ESPON 2006 PROGRAMME

SECOND INTERIM REPORT

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

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 + 12 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) Draft of assessment methodologies to identify key parameters linking energy policy and spatial structures (Territorial Impact Assessment of Energy Policies);

d) Provisional results on the spatial effects of energy infrastructures and energy supply (price and quality) in terms of the economic relocation and other spatial criteria (significance of energy networks as location parameter for investments and settlement decisions) (Territorial Impact Assessment of Energy Infrastructures and Markets).

These items will 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.

[1] 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).

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.

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 II) 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.
- 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 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 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 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 Candidate Countries (0.44 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 Candidate Countries 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; our preliminary calculations point to a higher elasticity, but of no more than 0.08.
- We found no conclusive study of the impact of energy prices disparities on location 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 renewables 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 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 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 (15% against 38%) 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 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 along the negotiations process in order to close some of the most sensitive reactor;
- 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 Candidate Countries 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 Accession Countries 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 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 acts as a determinant 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 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.

[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.

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:

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. 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.

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] and in Spain for about 2/3 of manufacturing production the weight of energy in total production costs is less than 2%. 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 2001 average EU electricity prices for industry were € 5.48 per 100 kWh and the average natural gas prices were € 5.62 per GJ. Differences between countries were in the order of € 2.42 (SE) to € 8.54 (I) in the case of electricity and in the order of € 3.55 (UK) and € 8.42 (SE) 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 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.

Income transfer

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[7]. "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

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

cover 50% of its energy needs.[8] There is, probably, no relationship among 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.

Household behaviour and quality of life

Domestic and tertiary consumption accounts for 40% of EU final energy consumption and transport for another one third. Energy and transport represent a substantial part of household expenses. It seems 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 telework opportunities.

Environment

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 are among the more promising fields for investment, with an huge impact in local development. Wind and biomass for energy production are natural candidates.

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 can 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.

[8] See Quinto, Javier and alii,- Second Report on Economic and Social Cohesion: the Role of Energy, December 2000.

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.

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.
- 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;

- Renewable sources development for electricity generation, in line with the directive for electricity from renewable 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[9] 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)[10] 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 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.

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

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 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

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

- 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 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[11].

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

From 1900 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,

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

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.

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[12]) we get a solid statistical relation among price variation and consumption variation.

We will investigate more deeply this last relation, but 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[13] 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.

[12] Thus excluding France, Germany, Ireland and Italy, for which data is available.
[13] Source: Observatoire de l' Énergie

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

Using the fixed energy budget hypothesis[14], the one that is more stringent towards the efficiency of price mechanisms on energy markets, points to two main effects:

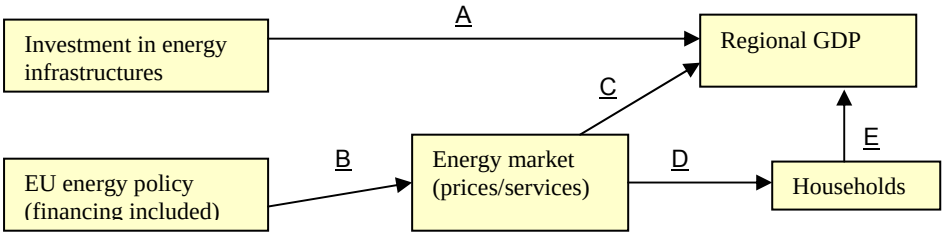
i) in the short run, price changes have some effect on growth, price increases implying lower levels of economic activities, and price decreases leading to enlarged aggregate supply, but with much larger elasticity to price increases;

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.

At this stage, we think that an input-output framework will be the most suitable method to quantify energy territorial impact.

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 n*x*n matrix of coefficients a_{ij} of the intermediary consumption of products of sector *i* necessary to obtain an unity of product *j*. 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, at the cost of some restrictive hypothesis, use the input-output framework to obtain an operator C of the impacts of energy price variation over regional GDP.

In an input-output framework the following relation can be verified B´P+W=P, where P is a nx1 vector of sectoral prices; B is a n*x*n matrix of coefficients b_{ij} of physical quantities of product *i* needed to the (domestic) production of a (physical) unity of *j*; W 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 $p_j=b_{1j}p_1+b_{2j}p_2+\ldots+b_{nj}p_n+w_j$. Solving, we obtain $P=(I-B')^{-1}W$.

[14] BOURDAIRE, J.M. (2000), "Le lien entre consomation d'energie et development economique", Revue de l'Energie, nº 15, mars-avril 2000.

The last equation allows us to assess the price impact of a variation in the price of energy, under the hypothesis that a variation in energy prices does not imply any input substitution, so that (technical) input coefficients remain constants. This hypothesis applies even for primary input coefficients, except for the energy price sector.

Input-output table is not useful to pass from price variation to GDP variation. We need some additional hypothesis:

First, we need to establish some relation between price variation and demand variation. If we make the hypothesis that energy price reduction is the result of increasing efficiency and it does not affect the domestic added value, we can assume that all the price savings will be transferred to final demand. This corresponds to assume that all products have a price-elasticity of –1. It is a restrictive hypothesis that can be improved if we can obtain information on price-elasticity.

Second, we must hypothesise a constant relation between the sectoral gross production (total of uses) and the sectoral gross added value.

Third, 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.

With these assumptions the model could be:

$P=(I-B')^{-1}W$ [1]

$Q = EQ$ (where E is a nxn with $e_{ii}=1/p_i$ and for $i \neq j$ $e_{ij}=0$; in a static situation all $p_i=1$) [2]

$X=AX+Q$ [3]

$V=TX$ (T is a n x n with $t_{ii}=v_i$ and for $i \neq j$ $t_{ij}=0$; vi value added for each unity of x_i) [4]

$R=MV$ (M is a rxn matrix with m_{ij} = share of region *i* in the production sector *j*) [5]

For the moment, we could only apply this model to Portugal. We tried to quantify the impact on regional GDP of a 10% (this is an arbitrary value) decrease in the prices of oil products and electricity (sectors 23 and 40 of IO table, 1999). From a total of 59 sectors, this 10% variation on energy price would imply a decrease of less than 0.5% in the price of about 30 sectors; about 10 sectors would have a price decrease of more than 1%.

Under the hypothesis made about the total transfer of price variations to final demand and the constancy of value added coefficients, this would imply an increase of 0.77% on national GDP and a regional effect ranging from 0,53% in Lisboa e Vale do Tejo to 1,3% in Alentejo.

We used the regional distribution of employment of different sectors from the 2001 Population Census to construct matrix M.

These results are of the order of magnitude of those referred in other studies and seem coherent in Portuguese situation. But our aim was only to verify the feasibility of the methodology and these are not yet accurate but only indicative results.

Although it is not yet clear the possibility of finding adequate data for the 27+2 countries, it seems a feasible methodology and will be used to construct an indicator to assess territorial impact of energy policies.

We are aware of the meaning of the restrictive hypothesis and of the weakness of the model:

The calculation of the impact of energy price variations on national GDP goes through assumptions of price-elasticities and constancy of input coefficients too much restrictive and too little realistic. But here we can improve results, namely by analysing the sensibility to different elasticities and confronting with results of other European models. The objective should be to construct an indicator of territorial impact, and, for an indicator, correct proportionality is the more important feature.

This methodological framework does not take into account the virtual 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[15]) 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. It is a minor weakness that, for the moment, we don't know how to surpass.

Furthermore, remains the fundamental question of the impact of energy policy on energy prices in each country. This is an urgent task that involves the analysis of past trends and of the studies that have been carried out on this subject.

Nevertheless, 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 this way will be a great advance in understanding the territorial impact of energy policy, with the possibility of including in the same framework the impacts via energy prices and energy investments.

[15] We will clarify this effect through case-study analysis.

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 CC + 2)[16] 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) Draft of assessment methodologies to identify key parameters linking energy policy and spatial structures (Territorial Impact Assessment of Energy Policies);

d) Provisional results on the spatial effects of energy infrastructures and energy supply (price and quality) in terms of the economic relocation and other spatial criteria (significance of energy networks as location parameter for investments and settlement decisions) (Territorial Impact Assessment of Energy Infrastructures and Markets).

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.

[16] 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).

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

Challenges for the future

Owing to severe lack of formal statistical information at regional level an extensive research activity must still be done in the near future in order to fill the statistical gaps both by dispersed information collection (utility reports, academic studies, country governments reports and others) and by missing data estimation techniques. The construction of databases of energy production, energy consumption and infrastructures available is assumed as the major instrumental task of the work.

The problems raised by insufficient information covering all the 29 countries to be considered strongly advise us to give an important relevance to case studies methodology in the framework of the assessment of energy territorial impacts. A methodological proposal is already presented in this report and some results are presented to illustrate the potentialities of the method and enable discussions. The core analysis will be based on interindustrial linkages using the input-output tools.

RES are well suited for application in rural areas and biofuels have a great potential for job creation and to develop alternative agricultural products and, in consequence, to open new opportunities to rural and lagging regions. A specific assessment covering this subject is being developed.

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 will be prepared. At the same time a data base with dummy variables will be prepared to enable the statistical connection of infrastructures availability with economic and physical variables.

Research on typologies for the European regions related to energy elementary facts has to be carried out after the stabilization of the data base.

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"[17]. 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 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

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

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.

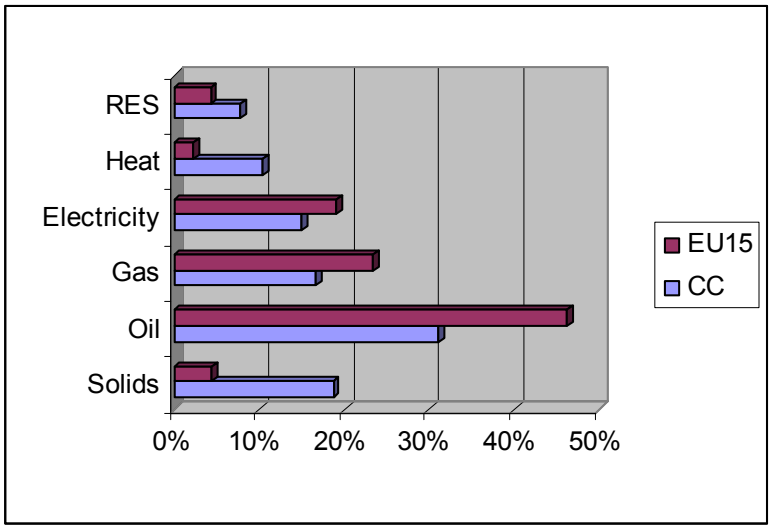
Nuclear energy is nowadays a very sensitive aspect in the energy debate. It is a clean technology in what greenhouse gases are concerned but security, deposits of radioactive residues and power stations dismantlement are still important barriers to the development of this energy carrier.

Comparing the European Union countries with the adhesion countries 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 reactor;
- 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

(CC – candidate countries)

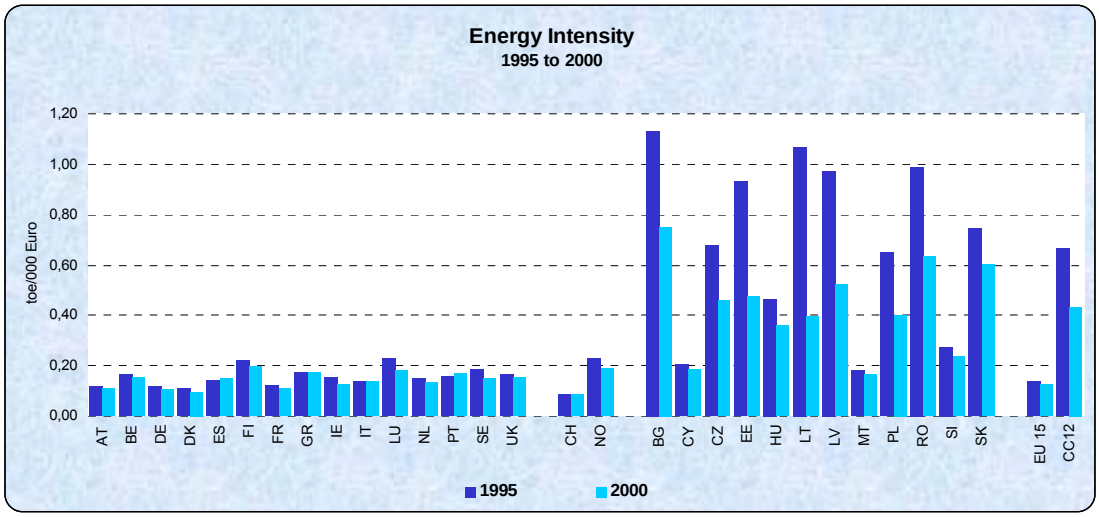


Four main pillars of the European Union energy strategy have been outlined in the European Commission Green Paper on Energy Security (November 2000): i) security of supply, ii) completion of the internal market, iii) environmental challenge and iv) promotion of renewable energy and demand management.

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).

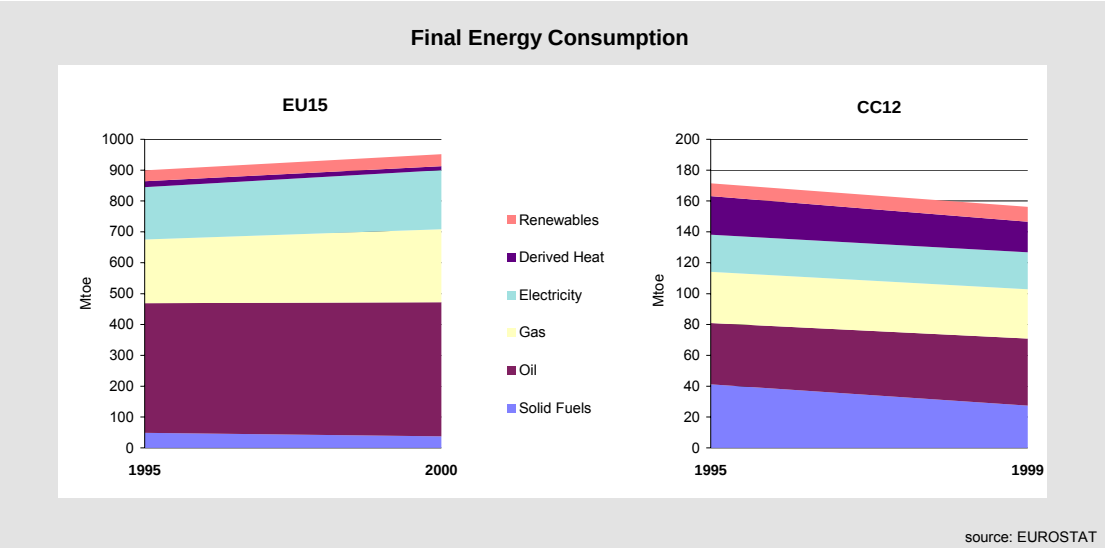
Figure 2 - Energy intensity for the enlarged Europe – 95/2000



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 Candidate Countries (CC12)



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 are among the more promising fields for investment, with an 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[18] 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)[19] 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.

[18] The Energy Charter Treaty of 17 December 1994 OJ N° L 69 of 9 March 1998
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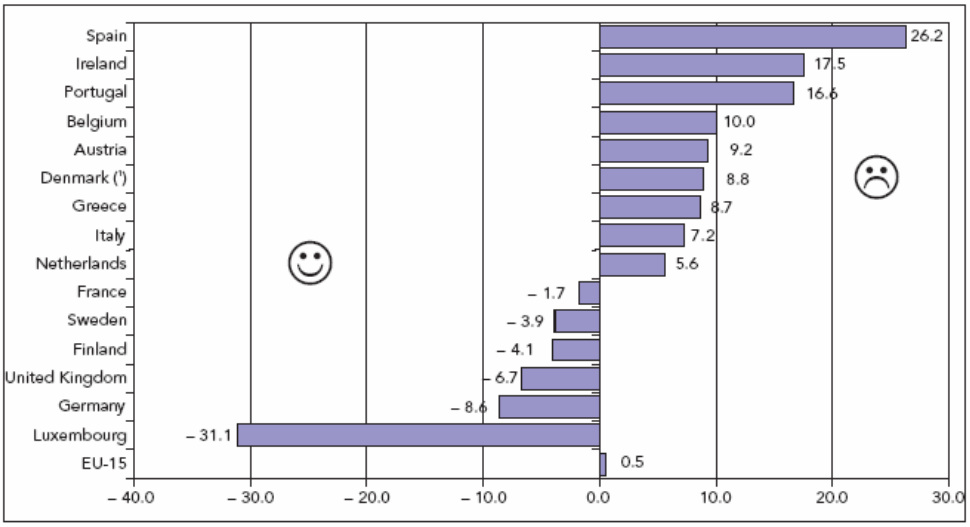
Figure 4 - Distance to target indicators for the Kyoto Protocol

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

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

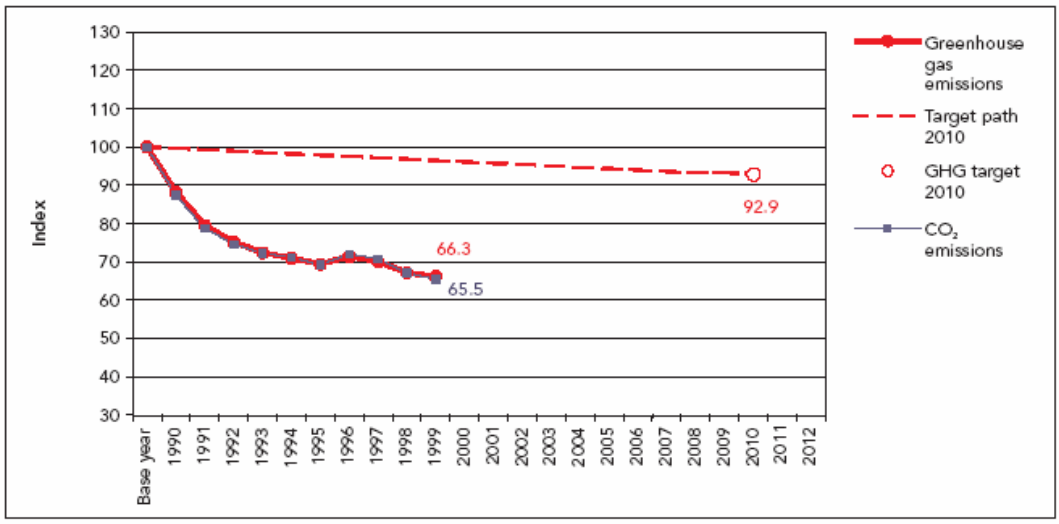


1) The Danish DTI is + 0.7 index points, if Danish greenhouse gas emissions are adjusted for electricity trade in 1990.

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.

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

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[20] 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.

[20] 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 First Interim Report, 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. During this project and through its analysis it will be confirmed the impacts on the territory of the energy policy.

Following this overview of the EU energy policy a survey is done 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 • 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.	OBJECTIVES 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 * Global partnership for sustainable development; * Strategy for sustainable development; * Integrating of environmental considerations in Community energy policy; * The energy dimension of climate change.	OBJECTIVES 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 *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).	OBJECTIVES 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 • Community framework for the taxation of energy products • Tax on carbon dioxide emissions and energy	OBJECTIVES 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 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.	OBJECTIVES 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 • 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.	OBJECTIVES 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: 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			
Internal market in energy			
Energy and sustainable development			
Energy efficiency			
Renewable energy development			
Taxation of energy products			
Trans-european networks			

- 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 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 tonnes 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 at a rate of 1% per year.

MAIN CONCERNS

NATURAL GAS

- Austria has domestic natural gas resources providing 23% of the country demand.
- Together with the oil fields, natural gas production fields have declined over the last 20 years and are expected to continue to decline as the sources are exempted.
- Austria imports almost 80% of its natural gas needs.
- 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 country's demand.
- The country imports over 90% of its crude oil needs and nearly 60% of its diesel needs.

RENEWABLES

- Austria has substantial hydropower resources which provide approximately 70% of its electricity needs.
- Small hydropower facilities (<10 MW) provided 1,3% of the country's 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: one is the feed-in tariff and in the other scheme one must get 8% of their power from small hydro facilities (<10 MW) and 1% (increasing to 4% by 2007) from other renewable energy technologies.

- 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 fuelled 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 country's 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.

POLICY ISSUES

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

- 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. Maximise 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 country's 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.

BELGIUM

MAIN HIGHLIGHTS

- Because of the country's geographical location, cross-border trade of electricity and gas as well as the energy policies of the neighbouring 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.
- In Belgium energy policy involve many different players. The region and federal governments, making the decisions inevitably complex.
- 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.
- Belgium is trying to open its electricity and gas markets at a faster pace than required by EU Directives - Market liberalization is very important for Belgium as it is expected to increase the social benefits and provide a competitive advantage for the Union.
- 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.

RENEWABLES & CHP

- Neither renewables nor CHP can be easily introduced in Belgium for economic reasons.
- Barriers should be removed. Putting in place back-up and buy-back tariffs for both renewables and CHP.
- CHP producers should be able to choose their gas supplier and sell their production to consumers freely.

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.
- Market systems for green electricity are being studied and put in place in the different Belgium regions.

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 ISSUES

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

- Consider giving further support to the introduction of CHP, rational use of energy 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 neighbouring 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.

DENMARK

MAIN HIGHLIGHTS

- Over the last decades 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 privatised at a time to be determined in the future.

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.

RENEWABLES

- The Government has established a target of producing 20% of its electricity from renewables.
- In 2000, 12,6% of electricity generation was from wind energy, and also the highest of any nation.
- 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.
- It will be possible to implement the off-shore 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.
- CHP and wind are given priority in dispatching.

ELECTRICITY

- The decisive step towards full liberalization was taken in 1999 with the Electricity Supply Act.

- Since 1 January 2003, all final costumers are eligible to choose their electricity supplier in the market.
- Electricity generation, transmission and distribution must be organized in different legal entities.
- Electricity market reform in Denmark goes beyond the requirements of the EU directive.

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 CO2 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.
- This priority dispatch requirement causes excess generation during certain periods.

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.
- It was given a subsidy to study the geothermal energy potential of the Copenhagen area for heating purposes.
- Funds are also being placed on wave energy, solar cells and hydrogen fuel cells.

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.

FINLAND

MAIN HIGHLIGHTS

- Finnish Energy markets have undergone a period of restructuring which started in 1995. It was then opened the market to 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 energy sources are wood, peat and hydropower.

MAIN CONCERNS

NUCLEAR ENERGY

- One third of the electricity is produced by nuclear power.
- 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 electricity production.
-

COAL

- Coal accounts for about 15% of the Finnish electricity production.

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 comes from CHP and 50% 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.

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.
- For climate reasons, Finland has the highest energy intensities in Europe, both per capita and per GDP. Finland also has energy intensive export industries.
- About half of the target emission reduction, 14 million CO2 tons, can be met by implementation of the energy conservation programme (3-4 million CO2 tons) and action plan for renewable energy sources (4-5 million CO2 tons).

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 privatisation of energy companies, ownership is spread among a large number of players and that cross-ownership is reduced.
- Set concrete targets for the different sectors for emission reductions.
- 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 and is expecting to stop the use of coal in 2005.
- In 2000 the national primary energy production accounted for 126 Mtep/year, which corresponds to 1,3% of the world production and 17% of EU production.
- In 2000 the total consumption of primary energy accounted for 258 Mtep/year, which corresponds to 2,6% of the world consumption and 18% of EU consumption.
- The CO_2 emissions due to energy (1998) correspond to 102 MtC/year, which corresponds to 1,7% of world emissions and 12% of EU emissions.
- In 1998, 80,5% of the primary energy production was from nuclear, 3% coal, 4,3% hydro and 9,2% other.
- France has three main objectives: security of supply, French economy competitiveness and environment care; and two main worries: employment and public service.
- France has low per capita and per-GDP carbon emissions 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 of 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 85,6Mt of oil, mainly from the North Sea, Saudi Arabia and Gulf area, and 1,4Mt of national production.
- Oil represents 52,6% (1998) of the total final energy consumption in France.
- The French economy is very vulnerable to the oil, namely in the transport sector.

COAL

- In 2000, France imported 20,6 Mt of coal, mainly from Australia, South Africa and USA and produced 4,1 Mt internally.
- There is a de-carbonisation of economy as its weight in the electricity generation is also decreasing.

NATURAL GAS

- In 2000, France imported 471TWh of natural gas, mainly from North Sea, Algeria and Russia, and produced 20TWh.
- The natural gas use has been growing rapidly over the last three decades, is now multiplied by 4 (14% in 2001). Its usages will be mostly on electricity generation.
- In 2000, France has opened 20% of the French gas market to competition and it is expected to raise this number up to 33% in 2008.
- 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.

- The management of the nuclear fuel cycle is one of the main concerns of the French energy policy.

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 2000, France had 66,4 MW of wind installed capacity.
- France has a heading in its energy policy of providing more support to renewables and to find a way to better integrate them in the regional energy generation.

ELECTRICITY

- In 1997, 78,4% of the electricity production in France was from nuclear, 13,4% from hydro and 4,4% 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.
- In 2000 France opened 30% of the electricity market to competition and in 2003 will further open to 35% - close to the minimum thresholds required by the directive.

POLICY ISSUES

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

- 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 administrations 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.

Source: Direction Générale de L'Énergie et des Matières Premières – Observatoire de l'Énergie; *La Politique Énergétique Française*; Ministére 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.

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

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 efficiency and conservation, cogeneration and renewables as well as fossil fuels will play a role in Germany's energy supply.
- 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: discommision safe and management of radioactive waste disposal.

NATURAL GAS

- Germany is the second largest European natural gas market after the UK, and one of the few 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.
- The absence of a regulator has been criticized.

OIL

- Gasoline consumption has decreased 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.

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 renewable sources 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 almost 9 GW of installed capacity.
- Germany has also ambitious targets for off-shore wind power.
- Renewable sources 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.
- The housing sector relies mainly on regulatory measures. The one key challenge in this sector is to reduce energy consumption in existing buildings.

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
- Analyse 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 renewable sources
- 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 for electricity and gas.
- 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-of-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 order 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.

ELECTRICITY

- Electricity supply is tight considering the expected evolution of demand, especially in dry years.
- Since transmission lines have also limited capacity, trade with neighbouring countries can have only a very small 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 or strengthen the competition.

R&D

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

POLICY ISSUES

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

- 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.

IRELAND

MAIN HIGHLIGHTS

- Apart from Luxembourg the Irish energy market is the smallest in the EU.
- Ireland spends 7 billion Euros 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 exacerbates Ireland's vulnerability to supply disruptions and/or price spikes.

