Version 26/10/2009

The ESPON 2013 Programme

ReRisk Regions at Risk of Energy Poverty

Applied Research Project 2013/1/5

Updated Interim Report

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This report presents the interim results of an Applied Research Project conducted within the framework of the ESPON 2013 Programme, partly financed by the European Regional Development Fund.

The partnership behind the ESPON Programme consists of the EU Commission and the Member States of the EU27, plus Iceland, Liechtenstein, Norway and Switzerland. Each partner is represented in the ESPON Monitoring Committee.

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This basic report exists only in an electronic version.

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1. Executive Summary

Europe is facing the challenge of growing dependence on energy imports and increasing energy prices. During 2007 and 2008, prices for all types of energy rose considerably and in almost all European countries, and this situation is expected to arise again, once the present economic downturn is overcome. Energy bills and transport costs have started to become a major concerns for both enterprises and households, but very little information is available on how much energy is being consumed at regional level in Europe and for what purposes. It is assumed that the impact of rising energy prices will affect regional competitiveness and cohesion and that some regions may be more exposed than others. It is the objective of this interim report to identify these regions and measure their vulnerability. Suggestions on how to reduce this vulnerability or "risk of energy poverty" will be presented at a later stage of this project.

In the ReRisk context, "Vulnerability" is defined in three dimensions:

1. Economic vulnerability, mainly due to regional specialization in industries with high energy spending.
2. The regions **dependence** on (motorized) **transport**, both in terms of employment and transport uses.
3. **Social vulnerability**, which refers to the segments of the population, which may have problems paying their energy bills.

The three dimensions discussed here (industry, transport and household) account for 84% of energy consumption in the European Union. The focus is set on energy **consumption** (demand) in this report, because the initial analysis of price developments has shown that oil price hikes spill through the entire economy and raise the prices of all types of energy, even in countries which make intensive use of nuclear or hydropower. Differences in regional vulnerability derive mainly from climate conditions, the economic and transport structure and the social situation in regions and cities.

On the demand side, responses to increasing energy prices in the short term on have proven to be very limited. Price increases have generally been too minor and too slow in the past to have provoked changes in consumption patterns. However, adjustments in demand in the medium and longer term can be accelerated with the right policy measures and investments in energy efficiency, thus mitigating the expected negative impact of rising energy prices on the main economic variables and the most vulnerable population.

So, what do we know presently about the possible impacts of rising energy prices in the regions? The impacts in economic terms can be estimated by identifying the industries with highest energy spending and by determining, which regions are specialized in these economic activities. Specialization means that a considerable part of employment and / or industrial output in the region depends on these industries. The analysis carried out here shows

that negative effects on regional economies are not limited to industries which are known to be energy-intensive, such as paper or aluminium, but are also derived from other sectors, for example the food processing industry.

Energy spending can be measured either in comparison to the level of spending by the same industry in other countries or within a given industry, in order to identify those processes, which require a high level of energy purchases. The assumption is that regions specialized in these types of activities may be especially vulnerable to rising energy prices, especially if their industries spend more money on energy purchases than their competitors.

It has been demonstrated that there are important differences between the EU countries with regard to industrial energy spending. Most of the Eastern countries have rather high expenses for energy purchases in a number of industrial sectors, and so does Luxemburg. These differences cannot be explained entirely by the levels of energy prices or general price indexes, so it has to be assumed that energy is not efficiently used in some industrial processes.

The available data on industrial energy consumption seems to confirm this hypothesis. We find that, after Bulgaria, Romania is the country that employs the largest amount of energy per million € of industrial gross value added (16.06 TJ), followed by Latvia (12.46 TJ), Luxembourg (10.10), Estonia (9.17 TJ) and Cyprus (5.80 TJ).

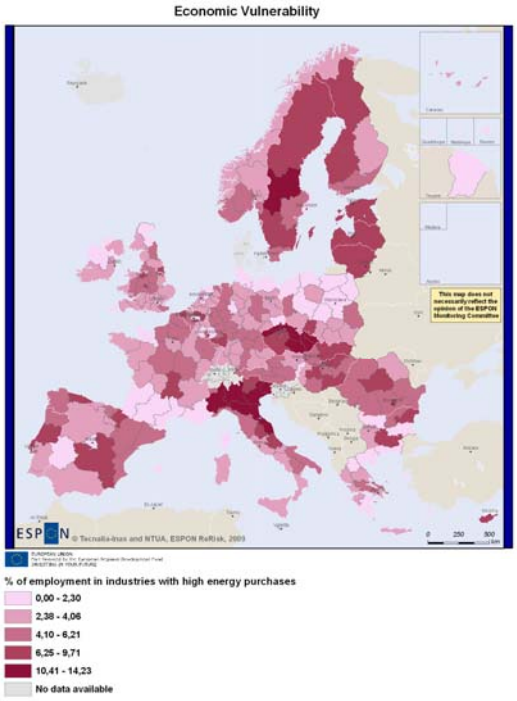
The question is if these findings on **national** industrial energy consumption can be extended to the **regional** level. The analysis of industrial energy consumption in NUTS I or 2 regions in France, Germany, Italy and the UK confirms that there is a positive correlation between the regional specialization in industries with high energy spending and their actual energy consumption.

The regions with the most unfavourable position in terms of **economic vulnerability** (> 10% of employment in industries with high energy spending) are located in the Czech Republic and in Italy. In the latter case, the highly vulnerable regions combined represent more than 50% of industrial employment. However, the Italian industries do not perform badly in the EU comparison with regard to energy spending, despite of the relatively high energy prices in the country. In the second group of regions, in which 7 – 10 % of employment depends on industries with high energy purchases, we find some belonging to countries that fare worse in the EU comparison of spending on energy purchases: Romania (Centru), and Hungary (Észak-Magyarország and Dél-Alföld), as well as Estonia and Latvia.

Map Nº 1 on the next page displays the "economic vulnerability index", indicating the percentage of industrial employment in sectors, for which energy costs are an important factor of competitiveness. This analysis on regional employment has been completed by calculating the percentage of industrial output (gross value added), which is produced in these sectors, showing that three Spanish regions (Asturias, the Basque Country and

Navarre) are also highly vulnerable. Furthermore, the Dutch provinces of Groningen and Zeeland, Niederbayern in Germany and the Greek Sterea Ellada show a high level of vulnerability to rising energy prices, due to their industrial structure.

Map N° 1 Regional Employment in Industries with High Energy Spending



By combining the results on industrial energy spending and regional wealth creation and employment, it is possible to identify those industrial processes, which should be subject to an in-depth analysis on regional level because they seem to be making a inefficient use of energy. These first results from the ReRisk project can therefore be used by regional decision-makers to focus energy efficiency policies on these industries, and thus reduce their vulnerability to rising energy prices. Some suggestions can be given for the regions with the most unfavourable industry structure in Italy, the Czech Republic and Hungary.

