 093	77	1 478	3 131	473	500	:	7 535	:	2 441	13	940	96	235	:	:	230	1 379	:	:			52 162	5 334
	Households	GWh	22 109	10 481	127 231	11 376	43 771	108 837	5 460	57 217	1 553	19 700	12 726	7 700	16 256	:	101 648	:	14 847	1 067	9 791	1 495	1 161	:	:	2 553	4 998	:	:			546 065	35 912
	Agriculture	GWh	:	1 736	33 685	2 011	4 402	2 613	:	4 518	:	3 152	1 486	374	790	:	3 868	:	1 762	366	889	521	250	:	:	:	904	:	:			58 635	4 692
	Services	GWh	10 270	9 128	100 630	8 782	41 155	88 993	3 596	49 409	:	21 914	4 948	6 590	11 396	:	82 221	:	9 189	1 288	6 955	1 437	1 270	:	:	:	:	:	:			439 032	20 139
	Others	GWh	:				4 678				:		6 568			:		:	1 682	-	519	-	-	:	:	:	5 303	:	:			11 246	7 504
(1)	**Gross Electricity Generation**	TWh	74,4	36,8	536,2	41,5	167,0	494,6	17,9	241,5	1,2	81,1	56,6	33,3	63,9	148,3	334,0	2,5	60,6	8,7	34,0	13,6	4,0	1,6	137,0	12,7	26,0	40,7	59,3	122,1	62,3	2 328,2	300,7
	Nuclear	TWh	41,3		154,1		55,4	377,2				4,0			19,2	69,9	88,9		12,2		14,0	11,8				4,8	11,4	17,3			24,9	810,1	54,3
	Hydro & wind (including pumping)	TWh	1,2	1,2	25,9	3,8	24,8	78,0	1,0	41,9	0,8	0,4	38,5	8,5	12,9	68,3	6,8		2,0	0,0	0,2	0,4	2,9		1,9	3,2	5,0	1,2	16,7	121,3	35,2	314,1	15,6
	Thermal	TWh	31,8	35,6	356,2	37,7	86,8	39,4	16,9	199,5	0,4	76,6	18,1	24,8	31,7	10,2	238,3	2,5	46,3	8,7	19,8	1,4	1,0	1,6	135,1	4,6	9,6	22,2	42,6	0,7	2,2	1 204,0	230,8
(1)	**Electricity Production Capacity**	GWh	14,9	10,7	115,3	8,9	45,8	107,6	4,4	65,9	1,3	19,0	17,4	9,3	14,4	33,6	70,1	0,7	13,9	3,5	7,0	5,6	2,0	0,3	29,5	2,7	7,1	12,1	22,3	27,6	16,7	538,8	72,3
	Nuclear	GWh	5,6		22,7		7,1	58,5				0,5			2,3	10,1	12,8		1,8		1,8	2,4				0,6	1,6	3,5			3,1	119,6	8,2
	Hydro & wind	GWh	1,4	0,6	9,9	2,6	16,9	25,2	0,5	19,9	1,1	0,3	11,3	4,4	2,8	16,2	4,4		1,5		0,0	0,7	1,4		2,0	0,8	1,9	1,4	6,0	27,3	12,7	117,6	8,5
	Thermal	GWh	7,9	10,1	82,6	6,4	21,9	23,9	3,9	46,0	0,1	18,2	6,1	4,9	9,3	7,3	52,9	0,7	10,7	3,5	5,1	2,6	0,6	0,3	27,4	1,3	3,5	7,1	16,3	0,3	1,0	301,6	55,6
(7)	**Energy Prices for Transport**	retail tax inclusive price																															
	Unleaded Gasoline	Euro per liter	0,8	0,8	0,8	0,6	0,6	0,9	0,7	0,8	0,6	0,9	0,8	0,8	:	0,8	0,7															0,8	
	Automotive Diesel	Euro per liter	0,6	0,6	0,6	0,5	0,5	0,6	0,7	0,6	0,5	0,6	0,6	0,54	:	0,8	0,7															0,6	
	Energy Prices for Industry	(excise taxes included)																															
(6)	Electricity	US$ per KWh	0,08	0,07	0,10	0,06	0,08	0,06	0,07	0,09		0,08	0,08	0,12	0,06	0,04	0,07		0,06		0,05				0,04		0,05		n.a.	n.a.	0,13		
(6)	Natural Gas	US$ per 10^7Kcal	141,6		207,0	n.a.	159,1	161,0	318,0	173,7		158,8	171,8	n.a.	146,0		127,1		157,5		105,6				129,7		127,7		n.a.		296,9		
(6)	Steam Coal	US$ per metric ton[3]		84,9	n.a.			116,4		50,4			81,0	n.a.	84,3		58,8		16,8		n.a.				38,5		n.a.		n.a.	n.a.	60,9		
(4)	Electricity	€ per 100 KWh	6,0	4,7	8,0	4,8	6,2	5,6	5,1	6,2	4,8	4,7	6,9	6,6	4,4	n.a.	5,2															6,3	
(4)	Low Sulphur Fuel Oil	€ per tonne	114,5	130,8	122,6	155,6	143,8	141,4	133,7	144,5	123,1	164,0	117,4	148,1	n.a.	327,0	121,4															143,5	
(4)	Natural Gas	€ per GJ (GCV)	3,3	3,2	4,4	n.a.	2,8	2,8	n.a.	3,3	3,9	3,0	n.a.	n.a.	2,6	n.a.	3,1															3,4	
(4)	Steam Coal	€ per toe (NCV)	n.a.	92,8	n.a.	n.a.	n.a.	115,6	n.a.	62,5	n.a.	n.a.	92,9	n.a.	102,4	n.a.	71,5																
	Energy Prices for Households	(excise taxes included)																															
(6)	Electricity	US$ per KWh	0,20	0,21	0,20	0,11	0,20	0,17	0,13	0,17	0,15	0,14	0,19	0,18	0,11	0,09	0,13		0,04		0,06				0,06		0,03		n.a.	0,08	0,17		
(6)	Natural Gas	US$ per 10^7Kcal	487,3	691,5	476,6	n.a.	609,9	500,4	473,2	667,5	298,1	406,4	459,4	n.a.	178,1		328,8		125,5		137,2				208,7		81,3		19,75		537,8		
(4)	Electricity	€ per 100 KWh	13,5	13,8	14,6	8,0	11,3	12,6	8,1	18,3	11,0	11,0	n.a.	11,7	7,3	n.a.	9,3															12,6	
(4)	Light Fuel Oil	€ per 1000 litres	177,5	528,7	214,0	315,1	252,8	308,1	219,8	615,5	196,6	292,8	314,0	n.a.	n.a.	472,1	176,7															292,6	
(4)	Natural Gas	€ per GJ (GCV)	15,1	n.a.	14,2	n.a.	12,8	12,6	16,8	10,0	10,7	10,0	n.a.	n.a.	n.a.	n.a.	8,5															11,1	

Sources:

(1) "2001 - Annual Energy Review" (energy balances)

(2) Espon Database v2_3

(3) Eurostat Newcronos

(4) Energy&Transport in Figures 2002

All available price data has been used in the calculation of EU-wide fuel price averages. The overall EU price is an average of the prices in the individual countries weighted by their consumption.

Electricity

The prices are as of 1 January in the year shown. Prices are collected at a variety of locations in each country.

The standard consumer used for domestic prices corresponds to a standard dwelling of 100 m2 with 4-5 rooms plus kitchen with an annual consumption of 7500 kWh.

For industrial prices, the standard consumer's annual consumption is 24000MWh.

The average price in each country is calculated as the median of the prices in the various locations. These country average prices are weighted by their final consumption (Domestic or Industry) to have the EU-wide price average.

The domestic prices shown here are the final selling prices while industrial prices shown less VAT.

Gas

The same methodology is used for gas price, but the standard used for domestic consumers corresponds to an annual consumption of 16.74 GJ while for industrial consumers this annual consumption is 418000 GJ.

(5) Eurostat SIRENE

(6) EIA - Energy end-use prices including taxes, converted using exchange rates (Brown coal prices for Czech Republic)

(7) Energy, transport and environment indicators 1991-2001, Eurostat

na not available

Primary energy consumption = gross inland consumption others=nuclear, hydro and wind, net imports of electricity and other energy sources

Gross Electricity Generation = Electricity Generation (energy balance)

Electricity Production Capacity = Generation Capacity (energy balance)

	1999		BE	DK	DE	GR	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	CY	CZ	EE	HU	LT	LV	MT	PL	SI	SK	BG	RO	NO	CH	EU 15	N10
																																total	total
(2)	Population (Million)	Million	10,2	5,3	82,1	10,5	39,6	60,3	3,7	57,6	0,4	15,8	8,0	10,2	5,2	8,9	59,5	0,7	10,3	1,4	10,1	3,7	2,4	0,4	38,7	2,0	5,4	8,2	22,5	4,4	7,1	377,4	75,0
(2)	GDP	bil.€	235,7	162,4	1 978,6	117,9	563,7	1 355,1	89,6	1 108,0	18,7	374,1	197,1	108,0	120,0	235,8	1 372,2	8,7	51,6	4,9	45,1	10,0	6,2	3,7	106,8	19,7	19,1	12,2	33,4	126,3	248,6	8 036,9	275,8
(1)	**Primary Energy Production**	Mtoe	13,6	23,5	136,8	9,5	30,4	122,5	2,6	33,1	0,05	59,5	9,4	2,7	15,2	32,6	278,9	0,01	25,2	3,7	11,3	3,6	1,7		84,9	2,7	4,4	9,1	26,0	209,8	11,8	770,5	137,6
	Solids	Mtoe	0,2		63,3	8,0	8,6	3,2	1,3	0,0			0,2		2,0	0,2	23,3		20,3	2,8	3,0	0,0	0,0		76,7	1,0	0,7	4,2	4,3	0,3		110,2	104,5
	Oil	Mtoe	0,0	14,8	3,0	0,0	0,3	1,9		5,1		2,6	1,0				139,2		0,4	0,2	1,8	0,3			0,5	0,0	0,1	0,0	6,2	153,4		167,8	3,3
	Natural Gas	Mtoe	0,0	6,9	16,7	0,0	0,1	1,7	1,1	14,3		54,1	1,5				89,0		0,2		2,5				3,2	0,0	0,2	0,0	10,7	44,1		185,5	6,2
	Nuclear	Mtoe	12,6		43,9		15,2	98,2				1,0			5,9	18,9	24,8		3,5		3,7	2,8				1,2	3,0	4,1	1,4		6,8	220,5	14,1
	Hydro & Wind	Mtoe	0,0	0,3	2,2	0,4	2,2	6,3	0,1	3,9	0,01	0,1	3,5	0,6	1,1	6,2	0,5		0,2		0,0	0,0	0,2		0,2	0,3	0,3	0,2	1,5	10,4	3,5	27,4	1,3
	Geothermal	Mtoe	0,0	0,0	0,0	0,0	0,0	0,1	0,0	2,8			0,0	0,1			0,0														0,1	3,0	
	Other renewables	Mtoe	0,8	1,6	7,8	1,0	4,0	11,2	0,2	7,0	0,04	1,7	3,1	2,0	6,2	7,4	2,1	0,01	0,6	0,7	0,3	0,6	1,5		4,2	0,2	0,1	0,5	2,0	1,5	1,5	56,1	8,1
(1)	**Net Imports**	Mtoe	46,8	-3,0	202,3	19,7	94,4	131,3	11,7	143,7	3,3	25,8	18,7	22,1	17,2	18,2	-46,9	2,3	11,4	2,3	13,9	4,7	3,1	1,1	9,4	3,7	11,0	9,6	10,5	-182,3	14,3	705,5	62,9
	Solids	Mtoe	7,3	4,2	17,1	0,7	11,9	12,2	1,5	11,9	0,1	7,2	2,7	3,7	2,6	2,1	14,0	0,02	-4,3	0,7	1,2	0,1	0,1		-14,1	0,2	2,3	1,9	2,2	0,7	0,1	99,2	-13,8
	Oil	Mtoe	25,9	-4,4	127,8	17,8	68,1	89,7	8,3	87,8	2,1	36,6	11,0	16,5	10,3	16,1	-56,6	2,3	8,1	1,1	5,2	3,6	1,7	1,1	18,1	2,9	3,2	5,0	4,7	-143,5	12,6	457,0	47,2
	Crude oil	Mtoe	31,0	-6,4	103,4	17,2	58,5	81,3	2,9	88,9		59,4	8,3	13,8	11,7	19,3	-47,6	na	na	na	na	na	na	na	na	na	na	na	na	-137,9	5,3	441,6	
	Oil products	Mtoe	-5,1	2,0	24,4	0,6	9,6	8,5	5,4	-1,1	2,1	-22,8	2,8	2,7	-1,4	-3,2	-9,0	na	na	na	na	na	na	na	na	na	na	na	na	-5,6	7,4	15,4	
	Natural gas	Mtoe	13,5	-2,6	57,3	1,2	13,9	34,8	1,9	40,5	0,7	-19,5	5,2	2,0	3,3	0,7	-5,5		7,6	0,6	7,3	1,2	1,0		5,6	0,8	5,5	2,7	3,6	-39,4	2,4	147,3	29,6
	Electricity	Mtoe	0,1	-0,2	0,1	0,0	0,5	-5,4	0,0	3,6	0,5	1,6	-0,2	-0,1	1,0	-0,7	1,2		0,0	-0,1	0,2	-0,2	0,2		-0,2	-0,1	0,1	0,0	0,0	-0,2	-0,9	2,0	-0,1
(1)	**Primary Energy Consumption**	Mtoe	56,8	20,4	339,4	26,8	117,5	249,9	13,9	175,2	3,4	74,4	28,4	24,0	32,7	50,4	229,2	2,2	36,6	6,0	25,2	8,3	4,8	1,0	94,3	6,5	15,4	18,7	36,5	26,6	26,7	1 442,4	200,2
	Solids	Mtoe	7,4	4,6	80,6	8,5	20,1	15,2	2,5	11,8	0,1	7,5	3,0	3,8	5,3	2,4	36,9	0,02	16,0	3,5	4,2	0,1	0,1		62,6	1,2	2,9	6,0	6,5	1,1	0,1	209,7	90,8
	Oil	Mtoe	22,5	9,6	132,9	15,6	62,2	89,9	8,1	90,5	2,1	28,0	12,0	15,6	9,9	15,6	80,7	2,2	8,5	1,2	7,0	3,9	1,7	1,0	18,7	2,9	3,2	5,0	10,9	9,0	13,2	595,3	50,2
	Natural Gas	Mtoe	13,3	4,4	72,0	1,2	13,3	34,5	3,0	55,6	0,7	34,6	6,8	1,9	3,3	0,7	82,9		7,8	0,6	9,9	1,2	1,0		8,9	0,8	5,7	2,8	14,3	4,8	2,4	328,3	35,7
	Other	Mtoe	13,6	1,7	53,9	1,5	21,9	110,3	0,3	17,3	0,5	4,4	6,5	2,7	14,2	31,8	28,7	0,01	4,3	0,6	4,2	3,1	1,9		4,2	1,6	3,6	4,9	4,9	11,7	10,9	309,1	23,5
(4) (5)	**Final Energy Consumption by source**	Mtoe	36,9	14,9	221,3	18,1	74,3	150,6	9,9	126,0	3,3	48,5	22,1	16,0	24,9	32,9	152,5	1,6	23,7	2,3	16,2	4,0	3,2	0,6	58,4	4,5	11,5	9,1	21,2	18,6	20,8	952,3	125,9
	Solids	Mtoe	3,3	0,3	10,5	0,8	1,7	5,8	0,6	3,7	0,1	1,4	0,6	0,4	1,2	1,0	6,9	0,02	4,6	0,1	1,0	0,1	0,1		16,2	0,1	2,9	1,4	0,8	1,0	0,1	38,4	25,2
	Oil	Mtoe	17,0	7,2	101,3	12,6	43,9	71,6	6,5	57,2	2,1	16,0	9,5	10,1	7,8	11,9	64,3	1,3	5,5	0,7	4,4	1,5	1,0	0,4	16,2	2,3	2,0	3,4	4,7	6,7	12,9	438,8	35,4
	Gas	Mtoe	9,5	1,8	55,9	0,2	10,0	31,4	1,0	37,9	0,6	20,4	4,0	0,6	1,9	0,7	52,9		6,1	0,1	6,4	0,3	0,3		7,0	0,6	4,0	1,0	6,0		2,2	228,8	24,9
	Electricity	Mtoe	6,4	2,8	40,2	3,5	15,2	32,2	1,6	22,4	0,5	8,1	4,3	3,1	6,4	10,9	27,8	0,2	4,1	0,4	2,5	0,6	0,4	0,1	7,9	0,9	2,0	2,0	2,9	9,4	4,5	185,5	19,1
	Heat	Mtoe	0,4	2,3	8,7		0,1					2,1	1,1	0,1	2,8	3,8			3,0	0,6	1,5	0,9	0,7		7,6	0,2	0,6	1,0	4,0	0,1	0,3	21,4	14,9
	Renewables	Mtoe	0,3	0,6	4,7	1,0	3,4	9,6	0,1	4,8	0,0	0,3	2,5	1,7	4,9	4,7	0,7	0,04	0,3	0,4	0,4	0,6	0,8		3,5	0,4	0,0	0,4	2,8	1,4	0,8	39,5	6,3
(4) (5)	**Final Energy Consumption by sector**	Mtoe	36,9	14,9	221,3	18,2	74,3	150,6	9,9	126,0	3,3	48,5	22,1	16,0	24,9	32,9	152,6	1,6	23,7	2,3	16,2	4,0	3,2	0,6	58,4	4,5	11,5	9,1	21,2	18,7	20,9	952,4	125,9
	Industry	Mtoe	13,2	3,0	56,5	4,2	22,4	35,8	2,1	38,8	0,9	12,8	5,7	5,3	12,3	12,3	37,7	0,4	10,3	0,5	3,7	0,7	0,7	0,0	18,2	1,3	5,1	4,0	8,0	6,6	4,1	263,0	41,0
	Transport	Mtoe	9,6	4,7	66,8	7,5	31,9	49,5	3,7	41,4	1,7	13,8	6,5	6,0	4,4	7,8	52,3	0,9	4,1	0,5	3,3	1,2	0,7	0,3	10,6	1,3	1,5	2,0	3,1	5,1	6,9	307,5	24,3
	Domestic & Tertiary	Mtoe																0,3	9,2	1,3	9,1	2,1	1,8	0,2	29,7	1,8	4,9	3,1	10,0	6,9	9,9		60,5
	Households	Mtoe	9,5	4,3	64,7	4,2	11,8	39,7	2,4	37,7	0,6	10,3	6,9	2,8	5,1	7,7	42,3															250,0	
	Agriculture	Mtoe	0,9	1,0	2,7	1,1	2,2	3,1	0,3	3,1	0,02	3,9	0,6	0,6	0,6	0,5	1,2															21,7	
	Others	Mtoe	3,7	1,8	30,7	1,3	6,1	22,6	1,4	5,0	0,1	7,7	2,4	1,3	2,5	4,7	19,1															110,2	
(5)	**Electricity Consumption by sector**	GWh	74 505	32 229	467 483	40 879	177 252	374 677	18 802	261 030	5 510	94 722	50 502	36 120	74 200	126 580	322 770															2 157 261	
	Industry	GWh	37 633	9 931	206 085	12 900	76 452	132 610	7 271	133 847	3 693	39 993	22 466	15 094	41 520	55 971	110 856															906 322	
	Transport	GWh	1 401	341	15 835	197	3 566	11 254	25	7 886	94	1 639	3 160	365	520	3 016	8 558															57 857	
	Households	GWh	23 482	10 283	131 281	13 484	45 443	126 933	6 544	60 717	750	21 350	13 163	9 523	18 445	40 163	110 308															631 869	
	Agriculture	GWh	251	1 937	7 477	2 553	4 583	2 608		4 682	80	3 360	1 224	694	830	1 338	3 837															35 454	
	Others	GWh	11 738	9 737	106 805	11 745	47 208	101 272	4 962	53 898	893	28 380	10 489	10 444	12 885	26 092	89 211															525 759	
(1) (4)	**Gross Electricity Generation**	TWh	84,5	38,9	555,4	49,9	209,0	523,2	22,0	265,6	1,0	86,7	60,4	43,3	69,4	155,3	366,7	3,1	64,2	8,3	37,0	13,1	4,1	1,8	140,0	13,3	27,6	38,0	50,7	121,7	68,5	2 531,3	312,4
	Nuclear	TWh	49,0		170,0		58,8	394,2				3,8			23,0	73,2	96,3		13,4		14,1	9,9				4,7	13,1	15,8	5,2		25,8	868,2	55,1
	Hydro & wind (including pumping)	TWh	1,5	3,1	29,2	5,2	28,2	77,5	1,3	52,2	0,8	0,7	41,7	7,7	12,8	72,1	9,2													120,9	40,0	343,3	
	Thermal	TWh	34,0	35,8	356,3	44,6	122,0	51,5	20,8	213,4	0,3	82,1	18,6	35,5	33,6	10,0	261,3	3,1	49,1	8,3	22,7	2,8	1,4	1,8	137,3	4,8	9,9	19,4	27,2	0,8	2,7	1 319,8	241,2
	Renewables	TWh																	1,7	0,0	0,2	0,4	2,8		2,7	3,7	4,6	2,8	18,3	121,5	41,5		16,1
(1) (6)	**Electricity Production Capacity**	GWh	15,6	12,7	114,7	10,9	52,4	114,6	4,3	73,7	1,2	20,6	17,7	10,8	16,2	33,6	75,7	0,7	15,2	3,3	7,8	6,5	2,1	:	33,2	:	7,8	13,3	:	28,6	16,2	574,6	76,7
	Nuclear	GWh	5,7		22,3		7,4	63,2				0,4			2,6	10,1	13,0														3,1	124,7	
	Hydro & wind	GWh	1,4	1,8	13,0	3,2	19,4	25,2	0,6	20,7	1,1	0,4	11,6	4,6	2,9	16,6	4,6													28,3	12,0	127,2	
	Thermal	GWh	8,4	10,9	79,4	7,7	25,6	26,2	3,8	53,0	0,1	19,7	6,2	6,2	10,6	6,9	58,1													0,3	1,1	322,8	
(4)	**Energy Prices for Industry**	(excise taxes included)																															
	Electricity	€ per 100 KWh	5,5	5,3	6,1	4,9	5,5	5,0	5,3	6,7	4,7	4,9	6,7	5,3	3,9	2,8	3,6															5,3	
	Low Sulphur Fuel Oil	€ per tonne	81,8	153,6	91,0	140,6	128,8	108,9	122,0	119,1	89,5	136,4	106,8	133,7	157,7	308,3	108,1															127,5	
	Natural Gas	€ per GJ (GCV)	2,6	2,7	4,0	n.a.	2,7	2,8	n.a.	3,3	3,7	2,7	4,8	n.a.	2,6	n.a.	2,8															3,2	
	Steam Coal	€ per toe (NCV)	n.a.	n.a.	n.a.	n.a.	n.a.	121,8	n.a.	50,9	n.a.	n.a.	79,0	42,7	126,3	n.a.	84,2																
(4)	**Energy Prices for Households**	(excise taxes included)																															
	Electricity	€ per 100 KWh	13,2	17,2	13,9	7,6	10,4	11,8	8,6	19,5	11,1	11,1	12,7	11,2	7,5	9,3	9,1															12,1	
	Light Fuel Oil	€ per 1000 litres	158,4	573,4	186,5	209,8	242,6	283,6	201,0	693,2	163,6	339,0	256,4	n.a.	228,7	413,4	161,8															275,0	
	Natural Gas	€ per GJ (GCV)	14,6	14,0	13,3	n.a.	13,1	13,0	16,2	11,4	10,9	10,3	11,3	n.a.	n.a.	14,9	9,0															11,5	

Sources:

(1) "2001 - Annual Energy Review" (energy balances)
(2) ESPON file "Database Newcronos_update_july_04.xls" andEspon Database v2_3
(3) Eurostat Newcronos
(4) Energy&Transport in Figures 2002
All available price data has been used in the calculation of EU-wide fuel price averages. The overall EU price is an average of the prices in the individual countries weighted by their consumption.
Electricity
The prices are as of 1 January in the year shown. Prices are collected at a variety of locations in each country.
The standard consumer used for domestic prices corresponds to a standard dwelling of 100 m2 with 4-5 rooms plus kitchen with an annual consumption of 7500 kWh.
For industrial prices, the standard consumer's annual consumption is 24000MWh.
The average price in each country is calculated as the median of the prices in the various locations. These country average prices are weighted by their final consumption (Domestic or Industry) to have the EU-wide price average.
The domestic prices shown here are the final selling prices while industrial prices shown less VAT.
Gas
The same methodology is used for gas price, but the standard used for domestic consumers corresponds to an annual consumption of 16.74 GJ while for industrial consumers this annual consumption is 418000 GJ.
(5) Eurostat SIRENE
(6) Statistical Yearbook on Candidate and South-East European Countries 2001
na not available

Primary energy consumption= gross inland consumption others=nuclear, hydro and wind, net imports of electricity and other energy sources
Gross Electricity Generation= Electricity Generation (energy balance)
Electricity Production Capacity= Generation Capacity (energy balance)

Ref	2000	Unit	BE	DK	DE	GR	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	CY	CZ	EE	HU	LT	LV	MT	PL	SI	SK	BG	RO	NO	CH	EU 15	N10
																																total	total
(1)	Population	Million	10,3	5,3	82,2	10,9	39,9	60,6	3,8	57,6	0,4	15,9	8,0	10,2	5,2	8,9	58,6	0,7	10,3	1,4	10,0	3,7	2,4	0,4	38,6	2,0	5,4	8,2	22,4	4,5	7,2	377,9	74,8
(2)	GDP constant prices (1995)	bil.€ 1995	242,2	157,4	2 055,8	106,4	539,4	1 355,9	81,1	923,7	19,6	380,7	206,0	100,1	125,0	222,9	1 000,9	8,2	42,3	3,5	41,5	5,8	4,4	3,1	139,1	17,7	17,6	9,6	25,4	134,5	257,1	7 516,9	283,2
(3) (11) (12) (13)	**Primary Energy Production**	Mtoe	13,5	27,6	133,0	9,9	31,2	130,4	2,3	30,6	0,1	57,1	9,4	3,1	15,0	29,8	268,7	0,04	29,5	3,2	11,1	3,2	1,3	:	78,2	3,0	6,0	9,8	28,6	227,9	11,8	761,7	135,4
	Electricity	Mtoe																	24,7	2,4	2,8		0,01		69,6	1,0	1,0	4,3	5,7	2,3			101,5
	Fossil fuels	Mtoe	0,2	25,5	78,8	8,5	8,1	6,2	2,0	18,2		54,3	2,9		1,2	0,2	244,1		0,3	0,2	1,7	0,4			0,8		0,1		6,6	166,4		450,4	3,4
	Natural Gas	Mtoe																			2,7				3,9		0,1		11,4	47,9			6,7
	Nuclear	Mtoe	12,4		43,8		16,0	107,1				1,0			5,8	14,8	21,9		3,8		3,6	2,2				1,3	4,2	4,8	1,4			222,8	15,1
	Renewable	Mtoe	0,8	2,0	10,4	1,4	7,1	17,1	0,3	12,3	0,1	1,8	6,6	3,1	8,0	14,8	2,7	0,04	0,6	0,5	0,4	0,5	1,2		3,9	0,8	0,7	0,7	3,4	11,4		88,5	8,7
(3) (12)	**Net Imports**	Mtoe	48,5	-7,1	201,9	22,0	98,3	132,8	12,3	152,6	3,6	34,2	18,9	21,6	18,5	19,4	-39,6	2,5	15,9	1,5	13,7	4,1	2,8	1,4	26,2	3,0	8,9	6,2	7,6	-203,5		737,9	80,0
	Solid fuels and Oil	Mtoe	34,9	-4,3	144,7	20,3	82,5	103,6	9,8	101,8	2,5	49,8	13,7	19,5	14,1	18,3	-31,5	2,5	8,1	0,7	4,8	2,0	1,4	1,4	18,8	2,3	3,0	4,1	5,1	-155,6		579,6	56,5
	Natural gas	Mtoe	13,3	-2,9	56,9	1,7	15,5	35,2	2,5	47,0	0,7	-17,2	5,3	2,0	3,4	0,7	-9,3		8,6	0,8	8,6	2,4	1,2		8,0	0,9	6,3	2,7	2,6	-48,3		154,7	36,8
	Electricity	Mtoe	0,4	0,1	0,3	0,0	0,4	-6,0	0,0	3,8	0,5	1,6	-0,1	0,1	1,0	0,4	1,2		-0,8	-0,1	0,3	-0,3	0,2		-0,6	-0,2	-0,3	-0,6	-0,1	0,3		3,7	-1,8
(3) (12) (4)	**Primary Energy Consumption**	Mtoe	57,2	19,6	337,1	28,1	122,6	256,9	14,0	175,6	3,6	75,6	28,4	24,1	32,6	47,5	230,0	2,4	41,0	5,0	25,1	8,2	4,3	0,8	90,2	6,6	18,5	18,9	36,9	26,9	26,2	1 452,9	202,1
	Solid Fuel	Mtoe	8,2	4,0	81,0	9,0	20,6	15,2	2,7	12,7	0,1	8,0	3,6	3,8	5,0	2,6	35,9	0,0	20,9	2,9	3,8	0,1	0,1		55,9	1,4	4,4	7,2	7,7	0,8	0,1	212,4	89,6
	Oil	Mtoe	21,9	9,0	129,9	15,9	63,2	88,4	7,7	88,9	2,3	28,4	11,8	15,1	9,3	14,3	80,7	2,3	8,2	0,9	6,8	2,6	1,2	0,8	19,8	2,4	3,1	4,0	11,1	8,3	12,7	586,8	48,2
	Natural Gas	Mtoe	13,4	4,4	71,9	1,7	15,2	35,1	3,4	57,9	0,7	34,7	6,5	2,0	3,4	0,7	87,5		8,2	0,7	10,8	2,2	1,3		10,8	0,8	6,1	2,5	13,3	5,4	2,4	338,5	40,9
	Nuclear	Mtoe	12,4		43,8		16,0	107,1				1,0			5,8	14,8	21,9		3,7		3,3	2,9				1,3	4,4	5,1	1,5		6,5	222,8	15,7
	Hydro	Mtoe			2,0	0,3	2,5	5,8	0,1	3,8			3,6	1,0	1,3	6,8	0,4														3,3	27,6	
	Wind	Mtoe		0,4	0,8		0,4					0,1					0,1															1,8	
	Other Renewables	Mtoe	0,7	1,7	6,6	1,0	4,0	11,2	0,2	8,4		1,5	2,9	2,2	6,5	7,8	2,1	0,0	0,8	0,6	0,5	0,7	1,5		4,5	0,8	0,7	0,8	3,3	11,8		57,6	10,1
	Others	Mtoe																	-0,8	-0,1	0,3	-0,3	0,2			-0,1	-0,4	-0,6		0,3	0,2		-1,3
(3) (9) (10)	**Final Energy Consumption by source**	Mtoe	36,9	14,6	213,8	18,5	79,3	150,1	10,4	126,0	3,5	49,8	22,6	16,9	24,5	32,9	152,4	1,6	24,1	2,4	15,7	3,7	2,9	0,5	55,6	4,5	7,9	8,5	22,4	19,5	20,0	952,2	118,9
	Solid Fuels	Mtoe	3,4	0,3	11,0	0,9	1,7	5,6	0,6	3,5	0,1	1,3	0,7	0,5	1,1	1,1	5,5	0,03	5,2	0,1	0,7	0,1	0,1		13,7	0,1	1,4	0,9	0,7	1,7	0,3	37,3	21,5
	Oil	Mtoe	16,2	6,9	97,9	12,6	45,8	71,5	6,7	56,3	2,3	16,5	9,5	10,5	7,8	11,4	63,0	1,3	5,4	0,8	4,2	1,4	0,9	0,4	15,4	2,2	1,9	3,0	5,6	7,3	12,2	434,9	33,8
	Gas	Mtoe	10,0	1,7	58,6	0,3	12,1	30,5	1,2	37,9	0,6	21,0	4,4	0,9	1,4	0,7	54,9		6,4	0,1	6,5	0,4	0,3		7,3	0,7	2,1	1,1	6,9	0,7	2,6	236,2	23,9
	Electricity	Mtoe	6,7	2,8	41,5	3,7	16,2	33,1	1,7	23,4	0,5	8,4	4,5	3,3	6,5	11,0	28,3	0,3	4,2	0,4	2,5	0,5	0,4	0,2	8,3	0,9	1,9	2,1	2,9	9,7	4,6	191,6	19,6
	Derived Heat	Mtoe	0,5	2,2			0,1					2,2	1,0	0,1	2,8	3,6			2,6	0,5	1,4	0,7	0,6		6,9	0,2	0,6	0,9	3,6	0,2	0,3	12,5	13,5
	Renewables	Mtoe	0,2	0,6	4,7	1,0	3,4	9,3	0,1	4,8		0,3	2,4	1,7	5,0	5,1	0,7	0,04	0,2	0,4	0,4	0,6	0,6		3,9	0,4		0,6	2,8			39,3	6,5
(3) (5) (9) (10)	**Final Energy Consumption by sector**	Mtoe	36,9	14,6	213,8	18,5	79,3	150,1	10,4	126,0	3,5	49,8	22,6	16,9	24,5	32,9	152,4	1,6	24,1	2,4	15,7	3,7	2,9	0,5	55,6	4,5	7,9	8,5	22,4	19,5	20,0	952,2	118,9
	Industry	Mtoe	13,7	2,9	58,8	4,4	25,4	35,4	2,2	40,0	1,0	13,8	6,3	5,5	12,1	12,9	37,4	0,5	10,7	0,5	3,5	0,7	0,7	0,1	18,8	1,4	2,8	3,5	9,0	8,4	4,1	271,7	39,6
	Transport	Mtoe	9,7	4,7	65,8	7,2	32,8	51,3	3,9	41,3	1,9	13,8	6,8	6,5	4,4	7,7	51,5	0,9	4,1	0,6	3,3	1,1	0,7	0,3	9,3	1,3	1,6	1,8	3,4	4,4	6,5	309,1	23,0
	Domestic & Tertiary	Mtoe	13,6	6,9	89,2	6,9	21,1	63,4	4,3	44,8	0,7	22,2	9,5	4,9	8,0	12,3	63,5	0,3	9,3	1,3	9,0	1,9	1,6	0,1	27,5	1,8	3,6	3,1	10,0	6,6	9,4	371,4	56,3
	Households	Mtoe	9,5	4,1	58,7	4,5	11,9	38,5	2,5	36,2	0,6	10,3	6,5	2,8	4,9	7,3	43,1												8,4	3,6	5,6	241,3	
	Agriculture	Mtoe	0,7	1,0	2,7	1,1	2,5	3,0	0,3	3,1	0,0	3,8	0,6	0,7	0,7	0,4	1,1												0,4	0,8	0,2	21,6	
	Others	Mtoe	3,5	1,8	27,8	1,3	6,7	21,9	1,6	5,5	0,1	8,1	2,4	1,4	2,4	4,7	19,4												0,8	2,2	3,6	108,6	
(5) (10)	**Electricity Consumption by sector**	GWh	77 539	32 462	482 603	43 151	188 459	385 111	20 201	272 547	5 716	97 938	51 881	38 373	75 446	128 347	328 919	3 110	50 881	5 134	30 543	6 446	4 583	1 569	96 231	10 942	23 452	24 593	36 294	112 287	54 046	2 228 693	232 891
	Industry	GWh	39 868	10 002	221 926	13 547	85 640	135 145	7 727	141 847	3 852	40 600	22 725	15 954	42 674	56 547	113 500	451	19 939	1 814	9 434	2 346	1 545	483	38 815	5 685	9 680	9 035	20 754	48 857	18 450	951 554	90 192
	Transport	GWh	1 440	348	15 910	227	4 163	11 681	26	8 086	97	1 630	3 249	360	538	3 099	8 816	24	2 117	84	1 031	90	173		4 638	263	30	500	1 785	1 670	2 698	59 670	8 450
	Households	GWh	23 738	10 242	128 907	14 207	43 619	128 720	6 945	61 112	750	21 800	14 088	10 056	18 135	42 117	111 842	1 042	14 239	1 585	10 130	1 818	1 239	540	21 376	2 675	5 222	9 751	7 724	38 803	16 179	636 278	59 866
	Agriculture	GWh	257	1 952	7 508	2 910	5 014	2 726		4 907	80	3 660	1 216	715	820	1 227	3 781	93	1 158	200	962	197	149		4 610	121	2 142	163	479	2 119	1 019	36 773	9 632
	Commerce and Public Services	GWh																1 432	11 849	1 451	8 388	1 995	1 436	546	26 792	1 495	6 378	5 144	5 552	20 838	15 700		61 762
	Others	GWh	12 236	9 918	108 352	12 260	50 023	106 839	5 503	56 595	937	30 248	10 609	11 288	13 279	25 357	90 980	68	1 579		598		41			703						544 424	2 989
(3) (9)	**Gross Electricity Generation**	TWh	83,9	36,2	571,6	53,6	225,1	540,7	24,0	276,6	1,2	89,6	61,8	43,8	70,0	145,9	374,9	3,4	73,5	8,5	35,2	11,4	4,1	1,9	145,2	13,6	30,7	40,9	52,0	139,7	66,0	2 598,8	327,5
	Nuclear	TWh	48,2		169,6		62,2	415,2				3,9			22,5	57,3	85,1		13,6		14,2	8,4				4,8	16,5	18,2	5,5		26,4	863,9	57,4
	Conventional thermal	TWh	33,1	30,0	360,5	49,0	124,2	49,7	22,5	218,5	0,2	81,5	16,6	30,2	24,2	5,3	276,7	3,4	57,0	8,5	20,7	2,4	1,3	1,9	140,8	5,0	9,2	19,8	31,7	0,7	1,1	1 322,4	250,2
	Coal	TWh	12,9	16,7	291,5	34,0	79,1	27,1	8,6	26,3		22,6	5,7	14,6	12,5	1,9	120,0		52,5	7,7	9,6		0,1		135,9	4,6	5,6	16,9	18,9			673,5	216,0
	Oil	TWh	0,8	4,4	4,8	8,9	22,6	7,7	4,6	85,9		3,1	2,0	8,4	0,6	1,8	5,6	3,4	0,4	0,1	4,4	0,7	0,1	1,9	1,9	0,1	0,2	0,7	3,4	0,1	0,1	161,3	13,1
	Gas	TWh	19,1	8,8	60,0	5,9	22,5	14,9	9,3	105,6	0,2	54,6	8,9	7,2	10,8	1,5	151,2		3,9	0,8	6,7	1,6	1,1		2,7	0,3	3,4	2,2	9,4	0,3	1,0	480,3	20,6
	Others	TWh	0,3	0,1	4,2	0,2	0,0			0,8		1,2	0,1		0,3	0,1			0,2				0,1		0,3	0,0				0,2		7,3	0,7
	Pumped storage	TWh	1,2		2,8	0,4	2,3	4,9	0,3	6,6	0,7		1,9	0,4		0,0	2,7		0,6				0,3		2,0		0,3	0,3				24,3	3,1
	Renewables	TWh	1,4	6,2	38,7	4,1	36,4	70,9	1,2	51,5	0,2	4,2	43,3	13,1	23,3	83,3	10,4		2,3	0,02	0,3	0,3	2,8		2,3	3,9	4,7	2,7	14,8	138,9	38,5	388,2	16,7
	*Hydro **	TWh	0,5	0,0	23,2	3,7	29,5	67,5	0,8	44,3	0,1	0,1	41,6	11,3	14,7	79,0	5,1		1,8	0,01	0,2	0,3	2,8		2,1	3,8	4,7	2,7	14,8			321,4	15,8
	Geothermal	TWh								4,7				0,1																		4,8	
	Wind	TWh	0,0	4,4	9,4	0,5	4,7	0,1	0,2	0,6	0,03	0,8	0,1	0,2	0,1	0,4	0,9								0,0							22,4	0,0
	Biomass	TWh	0,9	1,8	6,2		2,2	3,3	0,1	1,9	0,1	3,2	1,6	1,6	8,6	3,9	4,4		0,5	0,01	0,1				0,2	0,0		0,02				39,6	0,9
(3) (12) (13)	**Electricity Production Capacity**	GWh	15,672	12,7	118,3	10,9	52,6	115,6	4,7	71,4	1,2	21,0	17,7	10,9	16,3	32,8	78,9	1,0	15,4	2,2	8,4	6,6	2,1	2,0	30,7	2,9	8,7	13,9	20,9	28,866	16,2	580,5	79,9
	Nuclear	GWh	5,7		22,4		7,5	63,2				0,4			2,6	9,5	12,5		1,8		1,9	3,0				0,7	2,6	3,5	0,7		3,1	123,8	9,9
	Conventional thermal	GWh	8,5	10,226	80,8	7,7	25,5	26,8	4,1	50,1	0,1	20,1	6,1	6,3	10,7	6,7	62,0	1,0	11,5	2,2	6,5	2,7	0,6	2,0	28,4	1,3	3,2	7,5	14,0	0,272	12,0	325,6	59,3
	Hydro	GWh	1,4	0,01	9,0	3,0	17,7	25,6	0,5	20,3	1,1	0,0	11,5	4,5	2,9	16,4	4,3		2,1		0,05	0,9	1,5		2,2	0,9	2,9	2,9	6,1	28,581	1,1	118,3	10,6
	Geothermal	GWh								0,6				0,0																		0,6	
	Wind	GWh	0,0	2,418	6,1	0,2	1,9	0,1	0,1	0,4	0,01	0,4	0,0	0,1	0,0	0,2	0,2													0,01		12,2	
(12)	**Energy Prices for Transport**	retail tax inclusive price																															
	Unleaded Gasoline	Euro per liter	1,0	1,0	1,0	0,7	0,8	1,0	0,8	1,0	0,7	1,1	0,9	0,8	1,1	1,0	1,2															1,0	
	Automotive Diesel	Euro per liter	0,7	0,8	0,8	0,6	0,6	0,8	0,8	0,8	0,6	0,8	0,7	0,55	0,8	0,8	1,3															0,8	
	Energy Prices for Industry	(excise taxes included)																															
(7)	Electricity	US$ per 100 KWh	4,8	5,8	4,1	4,2	4,3	3,6	4,9	8,9		5,7	3,8	6,7	3,9	n.a.	5,5		4,30		4,90				3,70		4,20		n.a.	3,40	6,90		
(7)	Natural Gas	US$ per 10^7Kcal	n.a.		187,9	216,1	175,4	167,8	114,2	n.a.		166,5	n.a.	n.a.	130,7		104,6		147,6		124,9				133,0		101,8		n.a.		222,9		
(7)	Steam Coal	US$ per metric ton[3]		n.a.	n.a.			84,1		37,7			n.a.	33,10	77,9		53,1		14,4		n.a.				38,5		n.a.		n.a.	n.a.	51,5		
(3)	Electricity	€ per 100 KWh	5,5	n.a.	5,5	4,8	5,6	4,9	5,3	7,3	4,5	n.a.	n.a.	5,3	3,8	2,8	5,8											6,40				5,4	
(3)	Low Sulphur Fuel Oil	€ per tonne	142,2	194,7	155,0	209,4	194,3	165,1	n.a.	189,6	157,6	200,1	165,0	204,9	207,5	418,9	n.a.															196,2	
(3) (6)	Natural Gas	€ per GJ (GCV)	3,6	4,3	4,4	n.a.	3,9	3,8	n.a.	4,0	4,8	3,7	n.a.	5,5	4,3	n.a.	3,0															3,9	
(3)	Steam Coal	€ per toe (NCV)	n.a.	n.a.	n.a.	n.a.	n.a.	118,2	n.a.	66,2	n.a.	n.a.	n.a.	58,2	133,8	n.a.	91,5																
	Energy Prices for Households	(excise taxes included)																															
(7)	Electricity	US$ per 100 KWh	13,2	19,7	12,1	7,1	11,7	10,2	10,1	13,5	9,9	13,1	11,8	12,0	7,8	n.a.	10,7		5,4		6,5				6,5		5,0		n.a.	5,7			
(7)	Natural Gas	US$ per 10^7Kcal	407,7	735,1	373,4	297,2	491,4	347,5	345,8	n.a.	275,6	359,4	348,4	n.a.	159,5		292,8		214,1		166,3				247,5		108,6		60,08		411,3		
(3)	Electricity	€ per 100 KWh	13,2	18,4	14,0	6,9	10,0	11,5	8,6	18,6	10,9	10,9	12,4	11,2	7,5	9,5	10,1															12,1	
(3)	Light Fuel Oil	€ per 1000 litres	278,4	683,0	327,4	278,1	359,5	411,0	405,2	805,0	280,1	490,5	395,2	334,3	347,3	547,6	293,7															402,9	
(3)	Natural Gas	€ per GJ (GCV)	15,9	18,2	14,1	n.a.	13,5	12,4	16,2	12,3	11,3	10,4	11,3	n.a.	n.a.	15,7	9,8															12,1	

Sources:

(1) ESPON file "Database Newcronos_update_july_04.xls" and Espon Database v2_3
(2) Eurostat Newcronos
(3) Energy&Transport in Figures 2002 (for EU15)

* does not include pumped storage presented above

All available price data has been used in the calculation of EU-wide fuel price averages. The overall EU price is an average of the prices in the individual countries weighted by their consumption.