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 subsidized.
- The largest single measure is to shut down or fuel switch the coal-fired power stations. 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 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 Euros 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 coming 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 ISSUES

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

- 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 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, possibly 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.

MAIN CONCERNS

NUCLEAR ENERGY

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

NATURAL GAS

- Italy produces oil and natural gas. 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.
- 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

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.
- In Italy it was approved the obligation to produce a quota of green electricity by renewable energies since 2002.

ELECTRICITY

- After the phasing out of nuclear energy, the electricity demand growth has been met by the use of other sources and increase of imports.

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 ISSUES

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

- 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 an increase on 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.

LUXEMBOURG

MAIN HIGHLIGHTS

- Luxembourg is the smallest EU - 15 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.
- Its oil sector is strictly retail and the government sets price ceilings to avoid inflation.

NATURAL GAS

- Luxembourg is totally dependent on natural gas imports, which have increased rapidly over the last years.
- Imports are being diversified in order to increase Luxembourg's security of supply.

RENEWABLES &CHP

- Electricity generation from renewables and cogeneration expanded rapidly because of generous buy-back tariffs and direct subsidies.
- The importance of non-hydro energy in Luxembourg is 1%.
- 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.

ELECTRICITY

- 95% of the electricity consumed in Luxembourg was imported until 2001 when a combined cycle power plant has been commissioned.

SPECIFIC FEATURES

- Government of Luxembourg considers market liberalization as an opportunity for companies and domestic consumers as it will allow them to benefit from reduced energy prices.
- Some municipalities are directly engaged in electricity and natural gas distribution activities.
- Energy taxes are low in Luxembourg, particularly on automotive fuels.
- 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 ISSUES

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

- Continue to cooperate with neighbouring 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 neighbouring countries) to reduce energy consumption in the transport sector.

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

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 privatised.
- 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 privatisation of Petrogal.
- Price ceilings protect consumers from abuses.

RENEWABLES

- All of Portugal's primary 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, little energy is used in housing heating; however, electricity demand has been growing with the increased use of domestic appliances.

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 and 2012, further efforts on energy efficiency, renewable energies and cogeneration should be implemented.

POLICY ISSUES

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

- 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 internalise 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 labelling, 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.

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.
- Spain has not ruled out nuclear power as an option to future capacity needs.

NATURAL GAS

- A transmission system operator has been established and the arrangements to separating the vertically integrated incumbent are in process.
- The Spanish government is making continuous effort to diversify the sources of natural gas supply, including the expansion of connections to EU grids; however it is a complicated issue.
- Natural gas is subject to lower taxes than other oil products.

OIL

- There is a tax distortion between gasoline and diesel giving favour to diesel over gasoline, although the environmental externalities do not favour 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.
- In its plan to promote renewables it has set an ambitious target of 12% of total primary energy sources to be from renewables by 2010, as compared to about 6% today.
- Renewables contribute significantly to diversification of energy sources as well as to reach the environmental targets.
- A decision was taken to phase out subsidies to CHP units larger than 10 MWe by 2007.
- Wind energy has had a tremendous development over the last years supported on the strong technological content and the progressive reduction of unit costs. In 2006 it is expected to reach 5.550 MW of installed capacity.
- Solar photovoltaic has had a strong growth and a wider application area.

ELECTRICITY

- In the electricity sector, the transmission system and market operations have been separated out from the vertically-integrated utilities following the establishment of a Market operator and a transmission system operator.

SPECIFIC FEATURES

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

POLICY ISSUES

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

- Study the feasibility of emissions trading scheme.
- Continue to review supply-demand projections, especially considering 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 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 neighbouring 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.
- Encourage the construction of new liquefied natural gas terminals and gas network interconnections.
- 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.

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.

MAIN CONCERNS

NUCLEAR ENERGY

- The electricity supply industry expects major reductions in nuclear capacity over the next 20 years because of competitive pressures.

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 (principally woods and forest wastes) account for about 15% and hydro about 12%.
- 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.

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.

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.

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 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.

NATURAL GAS

- The Netherlands has one of the major gas fields in EU – 15.
- The Dutch government has the challenge to preserve the small field's policy in the potentially highly competitive new gas market.
- 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 it is almost impossible the use of hydropower for electricity generation.

CHP

- Flower and plant growers account for a significant amount of CHP production using natural gas.
- 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.
- 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 interconnector 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.
- 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.

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.
- Currently there are 67 000 gas costumers and 100 000 electricity consumers that switch suppliers every week.
- The restructuring has resulted in closer integration of the gas and electricity markets, as well as other utility services: water, telecommunications and financial services.
- UK has a target of a 12,5% reduction in greenhouse gas emissions by 2008-2012.
- UK has a national target of cutting its CO2 emissions by 20% until 2010.
- UK has in place a Climate Change Levy (not applicable to residential sector) and a Domestic Emission Trading scheme.
- The UK's Energy White paper states that distributed energy sources (micro-CHP and fuel 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. In the 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.

RENEWABLES

- The Government has implemented in 2002 the Renewables Obligation that will raise the contribution of renewable energy sources to England and Wales's electricity supply to 10% by 2010. It corresponds approximately to the installation of 10 000 MW of renewable energies capacity by 2010.
- The Renewables Obligation requires suppliers in England and Wales to obtain an increasing proportion of electricity from renewables year on year.
- It is expected a voluntary green certificates market to emerge on the basis of this obligation.
- 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.
- Developers have entered into agreements for leases of wind farm sites around UK coast with a total capacity of at last 1400 MW.
- Off-shore wind industry considers that 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 in industrial promises.
- The UK has a target of 10 GW of good quality CHP by 2010. This target could save about 1,25MtC per year.
- It is expected that a considerable amount 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%.
- Electricity markets in Scotland and Northern Ireland are not as competitive as England and Wales. NETA is to be expanded to Scotland by April 2004.
- Massive construction of gas fired plants is replacing coal plants.
- BETTA will mean that Scottish domestic and business customers will benefit from the same level of competition that is now established in England and Wales. BETTA will help to create a diverse generating base in UK and encourage new transmission capacity.

SPECIFIC FEATURES

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

POLICY ISSUES

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

- 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 large industries and include some 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 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.

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 increase, 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 privatised 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

- Privatisation 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.
- Privatisation 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, CO2 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.

Country	Energy market opening (electricity + gas)[21]	Main energy investments planned	Kyoto commitment by 2008-2012[22]	Renewables target Directive 2010[23]	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 CO_2 emitters. Shut down of fuel switch coal plants.

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

Country	Energy market opening (electricity + gas)	Energy investments planned	Kyoto commitment by 2008-2012	Renewables target Directive 2010	Obs.
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.

4. ENERGY POLICY INDICATORS

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

The methodology

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.

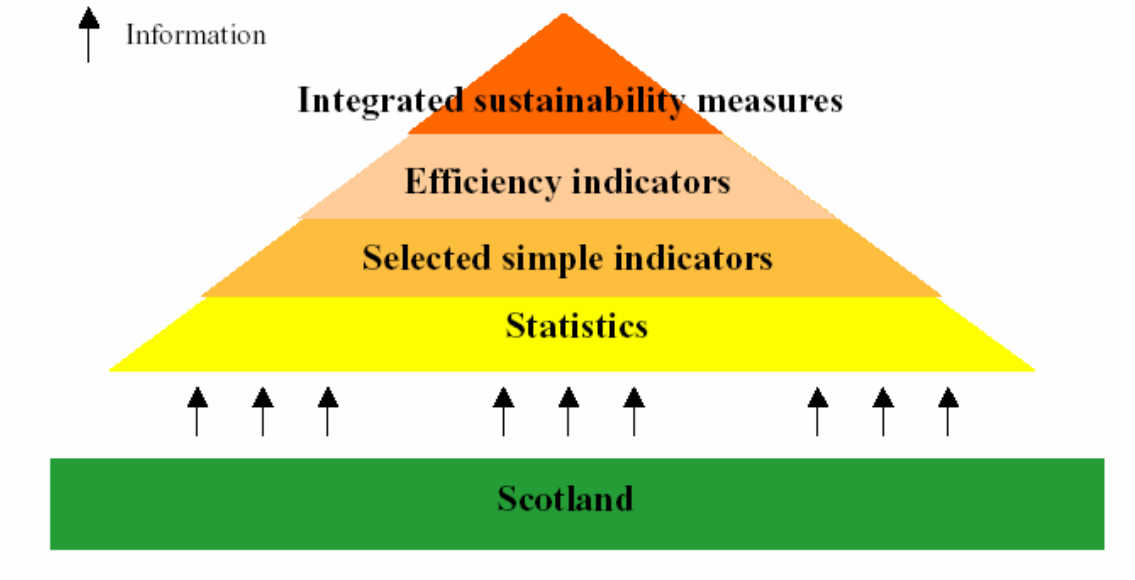
Our goal in the framework of the ESPON project is to use disaggregated indicators to show how energy infrastructures and energy production and consumption is linked with economic and human activity and to understand how spatial development depend or is influenced by the energy sector development and/or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

While developing the proposal for the indicators to be estimated we will try to classify them by broad chapters, in order to establish some common links among subsets of indicators, 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 approach to elaborate the final proposal for the set of indicators to be considered is as follows:

i) a first and complete set of variables and indicators will be proposed at a stage where data availability is not yet completely assessed. It is a first and 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 will be done taking into account data availability and quality. A second stage set of indicators will be 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 will be assessed, based on the criteria of information content, adequacy to answer the main policy questions, possibility of interregional comparisons.

The raw statistical data

For data collection of raw statistical information a set of variables has been defined taking in mind the proposed set of indicators presented in the next chapter.

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

The complete list of variables defined for the first stage of data collection is presented in "NOTE" at the end of this chapter.

The indicators

The contribution of the energy sector of the different countries 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 availability of data at country and regional level enabling comparisons.

In what follows, a proposal will be made for subsequent research on data availability.

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 have to be 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 depend mainly on national policies, resources location and technologies.

A. Economy, society and energy

A.1 TPES/population (toe per capita)

TPES – total primary energy supply

A.2 FEC/population (toe per capita)

FEC – final energy consumption

A.3 FEC service and residential sector/FEC total (%)

A.4 Electricity consumption/Population (kWh per capita)

A.5 TPES/GDP (toe per 000 Euro)

A.6 FEC/GDP (toe per 000 Euro)

A.7 GDP/FEC (000 Euro/toe)

A.8 Electricity consumption/GDP (kWh per 000 Euro)

A.9 GDP/Electricity consumption (Euro per kWh)

A.10 Household energy use (toe per capita)

B. Reliable supplies of energy

B.1 Average load factor (%)

B.2 Proportion of electricity generated by renewables (%)

B.3 Proportion of electricity generated by liquid fossil fuels (%)

B.4 Proportion of electricity generated by solid fossil fuels (%)

B.5 Proportion of electricity generated by natural gas (%)

B.6 Shares and diversity (Shannon-Weiner measure[24]) of fuels used for electricity generation

B.7 Gas capacity (kWh/day)

B.8 Ratio of energy production to primary energy consumption (%)

B.9 Fossil fuels dependency (fossil fuels as a percentage of primary consumption) (%)

B.10 Annual electricity failures (hours/year)

B.11 Crude oil refined/Fossil fuels primary consumption (%)

B.12 Grid density (high and medium voltage) (km/km^2)

C. Competitive energy markets

C.1 Fuel price indices for the industrial sector

- heavy fuel oil, gas, electricity, coal

C.2 Fuel price indices for the domestic sector

- gas and electricity

C.3 Fuel (petrol and gasoil) price indices for the transport sector

C.4 Competition in electricity generation (The Herfindahl-Herschmann measure[25])

D. Environmental objectives

D.1 Greenhouse gas emissions – global impacts (emissions, Kyoto targets)

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

[25] **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.

D.2 Acidification gas emissions – local impacts

Detailed analysis of the proposed indicators

Indicator	**A.1 TPES/population (toe per capita)**
Scope National level	
Description Total primary energy supply per capita	
Why is this indicator important? 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 and regions. 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.	
What are the links with other indicators? 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).	
Information source and frequency of reporting Country level: energy balances (time series), ESPON database, Eurostat Newcronos	

Indicator	A.2 FEC/population (toe per capita)
Scope National and regional level	
Description Final energy demand per capita	
Why is this indicator important? 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, the welfare of the population and the structure of the economy in terms of sectors. Final energy demand per sector can be used as a proxy to analyse the development stage of an economy (see indicator A3).	
What are the links with other indicators? 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.	
Information source and frequency of reporting Country level: energy balances (time series), ESPON database, Eurostat Newcronos Regional level: estimation for specific years (when possible)	

Indicator	A.3 FEC service and residential sector/FEC total (%)
Scope National and regional level	
Description Percentage of the service and residential sector final energy consumption in the total final energy consumption.	
Why is this indicator important? Developed economies have usually a strong service sector (high percentage in the ratio). This indicator is a good proxy to classify countries and regions according to their development level.	
What are the links with other indicators? It is expected that the evolution of this ratio goes in line with the importance of the service sector in terms of GDP.	
Information source and frequency of reporting Country level: energy balances (time series) Regional level: estimation for specific years (when possible)	

Indicator	A.4 Electricity consumption/Population (kWh per capita)
Scope National and regional level	
Description Electricity consumption per capita	
Why is this indicator important? It is a good proxy to measure the welfare of the population.	
What are the links with other indicators? The evolution of this indicator follows the evolution of A.3.	
Information source and frequency of reporting Country level: energy balances (time series), ESPON database, Eurostat Newcronos Regional level: estimation for specific years (when possible)	

Indicator	A.5 TPES/GDP (toe per 000 Euro)
Scope National level	
Description Total primary energy supply per unit of GDP (toe/000 Euro).	
Why is this indicator important? It shows the efficiency in using energy when comparing countries or regions with the same sector structure. However the magnitude depends on the structure of the economic activity and also of the efficiency in using energy.	
What are the links with other indicators? 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).	
Information source and frequency of reporting Country level: energy balances and national accounts (time series), ESPON database, Eurostat Newcronos	

Indicator	A.6 FEC/GDP (toe per 000 Euro)
Scope National and regional level	
Description Final energy consumption per thousand Euro of GDP	
Why is this indicator important? 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. Final energy demand per sector can be used as a proxy to analyse the development stage of an economy (see indicator A2). The inverse of this ratio gives the energy productivity (see A.7)	
What are the links with other indicators? It is the inverse of the energy productivity in terms of value added (see A7)	
Information source and frequency of reporting Country level: energy balances and national accounts (time series), ESPON database, Eurostat Newcronos Regional level: estimation for specific years (when possible)	

Indicator	A.7 GDP/FEC (000 Euros/toe)
Scope National and regional level	
Description Energy productivity in terms of value added	
Why is this indicator important? When comparing countries it shows those which are more or less dependent in final energy in the productive process. When comparing countries 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).	
What are the links with other indicators? It is the inverse of A6.	
Information source and frequency of reporting Country level: energy balances and national accounts (time series), ESPON database, Eurostat Newcronos Regional level: estimation for specific years (when possible)	

Indicator	A.8 Electricity consumption/GDP (kWh per 000 Euro)
Scope National and regional level	
Description Electricity consumption per unit of GDP.	
Why is this indicator important? It measures the degree of dependence of the economy from electricity.	
What are the links with other indicators? The inverse (see A.9) measures the productivity of electricity in terms of GDP.	
Information source and frequency of reporting Country level: energy balances and national accounts (time series), ESPON database, Eurostat Newcronos Regional level: estimation for specific years (when possible)	

Indicator	A.9 GDP/Electricity consumption (Euro per kWh)
Scope National and regional level	
Description Electricity productivity in terms of GDP.	
Why is this indicator important? It measures the relative efficiency in using electricity.	
What are the links with other indicators? The inverse (see A.8) measures intensity of electricity in GDP.	
Information source and frequency of reporting Country level: energy balances and national accounts (time series), ESPON database, Eurostat Newcronos Regional level: estimation for specific years (when possible)	

Indicator	A.10 Households energy use (toe per capita)
Scope National and regional level	
Description Final energy consumption per household	
Why is this indicator important? It enables the comparison of countries in terms of welfare of the population.	
What are the links with other indicators? It gives the same information of A.2	
Information source and frequency of reporting Country level: energy balances (time series) Regional level: estimation for specific years (when possible)	

Indicator	B.1 Average load factor (%)
Scope National level	
Description The average percentage of generating capacity used	
Why is this indicator important? It is a measure of the demand pressure under the electric sector and of the failures risk.	
What are the links with other indicators?	
Information source and frequency of reporting Country level: information from the utilities (time series)	

Indicator	B.2 Proportion of electricity generated by renewables (%)
Scope National level	
Description Share of renewables in electricity production.	
Why is this indicator important? 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 from renewables.	
What are the links with other indicators? It is complementary of the B.3, B.4 and B.5 ratios	
Information source and frequency of reporting Country level: energy balances (time series)	

Indicator	B.3 Proportion of electricity generated by liquid fossil fuels (%)
Scope National level	
Description Share of liquid fossil fuels in electricity generation.	
Why is this indicator important? It enables the assessment of the weight of liquid fossil fuels in electricity generation.	
What are the links with other indicators? It is complementary of the B.2, B.4 and B.5 ratios	
Information source and frequency of reporting Country level: energy balances (time series)	

Indicator	B.4 Proportion of electricity generated by solid fossil fuels (%)
Scope National level	
Description Share of solid fossil fuels in electricity production.	
Why is this indicator important? It enables the assessment of the weight of solid fossil fuels in electricity generation.	
What are the links with other indicators? It is complementary of the B.2, B.3 and B.5 ratios	
Information source and frequency of reporting Country level: energy balances (time series)	

Indicator	B.5 Proportion of electricity generated by natural gas (%)
Scope National level	
Description Share of natural gas in electricity production.	
Why is this indicator important? It enables the assessment of the weigh of natural gas in electricity generation.	
What are the links with other indicators? It is complementary of the B.2, B.3 and B.4 ratios	
Information source and frequency of reporting Country level: energy balances (time series)	

Indicator	B.6 Shares and diversity of fuels used for electricity generation
Scope National level	
Description Diversity measure. The smaller the measure the more dependent is the energy system of a reduced number of fuels.	
Why is this indicator important? 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.	
What are the links with other indicators? As a summary measure it sums up information given by indicators B.2 to B.5.	
Information source and frequency of reporting Country level: energy balances (time series)	

Indicator	B.7 Gas capacity (kWh/day)
Scope National and regional level	
Description Capacity for natural gas supply	
Why is this indicator important? It measures the available capacity for supplying natural gas. Knowing the demand over or underestimation of the capacity can be estimated.	
What are the links with other indicators? There is no link.	
Information source and frequency of reporting Country level: reports from sector entity (time series) Regional level: estimation for specific years (when possible)	

Indicator	B.8 Ratio of energy production to primary energy consumption
Scope National and regional level	
Description This indicator measures the primary energy self sufficiency. The complement is a measure on dependence of imports.	
Why is this indicator important? It gives a good measure of security of supply in terms of primary energy consumption.	
What are the links with other indicators?	
Information source and frequency of reporting Country level: energy balances (time series) Regional level: estimation for specific years (when possible)	

Indicator	B.9 Fossil fuels dependency (%)
Scope National and regional level	
Description It shows fossil fuels as a percentage of primary consumption.	
Why is this indicator important? It is an indicator which can be used to compare countries in terms of greenhouse gases emissions.	
What are the links with other indicators?	
Information source and frequency of reporting Country level: energy balances (time series) Regional level: estimation for specific years (when possible)	

Indicator	B.10 Annual electricity failures (hours/year)
Scope National and regional level	
Description This indicator shows the number of electricity disrupted supply hours per year.	
Why is this indicator important? It is a measure of the quality of the service of the electricity distribution utilities.	
What are the links with other indicators? There is no link.	
Information source and frequency of reporting Country level: reports from the regulators and electric utilities associations. Regional level: estimation for specific years (when possible)	

Indicator	B.11 Crude oil refined/fossil fuels primary consumption (%)
Scope National level	
Description Importance of refinery in fossil fuels primary consumption	
Why is this indicator important?	
What are the links with other indicators? There is no link.	
Information source and frequency of reporting	

Indicator	B.12 Grid density (high and medium voltage) (km/km2)
Scope National and regional level	
Description Number of km of high and medium voltage grids per km^2	
Why is this indicator important? It informs about more or less rarefaction of electricity supply in terms of the grid.	
What are the links with other indicators? There is no link.	
Information source and frequency of reporting Country level: information from the transmission utilities and from the regulators. Regional level: estimation for specific years (when possible)	

Indicator	C.1 Fuel price indices for the industrial sector
Scope National and regional level	
Description 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 (German was chosen because it is the larger consumer of the countries being considered).	
Why is this indicator important? It enables the assessment of relative competitiveness among countries.	
What are the links with other indicators?	
Information source and frequency of reporting Country level: price information published by national and international authorities. Regional level: estimation for specific years (when possible)	

Indicator	C.2 Fuel price indices for the domestic sector
Scope National and regional level	
Description 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 (German was chosen because it is the larger consumer of the countries being considered).	
Why is this indicator important? It enables the assessment of relative competitiveness and welfare of the population among countries.	
What are the links with other indicators?	
Information source and frequency of reporting Country level: price information published by national and international authorities. Regional level: estimation for specific years (when possible)	

Indicator	C.3 Fuel (petrol and gasoil) price indices for the transport sector
Scope National and regional level	
Description 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 (German was chosen because it is the larger consumer of the countries being considered).	
Why is this indicator important? It enables the assessment of relative competitiveness and welfare of the population among countries.	
What are the links with other indicators?	
Information source and frequency of reporting Country level: price information published by national and international authorities. Regional level: estimation for specific years (when possible)	

Indicator	C.4 Competition in electricity generation
Scope National	
Description Measures the degree of concentration in the electricity generation.	
Why is this indicator important? A better understanding of the behaviour of agents acting in the sector will be achieved.	
What are the links with other indicators?	
Information source and frequency of reporting Country level: information from dispersed sources.	

Indicator	D.1 Greenhouse gas emissions
Scope National level	
Description The amount of CO2 equivalent released to the atmosphere.	
Why is this indicator important? This indicator will help to monitor the Kyoto targets or the burden sharing targets.	
What are the links with other indicators?	
Information source and frequency of reporting Country level: Inventories supplied yearly to the IFCCC	

Indicator	D.2 Acidification gas emissions
Scope National and regional level	
Description The amount of acidification gases released to the atmosphere.	
Why is this indicator important? This indicator will help to monitor the existing targets for acidification gases.	
What are the links with other indicators?	
Information source and frequency of reporting Country level: Inventories supplied yearly to the IFCCC	

Raw statistical information

CORE INDICATORS

CI1 - Electricity production (GWh) by power source (fuel, gasoil, coal, natural gas, hydro, wind, biomass, others)
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:	**Consumption sector:**
. Oil products	. Residential
. Natural Gas	. Industry
. Electricity	. Commerce and services
. Coal	. Agricultural
. Biomass	. Transport

CI3 - Energy prices for industry (net and tax included)

VARIABLES

Besides these core indicators the following variables have to be collected in order to construct the indicators proposed in our first interim report:

V1 - Location of natural gas supply (by NUTS 3, "0" if there is not supply of natural gas and "1" if it exists);
V1A - underground storage facilities (m3)
V1B- reception, storage and re-gasification facilities for liquefied natural gas (m3/year)

V2 - Location of high voltage electricity networks (by NUTS 3, "0" if there is no network, "1" if it exists);
V2A – submarine links (KV)
V2B – cross border networks (KV)

V3 – Primary energy supply by energy product (oil products, hydro electricity, natural gas, other renewables, biomass) – NUTS 2

V4 – Power Plants installed capacity (MW by NUTS 3 level) per type: hydro, coal, natural gas, nuclear, oil products, and other renewables

V5 – Refineries capacity (NUTS 3)

V6 – Employment in the energy sector (NUTS 2)

V7 – Energy prices for the residential sector (electricity, natural gas, GPL) (NUTS2)

V8 – Energy prices for the transport sector (gasoil, petrol, natural gas, GPL) (NUTS2)

V9 – Hours of electricity supply disruption (NUTS 2)

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, for the time being, to calculate some of the proposed energy indicators and therefore hindering the elaboration of a detailed and complete assessment of energy sector in a regional perspective.

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, 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 Candidate Countries 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 Statistical Energy Yearbooks and Statistics of the Accession Countries 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.

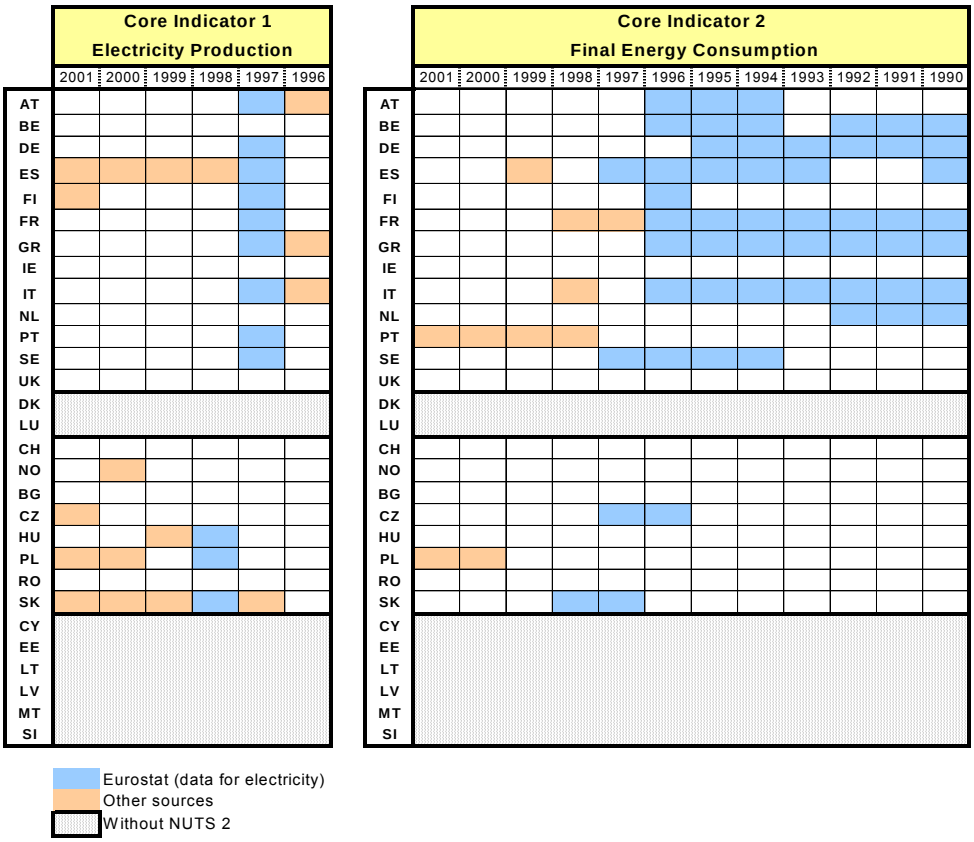
Another significant difficulty in the research is related to the quality of several sources. The energy data accessible from the Internet is also scarce and incomplete. Other sources like EUROSTAT do not provide sufficient information, neither at the country level nor regional level.