In the Italian regions of Emilia-Romagna, Lombardia, and Veneto, special attention should be paid to the manufacture of cement (NACE class DI2651), since energy purchases in this sector represent more than 30% of total purchases and energy spending is almost 10% higher than the EU average. A second critical sector is the "manufacture of glass fibres" (DI2614), in which more than 18% of purchases are dedicated to energy and energy spending is 8.6% above the average level of spending in the EU. The sector of "manufacture of other non-metallic mineral products", to which both

cement production and manufacture of glass fibres belong, employs more than 30,000 people in Lombardia and Veneto and more than 46,000 in Emilia-Romagna. Although cement production is regionally oriented and is therefore less exposed to international competition, improving efficiency would help to reduce the elevated level of industrial energy consumption in these regions. Analysis carried out on the international performance of the cement industry during the period of high energy prices has shown that the European cement industry was less affected by rising energy prices than the US industry, because, in some EU countries, companies make an important use of alternative, non-fossil fuels.

In the Czech region of Severovýchod, production processes in the sector of "other non-metallic mineral products" should be analyzed, since energy spending in this sector is 10% above EU average on national level and companies in this branch employ 21,564 persons in Severovýchod. Moravskoslezsko also has a very high level of employment (28,388 persons) in the basic metals industry. Special attention should be paid to processes related to "Forging, pressing, stamping and roll forming of metal; powder metallurgy" (DJ284), for which energy spending is about 5% higher than the EU average and represents 7.65% of total purchases. The region consumes 88% of all hard coal used in the Czech Republic and also ranks high in electricity consumption, confirming again the correlation between regional energy spending and consumption. Additionally, Moravskoslezsko ranks first with regard to wealth creation in sectors with high energy-spending, with more than 25% of regional GVA proceeding from these industries.

All of the mentioned regions in the Czech Republic (Moravskoslezsko, Střední Morava, Severovýchod, Severozápad and Jihovýchod) should analyze the performance of one branch of the chemical industry and more specifically the subsector "manufacture of industrial gases", since energy spending is 10% above EU average and energy represents close to 20% of total purchases. Employment levels in the chemical sector range from 4,225 in Moravskoslezsko to 7,943 in Severozápad.

In the case of Hungary, decision-makers from Észak-Magyarország should take a close look at the "manufacture of fertilizers and nitrogen compounds" (DG2415), since, on national level, this industry spends 40% more on energy purchases than the industry on EU average and energy purchases amount to almost 60% of total purchases. Észak-Magyarorszá ranks second among the Hungarian regions in employment in the chemical sector (6,215 employees), after Közép-Magyarország with 15,073 employees. Differences in energy spending with regard to Europe are also considerable in the "manufacture of starches and starch products" (DA1562; >12%) and this may especially affect the region of Dél-Alföld, where 25,444 persons work in the food-processing industry.

The data collected here therefore makes it possible to identify potential weaknesses in regional economies derived from higher than average levels of energy spending and thus sheds some light on the hitherto obscure question of industrial energy use in the European regions.

In order to measure **transport dependence**, several attributes have to be taken into account such as: employment in the transport sector, commuting, the cost of freight transport, the age of car parks and the dependence on air travel in remote regions and islands.

Differences in transport dependence are considerable between the EU regions in each of the above categories. The combination of transport indicators reveals that the most vulnerable regions are the large logistic centres, peripheral and island regions, but also some rural regions dependent on working opportunities in nearby urban poles or agricultural regions with high export levels.

Table Nº 1 Ranking of Regions by Transport Dependence

Transport employment / total employment		Fuel costs for freight as % of GDP		Commuting (persons working outside the region / inside the region)		Nº of passengers in air travel / total population (%)	
Region	%	Region	%	Region	%	Region	%
FI20 Åland	60.26	BG32 Severen tsentralen	14.22	BE31 Prov. Brabant Wallon	98.22	ES53 Illes Balears	28.60
DEA2 Köln	45.78	BG34 Yugoiztochen	8.18	UKI2 Outer London	77.29	GR42 Notio Aigaio	19.44
SK01 Bratislavský kraj	38.22	PL33 Swietokrzyskie	7.99	BE24 Prov. Vlaams Brabant	72.92	CH03 Nordwestschweiz	17.54
FR10 Île de France	27.69	BG33 Severoiztochen	7.16	NL23 Flevoland	60.62	NL32 Noord-Holland	16.93
BE10 Région de Bruxelles-Capitale	26.07	BG42 Yuzhen tsentralen	6.72	AT11 Burgenland (A)	50.66	ES70 Canarias (ES)	15.78
ES30 Comunidad de Madrid	25.45	PL43 Lubuskie	6.67	DE93 Lüneburg	48.34	BE24 Prov. Vlaams Brabant	15.32
DE50 Bremen	25.25	PL34 Podlaskie	6.59	BE35 Prov. Namur	45.16	UKI Outer London	15.00
DE71 Darmstadt	24.20	BG31 Severozapaden	6.39	BE34 Prov. Luxembourg (B)	45.14	GR2 Ionia Nisia	14.85
PL12Mazowieckie	24.09	CZ02 Strední Cechy	6.27	UKH2 Bedfordshire	37.17	DE7 Darmstadt	13.71

				Hertfordshire			

The costs of commuting or those associated to other car uses directly affects the budget of households, while increased costs for freight in the region will affect the general price level of goods, with further negative effects on available income. Additionally, households will have to face higher heating and electricity bills, so that the total energy expense may become a serious burden for families, which already struggle to make ends meet, due to low income or high indebtedness. This is the third dimension of "energy poverty" that is being analysed in the ReRisk project.

The present economic crisis is already showing its effect in the energy sector and companies, for example Enel in Italy, inform that the number of customers who can not pay their bills have increased over the last year, to 600.000 (up 30% since last year). In this case, it is not the rising energy prices, which cause this problem, but diminishing income, but the effects are similar.

Social vulnerability is obviously strongly related to the levels of poverty in the regions. People slide into poverty in different types of circumstances and the reasons vary considerably between the EU countries. And despite of the importance of this problem, few indicators are available to measure the risk of poverty in the regions. Long-term unemployment and low rates of economic activity are considered to be the main reasons for poverty. In 2005, 16 regions in Europe, plus the French overseas territories, had a long-term unemployment rate above 60% (of total unemployment). The list comprises a number of regions in Eastern Germany, as well as three regions in Bulgaria and two of the four Slovakian regions: Stredné Slovensko and Západné Slovensko. Activity rates below 50% are frequent in the Southern regions in Italy, and in four regions in Hungary: Észak-Magyarország, Észak-Alföld, Dél-Alföld and Dél-Dunántúl. Severozapaden in Bulgaria also belongs to the group of regions with the lowest level of economic activity (less than 43%) and another three regions from this country (Severen tsentralen, Severen tsentralen and Yuzhen tsentralen) follow closely.

Rising energy prices are bound to become a serious social problem in an area, which extends from Eastern Germany to the New Member States, especially those with a very low disposable income, such as Romania, Hungary and Poland. Energy costs represent a much more important strain on household budgets in these regions, which additionally have a high demand for heating in the winter time.