Electricity

The prices are as of 1 January in the year shown. Prices are collected at a variety of locations in each country.

The standard consumer used for domestic prices corresponds to a standard dwelling of 100 m2 with 4-5 rooms plus kitchen with an annual consumption of 7500 kWh.

For industrial prices, the standard consumer's annual consumption is 24000MWh.

The average price in each country is calculated as the median of the prices in the various locations. These country average prices are weighted by their final consumption (Domestic or Industry) to have the EU-wide price average.

The domestic prices shown here are the final selling prices while industrial prices shown less VAT.

Gas

The same methodology is used for gas price, but the standard used for domestic consumers corresponds to an annual consumption of 16.74 GJ while for industrial consumers this annual consumption is 418000 GJ.

(4) Eurogas Annual Report 2000
(5) Eurostat SIRENE
(6) The Odyssee Project, "Monitoring tools for energy efficiency in Europe", May 2003, page 35
(7) EIA - Energy end-use prices including taxes, converted using exchange rates (Brown coal prices for Czech Republic)
(8) Poland (IEA and energoproekt)
(9) Energy&Transport in Figures 2003, Eurostat, data for candidate countries
(10) 2001 IEA Energy Statistics
(11) Statistical yearbook on candidate countries 1997-2001, Eurostat
(12) Energy, transport and environment indicators 1991-2001, Eurostat - 2001 data for N10+2 + NO
(13) "2001 - Annual Energy Review" (energy balances) - 1999 for CH
na not available

Primary energy consumption = gross inland consumption
Gross Electricity Generation = Electricity Generation (energy balance)
Electricity Production Capacity = Generation Capacity (energy balance)

Economy, society and energy Indicators

	notes			BE	DK	DE	GR	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	CY	CZ	EE	HU	LT	LV	MT	PL	SI	SK	BG	RO	NO	CH	EU 15	N10
A.1	(1)	**TPES/Population**	1995	5,44	4,48	4,13	2,67	2,73	4,11	3,30	2,89	8,13	5,34	3,25	2,04	5,61	5,70	3,66	2,82	3,91	3,25	2,52	2,47	1,62	2,46	2,58	2,93	3,20	2,79	2,00	5,66	3,54	3,74	2,78
		(toe per capita)	2000	6,05	3,84	4,07	2,92	3,25	4,34	3,84	3,18	8,40	5,74	3,53	2,42	6,48	5,54	3,91	3,65	4,41	3,38	2,47	1,97	1,71	2,77	2,70	3,06	2,76	1,96	1,61	6,18	3,66	3,97	2,88
			Δ	11,2%	-14,4%	-1,3%	9,4%	19,0%	5,6%	16,5%	10,0%	3,4%	7,5%	8,6%	18,7%	15,5%	-2,8%	6,9%	29,7%	13,0%	4,2%	-1,8%	-20,3%	5,4%	12,6%	4,9%	4,5%	-13,9%	-29,6%	-19,5%	9,0%	3,3%	6,1%	3,5%
A.2	(2)	**FEC/Population**	1995	3,40	2,90	2,72	1,51	1,62	2,44	2,16	2,04	7,74	3,07	2,64	1,30	4,33	3,82	2,43	1,91	2,61	1,70	1,55	1,33	1,30	1,20	1,64	1,99	2,04	1,34	1,18	3,94	2,80	2,42	1,77
		(toe per capita)	2000	3,60	2,74	2,60	1,69	1,99	2,48	2,75	2,19	8,00	3,13	2,82	1,66	4,73	3,71	2,60	2,36	2,34	1,72	1,57	0,99	1,23	1,35	1,44	2,27	1,46	1,04	1,00	4,36	2,79	2,52	1,59
			Δ	5,8%	-5,7%	-4,2%	11,9%	22,7%	1,6%	27,3%	7,2%	3,3%	1,8%	6,9%	27,4%	9,4%	-2,9%	6,7%	23,6%	-10,2%	1,2%	1,6%	-25,5%	-5,4%	12,6%	-12,1%	14,2%	-28,4%	-22,7%	-15,1%	10,6%	-0,5%	4,1%	-10,3%
A.3	(2)	**FEC service and residential**	1995	40,3	49,2	43,6	33,5	26,8	42,6	48,9	35,9	21,0	47,1	42,9	30,2	36,0	39,7	42,5	17,0	35,6	47,5	59,0	46,8	56,3	23,2	50,6	36,7	40,7	31,1	32,8	38,0	48,9	40,5	46,8
		sector/ FEC total *(%)*	2000	36,9	47,4	41,7	37,2	26,6	42,2	41,5	35,5	20,1	44,5	42,3	28,9	32,6	37,5	41,7	20,7	38,5	53,4	57,2	52,9	53,3	25,0	49,5	39,6	45,1	36,8	44,6	34,0	47,0	39,0	47,4
			Δ	-8,6%	-3,5%	-4,3%	11,1%	-0,6%	-0,8%	-15,2%	-1,0%	-4,2%	-5,4%	-1,6%	-4,3%	-9,4%	-5,6%	-2,0%	22,3%	8,1%	12,4%	-3,0%	13,0%	-5,4%	7,8%	-2,2%	7,8%	10,9%	18,4%	35,8%	-10,5%	-3,9%	-3,6%	1,2%
A.4	(3)	**Electricity consumption**	1995	6 754	5 988	5 552	3 264	3 594	5 904	4 128	4 150	12 285	5 385	5 804	2 868	12 806	14 127	5 024	3 030	4 653	3 009	2 708	1 708	1 779	3 385	2 323	4 717	4 060	3 404	1 601	23 813	6 915	5 299	2 859
		per capita *(KWh per capita)*	2000	7 600	6 100	5 871	3 941	4 718	6 352	5 220	4 722	13 286	6 133	6 531	3 758	14 602	14 417	5 611	4 356	4 799	3 651	2 935	1 668	1 862	4 521	2 506	5 258	4 069	2 946	1 513	25 072	7 523	5 895	3 051
			Δ	12,5%	1,9%	5,7%	20,7%	31,3%	7,6%	26,5%	13,8%	8,1%	13,9%	12,5%	31,0%	14,0%	2,0%	11,7%	43,8%	3,1%	21,3%	8,4%	-2,3%	4,7%	33,6%	7,9%	11,5%	0,2%	-13,4%	-5,5%	5,3%	8,8%	11,3%	6,7%
A.5	(1)	**TPES/GDP**	1995	0,26	0,17	0,18	0,31	0,24	0,20	0,23	0,20	0,24	0,26	0,15	0,25	0,29	0,27	0,25	0,30	1,01	1,78	0,76	1,99	1,21	0,37	1,02	0,41	1,17	2,34	1,68	0,33	0,11	0,21	0,95
		(toe per 000 Euro)	2000	0,26	0,13	0,16	0,30	0,24	0,19	0,18	0,20	0,19	0,24	0,14	0,25	0,27	0,22	0,23	0,31	1,07	1,33	0,60	1,25	0,93	0,28	0,75	0,34	0,85	1,66	1,42	0,22	0,10	0,20	0,76
			Δ	-1,6%	-23,3%	-9,0%	-3,3%	0,5%	-3,4%	-23,0%	0,5%	-21,4%	-7,5%	-5,5%	-0,4%	-7,2%	-19,4%	-7,1%	1,7%	5,7%	-24,8%	-21,1%	-37,2%	-23,5%	-22,7%	-26,7%	-15,5%	-27,8%	-29,0%	-15,2%	-34,2%	-1,2%	-5,5%	-20,2%
A.6	(2)	**FEC/GDP**	1995	0,16	0,11	0,12	0,18	0,14	0,12	0,15	0,14	0,23	0,15	0,12	0,16	0,22	0,18	0,16	0,21	0,68	0,93	0,46	1,07	0,97	0,18	0,65	0,28	0,75	1,13	0,99	0,23	0,08	0,14	0,61
		(toe per 000 Euro)	2000	0,15	0,09	0,10	0,17	0,15	0,11	0,13	0,14	0,18	0,13	0,11	0,17	0,20	0,15	0,15	0,20	0,57	0,68	0,38	0,63	0,67	0,17	0,40	0,25	0,45	0,88	0,88	0,15	0,08	0,13	0,42
			Δ	-6,4%	-15,6%	-11,7%	-1,2%	3,5%	-7,1%	-15,8%	-2,0%	-21,5%	-12,4%	-7,0%	6,9%	-12,1%	-19,5%	-7,2%	-3,1%	-16,0%	-27,0%	-18,4%	-41,3%	-31,4%	-6,2%	-38,6%	-7,6%	-40,0%	-22,0%	-10,6%	-36,8%	-7,2%	-7,2%	-30,8%
A.7	(2)	**GDP/FEC**	1995	6,1	9,1	8,5	5,7	7,0	8,4	6,6	7,2	4,4	6,7	8,5	6,3	4,5	5,5	6,1	4,8	1,5	1,1	2,2	0,9	1,0	5,6	1,5	3,6	1,3	0,9	1,0	4,4	11,9	7,3	1,6
		(000 Euro per toe)	2000	6,6	10,8	9,6	5,8	6,8	9,0	7,8	7,3	5,6	7,6	9,1	5,9	5,1	6,8	6,6	5,0	1,8	1,5	2,6	1,6	1,5	6,0	2,5	3,9	2,2	1,1	1,1	6,9	12,8	7,9	2,4
			Δ	6,8%	18,4%	13,2%	1,2%	-3,4%	7,6%	18,7%	2,1%	27,3%	14,2%	7,6%	-6,5%	13,8%	24,2%	7,8%	3,2%	19,0%	36,9%	22,5%	70,3%	45,8%	6,6%	62,8%	8,2%	66,6%	28,2%	11,8%	58,2%	7,8%	7,8%	44,5%
A.8	(3)	**Electricity consumption**	1995	323	227	241	379	315	288	292	283	361	262	259	349	660	678	339	328	1 208	1 645	813	1 378	1 332	506	923	654	1 485	2 863	1 342	1 388	207	299	979
		/GDP *(KWh per 000 Euro)*	2000	322	207	235	404	349	284	244	295	297	257	254	383	605	574	329	370	1 166	1 440	708	1 060	1 011	563	696	590	1 247	2 500	1 335	835	210	296	806
			Δ	-0,5%	-8,7%	-2,5%	6,7%	10,8%	-1,5%	-16,4%	4,0%	-17,8%	-2,0%	-2,1%	10,0%	-8,4%	-15,4%	-2,9%	12,7%	-3,5%	-12,5%	-12,9%	-23,1%	-24,1%	11,2%	-24,6%	-9,8%	-16,0%	-12,7%	-0,5%	-39,8%	1,5%	-0,8%	-17,7%
A.9	(3)	**GDP/ Electricity Consumption**	1995	3,1	4,4	4,2	2,6	3,2	3,5	3,4	3,5	2,8	3,8	3,9	2,9	1,5	1,5	3,0	3,0	0,8	0,6	1,2	0,7	0,8	2,0	1,1	1,5	0,7	0,3	0,7	0,7	4,8	3,3	1,0
		(Euro per KWh)	2000	3,1	4,8	4,3	2,5	2,9	3,5	4,1	3,4	3,4	3,9	3,9	2,6	1,7	1,7	3,0	2,7	0,9	0,7	1,4	0,9	1,0	1,8	1,4	1,7	0,8	0,4	0,7	1,2	4,8	3,4	1,2
			Δ	0,5%	9,6%	2,5%	-6,3%	-9,7%	1,6%	19,6%	-3,8%	21,6%	2,0%	2,2%	-9,1%	9,2%	18,2%	3,0%	-11,3%	3,6%	14,2%	14,8%	30,0%	31,7%	-10,1%	32,7%	10,9%	19,1%	14,5%	0,5%	66,2%	-1,5%	0,9%	21,5%
A.10	(2)	**Household energy use**	1995	0,92	0,88	0,77	0,32	0,26	0,63	0,61	0,57	1,37	0,72	0,88	0,26	1,10	0,88	0,68															0,635	
	(4)	**Household FEC** *(toe per capita)*	2000	0,92	0,77	0,71	0,41	0,30	0,63	0,66	0,63	1,37	0,65	0,81	0,27	0,95	0,82	0,73		0,50		0,52				0,45		0,43		0,37	0,81	0,78	0,638	
			Δ	0,7%	-12,3%	-7,5%	28,7%	16,5%	1,5%	8,0%	9,2%	-0,1%	-10,4%	-7,3%	6,2%	-13,5%	-6,9%	8,1%															0,5%	

Notes:

Blue values refers to 1999

Δ Average Growth rate

(1) TPES - Total Primary Energy Supply is made up of indigenous production + imports - exports - international marine bunkers ± stock changes

Indigenous production is the production of primary energy

source: energy balances (primary energy production + net imports)

(2) FEC - Final Energy Consumption is the sum of consumption by the different end-use sectors

(3) Final consumption of electricity

(4) source for candidate countries - *http://www.dti.gov.uk/energy/inform/energy_indicators/indicators.pdf*

Reliable supplies of energy
Indicators

notes				BE	DK	DE	GR	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	CY	CZ	EE	HU	LT	LV	MT	PL	SI	SK	BG	RO	NO	CH	EU 15	N10
B.1	(6)	Average load factor	1995	57,0	39,3	53,1	53,0	41,6	52,5	46,4	41,8	11,3	48,7	37,0	40,7	50,5	50,4	54,4	40,4	49,6	28,5	55,4	27,5	22,8	72,8	53,1	52,6	41,8	38,5	30,4	50,5	42,5	49,3	
		(%)	1999	62,0	34,9	55,3	52,2	45,5	52,1	57,9	41,1	9,6	48,0	38,9	45,9	49,0	52,8	55,3	48,2	48,6	27,9	54,1	33,6	31,4	48,4	53,3	57,1	36,7	38,1	27,5	48,6	48,2	50,3	
			Δ	8,8%	-11,3%	4,1%	-1,5%	9,5%	-0,6%	24,8%	-1,6%	-14,5%	-1,5%	5,0%	12,8%	-3,0%	4,8%	1,8%	19,5%	-2,1%	-2,3%	-2,3%	22,1%	37,8%	-0,3	0,4%	8,6%	-12,1%	-0,9%	-9,4%	-3,8%	13,5%	2,0%	
B.2	(1)	Proportion of electricity	1995	1,7	3,3	4,8	9,2	14,9	15,8	5,5	17,4	66,6	0,5	68,0	25,5	20,2	46,0	2,0		3,3	0,02	0,5	2,7	73,8		1,4	25,6	19,1	3,1	28,2	99,4	56,5	13,5	5,2
		generated by renewables (%)	2000	3,1	17,2	7,3	8,5	17,2	14,0	6,2	21,0	80,4	4,7	73,1	30,9	33,3	57,1	3,5		3,9	0,2	0,8	5,6	68,1		3,0	28,4	16,2	7,3	28,5	99,4	58,3	15,9	6,0
			Δ	87,3%	423,6%	50,1%	-7,3%	15,7%	-11,2%	12,8%	20,9%	20,7%	837,2%	7,5%	21,3%	64,5%	24,1%	72,2%		17,0%	919,6%	72,0%	103,8%	-7,7%		117,6%	11,0%	-14,8%	137,5%	1,0%	0,0%	3,3%	17,7%	16,8%
B.3	(1)	Proportion of electricity	1995																															
		generated by liquid fossil fuels (%)	2000	1,0	12,2	0,8	16,6	10,1	1,4	19,3	31,0		3,5	3,2	19,2	0,9	1,2	1,5		0,5	0,7	12,5	5,7	2,7		1,3	0,4	0,7	1,6	6,5	0,1	0,2	6,2	4,0
			Δ																															
B.4		Proportion of electricity	1995																															
		generated by solid fossil fuels (%)	2000	15,4	46,0	51,0	63,5	35,1	5,0	35,8	9,5		25,2	9,3	33,4	17,9	1,3	32,0		71,5	90,1	27,3		1,9		93,6	33,9	18,2	41,4	36,4			25,9	65,9
			Δ																															
B.5	(1)	Proportion of electricity	1995																															
		generated by natural gas (%)	2000	22,8	24,3	10,5	11,1	10,0	2,8	38,6	38,2	19,6	60,9	14,3	16,5	15,4	1,0	40,3		5,3	8,9	19,1	14,0	27,3		1,9	2,1	11,2	5,3	18,1	0,2	1,5	18,5	6,3
			Δ																															
B.6	(2)	Diversity of fuels used for	1995	0,76	0,14	0,78	0,31	0,99	0,70	0,21	0,46	0,64	0,23	0,63	0,57	1,03	0,90	0,67		0,64	0,002	0,71	0,45	0,58		0,07	1,08	1,05	0,80	0,59	0,04	0,81	0,98	0,67
		electricity generation	2000	0,79	0,46	0,84	0,29	0,99	0,70	0,23	0,51	0,49	0,37	0,58	0,62	1,10	0,81	0,68		0,63	0,02	0,72	0,71	0,63		0,13	1,09	0,99	0,90	0,90	0,03	0,75	1,00	0,68
		(Shannon-Weiner measure)	Δ	4,7%	217,7%	8,4%	-5,1%	-0,3%	-0,3%	9,2%	11,3%	-22,3%	60,7%	-7,1%	9,0%	6,4%	-9,8%	0,8%		-1,0%	667,0%	1,7%	58,2%	8,9%		85,2%	0,8%	-5,3%	12,6%	50,7%	-10,0%	-7,3%	2,4%	2,3%
B.7		Gas Capacity	1995																															
		(KWh per day)	2000																															
B.8	(3)	Ratio of energy production	1995	22,6	75,1	41,9	40,2	30,7	52,4	38,6	18,9	1,4	90,0	33,1	13,3	45,7	62,4	114,4	0,6	77,5	61,8	52,0	40,1	18,2		99,3	47,8	28,4	43,6	69,4	776,1	43,7	54,2	75,8
		to primary energy consumption (%)	2000	23,5	140,7	39,5	35,4	25,5	50,8	16,3	17,4	1,6	75,6	33,2	13,0	46,0	62,7	116,8	1,5	71,9	63,0	44,2	38,7	29,5		86,7	45,8	32,2	52,0	77,6	848,5	44,2	52,4	67,0
			Δ	4,0%	87,3%	-5,9%	-12,0%	-17,1%	-3,0%	-57,8%	-8,0%	12,5%	-16,0%	0,3%	-2,2%	0,6%	0,5%	2,1%	169,0%	-7,3%	2,0%	-15,1%	-3,6%	62,0%		-12,7%	-4,1%	13,2%	19,2%	11,8%	9,3%	1,2%	-3,3%	-11,7%
B.9	(4)	Fossil fuels dependency	1995	77,2	93,0	86,7	94,4	80,0	55,0	98,0	92,5	85,7	96,0	77,6	86,3	59,3	38,6	88,8	99,4	90,6	94,5	83,0	64,2	81,8	100,0	95,2	72,0	79,2	79,1	93,2	53,2	58,7	79,7	89,4
		(fossil fuels as % of	2000	76,0	88,8	83,9	94,7	80,8	54,0	98,6	90,8	86,1	94,0	77,1	86,7	54,3	37,1	88,7	98,0	91,0	90,0	85,0	60,0	61,0	100,0	96,0	69,0	74,0	72,0	87,0	54,0	58,0	78,3	88,4
		primary consumption)	Δ	-1,5%	-4,6%	-3,2%	0,3%	1,0%	-1,9%	0,6%	-1,8%	0,5%	-2,0%	-0,7%	0,5%	-8,5%	-3,9%	-0,0%	-1,5%	0,4%	-4,8%	2,4%	-6,5%	-25,5%		0,8%	-4,2%	-6,6%	-9,0%	-6,7%	1,6%	-1,2%	-1,7%	-1,1%
B.10	(5)	Annual electricity failures	1999					n.a.	1,0	7,1	5,9		0,4		n.a.	4,9		1,3				8,1	n.a.						n.a.		4,9			
		(hours per year)	2001					3,6	1,1	6,4	5,0		0,6		9,8	3,9		1,4				6,2	2,2						3,9		5,1			
			Δ						10,2%	-9,2%	-16%		30,8%			-20,6%		6,5%				-24,0%									3,1%			
B.11	(7)	Crude oil refined/ Fossil fuels	1995	76,6	52,4	41,4	79,1	70,2	66,3	20,7	60,8		120,3	44,6	83,6	78,0	101,6	50,3	43,0	18,4		39,8	61,9			15,1	11,7	38,3	43,0	35,1	110,9	32,8	63,5	22,0
		primary consumption (%)	2000	89,7	49,6	43,3	85,1	61,8	64,4	24,1	61,9		121,9	43,1	61,3	72,6	125,2	45,6	50,6	16,8	3,3	39,1	108,2			22,6	4,3	45,6	43,5	36,7	111,2	32,0	63,2	27,3
			Δ	17,1%	-5,2%	4,5%	7,6%	-12,0%	-2,8%	16,5%	1,9%		1,3%	-3,5%	-26,7%	-6,9%	23,2%	-9,4%	17,7%	-8,9%		-1,8%	74,8%			49,8%	-63,0%	19,2%	1,0%	4,6%	0,3%	-2,4%	-0,6%	24,2%
B.12		Grid density	1995																															
		high and medium voltage *(km/km²)*	2000																															
			Δ																															

Notes:

Blue values refers to 1999

Δ Average Growth rate

(1) gross electricity generation (diferent sources of data)

in 2000 includes pumping like the others years

liquid fossil fuels = oil; natural gas = gas

(2) Shannon-Weiner measure = - Sum (p_i x ln (p_i))

p_i - proportion of the total supplied by fuel i - 3 groups of fuels: nuclear, renewables, thermal

(3) primary energy production / primary energy consumption

(4) Fossil Fuels = coal, oil and natural gas

(5) Council of European Energy Regulators, "Second Benchmarking report on quality of electricity supply" September 2003

Unplanned and planned interruptions (minutes lost per customer per year) more than 3 minutes

For HU, LT, BG data from "Quality of electricity supply" ERRA energy regulators regional association, April 2004

Competitive energy markets
Indicators

			BE	DK	DE	GR	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	CY	CZ	EE	HU	LT	LV	MT	PL	SI	SK	BG	RO	NO	CH
C.1	Electricity price indices for the industrial sector	1995	75,1	58,4	100	60,0	76,8	69,9	63,0	77,7	60,1	59,0	85,7	81,6	55,0		64,6														
		2000	101,3		100	87,9	103,1	89,7	97,1	133,0	81,7			96,2	69,6	51,6	105,5														
C.1	Low Sulphur Fuel Oil price indices for the industrial sector	1995	93,4	106,8	100	127,0	117,3	115,4	109,1	117,9	100,4	133,8	95,8	120,9		266,9	99,1														
		2000	91,7	125,6	100	135,0	125,3	106,5		122,3	101,7	129,1	106,4	132,2	133,8	270,2															
C.1	Natural Gas price indices for the industrial sector	1995	75,4	72,4	100		64,1	65,2		74,9	88,1	69,8			60,2		70,6														
		2000	81,9	96,3	100		87,6	86,0		90,6	108,4	82,6		123,9	97,4		67,0														
C.1	Steam Coal price indices for the industrial sector	1995																													
		2000																													
C.2	Electricity price indices for the residential sector	1995	92,9	94,4	100	54,6	77,2	86,5	55,3	125,5	75,2	75,2		80,5	50,4		63,6														
		2000	94,1	130,8	100	48,9	71,4	82,2	61,2	132,7	77,4	77,4	88,0	79,5	53,3	67,7	72,3														
C.2	Light Fuel Oil price indices for the residential sector	1995	82,9	247,0	100	147,3	118,1	144,0	102,7	287,6	91,9	136,8	146,7			220,6	82,6														
		2000	85,0	208,6	100	84,9	109,8	125,5	123,7	245,8	85,6	149,8	120,7	102,1	106,1	167,3	89,7														
C.2	Natural Gas price indices for the residential sector	1995	106,2		100		90,0	88,8	118,6	70,8	75,8	70,5					59,7														
		2000	112,9	129,1	100		96,1	88,1	115,3	87,5	80,4	73,9	80,2			111,7	70,1														
C.3	Fuel price indices for the transport sector	1995	100,0	97,9	100	79,3	82,1	102,9	96,4	101,4	81,4	105,7	98,6	95,0		114,3	97,9														
		2000	98,3	105,8	100	75,0	79,7	107,6	92,4	107,6	79,7	107,0	93,0	78,5	106,4	105,2	144,2														
C.4	Competition in electricity generation *(Herfindahl-Hershmann measure)*	1995																													
		2000																													

Other data source			BE	DK	DE	GR	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	CY	CZ	EE	HU	LT	LV	MT	PL	SI	SK	BG	RO	NO	CH
C.1	Electricity price indices for the industrial sector	1995	77,0	69,0	100	62,0	76,0	60,0	65,0	93,0		75,0	81,0	118,0	60,0	39,0	68,0		61,0		45,0				40,0		49,0				125,0
		2000	117,1	141,5	100	102,4	104,9	87,8	119,5	217,1		139,0	92,7	163,4	95,1		134,1		104,9		119,5				90,2		102,4	156,1			168,3
C.1	Natural Gas price indices for the industrial sector	1995	68,4		100		76,9	77,8	153,6	83,9		76,7	83,0		70,5		61,4		76,1		51,0				62,7		61,7				143,4
		2000			100	115,0	93,3	89,3	60,8			88,6			69,6		55,7		78,6		66,5				70,8		54,2				118,6
C.2	Electricity price indices for the residential sector	1995	97,5	103,0	100	56,2	96,1	82,3	65,0	83,3	71,9	66,5	94,6	89,2	53,7	46,3	62,6		18,2		28,6				30,5		15,3			38,4	81,3
		2000	109,1	162,8	100	58,7	96,7	84,3	83,5	111,6	81,8	108,3	97,5	99,2	64,5		88,4		44,6		53,7				53,7		41,3			47,1	
C.2	Natural Gas price indices for the residential sector	1995	102,2	145,1	100		128,0	105,0	99,3	140,1	62,5	85,3	96,4		37,4		69,0		26,3		28,8				43,8		17,1		4,1		112,8
		2000	109,2	196,9	100	79,6	131,6	93,1	92,6		73,8	96,3	93,3		42,7		78,4		57,3		44,5				66,3		29,1		16,1		110,1

Environmental Objectives
Indicators

	notes			BE	DK	DE	GR	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	CY	CZ	EE	HU	LT	LV	MT	PL	SI	SK	BG	RO	NO	CH	EU 15	N10
D.1	(1)	**Greenhouse gas emissions**	***1995***	152,10	77,30	1060,70	110,50	319,40	565,40	57,60	520,40	10,20	223,30	80,80	70,00	76,70	75,10	687,40	5,60	148,30	22,30	77,90	23,90	13,70	2,70	417,40	18,90	53,40	87,10	212,30	51,80	52,00	4086,90	784,10
		(Mio tonnes CO2 equivalent)	***2000***	150,30	68,20	983,30	130,10	387,10	565,30	68,30	543,80	6,00	216,80	82,00	82,30	75,40	68,90	649,10	7,00	147,70	19,70	83,30	23,90	9,90	2,80	386,20	19,80	47,90	64,50	155,80	55,70	52,40	4076,90	748,20
			Δ	-1,2%	-11,8%	-7,3%	17,7%	21,2%	-0,0%	18,6%	4,5%	-41,2%	-2,9%	1,5%	17,6%	-1,7%	-8,3%	-5,6%	25,0%	-0,4%	-11,7%	6,9%	0,0%	-27,7%	3,7%	-7,5%	4,8%	-10,3%	-25,9%	-26,6%	7,5%	0,8%	-0,2%	-4,6%
D.2	(1)	**Acidification gas emissions**	***1995***	21,70	17,30	139,40	28,40	103,90	113,30	14,60	106,80	1,20	26,30	9,10	23,50	10,90	12,40	139,90	2,40	48,30	5,50	30,70	6,60	3,70	:	124,50	6,60	13,70	57,10	48,20	7,40	7,70	768,70	242,00
		Acidifying Potential (kt)	***2000***	17,30	11,70	89,40	26,40	101,50	97,90	14,10	80,10	0,90	20,80	8,60	24,10	9,40	10,70	92,40	2,80	21,40	4,40	23,40	3,90	2,00	:	87,60	5,40	7,90	38,00	48,20	7,20	6,70	605,30	158,80
			Δ	-20,3%	-32,4%	-35,9%	-7,0%	-2,3%	-13,6%	-3,4%	-25,0%	-25,0%	-20,9%	-5,5%	2,6%	-13,8%	-13,7%	-34,0%	16,7%	-55,7%	-20,0%	-23,8%	-40,9%	-45,9%		-29,6%	-18,2%	-42,3%	-33,5%	0%	-2,7%	-13,0%	-21,3%	-34,4%

Notes:

Δ Average Growth rate

(1) "Energy, transport and envirenment indicators 1991-2001", Eurostat - UNFCCC, European Environment Agency / European Topic Centre on Air and Climate Change
The acidifying substances considered in this publication are sulphur dioxide (SO2), nitrogen oxides (NOx) and ammonia (NH3). Emissions of these gases are associated with the formation of acid rain.

Core Indicator 1 - Electricity Production by power source

Installed net capacity production of electricty by hydroelectric nuclea

(in megawatt)

Countries	2000	Hydroelectric power	Nuclear power	Thermal power	Wind power	1999	Hydroelectric power	Nuclear power
eu15 European Union (15 c	:	:	:	:		*574644*	*127192*	*124700*
be Belgium	**156724**	**14043**	**5713**	**8545**	**10**	**15569**	**1404**	**5713**
be1 Région de Bruxelles-C	**798**	:	:	:		**788**	:	:
be10 Région de Bruxelles-(	**798**	:	:	:		**788**	:	:
be2 Vlaams Gewest	**88702**	:	:	:		**86785**	:	:
be21 Prov. Antwerpen	**890**	:	:	:		**10711**	:	:
be22 Prov. Limburg (B)	**7132**	:	:	:		**7097**	:	:
be23 Prov. Oost-Vlaandere	**55611**	:	:	:		**55734**	:	:
be24 Prov. Vlaams Braban	**9818**	:	:	:		**6018**	:	:
be25 Prov. West-Vlaandere	**7241**	:	:	:		**7225**	:	:
be3 Région Wallonne	**67224**	:	:	:		**68117**	:	:
be31 Prov. Brabant Wallon	**741**	:	:	:		**726**	:	:
be32 Prov. Hainaut	**9669**	:	:	:		**10887**	:	:
be33 Prov. Liège	**54785**	:	:	:		**54765**	:	:
be34 Prov. Luxembourg (B	**769**	:	:	:		**769**	:	:
be35 Prov. Namur	**126**	:	:	:		**97**	:	:
bez Extra-Regio	:	:	:	:		:	:	:
bezz Extra-Regio	:	:	:	:		:	:	:
dk Denmark	**12654**	**10**	:	**10226**	**2418**	*12728*	*1782*	*0*
dk0 Denmark	12654	10	:	10226	2418	*12728*	*1782*	*0*
dk00 Denmark	12654	10	:	10226	2418	*12728*	*1782*	*0*
dkz Extra-Regio	:	:	:	:		:	:	:
dkzz Extra-Regio	:	:	:	:		:	:	:
de Germany (including ex-(	**118267**	**8982**	**22396**	**80794**	**6095**	*114691*	*12991*	*22329*
de1 Baden-Württemberg	:	:	:	:		:	:	:
de11 Stuttgart	:	:	:	:		:	:	:
de12 Karlsruhe	:	:	:	:		:	:	:
de13 Freiburg	:	:	:	:		:	:	:
de14 Tübingen	:	:	:	:		:	:	:
de2 Bayern	:	:	:	:		:	:	:
de21 Oberbayern	:	:	:	:		:	:	:
de22 Niederbayern	:	:	:	:		:	:	:
de23 Oberpfalz	:	:	:	:		:	:	:
de24 Oberfranken	:	:	:	:		:	:	:
de25 Mittelfranken	:	:	:	:		:	:	:
de26 Unterfranken	:	:	:	:		:	:	:
de27 Schwaben	:	:	:	:		:	:	:
de3 Berlin	:	:	:	:		:	:	:
de30 Berlin	:	:	:	:		:	:	:
de4 Brandenburg	:	:	:	:		:	:	:
de41 Brandenburg - Nordo	:	:	:	:		:	:	:
de42 Brandenburg - Südwe	:	:	:	:		:	:	:

de5 Bremen	:	:	:	:		:	:	:
de50 Bremen	:	:	:	:		:	:	:
de6 Hamburg	:	:	:	:		:	:	:
de60 Hamburg	:	:	:	:		:	:	:
de7 Hessen	:	:	:	:		:	:	:
de71 Darmstadt	:	:	:	:		:	:	:
de72 Gießen	:	:	:	:		:	:	:
de73 Kassel	:	:	:	:		:	:	:
de8 Mecklenburg-Vorpomn	:	:	:	:		:	:	:
de80 Mecklenburg-Vorpom	:	:	:	:		:	:	:
de9 Niedersachsen	:	:	:	:		:	:	:
de91 Braunschweig	:	:	:	:		:	:	:
de92 Hannover	:	:	:	:		:	:	:
de93 Lüneburg	:	:	:	:		:	:	:
de94 Weser-Ems	:	:	:	:		:	:	:
dea Nordrhein-Westfalen	:	:	:	:		:	:	:
dea1 Düsseldorf	:	:	:	:		:	:	:
dea2 Köln	:	:	:	:		:	:	:
dea3 Münster	:	:	:	:		:	:	:
dea4 Detmold	:	:	:	:		:	:	:
dea5 Arnsberg	:	:	:	:		:	:	:
deb Rheinland-Pfalz	:	:	:	:		:	:	:
deb1 Koblenz	:	:	:	:		:	:	:
deb2 Trier	:	:	:	:		:	:	:
deb3 Rheinhessen-Pfalz	:	:	:	:		:	:	:
dec Saarland	:	:	:	:		:	:	:
dec0 Saarland	:	:	:	:		:	:	:
ded Sachsen	:	:	:	:		:	:	:
ded1 Chemnitz	:	:	:	:		:	:	:
ded2 Dresden	:	:	:	:		:	:	:
ded3 Leipzig	:	:	:	:		:	:	:
dee Sachsen-Anhalt	:	:	:	:		:	:	:
dee1 Dessau	:	:	:	:		:	:	:
dee2 Halle	:	:	:	:		:	:	:
dee3 Magdeburg	:	:	:	:		:	:	:
def Schleswig-Holstein	:	:	:	:		:	:	:
def0 Schleswig-Holstein	:	:	:	:		:	:	:
deg Thüringen	:	:	:	:		:	:	:
deg0 Thüringen	:	:	:	:		:	:	:
dez Extra-Regio	:	:	:	:		:	:	:
dezz Extra-Regio	:	:	:	:		:	:	:
gr Greece	**10853**	**2967**	:	**7660**	**226**	***10903***	***3211***	***0***
gr1 Voreia Ellada	:	:	:	:		:	:	:
gr11 Anatoliki Makedonia T	:	:	:	:		:	:	:
gr12 Kentriki Makedonia	:	:	:	:		:	:	:
gr13 Dytiki Makedonia	:	:	:	:		:	:	:
gr14 Thessalia	:	:	:	:		:	:	:
gr2 Kentriki Ellada	:	:	:	:		:	:	:
gr21 Ipeiros	:	:	:	:		:	:	:
gr22 Ionia Nisia	:	:	:	:		:	:	:
gr23 Dytiki Ellada	:	:	:	:		:	:	:

gr24 Sterea Ellada	:	:	:	:		:	:	:
gr25 Peloponnisos	:	:	:	:		:	:	:
gr3 Attiki	:	:	:	:		:	:	:
gr30 Attiki	:	:	:	:		:	:	:
gr4 Nisia Aigaiou Kriti	:	:	:	:		:	:	:
gr41 Voreio Aigaio	:	:	:	:		:	:	:
gr42 Notio Aigaio	:	:	:	:		:	:	:
gr43 Kriti	:	:	:	:		:	:	:
grz Extra-Regio	:	:	:	:		:	:	:
grzz Extra-Regio	:	:	:	:		:	:	:
es Spain	**52615**	**17738**	**7503**	**25492**	**1882**	***52413***	***19415***	***7354***
es1 Noroeste	:	:	:	:		:	:	:
es11 Galicia	:	:	:	:		:	:	:
es12 Principado de Asturia	:	:	:	:		:	:	:
es13 Cantabria	:	:	:	:		:	:	:
es2 Noreste	:	:	:	:		:	:	:
es21 Pais Vasco	:	:	:	:		:	:	:
es22 Comunidad Foral de I	:	:	:	:		:	:	:
es23 La Rioja	:	:	:	:		:	:	:
es24 Aragón	:	:	:	:		:	:	:
es3 Comunidad de Madrid	:	:	:	:		:	:	:
es30 Comunidad de Madrid	:	:	:	:		:	:	:
es4 Centro (ES)	:	:	:	:		:	:	:
es41 Castilla y León	:	:	:	:		:	:	:
es42 Castilla-la Mancha	:	:	:	:		:	:	:
es43 Extremadura	:	:	:	:		:	:	:
es5 Este	:	:	:	:		:	:	:
es51 Cataluña	:	:	:	:		:	:	:
es52 Comunidad Valencian	:	:	:	:		:	:	:
es53 Illes Balears	:	:	:	:		:	:	:
es6 Sur	:	:	:	:		:	:	:
es61 Andalucia	:	:	:	:		:	:	:
es62 Región de Murcia	:	:	:	:		:	:	:
es63 Ciudad Autónoma de	:	:	:	:		:	:	:
es64 Ciudad Autónoma de	:	:	:	:		:	:	:
es7 Canarias (ES)	:	:	:	:		:	:	:
es70 Canarias (ES)	:	:	:	:		:	:	:
esz Extra-Regio	:	:	:	:		:	:	:
eszz Extra-Regio	:	:	:	:		:	:	:
fr France	**115632**	**25594**	**63183**	**26799**	**56**	***114583***	***25187***	***63183***
fr1 Île de France	:	:	:	:		:	:	:
fr10 Île de France	:	:	:	:		:	:	:
fr2 Bassin Parisien	:	:	:	:		:	:	:
fr21 Champagne-Ardenne	:	:	:	:		:	:	:
fr22 Picardie	:	:	:	:		:	:	:
fr23 Haute-Normandie	:	:	:	:		:	:	:
fr24 Centre	:	:	:	:		:	:	:
fr25 Basse-Normandie	:	:	:	:		:	:	:
fr26 Bourgogne	:	:	:	:		:	:	:
fr3 Nord - Pas-de-Calais	:	:	:	:		:	:	:
fr30 Nord - Pas-de-Calais	:	:	:	:		:	:	:

fr4 Est	:	:	:	:		:	:	:
fr41 Lorraine	:	:	:	:		:	:	:
fr42 Alsace	:	:	:	:		:	:	:
fr43 Franche-Comté	:	:	:	:		:	:	:
fr5 Ouest	:	:	:	:		:	:	:
fr51 Pays de la Loire	:	:	:	:		:	:	:
fr52 Bretagne	:	:	:	:		:	:	:
fr53 Poitou-Charentes	:	:	:	:		:	:	:
fr6 Sud-Ouest	:	:	:	:		:	:	:
fr61 Aquitaine	:	:	:	:		:	:	:
fr62 Midi-Pyrénées	:	:	:	:		:	:	:
fr63 Limousin	:	:	:	:		:	:	:
fr7 Centre-Est	:	:	:	:		:	:	:
fr71 Rhône-Alpes	:	:	:	:		:	:	:
fr72 Auvergne	:	:	:	:		:	:	:
fr8 Méditerranée	:	:	:	:		:	:	:
fr81 Languedoc-Roussillon	:	:	:	:		:	:	:
fr82 Provence-Alpes-Côte d	:	:	:	:		:	:	:
fr83 Corse	:	:	:	:		:	:	:
fr9 French overseas depart	:	:	:	:		:	:	:
fr91 Guadeloupe (FR)	:	:	:	:		:	:	:
fr92 Martinique (FR)	:	:	:	:		:	:	:
fr93 Guyane (FR)	:	:	:	:		:	:	:
fr94 Reunion (FR)	:	:	:	:		:	:	:
frz Extra-Regio	:	:	:	:		:	:	:
frzz Extra-Regio	:	:	:	:		:	:	:
ie Ireland	**4705**	**525**	**:**	**4064**	**116**	***4346***	***592***	***0***
ie0 Ireland	4705	525	:	4064	116	***4346***	***592***	***0***
ie01 Border Midlands and W	:	:	:	:		:	:	:
ie02 Southern and Eastern	:	:	:	:		:	:	:
iez Extra-Regio	:	:	:	:		:	:	:
iezz Extra-Regio	:	:	:	:		:	:	:
it Italy	**:**	**203461**	**:**	**547883**	**363**	**:**	**202543**	**:**
itc Nord Ovest	**:**	**95253**	**:**	**134459**		**:**	**94779**	**:**
itc1 Piemonte	**:**	**30871**	**:**	**23429**		**:**	**30608**	**:**
itc2 Valle d'Aosta/Vallée d'A	**:**	**8194**	**:**	**5**		**:**	**8136**	**:**
itc3 Liguria	**:**	**706**	**:**	**34419**		**:**	**696**	**:**
itc4 Lombardia	**:**	**55482**	**:**	**76606**		**:**	**55339**	**:**
itd Nord Est	**:**	**50741**	**:**	**10344**		**:**	**50494**	**:**
itd1 Provincia Autonoma Bo	**:**	**:**	**:**	**:**		**:**	**:**	**:**
itd2 Provincia Autonoma Tr	**:**	**:**	**:**	**:**		**:**	**:**	**:**
itd3 Veneto	**:**	**10604**	**:**	**51912**		**:**	**10595**	**:**
itd4 Friuli-Venezia Giulia	**:**	**4503**	**:**	**13815**		**:**	**4495**	**:**
itd5 Emilia-Romagna	**:**	**5992**	**:**	**36888**		**:**	**5992**	**:**
ite Centro (IT)	**:**	**13952**	**:**	**126004**		**:**	**13887**	**:**
ite1 Toscana	**:**	**2918**	**:**	**36183**		**:**	**2913**	**:**
ite2 Umbria	**:**	**5005**	**:**	**5395**		**:**	**4951**	**:**
ite3 Marche	**:**	**2125**	**:**	**4787**		**:**	**2123**	**:**
ite4 Lazio	**:**	**3904**	**:**	**79639**		**:**	**390**	**:**
itf Sud (IT)	**:**	**32035**	**:**	**100411**		**:**	**31906**	**:**
itf1 Abruzzo	**:**	**9844**	**:**	**4739**		**:**	**9848**	**:**