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 sometimes there were no answer at all. Moreover, the data from different sources vary and it is hard (if possible at all) to verify its quality.

At the present moment, the information collected by NUTS 2 level mainly comes from the database EUROSTAT Newcronos that 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 narrower than that theoretically possible.

Next table shows a summary of data available by NUTS 2 level that was possible to collect for Core Indicators 1 and 2, between 1990 and 2001.

Table 2 - Situation of data collection for Core Indicators 1 and 2 by NUTS 2



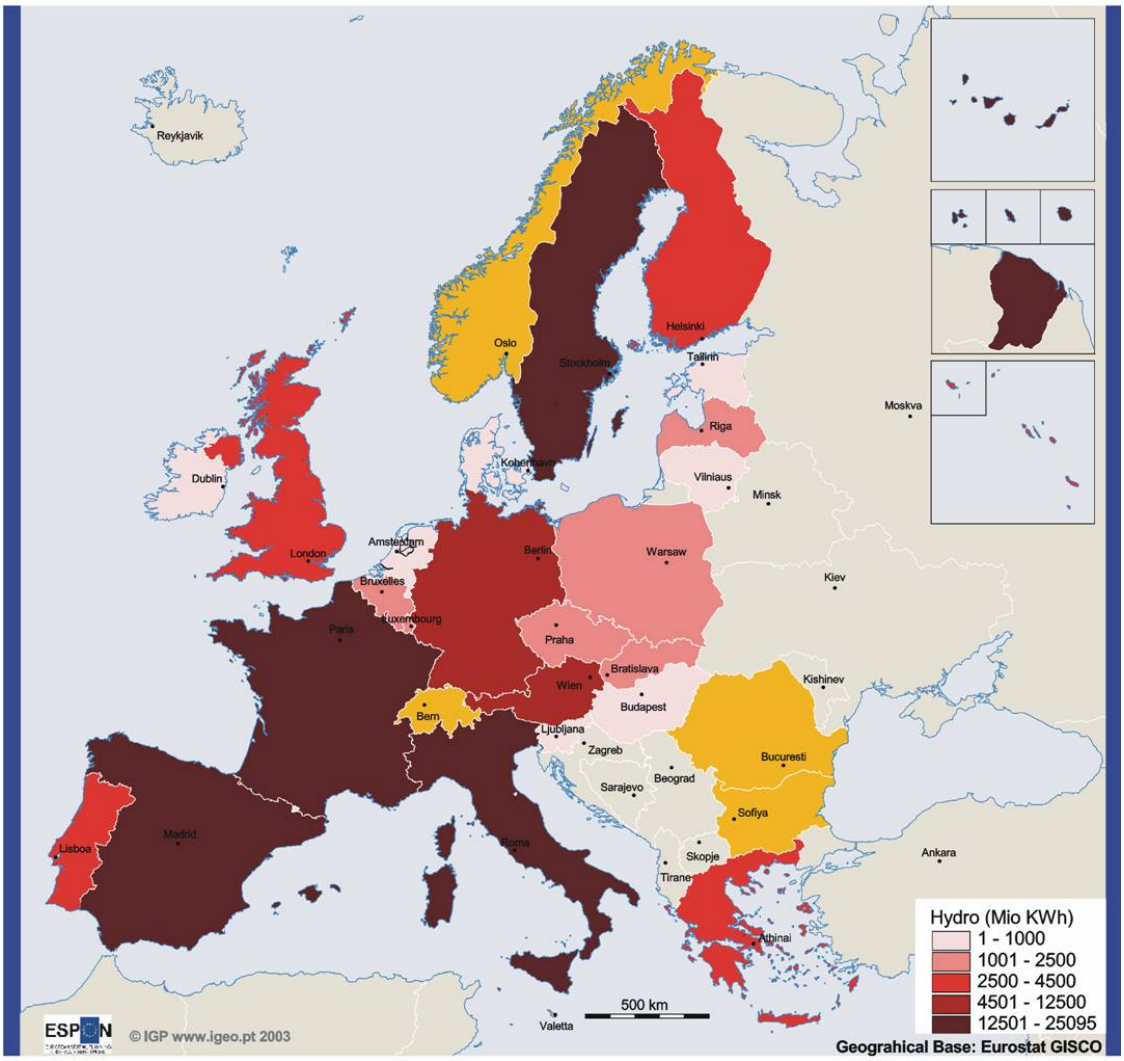
The following maps give a better idea of data availability and its consequences on further analysis.

In the representation of Core Indicator 1, for example, *electricity production by hydropower* can be seen by NUTS 0 in the first map bellow and by NUTS 2 in the second map bellow. Note that for Germany only 8 in 40 NUTS 2 regions have available data.

The source used is EUROSTAT Newcronos only gives regional information in 1997 for European Countries and in 1998 for Candidate Countries. The concerning data collected can be seen in the Annex 2.

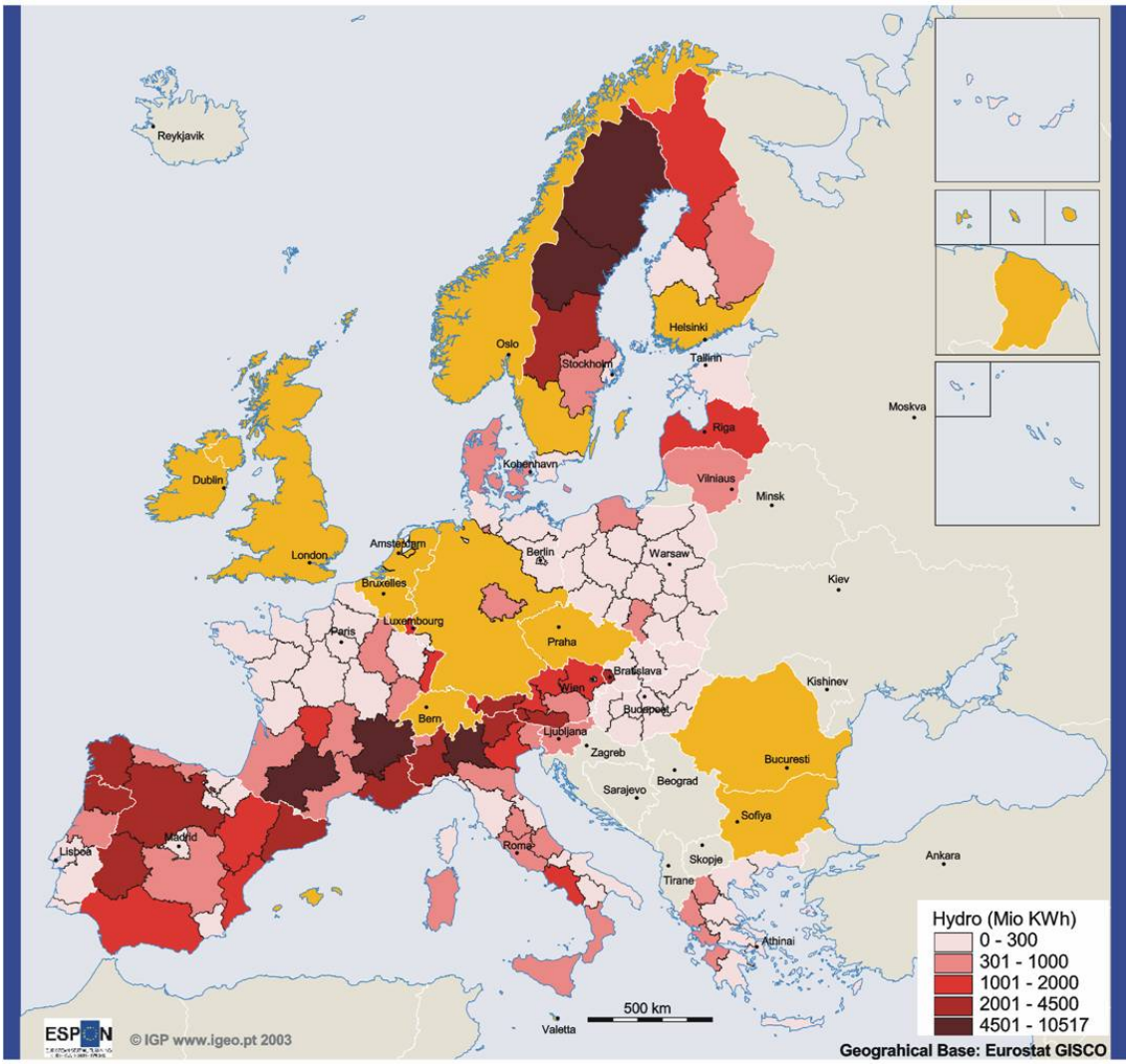
In all maps there are “yellow” regions, which mean that there is no information available for it. So, the comparative analysis is very limited.

Figure 7 - Electricity Production by Hydroelectric Power Plants - NUTS 0 (EU15 1997 and CC12 1998)



Note: "yellow" means data is not available
Source: Eurostat Newcronos

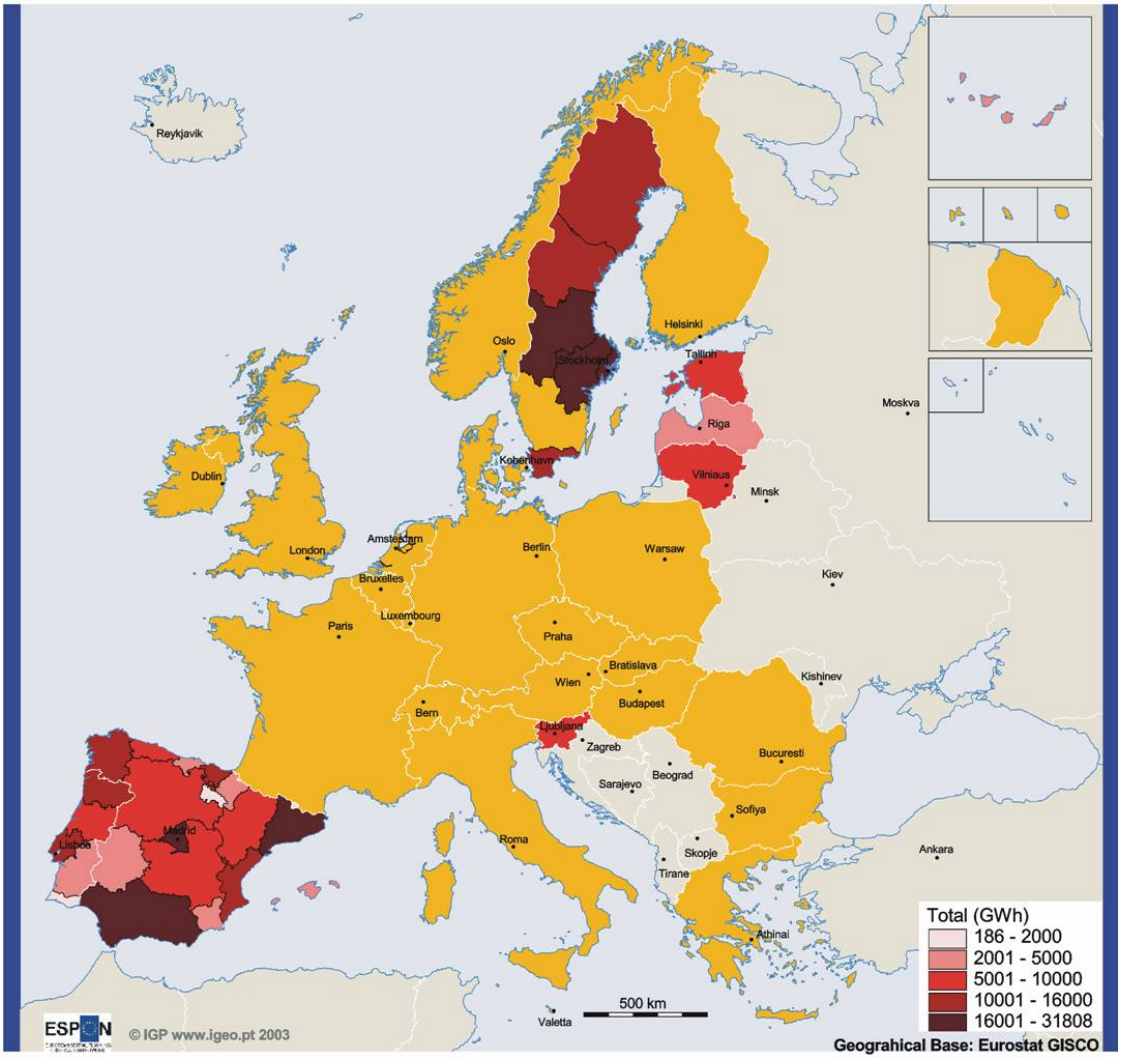
Figure 8 - Electricity Production by Hydroelectric Power Plants - NUTS 2 (EU15 1997 and CC12 1998)



Note: "yellow" means data is not available
Source: Eurostat Newcronos

A representation of Core Indicator 2 by NUTS 2, for example *final consumption of electricity*, can be seen in the following map. Once again the problem of data availability using a uniform database it is very significant, compromising any comparative analysis.

Figure 9 - Final Consumption of Electricity - NUTS 2 (1997)



Note: "yellow" means data is not available
Source: Eurostat Newcronos

The relevance of the present analysis depends on the transparency 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.

Considering the several difficulties in constructing an energy regional database, it does not seem too relevant to show all regional data collected until now because it is necessary a progressive harmonization of data (harmonization of data definition, and desegregation levels).

We will then concentrate the analysis on country level, through the application of the proposed indicators.

SECTION III - Brief analysis of the energy sector

For now we are able 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 areas covering different aspects of the energy sector.

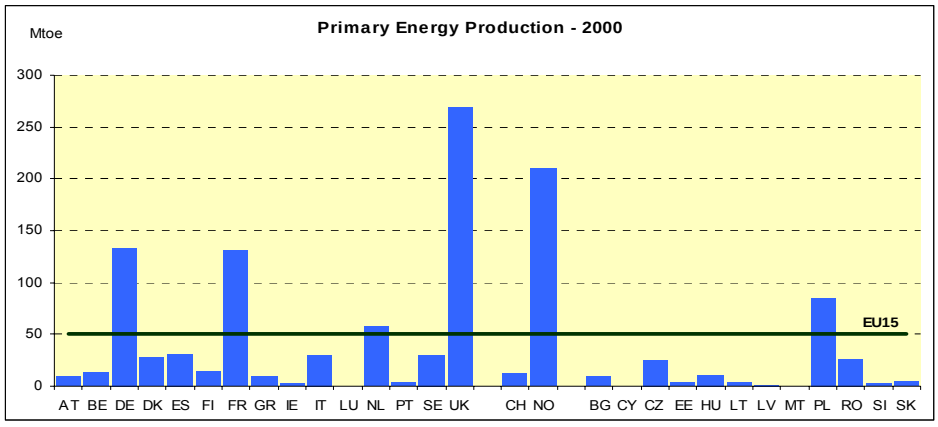
- Economy, society and energy *(indicators A)*
- Reliable supplies of energy *(indicators B)*
- Competitive energy markets *(indicators C)*
- Environmental objectives *(indicators D)*

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 parts of the considered period (1995 to 2000). For Candidate Countries, Norway and Switzerland information reports are for 1999. Some indicators and maps of this first stage of data collection are presented along the text and the remaining is presented in Annex 2.

Energy Supply

In 2000, United Kingdom was the most important producer of primary energy in our country sample, followed by Norway. There are few countries self sufficient in primary energy production and most countries are highly dependent on fossil fuels, especially imported oil.

Figure 10 - Primary Energy Production - 2000



Note: 1999 for CC12, NO and CH

Primary energy supply depends on final energy demand, on the endogenous resources and on the energy carriers to transform energy. Fossil fuels such as coal, oil and natural gas continue to dominate the countries energy supply. Despite considerable domestic production, an increasing majority of these have to be imported and the countries energy import dependency is growing. This is mainly due to an increase in overall consumption.

Between 1995 and 1999 primary energy production increased 4% in European Union countries and decreased 14% in Candidate Countries.

Figure 11 - Primary Energy Production EU15

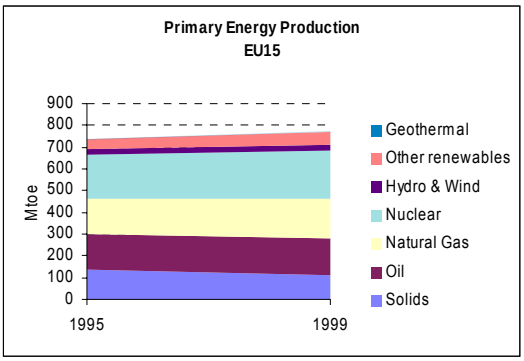
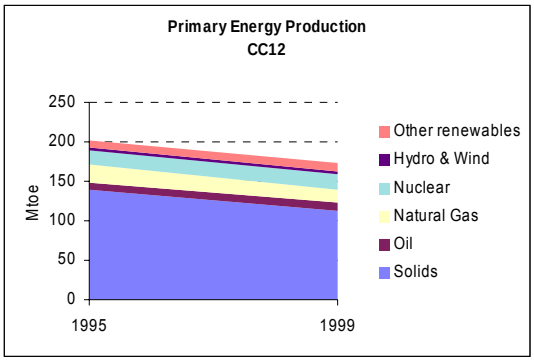
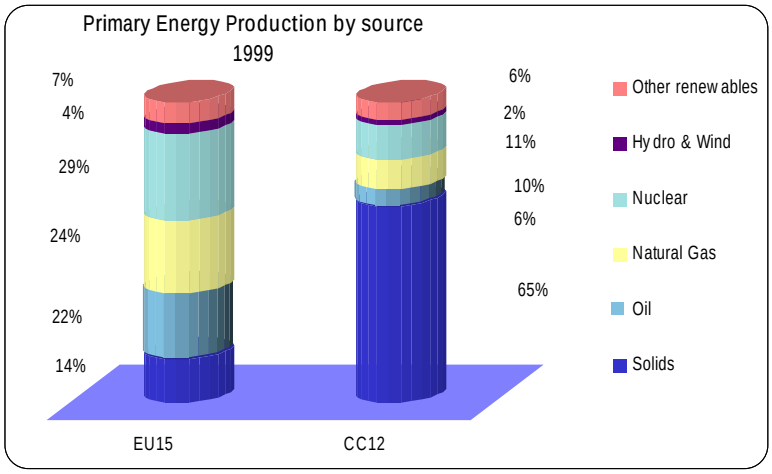


Figure 12 - Primary Energy Production CC12



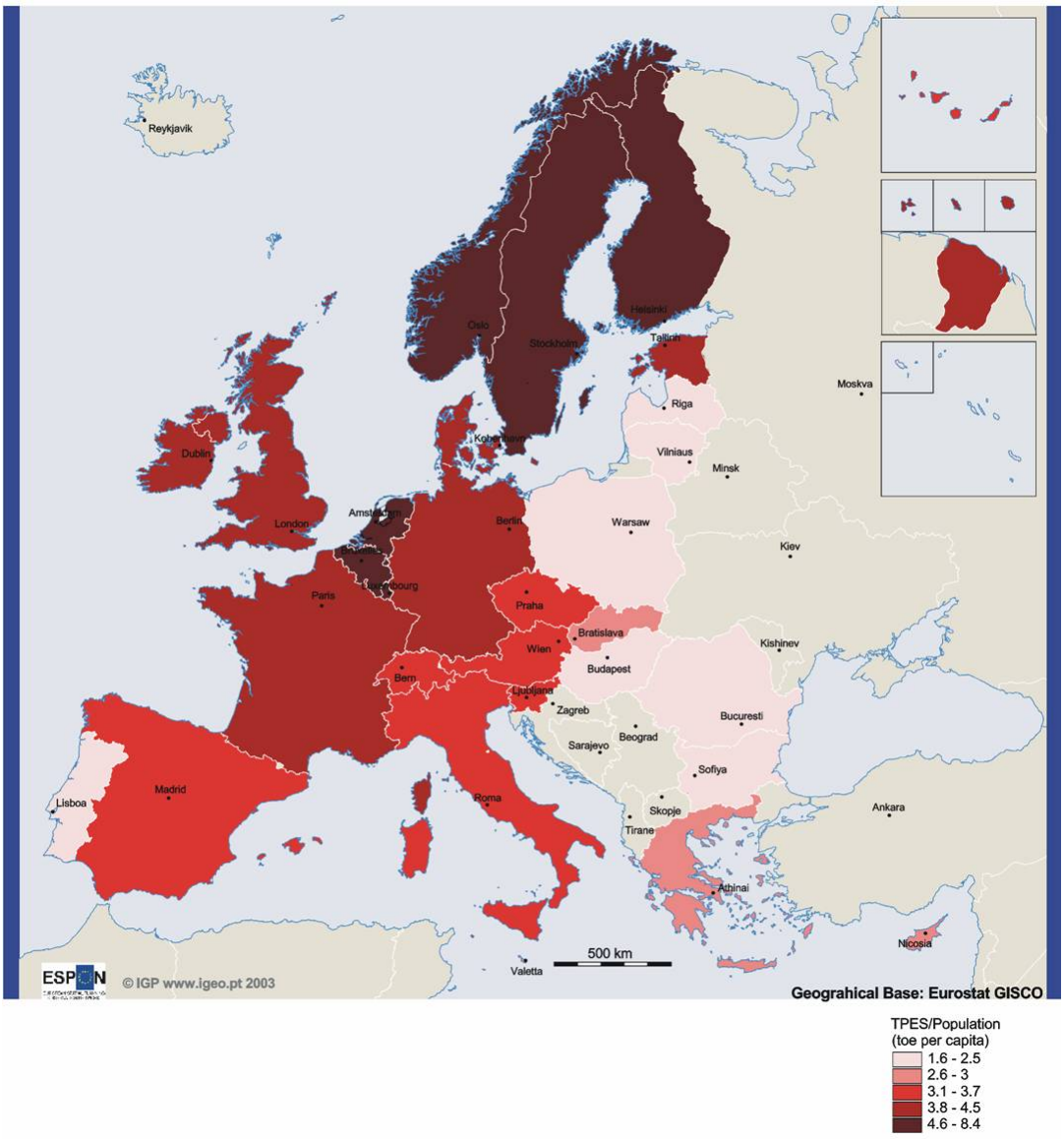
In 1999 the structure of primary energy production is not similar between European Union and Candidate Countries. These ones are considerably more intensive producers of solid fuels.

Figure 13 - Primary Energy Production by source (1999)



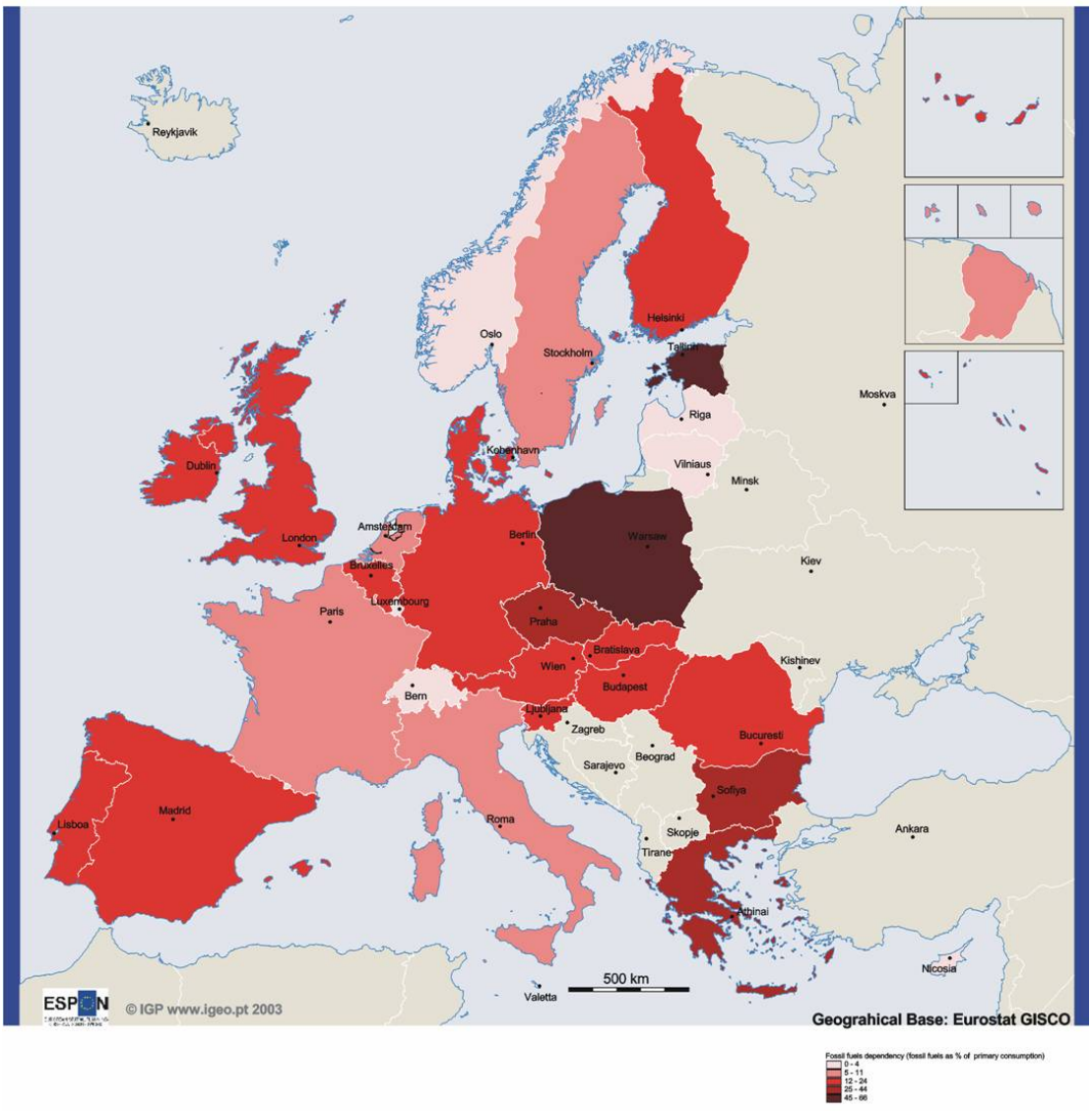
As we can see in the map below, the indicator *primary energy supply per capita* shows a significant difference between European Union and the Candidate Countries. It reflects differences in welfare of population, the way energy is used (efficiency degree) and the importance and structure of the industry sector versus services sectors.