2. Outline of Methodology

This report intends to measure the regions' vulnerability to rising energy prices in three dimensions:

1. Impacts on competitiveness and employment
2. Transport dependency
3. Social situation

As a first step, the research team carried out a thorough literature review on the impacts of rising energy prices on the economy as a whole, and more specifically, on elasticities of supply and demand in order to set the framework for the subsequent statistical analysis and the related work packages.

In the absence of harmonized statistics on regional energy consumption, data on energy spending and regional employment has been used to describe the regional economic structures and evaluate their vulnerability in terms of competitiveness. The results on energy spending in regions have then been compared to the industrial consumption data in four EU countries, confirming that there is a significant correlation between the two sets of data.

Dependence on transport is easier to measure, since several suitable indicators for passenger and freight traffic have been compiled by Eurostat and DG Regio.

Little is known, though, on the risk of poverty in the regions, being the only available indicator the long-term unemployment rate, which does not fully grasp the reasons that lead to poverty. It has therefore been necessary to build a combined indicator that takes into account other risk factors, such as the indebtedness of households and the at-risk-of-poverty rate. In this case, the analysis is preliminary and will be further elaborated when data on urban poverty features becomes available.

Details on methodology and data availability are explained in the beginning of each chapter, since data coverage is quite heterogeneous.

The main concern relates presently to the fact that the development perspectives (economic structure and the relating risk of poverty) in the regions and the risk of poverty are studied under pre-crisis conditions, based on data from 2005. It is therefore recommend that the present analysis should be updated once the structural impact of the present economic downturn is reflected in the Structural Business Statistics and the statistics on unemployment.

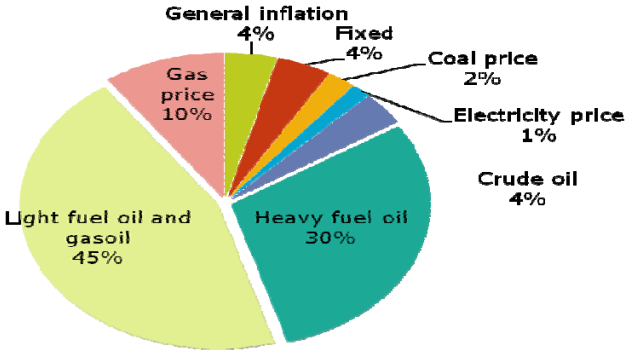
3. Presentation of Main Results Achieved so Far

3.1. Understanding the Economic Impact of Rising Energy Prices

The present part of the ReRisk project started out by reviewing the existing literature on the effect of rising energy prices on the economy, and more specifically, the elasticities of regional energy supply and demand. Literature in this field is rather limited, since price rises in the past have generally been too slow and minor, in comparison to general price increases, to have provoked strong responses by the economic and political actors[1].

However, there is clear evidence that increases in oil prices, as those observed between 2005 and 2007, spill through the entire economy, affecting all energy uses, including transport. Gas prices follow oil prices with a time lag of about 6 months, since, in Europe, 70 – 80% of gas supply contracts are indexed to oil prices (see graph nº 1).

Graph N° 1 Oil-price Indexation of Gas Contracts in Europe



Source: DG Competition[2]

The increase in gas prices then spreads into the electricity market, because the electricity wholesale markets are becoming increasingly integrated, thus levelling out price differences between countries with different fuel mixes for electricity production. A second important factor is that gas-fired power plants define the final price in most of these wholesale markets, which means that the national fuel mix for energy production is no longer the decisive factor of the price of electricity generation. Coal, for its part, which is generally considered a cheap and abundant alternative to gas and oil in power generation, followed the general price increase between 2005 and 2007, partly because of increased shipping costs.

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[1] Bernstein, Mark A.; Griffin, James, RAND Corporation (2005), *Regional Differences in the Price-Elasticity of Demand for Energy*.

[2] European Commission, DG Competition (2007), "*DG Competition Report on Energy Sector Inquiry*", Part I - IV

However, the extent to which the rise in oil prices affects final customers depends on many and diverse market and regulatory factors, such as:

- The importance of other cost components, including taxes, refinery, network and distribution costs. Most influential among them is the level of volume-based tax on fuels, which is not proportional to the net price, as opposed to VAT.
- In the case of large industrial users, bilateral contracts and industrial cogeneration influence the final energy price. However, cogeneration in Europe is also in more than 90% based on fossil fuels[3], so it will follow the general upward trend in prices.
- Switching rates of domestic customers in liberalized markets remain low and in many countries, regulated tariffs are still in place. Regulated tariffs mean that household users are initially shielded from price increases in the wholesale market, while in a liberalized environment without regulated tariffs, households could be more directly exposed.

From this review, we conclude that the impact of energy price increases will not vary significantly in most EU Member States because of different fuel mixes in electricity production, but because of different patterns on the consumption side, which in turn are defined by climate conditions, economic and transport structures and the social situation in the regions and cities.

The impact of energy price increases on the most energy-intensive sectors (such assteel, aluminium, pulp and paper, glass and cement) in Europe has already been thoroughly investigated by ICF International for DG TREN[4]. By comparing the impact of price increases between 2000 and 2006 on the EU and the US industries, conclusions can be drawn regarding the competitive position of each of the industries and the reason why some sectors fare better than others. The following table summarizes the findings of the ICF study:

Table N° 2 EU – US Comparison of Impact on Energy-intensive Industries

Sector	EU 25		US	
	Energy price increase	Cost increase manufacturing	Energy price increase	Cost increase manufacturing
Iron and steel	73%	15%	75%	11%
Aluminium	55%	20%	52%	17-18%
Pulp and paper	56%	11%	25%	4%
Cement	26%	no estimate	51%	no estimate
Glass	91%	no estimate	47%	no estimate

[3] Ioesoenen, P. (2008), "*Combined Heat and Power (CHP) in the EU and Turkey - 2005 data*", Eurostat, Statistics in Focus, 2/2008

[4] ICF International (2007), "*Analysis of the Economic Impact of energy product prices on competitiveness of the energy and manufacturing sectors in the EU: comparison between EU and US*". Submitted to European Commission, DG Transport and Energy, Brussels, Belgium

Source: Own elaboration based on ICF study

The differences in impacts derive from the fuel mix used in each industry and from the specialization on more or less energy-intensive processes. The European cement industry performs much better than the rest of the sectors because of the important use of alternative, non-fossil fuels.

3.2. Theoretical Discussion of Elasticities of Energy Supply and Demand

The cyclical nature of energy price developments in the past has generally been explained in economic theory by the time required to bring new resources into market after a period of increasing demand. What has changed during the last years is that even with increasing investments, "*the annual rate of output decline is 6.4 per cent*" '[in the case of oil][5]. Also, there are serious concerns about the "net energy balance" of the remaining resources, meaning that at a certain point it will take more energy to retrieve the resources than the energy they provide[6]. In economic terms, we are therefore confronted with declining elasticities on the supply side, which partly explain the continuing price increases between 2005 and 2007.