itf2 Molise	:	768	:	4919		:	753	:
itf3 Campania	:	13127	:	14831		:	13006	:
itf4 Puglia	:	8	:	55682		:	18	:
itf5 Basilicata	:	1231	:	2425		:	1231	:
itf6 Calabria	:	7057	:	17815		:	705	:
itg Isole (IT)	:	11477	:	83569		:	11477	:
itg1 Sicilia	:	718	:	49948		:	718	:
itg2 Sardegna	:	4297	:	33621		:	4297	:
itz Extra-Regio	:	:	:	:		:	:	:
itzz Extra-Regio	:	:	:	:		:	:	:
lu Luxembourg (Grand-Duc	1227	1139	:	74	14	1216	1148	0
lu0 Luxembourg (Grand-Du	1227	1139	:	74	14	1216	1148	0
lu00 Luxembourg (Grand-D	1227	1139	:	74	14	1216	1148	0
luz Extra-Regio	:	:	:	:		:	:	:
luzz Extra-Regio	:	:	:	:		:	:	:
nl Netherlands	20999	38	449	20070	442	20619	446	449
nl1 Noord-Nederland	:	:	:	:		:	:	:
nl11 Groningen	:	:	:	:		:	:	:
nl12 Friesland	:	:	:	:		:	:	:
nl13 Drenthe	:	:	:	:		:	:	:
nl2 Oost-Nederland	:	:	:	:		:	:	:
nl21 Overijssel	:	:	:	:		:	:	:
nl22 Gelderland	:	:	:	:		:	:	:
nl23 Flevoland	:	:	:	:		:	:	:
nl3 West-Nederland	:	:	:	:		:	:	:
nl31 Utrecht	:	:	:	:		:	:	:
nl32 Noord-Holland	:	:	:	:		:	:	:
nl33 Zuid-Holland	:	:	:	:		:	:	:
nl34 Zeeland	:	:	:	:		:	:	:
nl4 Zuid-Nederland	:	:	:	:		:	:	:
nl41 Noord-Brabant	:	:	:	:		:	:	:
nl42 Limburg (NL)	:	:	:	:		:	:	:
nlz Extra-Regio	:	:	:	:		:	:	:
nlzz Extra-Regio	:	:	:	:		:	:	:
at Austria	17718	11547	:	6134	37	17726	11566	0
at1 Ostösterreich	:	:	:	:		:	:	:
at11 Burgenland	:	:	:	:		:	:	:
at12 Niederösterreich	:	:	:	:		:	:	:
at13 Wien	:	:	:	:		:	:	:
at2 Südösterreich	:	:	:	:		:	:	:
at21 Kärnten	:	:	:	:		:	:	:
at22 Steiermark	:	:	:	:		:	:	:
at3 Westösterreich	:	:	:	:		:	:	:
at31 Oberösterreich	:	:	:	:		:	:	:
at32 Salzburg	:	:	:	:		:	:	:
at33 Tirol	:	:	:	:		:	:	:
at34 Vorarlberg	:	:	:	:		:	:	:
atz Extra-Regio	:	:	:	:		:	:	:
atzz Extra-Regio	:	:	:	:		:	:	:
pt Portugal	10894	4526	:	6285	83	10750	4584	0
pt1 Continente (PT)	:	:	:	:		:	:	:

pt11 Norte	:	:	:	:		:	:	:
pt16 Centro (PT)	:	:	:	:		:	:	:
pt17 Lisboa	:	:	:	:		:	:	:
pt18 Alentejo	:	:	:	:		:	:	:
pt15 Algarve	:	:	:	:		:	:	:
pt2 Região Autónoma dos /	:	:	:	:		:	:	:
pt20 Região Autónoma dos	:	:	:	:		:	:	:
pt3 Região Autónoma da M	:	:	:	:		:	:	:
pt30 Região Autónoma da	:	:	:	:		:	:	:
ptz Extra-Regio	:	:	:	:		:	:	:
ptzz Extra-Regio	:	:	:	:		:	:	:
fi Finland	16258	2882	2640	10698	38	*16164*	*2919*	*2640*
fi1 Manner-Suomi	:	:	:	:		:	:	:
fi13 Itä-Suomi	:	:	:	:		:	:	:
fi18 Etelä-Suomi	:	:	:	:		:	:	:
fi19 Länsi-Suomi	:	:	:	:		:	:	:
fi1a Pohjois-Suomi	:	:	:	:		:	:	:
fi2 Åland	:	:	:	:		:	:	:
fi20 Åland	:	:	:	:		:	:	:
fiz Extra-Regio	:	:	:	:		:	:	:
fizz Extra-Regio	:	:	:	:		:	:	:
se Sweden	32773	16372	9461	6731	209	*33588*	*16642*	*10076*
se0 Sverige	:	:	:	:		:	:	:
se01 Stockholm	:	:	:	:		:	:	:
se02 Östra Mellansverige	:	:	:	:		:	:	:
se04 Sydsverige	:	:	:	:		:	:	:
se06 Norra Mellansverige	:	:	:	:		:	:	:
se07 Mellersta Norrland	:	:	:	:		:	:	:
se08 Övre Norrland	:	:	:	:		:	:	:
se09 Småland med öarna	:	:	:	:		:	:	:
se0a Västsverige	:	:	:	:		:	:	:
sez Extra-Regio	:	:	:	:		:	:	:
sezz Extra-Regio	:	:	:	:		:	:	:
uk United Kingdom	78889	4273	12486	61956	174	*75662*	*4622*	*12956*
ukc North East	:	:	:	:		:	:	:
ukc1 Tees Valley and Durh	:	:	:	:		:	:	:
ukc2 Northumberland Tyne	:	:	:	:		:	:	:
ukd North West (including I	:	:	:	:		:	:	:
ukd1 Cumbria	:	:	:	:		:	:	:
ukd2 Cheshire	:	:	:	:		:	:	:
ukd3 Greater Manchester	:	:	:	:		:	:	:
ukd4 Lancashire	:	:	:	:		:	:	:
ukd5 Merseyside	:	:	:	:		:	:	:
uke Yorkshire and The Hur	:	:	:	:		:	:	:
uke1 East Riding and North	:	:	:	:		:	:	:
uke2 North Yorkshire	:	:	:	:		:	:	:
uke3 South Yorkshire	:	:	:	:		:	:	:
uke4 West Yorkshire	:	:	:	:		:	:	:
ukf East Midlands	:	:	:	:		:	:	:
ukf1 Derbyshire and Nottin	:	:	:	:		:	:	:
ukf2 Leicestershire Rutland	:	:	:	:		:	:	:

ukf3 Lincolnshire	:	:	:	:	:	:	:
ukg West Midlands	:	:	:	:	:	:	:
ukg1 Herefordshire Worces	:	:	:	:	:	:	:
ukg2 Shropshire and Staffo	:	:	:	:	:	:	:
ukg3 West Midlands	:	:	:	:	:	:	:
ukh Eastern	:	:	:	:	:	:	:
ukh1 East Anglia	:	:	:	:	:	:	:
ukh2 Bedfordshire Hertford	:	:	:	:	:	:	:
ukh3 Essex	:	:	:	:	:	:	:
uki London	:	:	:	:	:	:	:
uki1 Inner London	:	:	:	:	:	:	:
uki2 Outer London	:	:	:	:	:	:	:
ukj South East	:	:	:	:	:	:	:
ukj1 Berkshire Bucks and C	:	:	:	:	:	:	:
ukj2 Surrey East and West	:	:	:	:	:	:	:
ukj3 Hampshire and Isle of	:	:	:	:	:	:	:
ukj4 Kent	:	:	:	:	:	:	:
ukk South West	:	:	:	:	:	:	:
ukk1 Gloucestershire Wilts	:	:	:	:	:	:	:
ukk2 Dorset and Somerset	:	:	:	:	:	:	:
ukk3 Cornwall and Isles of	:	:	:	:	:	:	:
ukk4 Devon	:	:	:	:	:	:	:
ukl Wales	:	:	:	:	:	:	:
ukl1 West Wales and The V	:	:	:	:	:	:	:
ukl2 East Wales	:	:	:	:	:	:	:
ukm Scotland	:	:	:	:	:	:	:
ukm1 North Eastern Scotla	:	:	:	:	:	:	:
ukm2 Eastern Scotland	:	:	:	:	:	:	:
ukm3 South Western Scotl	:	:	:	:	:	:	:
ukm4 Highlands and Island	:	:	:	:	:	:	:
ukn Northern Ireland	:	:	:	:	:	:	:
ukn0 Northern Ireland	:	:	:	:	:	:	:
ukz Extra-Regio	:	:	:	:	:	:	:
ukzz Extra-Regio	:	:	:	:	:	:	:
bg Bulgaria	13854	2864	3532	7458	:	:	:
bg01 Severozapaden	:	:	:	:	:	:	:
bg011 Vidin	:	:	:	:	:	:	:
bg012 Montana	:	:	:	:	:	:	:
bg013 Vratsa	:	:	:	:	:	:	:
bg02 Severen Tsentralen	:	:	:	:	:	:	:
bg021 Pleven	:	:	:	:	:	:	:
bg022 Lovech	:	:	:	:	:	:	:
bg023 Veliko Tarnovo	:	:	:	:	:	:	:
bg024 Gabrovo	:	:	:	:	:	:	:
bg025 Ruse	:	:	:	:	:	:	:
bg03 Severoiztochen	:	:	:	:	:	:	:
bg031 Varna	:	:	:	:	:	:	:
bg032 Dobrich	:	:	:	:	:	:	:
bg033 Shumen	:	:	:	:	:	:	:
bg034 Turgovishte	:	:	:	:	:	:	:
bg035 Razgrad	:	:	:	:	:	:	:

bg036 Silistra	:	:	:	:	:	:	:
bg04 Yugozapaden	:	:	:	:	:	:	:
bg041 Sofia Stolitsa (capita	:	:	:	:	:	:	:
bg042 Sofia	:	:	:	:	:	:	:
bg043 Blagoevgrad	:	:	:	:	:	:	:
bg044 Pernik	:	:	:	:	:	:	:
bg045 Kyustendil	:	:	:	:	:	:	:
bg05 Yuzhen Tsentralen	:	:	:	:	:	:	:
bg051 Plovdiv	:	:	:	:	:	:	:
bg052 Stara Zagora	:	:	:	:	:	:	:
bg053 Haskovo	:	:	:	:	:	:	:
bg054 Pazardzhik	:	:	:	:	:	:	:
bg055 Smolyan	:	:	:	:	:	:	:
bg056 Kardzhali	:	:	:	:	:	:	:
bg06 Yugoiztochen	:	:	:	:	:	:	:
bg061 Burgas	:	:	:	:	:	:	:
bg062 Sliven	:	:	:	:	:	:	:
bg063 Yambol	:	:	:	:	:	:	:
cy Cyprus	**1004**			**1004**	**:**	**:**	**:**
cz Czech Republic	**15390**	**2145**	**1760**	**11485**	**:**	**:**	**:**
cz01 Praha	:	:	:	:	:	:	:
cz02 Strední Cechy	:	:	:	:	:	:	:
cz03 Jihozápad	:	:	:	:	:	:	:
cz031 Jihocecký	:	:	:	:	:	:	:
cz032 Plzenský	:	:	:	:	:	:	:
cz04 Severozápad	:	:	:	:	:	:	:
cz041 Karlovarský	:	:	:	:	:	:	:
cz042 Ústecký	:	:	:	:	:	:	:
cz05 Severovýchod	:	:	:	:	:	:	:
cz051 Liberecký	:	:	:	:	:	:	:
cz052 Královehradecký	:	:	:	:	:	:	:
cz053 Pardubický	:	:	:	:	:	:	:
cz06 Jihovýchod	:	:	:	:	:	:	:
cz061 Vysocina	:	:	:	:	:	:	:
cz062 Jihomoravský	:	:	:	:	:	:	:
cz07 Strední Morava	:	:	:	:	:	:	:
cz071 Olomoucký	:	:	:	:	:	:	:
cz072 Zlínský	:	:	:	:	:	:	:
cz08 Moravskoslezko	:	:	:	:	:	:	:
ee Estonia	**2223**			**2223**	**2614**	**1**	**:**
ee001 Põhja-Eesti	:	:	:	:	:	:	:
ee004 Lääne-Eesti	:	:	:	:	:	:	:
ee006 Kesk-Eesti	:	:	:	:	:	:	:
ee007 Kirde-Eesti	:	:	:	:	:	:	:
ee008 Lõuna-Eesti	:	:	:	:	:	:	:
hu Hungary	**8392**	**48**	**1866**	**6478**	**:**	**:**	**:**
hu1 Közép-Magyarország	:	:	:	:	:	:	:
hu101 Budapest	:	:	:	:	:	:	:
hu102 Pest	:	:	:	:	:	:	:
hu21 Közép-Dunántúl	:	:	:	:	:	:	:
hu211 Fejér	:	:	:	:	:	:	:

hu212 Komárom-Esztergom	:	:	:	:	:	:	:
hu213 Veszprém	:	:	:	:	:	:	:
hu22 Nyugat-Dunántúl	:	:	:	:	:	:	:
hu221 Gyor-Moson-Sopron	:	:	:	:	:	:	:
hu222 Vas	:	:	:	:	:	:	:
hu223 Zala	:	:	:	:	:	:	:
hu23 Dél-Dunántúl	:	:	:	:	:	:	:
hu231 Baranya	:	:	:	:	:	:	:
hu232 Somogy	:	:	:	:	:	:	:
hu233 Tolna	:	:	:	:	:	:	:
hu31 Észak-Magyarország	:	:	:	:	:	:	:
hu311 Borsod-Abaúj-Zemp	:	:	:	:	:	:	:
hu312 Heves	:	:	:	:	:	:	:
hu313 Nógrád	:	:	:	:	:	:	:
hu32 Észak-Alföld	:	:	:	:	:	:	:
hu321 Hajdú-Bihar	:	:	:	:	:	:	:
hu322 Jász-Nagykun-Szoln	:	:	:	:	:	:	:
hu323 Szabolcs-Szatmár-B	:	:	:	:	:	:	:
hu33 Dél-Alföld	:	:	:	:	:	:	:
hu331 Bács-Kiskun	:	:	:	:	:	:	:
hu332 Békés	:	:	:	:	:	:	:
hu333 Csongrád	:	:	:	:	:	:	:
lt Lithuania	6568	916	3000	2654	5982	869	2600
lt001 Alytaus (Apskritis)	:	:	:	:	0	0	-
lt002 Kauno (Apskritis)	:	:	:	:	1074	862	-
lt003 Klaipedos (Apskritis)	:	:	:	:	23	0	-
lt004 Marijampoles (Apskrit	:	:	:	:	4	1	-
lt005 Panevezio (Apskritis)	:	:	:	:	2	0	-
lt006 Siauliu (Apskritis)	:	:	:	:	5	0	-
lt007 Taurages (Apskritis)	:	:	:	:	0	0	-
lt008 Telsiu (Apskritis)	:	:	:	:	102	3	-
lt009 Utenos (Apskritis)	:	:	:	:	2602	2	2600
lt00a Vilniaus (Apskritis)	:	:	:	:	2170	1	-
lv Latvia	2102	1524		576	21156	1527	-
lv003 Kurzeme	:	:	:	:	184	22	-
lv005 Latgale	:	:	:	:	349	24	-
lv001 Riga (SRE 2001)	:	:	:	:	20414	1520	-
lv002 Vidzeme (SRE 2001)	:	:	:	:	66	16	-
lv004 Zemgale (SRE 2001)	:	:	:	:	143	8	-
mt Malta	1987			1987	:	:	:
pl Poland	33403	2195	:	31209	33581	2188	:
pl11 Lódzkie	4979	11	:	4968	4970	10	:
pl111 Lódzki	:	:	:	:	:	:	:
pl112 Piotrkowsko-skiernie	:	:	:	:	:	:	:
pl113 Miasto Lódz	:	:	:	:	:	:	:
pl12 Mazowieckie	4748	23	:	4725	4721	22	:
pl121 Ciechanowsko-plock	:	:	:	:	:	:	:
pl122 Ostrolecko-siedlecki	:	:	:	:	:	:	:
pl124 Radomski	:	:	:	:	:	:	:
pl21 Malopolskie	2235	173	:	2061	2787	173	:
pl211 Krakowsko-tarnowsk	:	:	:	:	:	:	:

pl212 Nowosadecki	:	:	:	:	:	:	:
pl213 Miasto Kraków	:	:	:	:	:	:	:
pl22 Slaskie	**7058**	**535**	:	**6523**	**6298**	**534**	:
pl31 Lubelskie	**185**	**1**	:	**184**	**184**	**1**	:
pl311 Bialskopodlaski	:	:	:	:	:	:	:
pl312 Chelmsko-zamojski	:	:	:	:	:	:	:
pl313 Lubelski	:	:	:	:	:	:	:
pl32 Podkarpackie	**556**	**145**	:	**412**	**562**	**145**	:
pl321 Rzeszowsko-tarnobr	:	:	:	:	:	:	:
pl322 Krosniensko-przemy	:	:	:	:	:	:	:
pl33 Swietokrzyskie	**1941**	**2**	:	**1939**	**1823**	**2**	:
pl34 Podlaskie	**176**	**1**	:	**175**	**182**	**1**	:
pl341 Bialostocko-suwalski	:	:	:	:	:	:	:
pl342 Lomzynski	:	:	:	:	:	:	:
pl41 Wielkopolskie	**2722**	**9**	:	**2713**	**3120**	**9**	:
pl411 Pilski	:	:	:	:	:	:	:
pl412 Poznanski	:	:	:	:	:	:	:
pl413 Kaliski	:	:	:	:	:	:	:
pl414 Koninski	:	:	:	:	:	:	:
pl415 Miasto Poznan	:	:	:	:	:	:	:
pl42 Zachodniopomorskie	**2229**	**163**	:	**2066**	**2152**	**161**	:
pl421 Szczecinski	:	:	:	:	:	:	:
pl422 Koszalinski	:	:	:	:	:	:	:
pl43 Lubuskie	**268**	**98**	:	**171**	**268**	**98**	:
pl431 Gorzowski	:	:	:	:	:	:	:
pl432 Zielonogórski	:	:	:	:	:	:	:
pl51 Dolnoslaskie	**2419**	**55**	:	**2364**	**2623**	**54**	:
pl511 Jeleniogórsko-walbrz	:	:	:	:	:	:	:
pl512 Legnicki	:	:	:	:	:	:	:
pl513 Wroclawski	:	:	:	:	:	:	:
pl514 Miasto Wroclaw	:	:	:	:	:	:	:
pl52 Opolskie	**1839**	**13**	:	**1826**	**1863**	**12**	:
pl61 Kujawsko-Pomorskie	**756**	**210**	:	**546**	**761**	**209**	:
pl611 Bydgoski	:	:	:	:	:	:	:
pl612 Torunsko-wloclawski	:	:	:	:	:	:	:
pl62 Warminsko-Mazurskie	**79**	**12**	:	**67**	**65**	**12**	:
pl621 Elblaski	:	:	:	:	:	:	:
pl622 Olsztynski	:	:	:	:	:	:	:
pl623 Elcki	:	:	:	:	:	:	:
pl63 Pomorskie	**1212**	**745**	:	**467**	**1212**	**745**	:
pl631 Slupski	:	:	:	:	:	:	:
pl632 Gdanski	:	:	:	:	:	:	:
pl633 Gdansk-Gdynia-Sop	:	:	:	:	:	:	:
pl073 Warszawski (SRE 20	:	:	:	:	:	:	:
pl075 Miasta Warszawa (S	:	:	:	:	:	:	:
pl0c1 Pólnocnoslaski (SRE	:	:	:	:	:	:	:
pl0c2 Poludniowoslaski (SF	:	:	:	:	:	:	:
pl0c3 Centralny slaski (SRI	:	:	:	:	:	:	:
ro Romania	**20864**	**6122**	**707**	**14035**	:	:	:
ro01 Nord-Est	:	:	:	:	:	:	:
ro011 Bacau	:	:	:	:	:	:	:

ro012 Botosani	:	:	:	:	:	:	:
ro013 Iasi	:	:	:	:	:	:	:
ro014 Neamt	:	:	:	:	:	:	:
ro015 Suceava	:	:	:	:	:	:	:
ro016 Vaslui	:	:	:	:	:	:	:
ro02 Sud-Est	:	:	:	:	:	:	:
ro021 Braila	:	:	:	:	:	:	:
ro022 Buzau	:	:	:	:	:	:	:
ro023 Constanta	:	:	:	:	:	:	:
ro024 Galati	:	:	:	:	:	:	:
ro025 Tulcea	:	:	:	:	:	:	:
ro026 Vrancea	:	:	:	:	:	:	:
ro03 Sud	:	:	:	:	:	:	:
ro031 Arges	:	:	:	:	:	:	:
ro032 Calarasi	:	:	:	:	:	:	:
ro033 Dâmbovita	:	:	:	:	:	:	:
ro034 Giurgiu	:	:	:	:	:	:	:
ro035 Ialomita	:	:	:	:	:	:	:
ro036 Prahova	:	:	:	:	:	:	:
ro037 Teleorman	:	:	:	:	:	:	:
ro04 Sud-Vest	:	:	:	:	:	:	:
ro041 Dolj	:	:	:	:	:	:	:
ro042 Gorj	:	:	:	:	:	:	:
ro043 Mehedinti	:	:	:	:	:	:	:
ro044 Olt	:	:	:	:	:	:	:
ro045 Vâlcea	:	:	:	:	:	:	:
ro05 Vest	:	:	:	:	:	:	:
ro051 Arad	:	:	:	:	:	:	:
ro052 Caras-Severin	:	:	:	:	:	:	:
ro053 Hunedoara	:	:	:	:	:	:	:
ro054 Timis	:	:	:	:	:	:	:
ro06 Nord-Vest	:	:	:	:	:	:	:
ro061 Bihor	:	:	:	:	:	:	:
ro062 Bistrita-Nasaud	:	:	:	:	:	:	:
ro063 Cluj	:	:	:	:	:	:	:
ro064 Maramures	:	:	:	:	:	:	:
ro065 Satu Mare	:	:	:	:	:	:	:
ro066 Salaj	:	:	:	:	:	:	:
ro07 Centru	:	:	:	:	:	:	:
ro071 Alba	:	:	:	:	:	:	:
ro072 Brasov	:	:	:	:	:	:	:
ro073 Covasna	:	:	:	:	:	:	:
ro074 Harghita	:	:	:	:	:	:	:
ro075 Mures	:	:	:	:	:	:	:
ro076 Sibiu	:	:	:	:	:	:	:
ro08 Bucuresti	:	:	:	:	:	:	:
ro081 Bucuresti (capital)	:	:	:	:	:	:	:
ro082 Ilfov	:	:	:	:	:	:	:
si Slovenia	2899	906	656	1337	**2549**	**790**	**632**
si001 Pomurska	:	:	:	:	**7**	**0**	**-**
si002 Podravska	:	:	:	:	**367**	**352**	**-**

si003 Koroska	:	:	:	:	**211**	**211**	**-**
si004 Savinjska	:	:	:	:	**706**	**34**	**-**
si005 Zasavska	:	:	:	:	**164**	**0**	**-**
si006 Spodnjeposavska	:	:	:	:	**747**	**0**	**632**
si009 Gorenjska	:	:	:	:	**90**	**85**	**-**
si00a Notranjsko-kraska	:	:	:	:	**1**	**0**	**-**
si00b Goriska	:	:	:	:	**100**	**99**	**-**
si00c Obalno-kraska	:	:	:	:	**0**	**0**	**-**
si00d Jugovzhodna Sloven	:	:	:	:	:	:	:
si00e Osrednjeslovenska	:	:	:	:	:	:	:
sk Slovak Republic	8681	2863	2640	3178	:	:	:
sk01 Bratislavský	:	:	:	:	:	:	:
sk02 Západné Slovensko	:	:	:	:	:	:	:
sk021 Trnavský kraj	:	:	:	:	:	:	:
sk022 Trenciaský kraj	:	:	:	:	:	:	:
sk023 Nitrianský kraj	:	:	:	:	:	:	:
sk03 Stredné Slovensko	:	:	:	:	:	:	:
sk031 Zilinský kraj	:	:	:	:	:	:	:
sk032 Banskobystrický kraj	:	:	:	:	:	:	:
sk04 Východné Slovensko	:	:	:	:	:	:	:
sk041 Presovský kraj	:	:	:	:	:	:	:
sk042 Kosický kraj	:	:	:	:	:	:	:
no Norge	28866	28581		272	*28620*	*28345*	*0*
no01 Oslo og Akershus							
no02 Hedmark og Oppland							
no03 Sør-Østlandet							
no04 Agder og Rogaland							
no05 Vestlandet							
no06 Trøndelag							
no07 Nord-Norge							
ch Scweiz					*16215*	*11960*	*3130*
ch01 Région lémanique							
ch02 Espace Mittelland							
ch03 Nordwestschweiz							
ch04 Zürich							
ch05 Ostschweiz							
ch06 Zentralschweiz							
ch07 Ticino							

Sources:

1990-2000 data Eurostat Newcronos
release date : Wed 7 Jul 04 08:39:12

theme	theme1	General Statistics
domain	regio	Regional statistics
collect	tran_enr	Transport and energy statistics
group	energy	Energy statistics
table	xencelec	**Electricity production capacity (in megawatt) - Candidate Co**
table	en2celec	**Electricity production capacity (in megawatt)**

green values "2001 - Annual Energy Review" (energy balances)

Electricity Production Capacity = Generation Capacity (energy balance)
hydro&wind

blue values Energy&Transport in Figures 2002 (for EU15); for N10+2 was considered the % in 2001; Ene
red values estimation based on regional structure

ır and thermal power in 1990-2000

Thermal power	1998	Hydroelectric power	Nuclear power	Thermal power	1997	Hydroelectric power	Nuclear power	Thermal power	1996	Hydroelectric power
322752	561601	122172	122770	316659	558813	120585	124180	314048	549931	119099
83272	153947	14039	5713	82717	146928	1408	5713	7572	14851	1407
:	782	:	:	:	822	:	:	:	:	:
:	782	:	:	:	822	:	:	:	:	:
:	89008	:	:	:	79538	:	:	:	:	:
:	870	:	:	:	8536	:	:	:	:	:
:	705	:	:	:	6073	:	:	:	:	:
:	56267	:	:	:	52387	:	:	:	:	:
:	9791	:	:	:	9928	:	:	:	:	:
:	720	:	:	:	2614	:	:	:	:	:
:	64157	:	:	:	66568	:	:	:	:	:
:	654	:	:	:	654	:	:	:	:	:
:	729	:	:	:	7342	:	:	:	:	:
:	54736	:	:	:	5703	:	:	:	:	:
:	512	:	:	:	542	:	:	:	:	:
:	965	:	:	:	100	:	:	:	:	:
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10946	12544	1454	0	11090	11813	1140	0	10673	11160	852
10946	12544	1454	0	11090	11813	1140	0	10673	11160	852
10946	12544	1454	0	11090	11813	1140	0	10673	11160	852
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79371	113624	11526	22314	79784	113983	10807	22314	80862	114896	10486
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7692	*10016*	*2894*	*0*	*7122*	*9575*	*2755*	*0*	*6820*	**9380**	**2550**
:	:	:	:	:	4793	:	:	:	4695	1009
:	:	:	:	:	3	:	:	:	3	0
:	:	:	:	:	83	:	:	:	81	81
:	:	:	:	:	4574	:	:	:	4481	798
:	:	:	:	:	133	:	:	:	130	130
:	:	:	:	:	2832	:	:	:	2774	1513
:	:	:	:	:	531	:	:	:	520	520
:	:	:	:	:	28	:	:	:	27	0
:	:	:	:	:	942	:	:	:	923	923

:	:	:	:	:	392	:	:	:	384	0
:	:	:	:	:	939	:	:	:	920	70
:	:	:	:	:	997	:	:	:	977	0
:	:	:	:	:	997	:	:	:	977	0
:	:	:	:	:	923	:	:	:	904	0
:	:	:	:	:	137	:	:	:	134	0
:	:	:	:	:	375	:	:	:	367	0
:	:	:	:	:	411	:	:	:	403	0
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25644	*50009*	*17466*	*7300*	*25243*	51142	17715	7584	25843	49237	17537
:	:	:	:	:	9533	4049	:	5484	9517	4056
:	:	:	:	:	5467	2902	:	2565	5455	2909
:	:	:	:	:	3517	722	:	2795	3516	722
:	:	:	:	:	549	425	:	124	546	425
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:	:	:	:	:	1587	147	:	1440	1558	147
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:	:	:	:	:	3765	1267	994	1504	3673	1267
:	:	:	:	:	1140	:	:	1140	844	0
:	:	:	:	:	7738	1192	:	6546	7063	1125
:	:	:	:	:	5007	1085	:	3922	4401	1079
:	:	:	:	:	969	38	:	931	969	38
:	:	:	:	:	:	:	:	:	:	:
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:	:	:	:	:	1684	69	:	1615	1623	8
:	:	:	:	:	1684	69	:	1615	1623	8
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26213	*112342*	*25109*	*61675*	*25558*	*113905*	*25099*	*62875*	*25931*	1193512	250952
:	:	:	:	:	564	:	:	:	5914	22
:	:	:	:	:	564	:	:	:	5914	22
:	:	:	:	:	3278	:	:	:	34351	947
:	:	:	:	:	5147	:	:	:	53931	7591
:	:	:	:	:	293	:	:	:	3068	38
:	:	:	:	:	10957	:	:	:	114814	184
:	:	:	:	:	13118	:	:	:	137456	906
:	:	:	:	:	2945	:	:	:	30854	244
:	:	:	:	:	323	:	:	:	3387	507
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:	:	:	:	:	9129	:	:	:	95657	897
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:	:	:	:	:	658	:	:	:	6898	4428
:	:	:	:	:	4349	:	:	:	45569	3159
:	:	:	:	:	3335	:	:	:	34944	94
:	:	:	:	:	88	:	:	:	924	276
:	:	:	:	:	132	:	:	:	1385	305
:	:	:	:	:	14417	:	:	:	151067	62477
:	:	:	:	:	563	:	:	:	5894	559
:	:	:	:	:	760	:	:	:	7964	4518
:	:	:	:	:	1192	:	:	:	12487	11707
:	:	:	:	:	27854	:	:	:	291853	114953
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:	:	:	:	:	963	:	:	:	10094	9784
:	:	:	:	:	8135	:	:	:	85236	41246
:	:	:	:	:	2277	:	:	:	23856	6826
:	:	:	:	:	543	:	:	:	5690	3291
:	:	:	:	:	43	:	:	:	448	151
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3754	*4457*	*585*	*0*	*3872*	*4291*	*571*	*0*	*3720*	**4297**	**518**
3754	*4457*	*585*	*0*	*3872*	*4291*	*571*	*0*	*3720*	4297	518
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:	*72352*	*20222*	*0*	*52130*	*70252*	*20066*	*0*	*50186*	**70641**	**20127**
:	:	:	:	:	22486	:	:	:	22611	9498
:	:	:	:	:	5008	:	:	:	5036	3069
:	:	:	:	:	818	:	:	:	823	822
:	:	:	:	:	3599	:	:	:	3619	67
:	:	:	:	:	13061	:	:	:	13133	5540
:	:	:	:	:	15004	:	:	:	15087	5067
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:	:	:	:	:	1715	:	:	:	1724	438
:	:	:	:	:	3973	:	:	:	3995	600
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:	:	:	:	:	3307	:	:	:	3325	289
:	:	:	:	:	934	:	:	:	939	501
:	:	:	:	:	418	:	:	:	420	214
:	:	:	:	:	7077	:	:	:	7116	397
:	:	:	:	:	12483	:	:	:	12552	2972
:	:	:	:	:	950	:	:	:	955	736

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:	:	:	:	:	2570	:	:	:	2584	1329
:	:	:	:	:	5767	:	:	:	5799	11
:	:	:	:	:	227	:	:	:	228	124
:	:	:	:	:	2533	:	:	:	2547	695
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68	*1210*	*1151*	*0*	*59*	*1278*	*1143*	*0*	*135*	*1264*	*1163*
68	*1210*	*1151*	*0*	*59*	*1278*	*1143*	*0*	*135*	*1264*	*1163*
68	*1210*	*1151*	*0*	*59*	*1278*	*1143*	*0*	*135*	*1264*	*1163*
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19724	*20158*	*398*	*449*	*19311*	*20091*	*370*	*449*	*19272*	*20395*	*336*
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6160	*17456*	*11474*	*0*	*5982*	*17860*	*11553*	*0*	*6307*	**17520**	**11378**
:	:	:	:	:	4768	:	:	:	4677	1193
:	:	:	:	:	3	:	:	:	3	1
:	:	:	:	:	3117	:	:	:	3058	1170
:	:	:	:	:	1647	:	:	:	1616	22
:	:	:	:	:	4346	:	:	:	4263	2810
:	:	:	:	:	2412	:	:	:	2366	2155
:	:	:	:	:	1934	:	:	:	1897	655
:	:	:	:	:	8747	:	:	:	8580	7375
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:	:	:	:	:	2896	:	:	:	2841	2837
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6166	*9784*	*4549*	*0*	*5235*	*9468*	*4467*	*0*	*5001*	:	**4353**
:	:	:	:	:	9166	:	:	:	:	42726

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10605	*16143*	*2898*	*2640*	*10605*	*15697*	*2873*	*2550*	*10274*	**140686**	**26885**
:	:	:	:	:	15641	:	:	:	140183	26878
:	:	:	:	:	1313	:	:	:	11765	4533
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6870	*33029*	*16438*	*10083*	*6508*	**34415**	**16462**	**10083**	**7870**	**34410**	**16343**
:	:	:	:	:	34415	16462	10083	7870	34410	16343
:	:	:	:	:	644	0	0	644	892	0
:	:	:	:	:	5447	569	3095	1783	5616	521
:	:	:	:	:	3164	58	1230	1876	2936	57
:	:	:	:	:	2696	2166	0	530	2657	2056
:	:	:	:	:	6030	5682	0	348	5633	5409
:	:	:	:	:	7388	7151	0	237	7681	7465
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58084	*72985*	*4594*	*12596*	*55795*	*72785*	*4604*	*12946*	*55235*	*73372*	*4483*
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:	*699*	0	0	*699*	*699*	0	0	*699*	*699*	0
:	*15045*	*2187*	1760	*11098*	15103	2050	1760	11293	14973	2014
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2613	2624	1	-	2623	2722	1	-	2721	2699	1
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:	60332	185	16001	44146	57874	261	16015	41598	57556	271
:	19883	0	-	19883	19068	0	-	19068	18972	0
:	1929	0	-	1929	2052	0	-	2052	2258	0
:	17954	0	-	17954	17016	0	-	17016	16714	0
:	5878	0	-	5878	5402	0	-	5402	5805	0
:	25	0	-	25	224	0	-	224	238	0

:	2641	0	-	2641	2636	0	-	2636	2604	0
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:	51	17	-	34	53	17	-	36	57	19
:	34	0	-	34	36	0	-	36	38	0
:	17	17	-	0	17	17	-	0	19	19
:	0	0	-	0	0	0	-	0	0	0
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:	16001	0	16001	0	16015	0	16015	0	16212	0
:	16867	122	-	16745	15712	176	-	15536	14933	181
:	1028	27	-	10253	9074	3	-	9044	872	34
:	6587	95	-	6492	6638	146	-	6492	6213	147
:	0	0	-	0	0	0	-	0	0	0
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:	54	0	-	54	51	0	-	51	28	0
:	31	0	-	31	17	0	-	17	4	0
:	105	46	-	59	117	68	-	49	12	71
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:	4	0	-	4	5	0	-	5	5	0
2513	5982	869	2600	2513	5791	678	2600	2513	5791	678
0	0	0	-	0	0	0	-	0	0	0
212	1074	862	-	212	883	671	-	212	883	671
23	23	0	-	23	23	0	-	23	23	0
3	4	1	-	3	4	1	-	3	4	1
2	2	0	-	2	2	0	-	2	2	0
5	5	0	-	5	5	0	-	5	5	0
0	0	0	-	0	0	0	-	0	0	0
99	102	3	-	99	102	3	-	99	102	3
0	2602	2	2600	0	2602	2	2600	0	2602	2
2169	2170	1	-	2169	2170	1	-	2169	2170	1
5886	20987	15243	-	5744	2096	15223	-	5737	20907	15218
162	169	8	-	161	154	4	-	15	151	1
325	275	17	-	258	333	18	-	317	282	17
5214	20393	15193	-	520	20388	15193	-	5195	20387	15192
5	66	16	-	5	8	8	-	0	8	8
135	84	9	-	75	76	1	-	75	75	0
:	*406*	*0*	*0*	*406*	*331*	*0*	*0*	*331*	*331*	*0*
31394	32947	2181	:	30766	32695	2080	:	30615	32429	2078
4959	4950	10	:	4939	4948	10	:	4938	4952	10
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4698	4724	22	:	4702	4690	21	:	4668	4622	21
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2080	2220	172	:	2048	2138	79	:	2059	2162	78
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6296	6637	535	:	6102	6720	534	:	6185	6647	535
184	185	1	:	184	185	1	:	184	185	1
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417	562	145	:	417	603	145	:	458	603	145
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1821	1833	2	:	1831	1831	1	:	1830	1831	1
181	183	2	:	181	183	2	:	181	182	1
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3111	2965	9	:	2956	2966	9	:	2957	2958	1
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1990	2010	10	:	2000	2010	9	:	2000	1975	9
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171	216	100	:	116	213	97	:	116	215	99
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2569	2391	53	:	2338	2170	52	:	2118	2397	60
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1648	1891	12	:	1879	1872	12	:	1860	1499	12
552	759	207	:	551	771	206	:	565	785	206
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53	62	10	:	53	44	10	:	35	43	9
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467	1361	894	:	467	1354	893	:	461	1374	892
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:	*22194*	*5929*	*705*	*15560*	*22663*	*5901*	*65*	*16112*	*228*	*6038*
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1127	**2497**	**746**	**632**	**1119**	**2517**	**768**	**632**	**1117**	**2524**	**768**
7	**7**	**0**	**-**	**7**	**7**	**0**	**-**	**7**	**7**	**0**
15	**345**	**330**	**-**	**15**	**347**	**330**	**-**	**17**	**351**	**330**

0	184	184	-	0	184	184	-	0	184	184
672	673	1	-	672	672	1	-	671	673	1
164	164	0	-	164	164	0	-	164	164	0
115	716	0	632	84	716	0	632	84	746	0
5	91	86	-	5	89	86	-	3	88	85
1	1	0	-	1	1	0	-	1	1	0
1	100	99	-	1	100	99	-	1	100	99
0	0	0	-	0	0	0	-	0	0	0
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:	77774	24175	2200	31599	78627	23991	1760	37036	74381	23893
:	6951	23951	2200	23559	66582	23785	1760	25197	6660	23718
:	1873	0	-	1873	5662	0	-	5662	:	:
:	36	0	-	36	36	0	-	36	:	:
:	371	0	-	371	56	0	-	56	:	:
:	1143	0	-	1143	4743	0	-	4743	:	:
:	2975	221	-	2754	2717	204	-	2513	:	:
:	2314	67	-	2248	2081	54	-	2028	:	:
:	661	154	-	507	636	15	-	485	:	:
:	3415	3	-	3412	3666	2	-	3664	:	:
:	856	0	-	856	1106	0	-	1106	:	:
:	2559	3	-	2556	256	2	-	2558	:	:
275	*28371*	*28097*	*0*	*274*	*27728*	*27435*	*0*	*293*	*27685*	*27392*
1125	*16059*	*11879*	*3080*	*1100*	*15990*	*11880*	*3080*	*1030*	*16009*	*11899*

ountries

ergy transport and environment indicators 1991-2001 Eurostat

Nuclear power	Thermal power	1995	Hydroelectric power	Nuclear power	Thermal power	1994	Hydroelectric power	Nuclear power	Thermal power	1993
121449	*309383*	5696206	1175727	138379	3138059	5729996	1172521	122004	3337435	:
5693	*7751*	15207	1407	5923	7877	14557	1407	5852	7298	*14052*
:	:	:	:	0	:	:	:	0	:	:
:	:	:	:	0	:	:	:	0	:	:
:	:	:	:	2909	:	:	:	2909	:	:
:	:	:	:	0	:	:	:	0	:	:
:	:	:	:	0	:	:	:	0	:	:
:	:	:	:	2909	:	:	:	2909	:	:
:	:	:	:	0	:	:	:	0	:	:
:	:	:	:	0	:	:	:	0	:	:
:	:	:	:	3014	:	:	:	2943	:	:
:	:	:	:	0	:	:	:	0	:	:
:	:	:	:	0	:	:	:	0	:	:
:	:	:	:	3014	:	:	:	2943	:	:
:	:	:	:	0	:	:	:	0	:	:
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:	:	:	:	:	:	:	:	:	:	:
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0	*10308*	10713	628	0	10085	*10604*	*540*	*0*	*10064*	10345
0	*10308*	10713	628	0	10085	*10604*	*540*	*0*	*10064*	10345
0	*10308*	10713	628	0	10085	*10604*	*540*	*0*	*10064*	10345
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22910	*81500*	1358111	89191	38337	88555	1213915	88491	23877	886654	1216099
:	:	14938	2654	4876	7408	148011	26571	4864	7280	149378
:	:	:	:	2205	:	:	:	2205	:	:
:	:	:	:	2671	:	:	:	2659	:	:
:	:	:	:	0	:	:	:	0	:	:
:	:	:	:	0	:	:	:	0	:	:
:	:	17319	2620	6360	8339	171895	26114	6270	83081	175018
:	:	:	:	0	:	:	:	0	:	:
:	:	:	:	2327	:	:	:	2317	:	:
:	:	:	:	0	:	:	:	0	:	:
:	:	:	:	0	:	:	:	0	:	:
:	:	:	:	0	:	:	:	0	:	:
:	:	:	:	1345	:	:	:	1345	:	:
:	:	:	:	2688	:	:	:	2608	:	:
:	:	2783	0	0	2783	28356	0	0	28356	29146
:	:	2783	0	0	2783	28356	0	0	28356	29146
:	:	6608	1	0	6607	68677	1	0	68667	73377
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:	:	1701	0	0	1701	1629	0	0	1629	17488
:	:	1701	0	0	1701	1629	0	0	1629	17488
:	:	1647	0	0	1647	16424	0	0	16424	15794
:	:	1647	0	0	1647	16424	0	0	16424	15794
:	:	6486	640	2525	3321	63921	6402	2504	32479	63662
:	:	:	:	2525	:	:	:	2504	:	:
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:	:	7337	17	0	732	6507	17	0	649	1457
:	:	7337	17	0	732	6507	17	0	649	1457
:	:	11846	264	4785	6797	129555	2638	4750	79417	125684
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:	:	3136	13	0	3123	3124	129	0	31111	3123
:	:	8597	1311	0	7286	8208	12901	0	69179	83315
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0	6830	99045	25507	0	73798	92082	25512	0	6657	9151
0	3686	46968	1011	0	36858	46963	10103	0	3686	46962
0	3	28	0	0	28	3	0	0	3	3
0	0	823	823	0	0	816	816	0	0	816
0	3683	44817	7987	0	3683	44817	7987	0	3683	44816
0	0	130	130	0	0	130	130	0	0	130
0	1261	36151	15131	0	2102	27634	15134	0	1250	27645
0	0	520	520	0	0	5203	5203	0	0	5203
0	27	35	0	0	35	165	0	0	165	176
0	0	17566	9231	0	8335	9231	9231	0	0	9231