Figure 14 - Total Primary Energy supply per capita (2000)



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

Figure 15 - Fossil Fuels Dependency (2000)



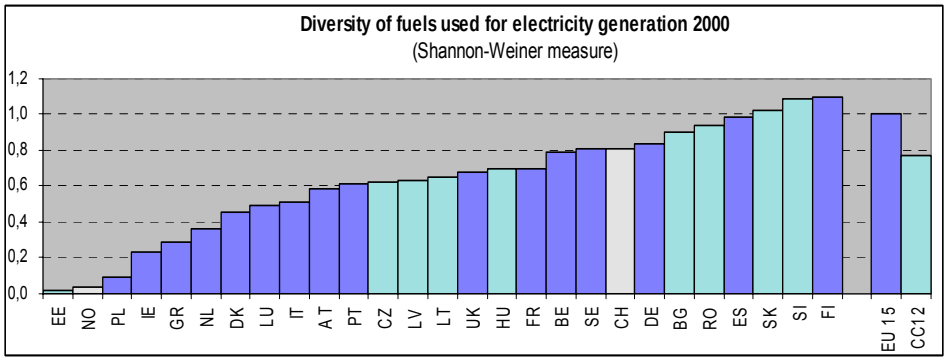
Most countries have reduced their dependence on fossil fuels since 1995 by developing alternative sources. Only Austria, Bulgaria, Cyprus and Estonia have raised their dependence between 1995 and 2000.

Diversity of supply contributes both to security of supply and to the stability in the broad cost of energy (because alternatives are available). Diversity thus carries benefits for individual consumers and for the national economy.

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

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

Figure 16 - Diversity of fuels used for electricity generation 2000

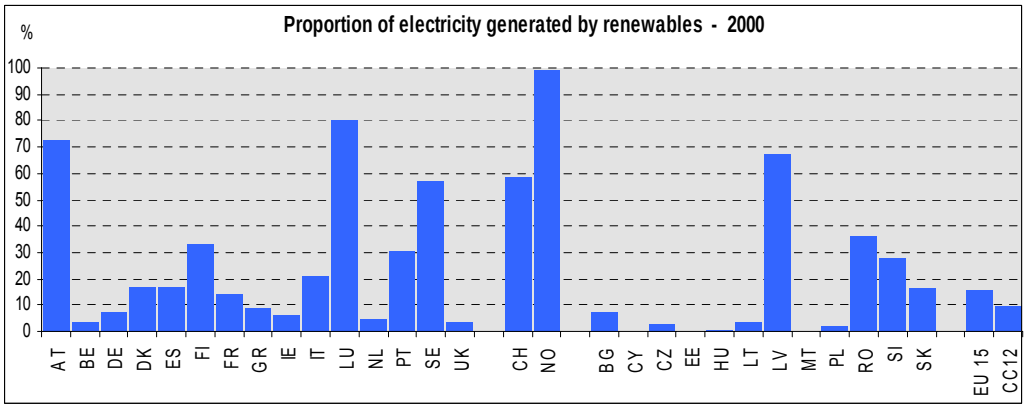


Note: 1999 for CC12, NO and CH

In what concerns electricity generation the shares of coal, gas and nuclear are better balanced. Further growth in the indicator is expected if renewables take a larger share of generation capacity.

In 2000, the proportion of electricity generated by renewables is significant in countries such as Austria, Luxembourg or Norway, although it must be understood that the nature of renewables in this context is very different among countries.

Figure 17 - Proportion of electricity generated by renewables - 2000

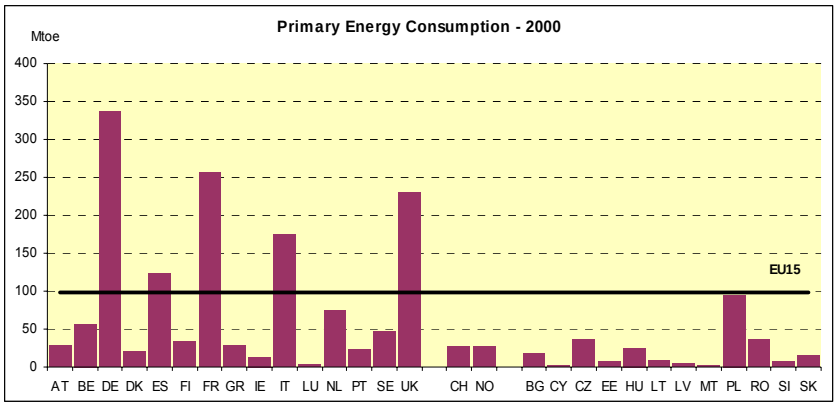


Note: 1999 for CC12, NO and CH

Energy Demand

Concerning *primary energy consumption*, Germany is the largest consumer followed by France and United Kingdom in 2000.

Figure 18 - Primary Energy consumption - 2000



Note: 1999 for CC12, NO and CH

In the European Union countries there is a growth of primary energy consumption between 1995 and 1999 of about 6% while in the Candidate Countries the trend was the opposite, decreasing about 8%.

Figure 19 – Primary Energy Consumption EU15

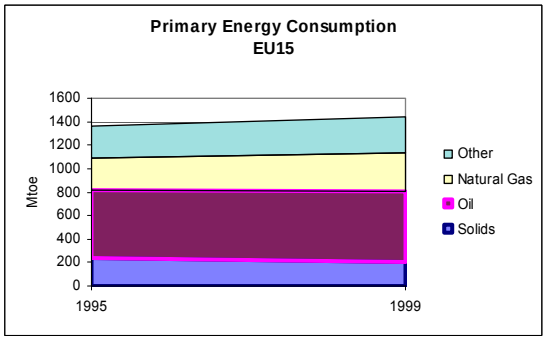


Figure 20 - Primary energy consumption CC12

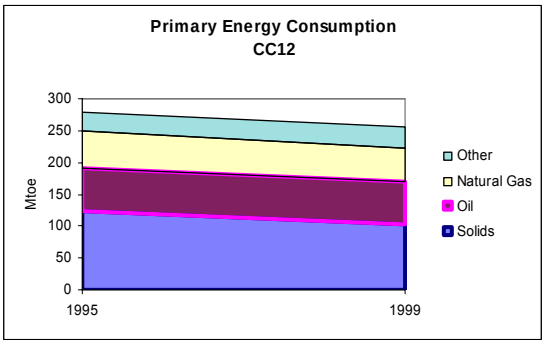
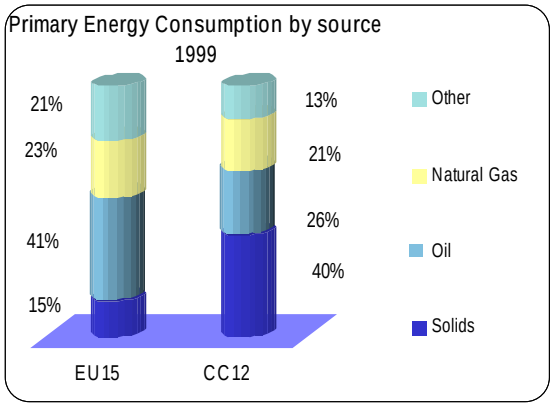


Figure 21 - Primary Energy Consumption by source (1999)



In a comparative analysis between countries, European Union has a structure of *final energy consumption* by source quite different from Candidate Countries. Oil is the most significant energy source in EU15, representing about 46%, while in the Candidate Countries the energy consumption is more differentiated among sources, also showing greater diversity amid countries.

Figure 22 - Final energy Consumption by source in EU15

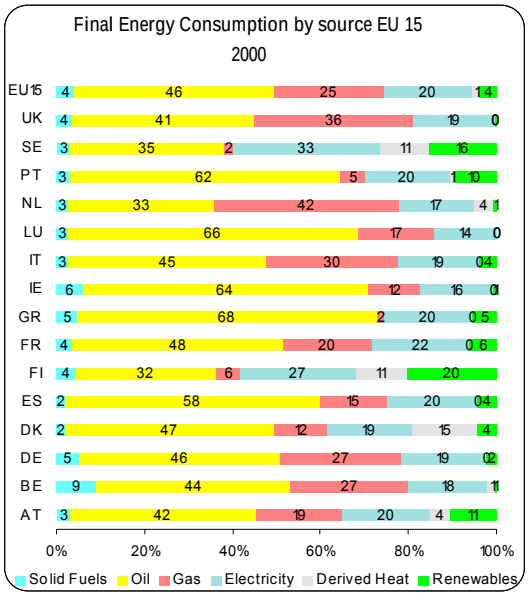
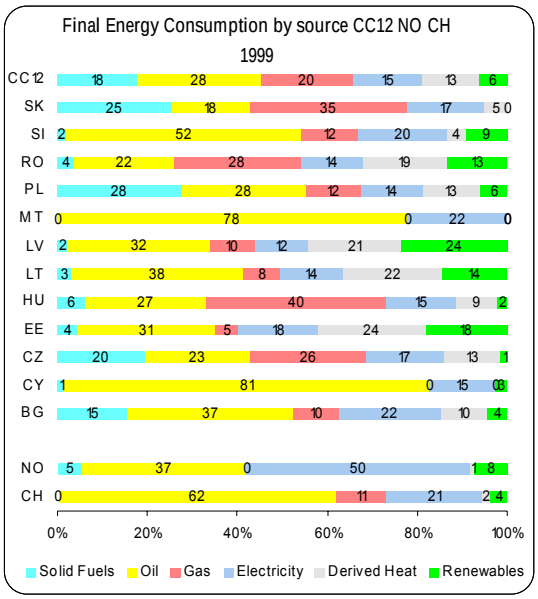


Figure 23 - Final Energy consumption by source in CC12, NO and CH



Although *final energy consumption by the domestic and services sectors* had increased slowly between 1995 and 2000, these sectors are responsible for nearly 40% of final energy consumption in European Union in 2000 and for 47% in Candidate Countries in 1999, making it the largest energy consuming sectors, ahead of the industrial sector and transport sector, in average terms.

Figure 24 - Final Energy Consumption by sector in EU15

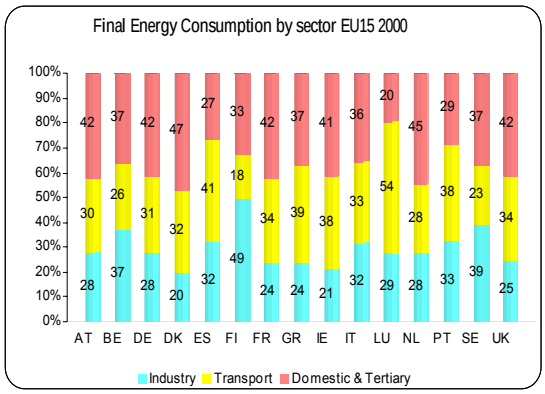
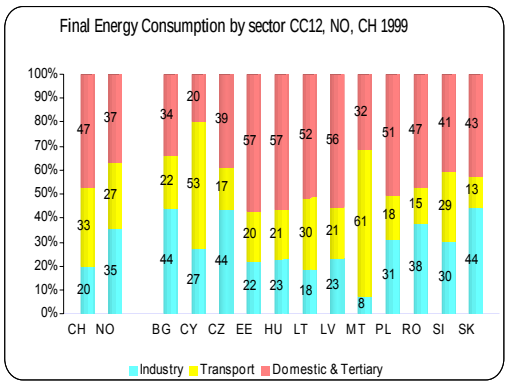


Figure 25 - Final Energy Consumption by sector in EU15

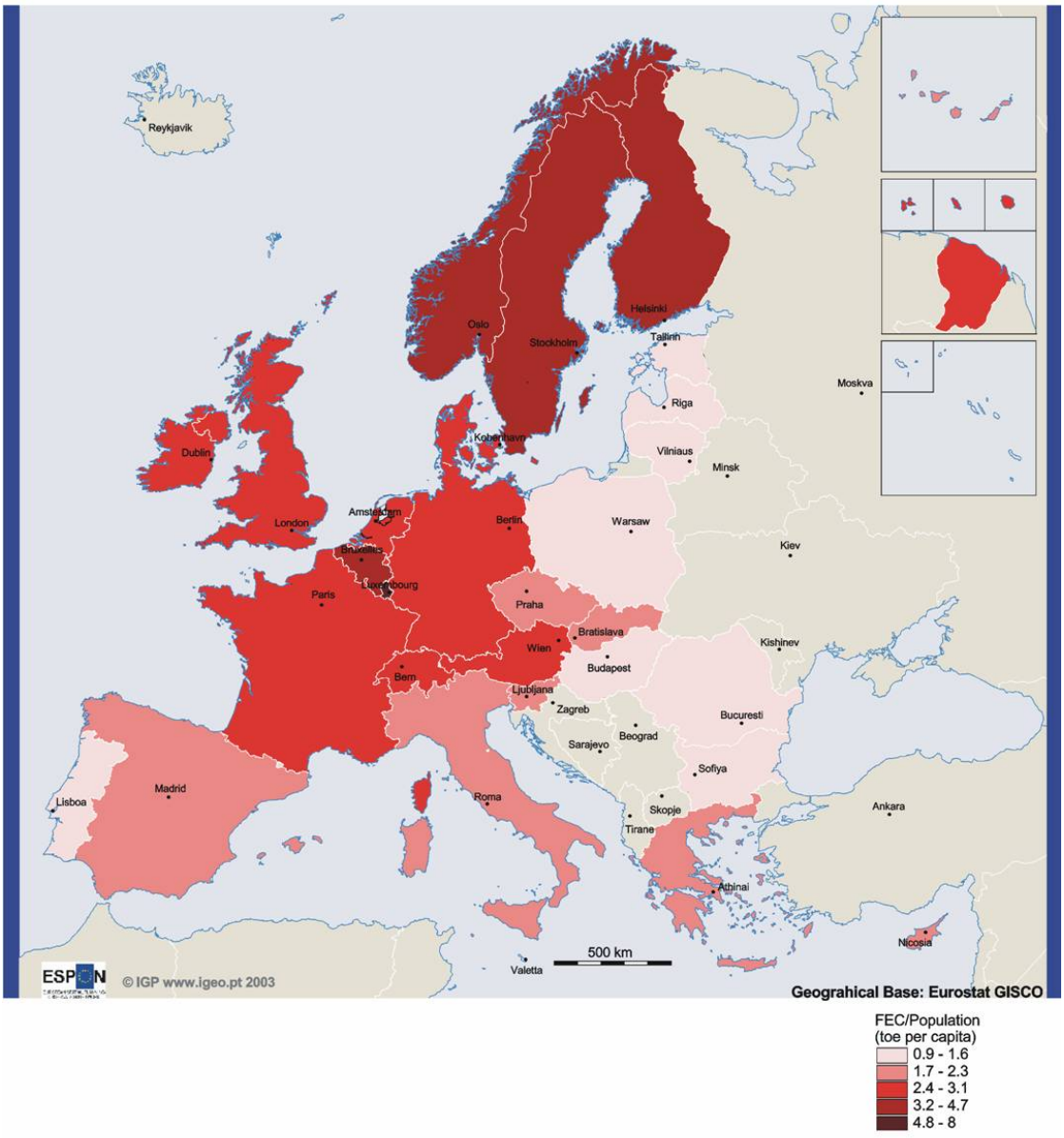


It is important to notice that final energy consumption by the transport sector had the most significant growth between 1995 and 2000, about 12% in European Union and 17% in Candidate Countries.

Considering that *final energy consumption per capita* reflects the welfare of the population, the structure of the economy and the energetic efficiency of the industrial equipment and buildings, the Scandinavian countries, as well as Luxembourg, have the highest per capita energy consumptions on our country sample, as can be seen in the map below.

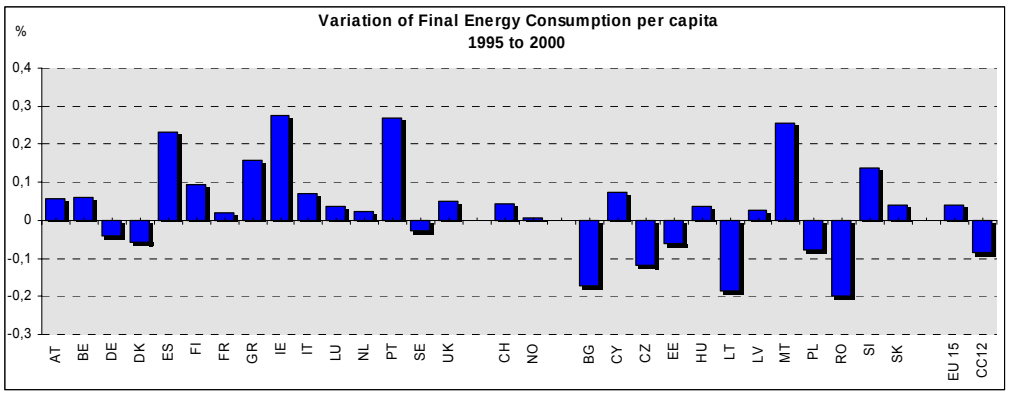
Total final energy consumption per capita in the more developed countries is about twice as high as in the Candidate Countries, which is mainly due to higher consumption in the industry and transport sectors.

Figure 26 - Final Energy Consumption per capita (2000)



It is important to note that between 1995 and 2000, Portugal, Spain, Ireland and Malta were the countries with more significant growth in this indicator.

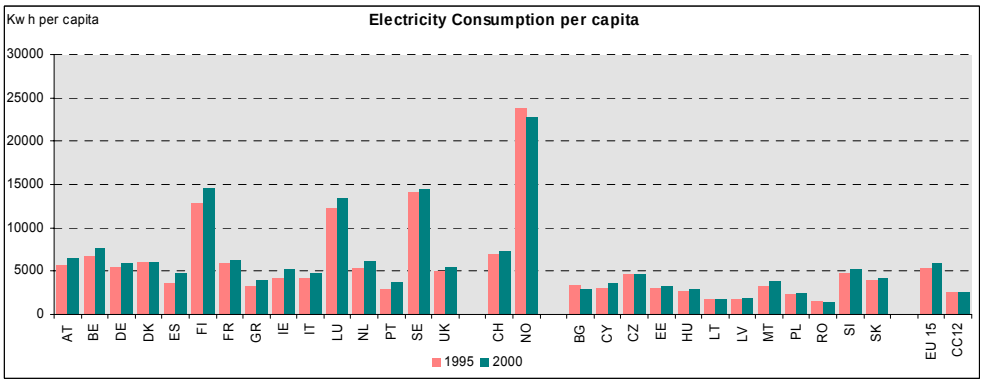
Figure 27 - Variation of Final Energy Consumption per capita



Note: 1999 for CC12, NO and CH

In the figure below we can see the evolution of *electricity consumption per capi*ta that shows a general trend of growth in the period 1995 to 2000, with few countries exceptions, such as Norway, Bulgaria and Romania.

Figure 28 - Electricity Consumption per capita

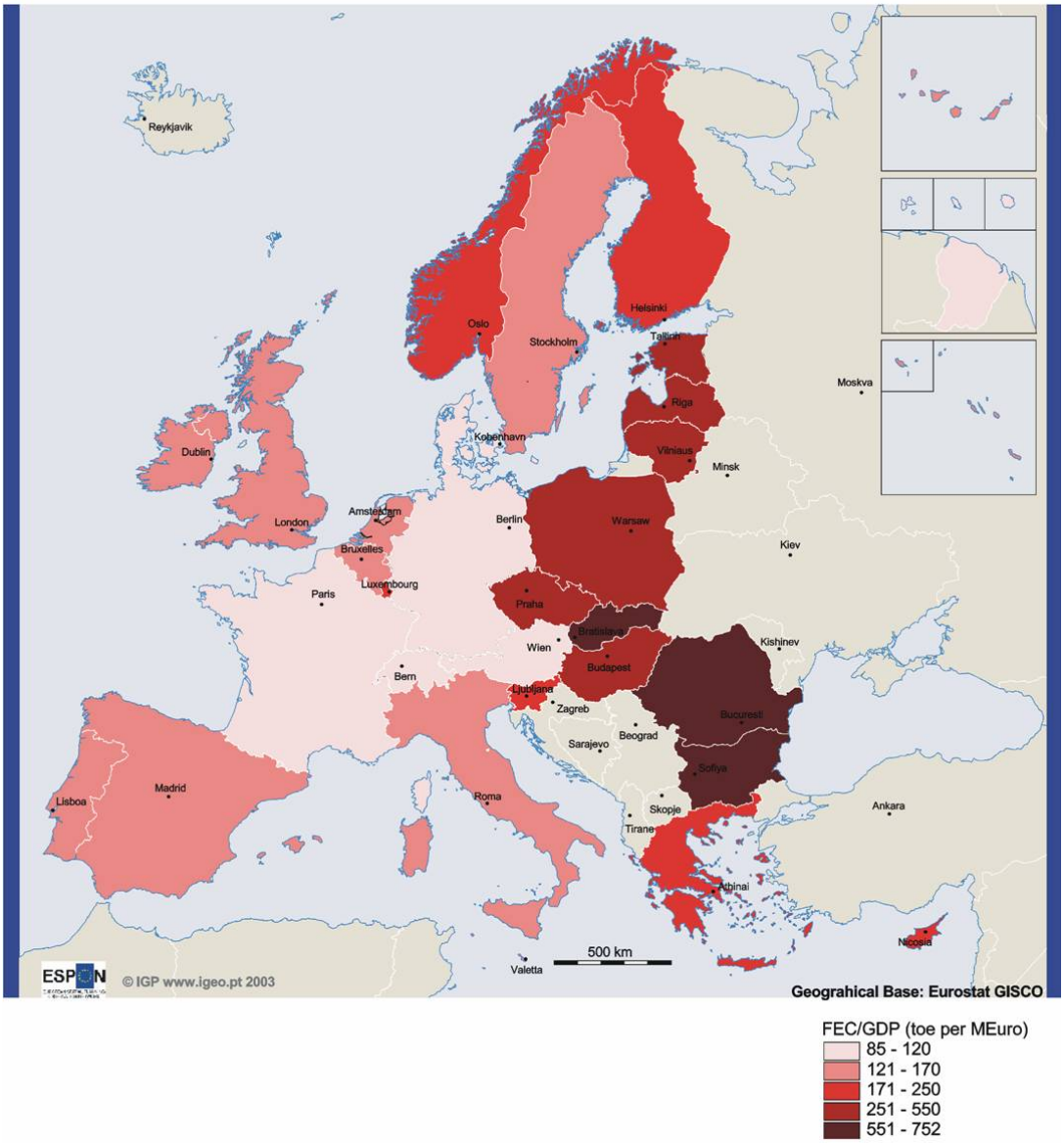


Note: 1999 for CC12, NO and CH

In 2000, the average of final energy consumption per GDP is around 0,13 toe per thousand Euros in EU15 and 0,44 toe per thousand Euros in the Candidate Countries.

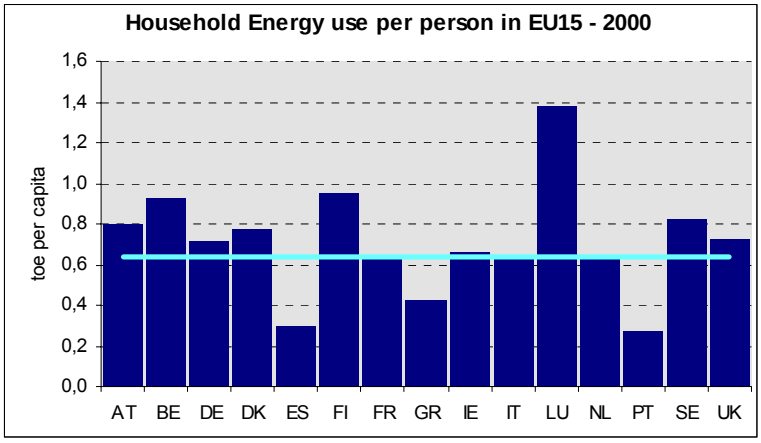
Large differences exist between countries ranging from 0,09 toe/000Euros in Switzerland to 0,6 toe/000Euro in Romania. Besides economic inequality between countries, the difference in this indicator may also reflect differences in energy consumption patterns as well as inefficiency within energy transformation.

Figure 29 - Final Energy Consumption/GDP (2000)



The countries vary considerably in the amount of energy each person uses at home. This variation is a combination of many factors, such as climate, household size, comfort levels, energy efficiency and energy prices.

Figure 30 - Household Energy use per person in EU15



Those countries with the lowest levels of *household energy use per person*, such as Portugal and Spain, have experienced increases in energy use per person between 1995 and 2000.

Energy Prices

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.

Next two figures provide a picture of electricity prices in European Union change from 1995 to 2001, for industry sector and household sector. In both sectors electricity prices on the European Union Countries decreased in average in that period. The case of Italy is the exception.

Figure 31 - Electricity Prices for Industry in EU15

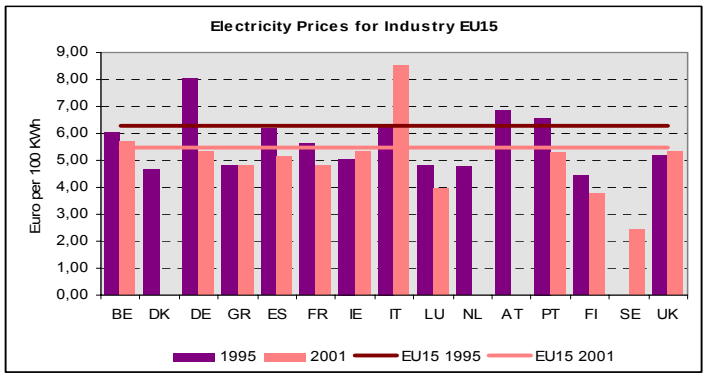
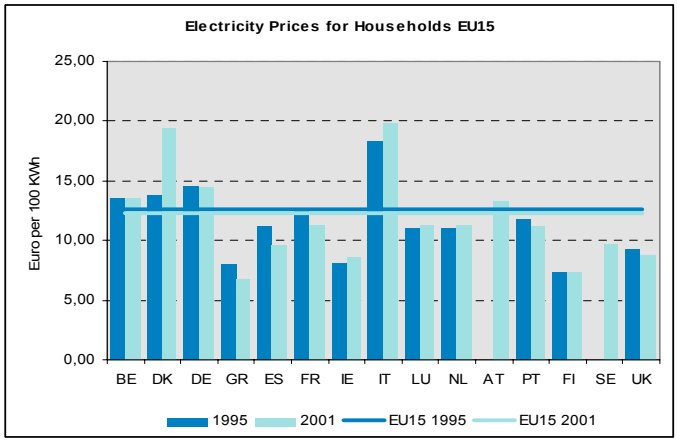


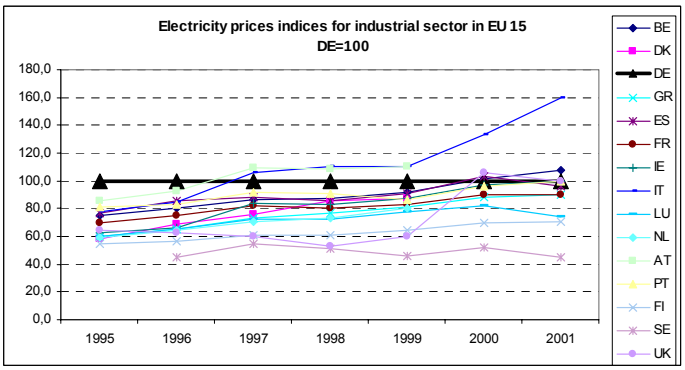
Figure 32 - Electricity Prices for households in EU15



To analyze the evolution of relative price indices of electricity used by industry, we use an indicator that shows the trends in *electricity prices* indexed to Germany prices (considered the largest consumer country in this study), trying so to assess the relative competitiveness among countries.