On the demand side, elasticities to price increase tend to be very limited in the short term, according to the studies reviewed. The only short-term response available is fuel switching in the power sector, while final uses are very much static[7]. In the longer term, ways of substituting energy by capital investments[8], for example, in efficiency measures, are more likely to occur, but while energy prices remained low, savings had often been minor due to rebound effects[9]. Now, some study on micro-level suggests that changes on the consumption side, especially in the residential sector, could be greater once energy prices reach a "pain threshold" and become a real strain in household budgets. According to a recent survey on increased transport fuel prices, carried out in the French regions[10], people seriously consider changing their mobility habits when the gasoline price reaches €1.60, if they had not done it yet. The preferred option differ between urban agglomerates, where greater use of public transport and walking are reasonable alternatives, while in rural areas, people look to more structural solutions, such as buying a hybrid car.

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[5] [5] Financial Times, 28/10/2008

[6] [6] EROI Institute on "*Energy Return on Investment*" or "*Net Energy Analysis*" http://www.aspo-ireland.org/index.cfm/page/index.cfm?page=speakerArticles&rbId=7

[7] See, for example, "Costello, D. (2006): *Reduced form energy model elasticities from EIA's regional short term energy model (RSTEM*). http://www.eia.doe.gov/emeu/steo/pub/pdf/elasticities.pdf

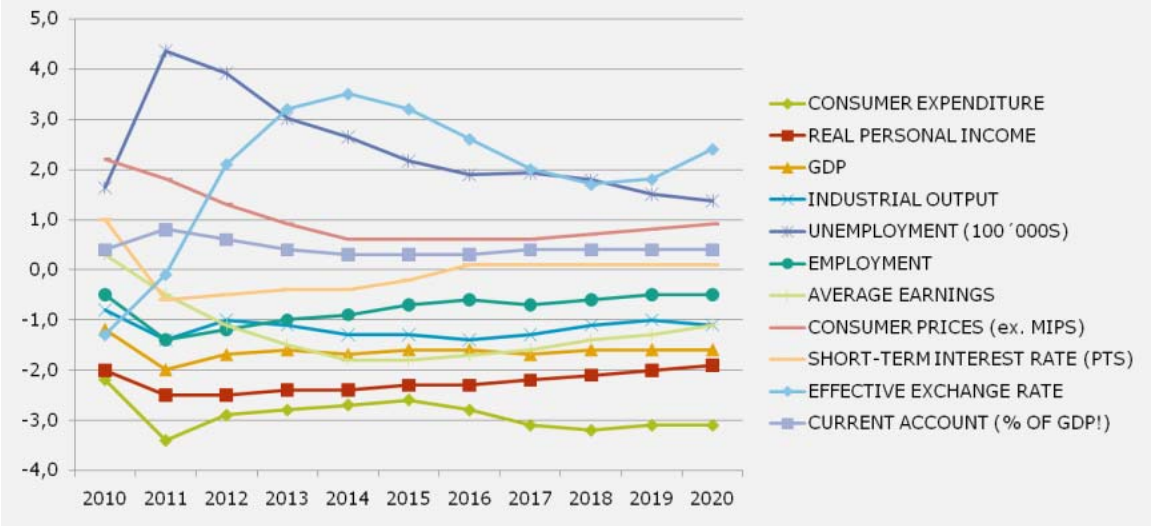
[8] Koetse, M.J., de Groot, H.L.F., Florax, R.J.G.M (2008): *Capital-energy substitution and shifts in factor demand: A meta-analysis*. Energy Economics, Vol. 30 pp. 2236-225

[9] Bertoldi, P / Atanasiu, B. (2007); *Electricity Consumption and Efficiency Trends in the Enlarged European Unio*n, Institute for Environment and Sustainability, JRC and Sorrell, S.et al. (2009), *"Empirical estimates of the direct rebound effect: A review*, Energy Policy 37 (2009) 1356–1371

[10] IFOP / Dimanche Ouest France (2008), *Les Français et le prix des carburants*

According to economic theory, "shocks that change real variables in the short run will trigger a round of nominal adjustments (to prices, wages, exchange and interest rates), which will ensure real variables converge on their equilibrium values in the long run"[11]. It is estimated that the time the economy needs to reach that new state of equilibrium of lower energy demand lasts from 10 to 20 years and the negative impacts are still visible at the end of this period. The possible quantitative impact of a 30% price increase in all final energy uses has been calculated by Oxford Economic Forecast for the EU countries (see graph nº 2).

Graph Nº 2 Estimated Economic Impact of a 30% Price Increase in all End-Uses of Energy



Source: Oxford Economic Forecast[12]

One of the central questions to be answered as a result of the ReRisk scenario exercise will therefore be related to how to shorten this adaptation process by policy measures, such as promoting energy-capital substitution. But, firstly, it is necessary to identify, which are the regional economies most exposed to energy price increases, due to their economic structure, their dependence on transport and the social situations of households. These three sectors have been chosen to structure the analysis, since they represent 84% of energy consumption in the European Union.

[11] Oxford Economic Forecasting (2006): *DTI Energy price scenarios in the Oxford Models*
[12] Oxford (2006), op. cit..

3.3. Vulnerability of Regional Economies

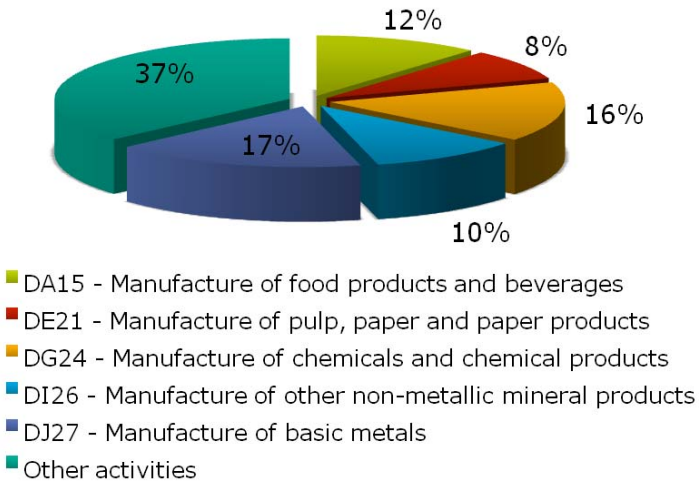
3.3.1. Methodological Approach and Limitations

3.3.1.1. Methodological Approach

For companies, energy is one of the main cost factors in the production process and therefore the amount companies spend on purchasing energy is more relevant in terms of competitiveness than their actual energy consumption. The following approach was chosen in order to determine the sectors and regions that are most vulnerable to energy price increases:

1. First, we estimated, for the EU 27, the sectors with the highest spending on energy products on NACE 2 digit level, and which, combined, represent 63% of industrial energy spending (see graph nº 3).