0	384	3835	0	0	3835	3835	0	0	3835	3835
0	850	920	70	0	850	920	70	0	850	920
0	977	700	0	0	700	800	0	0	800	800
0	977	700	0	0	700	800	0	0	800	800
0	903	8926	6	0	892	9221	11	0	921	864
0	134	142	0	0	142	1341	0	0	1341	134
0	367	348	0	0	348	3595	0	0	3595	3444
0	402	4026	6	0	402	4285	11	0	4274	3856
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7505	*24195*	48321	17418	7405	23498	47974	17343	7405	23226	46470
0	:	9485	4045	0	5440	9423	4034	0	5389	9084
0	:	5441	2898	0	2543	5388	2896	0	2492	5153
0	:	3514	722	0	2792	3512	720	0	2792	3414
0	:	530	425	0	105	523	418	0	105	517
0	:	4914	1918	0	2996	4822	1899	0	2923	4609
0	:	1524	157	0	1367	1527	157	0	1370	1445
0	:	175	137	0	38	174	136	0	38	154
0	:	42	40	0	2	40	38	0	2	29
0	:	2969	1486	0	1483	2965	1483	0	1482	2903
0	:	204	98	0	106	116	85	0	31	78
0	:	204	98	0	106	116	85	0	31	78
3589	:	14401	6842	3547	4012	14559	6791	3547	4221	14159
460	:	7396	3916	460	3020	7355	3885	460	3010	7197
1226	:	2976	762	1226	988	3186	752	1226	1208	2945
1903	:	4029	2164	1861	4	4018	2154	1861	3	4017
3916	:	12587	3494	3858	5235	12539	3500	3858	5181	12141
2922	:	8179	2242	2864	3073	8201	2249	2864	3088	7925
994	:	3564	1252	994	1318	3493	1251	994	1248	3375
0	:	844	0	0	844	845	0	0	845	841
0	:	6934	1119	0	5815	6631	1119	0	5512	6477
0	:	4378	1078	0	3300	4341	1078	0	3263	4227
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0	:	1535	3	0	1532	1279	3	0	1276	1238
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65791	28465	1148764	25049	61097	287304	113994	25005	61652	27337	1122914
0	5892	58506	219	0	58287	57967	125	0	57842	58121
0	5892	58506	219	0	58287	57967	125	0	57842	58121
29939	3465	303475	9467	25984	34168	302135	9461	25984	32834	302273
4509	125	36128	7591	2726	1277	35971	7593	2726	1118	35953
0	303	3062	38	0	3024	2728	38	0	269	2729
8910	2553	108345	181	8292	25244	107974	184	8292	2487	108206
13550	105	123986	906	12202	106	123691	904	12202	767	123341
2970	91	2863	244	2764	746	28525	242	2764	643	28806
0	288	3324	507	0	2817	3246	50	0	2746	3238
6048	1844	75265	5	5706	1820	77435	5	5706	2037	77422
6048	1844	75265	5	5706	1820	77435	5	5706	2037	77422

7880	3997	131939	1928	7288	39779	130764	1913	7288	38754	130609
5940	3536	90908	971	5448	35457	90336	896	5448	3496	90245
1940	214	34309	13907	1840	2002	34225	13902	1840	1923	34224
0	247	6722	4402	0	232	6203	4332	0	1871	614
0	4241	47516	3167	0	44349	41427	3163	0	38264	40929
0	3485	38455	105	0	3835	34218	108	0	3411	33898
0	648	7832	276	0	5072	6749	2759	0	399	6596
0	108	1229	302	0	927	46	296	0	164	435
7002	1857	146192	62222	6532	1865	144133	62165	6532	16648	143464
4032	1303	56642	5476	3804	13126	55908	5427	3804	12441	55597
2970	476	77035	45011	2728	4744	7605	45018	2728	3752	75723
0	78	12515	11735	0	78	12175	1172	0	455	12144
14922	2768	295933	11499	15337	27573	299697	11481	15892	25967	286454
14922	2737	285834	105169	15337	27295	289666	10499	15892	25756	276415
0	31	10099	9821	0	278	10031	982	0	211	10039
0	4399	89938	4114	250	46298	86387	41192	250	42695	83642
0	1703	26357	6923	250	16934	2590	6871	250	16529	23396
0	2399	59103	32709	0	26394	56092	32896	0	23196	55841
0	297	4478	1508	0	297	4395	1425	0	297	4405
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0	3779	4285	508	0	3777	3806	508	0	3298	3933
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0	50514	68224	20568	0	47656	66438	20466	0	45972	65759
0	13113	22171	9479	0	12692	21669	9469	0	12200	21501
0	1967	4887	3060	0	1827	4618	3052	0	1566	4526
0	1	822	821	0	1	822	821	0	1	823
0	3552	3616	66	0	3550	3619	66	0	3553	3619
0	7593	12846	5532	0	7314	12610	5530	0	7080	12533
0	10020	14747	5076	0	9671	14674	5051	0	9623	14575
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0	5290	6227	1074	0	5153	6225	1072	0	5153	6182
0	1286	1688	441	0	1247	1666	431	0	1235	1659
0	3395	3823	599	0	3224	3793	599	0	3194	3748
0	10399	10845	1884	0	8961	10140	1855	0	8285	10080
0	3036	3179	776	0	2403	3176	776	0	2400	3129
0	438	935	499	0	436	933	497	0	436	919
0	206	413	212	0	201	407	212	0	195	406
0	6719	6318	397	0	5921	5624	370	0	5254	5626
0	9580	11986	2946	0	9040	11596	2911	0	8685	11228
0	219	935	734	0	201	809	731	0	78	786

0	362	427	75	0	352	422	68	0	354	421
0	1255	2567	1317	0	1250	2563	1317	0	1246	2474
0	5788	5285	2	0	5283	5284	1	0	5283	5248
0	104	226	124	0	102	225	124	0	101	235
0	1852	2546	694	0	1852	2293	670	0	1623	2064
0	7402	8475	1183	0	7292	8360	1180	0	7180	8347
0	4511	5140	734	0	4406	5023	733	0	4290	5014
0	2891	3335	449	0	2886	3337	447	0	2890	3333
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0	*101*	1146	1140	0	117	1250	1132	0	118	1238
0	*101*	1146	1140	0	117	1250	1132	0	118	1238
0	*101*	1146	1140	0	117	1250	1132	0	118	1238
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505	*19554*	15101	294	505	14302	15222	174	505	14543	:
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0	6142	174398	113062	0	61336	174259	112388	0	61871	172604
0	3484	46499	11531	0	34968	46493	11527	0	34966	46475
0	2	31	11	0	2	31	11	0	2	31
0	1888	30166	11301	0	18865	30179	11316	0	18863	30162
0	1594	16302	219	0	16083	16283	20	0	16083	16282
0	1454	42335	27974	0	14362	42602	27629	0	14973	41545
0	212	2341	21444	0	1966	23222	21263	0	1959	23031
0	1242	18925	6529	0	12396	1938	6366	0	13014	18514
0	1206	85563	73557	0	12006	85164	73232	0	11932	84584
0	1112	29192	18124	0	11068	29108	18114	0	10994	28792
0	82	12867	12043	0	824	12591	11767	0	824	12482
0	4	28375	28338	0	37	28341	28304	0	37	28294
0	8	15129	15052	0	77	15124	15047	0	77	15016
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0	5790	99152	43252	0	5590	9532	4015	0	5517	90896
0	5498	95988	42448	0	5354	9213	3934	0	5279	:

0	446	3498	3078	0	420	3242	2877	0	365	3253
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0	213	212	1	0	211	212	1	0	211	211
0	124	1434	214	0	122	145	21	0	124	1558
0	124	1434	214	0	122	145	21	0	124	1558
0	168	173	59	0	114	173	59	0	114	1617
0	168	173	59	0	114	173	59	0	114	1617
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2310	**90701**	**140686**	**26885**	**2310**	**90701**	*14148*	*2736*	*2360*	*9052*	*14082*
2310	90205	140183	26878	2310	90205	:	:	0	:	:
0	7232	11765	4533	0	7232	:	:	0	:	:
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0	496	503	7	0	496	:	:	0	:	:
0	496	503	7	0	496	:	:	0	:	:
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10056	**8011**	**34395**	**16449**	**10040**	**7906**	**34395**	**16449**	**10040**	**7906**	*34648*
10056	8011	34395	16449	10040	7906	34395	16449	10040	7906	:
0	892	931	1	0	930	:	1	0	930	:
3095	2000	5750	537	3095	2118	:	537	3095	2118	:
1200	1679	2985	59	1200	1726	:	59	1200	1726	:
0	601	2027	1457	0	570	:	1457	0	570	:
0	224	5769	5510	0	259	:	5510	0	259	:
0	216	8235	8080	0	155	:	8080	0	155	:
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12916	*55973*	**70213**	**4322**	**12762**	**53129**	**69897**	**4272**	**12673**	**52952**	**68984**
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3538	*7148*	*12087*	*1401*	*3538*	*7148*	*12087*	*1401*	*3538*	*7148*	*12087*
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0	*699*	*699*	0	0	*699*	*624*	0	0	*624*	*666*
1760	**11199**	**13803**	**1399**	**1760**	**10644**	*13939*	1484	1760	*10695*	*14308*
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1760	:	:	:	1760	:					
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-	2698	2692	1	-	2691					
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16212	41073	5467	229	16135	38306	*6979*	48	1840	*5091*	*6855*
-	18972	16706	0	-	16706					
-	2258	1636	0	-	1636					
-	16714	1507	0	-	1507					
-	5805	5548	0	-	5548					
-	238	216	0	-	216					

-	2604	2548	0	-	2548					
-	2963	2784	0	-	2784					
-	38	5	17	-	33					
-	38	33	0	-	33					
-	0	17	17	-	0					
-	0	0	0	-	0					
16212	142	17644	0	16135	1509					
-	142	1509	0	-	1509					
-	0	0	0	-	0					
16212	0	16135	0	16135	0					
-	14752	14609	157	-	14452					
-	8686	8097	35	-	8062					
-	6066	6512	122	-	639					
-	0	0	0	-	0					
-	81	107	55	-	52					
-	28	0	0	-	0					
-	4	5	0	-	5					
-	49	102	55	-	47					
-	5	6	0	-	6					
-	0	0	0	-	0					
-	0	0	0	-	0					
-	5	6	0	-	6					
2600	**2513**	**5791**	**678**	**2600**	**2513**	*5621*	*701*	*2370*	*2550*	*5421*
-	0	0	0	-	0					
-	212	883	671	-	212					
-	23	23	0	-	23					
-	3	4	1	-	3					
-	2	2	0	-	2					
-	5	5	0	-	5					
-	0	0	0	-	0					
-	99	102	3	-	99					
2600	0	2602	2	2600	0					
-	2169	2170	1	-	2169					
-	**5685**	**20664**	**15069**	**-**	**5595**	*1902*	*1337*	*0*	*565*	*1812*
-	15	6	0	-	6					
-	265	277	12	-	265					
-	5195	20246	15051	-	5195					
-	0	6	6	-	0					
-	75	75	0	-	75					
0	*331*	*256*	*0*	*0*	*256*	*256*	0	0	*256*	*250*
:	**30351**	**32128**	**2066**	**:**	**30062**	*29636*	*2047*	0	*27589*	*2913*
:	4942	4971	4	:	4967					
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:	4600	4581	21	:	4560					
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:	2084	2139	75	:	2064					
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:	6113	6735	534	:	6201					
:	184	184	0	:	184					
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:	458	618	145	:	473					
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:	1830	1831	1	:	1830					
:	181	182	1	:	181					
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:	2957	2956	9	:	2948					
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:	1966	1992	9	:	1983					
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:	1487	1141	12	:	1129					
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:	483	1381	892	:	490					
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65	*16112*	*22276*	*5998*	*0*	*16278*	*2206*	*5938*	*0*	*16122*	*22261*
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632	**1124**	**2528**	**774**	**632**	**1122**	***2740***	***836***	***632***	***1272***	***2737***
-	**7**	**7**	**0**	**-**	**7**					
-	**21**	**368**	**347**	**-**	**21**					

-	0	192	192	-	0					
-	672	673	1	-	672					
-	164	164	0	-	164					
632	114	746	0	632	114					
-	3	88	85	-	3					
-	1	1	0	-	1					
-	1	100	99	-	1					
-	0	0	0	-	0					
:	:	:	:	:	:					
:	:	:	:	:	:					
1760	32888	72387	22603	1760	32184	*7115*	*1943*	*1632*	*3540*	*7115*
1760	25282	64709	22427	1760	24682					
-	:	:	:	-	:					
-	:	:	:	-	:					
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-	:	:	:	-	:					
0	*293*	*27611*	*27318*	*0*	*293*	*27498*	*27205*	*0*	*293*	*27336*
3080	*1030*	*16737*	*12657*	*3050*	*1030*	*16630*	*1255*	*3050*	*1030*	*16460*

Hydroelectric power	Nuclear power	Thermal power	1992	Hydroelectric power	Nuclear power	Thermal power	1991	Hydroelectric power	Nuclear power	Thermal power
:	110807	:	*519871*	*113261*	*117003*	*289607*	*520659*	*112727*	*116004*	*291928*
1406	5816	*7161*	13812	1388	5766	6658	147607	1449	5766	75457
:	0	:	91	0	0	91	111	0	0	111
:	0	:	91	0	0	91	111	0	0	111
:	2909	:	7111	4	2835	4272	79629	4	2835	51239
:	0	:	798	0	0	798	7981	0	0	7981
:	0	:	813	0	0	813	8864	0	0	8864
:	2909	:	5527	0	2835	2692	5528	0	2835	2693
:	0	:	:	:	:	:	:	:	:	:
:	0	:	192	4	0	188	1925	42	0	1883
:	2907	:	6609	1384	2931	2294	66868	1445	2931	23108
:	0	:	:	:	:	:	:	:	:	:
:	0	:	1016	175	0	841	1040	1754	0	8646
:	2907	:	5368	1191	2931	1246	54299	12521	2931	12468
:	0	:	55	3	0	52	484	34	0	45
:	0	:	98	14	0	84	991	145	0	846
:	:	:	:	:	:	:	:	:	:	:
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492	0	9853	9573	10	0	9563	9204	10	0	9194
492	0	9853	9573	10	0	9563	9204	10	0	9194
492	0	9853	9573	10	0	9563	9204	10	0	9194
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88479	23865	88897	122969	8726	23810	90433	125935	8741	23726	93468
2660	4852	74258	15089	2635	4852	7602	14969	2604	4790	7575
:	2205	:	:	:	2205	:	:	:	2156	:
:	2647	:	:	:	2647	:	:	:	2634	:
:	0	:	:	:	0	:	:	:	0	:
:	0	:	:	:	0	:	:	:	0	:
2599	6270	86328	17481	2610	6215	8656	17409	2550	6215	8644
:	0	:	:	:	0	:	:	:	0	:
:	2317	:	:	:	2307	:	:	:	2307	:
:	0	:	:	:	0	:	:	:	0	:
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:	0	:	:	:	0	:	:	:	0	:
:	1345	:	:	:	1300	:	:	:	1300	:
:	2608	:	:	:	2608	:	:	:	2608	:
0	0	29146	2913	0	0	2913	2970	0	0	2970
0	0	29146	2913	0	0	2913	2970	0	0	2970
1	0	73367	7673	1	0	7672	:	1	:	8544
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0	0	17488	1741	0	0	1741	1726	0	0	1726
0	0	17488	1741	0	0	1741	1726	0	0	1726
0	0	15794	1607	0	0	1607	1614	0	0	1614
0	0	15794	1607	0	0	1607	1614	0	0	1614
6364	2504	32258	5884	636	2504	2744	6130	650	2504	2976
:	2504	:	:	:	2504	:	:	:	2504	:
:	0	:	:	:	0	:	:	:	0	:
:	0	:	:	:	0	:	:	:	0	:
17	0	144	94	1	0	93	:	2	:	95
17	0	144	94	1	0	93	:	2	:	95
2635	4750	75549	13265	263	4750	8252	13270	263	4728	8279
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:	672	:	:	:	672	:	:	:	672	:
:	2683	:	:	:	2683	:	:	:	2661	:
4412	670	327267	34472	441	670	33361	34865	441	670	33754
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2281	1302	13139	2829	228	1302	1299	2832	228	1302	1302
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129	0	31101	3119	12	0	3107	3258	13	0	3245
129	0	31101	3119	12	0	3107	3258	13	0	3245
1287	0	70445	8462	1192	0	7270	:	1194	:	7651
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100	0	1459	1680	84	0	1596	:	84	:	2260
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1234	3517	16776	5444	123	3517	1804	5654	123	3517	2014
1234	3517	16776	5444	123	3517	1804	5654	123	3517	2014
4607	0	606	1109	460	0	649	:	552	:	747
4607	0	606	1109	460	0	649	:	552	:	747
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25243	0	66267	9285	2534	0	6751	9235	2519	0	6716
10102	0	3686	4696	1010	0	3686	46885	10025	0	3686
0	0	3	3	0	0	3	3	0	0	3
816	0	0	82	82	0	0	715	715	0	0
7986	0	3683	4481	798	0	3683	4481	798	0	3683
130	0	0	130	130	0	0	130	130	0	0
15134	0	12511	2757	1513	0	1244	27624	15134	0	1249
5203	0	0	520	520	0	0	5203	5203	0	0
0	0	176	10	0	0	10	163	0	0	163
9231	0	0	923	923	0	0	9231	9231	0	0

0	0	3835	383	0	0	383	3827	0	0	3827
70	0	850	920	70	0	850	920	70	0	850
0	0	800	974	0	0	974	1035	0	0	1035
0	0	800	974	0	0	974	1035	0	0	1035
6	0	8634	847	0	0	847	7466	6	0	746
0	0	134	128	0	0	128	1292	0	0	1292
0	0	3444	333	0	0	333	3228	0	0	3228
6	0	385	385	0	0	385	2946	6	0	294
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16896	7405	22169	:	:	7398	:	45403	16642	7398	21363
3775	0	5309	:	:	0	:	8992	3736	0	5256
2662	0	2491	:	:	0	:	5055	2622	0	2433
695	0	2719	:	:	0	:	3416	696	0	2720
418	0	99	:	:	0	:	521	418	0	103
1849	0	2760	:	:	0	:	4369	1725	0	2644
147	0	1298	:	:	0	:	1413	139	0	1274
128	0	26	:	:	0	:	109	91	0	18
29	0	0	:	:	0	:	30	30	0	0
1474	0	1429	:	:	0	:	2817	1465	0	1352
71	0	7	:	:	0	:	72	69	0	3
71	0	7	:	:	0	:	72	69	0	3
6727	3547	3885	:	:	3546	:	13967	6638	3546	3783
3826	460	2911	:	:	460	:	7103	3764	460	2879
748	1226	971	:	:	1226	:	2873	746	1226	901
2153	1861	3	:	:	1860	:	3991	2128	1860	3
3427	3858	4856	:	:	3860	:	11821	3378	3852	4591
2176	2864	2885	:	:	2864	:	7738	2128	2856	2754
1251	994	1130	:	:	996	:	3348	1250	996	1102
0	0	841	:	:	0	:	735	0	0	735
1118	0	5359	:	:	0	:	5086	1099	0	3987
1079	0	3148	:	:	0	:	4125	1061	0	3064
38	0	903	:	:	0	:	912	38	0	874
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249649	60344	269825	112276	24923	60219	27134	1113993	24879	59642	268783
103	0	58018	5704	7	0	5697	55958	75	0	55883
103	0	58018	5704	7	0	5697	55958	75	0	55883
9436	25953	33307	26438	943	22168	3327	258682	9357	21571	33616
7575	2726	1118	3594	757	2726	111	39167	7576	3046	113
38	0	2691	268	3	0	265	2693	38	0	2655
184	8296	25062	10816	18	8292	2506	94605	97	6910	25408
904	12167	767	8552	90	8386	76	90176	905	8851	761
243	2764	923	2880	24	2764	92	28799	246	2764	913
492	0	2746	323	49	0	274	3242	494	0	2748
5	5706	20357	7732	0	5706	2026	78749	5	5706	21685
5	5706	20357	7732	0	5706	2026	78749	5	5706	21685

19113	7288	38616	13046	1907	7288	3851	129775	19139	7288	37756
886	5448	34879	9020	85	5448	3487	8948	854	5448	34145
13901	1840	1923	3422	1390	1840	192	3427	13973	1840	1897
4326	0	1814	602	431	0	171	6026	4312	0	1714
3171	0	37758	4046	308	0	3738	40446	3153	0	37293
108	0	3379	3351	10	0	3341	3343	101	0	33328
2772	0	3824	651	269	0	382	6589	2767	0	3823
291	0	144	43	28	0	15	427	285	0	142
62029	6532	16115	12941	6195	5169	1577	130544	61786	5169	17068
5404	3804	12153	5554	536	3804	1214	56801	5341	3804	1342
4492	2728	3523	6206	4489	1365	352	61912	44739	1365	3523
11705	0	439	1180	1170	0	10	1183	11706	0	124
114806	14615	25498	33664	11460	19638	2566	336746	114563	19658	25603
10499	14615	25275	32665	10483	19638	2544	326755	104795	19658	2538
9816	0	223	999	977	0	22	9992	9769	0	223
40986	250	40156	8586	4097	250	4239	83096	40716	250	39879
6867	250	14029	2588	685	250	1653	23306	6773	250	14033
32694	0	23147	5583	3269	0	2314	55696	32569	0	23127
1425	0	298	414	142	0	272	4094	1374	0	272
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522	0	3411	4147	532	0	3615	4027	532	0	3495
522	0	3411	4147	532	0	3615	4027	532	0	3495
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20368	0	45391	63845	20048	0	43797	59978	19864	0	40114
9397	0	12104	21379	9400	0	11979	20881	9386	0	11495
3043	0	1483	4481	3047	0	1434	4431	3035	0	1396
822	0	1	822	821	0	1	822	821	0	1
66	0	3553	3619	66	0	3553	3602	66	0	3536
5466	0	7067	12457	5466	0	6991	12026	5464	0	6562
5038	0	9537	14191	5030	0	9161	13752	5022	0	8730
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1070	0	5112	5851	1070	0	4781	5422	1067	0	4355
429	0	1230	1658	428	0	1230	1657	427	0	1230
593	0	3155	3702	592	0	3110	3695	591	0	3104
1846	0	8234	9903	1834	0	8069	9024	1923	0	7101
776	0	2353	2977	768	0	2209	3063	860	0	2203
485	0	434	919	486	0	433	917	484	0	433
211	0	195	405	210	0	195	402	209	0	193
374	0	5252	5602	370	0	5232	4642	370	0	4272
2906	0	8322	10356	2611	0	7745	8672	2361	0	6311
727	0	59	773	726	0	47	775	727	0	48

67	0	354	417	63	0	354	162	63	0	99
1317	0	1157	2229	1066	0	1163	2072	816	0	1256
1	0	5247	4586	1	0	4585	3311	1	0	3310
124	0	111	250	123	0	127	252	123	0	129
670	0	1394	2101	632	0	1469	2100	631	0	1469
1182	0	7165	8016	1173	0	6843	7649	1172	0	6477
733	0	4281	5014	733	0	4281	5005	732	0	4273
449	0	2884	3002	440	0	2562	2644	440	0	2204
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1132	0	106	1254	1142	0	112	1254	1142	0	112
1132	0	106	1254	1142	0	112	1254	1142	0	112
1132	0	106	1254	1142	0	112	1254	1142	0	112
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111805	0	60799	172315	110956	0	61359	167793	110261	0	57532
11545	0	3493	48163	11554	0	36609	44392	11582	0	3281
11	0	2	31	11	0	2	31	11	0	2
11326	0	18836	30845	11335	0	1951	30875	11364	0	19511
208	0	16074	17287	208	0	17079	13486	207	0	13279
27249	0	14296	41376	27085	0	14291	4148	27065	0	14415
21142	0	1889	22896	21012	0	1884	23008	20999	0	2009
6107	0	12407	1848	6073	0	12407	18472	6066	0	12406
73011	0	11573	82776	72317	0	10459	81921	71614	0	10307
18043	0	10749	27592	1801	0	9582	27441	1801	0	9431
11762	0	72	11808	11088	0	72	11797	11082	0	715
28256	0	38	28335	28244	0	91	27922	27827	0	95
1495	0	66	15041	14975	0	66	14761	14695	0	66
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38966	0	5193	8536	3447	0	5089	7791	3127	0	4664
3851	0	:	8254	3417	0	4837	7529	3097	0	4432

2923	0	330	2829	2540	0	289	2470	2188	0	282
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1	0	210	211	1	0	210	210	1	0	209
148	0	141	1308	148	0	116	140	14	0	126
148	0	141	1308	148	0	116	140	14	0	126
317	0	130	1532	162	0	137	122	16	0	106
317	0	130	1532	162	0	137	122	16	0	106
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2736	*2360*	*8986*	*13357*	*2680*	*2360*	*8317*	*13350*	*2650*	*2360*	*8340*
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16477	*9909*	*8262*	*3456*	*1640*	*1000*	*816*	*3448*	*1633*	*1000*	*815*
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4233	12838	51913	60629	4106	13088	43435	74766	4200	12812	57754
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:	0	:	:	:	0	:	:	:	0	:
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:	1480	:	:	:	1480	:	:	:	1374	:
:	1800	:	:	:	1800	:	:	:	1760	:
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1401	*3538*	*7148*	*12087*	*1401*	*3538*	*7148*	*12146*	*1401*	*3538*	*7207*

0	0	*666*	*546*	0	0	*546*	*471*	0	0	*471*
1483	1760	*11065*	*14571*	1483	1760	*11328*	*14558*	147	1760	*11328*
48	1840	*4967*	*6741*	48	1654	*5039*	*6526*	48	1654	*4824*

501	*2370*	*2550*	*5551*	*501*	*2500*	*2550*	*5151*	*101*	*2500*	*2550*
1247	*0*	*565*	*1812*	*1247*	*0*	*565*	*1722*	*1157*	*0*	*565*
0	0	*250*	*250*	0	0	*250*	*250*	0	0	*250*
2045	0	*27085*	*28664*	2042	0	*26622*	*30984*	1918	0	*29066*

5872	0	16389	22268	5687	0	16581	22268	5723	0	16545

834	*632*	*1271*	*2700*	*797*	*632*	*1271*	*2700*	*797*	*632*	*1271*

1943	1632	3540	6295	1660	1760	2875	6295	1660	1760	2875
27050	0	286	27281	27030	0	251	2714	26890	0	250
12440	2990	1030	16445	12430	2985	1030	16341	12361	2950	1030

1990	Hydroelectric power	Nuclear power	Thermal power
522977	*111734*	*116650*	*294593*
14783	1449	5766	7568
91	0	0	91
91	0	0	91
8024	4	2835	5185
7801	0	0	7801
8864	0	0	8864
55883	0	2835	27533
5215	:	:	:
1911	42	0	1869
6668	1445	2931	2292
61	:	:	:
10213	1754	0	8459
54299	12521	2931	12468
484	34	0	45
991	145	0	846
:	:	:	:
:	:	:	:
8789	11	0	8778
8789	11	0	8778
8789	11	0	8778
:	:	:	:
:	:	:	:
103700	6882	23676	73142
14929	2601	4782	7546
:	:	2156	:
:	:	2626	:
:	:	0	:
:	:	0	:
17066	2536	6205	8325
:	:	0	:
:	:	2297	:
:	:	0	:
:	:	0	:
:	:	0	:
:	:	1300	:
:	:	2608	:
2616	0	0	2616
2616	0	0	2616
:	:	:	:
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1713	0	0	1713
1713	0	0	1713
1510	0	0	1510
1510	0	0	1510
6141	650	2504	2987
:	:	2504	:
:	:	0	:
:	:	0	:
:	:	:	:
:	:	:	:
13284	263	4708	8313
:	:	0	:
:	:	1395	:
:	:	672	:
:	:	2641	:
34554	441	670	33443
:	:	0	:
:	:	0	:
:	:	0	:
:	:	670	:
:	:	0	:
2874	228	1302	1344
:	:	1302	:
:	:	0	:
:	:	0	:
3257	13	0	3244
3257	13	0	3244
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5615	124	3505	1986
5615	124	3505	1986
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:	:	:	:
8811	2411	0	6400
4682	999	0	3683
0	0	0	0
3952	869	0	3083
600	0	0	600
130	130	0	0
2338	1408	0	930
415	415	0	0
0	0	0	0
985	985	0	0

388	8	0	380
550	0	0	550
1034	0	0	1034
1034	0	0	1034
757	4	0	753
:	:	0	:
:	:	0	:
295	1	0	294
:	:	:	:
:	:	:	:
45843	16642	7838	21363
8992	3736	0	5256
5055	2622	0	2433
3416	696	0	2720
521	418	0	103
4369	1725	0	2644
1413	139	0	1274
109	91	0	18
30	30	0	0
2817	1465	0	1352
72	69	0	3
72	69	0	3
13942	6638	3521	3783
7103	3764	460	2879
2848	746	1201	901
3991	2128	1860	3
12286	3378	4317	4591
8224	2128	3342	2754
3327	1250	975	1102
735	0	0	735
5086	1099	0	3987
4125	1061	0	3064
912	38	0	874
:	:	:	:
:	:	:	:
1100	1	0	1099
1100	1	0	1099
:	:	:	:
:	:	:	:
109518	24710	59025	25783
56171	21	0	5615
56171	21	0	5615
266842	9343	22351	33989
39179	7589	3046	113
2821	38	0	2783
94222	97	6910	25025
97971	904	9631	757
29434	248	2764	1546
3215	467	0	2748
79998	5	5706	22933
79998	5	5706	22933

116179	19018	5926	37901
75888	77	4086	34257
34299	13976	1840	1923
5992	4272	0	172
40219	3135	0	37084
33192	81	0	33111
6599	2768	0	3831
428	286	0	142
130241	6151	5169	1704
56741	5309	3804	13393
61654	44481	1365	3523
11845	11721	0	124
323454	113929	19623	13294
313447	104145	19623	13071
10007	9784	0	223
82077	40139	250	39438
23274	6743	250	14031
55499	32422	0	23077
3304	974	0	233
:	:	0	:
:	:	0	:
:	:	0	:
:	:	0	:
:	:	0	:
:	:	:	:
:	:	:	:
4025	531	0	3494
4025	531	0	3494
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:	:	:	:
58596	19480	0	39116
20477	9350	0	11127
4373	3020	0	1353
820	819	0	1
3602	66	0	3536
11682	5445	0	6237
13828	5015	0	8813
:	:	:	:
:	:	:	:
5568	1067	0	4501
1575	421	0	1154
3709	590	0	3119
8909	1843	0	7066
2962	783	0	2179
908	483	0	425
395	209	0	186
4644	368	0	4276
7792	2112	0	5680
810	728	0	82

162	63	0	99
1820	566	0	1254
2650	1	0	2649
250	123	0	127
2100	631	0	1469
7590	1160	0	6430
4958	732	0	4226
2632	428	0	2204
:	:	:	:
:	:	:	:
1254	1142	0	112
1254	1142	0	112
1254	1142	0	112
:	:	:	:
:	:	:	:
17655	36	539	17080
:	:	0	1876
:	:	0	1212
:	:	0	664
:	:	0	0
:	:	58	2529
:	:	0	791
:	:	58	787
:	:	0	951
:	:	481	6358
:	:	0	949
:	:	0	2294
:	:	0	2692
:	:	481	423
:	:	0	3873
:	:	0	2065
:	:	0	1808
:	:	:	:
:	:	:	:
166869	109473	0	57396
44112	11585	0	32527
12	11	0	1
30793	11376	0	19417
13307	198	0	13109
4124	26829	0	14411
22884	20887	0	1997
18356	5942	0	12414
81517	71059	0	10458
27441	17855	0	9586
11423	10707	0	716
27892	27802	0	9
14761	14695	0	66
:	:	:	:
:	:	:	:
8167	3573	0	4594
7417	3064	0	4353

2431	2150	0	281
:	:	:	:
:	:	:	:
:	:	:	:
207	1	0	206
379	253	0	126
379	253	0	126
371	256	0	115
371	256	0	115
:	:	:	:
:	:	:	:
13220	*2620*	*2360*	*8240*
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:	:	:	:
3419	*1634*	*997*	*788*
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77869	**4192**	**12692**	**60985**
:	:	1120	:
:	:	1120	:
:	:	0	:
:	:	2680	:
:	:	240	:
:	:	0	:
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:	:	2440	:
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:	:	0	:
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:	:	758	:
:	:	500	:
:	:	0	:
:	:	258	:
:	:	:	:
:	:	:	:
:	:	:	:
:	:	1264	:
:	:	0	:
:	:	0	:
:	:	0	:
:	:	1264	:
:	:	2310	:
:	:	450	:
:	:	1860	:
:	:	:	:
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:	:	1460	:
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:	:	3100	:
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:	:	0	:
:	:	0	:
:	:	:	:
:	:	:	:
11129	*1973*	*2760*	*6396*

471	0	0	*471*
15356	1470	1760	*12126*
3478	*0*	*0*	*3478*
6603	48	1654	*4901*

5151	*101*	*2500*	*2550*
1722	*1157*	*0*	*565*
250	0	0	*250*
30907	1851	0	*29056*

22478	*5666*	*0*	*16812*

2653	*752*	*632*	*1269*

6332	1652	1760	2920
27134	26884	0	250
15646	11666	2950	1030

Core Indicator 2 - Final Energy Consumption

Electricity consumption by sector, 1990-2001

(in gigawatt hours)

	2001 total	2001 industrial	2001 energy	2001 transport	2001 households	2001 agriculture	2001 services	2001 Other	2000 total
eu15 European Union (15 countries)									:
be Belgium	78142	39224		1467	24396	264	12791		79166
be1 Région de Bruxe									5245
be10 Région de Bru:									5245
be2 Vlaams Gewest									50338
be21 Prov. Antwerpe									19096
be22 Prov. Limburg									7141
be23 Prov. Oost-Vla									10893
be24 Prov. Vlaams E									5010
be25 Prov. West-Vla									8198
be3 Région Wallonn									23583
be31 Prov. Brabant '									2033
be32 Prov. Hainaut									9832
be33 Prov. Liège									7146
be34 Prov. Luxembo									1748
be35 Prov. Namur									2825
bez Extra-Regio									:
bezz Extra-Regio									:
dk Denmark	33014	10257		349	10225	2013	10170		32462
dk0 Denmark									:
dk00 Denmark									:
dkz Extra-Regio									:
dkzz Extra-Regio									:
de Germany (includi	501669	230347		15965	139094	7534	108729		482603
de1 Baden-Württemberg									:
de11 Stuttgart									:
de12 Karlsruhe									:
de13 Freiburg									:
de14 Tübingen									:
de2 Bayern									:
de21 Oberbayern									:
de22 Niederbayern									:
de23 Oberpfalz									:
de24 Oberfranken									:
de25 Mittelfranken									:
de26 Unterfranken									:
de27 Schwaben									:
de3 Berlin									:
de30 Berlin									:
de4 Brandenburg									:
de41 Brandenburg - Nordost									:
de42 Brandenburg - Südwest									:

de5 Bremen									:
de50 Bremen									:
de6 Hamburg									:
de60 Hamburg									:
de7 Hessen									:
de71 Darmstadt									:
de72 Gießen									:
de73 Kassel									:
de8 Mecklenburg-Vorpommern									:
de80 Mecklenburg-Vorpommern									:
de9 Niedersachsen									:
de91 Braunschweig									:
de92 Hannover									:
de93 Lüneburg									:
de94 Weser-Ems									:
dea Nordrhein-Westfalen									:
dea1 Düsseldorf									:
dea2 Köln									:
dea3 Münster									:
dea4 Detmold									:
dea5 Arnsberg									:
deb Rheinland-Pfalz									:
deb1 Koblenz									:
deb2 Trier									:
deb3 Rheinhessen-Pfalz									:
dec Saarland									:
dec0 Saarland									:
ded Sachsen									:
ded1 Chemnitz									:
ded2 Dresden									:
ded3 Leipzig									:
dee Sachsen-Anhalt									:
dee1 Dessau									:
dee2 Halle									:
dee3 Magdeburg									:
def Schleswig-Holstein									:
def0 Schleswig-Holstein									:
deg Thüringen									:
deg0 Thüringen									:
dez Extra-Regio									:
dezz Extra-Regio									:
gr Greece	**44535**	**13762**			**214**	**14546**	**2780**	**13233**	**43151**
gr1 Voreia Ellada									:
gr11 Anatoliki Makedonia, Thraki									:
gr12 Kentriki Makedonia									:
gr13 Dytiki Makedonia									:
gr14 Thessalia									:
gr2 Kentriki Ellada									:
gr21 Ipeiros									:
gr22 Ionia Nisia									:
gr23 Dytiki Ellada									:

gr24 Sterea Ellada									:
gr25 Peloponnisos									:
gr3 Attiki									:
gr30 Attiki									:
gr4 Nisia Aigaiou, Kriti									:
gr41 Voreio Aigaio									:
gr42 Notio Aigaio									:
gr43 Kriti									:
grz Extra-Regio									:
grzz Extra-Regio									:
es Spain	**200953**	**90267**		**4558**	**49685**	**5177**	**51266**		**188459**
es1 Noroeste									:
es11 Galicia									:
es12 Principado de Asturias									:
es13 Cantabria									:
es2 Noreste									:
es21 Pais Vasco									:
es22 Comunidad Foral de Navarra									:
es23 La Rioja									:
es24 Aragón									:
es3 Comunidad de Madrid									:
es30 Comunidad de Madrid									:
es4 Centro (ES)									:
es41 Castilla y León									:
es42 Castilla-la Mancha									:
es43 Extremadura									:
es5 Este									:
es51 Cataluña									:
es52 Comunidad Valenciana									:
es53 Illes Balears									:
es6 Sur									:
es61 Andalucia									:
es62 Región de Murcia									:
es63 Ciudad Autónoma de Ceuta (ES)									:
es64 Ciudad Autónoma de Melilla (ES)									:
es7 Canarias (ES)									:
es70 Canarias (ES)									:
esz Extra-Regio									:
eszz Extra-Regio									:
fr France	**395489**	**134665**		**11686**	**133887**	**2879**	**106347**	**6025**	**385111**
fr1 Île de France									:
fr10 Île de France									:
fr2 Bassin Parisien									:
fr21 Champagne-Ardenne									:
fr22 Picardie									:
fr23 Haute-Normandie									:
fr24 Centre									:
fr25 Basse-Normandie									:
fr26 Bourgogne									:
fr3 Nord - Pas-de-Calais									:
fr30 Nord - Pas-de-Calais									:

fr4 Est								:
fr41 Lorraine								:
fr42 Alsace								:
fr43 Franche-Comté								:
fr5 Ouest								:
fr51 Pays de la Loire								:
fr52 Bretagne								:
fr53 Poitou-Charentes								:
fr6 Sud-Ouest								:
fr61 Aquitaine								:
fr62 Midi-Pyrénées								:
fr63 Limousin								:
fr7 Centre-Est								:
fr71 Rhône-Alpes								:
fr72 Auvergne								:
fr8 Méditerranée								:
fr81 Languedoc-Roussillon								:
fr82 Provence-Alpes-Côte d'Azur								:
fr83 Corse								:
fr9 French overseas departments (FR)								:
fr91 Guadeloupe (FR)								:
fr92 Martinique (FR)								:
fr93 Guyane (FR)								:
fr94 Reunion (FR)								:
frz Extra-Regio								:
frzz Extra-Regio								:
ie Ireland	**20929**	**7760**		**26**	**7333**		**5810**	**20201**
ie0 Ireland								:
ie01 Border, Midlands and Western								:
ie02 Southern and Eastern								:
iez Extra-Regio								:
iezz Extra-Regio								:
it Italy	**277724**	**143205**		**8567**	**61553**	**5163**	**59236**	**272547**
itc Nord Ovest								:
itc1 Piemonte								:
itc2 Valle d'Aosta/Vallée d'Aoste								:
itc3 Liguria								:
itc4 Lombardia								:
itd Nord Est								:
itd1 Provincia Autonoma Bolzano-Bozen								:
itd2 Provincia Autonoma Trento								:
itd3 Veneto								:
itd4 Friuli-Venezia Giulia								:
itd5 Emilia-Romagna								:
ite Centro (IT)								:
ite1 Toscana								:
ite2 Umbria								:
ite3 Marche								:
ite4 Lazio								:
itf Sud (IT)								:
itf1 Abruzzo								:

itf2 Molise									:
itf3 Campania									:
itf4 Puglia									:
itf5 Basilicata									:
itf6 Calabria									:
itg Isole (IT)									:
itg1 Sicilia									:
itg2 Sardegna									:
itz Extra-Regio									:
itzz Extra-Regio									:
lu Luxembourg (Gra	5633	3693		101	723	76	1040		5716
lu0 Luxembourg (Grand-Duché)									:
lu00 Luxembourg (Grand-Duché)									:
luz Extra-Regio									:
luzz Extra-Regio									:
nl Netherlands	99428	40637		1577	22100	3690	31424		97938
nl1 Noord-Nederland									:
nl11 Groningen									:
nl12 Friesland									:
nl13 Drenthe									:
nl2 Oost-Nederland									:
nl21 Overijssel									:
nl22 Gelderland									:
nl23 Flevoland									:
nl3 West-Nederland									:
nl31 Utrecht									:
nl32 Noord-Holland									:
nl33 Zuid-Holland									:
nl34 Zeeland									:
nl4 Zuid-Nederland									:
nl41 Noord-Brabant									:
nl42 Limburg (NL)									:
nlz Extra-Regio									:
nlzz Extra-Regio									:
at Austria	56471	23187		3776	15753	1220	12535		51881
at1 Ostösterreich									:
at11 Burgenland									:
at12 Niederösterreich									:
at13 Wien									:
at2 Südösterreich									:
at21 Kärnten									:
at22 Steiermark									:
at3 Westösterreich									:
at31 Oberösterreich									:
at32 Salzburg									:
at33 Tirol									:
at34 Vorarlberg									:
atz Extra-Regio									:
atzz Extra-Regio									:
pt Portugal	40541	16104		466	10625	780	11936	631	38939
pt1 Continente (PT)	39414	15945		460	10239	769	11383	618	37913