As we can see in the figure below the situation in 2001 is quite different from 1995, reflecting a trend of larger disparities between electricity prices for industry. With Germany electricity prices as basis for comparison and considering that those prices decreased there much more then anywhere else, we realize that EU countries haven't been able to follow up this trend, improving their competitiveness.

Figure 33 - Electricity Prices Indices for industrial sector in EU15 (Germany=100)



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 been trying to overcome severe difficulties in constructing an energy regional database.

In this section we present:

a) Some results of the analysis at country level and at regional level for a country (France) in order to identify relevant relations between energy and development. The preliminary conclusion is that econometric models will be of little help to put in evidence the impact of energy on territorial development.

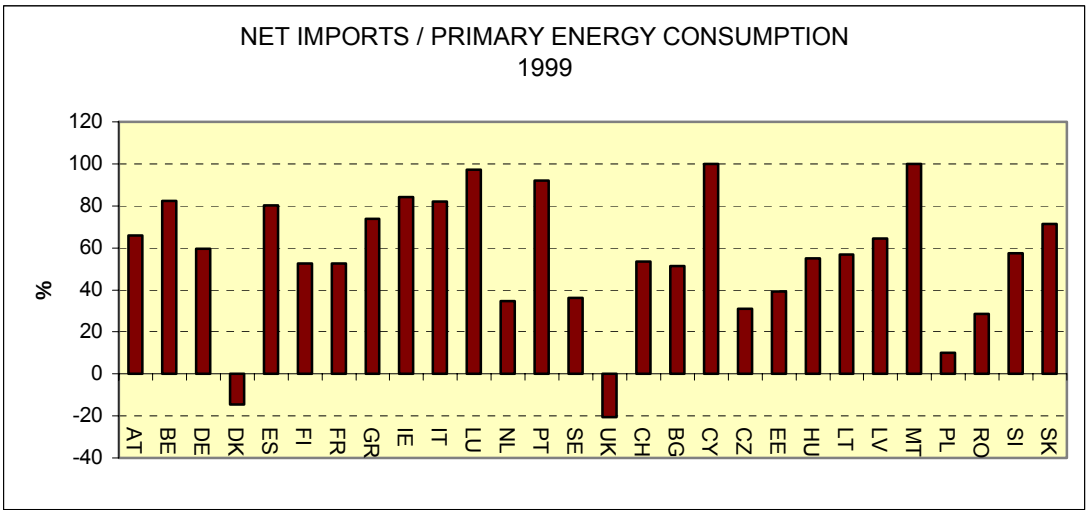
b) A theoretical reasoning on what can be expected on energy territorial impact and results of some studies aiming to quantify the economic impact of changing the conditions of energy supply. The conclusion of these studies point to a significant but small impact.

c) The framework we will develop to assess energy territorial impact and the results obtained when it is applied to Portuguese 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[26]. "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 their energy needs.

Figure 34 - Net energy imports and primary energy consumption



Note: For better legibility, Norway is not represented on this chart

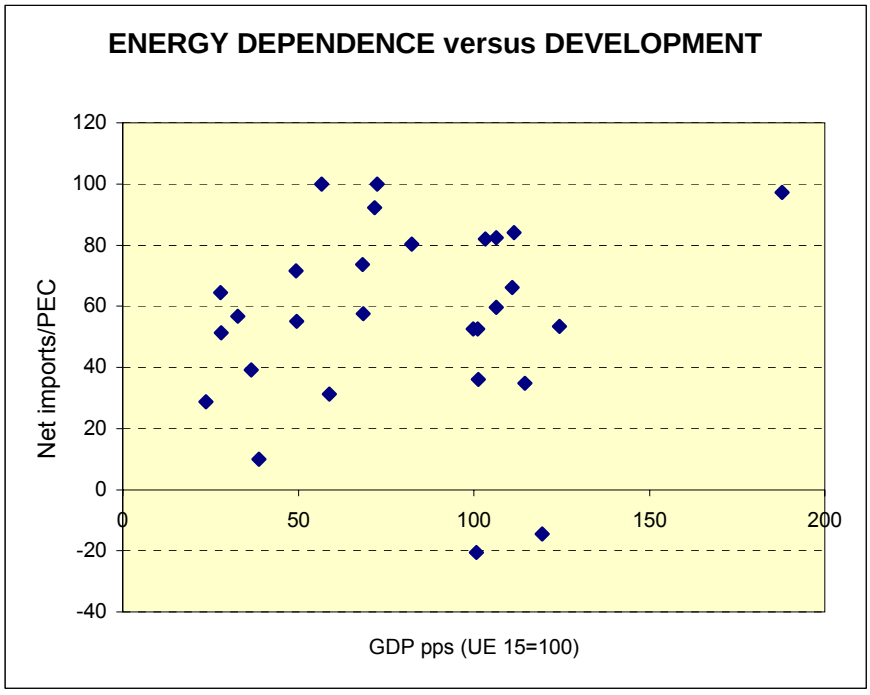
Energy is fundamental for almost every human activity and access to energy is crucial for economic development. But we cannot expect to find a clear relationship between development and energy. Nowadays, energy is more or less easily transportable and, at least

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

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 (ppp).

Figure 35 - Energy Dependence and Economic Development, 1999



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*"[27] 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 there are changes in the relations between economic development and energy as economies progress through different development thresholds, pointing to the advantages of regional and national typologies as a mean to identify and understand policy needs.

[27] 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.

Defining a Typology of Regions towards Energy Ladders

Setting up a typology framework with the aim to define energy ladders must consider, at least, a set of variables that reflect:

a) different energy sources available at the appropriate territorial level, represented by dummy variables;

b) energy prices indices related to a national average or to the leading economic centers;

c) indicator for the quality of supply represented by an indicator of hours of disruption per year;

d) indicators of the type of industrial structure and industrial energy consumptions;

e) indicator of the territorial urban structure;

f) indicators of population density and household energy consumptions.

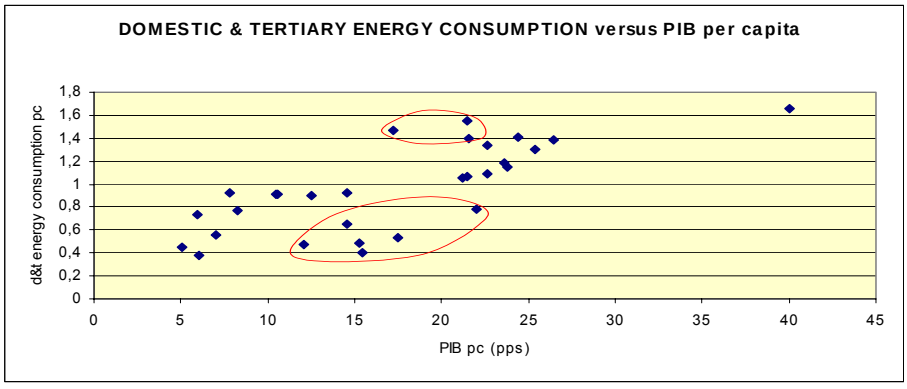
So far we have not been able to develop such framework, basically by the lack of consistent indicators that could allow the use of variables quoted on items a), b) and c).

This exercise must be performed at NUTS 2 level.

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 36 - Domestic and tertiary energy consumption and GDP per capita, 1999

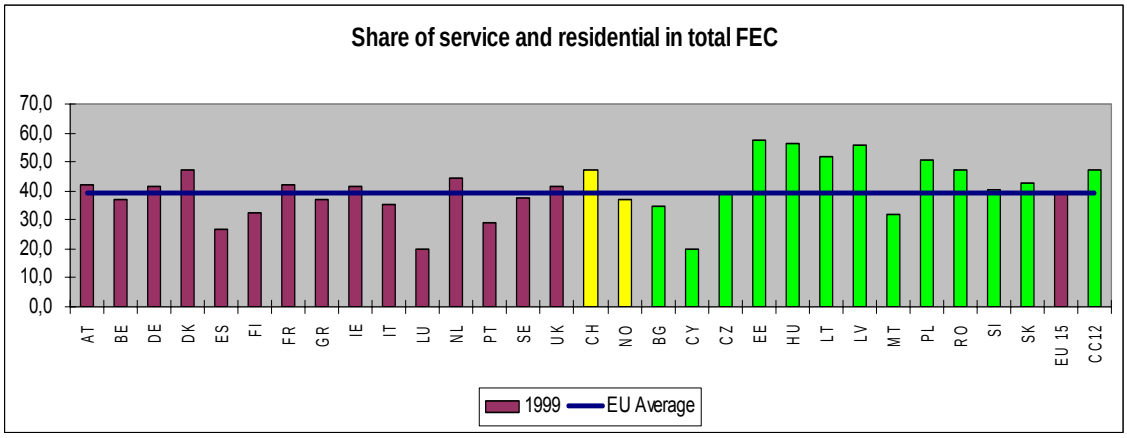


In Figure 3, the Mediterranean and Nordic countries are identified, but it is clear that, in what concerns households, the most important factor seem to be differences in wealth. There is a clear and linear relation between domestic and tertiary per capita energy consumption and

GDP per capita (correlation = 0.75). This relation is even stronger (r=0,87) when only EU-15 countries and households' consumption are considered.

Another important relation, in as much as domestic and services consumption is concerned, could reflect economic structure and building efficiency. This is shown in data provided in **Erro! A origem da referência não foi encontrada.**.

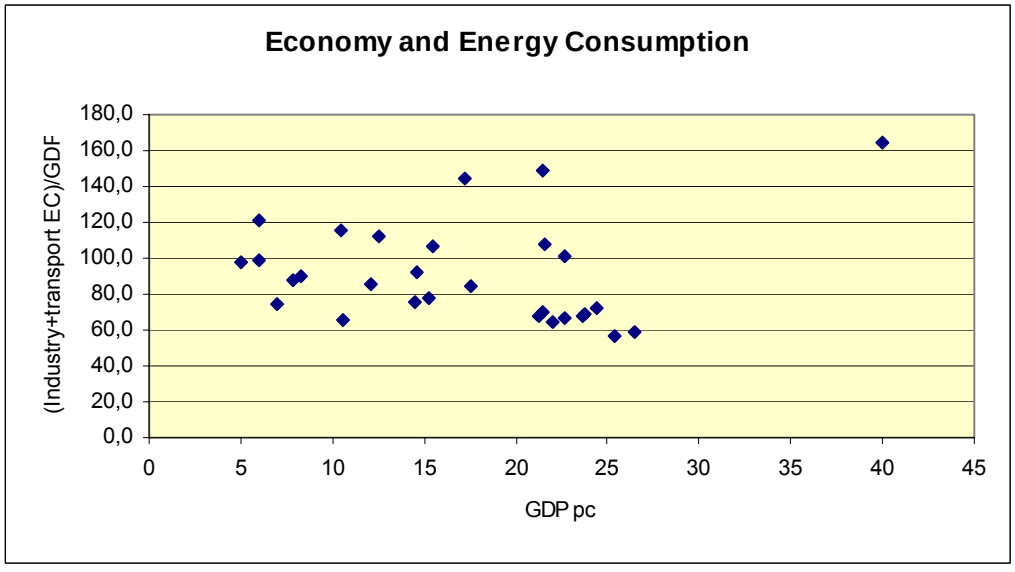
Figure 37 - Share of service and residential energy consumption in Final Energy Consumption



Note that 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 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.

Figure 38 - Economic development and energy consumption, 1999

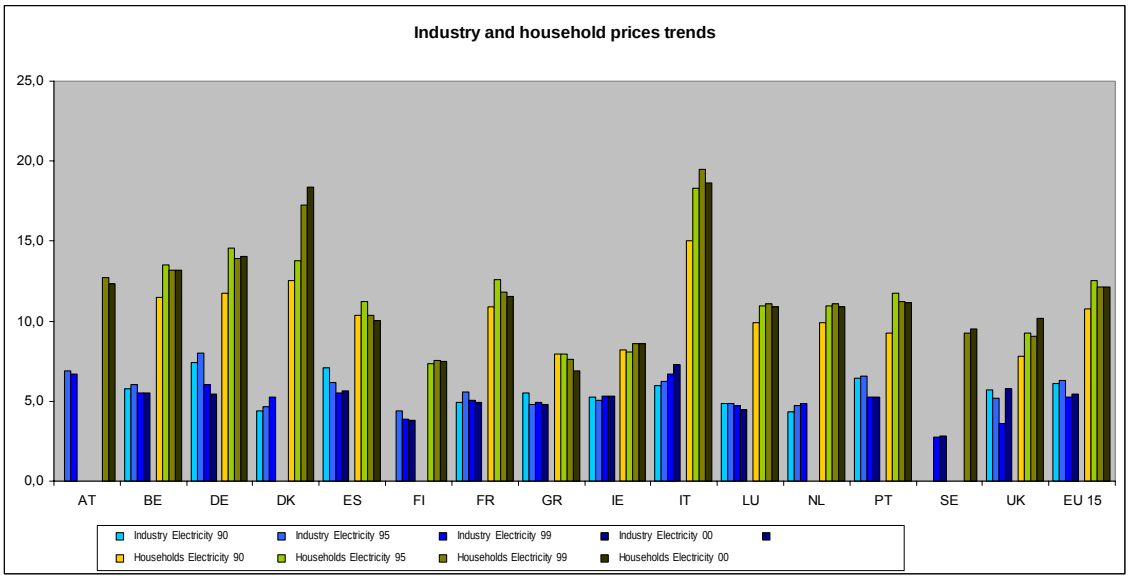


Energy prices will be the core variable through which territorial energy impacts will occur. But in spite of some weak statistical relations that can be estimated, energy prices seem not relevant to explain either energy consumption or development differences between countries.

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 clear significant statistical relation between energy prices, energy consumption and rhythm of economic growth. Perhaps, that is a problem of time lag that needs time series or more sophisticated econometric relations. We will continue to investigate in this direction.

Figure 39 provides a picture of price trends of electricity in EU countries from 1990 to 2000.

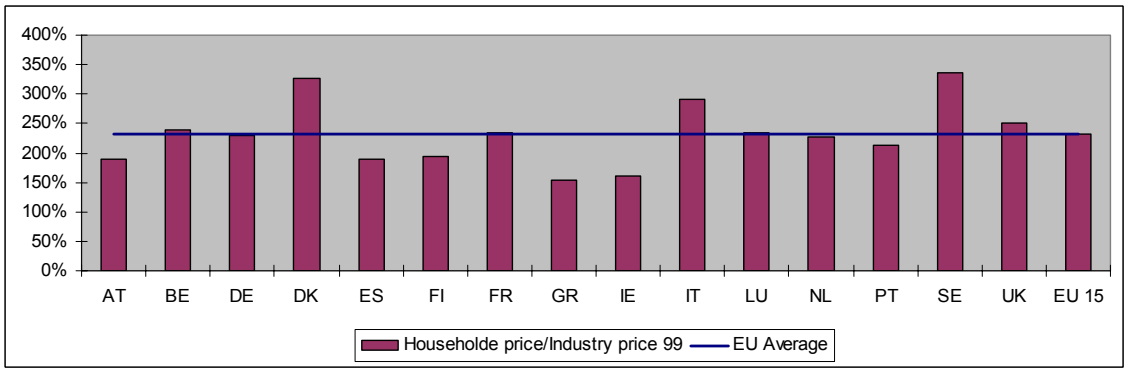
Figure 39 - Industry and household electricity price trends 90-2000



A number of features can be highlighted from this data. 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.

Figure 40 pictures the average differences between industrial and residential prices on EU countries in 1999.

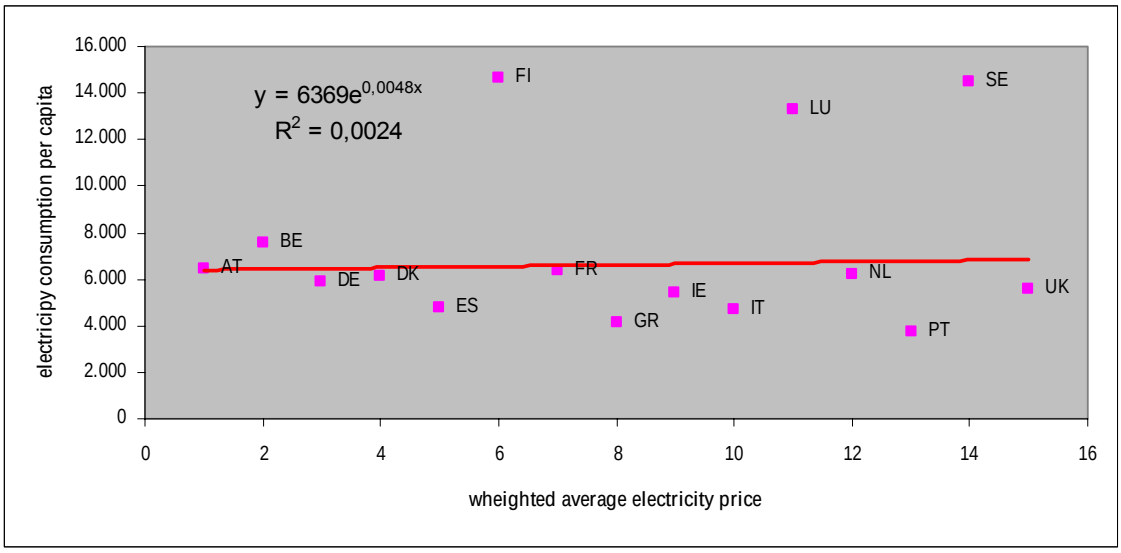
Figure 40 - Relation between household and industry electricity final prices



Note that, on average, the EU domestic prices are one and a 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, as it is pictured in the Figure 41[28].

Figure 41 - Electricity consumption and electricity prices in EU countries in 1999



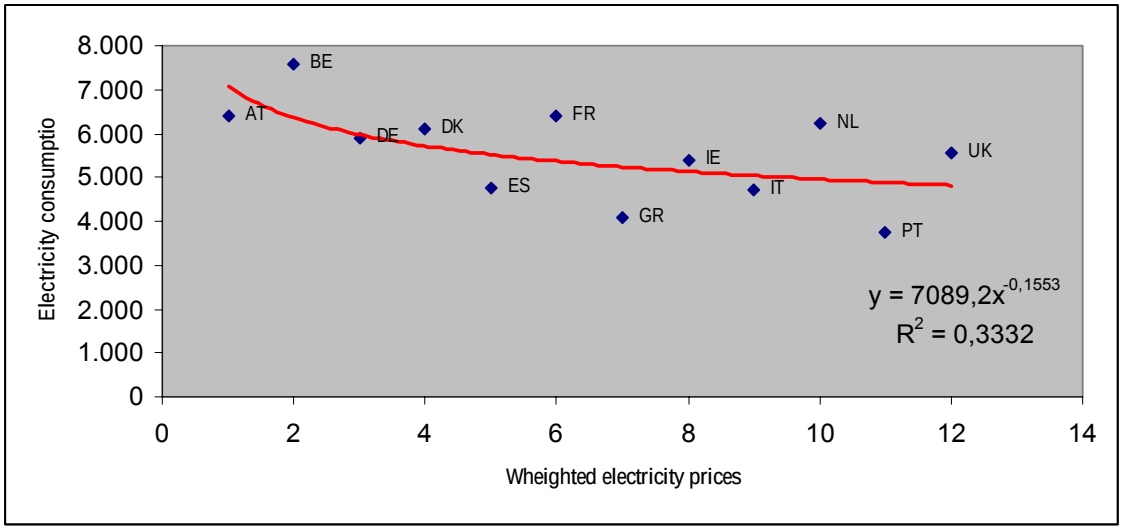
The picture clearly shows that EU countries have a distribution of electric consumption per capita that has no relation with price level (note the value of R^2 and the sign opposed to what would be expected).

But if we exclude from the analysis the countries that are shown out of the flock (Finland, Luxemburg and Sweden)[29], a relation among prices and consumptions seems to appear, as it is shown in the

.

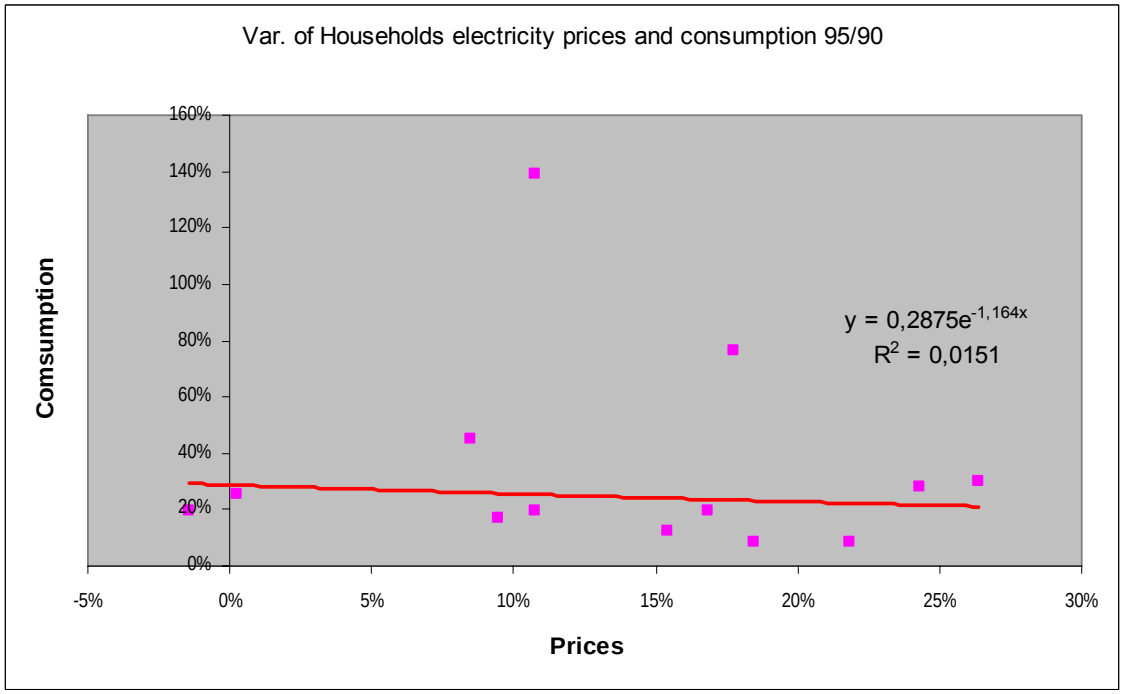
[28] Data is referred to 1999 and weighted prices are based on average prices per sector and relative share on total electricity consumption.
[29] This is acceptable because in Finland and Sweden climate generates different household consumption patterns and in the case of Luxembourg the urban agglomeration also implies a different analysis.

Figure 42 - Electricity consumption and electricity prices in some EU countries in 1999



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 Figure 43.

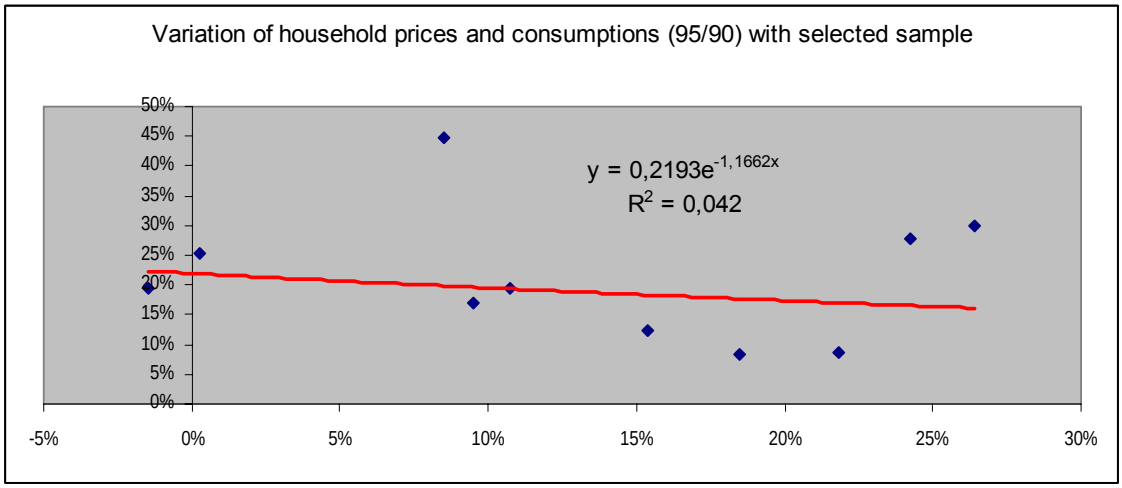
Figure 43 - Variation of electricity prices and consumptions of EU households from 1990 to 1995



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.