Graph N° 3 NACE Sectors with Highest Overall Energy Spending



Source: Own elaboration based on Structural Business Statistic

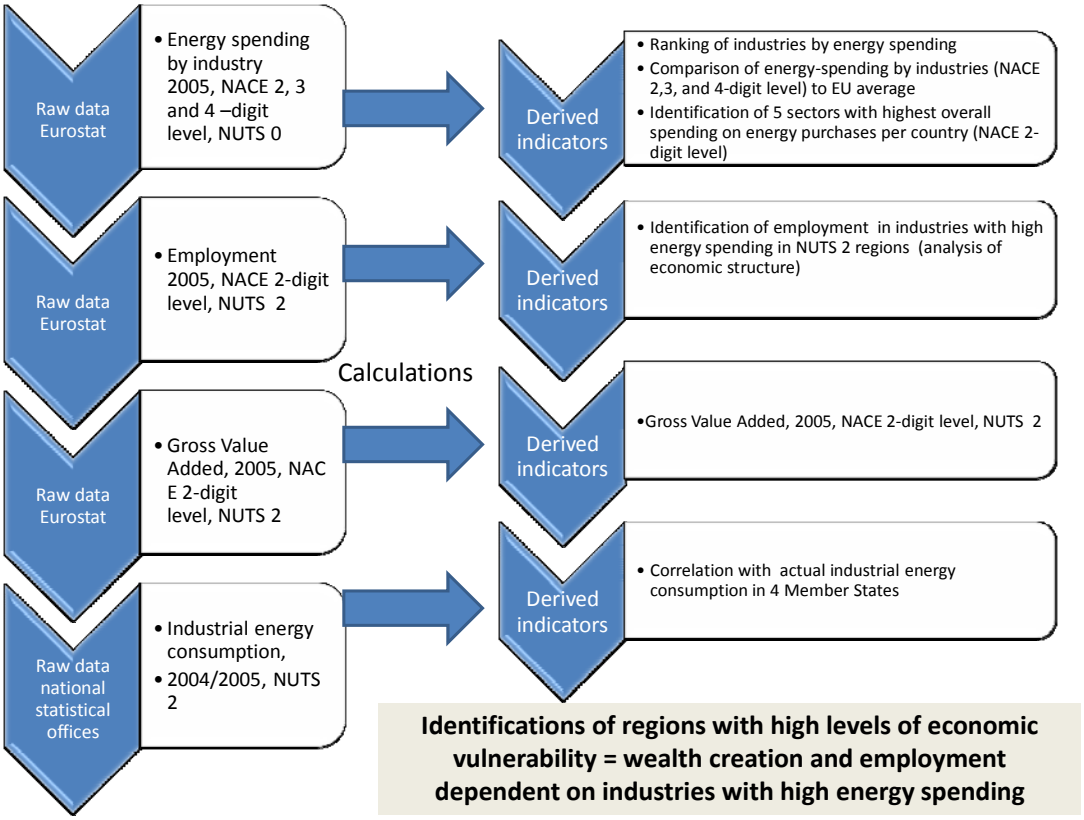
Furthermore, it was checked if the national data diverges significantly from the EU average and if some adjustments had to be made for countries with a different profile of energy spending.

2. In a second step, we calculated the ratio between "total purchases of goods and services" and the energy purchase in each sector (down to NACE 4 digit) for those EU countries, for which complete data sets are available for both categories. This made it possible to identify the subsectors and processes with the highest energy purchases, and also to determine the relative position of each EU country in terms of energy spending.

3. Then, we identified the EU regions, in which large part of the industrial employment and gross value added depends on sectors with high energy spending and which may therefore be more vulnerable to energy price increases.
4. Finally, we confirmed that there is a significant correlation between the industrial energy spending in the regions and their energy consumption, using actual consumption data from 4 Member States.

The above-mentioned steps are presented in graph nº 4.

Graph N° 4 Methodological Approach for Analyzing the Regions' Economic Vulnerability



Source: ReRisk Project

3.3.1.2. Limitations

This analysis is based on data collected in 2005, which means that it describes the structure of EU industry prior to the present economic crisis. It can be expected that the economic downturn might have a heavy structural impact in many sectors and regions, also changing the patterns of energy spending within the economies. So, the present will have to be revised when

the long-term impact of the present crisis can be documented in the Structural Business Statistics.

Further limitations to our research derive from the lack of data for some countries, as shown in the table Nº 3 below.

Table N° 3 Countries Excluded from the Analysis for Lack of Data

Country	Data Availability
AL Albania	No data
BG Bulgaria	No data on energy purchases
CH Switzerland	No data
LT Lithuania	No data
MT Malta	No data
PL Poland	No data on energy purchases
SI Slovenia	No data on energy purchases

Source: Own elaboration based on Structural Business Statistics

For some countries and sectors, there is no aggregated data on 2-digit level, but this has generally not been a major problem for carrying out the analysis, since 3-digit level data could be used. Finally, for some sectors, data on NACE 3 and 4 digit level was insufficient to estimate a meaningful EU average (less than 10 values for EU 27), so these sectors have not been taken into account in the present analysis.

3.3.2. The EU Perspective

3.3.2.1. Economic sectors with the largest energy purchases in the European Union (NACE 4 digits)

The five sectors, which, together, represent more than 60 % of industrial energy purchases in the EU 27, are the manufacturing of chemicals, basic metals, foods and beverages, pulp and paper and "other non-metallic minerals". While in the case of chemicals and for food and beverages, energy purchases do not represent a major cost item for industry, with regard to the total amount of purchases, it is relevant for the manufacture of basic metals and other non-metallic minerals, as well as for the paper industry:

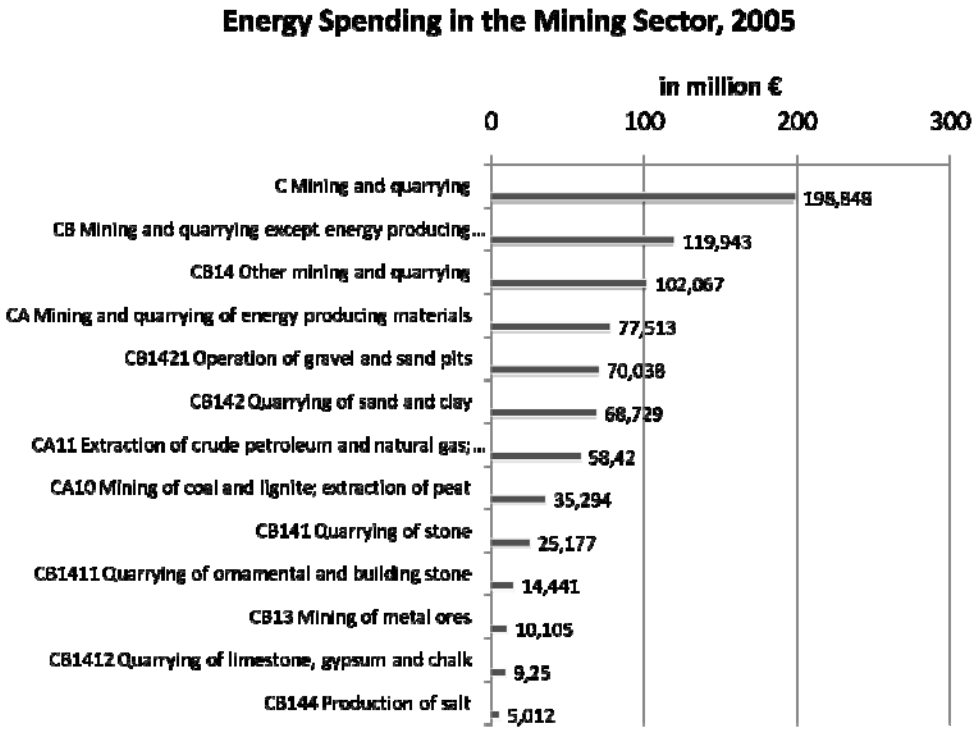
Table N° 4 Energy Purchases of Industry, 2005