pt11 Norte	13165	5517		41	3867	119	3380	241	12737
pt16 Centro (PT)	8186	4553		110	1698	114	1628	83	7758
pt17 Lisboa	14041	4573		305	3555	342	5054	211	13607
pt18 Alentejo	2315	1123		2	521	128	502	40	2256
pt15 Algarve	1707	178		2	599	65	820	42	1554
pt2 Região Autónom	489	90		1	184	6	205	3	456
pt20 Região Autónoı	489	90		1	184	6	205	3	456
pt3 Região Autónom	638	68		5	201	5	348	10	571
pt30 Região Autónoı	638	68		5	201	5	348	10	571
ptz Extra-Regio									:
ptzz Extra-Regio									:
fi Finland	77296	42384		565	19373	850	14124		75446
fi1 Manner-Suomi									:
fi13 Itä-Suomi									:
fi18 Etelä-Suomi									:
fi19 Länsi-Suomi									:
fi1a Pohjois-Suomi									:
fi2 Åland									:
fi20 Åland									:
fiz Extra-Regio									:
fizz Extra-Regio									:
se Sweden	132667	55402		3119	45074	1341	27731		128347
se0 Sverige									:
se01 Stockholm									:
se02 Östra Mellansverige									:
se04 Sydsverige									:
se06 Norra Mellansverige									:
se07 Mellersta Norrland									:
se08 Övre Norrland									:
se09 Småland med öarna									:
se0a Västsverige									:
sez Extra-Regio									:
sezz Extra-Regio									:
uk United Kingdom	333806	112431		8843	115336	4577	92619		328919
ukc North East									:
ukc1 Tees Valley and Durham									:
ukc2 Northumberland, Tyne and Wear									:
ukd North West (including Merseyside)									:
ukd1 Cumbria									:
ukd2 Cheshire									:
ukd3 Greater Manchester									:
ukd4 Lancashire									:
ukd5 Merseyside									:
uke Yorkshire and The Humber									:
uke1 East Riding and North Lincolnshire									:
uke2 North Yorkshire									:
uke3 South Yorkshire									:
uke4 West Yorkshire									:
ukf East Midlands									:
ukf1 Derbyshire and Nottinghamshire									:
ukf2 Leicestershire, Rutland and Northants									:

ukf3 Lincolnshire								:
ukg West Midlands								:
ukg1 Herefordshire, Worcestershire and Warks								:
ukg2 Shropshire and Staffordshire								:
ukg3 West Midlands								:
ukh Eastern								:
ukh1 East Anglia								:
ukh2 Bedfordshire, Hertfordshire								:
ukh3 Essex								:
uki London								:
uki1 Inner London								:
uki2 Outer London								:
ukj South East								:
ukj1 Berkshire, Bucks and Oxfordshire								:
ukj2 Surrey, East and West Sussex								:
ukj3 Hampshire and Isle of Wight								:
ukj4 Kent								:
ukk South West								:
ukk1 Gloucestershire, Wiltshire and North Somerset								:
ukk2 Dorset and Somerset								:
ukk3 Cornwall and Isles of Scilly								:
ukk4 Devon								:
ukl Wales								:
ukl1 West Wales and The Valleys								:
ukl2 East Wales								:
ukm Scotland								:
ukm1 North Eastern Scotland								:
ukm2 Eastern Scotland								:
ukm3 South Western Scotland								:
ukm4 Highlands and Islands								:
ukn Northern Ireland								:
ukn0 Northern Ireland								:
ukz Extra-Regio								:
ukzz Extra-Regio								:
bg Bulgaria	**24593**	**9035**		**500**	**9751**	**163**	**5144**	
bg01 Severozapaden								
bg011 Vidin								
bg012 Montana								
bg013 Vratsa								
bg02 Severen Tsentralen								
bg021 Pleven								
bg022 Lovech								
bg023 Veliko Tarnovo								
bg024 Gabrovo								
bg025 Ruse								
bg03 Severoiztochen								
bg031 Varna								
bg032 Dobrich								
bg033 Shumen								
bg034 Turgovishte								
bg035 Razgrad								

bg036 Silistra								
bg04 Yugozapaden								
bg041 Sofia Stolitsa (capital)								
bg042 Sofia								
bg043 Blagoevgrad								
bg044 Pernik								
bg045 Kyustendil								
bg05 Yuzhen Tsentralen								
bg051 Plovdiv								
bg052 Stara Zagora								
bg053 Haskovo								
bg054 Pazardzhik								
bg055 Smolyan								
bg056 Kardzhali								
bg06 Yugoiztochen								
bg061 Burgas								
bg062 Sliven								
bg063 Yambol								
cy Cyprus	**3110**	**451**		**24**	**1042**	**93**	**1432**	**68**
cz Czech Republic	**50881**	**19939**		**2117**	**14239**	**1158**	**11849**	**1579**
cz01 Praha								
cz02 Strední Cechy								
cz03 Jihozápad								
cz031 Jihocecký								
cz032 Plzenský								
cz04 Severozápad								
cz041 Karlovarský								
cz042 Ústecký								
cz05 Severovýchod								
cz051 Liberecký								
cz052 Královehradecký								
cz053 Pardubický								
cz06 Jihovýchod								
cz061 Vysocina								
cz062 Jihomoravský								
cz07 Strední Morava								
cz071 Olomoucký								
cz072 Zlínský								
cz08 Moravskoslezko								
ee Estonia	**5134**	**1814**		**84**	**1585**	**200**	**1451**	
ee001 Põhja-Eesti								
ee004 Lääne-Eesti								
ee006 Kesk-Eesti								
ee007 Kirde-Eesti								
ee008 Lõuna-Eesti								
hu Hungary	**30543**	**9434**		**1031**	**10130**	**962**	**8388**	**598**
hu1 Közép-Magyarország								
hu101 Budapest								
hu102 Pest								
hu21 Közép-Dunántúl								
hu211 Fejér								

hu212 Komárom-Esztergom									
hu213 Veszprém									
hu22 Nyugat-Dunántúl									
hu221 Gyor-Moson-Sopron									
hu222 Vas									
hu223 Zala									
hu23 Dél-Dunántúl									
hu231 Baranya									
hu232 Somogy									
hu233 Tolna									
hu31 Észak-Magyarország									
hu311 Borsod-Abaúj-Zemplén									
hu312 Heves									
hu313 Nógrád									
hu32 Észak-Alföld									
hu321 Hajdú-Bihar									
hu322 Jász-Nagykun-Szolnok									
hu323 Szabolcs-Szatmár-Bereg									
hu33 Dél-Alföld									
hu331 Bács-Kiskun									
hu332 Békés									
hu333 Csongrád									
lt Lithuania	**6446**	**2346**		**90**	**1818**	**197**	**1995**		
lt001 Alytaus (Apskritis)									
lt002 Kauno (Apskritis)									
lt003 Klaipedos (Apskritis)									
lt004 Marijampoles (Apskritis)									
lt005 Panevezio (Apskritis)									
lt006 Siauliu (Apskritis)									
lt007 Taurages (Apskritis)									
lt008 Telsiu (Apskritis)									
lt009 Utenos (Apskritis)									
lt00a Vilniaus (Apskritis)									
lv Latvia	**4583**	**1545**		**173**	**1239**	**149**	**1436**	**41**	
lv003 Kurzeme									
lv005 Latgale									
lv001 Riga (SRE 2001)									
lv002 Vidzeme (SRE 2001)									
lv004 Zemgale (SRE 2001)									
mt Malta	**1569**	**483**			**540**		**546**		
pl Poland	**98978**	**39301**		**5677**	**21374**	**4609**	**28017**		**99574**
pl11 Lódzkie	**7398**	**1510**		**530**	**1431**	**414**	**3513**		**7 289**
pl111 Lódzki									
pl112 Piotrkowsko-skierniewicki									
pl113 Miasto Lódz									
pl12 Mazowieckie	**11418**	**4697**		**821**	**3172**	**691**	**2037**		**11 190**
pl121 Ciechanowsko-plocki									
pl122 Ostrolecko-siedlecki									
pl124 Radomski									
pl21 Malopolskie	**8821**	**4473**		**483**	**1821**	**508**	**1536**		**9 118**
pl211 Krakowsko-tarnowski									

pl212 Nowosadecki								
pl213 Miasto Kraków								
pl22 Slaskie	**20080**	**6694**		**862**	**3172**	**140**	**9212**	**19 274**
pl31 Lubelskie	**3754**	**2001**		**151**	**879**	**459**	**264**	**3 865**
pl311 Bialskopodlaski								
pl312 Chelmsko-zamojski								
pl313 Lubelski								
pl32 Podkarpackie	**3054**	**1530**		**116**	**722**	**339**	**347**	**3 268**
pl321 Rzeszowsko-tarnobrzeski								
pl322 Krosniensko-przemyski								
pl33 Swietokrzyskie	**3737**	**1504**		**212**	**468**	**221**	**1332**	**3 600**
pl34 Podlaskie	**1868**	**512**		**52**	**474**	**284**	**546**	**1 824**
pl341 Bialostocko-suwalski								
pl342 Lomzynski								
pl41 Wielkopolskie	**7736**	**2891**		**564**	**1955**	**440**	**1886**	**8 324**
pl411 Pilski								
pl412 Poznanski								
pl413 Kaliski								
pl414 Koninski								
pl415 Miasto Poznan								
pl42 Zachodniopom	**3659**	**1417**		**288**	**1007**	**101**	**846**	**3 500**
pl421 Szczecinski								
pl422 Koszalinski								
pl43 Lubuskie	**2216**	**918**		**167**	**566**	**101**	**464**	**1 984**
pl431 Gorzowski								
pl432 Zielonogórski								
pl51 Dolnoslaskie	**8274**	**3356**		**443**	**1726**	**175**	**2574**	**8 740**
pl511 Jeleniogórsko-walbrzyski								
pl512 Legnicki								
pl513 Wroclawski								
pl514 Miasto Wroclaw								
pl52 Opolskie	**3778**	**1825**		**208**	**640**	**168**	**937**	**3 912**
pl61 Kujawsko-Pom	**5260**	**3224**		**287**	**1120**	**234**	**395**	**5 650**
pl611 Bydgoski								
pl612 Torunsko-wloclawski								
pl62 Warminsko-Ma	**1800**	**615**		**126**	**774**	**181**	**104**	**1 802**
pl621 Elblaski								
pl622 Olsztynski								
pl623 Elcki								
pl63 Pomorskie	**6125**	**2134**		**367**	**1447**	**153**	**2024**	**6 234**
pl631 Slupski								
pl632 Gdanski								
pl633 Gdansk-Gdynia-Sopot								
pl073 Warszawski (SRE 2001)								
pl075 Miasta Warszawa (SRE 2001)								
pl0c1 Pólnocnoslaski (SRE 2001)								
pl0c2 Poludniowoslaski (SRE 2001)								
pl0c3 Centralny slaski (SRE 2001)								
ro Romania	**36294**	**20754**		**1785**	**7724**	**479**	**5552**	
ro01 Nord-Est								
ro011 Bacau								

ro012 Botosani								
ro013 Iasi								
ro014 Neamt								
ro015 Suceava								
ro016 Vaslui								
ro02 Sud-Est								
ro021 Braila								
ro022 Buzau								
ro023 Constanta								
ro024 Galati								
ro025 Tulcea								
ro026 Vrancea								
ro03 Sud								
ro031 Arges								
ro032 Calarasi								
ro033 Dâmbovita								
ro034 Giurgiu								
ro035 Ialomita								
ro036 Prahova								
ro037 Teleorman								
ro04 Sud-Vest								
ro041 Dolj								
ro042 Gorj								
ro043 Mehedinti								
ro044 Olt								
ro045 Vâlcea								
ro05 Vest								
ro051 Arad								
ro052 Caras-Severin								
ro053 Hunedoara								
ro054 Timis								
ro06 Nord-Vest								
ro061 Bihor								
ro062 Bistrita-Nasaud								
ro063 Cluj								
ro064 Maramures								
ro065 Satu Mare								
ro066 Salaj								
ro07 Centru								
ro071 Alba								
ro072 Brasov								
ro073 Covasna								
ro074 Harghita								
ro075 Mures								
ro076 Sibiu								
ro08 Bucuresti								
ro081 Bucuresti (capital)								
ro082 Ilfov								
si Slovenia	**10942**	**5685**		**263**	**2675**	**121**	**1495**	**703**
si001 Pomurska								
si002 Podravska								

si003 Koroska								
si004 Savinjska								
si005 Zasavska								
si006 Spodnjeposavska								
si009 Gorenjska								
si00a Notranjsko-kraska								
si00b Goriska								
si00c Obalno-kraska								
si00d Jugovzhodna Slovenija								
si00e Osrednjeslovenska								
sk Slovak Republic	**23452**	**9680**		**30**	**5222**	**2142**	**6378**	
sk01 Bratislavský								
sk02 Západné Slovensko								
sk021 Trnavský kraj								
sk022 Trenciansk‎ý kraj								
sk023 Nitrianský kraj								
sk03 Stredné Slovensko								
sk031 Zilinský kraj								
sk032 Banskobystrický kraj								
sk04 Východné Slovensko								
sk041 Presovský kraj								
sk042 Kosický kraj								
no Norge	**112287**	**48857**		**1670**	**38803**	**2119**	**20838**	**112307**
no01 Oslo og Akersh								
no02 Hedmark og O								
no03 Sør-Østlandet								
no04 Agder og Roga								
no05 Vestlandet								
no06 Trøndelag								
no07 Nord-Norge								
ch Scweiz	**54046**	**18450**		**2698**	**16179**	**1019**	**15700**	**54056**
ch01 Région lémani								
ch02 Espace Mittella								
ch03 Nordwestschw								
ch04 Zürich								
ch05 Ostschweiz								
ch06 Zentralschweiz								
ch07 Ticino								

Sources:

IEA

Eurostat Newcronos release date : Wed, 7 Jul 04 08:40:08

theme	theme1	General Statistics
domain	regio	Regional statistics
collect	tran_enr	Transport and energy statistics
group	energy	Energy statistics
table	en2cons	**Electricity consumption by sector (in gigawatt hours)**
table	xencons	**Electricity consumption by sector (in gigawatt hours) - Candidate Count**

green values IEA (services sector=commerce and public services)

blue values	data from Poland partner (PL)
orange values	DGE (data for Portugal) (agriculture=agriculture&fisherie; services=commerce&service
red values	Eurostat SIRENE
cinzento escuro	CNE (1999 data for Spain)
roxo	Norway and Switzerland - "Energy & Transport in Figures", Eurostat ; "2001 - Annual E

2000 industrial	2000 energy	2000 transport	2000 households	2000 agriculture	2000 services	2000 Other	1999 total	1999 industrial	1999 energy	1999 transport	1999 households
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							12945				
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135145		11681	128720	2726		106839	374677	132610		11254	126933

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					7275	2407	732	116	1886
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					1651	794	49	15	397
					826	248	49	-	230
					303	92	2	-	95
					664	282	31	23	146
					653	217	34	-	178
					144	20	5	-	59
					703	68	461	-	83
					234	68	12	-	71
					1699	421	60	78	544
					4745	1357	279	154	1147
					432	279	11	2	-
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1999 agricul ture	1999 service s	1999 Other	1998 total	1998 industri al	1998 energ y	1998 transp ort	1998 househ olds	1998 agricul ture	1998 service s	1998 Other	1997 total
:	:	:	377315	150590	6496	68	72061	7085	70188	:	:
251	:	:	75527	:	:	:	:	:	:	:	73321
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1937		9737	32101	9963		325	10176	1975		9662	:
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2488	**11533**	:	**40979**	**12890**	**921**	**68**	**12786**	**2598**	**10841**	:	**38875**
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36	2297	:	6128	2083	171	572	1762	36	2247	:	6017
675	11534	:	54650	33349	946	1373	9695	657	10950	:	52661
1565	13926	:	60178	34119	438	1968	11149	1463	13447	:	57951
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783	5362	:	21496	11113	173	690	4412	740	5231	:	20684
672	14159	:	46616	20276	902	2050	12129	655	13556	:	45374
210	4511	:	17432	9090	361	671	3836	199	4306	:	17102
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101	1518	:	5654	2752	193	205	1342	98	1463	:	5397
271	7285	:	18433	5044	334	1074	6138	267	6984	:	17931
898	10122	:	42600	19483	569	1222	12645	920	9553	:	41715
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430	3729	:	15772	6592	1513	257	5327	369	3485	:	15543
170	1501	:	9815	6364	574	57	1913	158	1381	:	9974
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80		893	5297	3292		87	752	79		1087	:
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3360		28380	92744	39378		1630	20800	3300		27636	:
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1224		10489	48767	19492		2187	13005	1536		12547	:
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697	10417	487	34411	14617		447	8784	628	9470	464	32438
690	9972	472	33532	14493		447	8468	621	9050	454	31650

107	2960	176	11275	5028		34	3265	100	2688	160	10574
98	1416	55	6781	3849		121	1392	91	1279	48	6458
303	4467	182	12038	4298		288	2935	266	4054	196	11384
113	434	27	2116	1174		1	421	104	395	21	2009
68	695	33	1321	144		1	455	59	634	29	1225
4	175	3	391	72		0	152	4	159	3	358
4	175	3	391	72		0	152	4	159	3	358
4	271	13	489	52		0	164	3	261	8	430
4	271	13	489	52		0	164	3	261	8	430
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830		12885	72806	40773		515	18141	820		12557	:
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1338		26092	123525	54369		2803	42336	1684		22333	132102
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3837		89211	315644	105547		8372	109610	3872		88243	:
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226	**1908**	**-**	**7631**	**2620**	**878**	**103**	**1743**	**414**	**1873**	**-**	**7465**
5	84	-	:	217	31	-	:	10	:	-	:
54	342	-	:	901	61	17	:	91	:	-	:
7	292	-	:	250	48	-	:	23	:	-	:
21	93	-	:	123	5	-	:	38	:	-	:
43	139	-	:	309	37	24	:	74	:	-	:
43	181	-	:	263	36	-	:	83	:	-	:
10	50	-	:	19	1	-	:	15	:	-	:
7	84	-	:	66	564	-	:	18	:	-	:
7	76	-	:	67	10	-	:	16	:	-	:
29	567	-	:	405	85	62	:	46	:	-	:
182	**1626**	**-**	**4925**	**1441**	**379**	**170**	**1111**	**178**	**1646**	**-**	**4826**
26	114	-	648	289	15	2	-	28	314	-	503
16	72	-	382	254	11	48	-	14	55	-	388
19	1359	-	2021	607	341	120	-	32	921	-	2273
41	45	-	420	188	4	0	-	37	191	-	322
80	36	-	343	103	8	0	-	67	165	-	258
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1997 industrial	1997 energy	1997 transport	1997 households	1997 agriculture	1997 services	1997 Other	1996 total	1996 industrial	1996 energy	1996 transport	1996 households	1996 agriculture
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68819	4412	3604	40105	4111	39647	2741	155498	64457	3953	3460	39675	4305
15233	919	151	4120	80	3210	54	23062	14732	955	146	4012	76
7762	503	44	2621	53	1952	9	12725	7685	514	43	2541	52
5257	403	72	1019	8	813	11	7318	5023	427	69	1000	7
2214	13	35	480	19	445	34	3019	2024	14	34	471	17
17991	532	1263	10297	301	9382	2031	39881	16662	529	1205	10351	321
9000	348	215	2182	27	1758	171	12704	8101	334	198	2162	38
1823	14	49	576	56	487	29	2913	1665	16	46	673	61
462	2	20	300	19	230	18	985	415	2	15	294	17
3233	101	173	1394	168	1204	227	6156	3109	107	150	1354	170
3473	67	806	5845	31	5703	1586	17123	3372	70	796	5868	35
3473	67	806	5845	31	5703	1586	17123	3372	70	796	5868	35
5718	1149	506	4990	1040	3996	225	16488	5253	706	475	4935	1060
3241	344	254	2491	360	1935	120	8555	3117	359	241	2461	348
2052	793	249	1730	534	1420	62	5983	1763	333	230	1708	573
425	12	3	769	146	641	43	1950	373	14	4	766	139
21427	835	1120	12144	851	14093	277	47806	19925	825	1092	11910	912
15129	599	766	6960	284	7906	164	30196	14065	617	788	6844	277
6041	225	193	4204	509	4583	113	14756	5618	196	181	4106	582
257	11	161	980	58	1604	0	2854	242	12	123	960	53
8450	977	564	8554	1839	8966	154	28261	7885	938	542	8467	1936
6884	722	351	6395	830	5564	61	19982	6445	691	350	6378	766
1118	147	10	986	473	993	93	3628	1028	140	10	938	608
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439	108	203	1076	536	2329	0	4472	395	107	182	1064	562
439	108	203	1076	536	2329	0	4472	395	107	182	1064	562
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49320	1629	2648	15732	896	17170	:	80621	:	:	:	15616	892
14657	464	716	4418	222	4322	:	22955	:	:	:	4418	218
402	4	56	173	4	243	:	749	:	:	:	176	3
2057	154	562	1746	34	2180	:	5929	:	:	:	1764	35
32204	1007	1315	9395	637	10425	:	50988	:	:	:	9258	636
32946	421	1894	10787	1385	12833	:	55888	:	:	:	10582	1320
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14920	208	504	4350	447	4758	:	23714	:	:	:	4295	434
5099	27	398	1239	99	1546	:	7560	:	:	:	1222	96
10683	165	683	4272	685	5044	:	20056	:	:	:	4168	665
19725	809	2048	11941	626	13082	:	43799	:	:	:	11843	577
9012	385	654	3751	189	4151	:	16439	:	:	:	3714	180
3296	14	100	793	85	770	:	4747	:	:	:	782	80
2593	185	206	1308	88	1408	:	5251	:	:	:	1285	80
4825	226	1088	6089	265	6753	:	17362	:	:	:	6062	237
18841	598	1218	12730	953	9190	:	40488	:	:	:	12745	845
3115	33	139	1105	69	1166	:	5206	:	:	:	1104	67

621	5	18	256	21	207	:	1040	:	:	:	256	17
4896	78	555	5303	196	3644	:	13731	:	:	:	5300	188
7593	446	226	3709	495	2512	:	13911	:	:	:	3721	408
1349	11	25	454	55	338	:	2078	:	:	:	449	51
1268	24	255	1903	117	1323	:	4522	:	:	:	1915	114
13083	1936	302	7296	494	4644	:	25158	:	:	:	7211	473
6496	1365	252	5389	334	3324	:	15214	:	:	:	5333	333
6587	571	50	1907	160	1320	:	9944	:	:	:	1878	140
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13956	:	407	8423	567	8675	411	30794	13237	:	393	8164	533
13855	:	406	8125	562	8300	403	30039	13137	:	392	7881	529

4703	:	34	3136	90	2461	150	10020	4512	:	35	3021	86
3701	:	118	1332	83	1177	47	6096	3492	:	100	1283	76
4166	:	251	2832	249	3723	164	10920	4001	:	251	2775	240
1147	:	1	399	85	361	16	1833	1013	:	4	387	74
138	:	1	426	56	578	27	1171	119	:	1	416	53
63	:	0	144	2	146	2	342	61	:	0	136	2
63	:	0	144	2	146	2	342	61	:	0	136	2
37	:	1	154	3	230	5	412	39	:	1	147	1
37	:	1	154	3	230	5	412	39	:	1	147	1
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3319	:	:	5477	:	:	:	19388	3241	:	:	5710	:
7860	:	:	4928	:	:	:	20869	7676	:	:	5178	:
4532	:	:	4532	:	:	:	14844	4426	:	:	4756	:
9870	:	:	3265	:	:	:	18372	9640	:	:	3464	:
6711	:	:	1774	:	:	:	11568	6554	:	:	1856	:
6771	:	:	3145	:	:	:	12686	6613	:	:	3327	:
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2777	729	101	1720	426	1712	-	7337	2520	821	103	1606	501
205	32	-	:	9	108	-	:	:	:	:	:	:
925	42	20	:	82	358	-	:	:	:	:	:	:
246	42	3	:	16	227	-	:	:	:	:	:	:
135	-	-	:	41	76	-	:	:	:	:	:	:
334	34	24	:	87	121	-	:	:	:	:	:	:
248	32	-	:	91	140	-	:	:	:	:	:	:
23	-	-	:	10	36	-	:	:	:	:	:	:
69	493	-	:	7	58	-	:	:	:	:	:	:
70	4	-	:	16	63	-	:	:	:	:	:	:
522	50	54	:	67	525	-	:	:	:	:	:	:
1807	294	176	1082	187	1280	-	4735	1680	244	178	1093	206
361	12	2	-	26	102	-	504	226	35	2	:	31
253	9	45	-	17	64	-	534	317	41	41	:	20
813	262	129	-	19	1050	-	1886	846	116	134	:	47
235	6	0	-	43	38	-	374	180	22	0	:	46
145	5	0	-	82	26	-	344	111	31	0	:	63
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4853	153	264	2637	:	:	:	9582	4931	168	258	2594	:
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1996	1996	1995	1995	1995	1995	1995	1995	1995	1995	1994	1994
services	Other	total	industrial	energy	transport	households	agriculture	services	Other	total	industrial
:	:	:	883127	:	54880	579209	:	:	:	2000453	849829
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8827	:	34450	12214	865	67	11376	2011	8782	0	33420	12476
2434	:	11002	4129	:	0	3395	986	2492	:	10825	4416
380	:	1419	481	:	0	407	174	357	:	1414	447
1390	:	6336	2460	:	0	2053	304	1518	:	5531	2062
175	:	663	152	:	0	299	58	155	:	1384	888
489	:	2585	1036	:	0	637	450	462	:	2496	1019
1503	:	9883	5437	:	0	1970	712	1765	:	9594	5507
218	:	638	113	:	0	265	45	215	:	600	119
249	:	508	41	:	0	218	11	239	:	482	46
226	:	1217	372	:	0	418	146	282	:	1185	370

413	:	6126	4638	:	0	530	299	659	:	5922	4635
397	:	1394	273	:	0	540	212	369	:	1405	337
3545	:	10952	2434	:	67	5055	129	3333	:	10516	2363
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1257	:	2546	215	:	0	955	184	1192	:	2421	190
156	:	358	31	:	0	192	11	124	:	349	24
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609	:	1334	129	:	0	449	157	599	:	1278	119
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1880	10	12309	7561	550	49	2304	44	1765	36	11754	7078
779	13	7251	5038	421	68	944	7	763	10	6198	4160
422	37	2943	1969	16	35	452	13	423	35	2707	1819
8992	1821	39146	16879	551	1116	9824	322	8497	1957	36307	15276
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1904	125	8348	2992	375	248	2292	372	1510	559	7730	2629
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610	44	1750	292	11	3	710	113	542	79	1651	241
12373	769	46077	19471	702	1217	11358	1064	11491	774	43581	17904
7403	202	29250	13935	496	935	6549	320	6788	227	28267	13064
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8197	296	27195	8549	1001	402	7651	1636	7807	149	26165	8349
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1345	0	9119	2847	171	785	3125	39	2152	0	9093	2760
3370	0	30645	18151	578	660	6180	86	4990	0	30557	18113
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1713	0	17894	9498	1139	392	4099	28	2738	0	17683	9226
1956	0	12399	6041	307	160	3122	25	2744	0	12304	5914
728	0	7222	3729	100	105	2002	13	1273	0	7208	3684
5844	0	37969	10825	1228	581	15378	961	8996	0	37855	10468
2388	0	16019	4868	715	263	6193	315	3665	0	15987	4670
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:	:	19173	:	:	:	:	:	:	:	18665	:
:	:	9416	:	:	:	:	:	:	:	9220	:
:	:	3130	:	:	:	:	:	:	:	3035	:
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8096	371	29237	12961	487	366	7588	514	7452	358	27751	12302
7739	361	28544	12873	:	364	7318	512	7127	349	27096	12224

2228	136	9521	4445	:	34	2827	80	2004	132	9057	4224
1101	44	5734	3330	:	92	1196	72	997	48	5447	3170
3509	144	10382	3934	:	236	2555	238	3287	133	9824	3715
346	10	1789	1046	:	1	361	63	309	9	1709	999
555	27	1118	119	:	2	379	60	530	27	1060	115
140	2	320	56	:	0	129	0	132	3	309	55
140	2	320	56	:	0	129	0	132	3	309	55
217	7	373	31	:	1	141	1	193	6	347	24
217	7	373	31	:	1	141	1	193	6	347	24
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11886	**0**	**65999**	**36362**	**695**	**500**	**16256**	**790**	**11396**	**0**	**65420**	**35360**
11821	**0**	:	:	:	:	:	:	:	:	:	:
1470	**0**	:	:	:	:	:	:	:	:	:	:
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:	:	124573	:	:	:	:	:	:	:	**129615**	**50432**
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:	:	**12820**	**6083**	:	:	**3257**	:	:	:	**12605**	**5851**
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9897	2119	52155	18161	4073	2441	14847	1762	9189	1682
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7321	674	28919	8347	1478	940	9791	889	6955	519
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1334	-	4807	1716	175	235	1161	250	1270	-
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1994 energy	1994 transport	1994 households	1994 agriculture	1994 services	1994 Other	1993 total	1993 industrial	1993 energy	1993 transport	1993 households	1993 agriculture
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1375	1384	21358	:	10097	0	64644	31255	1344	1360	21090	:
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160	270	3544	90	2016	0	10899	5094	147	247	3431	99
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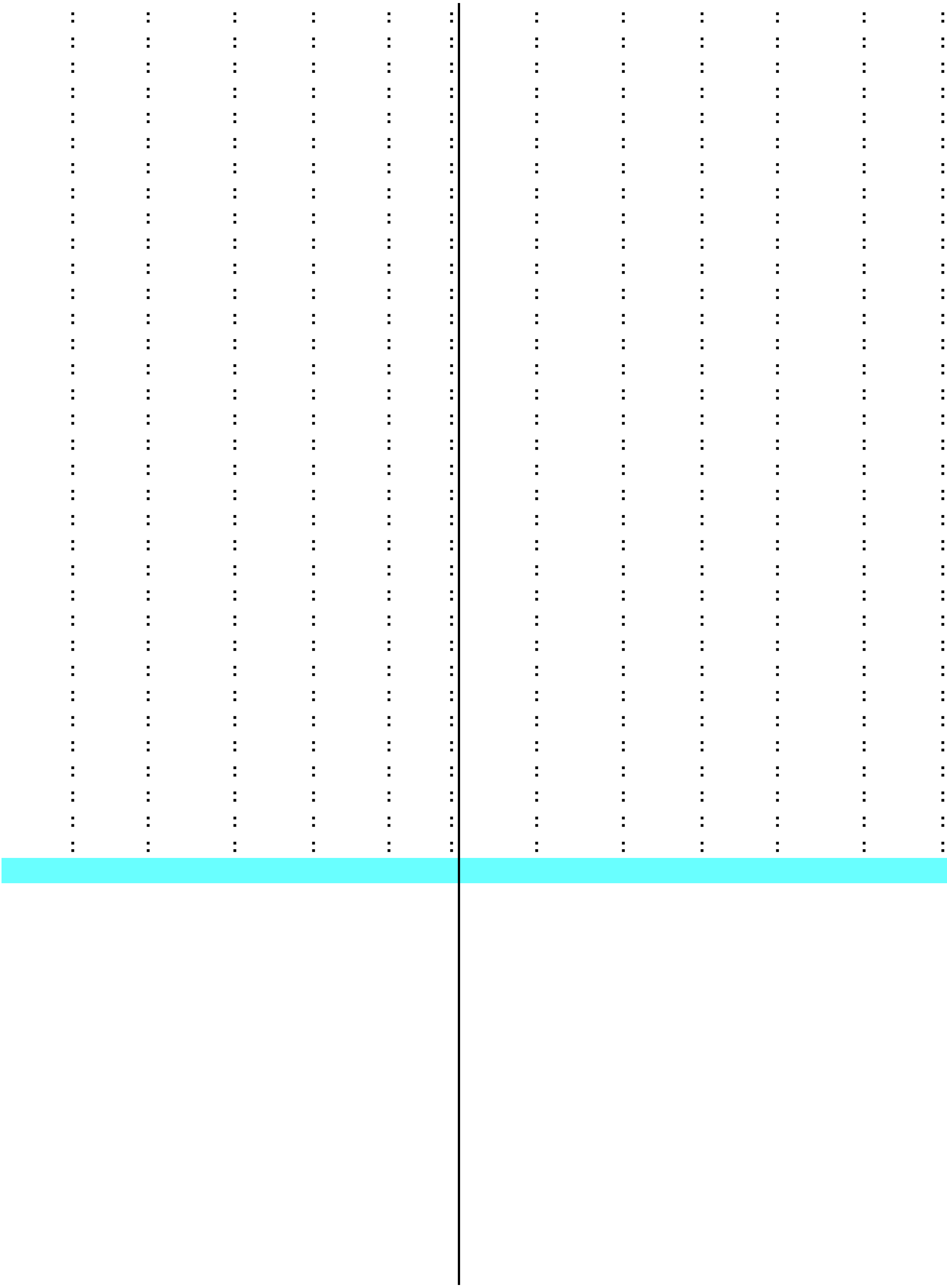

1993 services	1993 Other	1992 total	1992 industrial	1992 energy	1992 transport	1992 households	1992 agriculture	1992 services	1992 Other	1991 total	1991 industrial
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9595	0	63870	32269	1229	1305	20550	:	8516	:	61783	31141
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14420	0	:	28878	:	2443	16419	2023	14525	0	63914	28862
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1877	0	20775	7955	:	449	2758	7955	1658	0	14208	7627
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2780	0	12593	5797	:	853	3130	18	2795	0	12389	5688
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9342	0	:	22045	:	1546	11378	1507	9105	0	45347	22771
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2292	0	21830	7311	:	750	4788	7311	1670	0	16197	8650
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886	0	:	8546	:	564	3178	8546	667	0	14446	8630
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304	0	1311	467	:	:	416	150	278	0	1210	439
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137	0	1163	723	:	:	272	42	126	0	1053	641
360	0	2227	983	:	:	564	328	352	0	2174	1082
1153	0	9113	5573	:	:	1700	594	1247	0	9100	5626
170	0	520	101	:	:	227	34	158	0	493	101
189	0	403	37	:	:	177	10	179	0	365	32
259	0	1115	376	:	:	376	121	242	0	1372	447

420	0	5809	4760	:	:	446	232	370	0	5708	4762
115	0	1267	298	:	:	474	198	297	0	1162	284
2908	0	9912	2235	:	:	4892	130	2655	0	9234	2249
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124	0	321	28	:	:	169	9	115	0	292	28
391	0	700	45	:	:	280	15	360	0	604	46
505	0	1132	119	:	:	456	102	455	0	1022	105
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13433	0	75473	43095	1754	1947	14562	926	13189	0	74542	43262
3346	0	20804	12231	333	589	4194	215	3242	0	20411	12041
158	0	781	421	15	24	165	2	154	0	781	432
1622	0	5723	1817	269	352	1651	36	1598	0	5650	1880
8307	0	48165	28626	1137	982	8552	673	8195	0	47700	28909
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3875	0	17376	8422	111	525	3764	791	3763	0	16890	8236
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3288	0	15093	7236	336	564	3579	163	3215	0	14814	7159
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1115	0	4666	1998	209	145	1171	77	1066	0	4422	1928
5592	0	16550	4081	165	719	6028	229	5328	0	16213	4104
8361	0	37919	15003	376	1002	12607	870	8061	0	36860	14664
931	0	4519	2413	22	107	1030	65	882	0	4324	2293

239	0	938	427	7	14	240	14	236	0	860	380
3235	0	13295	4160	46	458	5357	187	3087	0	13128	4144
2443	0	12997	6074	271	183	3690	430	2349	0	12568	5951
339	0	1678	794	8	23	430	60	363	0	1531	678
1174	0	4492	1135	22	217	1860	114	1144	0	4449	1218
4752	0	24675	10515	1550	176	7334	498	4602	0	24167	10603
3435	0	15435	5054	1094	158	5425	369	3335	0	14863	4852
1317	0	9240	5461	456	18	1909	129	1267	0	9304	5751
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5738	0	26035	12800	382	332	6797	285	5439	:	25256	12512
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1991	1991	1991	1991	1991	1991	1990	1990	1990	1990	1990	1990	1990
energy	transp ort	househ olds	agricul ture	service s	Other	total	industri al	energy	transp ort	house holds	agricu lture	servic es
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1206	1276	19897	:	8262	0	59108	30619	1028	1249	12555	:	13657
17	288	1609	:	1938	0	4091	407	22	281	824	:	2557
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1157	525	12177	:	4020	0	36986	20575	972	516	7530	:	7393
922	158	3392	:	1203	0	13470	8330	748	151	2032	:	2209
146	17	1550	:	419	0	5659	3643	169	17	1043	:	787
59	154	2888	:	770	0	8585	4974	54	157	1807	:	1593
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30	97	2457	:	767	0	5696	2668	1	92	1366	:	1569
33	462	6111	:	2304	0	18028	9635	35	451	4201	:	3706
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28	181	2126	:	860	0	7453	4404	30	179	1492	:	1348
4	100	1986	:	640	0	5867	3251	4	97	1381	:	1134
0	56	460	:	181	0	1024	371	0	57	293	:	303
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:	0	1780	199	922	0	4689	1973	:	0	1607	250	859
:	0	271	28	113	0	1253	866	:	0	247	32	108
:	0	535	254	304	0	2253	1143	:	0	479	349	282
:	0	1741	541	1193	0	8893	5582	:	0	1555	621	1137
:	0	216	28	148	0	445	100	:	0	190	18	137
:	0	165	8	160	0	336	28	:	0	149	8	152
:	0	476	159	290	0	1308	451	:	0	423	165	269

:	0	443	178	326	0	5661	4725	:	0	395	225	316
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:	0	808	118	812	0	1794	186	:	0	732	112	765
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:	0	240	13	305	0	561	46	:	0	220	12	283
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102	29	2895	51	1559	0	6604	2333	101	29	2643	47	1451
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701	381	5887	66	4106	0	24548	14044	681	356	5539	58	3870
701	381	5887	66	4106	0	24548	14044	681	356	5539	58	3870

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16	144	713	88	574	0	4114	2674	16	98	697	82	547
177	93	1138	71	1015	0	4251	1808	167	143	1105	67	961
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25	105	1007	59	835	0	4055	2132	18	99	968	60	778

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57	446	5326	178	2977	0	13020	4570	82	428	5013	167	2760
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11	22	424	54	342	0	1428	608	20	22	404	53	321
18	211	1802	105	1095	0	4290	1248	17	200	1717	116	992
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Case study:
The Danish policy and programme for introducing active solar heating in Denmark.

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1 Case study objective and scope

The scope of this case study is the implementation and results of the Danish offcicial policy programmes to introduce active solar heating systems in Denmark. The objective being to understand the effect of these policy programmes influenced on the actual development of the market in Denmark and on the development of supporting organisational structures.

2 Methodology used and information sources

The case study is organised as a historical account of the implementation of different policy programmes during the years 1979-2001. The sources of information are: Laws, statistics, reports, conference papers, web-sites.

3 Description of the case study

3.1 How it all began

The Danish solar thermal development started without governmental programme at the time of the first energy crisis 1973/74. A little group of small manufacturers started 3 different productions of solar thermal systems, 2 of them Batec and Arcon are still active in the field as the largest manufacturers in Denmark.

At the same time the Danish Technical University (DTU) took the initiative to start research in active solar thermal energy (ASTE).

3.2 The first governmental initiatives

The first official governmental initiative started in 1978/79 with 2 elements:

3.2.1 The renewable energy research programme

The Ministry of Trade allocated means for research and development of renewable energy technologies. In the field of solar energy DTU carried out basic research including demonstration projects and monitoring programmes, which formed the basis for the development in the 80th carried out in a co-operation between DTU, Danish Technological Institute (DTI) and the manufacturers. The financing of the programme were in 1981 delegated to Danish Energy Agency (DEA) – today the Danish Energy Authority.

3.3 Further R&D&D - the solar development programme

As a consequence of the growing dissemination of solar thermal systems, increased research and development was necessary. Under the supporting programme Development of Renewable Energy (UVE) DEA allocated in the 90th between € 1,6 and 2,6 million yearly to solar research, development, information, solar computer programmes, campaigns and demonstrations projects including monitoring.

Moreover the UVE-programme administrated the grants to standard solar systems and medium sized and large plants (yearly € 2,6 million rising to € 5,3 million in 1996) and the basic support to the test laboratory. The total yearly solar budget rose from € 3,7 million in 1991 to € 8,9 million in 1996.

To assist DEA in the organization in the future development and in prioritising the means, the Solar Energy Council was established in 1991. It consisted of 15-20 leading members of the Danish solar stakeholder group, encompassing manufacturers, installers, the test laboratory, Technical University (DTU), consulting engineers and architects, Renewable Energy Information Centre and the Danish Organization for Renewable Energy (OVE).

The Solar Energy Council worked out 3 plans of action for the periods of 1991-95, 1995-97 and 1998-2000. The council played a very important role in the organization, and assisted DEA with detailing the plans of actions, fixing the order of priority to incoming projects, follow-up upon on-going activities and evaluation of finished projects until 2002, where the new government cancelled the UVE-programme.

3.3.1 Economical subsidies

The Danish government decided as soon as in 1979 to give direct grants at 30 % of the costs of the installation of standard solar thermal systems. The administrative set-up was very simple in the beginning, but more restricted in the 80th under the administration of DEA. After some years it was clear, that some of the solar installation bills contained certain plumber tasks not related to the solar installation. Moreover, a fixed 30% grant to every solar plant regardless of its quality was not appropriate in the long run. DEA decided therefore in the late 80th that subsidies could only be given to approved products, and later on in the beginning of the 90th, that subsidy should be dependent on the energy harvest of the system under standard conditions, but max.30% of the costs. This meant on the negative side increased administration, but on the positive side increased stimulation among the manufacturers to produce the best collectors, since they would call forth the highest grants. The revised subsidy rules shifted to € 0.67 per kWh of the yearly solar energy production - for a standard 5 m2 plant producing 1800 kWh a year: € 1200.

As the dissemination increased in the 90th DEA decided to reduce the grants stepwise with the goal of ordinary commercial conditions without subsidies after 5 years. The first step was reducing €0,67 to € 0,53 per kWh in 1996, and the year after subsidies in district heating areas were cancelled, and in 2002 the new government decided to remove subsidies to all solar thermal plants.