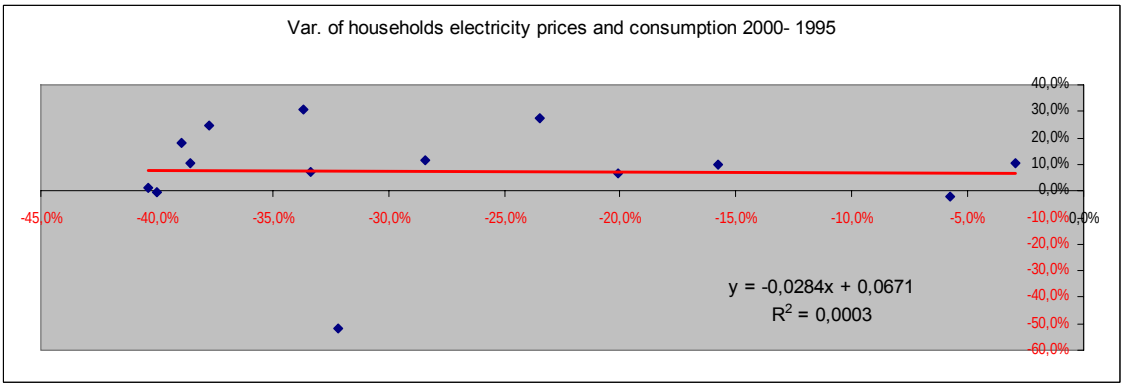
If, again, we excluded from the regression countries that show different performance, in this case Belgium and Luxembourg for having abnormal consumption growth rates, we get a different outcome, shown in Figure 44, but statistical relation doesn't improve.

Figure 44 - Variation of household prices and consumptions (95/90) with selected sample of EU countries



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.

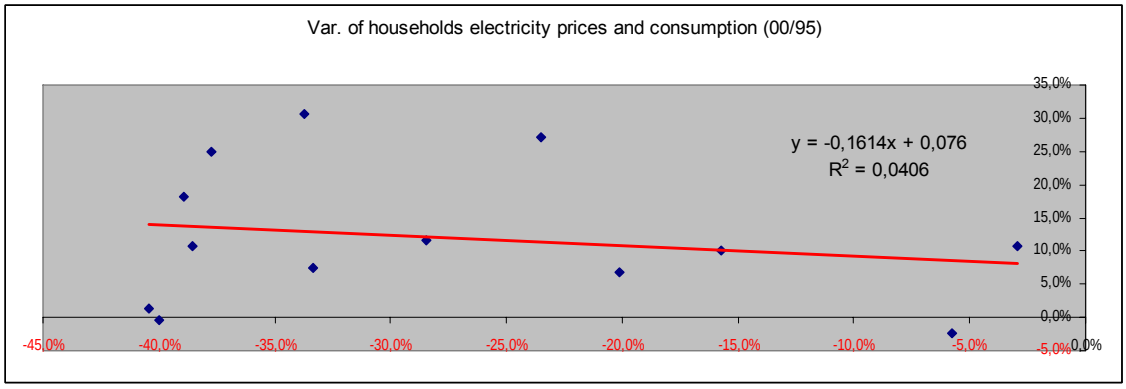
Figure 45 - Variation of electricity prices and consumptions on EU households from 1995 to 2000



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 try the 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.

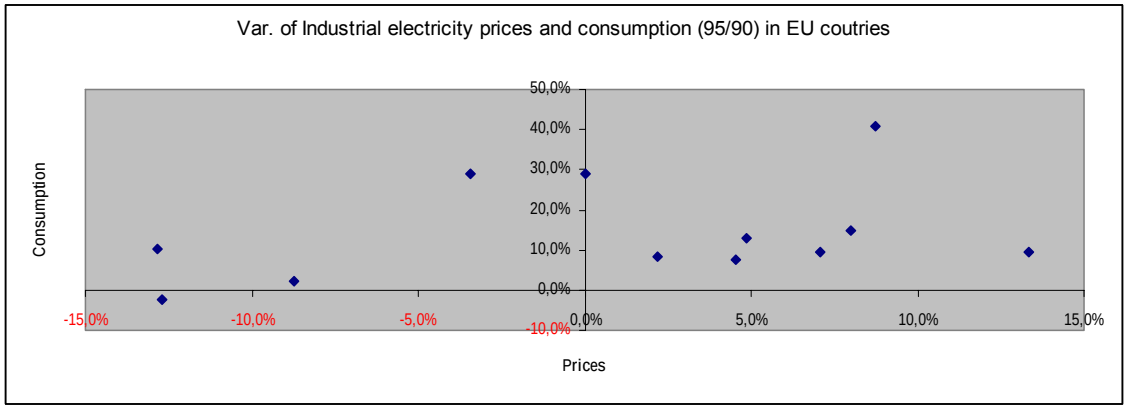
Figure 46 - Variation of household electricity prices and consumption (00/95) in selected EU country sample



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

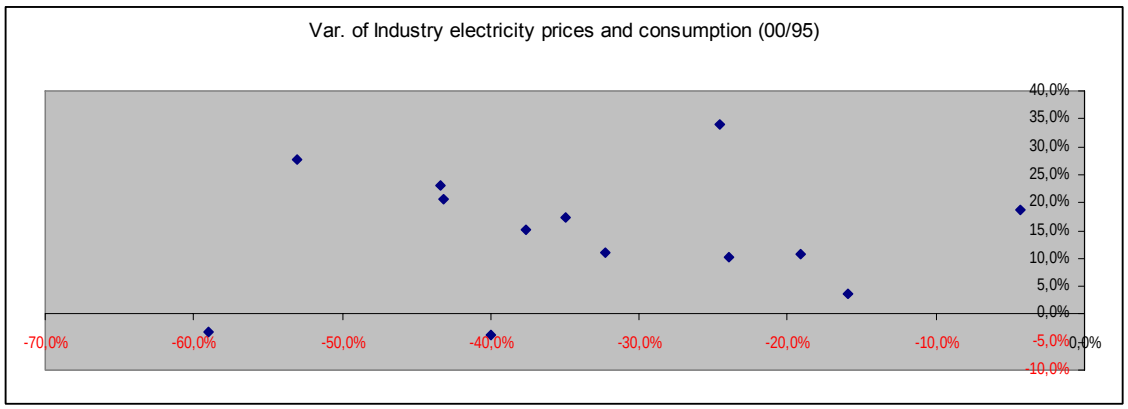
In the 1990 to 1995 period a mix of policies can be portrayed with an overall outcome of consumption growth.

Figure 47 - Variation of industrial electricity prices and consumption (95/90) in EU countries



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.

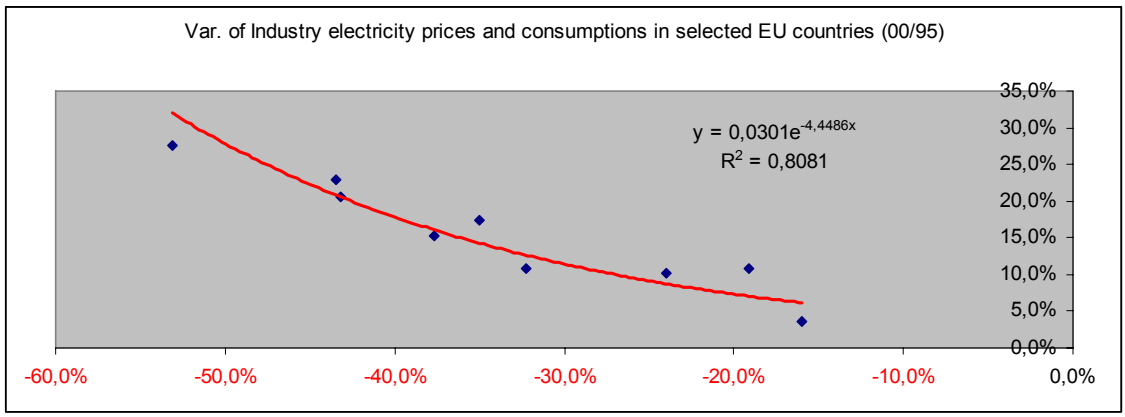
Figure 48 - Variation of industry electricity prices and consumption (00/95)



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[30]) we get a solid statistical relation among price variation and consumption variation, which is pictured in the following figure.

Figure 49 - Variation of industry electricity prices and consumptions in selected EU countries (00/95)



We will investigate more deeply this last relation, but 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

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

database is yet under construction, but we have tried relations at regional level for French regions[31] with data referred to 1998. For the moment, we found that:

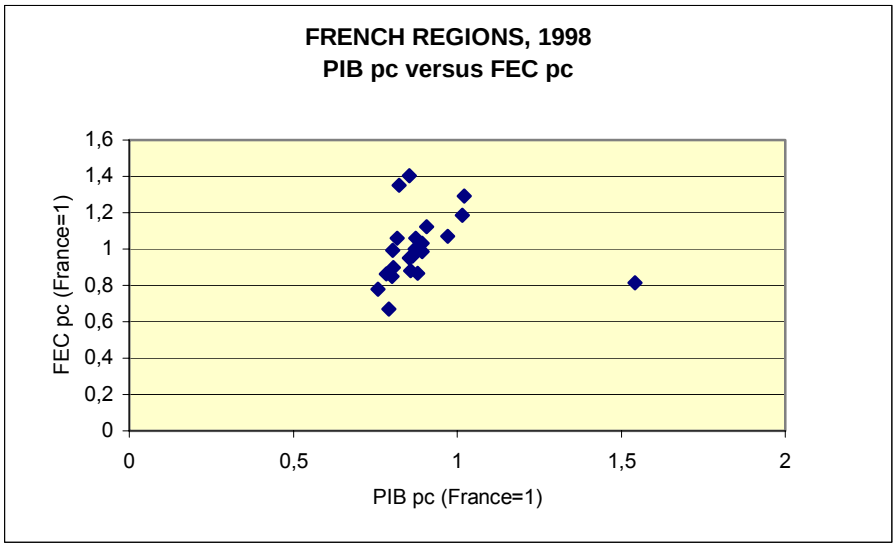
a) Final energy consumption is much lesser concentrated in Ile-de-France than economic activity: Ile-de-France represents 29% of GDP but only 15% of FEC. Other regions represent a higher share of FEC than the respective share of GDP.

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 per capita) 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.

Figure 50 - 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. As regional database is constructed we will continue to test this kind of relations and to define regional typologies that are suitable for clarify the impact of energy on territorial development. But it begins to become clear that we must concentrate our efforts on alternative methodologies.

B. Energy territorial impact: what can we expect?

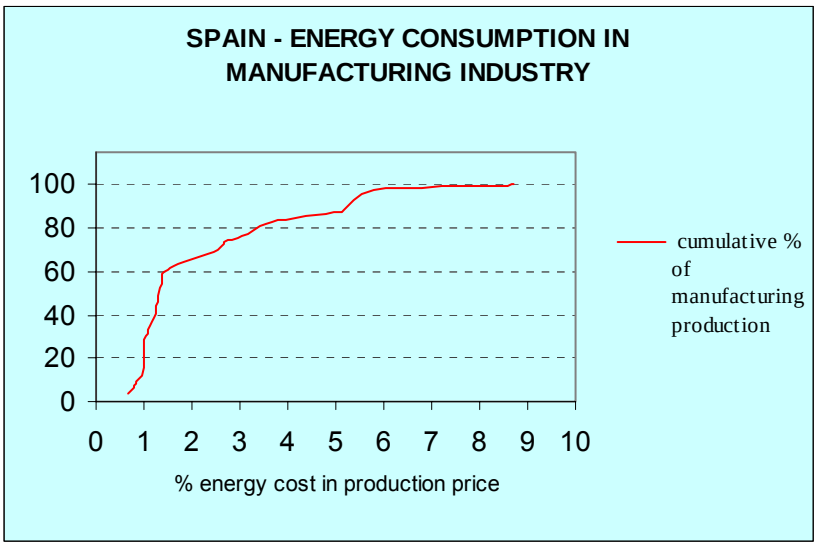
Energy is fundamental for almost every human activity. So, energy availability is a necessary condition for economic growth and differences on access to energy was an important determinant of spatial patterns and territorial development. But nowadays, in developed countries the potential of energy to territorial changes seems to be weak and relevant only at a small territorial level.

[31] Source: Observatoire de l' Énergie

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. If we take the case of Spain, for example, for about 2/3 of manufacturing productions the weight of energy in total production cost 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. Because those variations are small or inexistent inside the same country, we can expect a small impact of energy in real transformation of spatial patterns.

Figure 51 - Energy costs in industry production prices, 1998



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.

In accordance with this small potential impact, the most frequent energy models assume that energy demand is commanded by economic growth.

It is not frequent to find studies that search to quantify the economic impact of changing energy conditions. So, there is little past experience that can guide the establishment of a methodology for the territorial impact assessment. In the following, we will refer three studies that exemplify the alternative approaches and confirm the small territorial impact we can expect.

B.1. The first possible approach can be exemplified by a paper from Stephan J. Goetz[32]. 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

[32] 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

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 (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 mainly the evidence of the small impact of energy prices when other location factors are considered.

This paper is an application of a possible way of analyzing energy territorial impact, seeking 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.

B.2. Another way of assessing the territorial impact of energy is through the modelling of regional economies.

A study by Barnett et alii[33] 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 to be "*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. A second scenario, 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.

A quantitative similar result was obtained for Taiwan, where one[34] 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%.

B.3 Kouvaritakis et alii[35] analysed the economic impacts of energy tax policies in the EU with GEM-E3 model. This is a macro-sectoral general equilibrium model that permits assessing

[33] Andy Barnett, Henry Thompson, Samuel Addy, Ahmad Ijaz – Economic Impact of Retail Electric Competition in Alabama, Economic Development Institute, Auburn University.
[34] 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)
[35] Nikos Kouvaritakis, Leonidas Parousso and Denise Van Regemorter – "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.

impacts in terms of economic indicators. 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. Nonetheless, this study makes assumptions about the use of taxes revenue, assumptions whose impacts deserve additional clarification.

The conclusions of this study seem to be in the centre of our concerns and we will explore further the possibilities of GEM-E 3 model.

B.4 All this results point to the idea that only great variations in energy prices will have a visible impact on location decision of firms and in the growth of GDP.

As in anything related with economic development, the relation seems to became blurred has we move closer. In fact the first approach points towards a link (that in fact does exist even in a mechanic manner) but as sharper relations are required they become more and more difficult to establish.

It remains the question of the link between energy development (increased availability in quantity and quality) and economic development.

It is important to establish such a relationship, as the traditional approach (economic development leads towards energy development) is not satisfactory, when we face the need for the evaluation of investment and regulatory efforts using scarce resources for development.

The first component of the assessment work is to clarify whether energy policies, namely liberalization (meaning larger role for market mechanisms on price and supply determination), can lead to improved development conditions.

The second assessment required is which can be the impact of liberalization on security of supply and on environment and, generally, on the policy targets for the energy sector that can be set fourfold:

1. the need for a price mechanism that optimizes competitiveness conditions for industries and quality of life for the households;
2. the need for a regulatory mechanism that ensures polycentric and territorially balanced development patterns;
3. the need for a sustainable and secure energy supply;
4. the need for an environmental friendly energy development.

Two ideas are to be highlighted as being backbones of policy making in this field:

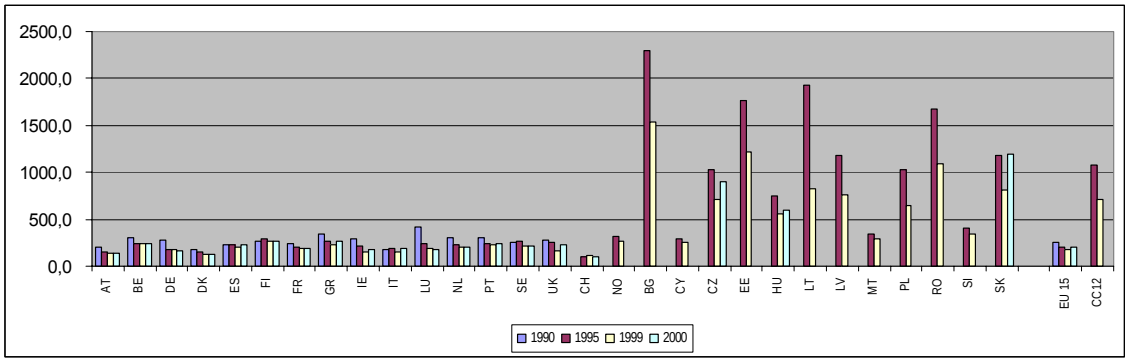
a) firstly, that price mechanisms are efficient to ensure optimizing behaviours by economic agents (industries and households);

b) secondly, that reducing consumption is something positive *per se*.

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, 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.

Figure 52 - Energy intensity of GDP (TOE/€ million)



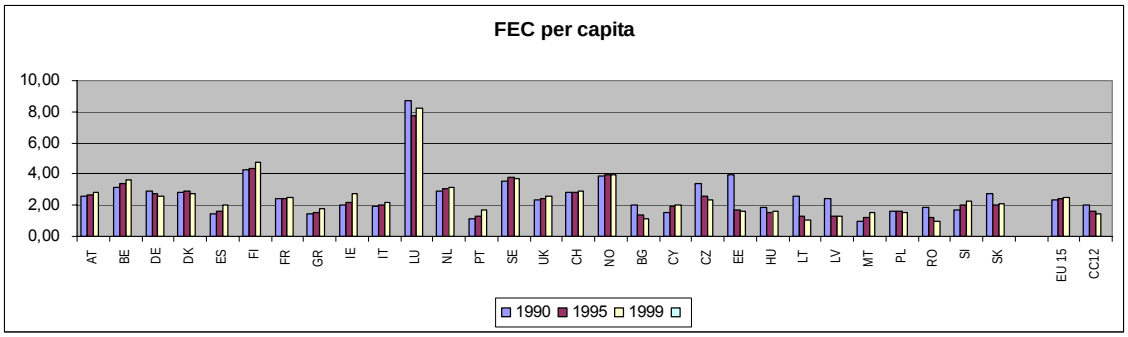
These efficiency gains, which are recognized by all the available research data, place the issue in the energy/capital trade off, raising the always difficult question of technological change.

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.

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.

Figure 53 - Final Energy Consumption per capita (TOE)



In third place comes 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[36], 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;

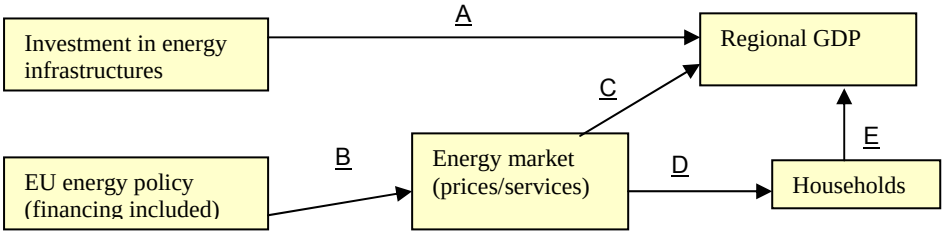
ii) in the long run we can expect technological change and possible delocalisation of more energy intensive industries.

But as we have seen before this hypothesis hardly holds considering recent data for European countries.

Finally, the link among energy investment, namely infrastructure investment (TEN-E and other EU lead investment or private investment) and economic development must be considered, although one can not hope for major developments in our work considering that this is the component of territorial impact that has been the most frequent object of assessment.
Anyway a special attention will be paid to the potential regional effects of investment in renewables.

C. 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.

At this stage, we think that an input-output framework will be the most suitable method to quantify energy territorial impact.

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*. 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, although with some restrictive hypothesis, use the input-output framework to obtain an operator C of the impacts of energy price variation over regional GDP.

[36] BOURDAIRE, J.M. (2000), "Le lien entre consomation d'energie et development economique", Revue de l'Energie, nº 15, mars-avril 2000.

In an input-output framework the following relation can be verified B´P+W=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 (domestic) production of a (physical) unity of *j*; w 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 $p_j=b_{1j}p_1+b_{2j}p_2+\ldots+b_{nj}p_n+w_j$. Solving, we obtain $P=(I-B')^{-1}W$.

The last equation allows us to assess the price impact of a variation in the price of energy, under the hypothesis that a variation in energy prices does not imply any input substitution, so that (technical) input coefficients remain constants. This hypothesis applies even for primary input coefficients, except for the energy price sector.

Input-output table is not useful to pass from price variation to GDP variation. We need some additional hypothesis:

a) First, we need to establish some relation between price variation and demand variation. If we make the hypothesis that energy price reduction is the result of increasing efficiency and it does not affect the domestic added value, we can assume that all the price savings will be transferred to final demand. This corresponds to assume that all products have a price-elasticity of –1. It is a restrictive hypothesis that can be improved if we can obtain information on price-elasticity.

b) Second, we must hypothesise a constant relation between the sectoral gross production (total of uses) and the sectoral gross added value.

c) Third, 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.

With these assumptions the model could be:

$P=(I-B')^{-1}W$ [1]

$Q = EQ$ (where E is a nxn with $e_{ii}=1/p_i$ and for $i\neq j$ $e_{ij}=0$; in a static situation all $p_i=1$) [2]

$X=AX+Q$ [3]

$V=TX$ (T is a nxn with $t_{ii}=v_i$ and for $i\neq j$ $t_{ij}=0$; v_i value added for each unity of x_i) [4]

$R=MV$ (M is a rxn matrix with m_{ij} = share of region i in the production sector j) [5]

For the moment, we could only apply this model to Portugal. We tried to quantify the impact on regional GDP of a 10% (this is an arbitrary value) decrease in the prices of oil products and electricity (sectors 23 and 40 of IO table, 1999). From a total of 59 sectors, this 10% variation on energy price would imply a decrease of less than 0.5% in the price of about 30 sectors; about 10 sectors would have a price decrease of more than 1%.
Under the hypothesis made about the total transfer of price variations to final demand and the constancy of value added coefficients, this would imply an increase of 0.77% on national GDP.
We used the regional distribution of employment of different sectors from the 2001 Population Census to construct matrix M. The following table summarizes the results obtained:

Table 3 - Some results of I/O impact evaluation for Portugal

Impact of a 10% decrease of the price of sectors 23 and 40 (energy) of IO Table						
On national GDP = 0.77%						
On regional GDP						
Norte	Centro	Lisboa e V. Tejo	Alentejo	Algarve	Açores	Madeira
0.86	1.19	0.53	1.30	0.83	0.95	0.69

These results are of the order of magnitude of those referred earlier and seem coherent in Portuguese situation. But our aim was only to verify the feasibility of the methodology and these are not yet accurate but only indicative results.

Although it is not yet clear the possibility of finding adequate data for the 27+2 countries, it seems a feasible methodology and will be used to construct an indicator to assess territorial impact of energy policies.

We are aware of the meaning of the restrictive hypothesis and of the weakness of the model:

a) The calculation of the impact of energy price variations on national GDP goes through assumptions of price-elasticities and constancy of input coefficients too much restrictive and too little realistic. But here we can improve results, namely by analysing the sensibility to different elasticities and confronting with results of other European models. The objective should be to construct an *indicator* of territorial impact, and, for an indicator, correct proportionality is the more important feature.

b) This methodological framework does not take into account the virtual 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[37]) 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.

c) 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. It is a minor weakness that, for the moment, we don't know how to surpass.

d) Furthermore, remains the fundamental question of the impact of energy policy on energy prices in each country. This is an urgent task that involves the analysis of past trends and of the studies that have been carried out on this subject.

Nevertheless, 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 this way will be a great advance in understanding the territorial impact of energy policy, with the possibility of including in the same framework the impacts via energy prices and energy investments. Energy investments can be considered through equation [3] in as much as they correspond to an increase of final demand directed to some productive sectors.

[37] We will clarify this effect through case-study analysis.