Sector	Energy purchases 2005 (in millions of €)	% of total purchases
DG24 Manufacture of chemicals and chemical products	784,829	3.91%
DJ27 Manufacture of basic metals	723,421	6.73%
DA15 Manufacture of food products and beverages	548,192	2.59%
DI26 Manufacture of other non-metallic mineral products	504,333	8.36%
DE21 Manufacture of pulp, paper and paper products	392,487	7.91%
Total industrial energy purchase purchases (D)	4803,829	2.54%

Source: Own elaboration based on Structural Business Statistics

Mining is also very energy-intensive, but, as in the case of pulp and paper production, activity in this sector is limited to a few Member States. Within the mining sector, the subsectors, which spend most on energy purchases, are the quarrying of stone and "other mining and quarrying".

Graph N° 5 Energy Purchases in the Mining Sector, 2005



Source: Own elaboration based on Structural Business Statistics

The main conclusion we can draw from the analysis of total energy spending by sector is that the increase of energy prices has a heavy impact on all basic industry, including food production, and not only on the so-called energy-intensive sectors.

The construction business, in turn, is affected in a minor way and rather indirectly, since most energy purchases correspond to the supplier industry. The European construction industry spent a total of 713,786 million € on energy purchases in 2005, but data for this sector is slightly distorted, due to an error in the figures for Spain.

3.3.2.2. Differences among EU Countries

The selection of sectors with high energy spending is valid for most EU Member States, since in most cases at least four out of five sectors are identical, although the ranking of the sectors may vary slightly. The following country-specific differences can be observed:

In *Cyprus*, special attention should be paid to "DD20 Manufacture of wood and of products of wood and cork" and to "DE22 Publishing, printing,

reproduction of recorded media", since these sectors are more relevant in terms of energy purchases than the manufacture of paper and basic metals.

In the *Czech Republic*, energy purchases for "DK29 Manufacture of machinery and equipment" and "DJ28 Manufacture of fabricated metal products, except machinery and equipment" are higher than those for food processing and paper production. The paper industry is also overtaken in *Germany* by "DM34 Manufacture of motor vehicles, trailers and semi-trailers", while, in *Denmark*, "DK29 Manufacture of machinery and equipment" is more important in terms of energy spending than the manufacture of basic metals.

The *Estonian* industry structure differs considerably from the EU average, due to important energy purchases by the wood and furniture industries (DD20 and DN 36), while the manufacture of basic metals and the pulp and paper industry are not as relevant in terms of energy purchases

In *Finland*, the wood industry is more relevant than food processing, a sector which is also of lower importance in *France*, being displaced by "DH25 Manufacture of rubber and plastic products".

In *Greece*, the third most relevant activity in terms of energy spending is "DF23 Manufacture of coke", substituting the paper industry on the list of sectors with highest energy purchases. This sector is also less important in *Ireland*, where "DL32 Manufacture of radio, television and communication equipment and apparatus" has to be taken into account.

Italy is the country with the greatest difference to the EU average, since it spends less money on energy consumption for food processing, paper production and chemicals than for the manufacture of machinery and equipment (DK 29), of rubber and plastic products and on fabricated metals.

In *Lithuania*, as in Estonia, the wood industry is very relevant in terms of energy purchases, but also "DL32 Manufacture of radio, television and communication equipment and apparatus", while the fabrication of basic metals and the manufacture of paper are of lower importance.

Luxembourg spends a very large share of its industrial energy purchases on the manufacture of rubber and plastic products, but little on food processing. Also, spending in the manufacture of fabricated metal products replaces the paper industry in the list of most relevant sectors.

The structure of the *Latvian* economy with regard to energy purchases is very similar to the Estonian, with a predominance of the wood and furniture industry and less spending in the paper and chemical industries.

The *Netherlands* differ from the EU average in that the manufacturers of coke, refined petroleum products and nuclear fuel have higher energy spending than the food-processing industry, a sector which is also overtaken in *Norway*, in this case by the wood industry.

In *Portuga*l, more money is spent on energy purchases when fabricating metal products than in the manufacture of basic metals. In *Romania*, we find

that the fifth-ranking sector is the manufacture of machinery and equipment, while the paper industry is of less relevance.

Differences are greater in *Sweden*, where the manufacture of wood and of "motor vehicles, trailers and semi-trailers" registers higher energy purchases than food processing and the manufacture of other non-metallic mineral products.

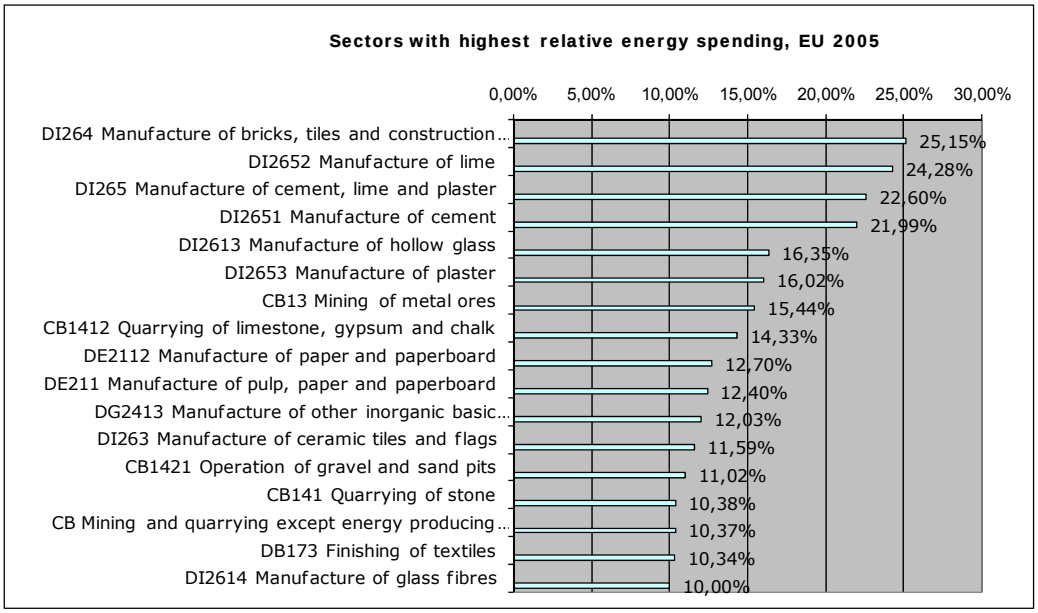
Energy spending for food processing is also somewhat less relevant in *Slovakia* and the *UK*, being replaced by the manufacture of machinery and equipment in the case of Slovakia and the production of metal products in the case of the UK.