3.4 Quality testing and assurance

3.4.1 Establishment of a test laboratory

In the years of 1979-80 a lot of immature solar systems were installed, not only in Denmark, but also in a lot of European countries. The collectors were often made of iron and corroded very quickly. To cure these ‘children-diseases’ DEA reacted and established 1981 a test laboratory in DTI to guard the quality of the products. An approval scheme encompassing the whole system of collector, tank and electronic control was made, and the national grants could only be given to approved systems.

Later the approval scheme was changed to separate type-approval of each main component, stimulating product development of these separately, and the plumbers could therefore combine components from different manufacturers, according to guidelines produced by the test laboratory. This also resulted in price reductions of a complete solar thermal system.

The test laboratory participated together with DTU and about 12 manufacturers actively in the product development of the components and systems. Most of the researchers, developers and administrators from DTI, DTU and DEA are still active in the field to day, showing the importance of having skilled and long-term devoted people to stimulate a development in a minority area. The approval and development activities in the test laboratory were financed by DEA with a yearly budget of € 0.5 million in 1981 rising to € 1 million a year in the end of the 90^{th}. As a result the average solar thermal yield increased from about 300 to 500 kWh per m2 a year in the period.

In 1998 the DTI solar test laboratory and the solar activities in DTU made a fusion in The Danish Solar Energy Centre.

3.5 Quality assurance scheme

As part of the national campaigns two independent market analyses were carried out including telephone interviews with potential customers. The first investigation concluded, that information about solar thermal was already wide spread, and that the primary target group still was schoolteachers, police officers, academics, idealists and people with great environmental awareness. Another large group of 'ordinary' Danes were interested – especially women – but wouldn't be 'rabbits' for experiments with new technology or uncertain installations.

As a consequence of this result a quality assurance scheme for solar installations (KSO) was therefore established in co-operation with the plumber organizations, parallel to the already existing quality assurance scheme for solar thermal products and components. A transition scheme for the already educated solar plumbers was made, but new solar plumbers had to participate in a 3 days course with a following approval of an actual solar installation to obtain certification.

The scheme resulted in more than 1000 certificated solar installers, that is one third of the total amount of Danish plumbers.

The comprehensive control in the field of a number of casual selected installations was very important and were carried out smoothly, probably because the controlling leader of the KSO-secretary besides being an engineer also was educated as a plumber (He is still leader of the secretary and also participating in the Irish SolaCert project). Due to the scheme only 25 out of 4000 installations were reported as problematic in 1996.

The plumber organizations – being at the beginning sceptical to the scheme – adopted gradually the arrangement fully, also as a marketing factor guaranteeing the quality and thereby increasing the business of the plumbers. For this reason the plumbers were opposed to a possible parallel DIY (Do-It-Yourself) scheme, but it succeeded to make a DIT-scheme: 'do-it-together' with a certificated solar plumber as supervisor. The DIT concept, which was approved by the Solar Energy Centre, consists of components that are prepared for easy installation following a detailed installation manual which also have to be approved. During the installation the costumer can call the installer for help or clarification and after completing of the installation the installer have to approve the plant. Such installations could obtain grants as normal installations.

3.6 Information campaigns

3.6.1 Regional campaigns

The quality assurance activities resulted in reliable national standards, but it lasted 6 year before the negative image of solar thermal due to the former functioning problems was obliterated in the eyes of the population. The yearly amount of solar installations was only 250, compared to 1000 in the 'boom years' in 1979/80. Not till 1987 it was possible to start campaigns for ASTE of these reasons. In 1988 the first regional campaign was carried out in the county of northern Jutland, financed by DEA with € 1,5 million.

The campaign intentions were twofold:

1. To create public awareness of the possibilities of solar thermal systems through advertising, a solar energy newspaper, exhibitions on market days, cattle shows etc.
2. To educate a local cops of solar plumbers. The plumbers got a simple one-day course in installing solar thermal systems, and could thereafter man the exhibitions and try to sell systems.

Around 100 systems were installed as a result of the campaign, but more important 30 solar installers were initiated in the county.

In the following years 3 new regional campaigns were carried out with 3-4 new Danish counties in each of them, financed by DEA. The yearly budget was about 1,7 million € and crucial for the organizing was the appointment of a campaign coordinator and the involvement of local energy offices and the central Renewable Energy Information Centre (comparable to REIO) as well as the following up of DEA. The success was very clear: the public awareness and the confidence in the products were significant increased, and the yearly amount of solar installation rose from 250 to about 1000. At the same time more than 300 solar installers were recruited.
The regional campaign set-up was honoured with the European solar energy price in 1994.

3.6.2 National solar thermal campaigns

With the regional campaigns the foundation was created for further dissemination, but more campaigns were needed to maintain the gradient in the development. DEA decided therefore in co-operation with the Solar Energy Counsel to implement a series of national campaigns with the assistance of professional marketing bureaus. The campaign elements were advertising in regionally distributed newspapers, posters, television and radio spots, homepage, and various solar information brochures, pamphlets and fact sheets. The local follow up by the solar plumbers was organized with assistance of the independent nationwide regional energy offices.

The yearly budget of these campaigns (1992-98) was € 0.3-0,4 million.

3.6.3 Involvement of architects

A barrier in the development has been relative little involvement of architects in the field of solar energy, and the opinion among many people, that solar thermal plants in application forms did not adorn the buildings. Several manufacturers therefore developed roof-integrated solutions. DEA arranged a solar architecture competition, and consulting architects worked out booklets with guidelines for placing solar systems.

3.6.4 Involvement of utilities

A strong element in the national campaigns 1995-98 was the involvement of utilities, especially the natural gas-companies. The electricity companies and the oil companies participated in the campaigns with limited success, but the natural gas-companies doubled in two years the yearly amount of solar thermal installations from 2000 to 4000, thanks to their very effective marketing.

This solar marketing filled in a big hole, since the weak point in the Danish development was absence of commercial sales companies (except the manufacturers), and since only a few of the installers were in possession of the necessary capacity and ability for marketing. The gas-companies co-financed the solar campaigns with nearly half of the budgets.

However, the engagement of the natural gas-companies in the field of solar thermal was not lasting for long, and relying on the special circumstance, that the companies could use a combined gas-solar offer as a idealistic 'lever' in a marketing process of stimulating potential customers to convert from oil or electricity to gas. Having used these residual possibilities to its limit, the involvement of the gas-companies in solar thermal marketing decreased.
A similar slight opportunism among some of the solar plumbers was seen in the years after, where 'boom' in kitchen- and bathroom installations persuaded a lot of the installers to do without solar installations. These two 'desertions' caused a very serious setback of the development, which moreover in 2002 had to suffer from the governmental cancelling of the grants to solar installations.

3.6.5 Special campaigns

Besides the regional and national campaigns special campaigning activities were carried out:

1. Campaigns for medium sized and large plants. To these a sketch project scheme was established, making it possible for institutions and housing companies to get a sketch project for a solar plant without expenses. The projects were sketched out and economically calculated by a group of solar engineers, supported by DEA.

2. Nomination of Danish cities as 'Solar City of the Year'. Based on neutral recommendations the Renewable Energy Information Centre appointed in a period every year a city as Solar City, due to its solar initiatives.

3. Campaign for solar prepared tanks. This was addressed to the situations where old hot water tanks should be replaced quickly without the time to

consider an installation of a solar thermal system. In such situations a part of the standard solar subsidy could be obtained, if a solar tank was chosen.

4. A special information campaign for renewable energy including solar energy in the schools was carried out in the 'Energy Forum of the Schools'.

3.7 Legal inititiatives - solar thermal obligation in new buildings

In 2000 the Danish Parliament passed a law about obligation to install solar thermal plants in most of the new buildings, if economically attractive – that is, if the value of the energy savings was comparable or lesser than the solar system costs.

However, the obligation was never carried out in practise as the new government cancelled the law by a new anti-law in 2002.

3.8 Results of the programme

The total active solar thermal programme in the period of 1979-2003 resulted in nearly 40.000 solar thermal systems, corresponding to 350.000 m2 collector area.

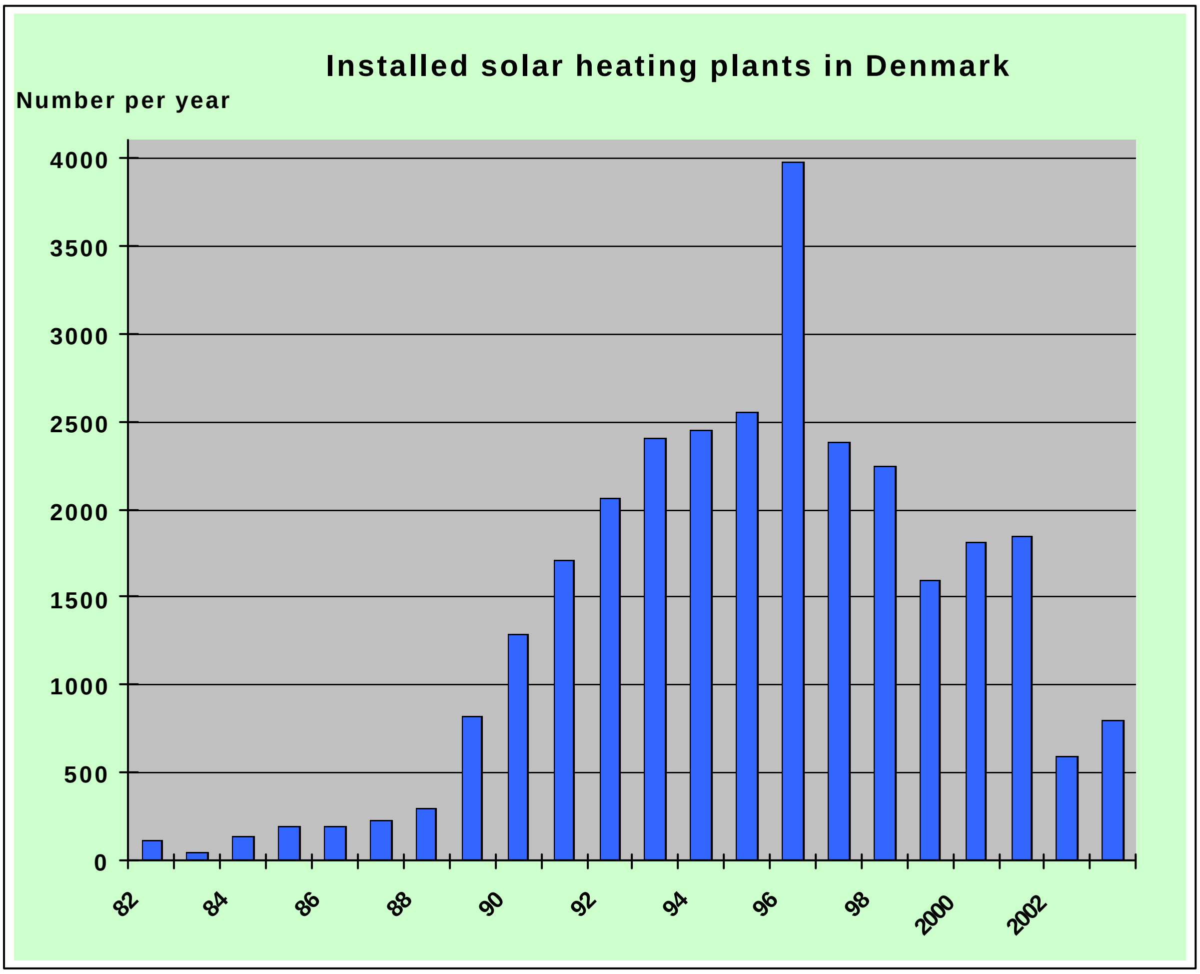
The development lasted more than 25 years, but only the last 12 years had the character of an actual organized programme.

The total amount of public means to solar thermal energy in the period of 1979-2001 was in round figures € 75 million, comparable to one third of the commercial costs of the installed solar thermal plants.

Around two thirds of the public funding were spent on grants, the rest were spent on R, D & D, quality assurance, information and campaigns

3.8.1 Summary statistics:

Year 2001:
Inhabitants: 5,3 million
Solar collector area, cumulative: 259.000 m^2
Solar collector area, cumulative per inhabitant: 0,049 m^2
Solar collector area, installed 2001: 13.000 m^2
Market trend: Declining



4 The observed phenomena – descriptions and conclusions

The programmes of the Danish Government to introduce active solar heating systems into the market covered a number of different activities:

- R&D&D
- Economical subsidies
- A quality assurance scheme
- Information campaigns – regional and national and a
- Legal initiative

It can be concluded that the overall result of these programmes was a successful introduction of solar heating systems into the Danish market and with that a maturing of the Danish Active Solar Heating Industry that has lead to a situation where it is competitive on the international market – especially when it comes to the quality of products and systems.

The conclusions for the individual elements of the programme are stated below:

4.1 R&D&D and Quality assurance scheme

There was a close interconnection/synergy between these two parts of the programme and it can be clearly seen that the efficiency of the solar collectors and of the whole systems as well as the general quality of the components were greatly improved thanks to these programmes. To day, Danish collectors are top-quality products that are sold on the international market and Danish know-how is currently transferred to developing countries.

A internationally recognized collector and system testing laboratory was established at the Danish Technogical Institute. But as the present government has withdrawn the support to the testing laboratory its annual turnover was too small to keeo it running and it has therefore been closed.

4.2 Economical subsidies

Active solar heating has difficulties competing on the Danish energy market due to relatively low energy prices and limited solar input. Therefore the subsidy was an essential part of the Danish programme as it boosted the Danish home market for the industry and installers. Again the present government has stopped the subsidy part of the programme and the sales of solar systems has dropped more that 50 % as a result of that.

4.3 Information campaigns – regional and national

The information campaigns has worked hand in hand with the other parts of the programme and has created a considerable awareness about the possibilities of active solar systems in Denmark and has thus created part of the demand for the systems. As most of the Danes are quite concerned with the economical payback of these systems – such awareness should and has in the past work in combination with a subsidy programme.

4.4 Legal initiative

The legal initiative that is described under 3.7 was never in force and it is not possible to draw any conclusions as to what effect it might have had. However, the very existence of the initiative made some builders consider the possibility of installing solar heating systems for new constructions and have these economically evaluated. Therefore it is quite likely that such a law would have had a positive effect on the sales of active solar heating systems in Denmark.

4.5 The transferability of the observed results

The barriers to large scale introduction of solar heating systems in Denmark are not much different to the barriers that can be observed in many other countries. It is basically questions about awareness, quality and economy of the systems that govern the situation. Also based on observations of parallel programmes that have been active in other countries, for example: Sweden, Austria and the Netherlands similar observations can be made and conclusions drawn.

5 Recommendations

Based on the experiences of this case study in Denmark a number of recommendations can be drawn up. These are categorised in two areas: political and research below.

5.1 Policy recommendations

- Financial incentives and subsidies are only effective when they are stable.

- The co-ordination of a large campaign with many different activities like training, marketing and promotion requires a strong central organisation that has the end responsibility on content and financial sides, and that assumes a co-ordinating role.

- Merely realising an investment subsidy for solar water heaters without taking other promotion measures has proven insufficient. In several countries, such subsidies are or have not been well used because of a lack of demand.

- Energy performance regulations for buildings, like the European Directive under construction, can be effective, but only when they are strict enough so that solar water heaters are able to fulfil the requirements.

5.2 Research recommendations

- In the long term, research and development remains an important driving factor to fully exploit the potential.

DEVELOPMENT OF BIOMASS-FOR ENERGY SECTOR IN POLAND

CASE STUDY under the ESPON project 2.1.4

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Annexes

1. Case study objective and scope

The objective of this Case Study is to analyse the present state of development of the biomass-based energy production in Poland, to identify the existing barriers and the needs for stimulating further development of this sector, as well as to assess the impact of the programmes in this area.

The scope of the Study comprises the assessment of the impact of energy policy (local, national or European) on the development of the biomass-for-energy sector in Poland, evaluation of the role of local (self-government) authorities, assessment of the growth in biomass business activity and its implications for the labour market and for the development of other economic activities. From the end use perspective the scope of the Study covers the use of biomass for heating and power generation (and co-generation), as well as for biomass derived motor fuels. The gaseous biomass-derived fuels are not included in the Study due to their minor role at present and lack of actual field data.

Based on the information gathered, an attempt is made at finding a common denominator for the observed tendencies and phenomena. Common features, problems, success factors are identified along with the existing barriers and reasons for failures. Actual and forecasted outcomes and development trends of the observed phenomena are outlined. Potential transferability of the good practice examples is discussed and observations concerning measures that should be taken to avoid errors, which have led to failures, are given. Special attention is devoted to recommendations related to research aimed at optimisation of the use of the biomass resources available in a given area.

The particular aspects are illustrated by selected representative examples, which are described in more detail in the Annexes. The examples address the issues of planning and implementation, barriers to and needs for further development and the environmental impacts of the use of biomass for energy purposes.

2. Methodology used and information sources

In designing this case study we had to bear in mind that the problem of the energy use of biomass cannot be treated consistently in an item-by-item manor. This basic observation follows from the fact that the final forms of biomass-derived energy compete to the same **limited resource in a given territory,** which basically is determined by: **(i)** available land area, **(ii)** soil characteristics and **(iii)** insolation and rainfall levels. Consequently, the Case Study is organised as a thematic (issue) account, rather than individual case analysis, although it includes also historical notes on planning and implementation of particular projects selected as examples for the Study. Depending on the particular example or issue the sources of information are: **(i)** own data, **(ii)** national official documents and reports (or other reports), **(iii)** laws and, statistics, **(iv)** articles in local and national newspapers, **(v)** conference papers, **(vi)** professional publications, **(vii)** web sites, and information obtained directly from:

- Interviews with stakeholders (direct or telephone),
- Units of the local administration,
- District Heat Companies,
- Agriculture and Environment Protection Departments,
- Business sector (public and private, especially SMEs),

- Agencies for: Energy, Employment, Agriculture Modernisation, Communal Development,
- Representatives of member communes and farmers in the area.

3. Description of the structure of the Case Study

In the next Section a general geographical and historical background of the Study is given, including relevant, most important general statistical data. **Section 5** deals with the administrative division of the country, which provides important background information for the understanding of the Study. In **Section 6** the general legal framework related to Renewable Energy Sources in Poland is described to justify why biomass – one of the RES – has been selected for the Study.

A more detailed treatment of biomass as one of the Renewable Energy Sources (**RES**) is presented in **Section 7**, including political, legal, planning, financial and physical potential issues. **Section 8** is focused on the description of identified barriers as well as on the needs to promote further development of the Sector. The role of public authorities and involvement of private sector or capital investors (PPP ventures) is discussed. A separate important issue dealt with is integration of fuel conversion from fossil fuels to biomass with energy efficiency measures on the demand side, which is addressed in **Section 9**. Section 9 describes also the problems associated with co-firing biomass with coal, a tendency that has exploded recently in Poland. **Section 10** is a case study of a failed political initiative to promote liquid biofuels for motor vehicles. **Section 11** summarises the results of the Study and gives suggestions for overcoming the existing barriers to the development of the biomass-for-energy sector in Poland. It contains discussion of: **(i)** actual and forecasted outcomes and development trends of the observed phenomena, **(ii)** potential transferability of the good practice examples, **(iii)** recommendations concerning measures that should be taken to avoid errors, which have led to failures. Special attention is devoted to **(iv)** policy recommendations concerning local energy planning and **(v)** recommendations concerning research aimed at optimisation of the use of the biomass resources available in a given territorial area.

The Study is supplemented by concrete examples illustrating the particular issues raised earlier. For the sake of clarity these are presented separately in Annexes 1- 5.

4. General political background and historical note

4.1 General information about Poland

Poland is situated between the Baltic Sea in the North and Carpathian Mountains in the South. Polish climate is temperate: the yearly temperature average is about +7°C. In winter, the average is about –8°C and in summer about +15°C. These averages have varied over time: between 1951 and 1995, maximum temperatures ranged from +30.7°C to 38.0°C, while the minimum temperatures from -18.2°C to -35.4°C. Therefore, the use of energy for heating is one of the major problems.

The population of Poland is approximately 39 million, which gives the population density of ca. 125 persons per square kilometre. There are approximately 12.5 million households with 61.7% of the population living in cities. Forests cover 28.1% of the country (remarkably: the forested area has increased from 27.7% over the past 10 years, as a result of a continued, planned effort). Farmland constitutes 59% of the country area, which gives 0.38 hectares per capita - much more than that of EU15.. The average farm size is only 5,76 hectare; while in large parts of the country it is still smaller (e.g. in Malopolska, a Southern province, it is merely 2,1ha).

The Polish economy has grown in 2003 at an annual rate of 4,5%. Per capita GDP is estimated at 4500 USD, which constitutes only 42,5% of the EU-15 average. Unemployment remains at a high level of around 20%, and is particularly high in rural areas; this is exactly where the potential for biomass production is the greatest and its wider use for energy production could create new jobs.

4.2 Historical note

In 1989 Poland initiated the political and economic reforms in the former Soviet bloc.. The political and economic transition in Poland, which led to this reform, began in 1980 with the peaceful revolt of the Polish shipyard workers in Gdansk, which ended on August 31, 1980 with creation of the independent trade Union “Solidarnosc”.

In the wake of the victorious emergence of “Solidarnosc”, first independent environmental NGO, the Polish Ecological Club (PKE), was established in September 1980, which began campaigning for a cleaner environment - a topic that had been a taboo in all communist countries before then. Based on early PKE achievements (e.g. closure of the Aluminium Plant in Krakow, contribution to cancellation of the nuclear programme) it is worth mentioning that the role of the environmental NGOs was no doubt significant in the initial phase of the transition. Unfortunately, their significance decreased with time, yielding influence to **powerful businesses and media** for which the environmental issues are often of a secondary (if any) importance. Also the public opinion, which considered the environmental pollution as one of top priority issues in early eighties, has become gradually much less interested in this issue, as unemployment, crime and other compelling problems became dominant.

The dominance of energy intensive, heavily polluting raw material industries was ingrained in the official ideology. The extensive industrial development had led to a lavish use of energy. Even stable imports of gas and oil from (then) the Soviet Union and abundance of domestic coal were not sufficient to meet the demand; power shortages were commonplace.

The fossil-based energy was heavily subsidized, and no motivation existed for increasing energy efficiency or looking for alternatives offered by renewable energy sources. With the transition to a market economy and with withdrawal of most of the subsidies, the energy prices increased by nearly one order of magnitude. In early 90-ties most of the energy intensive industries drastically reduced their output or collapsed; other improved their energy efficiency. Consequently, the energy shortages soon turned into oversupply. This situation has remained till present as regards electricity and gas supplies, which is an important factor when considering the use of biomass for power generation in particular.

In 1989 the first non-communist government cancelled plans made before 1980 to build nuclear power plants. The program has not been resumed until present and Poland remains nuclear free, which is another important factor for the development of RES in the long-term perspective.

4.3 Primary Energy Structure and the Environment

As a result of the price increases the energy intensity of Poland's economy improved significantly as illustrated in Fig. 1. The main mechanism, which induced this change, was market force. The economic necessity has lead to increased energy awareness and development of businesses offering services such as thermal insulation of buildings. Other instruments (legal, financial support), however important, seem to have played a rather secondary or supplementary role.

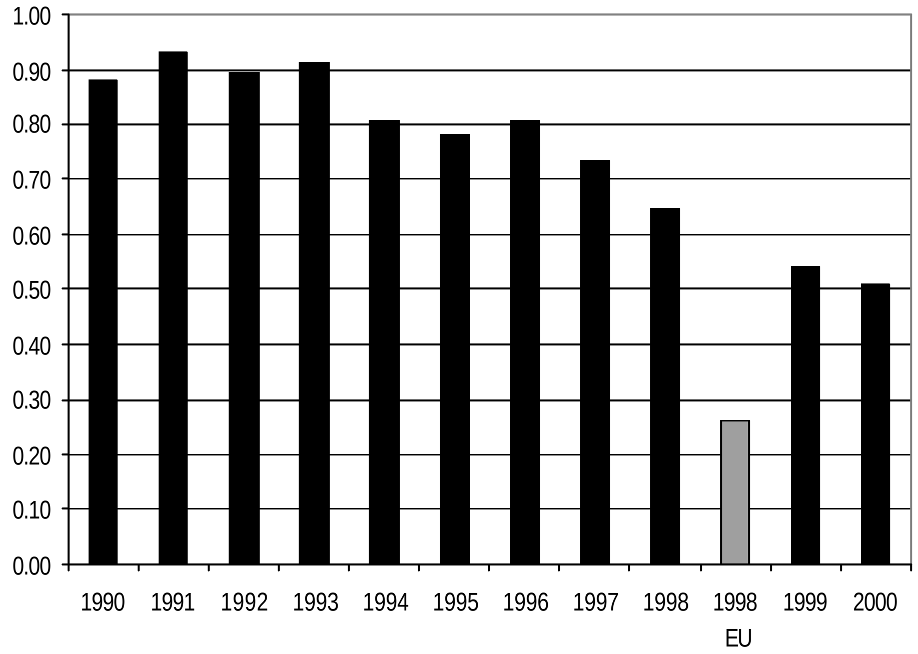


Figure 1, (primary) energy intensity of GDP in Poland [kgoe/000$]. Source: Current situation in energy sector, Ministry of Economy, http://www.mg.gov.pl.; European Union Energy & Transport in Figures 2001, European Commission in co-operation with Eurostat

The development of renewable energies was much slower, as the price-stick couldn't be applied here and there was very little, or virtually no money for carrots.

The Polish economy still relies heavily on domestic coal, which provides 64,6% (c.a. 3 times more than in OECD countries) of primary energy, despite dramatic reduction of its output (from 76,2% in 1990). Oil and gas contribute 32,5%, and other sources,, including RES, contribute the remaining c.a. 2,9%.

In fact, Poland has only very scarce deposits of gas and oil. In addition, the potential for hydropower and wind energy is relatively small. Consequently, power generation and space heating (to a somewhat smaller degree) are almost entirely coal-based. This places Poland high on the list of per capita air polluters, with 8.74 tones per capita in 1998 which is the baseline year for Poland's Kyoto commitment.

5. Administrative structure of the country, responsibilities

Before the transition in 1989 there were two-levels of the territorial division of the country: the basic unit, *gmina* (commune or municipality) and *wojewodztwo* (or province). There were above 2500 municipalities and 49 provinces. As for a country of nearly 40 million people and 312 thousand square km, the provinces *(wojewodztwo)* were too small to play any essential role in politics, in particular in the regional development planning. The communists replaced the traditional (pre-World War II) three-stage division of the country (commune, county, province) by the two-stage one with the aim of strengthening the authoritarian rule of the Communist Party. With the political transition in early 1989, a long and heated discussion began which finally led to returning to the three-stage administration system in January 1999, with 16 provinces, over 300 *powiats* and above 2500 *gminas.*

The local and regional administrations were given significant autonomy, in particular in the planning area, including energy planning. However, this devolution of power and responsibilities has not been sufficiently matched with the ability of the local governments to finance the new tasks. In case of energy, apart from the national level issues (international contracts, high voltage grids etc), energy plans to secure energy supplies to the local residents and industries were made the responsibility of the lowest administration units, the *gminas.*
By this virtue, the role of the local administrations in Poland's fulfilment of its international obligations related to the global environmental threats increased immensely. However, at such a low level, neither the expert potential nor financial resources to produce reliable forecasts or assessments, are usually in place. This is a serious obstacle for a rational development of Renewable Energy Sources in particular.

6. Policy framework for renewable energies in Poland

The legal framework for the promotion of Renewable Energies has been established as a component of Sustainable Energy Development by the Energy Act of April 10th, 1997. The Act entered into force in January 1998 and it still remains the main legal document in the field of energy in Poland.
The Act defines the principles of the national energy policy regarding the supply and use of energy, as well as concerning operation of energy enterprises. It also defines which agencies have jurisdiction over the issues of fuel and energy economy.

The purpose of the Act is to create conditions to provide energy security, rational use of energy, and the development of competition. It also defines the conditions of conducting economic activities in the energy sector, imposes certain obligations on economic entities, and guarantees certain rights for them. Since 1998 the Energy Act was updated several times. The most recent and major amendment was done in July 2002 and the changes entered into force in January 2003.

Both basic components of energy sustainability: Energy Efficiency and Renewable Energy Sources, are addressed in the Act as important factors in energy planning and policy-making. As far as energy planning is concerned the Act stipulates that the main authority responsible for national energy planning is the Minister of Economy, while energy utilities and municipalities are obliged to prepare plans for energy supplies in their respective service areas.

As mentioned before, the improvements in Energy Efficiency have been driven primarily by the price signals, which provided sufficient economic motivation without the need to refer to additional financial support (state or foreign). However, in the case of Renewable Energies this has turned out to be not sufficient or even possible. Thus, unlike energy efficiency, the driving factors of the development of RES have been so far Poland's international obligations related to Climate Change. This emphasizes, in particular, the significant role and impact of the EU legislation and accession requirements on Poland's policy making and – as a consequence – on the progress achieved in the development of Renewable Energy Sources.

Poland signed the UNFCCC in 1992. The ratification procedure was completed in 1994 and Poland became party to the Convention. The Kyoto Protocol was signed in July 1998 and ratified in 2002. Poland's commitment was a 6% reduction of GHG emissions related to 1988, which - as trends indicate - is likely to be achieved or even exceeded.

The main legal framework for RES is the *Development Strategy of Renewable Energy Sources,* adopted by the Polish Parliament in 2001. The *Strategy* sets a goal to increase the RES share in Poland's primary energy balance from the present ca. 2.5% to 7.5% in 2010 and 14% in 2020. The goal is ambitious and achieving it will not be easy. The problem is huge costs of the investment needed to achieve these targets, which is the main barrier to a wider use RES.

7. Importance of biomass as RES in Poland

Poland is not particularly rich in Renewable Energy Resources. Estimates given by different authors vary widely. It is rather understandable, as the estimates are strongly dependent on the cost threshold assumed.

Poland is a predominantly flat country; consequently it possesses rather little hydro-energy potential. The same applies to wind with the exception of the Baltic coast or offshore sites. Geothermal potential is significant, but investment costs prevent any fast progress in this area in the foreseeable future. Solar potential is moderate, typical for this geographic latitude.

The dominant Renewable Energy Source is biomass, which will constitute up to ca 85% in the RES mix in Poland in short and medium term.

Due to its local character, biomass is an important factor for social, economical and spatial development of individual regions. It may play a very important role, particularly in areas where access to the central gas grid does not exist or is limited. Biomass for energy production is of a particular importance for rural areas, where unemployment rate is usually high. The bioenergy business may create jobs and provide income to the local population.

This, in particular, concerns the dedicated energy plantations, such those of fast growing willow copies (*salix viminalis*). With insufficient domestic demand for nutrition crops and decreasing exports, about 2 million hectares of agricultural land are not used at present. Additionally, as mentioned above, the per capita area of farmland is almost four times higher than in EU. In this situation the energy plantations provide a very attractive alternative, which may **create jobs and provide the very needed income for farmers**. For example, the estimates obtained from the *salix viminalis* plantation owners (sample: total area of ca. 1200 ha) show that on average **1 person full time equivalent employed is created per 10 ha** of the plantation. The assumption is that at least in the near future the work will be done manually, which is justified by the present rate of unemployment in rural areas and cost of labour.

The relative importance of different Renewable Energy Sources in Poland and their present use are illustrated in Tables 1and 2 and Fig. 2. It is seen that the dynamics of the growth of straw based District heating systems is remarkable, which illustrates the success of the Polish policies in support of biomass. This statement would be most likely questioned by those doing business in the bioenergy sector in Poland. Still, one should admit that the existing financial support schemes have a positive impact on the development of bioenergy in Poland, while the legislative solutions at least do not hamper the initiatives. The exception is the failed attempt of the Polish Liquid Biofuels Act, which is described separately in Section 10.

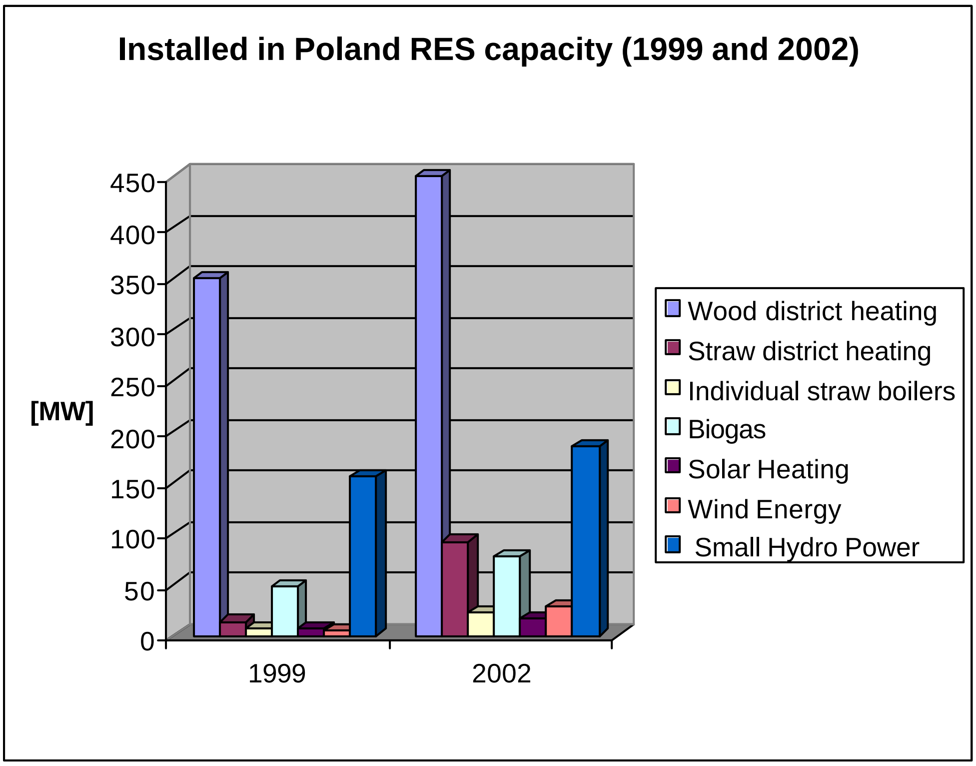


Fig. 2. RES installed capacity in Poland in 1999 and 2002

As can be seen the potential of biomass is quite significant. However, its wider use faces several important barriers, which are discussed below together with description of the support schemes for promotion of the energy use of biomass.

Table 1. Estimated potentials of RES in Poland and their present use [derived from Wisniewski, ECBREC 2004]

RES	***Total potential*** [PJ]	**Total production 2002** [PJ]	**Percentage of total production** [%]
1. **BIOMASS (total)**	**891,6**	**107**	**97,83**
2. Solar Energy	1 500	0,03	0,08
3. Wind Energy	50	0,05	0,41
4. Small Hydro Power	40	2	1,68
Total RES	**2 681,6**	**109,3**	**100**

Fig. 3. Territorial distribution of straw available for energy production in different provinces.

For illustration Fig.3 shows the distribution over different provinces of the straw potential [thousand tonnes] that could be used for energy production (1999/2000). As can be seen the distribution is rather uneven, which means that the RES policies should be adapted to the regional conditions.

Table 2. Installed RES capacity in 1999 and 2002 [Wisniewski, ECBREC 2004]

RES	**Installed capacity 1999** [MW]	**Installed capacity 2002** [MW]	**Increacemental rate** [%]
Wood district heating	350	450	29
Straw district heating	13	92	**610**
Individual **straw boilers**	~ 7	~23	~229
Individual **wood boilers**	?	?	?
Biogas	48	77	61
Solar Heating	6,5	17	166
Wind Energy	4	28,5	612
Small **Hydro** Power	156	184,9	25
Total RES	**584,4**	**872,3**	**49**

8. Barriers vs. Support

There are several factors influencing the growth of the bioenergy sector in Poland. The most important of them are:

(i) investment costs,
(ii) technology
(iii) local expert potential,
(iv) structure of farming
(v) institutional solutions
(vi) (energy/environment related level of awareness and knowledge of the decision-makers

The particular factors are discussed below with the emphasis put on the existing barriers hampering the growth of the bioenergy sector on one hand, and the support schemes on the other.

8.1 Investment costs

As mentioned above the remarkable improvement of energy efficiency of Poland's economy has been driven primarily by the energy price shock of early 90-ties. The high prices have on one hand made people to save energy by reducing the level of energy service and, on the other hand, they made the industries (and individual people as well) to invest in more efficient equipment or in insulation of buildings to decrease the energy demand.

The situation was different as regards Renewable Energy Sources. Economic motivation without additional financial support (state or foreign) has turned out here to be far from sufficient. Conversion from coal to biomass was usually much more expensive then continuing exploitation of the old inefficient coal boilers. As coal was becoming more and more expensive, individual people living in areas with available logwood started increasingly using wood to minimize the purchase of coal. However, they still continued using their old inefficient coal stoves or furnaces. With decentralized coal sales (individual deliveries by lorries) it is difficult to assess, even approximately, the extent of this phenomenon (use of wood in individual farms or households in rural areas).

It should be admitted that the investment cost barrier has been relatively well addressed by the existing domestic grant and soft loan schemes. Over the past decade the main sources of financial support have been the National Fund for Environmental Protection (NFOS) and its 16 provincial branches (WFOS). Their revenues come predominantly from the environmental fees and penalties paid by industrial enterprises operating in Poland. Both subsidies and soft loans have been granted, the latter being channelled largely by the Bank of Environmental Protection (BOS). In 1989-2000, NFOS alone disbursed 710 million USD in support to air pollution reduction measures (SO_2, NO_X, particulates, efficiency). The other important source is ECOFUND, which distributes the debt-for-nature swap money (eco-conversion of Poland's debt to the Paris Club). The policies of these funding sources differ in details, however; support is given primarily to public institutions (municipalities in particular). For example, ECOFUND supports projects only by grants in the implementation stage, i.e. it does not provide finance for project preparation or documentation. During the 10 years of its activity (1992-2002) ECOFUND distributed nearly 230 mln USD in environmental protection projects, which generated projects' total of 1250 mln USD. In recent years increasing emphasis is put on RES projects, which were supported by a total of 32 mln USD in 2002 alone. The role of biomass has significantly increased in their funding over the past few years. **The "hardware oriented" policy of ECOFUND and NFOS/WFOS (the latter provide money also for design), is no doubt a very effective way of supporting the fuel conversion or new biomass projects.** This should be confronted with many foreign (including EU) assistance schemes. These often seem to put (too) much emphasis on "soft" projects, which involve more <u>routine</u> consulting services than innovative engineering work. Too much money seems to be spent on soft ("report oriented") projects, which end with documents that get outdated before they mange to be implemented. An example is given in Annex 3. This observation does not apply to projects, which are directed to concrete, demonstration-based training of decision-makers and at research aimed at technological development or adaptation of existing technologies to given local conditions. The latter should include also the design of the projects of a genuinely innovative character, which could not be financed otherwise.

One should mention, however, that the aforementioned domestic schemes ECOFUND or NFOS/WFOS) also misspent some money, as far as promotion of biomass is concerned. Both schemes included initially a substantial support for conversion from coal to gas or oil in space heating, with the aim of decreasing local air pollution from individual inefficient coal stoves. Such support was, no doubt, justified in urban areas. Unfortunately, it was also used to build gas grids in areas with scattered settlement structure. From the environmental perspective this support has been rather counterproductive, as in those mostly rural areas the biomass potential is usually sufficient to replace large fraction of coal used for heating. Moreover, the ability of the individual investors to finance the gas or oil installation, often did not match their ability to pay high bills for the new fuel, as the prices of these energy carriers increased significantly afterwards. Consequently, many people who had not dismantled their coal stoves (old, inefficient and polluting) started using them again as their primary heat source. In some cases, alas rarely, gas or oil boilers have later on been replaced by the biomass ones. One could expect many more such "reverse" fuel conversions, would ECOFUND or the NFOS/WFOS have included them in their subsidy portfolios. Unfortunately this is not the case as yet.

Another tool to address the cost barrier is the **effect of scale**. Considering the structure of the agricultural sector in Poland, where small and medium-size farms dominate, there exists a huge market for biomass boilers of low-to-medium capacity (25-300 kW) for straw or wood in various forms (logwood, chips, industrial or forest residues, willow from energy plantations, etc). The estimates give a potential of ca. 400 000 units, which could be installed countrywide in individual farms. The first pilot project of this kind has been developed in the commune of Trzcianne in northeastern Poland, where 41 small individual boilers and 3 larger ones have been installed in a single project. The transaction costs, project design, shipment of boilers and costs of boilers themselves have been significantly reduced. The support to the hardware component was given by NFOS and the regional WFOS in Bialystok. Small Grants Programme of the Global Environment Facility (GEF) contributed to the design of the project taking into account its innovative character. It should be noted that the biomass fuel for these boilers would be locally produced (mostly auto-produced). This will:

- lower the energy bills of the users
- create local jobs as installation and maintenance is left to local companies
- boost countrywide the SME businesses involved in boiler manufacturing, especially if the "400000 program" is launched successfully.

In fact the phenomenon of the latter development has already been observed also for industries larger than SMEs. Annex 1 gives the list of companies which developed their business in biomass boilers in the wake of the growing interest in renewable energies observed in Poland in the past decade.

8.2 Technology

Technology itself does not constitute any more any significant barrier. As far as the traditional – even advanced – solutions or designs are concerned, there exists sufficient engineering potential (both design and manufacturing) to meet the existing and development needs (the latter holds under assumption that the potential will grow as the market grows). As far as the emerging advanced technologies are concerned (e.g. fuel cells using biogas or syngas) there are also highly qualified scientists who would be able to lead practical development in these areas. Progress in these fields will be most likely achieved as a result of a common Pan-European effort.

An important observation seems to be that the experience (at least the Polish one) indicates that the **progress cannot be achieved by relying on market force alone**. **Market is an important player, provided its signals are based on scientific research and demonstration**. Business – especially SMEs – is too often driven by fashions and power of advertising, instead of well scientifically grounded data and information A good example seems to be provided by the “rat race” to invest in *salix viminalis* plantations in Poland (see Section 9.2).

8.3 Structure of agricultural sector – the PPP option

As it has been mentioned in Section 4.1. The average farm size in Poland is only 5.76 ha, while in some parts of Poland it is still smaller. This structure will certainly change in favour of bigger farms, however, it will take time. This observation constitutes an important factor when one considers the domestically grown biomass as a source of energy. Small farms taken separately cannot produce biomass on an industrial scale. Organisations of producers need to be created. This – of course - applies to all kinds of agricultural production, biomass-for energy including. Attempts of such initiatives are observed, but the scale of the phenomenon is very small at present.

A special case is biomass used for energy purposes locally (self supply or local supply to meet the local needs). Straw as by-product of cereals production is particularly important. Small farms do not provide sufficient economic stimulus to convert from coal to biomass. As a result a widespread practice of burning the post-harvest straw in the fields is observed countrywide. Apart from environmental damage, such practice means tremendous waste of the precious clean energy resource.

One way to solve the problem is the approach used in Trzcianne, which was described above. It basically relies on self-supplies. However, the size of farms in a given area varies largely. Consequently, some of them may have surplus biomass, while the others may need supplementary supplies. Moreover, the situation may be different in different seasons, due to weather conditions, disease or mix of contracted crops.