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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 environment 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, graphics and maps

Tables (see excel files)

Maps and Graphics

Figure 1 – Total Electricity Production by NUTS 0 (1997)

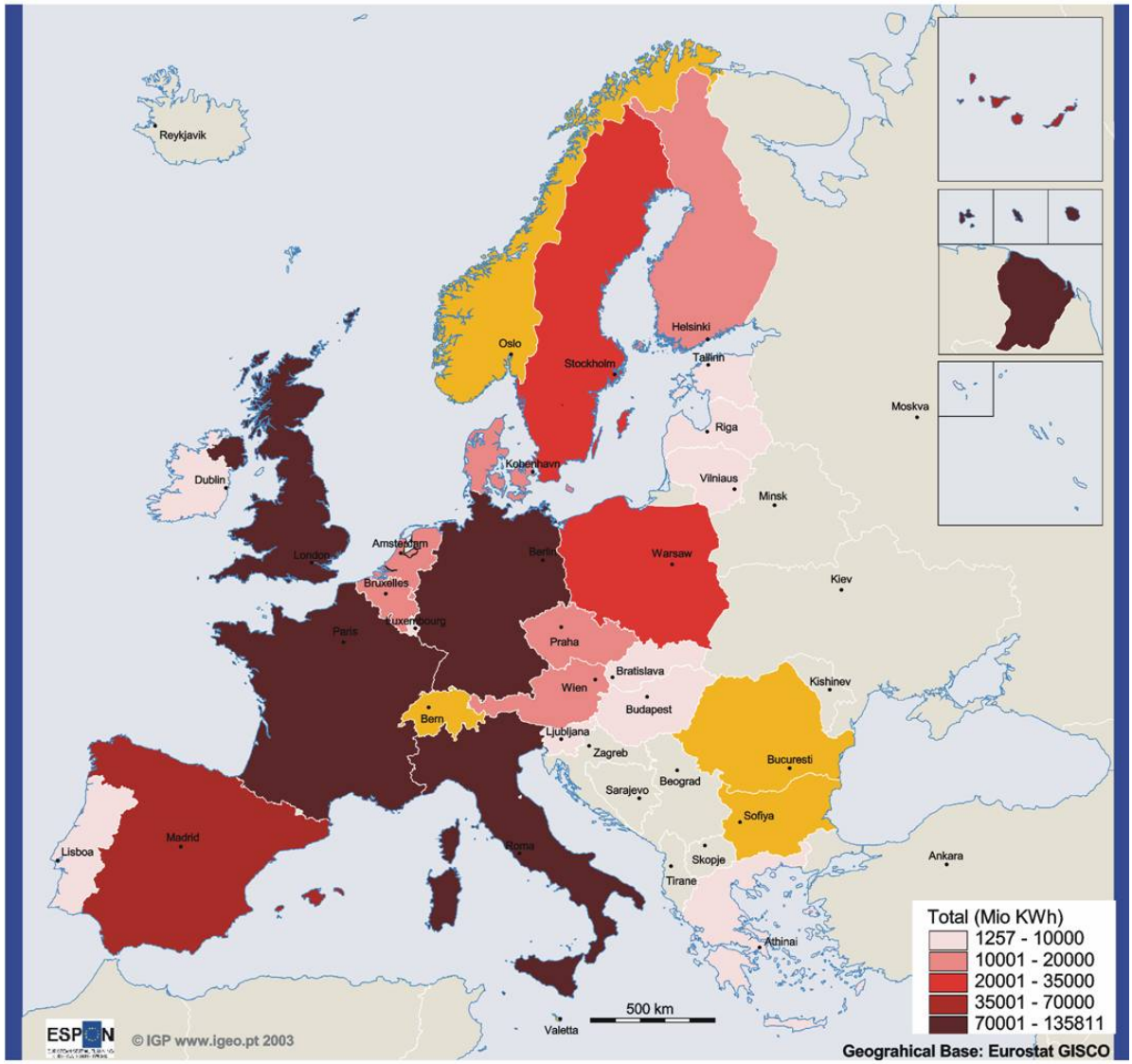

Figure 2 – Total Electricity production by NUTS 2 (1997)

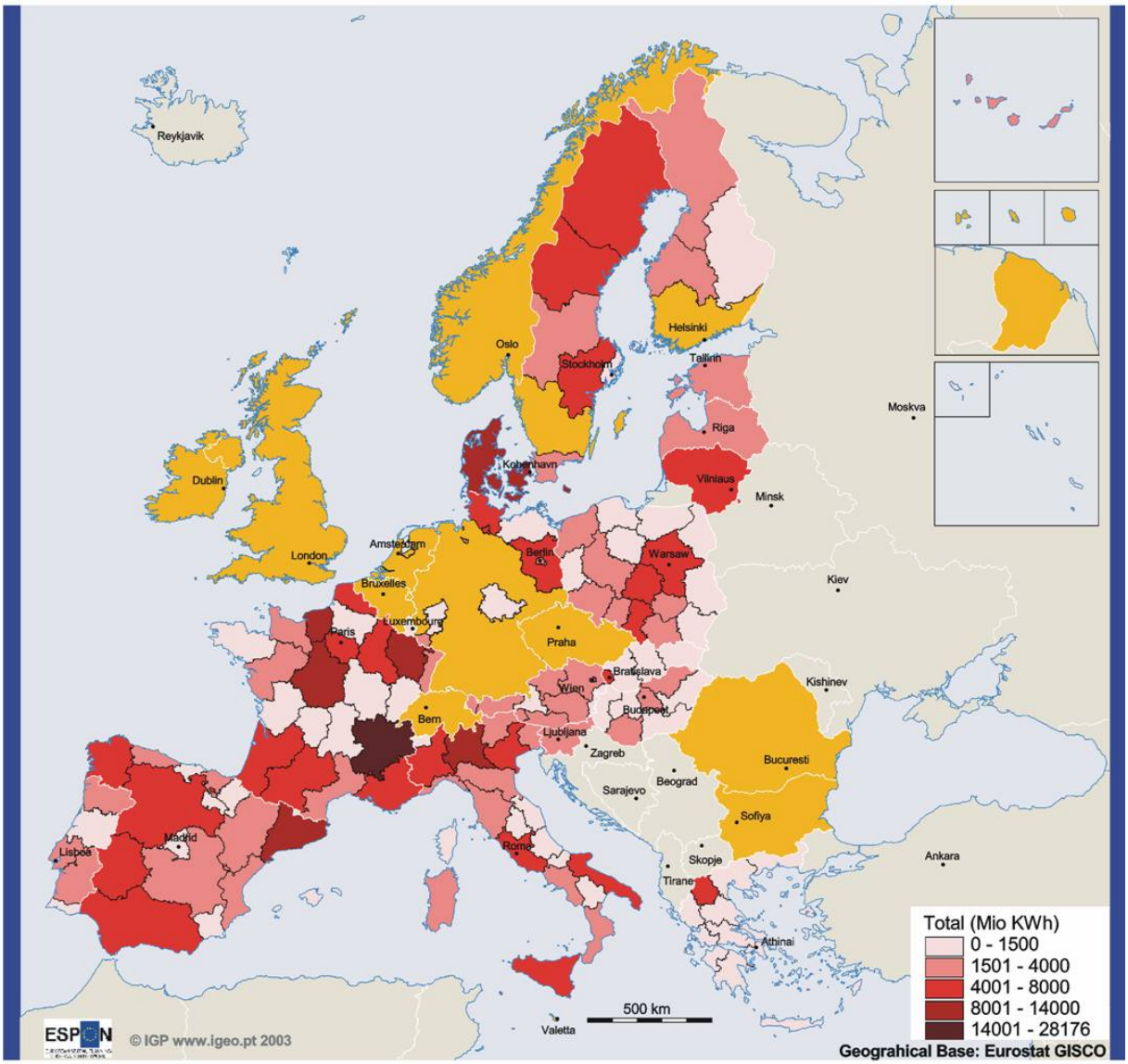

Figure 3 - Thermal Electricity Production by NUTS0 (1997)

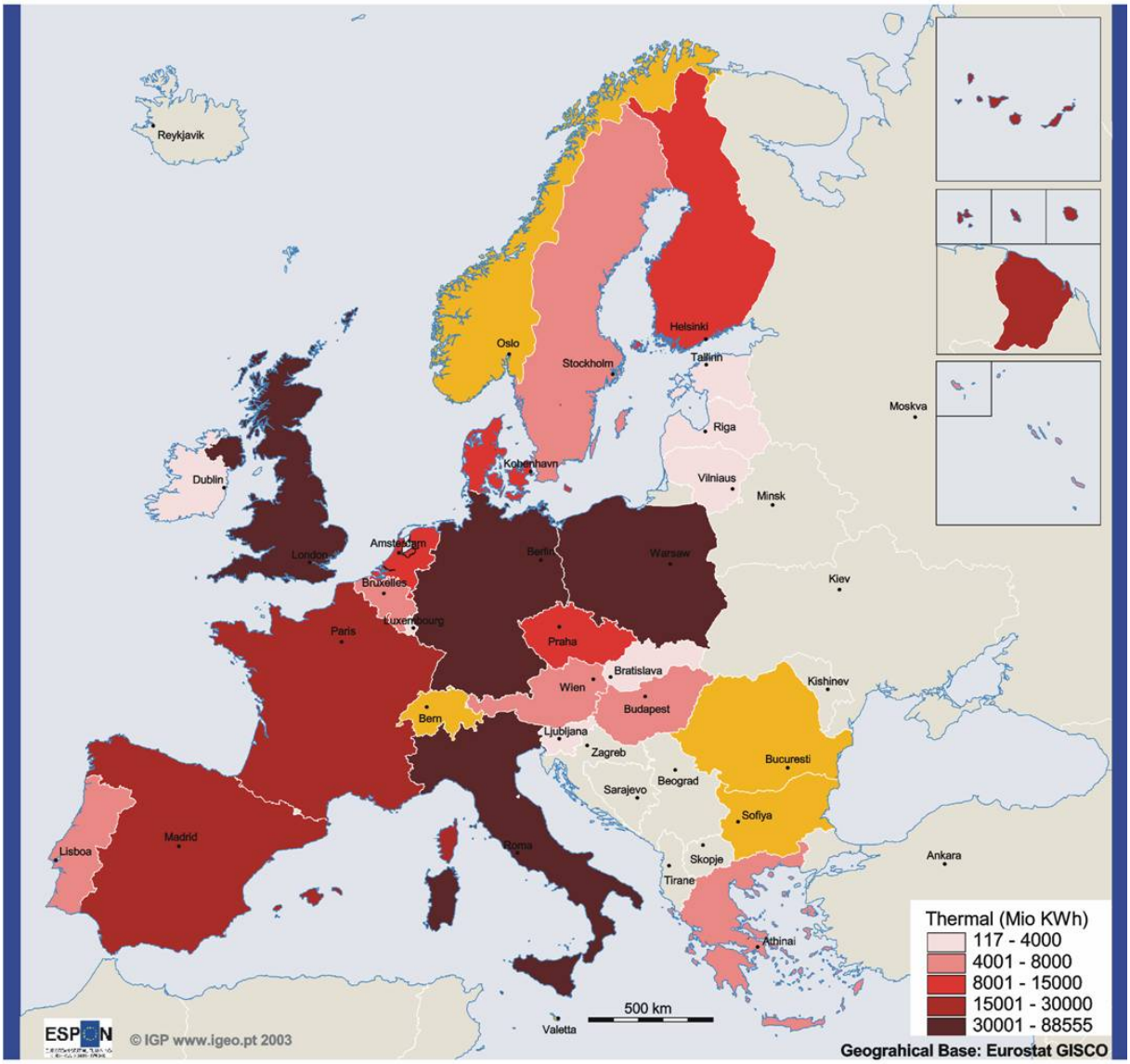

Figure 4 - Thermal Electricity Production by NUTS 2 (1997)

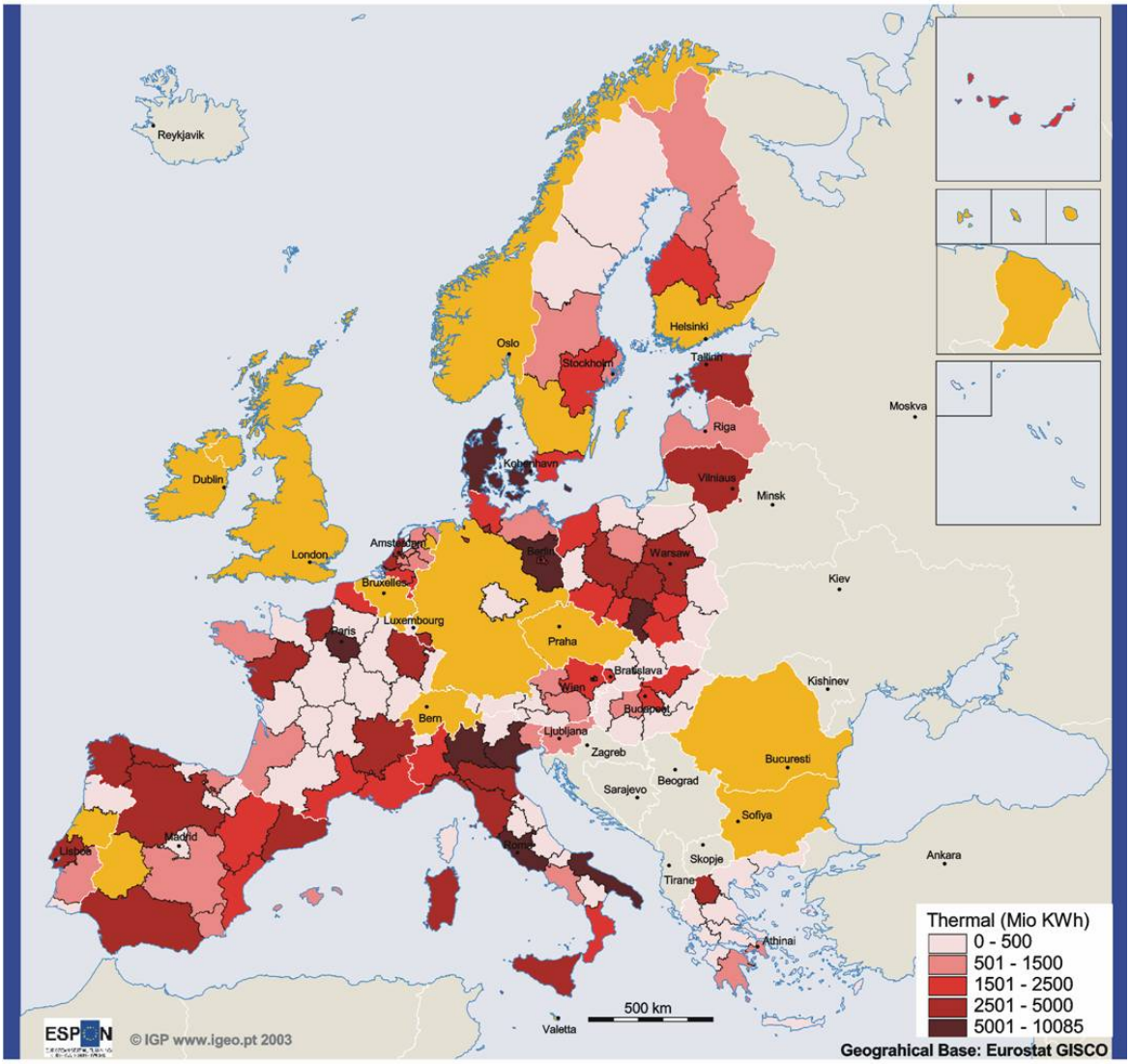

Figure 5 - Nuclear Electricity Production by NUTS 0 (1997)

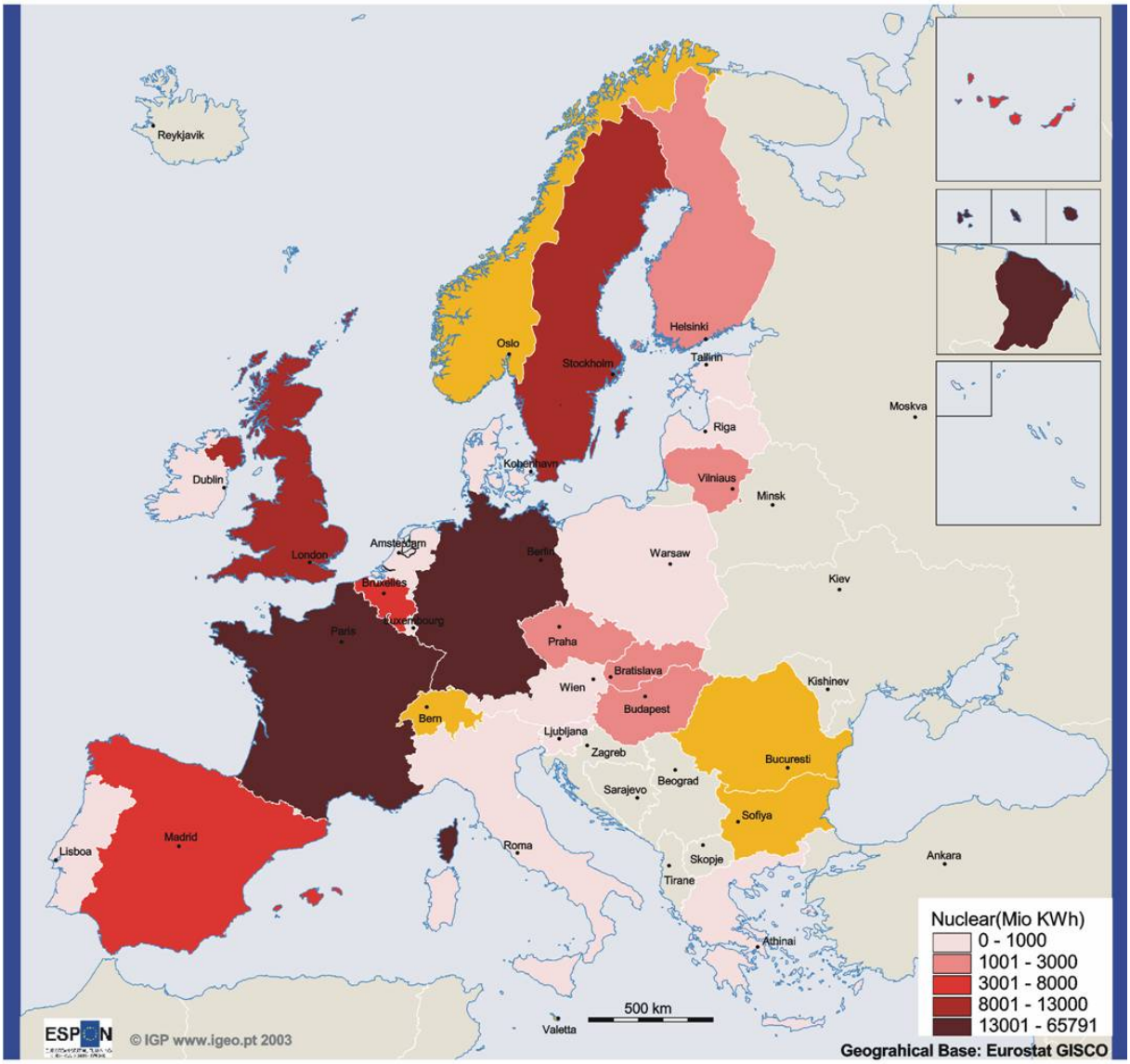

Figure 6 - Nuclear Electricity Production by NUTS 2 (1997)

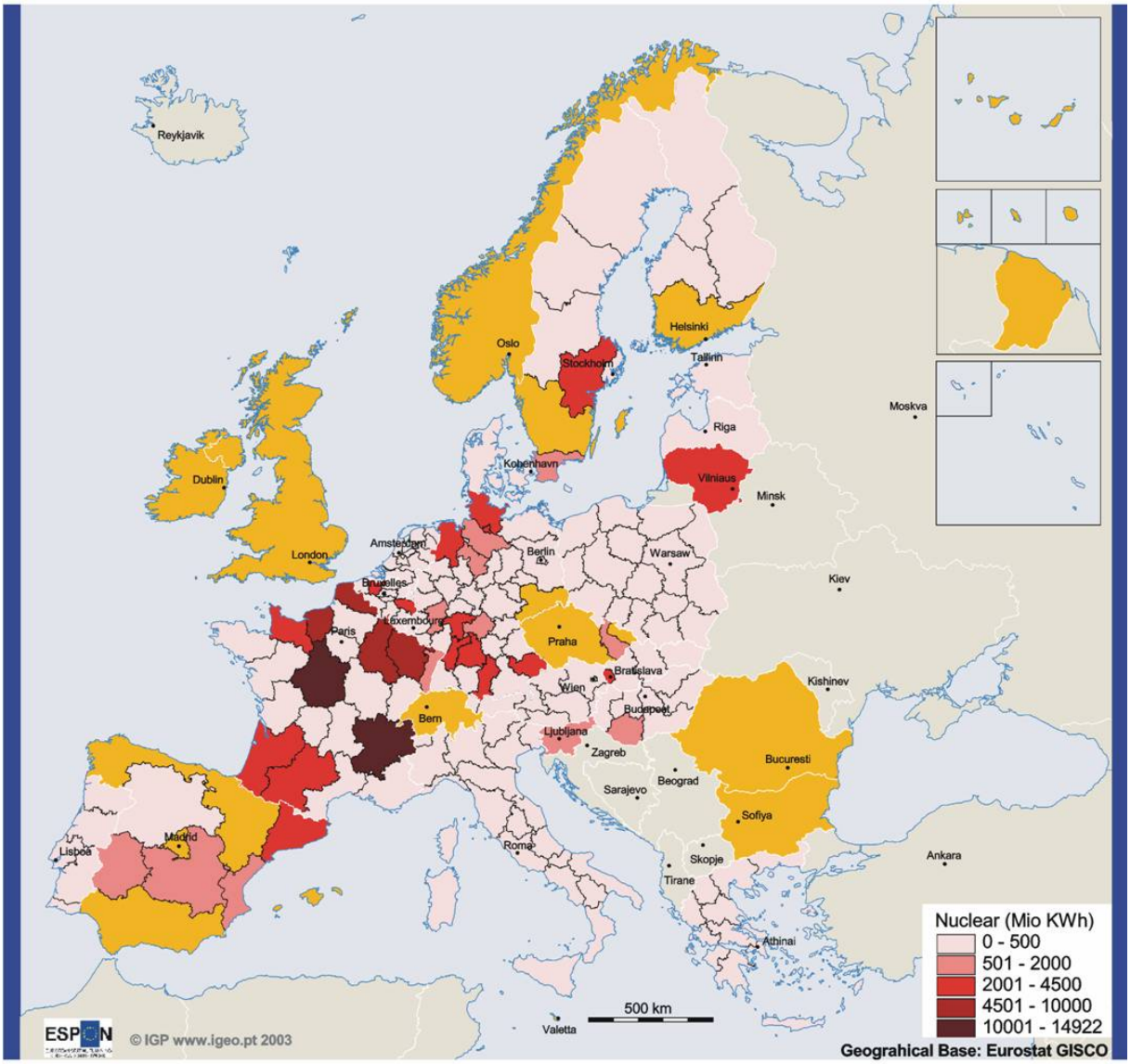

Figure 7 - TPES/GDP (2000)

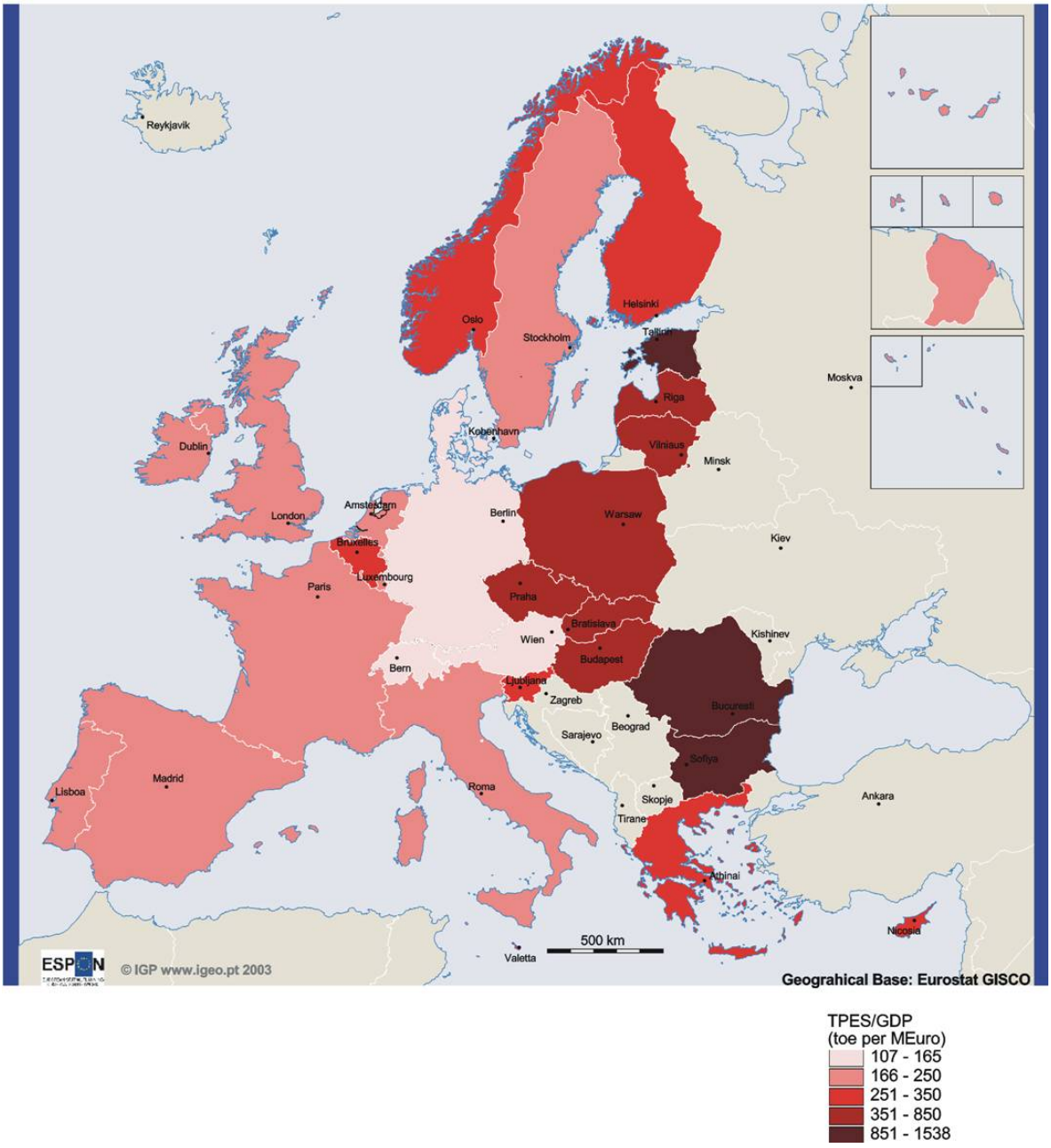

Figure 8 - GDP/FEC (2000)

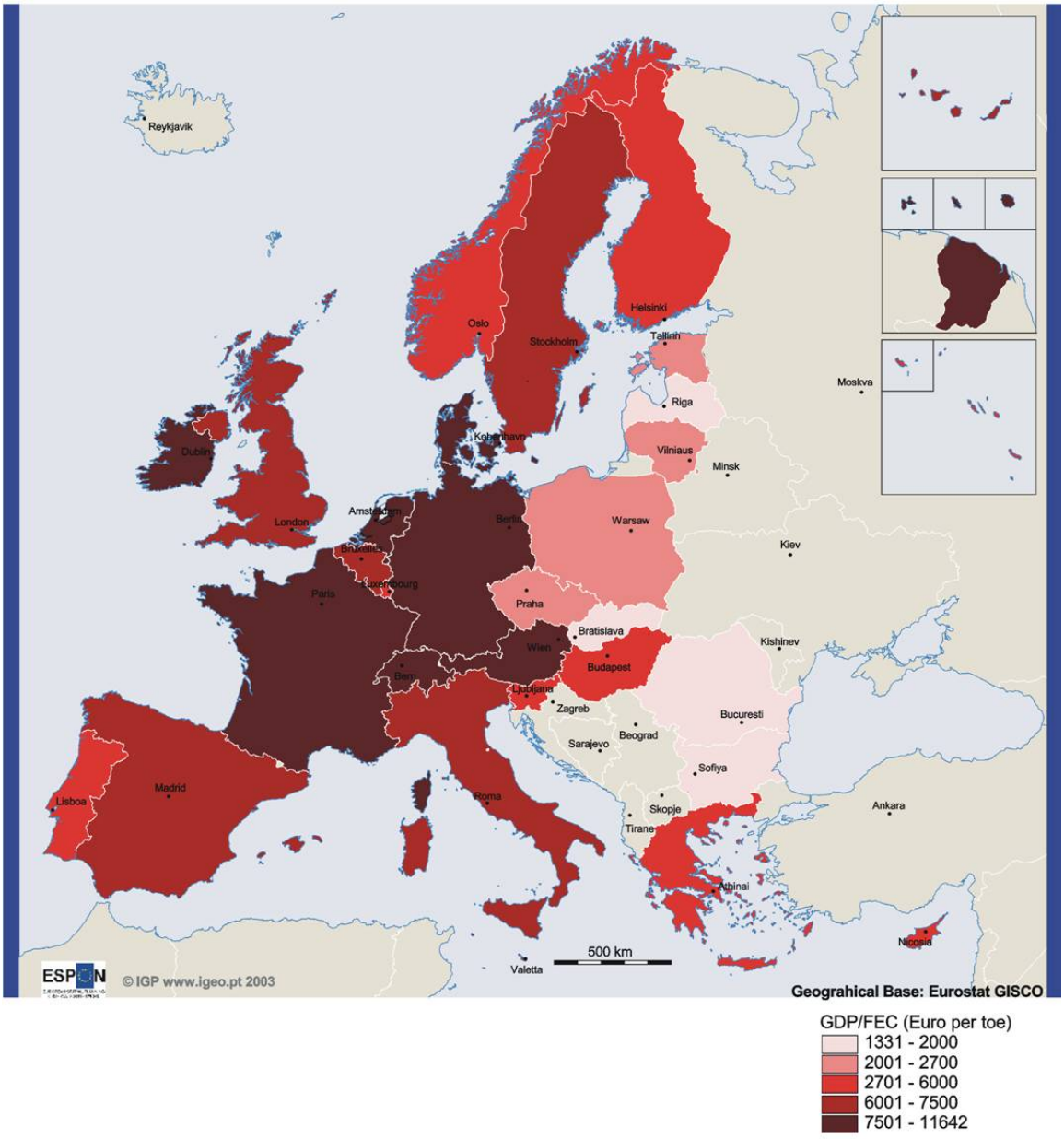

Figure 9 - Electricity Consumption/GDP (2000)