In Annex I, the specific national sectors, which have been taken into account for the identification of adversely affected regions, are described in detail with regard to their overall and energy spending and their performance with respect to the EU average spending by sector.

3.3.2.3. Sectors in which energy purchases represent a high share of total purchases

In order to measure the impact of increasing energy prices on the companies' production costs, it should be taken into account their overall spending and the percentage that is spent on energy purchases. By breaking the data down to NACE 3 and 4-digit, we can identify those production processes, which spend more than 10% of their total purchases on energy. Graph nº 6 depicts neatly that it is the raw materials sector and the suppliers to the construction industry for which energy purchases represent a major problem. Further industry branches that have to be cited here are the manufacture of paper and paper board, basic chemicals and the finishing of textiles:

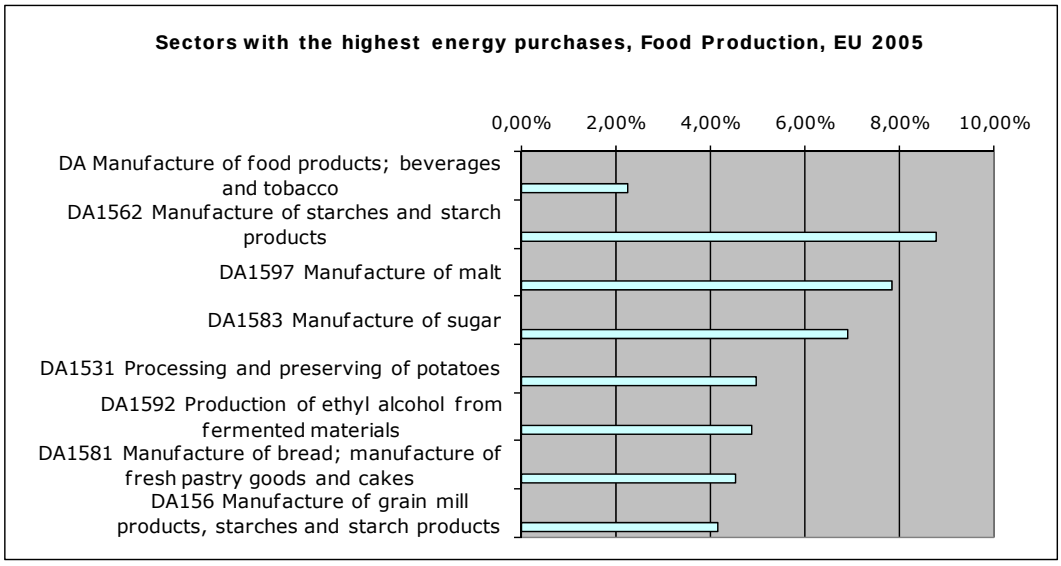
Graph Nº 6 Sectors with Highest Energy Purchases (as % of total purchases)



Source: Own elaboration based on Structural Business Statistics

Major differences are also observed with regard to energy purchases within the industrial sectors. Looking, for example, at the production of food and beverages, we see that the average industry spending on energy represents slightly more than 2% of total spending, but for the manufacture of starches, energy accounts for almost 9% of spending (see graph nº 7).

Graph Nº 7 Subsectors with Highest Energy Purchases, Food Processing

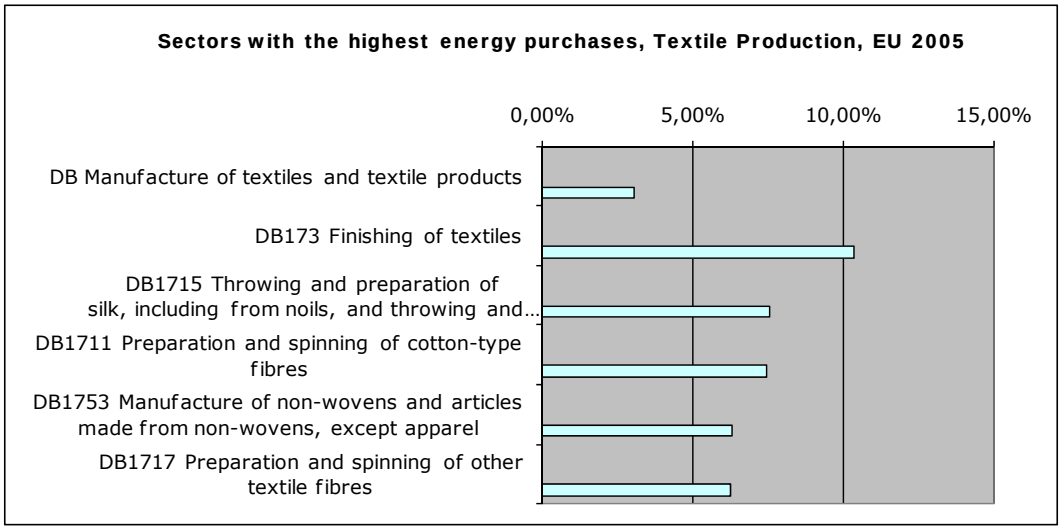


Source: Own elaboration based on Structural Business Statistics

As cited above, the "finishing of textile" is the process within the textile industry, for which energy costs are considerable, when compared to other

purchases. Other activities within this sector with above-average energy spending are the fabrication of silk, cotton and non-woven textiles.