In typically agricultural areas the total potential of the residue biomass exceeds the total individual demand and the surplus can be sold to the neighbouring, municipalities (cities or housing establishments). There are already numerous examples of such arrangements. One of them is described in more detail in Annex 2.

Yet one more factor needs to be taken into account: In rural areas with a compact settlement structure it may be more cost-effective to make a common District Heat (DH) investment instead of investing in hundreds of individual boilers. Such solution would increase the comfort of the consumers and create local jobs. An example of such an attempt is described in Annex 3 (project in Podhale).

The project in Podhale is an example based on creation of a local public-private company; a Public-Private Partnership (or PPP) venture of the involved municipalities and a capital investor. The biomass there is wood waste produced by ca. 900 small timber mills and wood-processing workshops scattered over an area of ca. 10x20 kilometres. These are rural communities where small wood-processing industry supplements (and gradually replaces) the farming activity. The surplus wood waste that is not used by the produces themselves for heating or timber drying is dumped in unauthorised landfills, riverbanks or roadside ditches. As in the case of straw,, precious energy resource is wasted and environment (especially rivers) is polluted. The “topological” structure of the problem is exactly the same as for straw.; Consequently an organisational solution found for agricultural waste will apply in this case too (or vice versa). Moreover, the same “topological” feature and possible solution applies to organic waste (manure and slaughter house residues).

The possible structure would be that of a co-operative or Ltd. Company. The latter would preferably be a PPP venture, as it would help solve the problem of access to capital and involvement and control function of public bodies. One should note that,, there is practically no positive tradition of co-operative ventures in Poland, the more that the forced introduction of them by the communist government after World War II and the economic failure of that move, have created a psychological barrier that will be not easily overcome. One may conclude that taking into account the structure (small size farms) of the Polish agriculture and the above-mentioned factors, **creation of PPP based local biomass markets seems to be a very appropriate solution**.

8.4 Local expert potential

Having said in Section 8.2 above that there is sufficient engineering (design and manufacturing) potential to develop bioenergy technologies in Poland, it should be noted that it is not matched by the potential of local experts who would be able to introduce RES options into the local energy development plans, oversee their implementation and supervise management of such projects. The importance of this problem follows from the Polish Energy Act of 1997, which delegates the preparation of local energy plans for heat, electricity and gas supplies to the basic territorial units, the *gmina*. The general planning principles are defined by the *National Energy Policy until 2020 Guidelines Act* of 2001, which highlights the importance of renewable energy sources and energy efficiency in the local energy planning. However, in the majority of rural or semi-rural areas there are no experts who would be sufficiently trained in technological, environmental or economic aspects of RES. In this situation the plans are most often done in a "traditional" way, i.e., with giving little or no consideration to biomass or energy efficiency (DSM) actions.

Another related factor, hampering the introduction of biomass options into the local energy plans is the competition of gas and oil. The 'marketing power' of gas and oil boiler dealers or installers greatly exceeds that of their biomass counterparts, especially at the local level. The experts - if hired by the municipality - most often line up with the oil or gas lobby and give no attention to the use of RES. **Biomass is given due attention practically only when the mayor and/or important local decision-makers possess sufficient own knowledge about sustainable energy options. Most of the successful biomass projects were realized in *gminas* where at least some of the important local decision makers underwent relevant training**. This emphasizes the need to continue and enhance education and training effort targeted at local decision-makers such as the TEMPUS Project described in Annex 5. Unfortunately, the local administrations are preoccupied by other problems, such as health care or unemployment and are not anxious to spend their limited financial resources on training related to sustainable energy. The programs, such as TEMPUS, were successful primarily due to the external funding. An example illustrating the need of continuation of such projects is the fate of the plan to train forestry administration people in modern energy oriented forest management and establishing fast growing tree plantations, which is also described in Annex 5.

The availability of local experts and awareness of local decision-makers becomes particularly important when it comes to the use of the Structural Funds where production and utilisation of biomass for energy production should be included as a very important component.

8.5 Biomass in local energy planning

At this point it is important to note that the lowest level administration units (*gmina*) is usually not an optimum size for local energy planning, especially as regards inclusion of the biomass option. The majority of *gminas* in Poland are rural or semi-rural, where – as mentioned above - there are no people who would be sufficiently trained in the area of RES (or Energy Sustainability in general), as far as the technological, environmental or economic aspects are concerned. The financial resources of the municipalities are as a rule scarce or very scarce so that doing the necessary research, which most often requires hiring external experts, creates a significant burden for their budgets. Hence, municipalities face a difficult task, because neither the expert potential nor the financial capacities are usually available locally. Moreover, it should be mentioned that – although the preparation of such plans is mandatory by law – the deadlines for completion of this task have not been set. Consequently, so far, only ca. 10 % of the municipalities have prepared the mandatory plans. Unfortunately, due to the lack of sufficient knowledge about the RES or energy efficiency potentials and technologies, such plans are most often done in the “traditional” way, i.e. without giving consideration to any DSM actions or elimination of fossil fuels by RES. The latter, if taken into account at all, usually boil down to plans to eliminate coal boilers by switching to grid gas or heating oil, which is an obvious misunderstanding. This is usually seconded by intensive marketing of such equipment by dealers and installers, as well by a supportive attitude of the Gas Distribution Utilities. Also, the external experts, once hired, often line up with the oil or gas lobbies and no insufficient attention is put to use of RES.
Energy utilities are also obliged to prepare their own plans for energy supplies. They have to make them available (free of charge) to the municipal administrations in their respective service areas. Optimally the plans should be developed in cooperation of both, the utilities and the municipalities. However, the utilities are rather reluctant to purchase expensive RES-energy, basically because it is in conflict with their business policy. Power utilities and producers have to secure certain mandatory fractions of “green electricity” which has led to a dramatic increase of interest of power generators in buying wood chips for co-firing with coal (see Section 9.2). On the other hand, District Heat Utilities are obliged to buy any offered green heat. However, the obligation applies only if such purchase doesn’t lead to deterioration of their economic performance indicators. This can hardly be denied if the DHU claims so. In order to avoid the potential conflicts between a municipality, which may be interested in using local biomass for heating, as a representative of local biomass suppliers or heat consumers, a strong instrument has been given to municipalities. If the energy development plan prepared by the local energy utility does not meet the guidelines of municipal energy development, the municipality mayor (or president) is in charge of preparing their own plan, based on the guidelines set forth by the municipal council.

According to the Energy Act, the provincial governor reviews the compliance of local energy development plans with the national energy policy. Additionally, co-ordination with the plans of other municipalities in the province should be assessed by provincial administration. However, in case or RES and DSM, co-ordination hardly exists in practice. Moreover, even if such co-ordination were attempted, the province level would not be relevant to the sustainable energy part of the plans for reasons described below.

As mentioned above, energy planning at the basic territorial units level has been so far rather ineffective. Moreover, for such small territorial level the production and use of biomass cannot be effectively optimised: some of the neighbouring *gminas* may have surplus, (or potential surplus) of biomass, while the other may have too little. Besides the lack of financial capacity and know-how, it is difficult to coordinate the actions among municipalities (*gminas*) if plans are made independently. On the other hand, Polish provinces *(wojewodztwo)* are territorially too large and inhomogeneous for such planning to be effectively harmonised, as the topological and agricultural conditions, potential resources, settlement structure and development priorities differ in different parts of the same province. **In the present administrative structure, the most appropriate level seems to be the level of *powiats* (counties) or groups of several neighbouring ones with similar or complementary characteristics. Such a scale of planning of the use of RES would, in particular, facilitate the cost-effective allocation of surplus biomass from the production area to the communes where the demand is higher than the existing potential. Thus the effective solution would be to bring the co-ordinationt down to the county or NUTS3 level (groups of counties) and bring the local planning to same level from *gminas*.**

One should note that in the future such territorial units for energy planning might comprise counties or municipalities neighbouring across the national borders. An example of such an initial attempt was the *"Strategy for the Use of Biomass in the Polish-Slovak Border Region with Emphasis on Wood Waste"* developed jointly by "Biomasa", Association of Slovak Municipalities, and the Krakow Institute for Sustainable Energy in 2003.

8.6 Energy awareness of local decision-makers

The environmental awareness of local decision-makers (elected representatives and executive officers alike) related to energy production and use, is of crucial importance for re-orienting the present non-sustainable energy management patterns towards more environmentally oriented ones. In Poland the average level of energy-environmental awareness of local decision makers is still highly insufficient. However, it must be admitted that the situation has significantly improved over the past decade. It should be largely attributed to the variety of training and education projects supported by the NFOS and other sources such as the EU TEMPUS Programme, German Marshall Fund of the US and other American or European organizations. Form the point of view of the development of RES, the most important target groups were the representatives of the local administration and Small and Medium Size Enterprises. Many examples can be given of the implemented projects, inspired by such training and education efforts. One should note, however, that the 4-year term in office of the local government is often not sufficient to close the investment cycle. It happens that a good biomass project is cancelled by the new mayor or municipal council, often for political reasons rather than based on its environmental or economic merits. **Therefore the awareness-raising and education effort targeted at local decision-makers should be a continuous process.**

One of the factors, which generated the interest of the local administrators in RES, has been the planning obligation imposed on the local authorities by the Energy Law of 1997, through its emphasis on renewable energies and energy efficiency. This factor should become interested in the issue, was the financial support schemes for energy efficiency, such as the Thermal Renovation Fund on one hand, and grants or soft loans for RES provided by ECOFUND or the National Fund for Environmental Protection and its provincial branches. One should note here that the support schemes once driven only by simplified financial considerations, have sometimes led to counterproductive results from the point of view of RES, as illustrated above by conversions to gas and oil. In this situation, the awareness raising effort of an educational character is very important and needed. Such an effort can produce particularly good results if it includes visiting the working demonstration sites, as is illustrated by the impact of training courses addressing the issue of on Sustainable Energy Development organised for Polish local decision makers within the TEMPUS Programme (see Annex 5).

9. Particular issues

9.1 Integration with energy Efficiency

Although energy efficiency of Polish economy has substantially increased since 1990, Poland's energy intensity still remains higher by a factor of c.a. 2 compared with the EU-15 average. The energy saving potential is especially significant in the space-heating sector. A fundamental question that arises when policy of supporting biomass is considered is why such schemes should be used for supporting also losses of energy (heat or electricity) derived from RES. Most of the support schemes (Polish, EU or other international) address the two issues separately, while the logic would indicate that **the RES investments should be integrated with energy efficiency improvements to the greatest possible extent**.

In Poland the very successful GEF-IFC Project "Polish Efficient Lighting Project, PELP, (promotion of Compact Fluorescent Lamps) implemented in 1996-1998, preceded the green electricity promotion scheme (mandatory quota) introduced in 2001. However, as the recent experience shows there is still ample room for increasing the efficiency of the end-use of electricity that should be harmonised with the green electricity drive. **Market signals will not solve this problem in the deregulated electricity system.** A regulatory solution has to be devised**,**

In 1999 the Krakow Centre of the Polish Foundation for Energy Efficiency (FEWE) suggested an idea of an integrated approach to space heating and shaped into a project together with the AGH-University of Science and Technology (see Annex 3). Conversion of ca. 6 MW from coal to locally produced wood waste was to be integrated with low-cost thermal retrofits of the buildings that were to be connected to the DH grid fed by biomass-derived heat. At that time the project was sufficiently innovative to obtain the GEF grant of 950 000 USD, which was finally approved by the GEF Council in March 2001. At present, possibly related in time to that initiative, more and more similar support schemes have been put in place. Notably the Thermal Modernisation Act includes as eligible also costs associated with conversion from coal to biomass. Similarly ECOFUND has launched grant lines integrating RES and energy efficiency. Another project following the same philosophy is described (Slupsk in Annex 3). One should consider this development as very positive. **The "Integrated Approach" is worth to be "institutionalised" as an inherent component of the RES projects also at the EU and/or GEF level.**

9.2 Co-firing of biomass with coal

The last (amended) version of the Polish Energy Act introduces obligation for energy utilities to purchase RES electricity. The minimum quotas on the share of green electricity in their purchase portfolios are determined quantitatively by the ordinance of Minister of Economic Affairs. The first ordinance to the Energy Act concerning RE purchase obligation came into effect on December 15th 2000. The Ordinance set the green energy fraction at 2.4% in 2001, which would be gradually increased up to 7.5% in 2010. However, the Ordinance had several essential drawbacks: there were uncertainties about fulfilling recommended quotas and about penalties that were to be imposed on energy utilities failing to meet the targets. Most importantly, it made it possible to count the same green electricity several times by different utilities, as the "certificates of origin" were not yet in place. Consequently, the Ordinance was updated on May 30th, 2003 with the fractional quotas remaining unchanged, but now also extended to power generation. Presently the Energy Regulatory Authority (URE) is preparing an updated version of the Ordinance, extending it to co-generation. The Green Heat obligation remains so far unchanged and there is no work going on its modification.

The enacting of the green electricity ordinance and prospects of its consequent execution have led to an explosion of demand for biomass for co-firing with coal in power stations. Although, from the global environmental point of view, the tendency should be welcome, a critical analysis is needed. On one hand, it is argued that with the ca. 2 million hectares on unused arable land the needs of Polish thermal coal-based power plants and needs of other users can be satisfied, even leaving room for exports. Indeed, this is possible and attractive, since technical evidence already exists that replacing up to ca. 10% of coal in the existing power plants is technologically feasible and does not require any significant investments. On the other hand, however, one may expect that within the radius of 50-100 km from most of the power plants the potentially available biomass will be totally drained by power stations for electricity generation, leaving no biomass for space heating. From the social, economic and environmental perspective this solution can be far from optima. In Poland, where coal is abundant, the rationale for introducing green electricity quota is **mitigation of Global Climate Change rather than economic considerations.** On the other hand, it is not so when it comes to the local use of biomass, where it is often a practically free resource. Therefore, a careful analysis is needed which should take into account also such factors as embedded GHG emissions and energy costs for the final consumer. The Ordinance should be appropriately modified to reconcile the global environmental benefits with the national and local ones. Finding the solution to this problem is important also for other EU counties, notably to the coal based transition ones, as e.g. the Czech Republic. Such an analysis may also provide an input to revision of EU RES policies, which seem to put too little emphasis on biomass as fuel for space heating as opposed to electricity production or co-generation.

The associated problem is the explosion of interest in plantations of fast growing willow (*salix viminalis*), which is driven by the green electricity purchase obligation. The expectation of huge profits has stimulated significant investment in willow plantations. Given the local agro-technical conditions this needs not to be an optimum solution, as there are other plants that may give more final energy yield or financial revenue per hectare. A systemic approach to the problem is lacking. At present there is practically no co-ordination of actions and initiatives, which are mostly undertaken *ad hoc*, to locate "hot money". These may turn out to be investments leading to stranded costs, especially that *salix viminalis* is an investment calculated for a lifetime of 25-30 years. In this situation **a research effort to optimise the production and use of biomass in a given territorial area should be undertaken as soon as possible, the more that scientifically meaningful results of such a research would not be available "overnight".** An attempt to fill this gap is described in Annex 4.

10. Motor Biofuels

The fate of the Polish Liquid Biofuel Act is an example of a failure to achieve political solution that would provide Poland's contribution to mitigating the global environmental threat posed by Climate Change. In the past two years Poland witnessed a hot political debate about liquid biofuels for motor vehicles. Several proposals were prepared, submitted for the Parliament's approval, accepted, vetoed afterward by the President, returned to the Parliament, modified, again approved, again submitted…Finally a tediously elaborated agreement was reached, the bill was signed by the President of the country in November 2003……. only to be killed by the Constitutional Tribunal in the end of April 2004, on grounds of violating (according to CT interpretation) the principles of the Polish Constitution. Consequently, over two years of tedious negotiations and huge amount of work done by experts and politicians in rounds of exchanges between the government, Parliament and President have been wasted.

Below the history of the Biofuel Act is described in some detail as it provides a case study of a political failure of great significance for Poland and possibly for other countries.

The **first proposal** of the Biofuel Act of **early 2002** was rather radical. It would place Poland as the European leader in imposing mandatory contents of bio-components in motor fuels. The proposal was successfully lobbied by the (then) coalition party PSL, representing mainly the Polish farmers. The main goal of the Act was to promote biofuels i.e., mixtures of petrol with ethanol or diesel with the methyl or ethyl esters. The proposed mandatory admixture of bio-components was 4.5%, to be enacted starting from January **1st, 2003.** The proposal faced fierce opposition from the oil and car lobbies, and from the opposition parties, mostly from the right wing liberal Citizens' Platform (Platforma Obywatelska, PO) and the populist Samoobrona. On July 23rd three different proposals were submitted to the Chamber: the aforementioned government proposal, and two other proposals prepared by PO and Samoobrona. After prolonged wrangling in the parliamentary commissions, the version proposed by the government was finally adopted on **November 13th, 2002** with the SLD-PSL coalition votes. According to constitutional procedures the Act was passed to the Senate for approval. The Senate, however, "softened" the proposal to the extent hardly acceptable by the leading proposer, the PSL. In particular, the Senate's amendment #49 required leaving consumers the choice of buying "pure" fossil-derived fuels and placing information on the filling stations which fuel is which at each pump. This would, of course, require huge investments, as additional tanks and pumps would have to be installed in all petrol stations. The modified Act was returned to the Lower Chamber, which rejected the Senate's amendments on **December 12th, 2002**. Since then, only the signature of the President of the country remained for the proposal to became law. However, the president Mr. Kwasniewski yielded to the pressure of the anti-biofuel lobby and **vetoed the Act, on January**

18th, 2003. This meant returning the whole Act to the Sejm (the lower chamber) to introduce changes required by the Senate and President or to reject the President's veto. The veto, however, was not rejected, due to the split in the SLD MPs' ranks. This was a serious blow to the prestige of the coalition party PSL. Consequently, PSL took a deadly revenge, by voting against another act that envisaged introducing payments for the use of Poland's roads, based on the examples of (e.g.) Austria or Slovakia. That act was an initiative of SLD; no doubt very much needed to raise funds for construction of new roads and motorways to match the EU support. This exchange of blows soon led to the split of the coalition in March 2003.

This notwithstanding the (since then) minority SLD government prepared a **second proposal,** which was approved by the Lower Chamber on **July 10th, 2003**. The date for introducing the obligation to add bio-components was shifted to **October 1st, 2003** and the minimum fraction of admixture was lowered to 3.5% from 4.5%, for the period October 1st – December 31st, 2003, and to 4% since then on. At the same time, the upper limit on the bio-component fraction was set at 5%. The new Biofuel Act took into account the newest World Fuel Chart of December 5th, 2002 and the EU directive 2003/30/EC.

This time the Senate introduced "only" 15 changes, among them shifting again the commencement date **to January 1st, 2004** and adding obligation to place information for consumers about what is the actual fraction of bio-component at each pump. The Act was returned to the Sejm on August 7th, 2003. However, at this point a puzzling thing was discovered. The text, now again in the Lower Chamber, differed from the one the MPs believed they had voted for. The difference was merely two words: **"and other".** This difference was, however, absolutely crucial in the whole debate for winning the support of the farmers' parties, PSL included (now in opposition). Indeed, the „believed" version stipulated that the bio-components must be produced only from plants harvested domestically for the period of five years since the Act would have entered into force. To make it sure the "eligible" plants were explicitly enumerated. Somehow, rather mysteriously, at the end of the list two words: "and other" (plants) appeared, invalidating the whole idea.

This evoked an abrupt reaction of the Marshal (President) of the Lower Chamber, Mr. Borowski, who scrapped the whole Act and ceased the legislative procedure on **August 28th, 2003**. No wonder, Poland was then living with a huge corruption scandal, where an attempt was apparently made to "buy" changes in the parliamentary act regulating the media market. The trick was very similar; in that case two words, **"or periodicals"**, were deleted which meant in practice millions of EURO annually for the potential beneficiaries. The case was subject to public prosecutor's inquiry, and an investigation by a special parliamentary commission (labelled "Rywingate" = Polish Watergate). The Biofuel Act case was also brought to the prosecutor, who concluded, however, that this time it was merely a technical mistake.

The work on the formally new act was resumed quickly. This time, both the ruling party SLD and all opposition parties, except for PO (the rightmost party as far as economical policies are concerned) worked jointly. Sejm accepted **the third consecutive proposal** on **October 2nd, 2003**. The "domestic origin" clause was limited in time only until accession on May 1st, 2004, although the pressure to protect Polish farmers was quite significant. This time the Act also set an upper limit on bio-components in the fuel at 5%. The lower bound has been delegated to government executive regulation, which would be revised annually. The fuels with contents below 5% were classified as "normal" fuels and no additional information for consumers at the filling columns needed to be displayed. Only columns with fuels with a higher content (now referred to as “biofuels”) would have to be labelled appropriately (if a particular filling station would decide to include them in its offer). This time the Senate introduced no changes and president Kwasniewski signed the Act on **November 17th, 2003**. Consequently, the Act should have entered into force on **January 1st, 2004**. Unfortunately, this was not the case, as the supplementary legislation delegated to the ministerial level was not yet ready. Those was soon prepared. However, meantime the Polish ombudsman filed the case to the Constitutional Tribunal, which - as mentioned above - killed the bill on **April 21st 2004** arguing that it violates several principles of the Polish Constitution. The arguments were that it would

(1) limit the freedom of the (free market) economic activity,
(2) infringe consumers’ right of free choice and
(3) cut consumers’ access to information about product specification.

Over two years were wasted in exchange of blows, more than pondering arguments related to the subject of the matter. The delay was due mostly to regrettable political wrangling and infighting, having little to do with the real issue itself. Unfortunately, as mentioned in Section 4.2, the environmental NGOs proved to be too weak to influence the process of decision-making. Public opinion was greatly influenced by media. The majority of media implicitly or explicitly sided with the powerful anti-biofuel lobby, and created a degree of panic among the car users and fuelled arguments for anti-biofuel politicians.

At the same time, the arguments that the introduction of the mandatory admixtures of bio-components to fossil fuels for motor vehicles - apart from the global impact - would greatly help the troubled Polish agricultural sector and, by this virtue, Poland’s economy at large, were played down. Other arguments were overshadowed as well (energy security of the country, improved trade balance, increased volume of Poland’s GHG emission credits). Even the hot unemployment issue did not surface, despite the fact that job creation in unemployment-ridden areas would be a significant effect; according to government estimates **ca. 100 thousand people would find employment in the biofuel sector by 2005.** The same source estimated the farmers’ total revenue from rape-for-biodiesel production alone at 46, 126, 219 and 328 mEURO in 2002, 2003, 2005 and 2007, respectively. These are – as it looks now – lost opportunities. No doubt, the cancellation of the Act has benefited the (fossil) oil lobby instead.

Unfortunately, the prospects of returning the act again on the legislative path are rather slim. The main proposer of the Act, representing the Polish farmers, the PSL, will most likely be no more much interested in resuming the effort, as the “domestic origin” clause cannot be kept valid any more after May 1st, 2004 (one should note in passing that such a clause would be highly justified once embedded GHG emissions are taken into account).

The fate of the Polish Liquid Biofuels Act seems to provide an example of the lack of environmental concerns of the top-level decision-makers, who – while exposing principles of free market and right to choose or be informed - ignore the global threats of Climate Change and peoples’ rights to live in a cleaner and healthier environment. One may reflect that, along with the postulated awareness raising effort, directed at local administration people, some kind of awareness raising effort targeted at the very **top political and media decision-makers** should be devised, (assuming that the trainees are ready to listen to arguments).

11. Conclusions

11.1 Identified phenomena and tendencies

As mentioned in Section 2, in designing this case study one had to bear in mind that the problem of the energy use of biomass cannot be treated consistently in an item-by-item manor since the particular phenomena are correlated or influenced by each other. Having reviewed a range of issues and problems, an attempt is made below at identifying some common phenomena and tendencies of the development of the bioenergy sector in Poland. In the following these phenomena and tendencies are analysed from the point of view of:

- Actual and forecasted outcomes
- Transferability
- Policy recommendations
- Research recommendations

In fact, the identified phenomena can be classified into two main categories (of course there is a degree of overlap). These are those pertinent to: (A) policymaking and (B) research

A. The phenomena of the first category are:

1. Growth of interest in production and use of biomass for energy purpose, still requiring a scientifically grounded guidance (Sections 8.4, 8.6 and 9.2, and Annex 4)
2. Growth of business activity in the bioenergy sector and related industries (Sections 7, 9.2 and Annex 1)
3. Growth of awareness of local decision makers, however insufficient and requiring continuous training/education/demonstration effort (Annex 5 and Section 8.6, as well as Section 10 in its negative dimension).
4. Actual and potential positive impact on country's economy business development (Annex 1), job creation (Sections 4,7 and 10)
5. Local energy planning as regards size of unit territorial area for which the RES are made (Section 8.5) and importance of local strategy (Annex 3)
6. The need of integration (coupling) of RES investments with energy efficiency (DSM) undertakings (section 9.1 and Annex 3).
7. The need of putting more emphasis on real "hardware" projects at the expense of "soft" projects, which do not provide examples to be followed in practice (section 8.1 and Annex 3)
8. Solution of the problem of small-scattered biomass suppliers (Section 8.3, Annex 3).
9. The impact of the EU-legislation on the improvement of the Polish legal framework related to the environment and energy, biomass inclusive (Sections 7 and 6)
10. The role of media, NGOs, and inertia of public opinion (Section 4.2 and 10)

Bearing in mind that most of the issued listed above are related also to research needs, one can include specifically in the second category:

1. Need to provide scientifically grounded guidance for the Market Force, as the market signals to business can be misleading
2. Creating model to support decision-making in energy planning as regards the optimisation of the use of the locally available (or achievable) RE resources.
3. The need to support both applied and fundamental research in the development of new biomass technologies

11.2 Actual and forecasted outcomes

It should be noted first that the present level of utilisation of the biomass resources in Poland is rather small. However the growth rate is remarkable. The growth of interest in and the growth of business in the bioenergy sector is an observed phenomenon. Annex 1 illustrates this in particular, although other annexes give also support to this statement.. These trends will most likely persist in the foreseeable future. The targets set forth in the "*Development Strategy of Renewable Energy Sources,*" may be difficult to achieve in general, however it is rather obvious that, if the targets are to be approached at all, biomass will have to play a dominant role. Poland has a good chance to become one of the European leaders in the field of the use of biomass for energy purposes.

The energy-environment awareness of the local decision-makers is a crucial factor for development and implementation of bioenergy projects. This has increased significantly over the past decade, partly due to the financial support schemes such offered by NFOS or ECOFUND and partly (in fact largely) due to determined awareness raising effort supported by domestic and foreign grant sources. (eg. . Annex 5). However, bearing in mind that the term in office of those officials is typically 4-8 years the awareness raising (training, education, demonstration) should be maintained in the mid-term future. The difficulties that appear are best illustrated by an attempt of the Krakow Agricultural University, which has planned to offer postgraduate courses in forestry oriented at production of biomass for energy. The courses have been offered to people involved in forestry (primarily, state, provincial and local forest administration or local self-government representatives). However the response of the State Forest Administration was practically negative, while without their support, the course will raise little interest. On the other hand, if the courses were offered free and included visits to successful examples in the EU countries, the number of candidates would be certainly sufficient. In the past decade such projects were possible within the TEMPUS programme in particular, and turned out to be very successful in terms of producing long-term effects.

Without finding a solution to continue the awareness raising effort the tendency may decline. It may slow down the aforementioned growth of the bio-energy sector; however, it is unlikely that this may lead to its reversal.

No studies of the up to date impact of the development of the bioenergy sector on the country's economy are available. In fact, it would be difficult to disentangle the relevant numbers from the macroeconomic data. Nevertheless,some observations are obvious: Annex 1 illustrates the business growth effect while the job creation effect is quite real as empirical data indicate (one full time job for each 10 hectares of willow plantation). The government forecasts of 100000 jobs in the bio diesel production were based on a sufficiently careful analysis under the assumptions used. The tendency of job creation will most likely persist, as the energy plantations (of whatever energy plants) will no doubt grow at a rather rapid pace, considering the demand generated by the green electricity purchase obligation, in particular.

In general, local energy plans include the RES option in a highly unsatisfactory degree. This is one of the reasons why the present level of utilisation of renewable energy resources is so small (still one should bear in mind the dynamics of the development). The failure of the local energy plans to include RES should be attributed to the structural deficiency, i.e. energy planning at the lowest administration level. It is difficult to foresee when and how this deficiency will be removed. Still shifting the responsibility to a county or NUTS 3 level would help optimise the use of the local biomass resource. In particular this would help finding optimal solutions for making an energy use of biomass produced by small-scattered suppliers via PPP ventures. At present, this phenomenon is only emerging. However, with sin other new member states.

The present policy of the domestic financial assistance sources (ECOFUND NFOS/WOS) with the emphasis on hardware projects has, no doubt, a positive impact on the development of the bioenergy sector in Poland. Both sources put an increasing emphasis on biomass. It should be assumed that this tendency will continue in the future, partly due to the *"Development Strategy of Renewable Energy Sources".* The same tendency is observed concerning the support to "integration" of RES investments with DSM undertakings. It would be much more effective if this approach were institutionalised as a principle in giving support to the RES investments.

The impact of EU legislation has been indirect but essential for the development of RES in Poland. This phenomenon by its formal nature will be now enhanced. The impact of the national policies in support of biomass is noticeable, especially if one considers the financial support schemes. Again there are reasons to believe that this tendency will be continued.

The important observed phenomenon is the relative weakness of environmental NGO when it comes to a decisive political debate. The information policy of the majority of media as the biomass issue is concerned is lukewarm to say the least. Media seem to be influenced much more by business than by environmental organisations. This has an impact on public opinion, which became ambivalent as regards the environmental problems. This phenomenon does not seem to disappear quickly.

11.3 Transferability

Some of the phenomena listed above are transferable at the national scale, some also at the EU level, particularly of the new MS. The latter would include the "hardware" oriented policies of ECOFUND and NFOS, as well as the tendency of integration of RES investments with DSM measures.

The same concerns the awareness raising efforts, which are most successful when it includes practical demonstration (visits in actually operating demonstration facilities).

Some of the listed phenomena are only potentially transferable: One may assume that once the PPP approach to manage the locally available biomass resources, , possibly coupled with the shift of local energy planning to the NUTS 3 level are successfully demonstrated, they would find a great dissemination potential. The same concerns the effect-of-scale approach developed in Trzcianne, and – if implemented – the 400000 country-wide project.

Similarly, the concerns raised in Section 9.2 about the impact of co-firing biomass in large power plants, about insufficient attention paid to biomass as fuel for space heating should be analysed at the EU (especially the new MS) level.

However, some lessons learned should be transferred to other entities in Poland and abroad. These are: the experience of the failed Polish Liquid Biofuel Act and that of the project described in Annex 3. The latter shows that people who have sufficient engineering background and experience should manage technical „hardware" projects, rather than people whose knowledge of the technical substance of the subject is small or next to none.

11.4 Policy recommendations

The main policy recommendation concerning the bioenergy sector follows from the fact that biomass is used most optimally in the area where it is produced. In Poland, due to the climate conditions, the major problem is space heating. This means that a bulk of the users is small energy consumers (individual households or farms, schools, small or medium size DH systems). This in turn means that public support to such individual projects will have to be continued, which will benefit particularly rural communities, but also – indirectly – the country's economy at large.

The present policy of supporting such investment in their "hardware component" should be continued. The biomass co-generation projects should be given particular attention and should be analysed together and confronted with the no-cogen option.

The green electricity ordinance should be modified based on a careful analysis of its global environmental and local economic impacts.

The policy of integrating the biomass (RES in general) investments with the energy efficiency (DSM) measures, whenever possible and effective, should be "institutionalised" in the policy of awarding public support to fuel conversion (or new biomass) projects.

The level of local energy planning should be placed at the county or NUTS3 level at least as far as biomass use is concerned. At the same time the public support to training of local decision-makers in energy sustainability should become a constant component of the NFOS funding. The best solution would be to delegate the effort to a selected organisation or institution with sufficient experience in this area.

11.5 Research recommendations

Research in the area of the energy uses of biomass is greatly insufficient due to the lack of funding. This applies both to the technological development and more general related research. Therefore, the basic and most obvious recommendation is to increase the funding. In view of the rapid growth of the bioenergy sector in Poland, and the possibility of obtaining "stranded" effects, the most urgent need is to provide scientifically based guidance for investors and planners. This applies both the local and national level.

A particular task concerns the biomass-coal co-firing described in Section 9.2. A model taking into account the GHG emissions reduction (with embedded emissions included), the local economic factors and social effects (employment in particular) should be created.

Since the final forms of biomass-derived energy compete to the same **limited resource in a given territory,** a more general problem is identifying a spectrum of close to optimum solutions for the use of locally available (potentially available) biomass resources in a given territorial area. By its very nature such research is multidisciplinary and will require involvement of scientists representing different research areas. To keep the long-term perspective as guidance for the future, such research should be done parallel with the R&D work of a technological and fundamental character.

It is worth to emphasize again that as the Polish experience indicates **market is an important player, provided its signals are based on scientific research and demonstration**.

Annex 1

List of boiler manufacturers and distributors who developed their business in the recent years

(the list may not be complete)

MANUFACTURERS AND DISTRIBUTORS OF BOILERS	APPLCATION	CAPACITY	FUEL
AGRO ENERGIA- Poznan	• central heating • hot water	• 25-100 kW • 25-115 kW	pellets, wood
AGROENERGETYKA- Luban	• public boilers • industrial boilers	• 750-3500 kW	straw
ASBUD	• central heating • hot water	• 6-45 kW • 10-24 kW • 35-1105 kW	wood
ATEX	• out of limitation	• 200-1500 kW	straw, wood
ATMOPOL - Wroclaw	• public buildings • houses • industrial buildings	• 8-100 kW • 14-75 kW • 10-50 kW	wood
ATMOS	• public buildings • houses • industrial buildings	• 15-80 kW	wood
BARRIER	• to heat surface above 300 m	• 46 kW	straw, wood
CICHEWICZ-KOTLY Plonsk	• houses • public buildings • industrial buildings	• 6.9-40 kW • 15-30 kW • 14-100 kW	pellets
EKOCENTR- Pleszew	• houses • industrial buildings • store	• 18-80 kW	wood, willow
EKO-VIMAR ORLANSKI- Otmuchow	• various central heating	• 4-85 kW	solid fuels
FERROLI	• wood industry • sawmill industry • technological boilers • public boilers	• 200-8000 kW	wood
FERRUM	• central heating- out of limitation	• 20-60 kW	wood, coal, various solid fuel
FINNMARCON	• central heating	• 300 kW • 600 kW • 1000 kW • 2000 kW • and other	wood, biomass
FU-WI PPHU- Elblag	• public buildings • houses • industrial buildings	• 10 kW • 20 kW • 30 kW	wood
GIZEX PHPU- Pleszow	• to heat a surface between 370-5900m	• 41-650 kW	straw
GRASO	• to heat various rooms	• 60-1100 kW	straw, wood
GROS-POL- Poznan	• public boilers • industrial boilers	• 4000 kW • 2000 kW • 1000 kW	straw straw and wood straw

HAMECH Z.M- Hajnowka	• houses • industry buildings	• 50 kW • 100 kW • 250 kW • 500 kW • 1000 kW	• wood-granulated max.30mm and humidity 30-50% • wood-humidity 40-60%
HEF- Lubliniec	• public buildings • houses • industrial buildings	• 17-50 kW • 25-1200 kW • 25-50 kW	• wood, pellets • coal, pellets
HEITZMANN POLSKA Milomlyn	• out of limitation	• 20-110 kW	wood, sliver, brushwood
INVESTEAM- Lubowidz	• houses • structures below 1000m • structures below 30.000 m	• 25 kW • 25-100 kW • 100-35.000 kW	• pellets • pellets, wood • pellets, wood
KORTEX Sp. z o.o.	• public buildings • houses • industrial buildings	• 11-500 kW	coal, wood
KOSTRZEWA- Gizycko	• houses • flats	• 25-300 kW • 23-95 kW	• Straw, wood-granulated 5-25mm • Straw, wood-granulated 5-10mm
KOTLAN Sp z o.o. Ciechanow	• houses • flats • industrial buildings	• 14-70 kW	wood, coal
KOTLARZ	• houses • public buildings • industrial buildings	• 18-80 kW • 18-110 kW	waste(material),wood
LECHMA	• out of limitation	• 15 kW • 19 kW • 24 kW	wood
MAWI P.P.H.	• houses • public buildings • industrial buildings	• 25 kW • 80 kW	wood
METALERG- Scinowa Polska	• houses between 100-300m • industrial buildings	• 15-32 kW • 40-700 kW	wood, straw, energetic willow
MODERATOR- Hajnowka	• central heating • hot water	• 12-600 kW • 25-120 kW	biomasa
PELIKAN	• out of limitation	• 14-600 kW	Biomasa, coal
POLYTECHNIK DPU Sp. z o.o.- Strzegam	• industrial buildings	• 40-1500 kW	wood
PGK SYSTEM- Osielsko	• houses • flats	• 22-250 kW • 50-200 kW • 30-50 kW • 12-14.9 kW • 15-25 kW	• wood, coal • biomass • wood • wood, coal • pellets
SHELLING POLSKA	• hotels • social buildings • individual buildings	• 110-859 kW • 1100-5000 kW	wood+gas+fuel oil
SM 21 ENERGETYKA Sp.z o.o.- Lodz	• wood industry • food industry	• 180-650 kW	wood, paper, energetic willow

UNICAL	• heating installation in self contained	• 6-45 kW • 10-24 kW	wood, coal
URBIS - Torun	• city • country	• 14-100 kW • 20-250 kW • 20 do kilku MW	• wood • biomass, coal oil • wood, pellets
VERNER POLSKA	• houses • flats • warehouse	• 7-25 kW • 25 kW • 25 kW	• pellets • wood • wood
WARYNSKI- Torun	• out of limitation	• 1000 kW • 3500 kW • 2000 kW • 750 kW	straw
WAT- Warszawa	• houses between 100-300m • industrial buildings • flats	• 15-32 kW • 40-700 kW	• wood, straw, energetic willow • wood, straw, energetic willow
WEISS A/S	• any	• 500-12.000 kW	wood, straw
ZAMER- Kraszewo	• industrial buildings	• 500-3000 kW • 500-8000 kW • 500 kW	woods waste
ZUK- Staporkow	• modernization of coal boilers in many kinds of buildings	• 1 MW • 2 MW • 4 MW	wood
ZUBR- Hajnowka	• houses • schools	• 6-700 kW	biomass, wood, straw
ZAR	• individual buildings • small industry	• 20-50 kW	wood

Annex 2

Straw-based heating in District Heating in Luban

Introduction

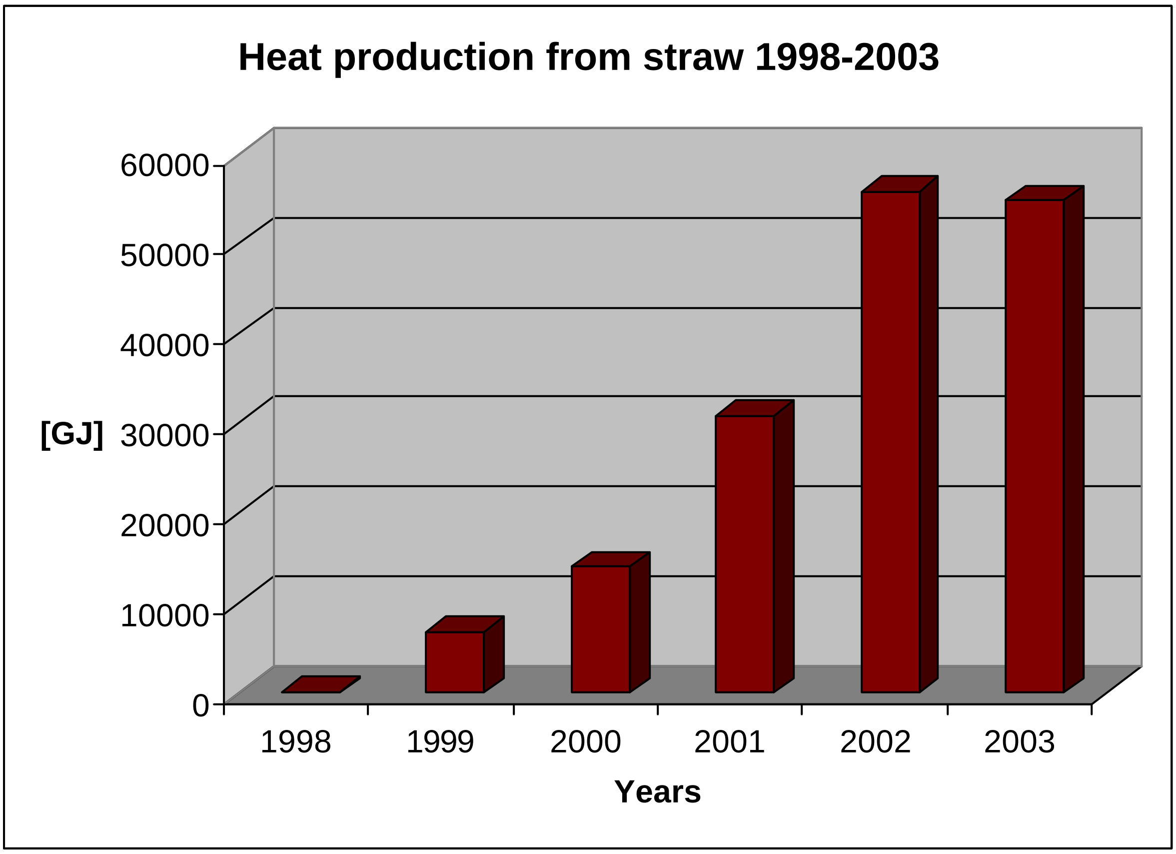
Luban is one of the newly created counties. It is situated in the West of the Lower Silesia (Dolnoslaskie) Province. The county belongs in part to the geographic macro-region of the West Sudety Mountains in South-West Poland. The capital of the county is the City of Luban town.