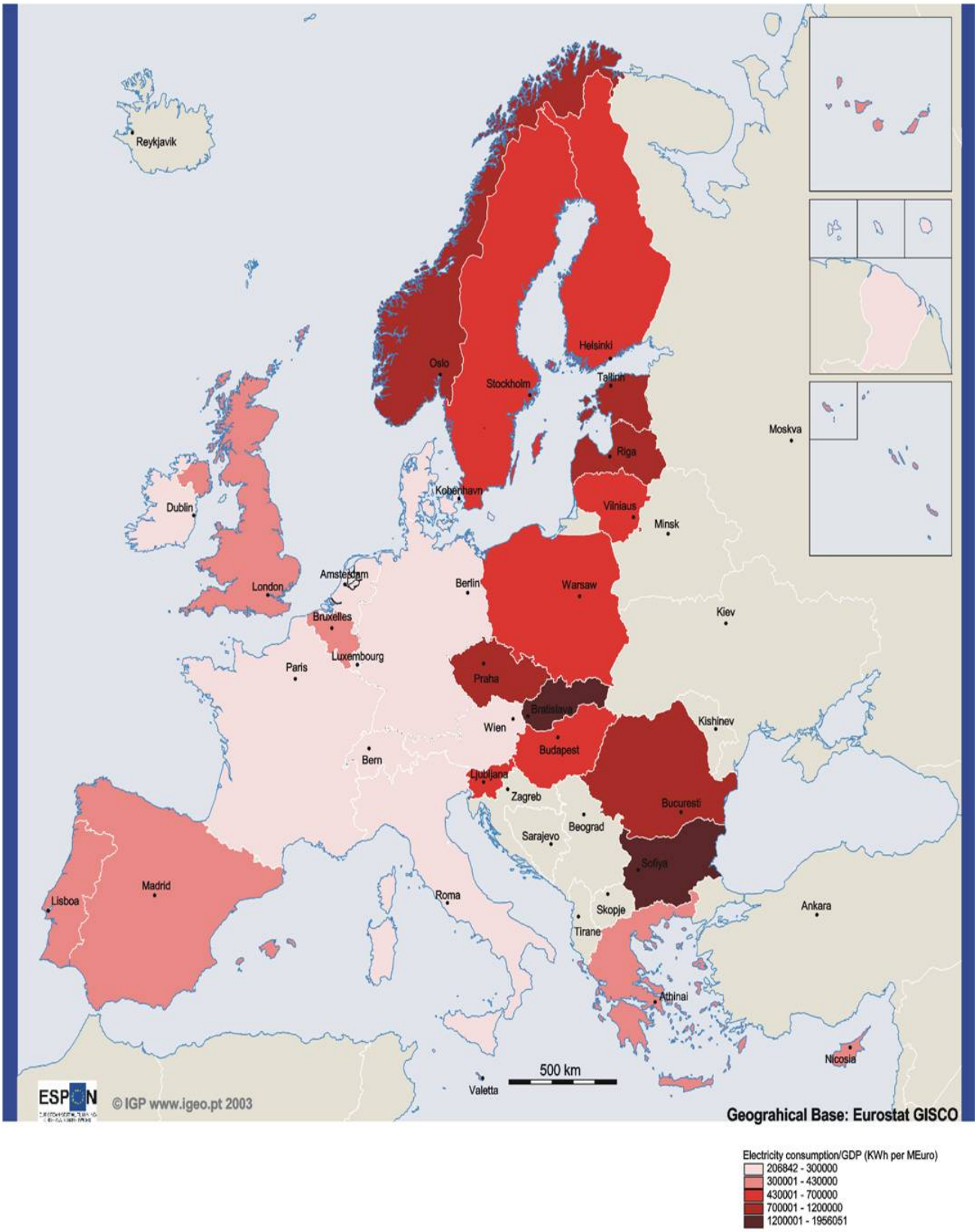

Figure 10 - GDP/Electricity Consumption (2000)

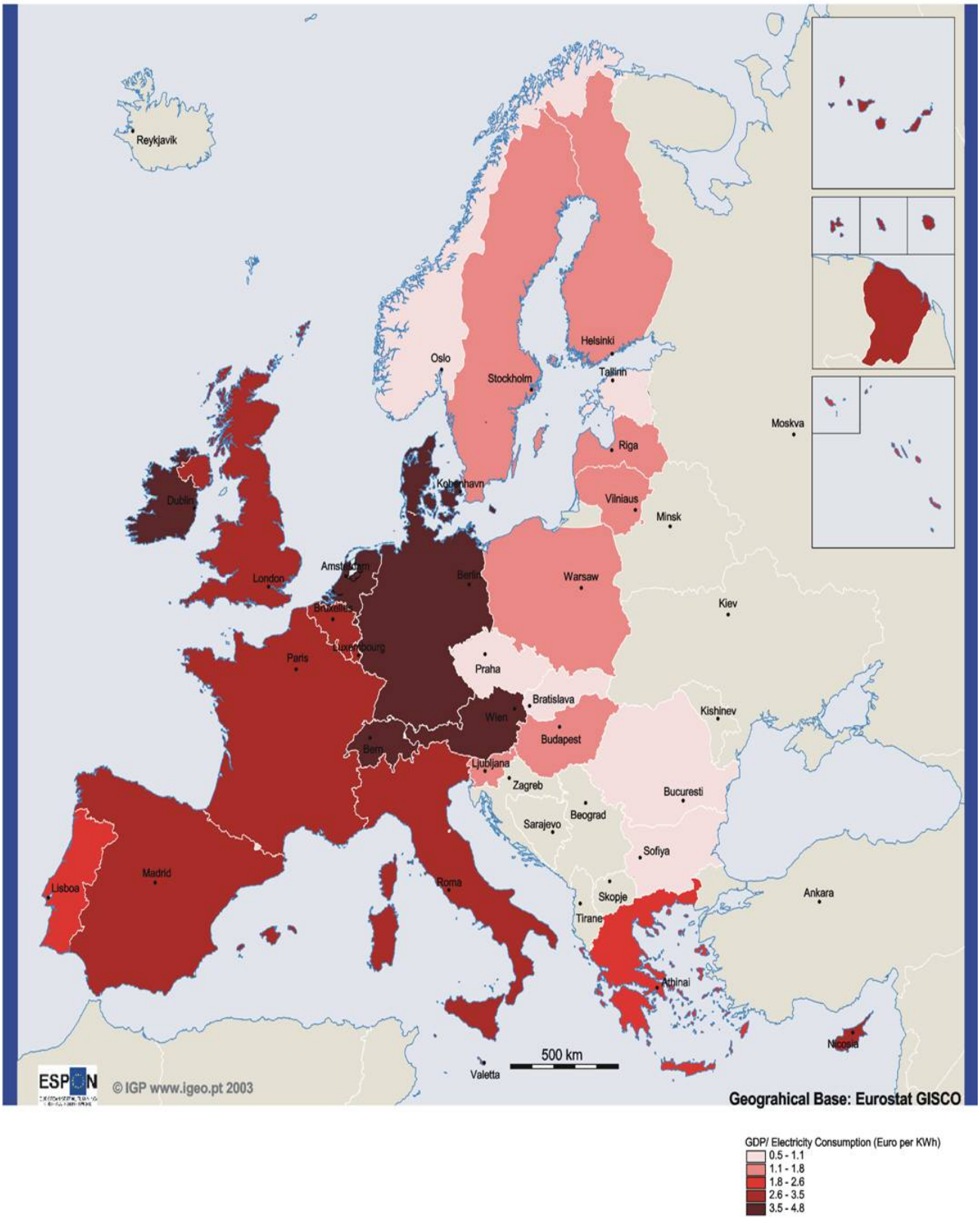

Figure 11 - Proportion of electricity generated by liquid fossil fuels (2000)

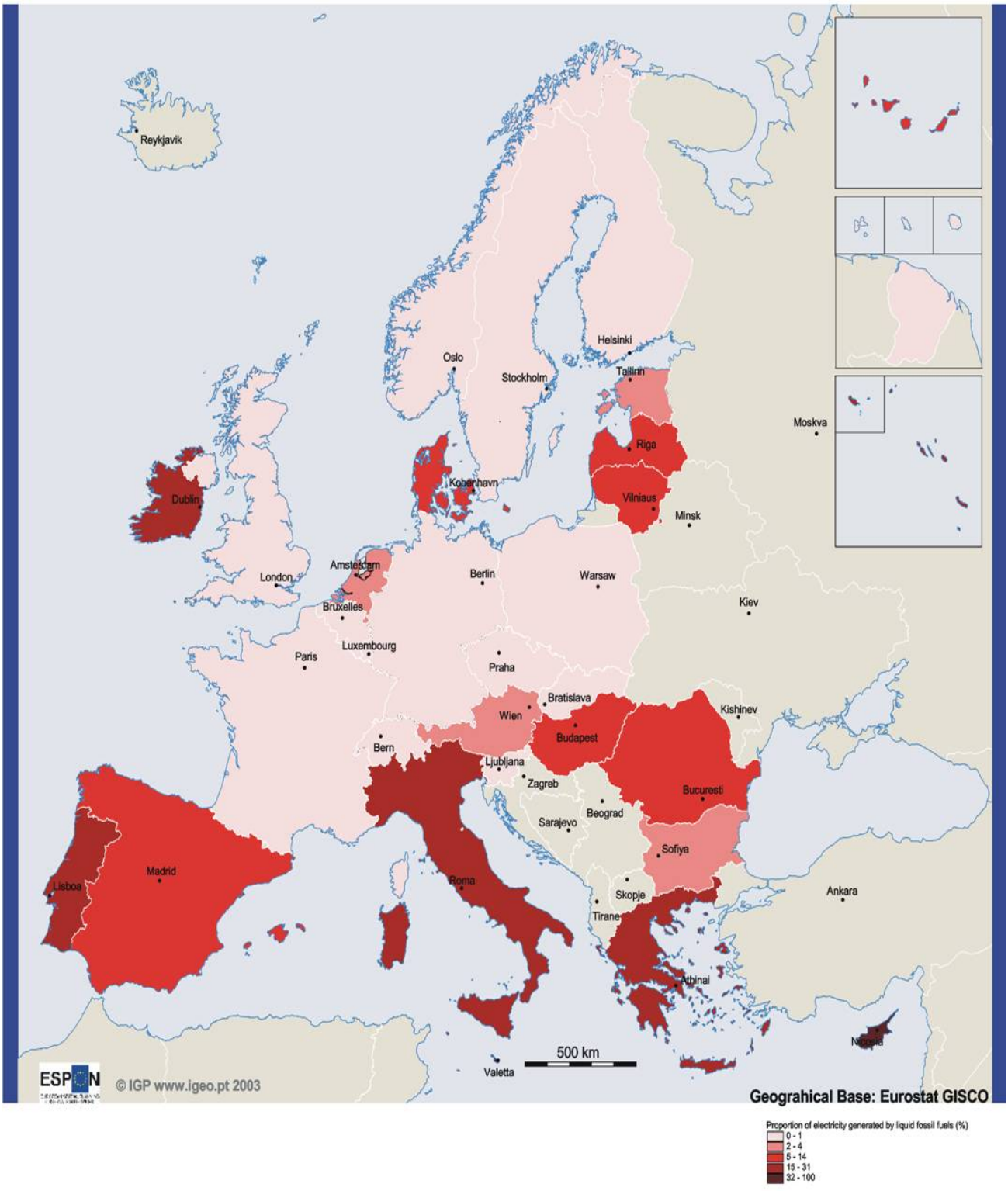

Figure 12 - Proportion of electricity generated by solid fossil fuels (2000)

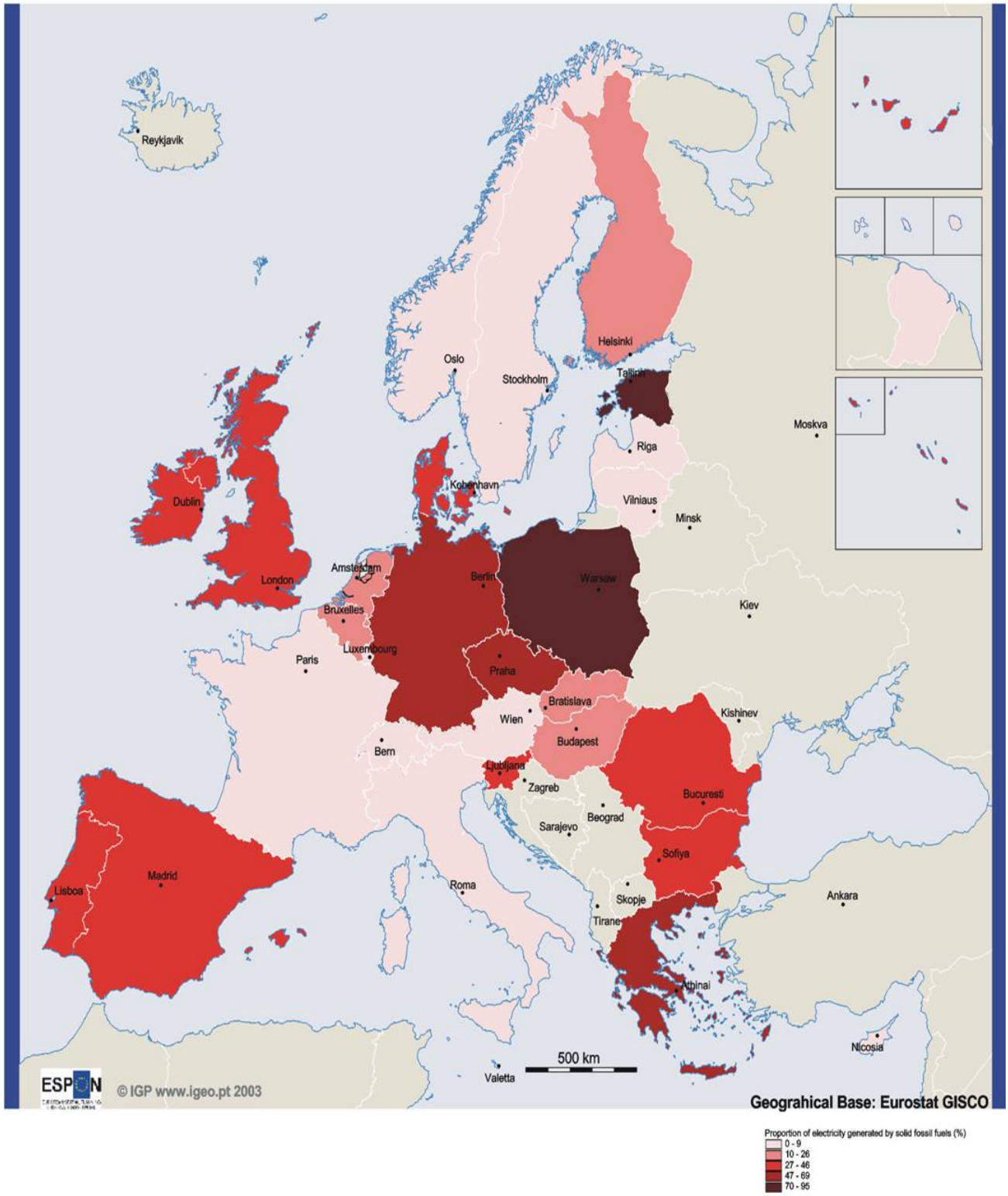

Figure 13 - Proportion of electricity generated by natural gas (2000)

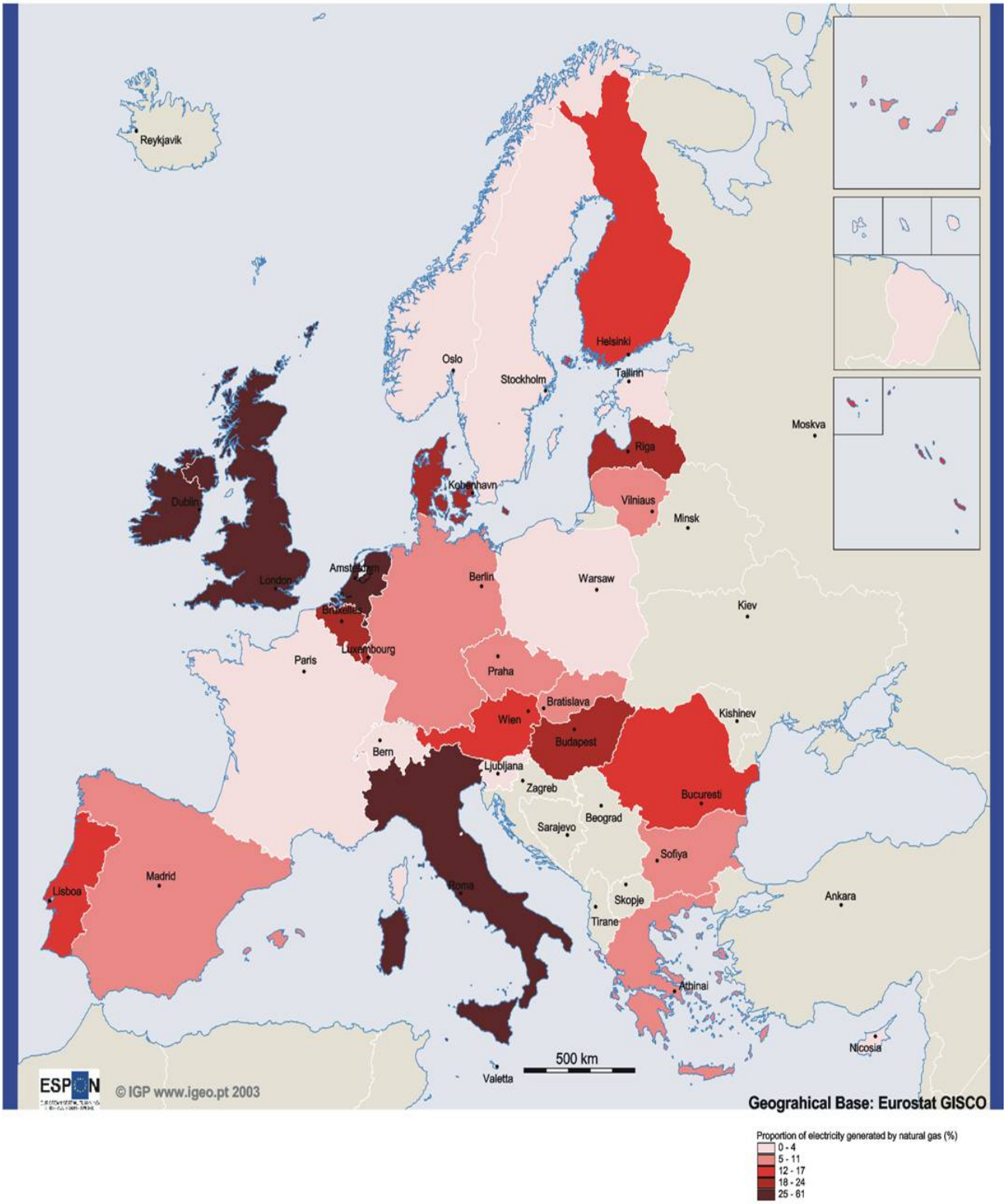

Figure 14 - Ratio of energy production to primary energy consumption (2000)

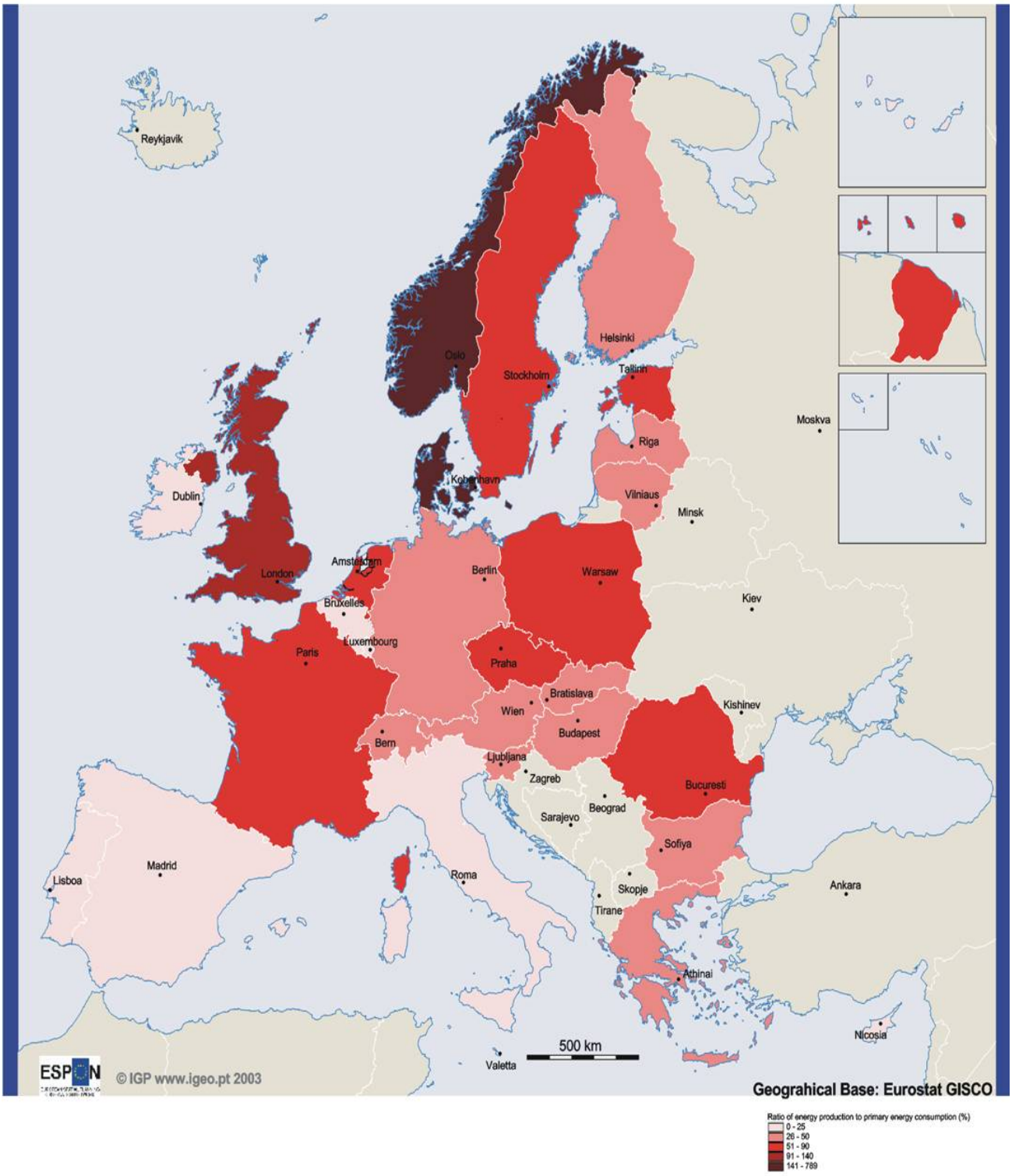

Figure 15 - Electricity price indices for household sector in EU15 (DE=100)

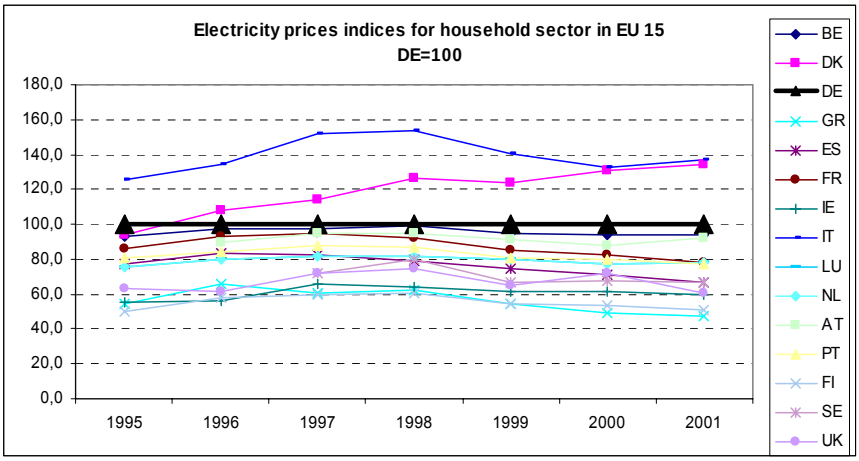

Figure 16 - Natural gas prices indices for industry sector in EU15 (DE=100)

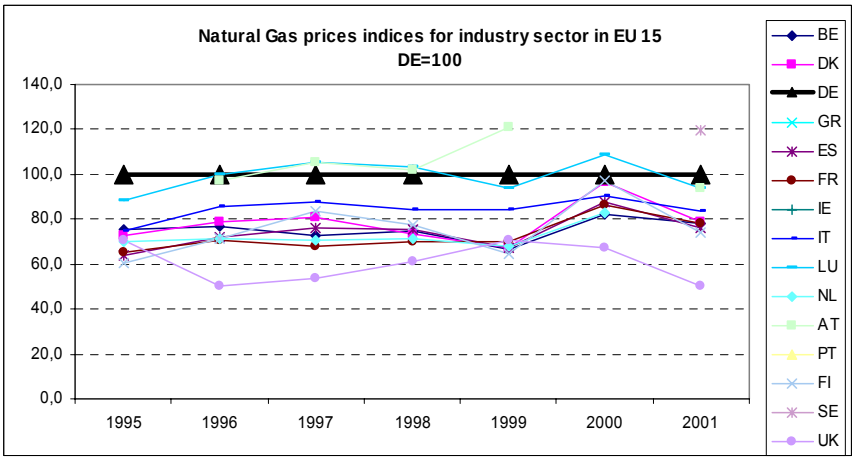

Figure 17 - Natural gas prices indices for household sector in EU15 (DE=100)