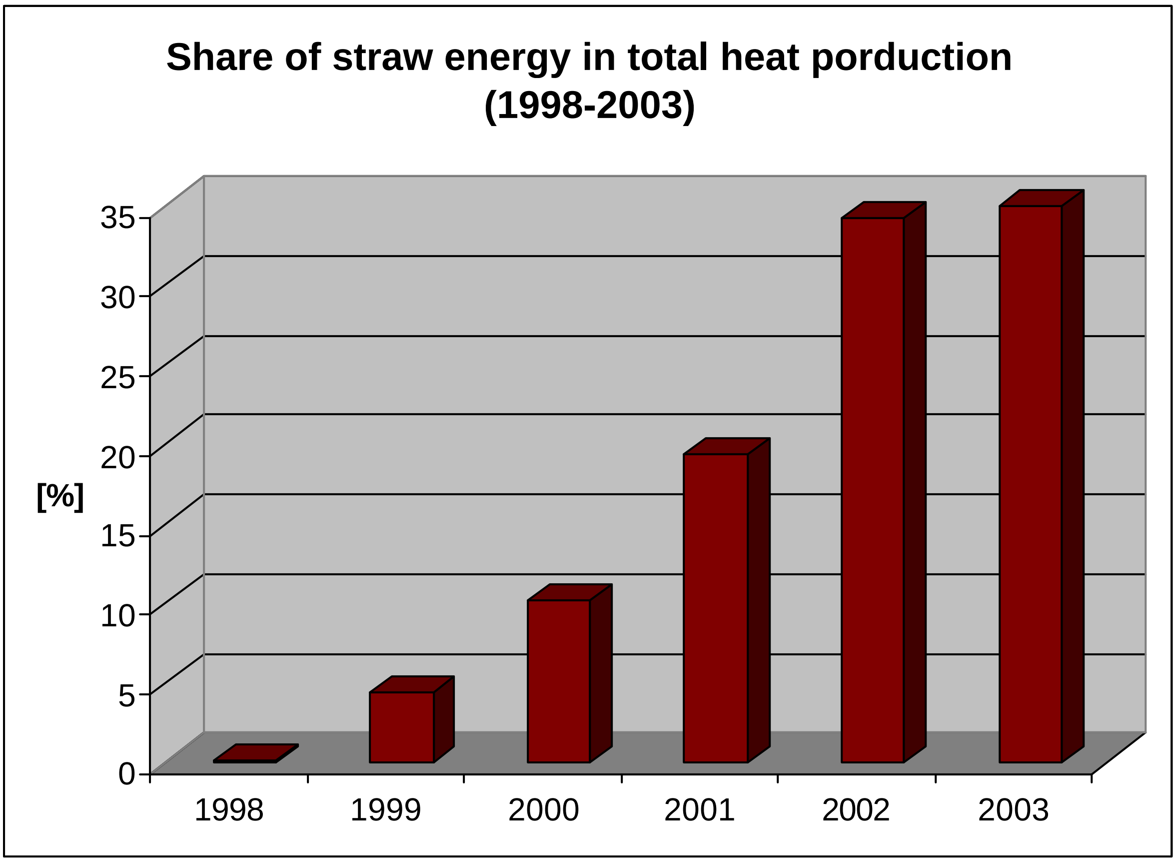
The settlement structure is: 3 towns and 54 villages with an area of 429 $km^{2,}$ of which the towns make 10.6%, while rural areas cover almost 90% of the area. The nistance from the most important European cities: Berlin - 200 km; Prague - 150 km; Vienna - 400 km, Warsaw - 505 km.
The Case Study is based on the experience of District Heat Company in Luban (PEC-Luban) established in 1998. PEC-Luban operates one of the largest straw-based DH systems in Poland total straw-based capacity of 8,0 **MW** (2 x 3,5 MW and 1 x 1,0 MW boiler). Total DH capacity is 29,47 MW (8 MW- straw, 21,4 MW- coal, 0,17 MW- gas). The strategy of the Company is to maximise the fraction of biomass in the fuel mix. At present c.a. 40% total heat production is derived from straw. The whole investment cost was c.a. 6 433 100 PLN (c.a. 1.4 million EURO) and it was financed by three sources:

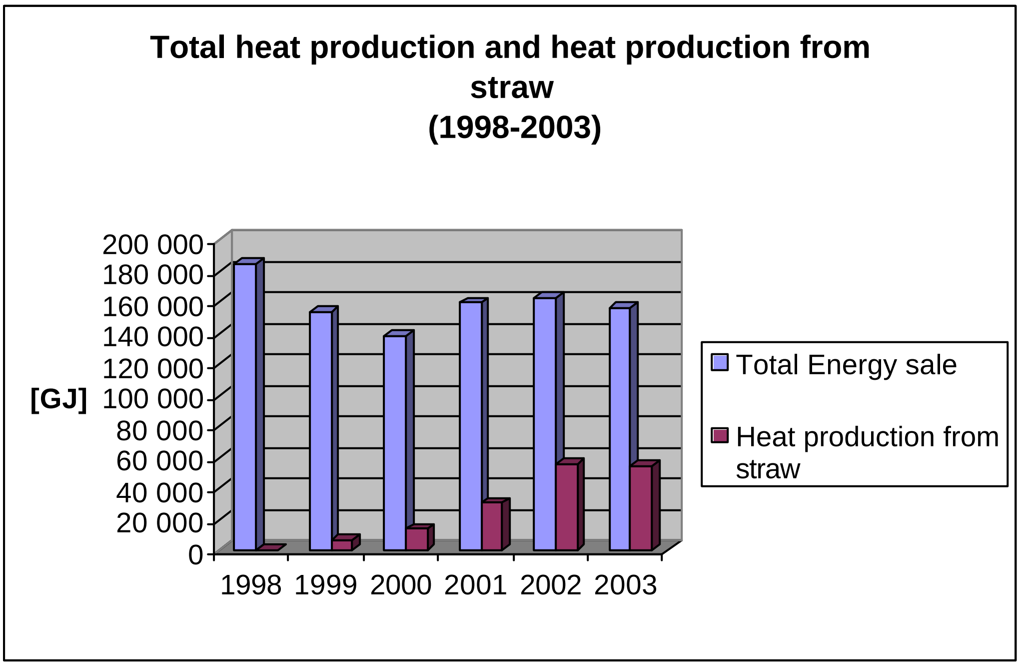
1) ECOFUND, supported project by a grant;for hardware (47%)
2) Luban District Heating Company, own sources: 35% for project development, and design
3) WFOS- Wroclaw, one from 16 provincial chapters of National Fund for Environmental Protection (NFOS) soft loan for hardware

Tab 1. Technical data for Luban District Heating company

	unit	1997	1998	1999	2000	2001	2002	2003
Total Energy sale	**TJ**	**178,9**	**184,2**	**154,2**	**138,3**	**159,6**	**163,3**	**156,7**
Heat production from straw	**TJ**	**-**	**84**	**6,7**	**14, 0**	**30,8**	**55,8**	**54,8**
Share of straw energy in total	**%**		**0,046**	**4,36**	**10,15**	**19,33**	**34,17**	**34,99**
Straw in Heat production	**1000 tones**	**-**	**0,009**	**0,718**	**1,34**	**13,09**	**11,19**	**12,80**


Heat production from straw 1998-2003
[GJ]
60000
50000
40000
30000
20000
10000
0
1998
1999
2000
2001
2002
2003
Years


Share of straw energy in total heat porduction (1998-2003)
[%]
35
30
25
20
15
10
5
0
1998
1999
2000
2001
2002
2003



Outcomes

The scope of the Case Study research includes assessment of the impact of the Programme on job creation and environmental and financial effects.

Social impact

The most important for local economy and regional development is number of **jobs create or saved**. In the case of PEC it was 15-16 half-year jobs, which is now being increased by 5 more. In summer the M&O team was idle due to lack of the heat demand. They would be seasonally laid-off. Instead, once straw boilers were put in operation they have full year employment. In summer they collect after-harvest straw contracted with local farmers using the PEC special machinery and store it partly in the fields and partly in a special barn at the facility itself.

Indirect job creation impact is that, the first 1MW boiler was produced in Denmark, the other two 3.5 MW each were made by Polish companies

It should be also noted that the long term contracts signed with the local farmers have led to the increase of activity in rural areas.

The logistic problem is the fragmented agricultural structure. Large farms are obviously preferred. Still quite many are involved, which requires a special organisation system of acquisition of straw,, storing and transportation. At present one observes a growing interest among farmers to manage this process themselves. It should be noted that initially when the Heating Company approached framers to buy straw, farmers were not interested. Now, once the investment in the Heating Company became a fact, and the customer is stable constant for a long period., the situation has changed; now the farmers see that they can raise money in this business activity. It illustrates how strong there are mental and social barriers in implementing bioenergy activities in rural areas. This example shows also that awareness of farmers that they can make additional money is insufficient and should be increased in rural areas.

Obviously with the present system the crops of straw for fuel does not create jobs for them but creates supplementary income. Initially farmers were not convinced. This is an example which shows how bioenergy market is “working” in practice.

The facts presented above facts are crucial for successful development for bioenergy business activity and, more importantly for regional development. It means that such information should be aggregated by analysts in practical “data base knowledge” and, in consequence, should be used in developmental decisions by politicians.

This research has that this kind of information is one of the most important ones for regional development aspects because the scarcity of knowledge in this matter and social (mental) barriers are important. In the past few years since the operation of the straw boilers has begun, about 3000 people, among them local decision-makers, businessmen, NGO representatives, students and researchers visited the site. The PEC arrange a special well equipped lecture room and made video materials illustrating the principles and the case itself. It is remarkable to note that those visits inspired some of the visitors to follow the example. One can mention i.a. investments in straw boilers in: Skwierzyna (2MW), Ostrow (1 MW), Scinawa (1,5 MW), Milicz (1MW) Mikolow (0.4MW), the training tours which included also visits in willow plantation in Marzecin, north from Luban, inspired investments in wood chip DH systems i.a. in Nowa Deba, Trzcianka, Sepolno.

The Luban case is very Apart from production and distribution of heat the Heating Company in Luban provides consulting and education services in the biomass area. This investment has the impact on biomass- energy education campaigns but it should be more efficient.

Financial aspect

The cost of straw, as fuel, is lower than coal: approximately 20% including transport. The production of heat from straw lowered the cost of 1 GJ of heat (to approximately 20 PLN; 4,4 EUR compared to typical 35-40 PLN). At present, the cost of heat production from straw is lower than that from the worst kind of coal. According to this the Heating Company achieved significant savings on environmental payments (fees) approximately 40 000 PLN per year or 9 000 EUR). In addition, the work conditions for the employees have become significantly better.

Environmental effect

The use of straw as significantly reduced emissions to the atmosphere. This is presented in Table1 and Figure 1.

As can be seen the environmental impact is very significant.

Conclusions

The income of rural population from biomass-energy crops may increase thanks to better organisation and management in the biomass sector. The Case Study assumes that the rural labour market may become attractive in its diversity, and as such able to offer new job opportunities, thanks to among other factors: biomass energy plantations, development of the small business and tourist service sector.

Table 1. **Environmental effect (for production heat from straw: 21 000 MWh/year)**

	Annual Emission		Environmental effect	
	Before biomass investment [tonnes/year]	After biomass investment [tonnes/year]	Total reduction [tonnes/year]	Total reduction [%]
SO_2	72,1	14,6	57,5	79,8
NO_2	19,1	16,5	2,6	13,6
CO_2	10 573	0 (photosynthesis effect)	10 573	100
Coal dust	68	5	63	92

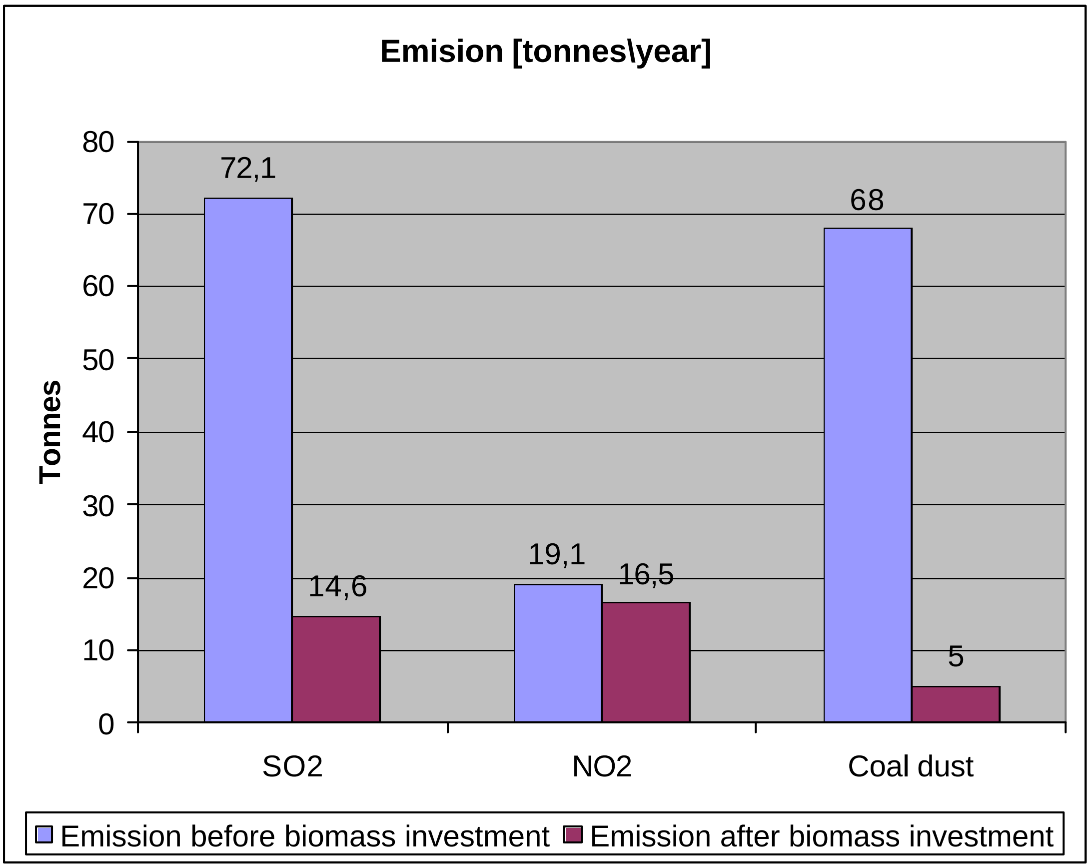


Figure 3. **Emission before and after biomass investment**

The alternative use straw crops have influenced the local farming conditions. In order to be economically efficient the farms cannot be too small The logistics of straw collection are one of the factors may help restructure the farms. The average farm size is rising which is in accordance with EU CAP. It shows that bioenergy investments can influence implementation of EU policy. Larger, specialised farms (biomass production, energy plantation) may decrease the economic imbalance in the rural areas, increase energy self-reliance, decrease air pollution and lower the costs of energy supply for industry and households.

Annex 3:
Integrated approach to biomass heating (Projects in Podhale and Slupsk)

He present Annex describes two projects in which the RES investment has been coupled with thermal modernisation of buildings. A description of a GEF supported wood-waste project in Podhale in southern Poland (A) and a short account of a similar approach in Slupsk (B) in the North are given. The firs project also illustrates the problem of small-scattered biomass suppliers.

A

Integrated Approach to Wood Waste Use for Space Heating GEF Project in Podhale in Poland – Some Political Aspects

Introduction

One of the traditional industries in the region of Podhale in Southern Poland is wood processing, typically in small family-owned workshops or enterprises. The residues originating from the production process constitute precious environmentally neutral fuel, which is only partly used for the own needs by the workshop owner and the surplus is most often dumped in unauthorised land-fills or burnt at the production site without providing any useful energy service. On the other side, even if it is used for heating the premises of the enterprise or for timber drying, usually no attention is paid to energy efficiency of such processes. On the end-use side, one can estimate that about 15-25% of heat can be saved by simple, low-cost improvements of the building envelopes. If such saving measures were implemented, the disposable surplus of wood residues would increase correspondingly, without affecting the production process or heating comfort at the facility.

Therefore, in order to increase the benefits of using wood to replace fossil fuels for heat production, the idea of an integrated approach to the use of wood waste for heat production has been formulated, which combines fuel conversion (a Supply-Side Measure, SSM) with end-use efficiency (Demand-Side Measures, DSM). This has led to a project proposal, the main objective of which was to optimise the use of the existing potential of wood-waste for space heating in order to achieve maximum environmental and economic benefits from fuel conversion investments.

Demonstration of the integrated approach

Although the idea of integrating energy efficiency with fuel conversion is rather natural, it has been seldom applied in practice in Poland. Therefore, a project aimed at demonstrating such an approach in real field conditions has been formulated and submitted to the Medium Size Project grant scheme of the Global Environment Facility, GEF in September 1997. Originally the idea was to select 8-12 good candidates for an SSM-DSM integrated fuel conversion investment. However, since large fraction of the "theoretical" work had been done already, the proposer decided to use part of the PDF-A grant for a "physical" demonstration project. A primary school in the city of Krapkowice was selected, where previously thermal improvements of the building had been made which lowered the required heat capacity from 340 to 270kW. The works were successfully completed and the wood-waste boiler is in operation the fourth heating season now. At the same time, fourteen very good candidates for the demonstration of the integrated approach were identified. The report from the PDF-A phase was submitted in January 2000 and soon approved together with the financial statement of expenditures.

The PDF-A phase have identified three main categories of potential fuel switch projects.

- Linking a small wood waste supplier (e.g. a carpenter workshop) with a small user (say a school). Such was the case in Krapkowice
- Linking a big supplier (e.g. a medium size or big timber mill) with many end users (say a village to be connected to a district heat boiler). Such was the case identified e.g. in Uscie Gorlickie in southern Poland.
- Linking many scattered (relatively) small suppliers with many end users, possibly via an intermediary. Such was the case identified in the city of Jordanow an communes Bystra and Sidzina in the Podhale Region.

The latter case presented a very challenging picture and in itself it could become GEF Medium Size Project, or even a Full Size Project (above 1m USD). Therefore, it has been decided that all other candidates will be put aside for other projects and only the latter one will be considered for the MSP application. The very intensive work began in February 2000 and lasted until Fall of 2001

Finally, the total cost of the project was estimated at ca. 3.6 m$ (with 950 000 GEF contribution). The plan envisages establishing a wood-waste storing/reprocessing facility and building three district heating network systems with the respective boiler capacities: 4.7, 0.9 and 0.7 MW in the city of Jordanów (population ca. 5000) and neighbouring villages Bystra and Sidzina. All buildings connected to the grids are presently heated by burning coal (as are most of the buildings in the area), usually in inefficient old boilers.

A PPP venture

Another innovative feature of the project, as far as Polish conditions were concerned, was the plan to establish a Private-Public Partnership (PPP) company as a common venture of the involved municipalities and a capital investor (in the approved Prject Document it was a state owned company Pumped Storage Power Plants, ESP S.A. which had covered the costs of project development. The PPP company was to enter long term contracts with wood waste suppliers on one hand, and customers buying heat for about 40 housing blocks of flats, schools and other public buildings. Prior to the connection to the grid the buildings will be thermally retrofitted.

Some political aspects of project development and implementation

As mentioned above the work on the selected project began in February 2000. It required collection of a huge amount of data (detailed data were collected from 670 enterprises in the area from among ca. 900). At the same time a prefeasibility and feasibility study have been commissioned by ESP S.A., which also covered the cost of the studies as their contribution to the Project. ESP S.A. invested so heavily in the project because it was earmarked to become the capital investor in the planned PPP venture. The company has had huge experience in such projects and promotion of renewable energies was part of its mission. ESP was also ready to become a

shareholder of the PPP Company, offering to take equity on very soft, preferential conditions. The final approval came on 18 March 2001, upon a number of consultations with UNDP Warsaw, Regional UNDP/GEF Office in Bratislava and the New York GEF Headquarters. According to the GEF procedures a meeting of the so called Local Project Appraisal Committee (LPAC) should take place before formally signing an agreement between UNDP, the Executing Agency (EA), representing the Polish Government and the Implementing Agency (IA), then assumed to be ESP. Formal difficulties in identifying the EA (responsibility of UNDP) caused a significant delay in convening the LPAC. The difficulties were mostly due to the parliamentary elections, which took place in September 2001, and uncertainties about who would stay in the offices after the elections. The initial date of starting the Project in June 2001 passed. The LPAC convened only on 13 August 2001. The content of ProDoc was discussed, and practically no changes had been requested. It was decided to set the date of the commencement of the project for 3 September 2001.
However, due to the elections, which brought about a major reshuffle of the government, the whole process had been stalled. The consecutive dated were shifted, October 2001, December 2001, finally June 2002. In January 2002 the department of Investments and Technology Development of the Ministry of Environment was chosen as the Executing Agency (EA) to supervise the Project on behalf of the government.

A troubled development

Meantime an unexpected development took place: the ESP S.A, the expected Implementing Agency, has been eliminated from the Project, for reasons that were never communicated to the Project proposer or to ESP. The minister of environment has appointed members of the Steering Committee of the Project in February 2002. The EA selected to play the role of the IA a small NGO, Foundation Partnership for Environment for CEE, based in Krakow working largely with youth and children in environmental, tourism and social development related areas. Soon after the project proposer, who conceived, designed and developed the project was also eliminated from further work on the project. Its tasks and responsibilities were transferred to the new IA. The aspect, which is rather puzzling, is that the IA appointed by the government had had no experience in any kind of the engineering projects, not to say in projects of this size. Apparently this is the main reason why no real progress has been made in the physical implementation of the Project so far, although the project started on 21 June 2002. Two heating seasons have been lost, although all documentation was ready in 2001. This has created serious anxiety of the municipal governments who made their boiler refurbishment plans with the GEF project taken as one of the components.

The problems due to the delays have been further aggravated by the fact that waiting in vane some potential wood waste suppliers have signed contracts with other recipients. Also some potential heat customers have switched from coal to oil, because they could not wait any longer with their dilapidated boilers.

The fate of the Project is uncertain at the moment. It is anyhow given here as another case study of a failure caused by political factors or actors.
The conclusion is that a very needed and well-designed demonstration project can fail if its management is given to people who have no relevant knowledge or experience. In this case the engineering knowledge was crucial, while the project was given to an organisation whose experience in this field was next to none.

B

Integrated Approach Project in Slupsk

Introduction

This project illustrates the usefulness and relevance of the Integrated Approach, if it is professionally managed. Slupsk commune is situated in the north of Poland (Pomorskie Province). The Slupsk county is an example of biomass use in public schools. During the period 2001-2003 a programme was implemented, in which heating systems in a number of schools were converted from coal to biomass.

Outcomes of the research

At the beginning the fuel will be based on industrial wood waste because there exists a surplus of unused post-production residues. The next stage of the programme is to use biomass fuel from local energy plantations. The programme is linked with active effort of the local authorities to create new jobs for local people.

The programme was divided on two stages:

- Thermal modernisation of buildings
- Replacing 10 coal boilers of total capacity **1673 kW** by biomass ones of total (reduced) capacity of **1147 kW**.

The project was initiated in 2001 and completed in September 2003.

In effect, the whole programme resulted in:

- effect of the reduction of heat demand
- environmentalpollution reduction effect and
- financial effect

Reduction of Heat Demand

In the first stage the programme gave the 30-35% heat savings which (reduction of heat demand from 1673 kW down to ca 1100 kW). This was achieved mainly by thermal modernisation of the buildings.

The second stage of the programme was elimination of ineffective old coal boilers. The old boilers' heat efficiency was as low as 60%.

Due to the reduction of heat demand the investment costs on the biomass boiler side became lower. It also meant lower costs of fuel purchases.

Environmental effect

The environmental effect was achieved by reduction of gaseous emissions, which are presented in Table 1 and Figure 1.

Financial effect

The financial effect is ca 900 000 PLN (ca 200 000 EUR) per year for an average year i.e. for ca. 30000 GJ of heat annually. This means the lower costs of maintenance of the schools, managed by the public authority.

Table2. **Reduction of emission for the whole Slupsk commune**

	Total Annual Emission		**Environmental effect**	
	Before biomass investments [tonnes/year]	**After biomass investments [tonnes/year]**	**Total reduction [tonnes/year]**	**Total reduction [%]**
SO_2	**17,6**	**0,7**	**16,9**	**96,2**
NO_x	**2,7**	**0,6**	**2,1**	**76,3**
CO_2	**3 746,2**	**23,5**	**3 722,7**	**99,4**
Coal dust	**58,1**	**1,3**	**56,8**	**97,7**

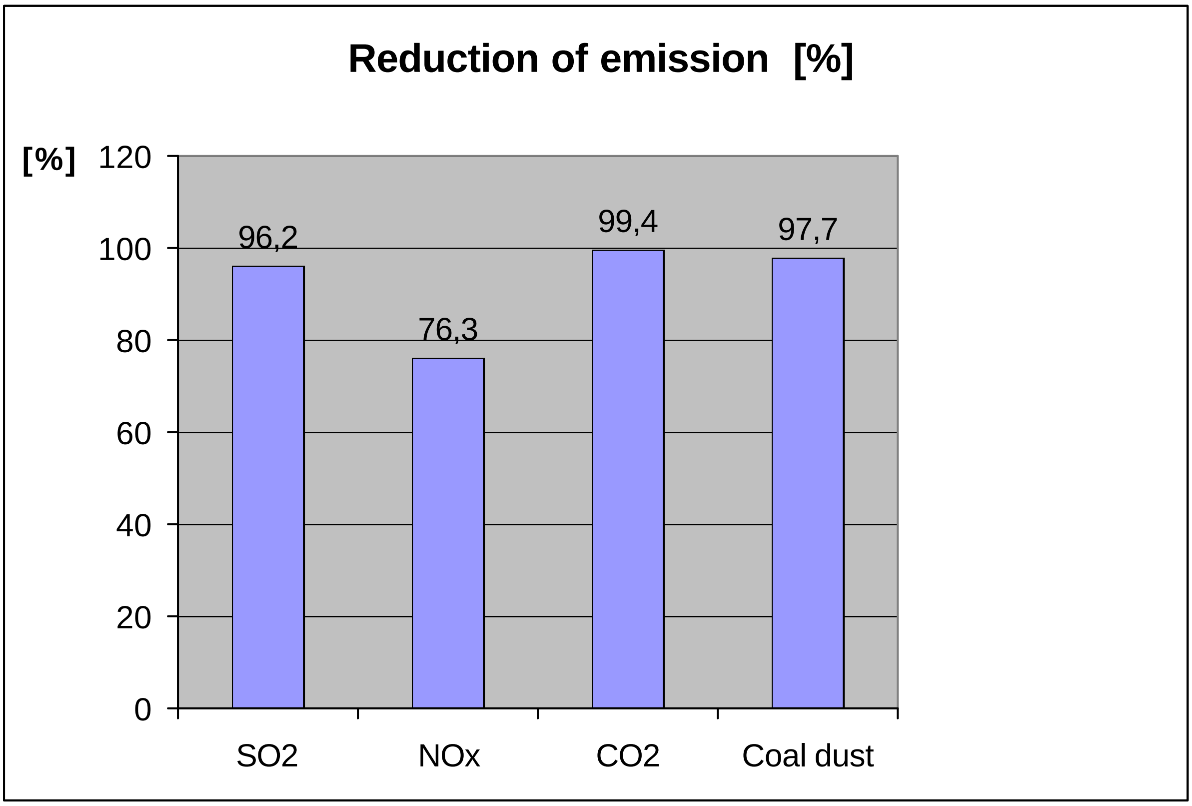


Figure 2. **Reduction of emissions**

Conclusions

The Slupsk example shows the possible impact of biomass investments in public buildings in the environmental and socio-economic areas. Jobs are created in the retrofit business and wood supply. .

The achieved financial results show that biomass programme ca also be financial ly effective. This is a positive example of rational use of public financial sources and efficient use of energy.

It also demonstrates high awareness of local public authority and their influence on implementation the energy policy.

It also demonstrates the importance of the **county level energy planning** as the whole project has been implemented in accordance with the "*Strategy of social and economic development of the county of Slupsk for 2001-201*1"

ANNEX 4

REGIONAL BIOMASS PROJECT IN SOUTHERN POLAND
JOINT INITIATIVE OF KRAKOW UNIVERSITIES

Background

Experts often enumerate barriers hindering the development of RES in Poland. The barriers usually enumerated are: **(i)** legal and financial barriers, **(ii)** insufficient information, **(iii)** difficult access to new technologies, **(iv)** lack of education and training programmes.

However, if one looks at the prospective development of biomass-based energy in Poland or its particular regions, one more barrier should be mentioned, which is lack of a comprehensive approach to the problem and lack of co-ordination of actions and initiatives, which so far are rather *ad hoc* and sporadic.

When considering any coordination or planning attempts in the area of the energy use of biomass one should bear in mind that the forms of biomass-derived energy compete to the same **limited resource in a given territory,** which is basically determined by: **(i)** available land area, **(ii)** soil characteristics and **(iii)** climatic conditions such as insolation or rainfall levels. Therefore, the natural problem that emerges is the problem of **optimisation** of the use of the (potentially) available resource given the constraints outlined above which, basically constitute boundary conditions in searching for a minimum or maximum of a given function (total final energy in that can be derived, total GHG emission reduction, cost of unit GHG reduction, total local revenue etc.). The task that emerges is to provide a model that would support decision-making especially concerning the allocation of public money to promotion of biomass or Renewable Energy Sources in general.

Urgency

At present one observes an explosion of interest in planting the fast growing willow (*salix viminalis*) for direct combustion in boilers or production of pellets or briquettes. Given the local agro-technical conditions this needs not to be an optimum solution - there are other plants that often can give more final energy yield or financial revenue per hectare. A systemic approach to the problem is lacking and there is practically no co-ordination of actions and initiatives, which are mostly of an “at random” character. A scientifically verified data are needed to provide the guiding information for investors and local or regional authorities responsible for development and planning.. This, however, requires adequately trained specialists, which are too few to meet the needs; notably:

- the ambitious targets set for “green electricity” which have already created practically unlimited demand for wood chips of *salix viminalis*
- the increasing demand for biomass for heating - particularly district heating – which creates a significant and constantly growing demand for biomass. This biomass may originate from the agricultural residues, particularly straw, other energy plantations, such as *topinambur, sida hermaphodita or miscantus giganteus*, as well as for forest wood waste or post-production wood residues.
- The targets set for the fractional shares of liquid biofules for motor vehicles which have already led to enormous interest among farmers and investors in planting

crops for ethanol production and rape for biodiesel, as well as created a huge controversy concerning the state policy in this area].

Joint research project

Considering these circumstances four Krakow Universities

- Jagiellonian University,
- AGH University of Science and Technology,
- Krakow Polytechnic and the
- Krakow Agricultural University)

decided to undertake a common effort to provide scientifically based information for investors, utilities or local administrations to enable them make optimal decisions to maximize parameters of their interest. .

The project is of a multidisciplinary character and covers a broad spectrum of scientific research: biotechnology, genetic engineering botanic, agriculture, boiler and combustion engineering and chemistry.

The project has both research and demonstration components. It covers the whole chain of processes:

- biotechnology research
- selection of plants,
- agriculturar technology (from planting to harvesting)
- processing into the final form of fuel (solid, liquid or gaseous)
- combustion, heat exchange etc up to
- treating the final combustion products (solid and gaseous)

.

So far, **32 research teams joined** the programme. A map of research plans, equipment and human resources has been made to avoid doubling of efforts and costs.

Training and Demonstration

Another dimension of the project is awareness raising and education by emonstrating the equipment or solution in field conditions. Therefore, one of the firs st steps is creation at AGH-University of Science and Technology of a **Education-Demonstration-Research Centre,** the target audience of which would be representatives of local administrations and SMEs.

The investment will be realised in several phases, staring with a straw boiler of capacity of 180 kW in the laboratory hall of the Foundry Faculty. The produced heat will be used initially for heating of the hall itself, which at present is heated by electricity. Since electrical heating is very expensive, the operation costs of the biomass boilers will be much smaller than the present costs of electricity.

Since installation of much higher capacities in the hall is possible, gradual connection of other objects is planned. As long as the adjacent AGH facilities are considered, connection of up to 3.5 MW heat via the existing grid can be accomplshed at a relatively low cost.

It is tentatively estimated that once the system is expanded above 500 kW, it will become cost effective compared with the DH option. Still one should remember that, as mentioned above, the facility will also be used for teaching students and research, so that demonstration will present an additional value. One should also mention that the facility will be made available to students of other universities, and such is the understanding of the co-operation between universities of the AKCENT Consortium.

ESPON 2.1.4

Case Study Analysis

Portugal

PEGO Coal Power Station and its impact on local and regional development

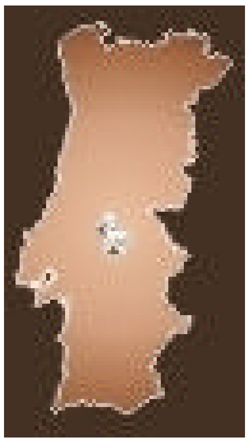
List of contents

Case study objective and scope

The scope of this case study is the impact at local and regional levels of a relevant project like a big energy infrastructure. In Portugal, two power plants are using coal to generate electricity. The more recent one (Pego coal power station) is the one chosen for the present case study.

Pego power station was build between 1988 and 1995, reinforcing the electric national producing system in response to the increasing of consumption in 90's and the necessity of energy sources diversification. Pego project was designed to receive four units of 300 MW each. Nevertheless, until now, only two units have been constructed and are operating.

In 1993 Tejo Energia, S.A. entered into an agreement with Electricidade de Portugal S.A. ("EDP") to own, operate and maintain the Pego Power Station for a period of 28 years. An international consortium bought the power station, introducing the private sector in a significant part of the electricity national production. Since then Tejo Energia became an innovation project (a joint venture involving four companies from different countries, United Kingdom, Spain and France), a reference in the world wide electricity markets.



From the administration point of view, Pego power station occupies a site of 180 ha, close to the Tagus river, in the parishes of Pego and Concávada, a particularly rural area surrounded by an olive grove and a cork plantation, located in *Abrantes municipality* in the region **NUTS III** - *Médio Tejo* and **NUTS II** - *Centro*.

Pego power station becames a reference place specially to local and regional schools, as well as universities (more than 7.000 people visit the power station in 2002).

In 2003 the Pego Power Station represented more than 10% of the total installed generating capacity in Portugal.

The present case study is a contribute to understand:

- how energy policy and infrastructures changes socio-economic territorial patterns;
- how investment in this type of infrastructure is translated into more favourable conditions of energy supply to industry and households;
- what are the relations between the development of this infrastructure and the growth of regional economy;
- how investors and households changes their behaviour in consequence of changes in the conditions of energy supply;

- what are the real degrees of regional disparities concerning access to energy;

To answer these questions the following research areas have been distinguished:

- environmental,
- demographic (structure and qualifications in labour market),
- economic (business activity, local finance),
- energy infrastructure, (technical, quality),
- social infrastructure (living standards).

This will give valuable information about the relation of this type of energy infrastructure to local and regional development, achieving the following objectives:

1. assessment of the impact of the infrastructure implementation,
   a. assessment of the business activity growth and its influence on labour market
   b. the influence of the power station on the development of other activities, e.g. education
2. evaluation of the role and performance of local public authorities (municipality) in policy implementation,
3. evaluation of local energy infrastructure influence on the image and attractiveness of the municipality for potential investors.

Methodology and information sources

The case study methodology is based on collection and analysis of relevant data. The main sources of information were the following:

- companies annual reports,
- regional studies,
- articles in local and national newspapers,
- official statistics.

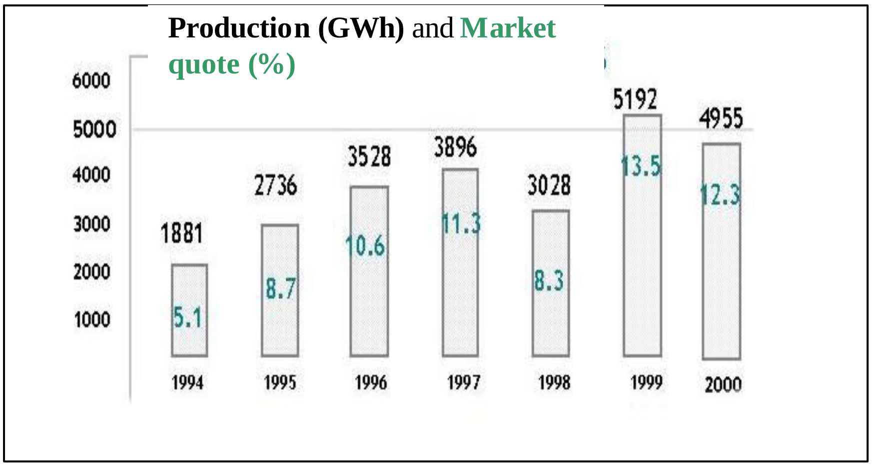
Actual and forecasted outcomes of the observed phenomena

The research is based on the "historical" observations concerning the impacts of previous activities, as well as on forecasted outcomes.

Actual outcomes

PEGOP is the managing company of the Pego power station, and it constitutes the biggest enterprise group of the Santarém district, with a volume business-oriented of 258 million euros in 2003. The income tax (IRC) is about 20 million euros, which represents 26 percent of the total IRC in Santarém district and 80 percent of total IRC in Abrantes municipality.

In 2000 the Pego power station assures with two units (300 MW per unit) an annual electricity generation of 4.955 GWh, which represented approximately 12 percent of the total Portuguese electricity consumption in that year.



Source: Pegop, Energia Eléctrica, SA

The initial investment was about 848 million euros (direct technical costs at constant prices of 1988) not including financial costs. The national participation in the project was very significant, regarding to the engineering of conception and management of the project (EDP Portuguese electricity national company) as well as the metal national industry.

Assessment of the impacts in environment

The power station generates electricity from pulverised coal trough direct combustion. The coal used is mainly imported and transported by railway from the harbour of Sines (NUTS II - *Alentejo Litoral*) to the power plant, covering a distance of 320 km[1].

The major burdens identified for this fuel cycle are the atmospheric emissions of pollutants from the transport and power generation stages, solid wastes from the power generation stage, and occupational and public accidents from the mining and transport stages. The most relevant impacts are those caused by atmospheric emissions from the power generation stage on human health and by global warming effects.

Nevertheless, in 1997 Pego Station gained ISO 14001 approval for its environmental management system. This was an important step for PEGOP, the managing company, as the electricity industry worldwide attaches considerable importance to achieving and maintaining environmental standards due to the high profile associated with the burning of fossil fuels.

Since 2000 the company has an EMAS's registration (Eco-Management and Audit Scheme, which is a voluntary initiative designed to improve companies' environmental performance) having been the first company in Portugal to obtain this classification.

The station manager for Pegop observed: "The roll-out of the certification enabled us to demonstrate a thorough understanding of the issues and the actions we were putting in place to further increase our levels of environmental control. This has helped us to achieve a situation where the power station appears to be fully accepted as part of the surroundings. We have over 6,000 visitors annually to the site and it is very important that we can show them something of how we care for the environment in which we operate."

Environment studies had been carried through allowing a previously characterization of the place and its involving region to the beginning of the power station construction. It had been defined several measures of environment protection which were incorporated by the power station, to assure that the resultant environment impacts of its construction and exploration if kept below of the levels that the regulations application, as well as the knowledge of the characteristics of the involving region, had allowed to establish as permissible.

The control instruments had been established, which allow a permanent monitoring of the quality of the environment after the entrance in service of the first unit of the power station. The automatic measures of the pollutant

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[1] In "Implementation in Portugal of the Externe accounting framework", CEETA, Portugal.

emissions and of the parameters that characterize the atmospheric and the fluvial way, supply the necessary information on the evolution of the quality of the environment to the exploration of the power station and to the responsible entities.

The main objective of the previous study of environmental impact consisted in a systematic evaluation of the induced effect in the involving environment, having in account economic and technician factors of the project, as well as characterization data of environment and social environment.

Its results, proven per some years of functioning of the installations, had indicated that the global impact of the enterprise is not only compatible with the maintenance of demanding standards of environment quality, as also induces dynamic effects to the social and economic development of the region.

Assessment of the impact on job creation and local business activity.

The approach adopted to estimate the effects on employment used statistical data on employment to estimate direct labour and input-output methodology to estimate indirect labour[2].

In order to assess the impact on job creation, we distinguish between:

- direct employment (number of jobs that exist at each stage of the coal fuel cycle: mining, construction and dismantling of the power plant, transport of lime, gypsum, coal and ash and operation of the power plant)
- indirect employment (employment generated by the production of goods and services needed to build and operate the Pego power plant).

Although not completely quantified, the annual direct labour requirements of the Pego power plant are relatively substantial. They amount to more than 284 jobs equivalent per year. The impact in terms of indirect labour requirements is **33.486 jobs** equivalent per year.

The installation of the Pego power station induced an intense search of construction materials, services (ceramic, hardened, inert, wood, transports, tourism, etc.), and workforce at local level.

During the construction the number of jobs was increasing until the 3rd year of construction, reaching a maximum that exceeded the 2.000 workers, having in consideration the staff of the contractors, sub-contractors and the ones of the national electricity company (EDP).

[2] See previous footnote.

When exploration started more than 200 direct jobs were created in the region and some indirect jobs related to food services, cleanning, security, transports and conservation. In the last years the power station employed in average 114 people.

Assessment of the impacts in local public finance

Regarding the evolution of some of local public administration finance items, after the power station began its exploration, the public investment in Abrantes municipality increased around 160% in the period 1995-1998, which reveals some dynamism in the local development, related to this infrastructure.

1995 -1998	Abrantes Municipality		Médio Tejo (NUTS III)	
	Variation	Average Anual Growth	Variation	Average Anual Growth
Current revennue	+40,9%	+13,6%	+30,8%	+10,3%
Direct Taxes	+72,9%	+24,3%	+54%	+18%
Central Public Administration Transfers	+24,8%	+8,3%	+22,6%	+7,5%
Investment	+159,8%	+53,3%	+114%	+38%

Source: "As finanças locais no distrito de Santarém. Estrutura e evolução entre 1995 e 1998". Governo Civil de Santarém.

Assessment of the impact on society

Apart from production and distribution of electricity the company provides consulting and education services. Pego thermal power station has on-going community support activities in cooperation with a number of local organisations. The investments reveal a social responsibility inherent to the economic activity.

Notable projects include financial support to a care centre for the elderly and a care centre for children. Along with staff from Tejo Energia, Pego personnel have volunteered their time to facilitate the running of a summer holiday camp for a group of children suffering from Leukaemia and Aids. Activities have also included hosting a Christmas party for children from a local orphanage.

Besides being one of the biggest entities employers, the group of companies of the Pego's thermal power station has supported the improvement of the living conditions of the Abrantes inhabitants. The politics "has been to support the people most disfavoured, through the entities related to this activity". As all the production of the power station is sold, it is not necessary to invest in campaigns of marketing or advertising and this amount of money is canalized for the social support.

From the didactic point of view, the Pego's thermal power station constitutes an important centre in the region, having been increasing the number of visitors who annually visit it. Only in 1998, this number surpassed the 6500 visitors.

Forecasted outcomes

The PEGOP, managing entity, was created five years after the entrance in functioning of the thermal power station that produces energy through the coal, and will go to invest 100 million euros in the acquisition of equipment sophisticated for the reduction of the gaseous emissions.

The energy production, integrally sold to the National Electricity Net (Rede Eléctrica Nacional (REN)), through natural gas appears as a new challenge. This alteration in the raw material will compel to the construction of two new groups of energy production. This project is being studied and it will have that to count on the new rules of the Iberian electricity market.

Transferability of the observed results

The observed results such as:

- stimulation of business activity in the region,
- adaptation of professional skills and qualifications of inhabitants to the local labour market demand,
- growth in the number of people running private businesses (specially in service sector),
- higher living standard of rural communities,
- involvement with local community, at social level.

can be produced elsewhere in our overall project territorial scope. This phenomena is possible to be observed elsewhere.

If conveniently inserted in programs of regional development, a project of this nature can be inductive of progress and social and economic welfare, regarding the:

- Appealing to coordinating entities - Inter-ministerial Commissions of Accompaniment - that, for beyond the responsible agencies of the Central Administration for the licensing and the company that assures the power station exploration, they still involve the interested municipalities;

- Engagement in a continued politic of dialogue, clarification and information of the populations;
- Anticipated accomplishment of characterization environmental studies and evaluation of the power station predicable impacts;
- Decision to include in the project effective measures of environment protection and control.

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