Graph N° 8 Subsectors with Highest Energy Purchases, Textile Production

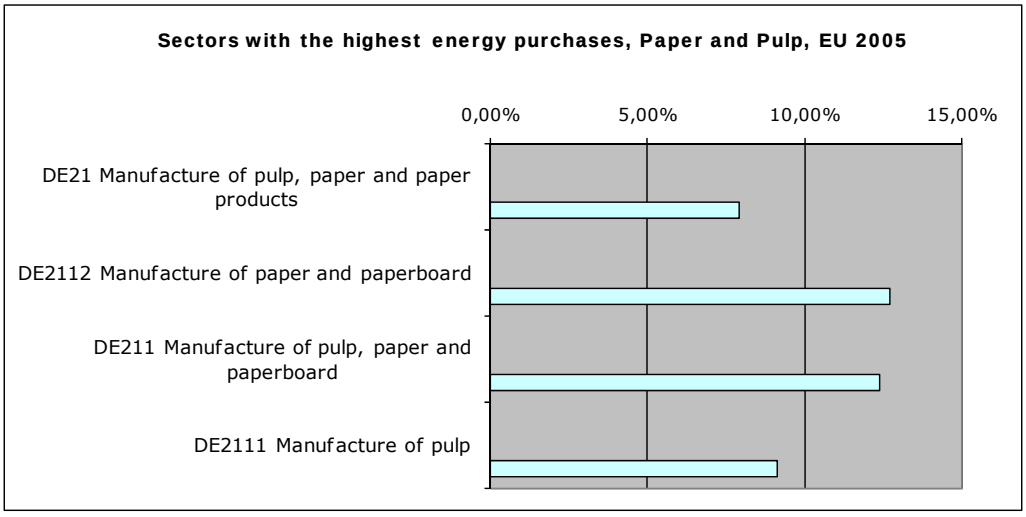


Source: Own elaboration based on Structural Business Statistics

Differences are minor in leather production, but within the wood industry, which spends an average of 3.32% of purchases on energy, one sector, the "manufacture of veneer sheets; manufacture of plywood, laminboard, particle board, fibre board and other panels and boards", spends 5.86% of its purchases for the same purpose.

The results for the paper industry show that energy purchases constitute an important cost item both for the manufacture of paper and paper board and the preparation of pulp, while the rest of the activities included in this sector, such as publishing and printing, spend a much lower share of their purchases on energy.

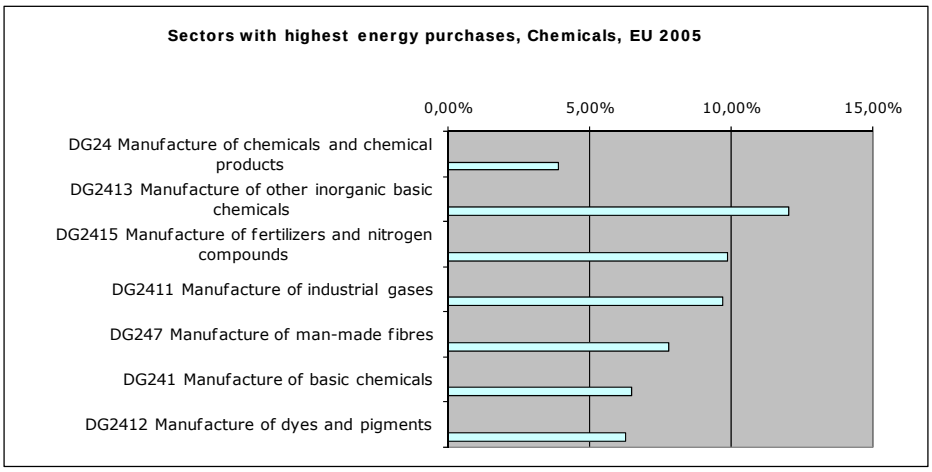
Graph N° 9 Subsectors with Highest Energy Purchases, Paper and Pulp



Source: Own elaboration based on Structural Business Statistics

The average spending on energy in the chemical industry is below 4%, but manufacturers of "other inorganic chemicals", "fertilizer and nitrogen compounds", "industrial gases" and "dyes and pigments" spend between 10 and 12% on energy.

Graph N° 10 Subsectors with Highest Energy Purchases, Chemicals

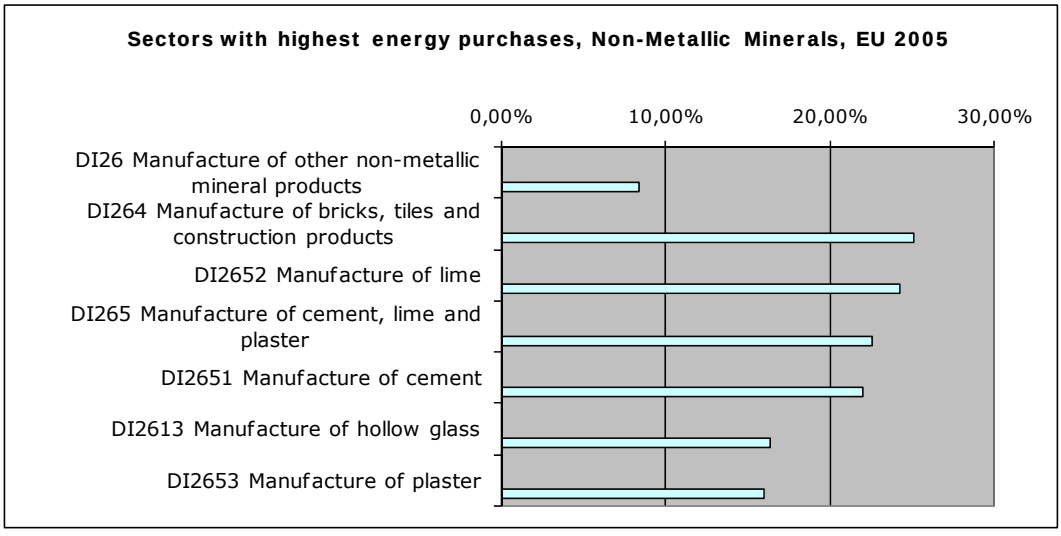


Source: Own elaboration based on Structural Business Statistics

The rubber and plastics industry, on the contrary, has quite homogenous values when it comes to energy spending (around 3% of total spending).

Differences in energy spending are again greater within the supplier industry to the construction sector, for which energy spending represents 20 to 25% of total purchases in the case of manufactures of bricks, lime and cement. Two more sectors should be mentioned here, as they lie far above the sector average: manufacture of hollow glass and plaster.

Graph N° 11 Subsectors with Highest Energy Purchases, Non-Metallic Minerals



Source: Own elaboration based on Structural Business Statistic

In the basic metals sector, which spends an average of 6.37% on energy, the industries with the highest percentages are iron casting (9.93%), and the manufacture of basic iron and steel (9.17%), and, to a lesser extent, aluminium production (7.39%).

Within the "manufacture of fabricated metal products", only the "treatment and coating of metals" shows a value far higher than the sector average (7.7% vs 2.47%). Energy costs are much less relevant for the production of other machinery and the subsector with the highest spending in this category, the "manufacture of machinery for metallurgy" remains below 3%. Likewise, within the "manufacture of electrical and optical equipment", the only sector with an above average spending on energy is the "manufacture of accumulators, primary cells and primary batteries" (2.66%). With regard to the manufacture of transport equipment, the rather anecdotic finding is that the subsector, which spends most on energy in relative terms, is the production of bicycles (3.64% as compared to a sector average of 0.83%). Finally, within the recycling business, we find that the subsector with the most unfavourable position with regard to energy spending is "recycling of non-metal waste and scrap" (4.14% as compared to a sector average of 1.74%).

This analysis should give regional policymakers some orientations as to which economic activities may first suffer from the impact of rising energy prices. It could also be useful for directing energy saving measures in industry towards those businesses, for which energy spending is a considerable cost item and which may therefore be more easily motivated to reduce energy consumption.

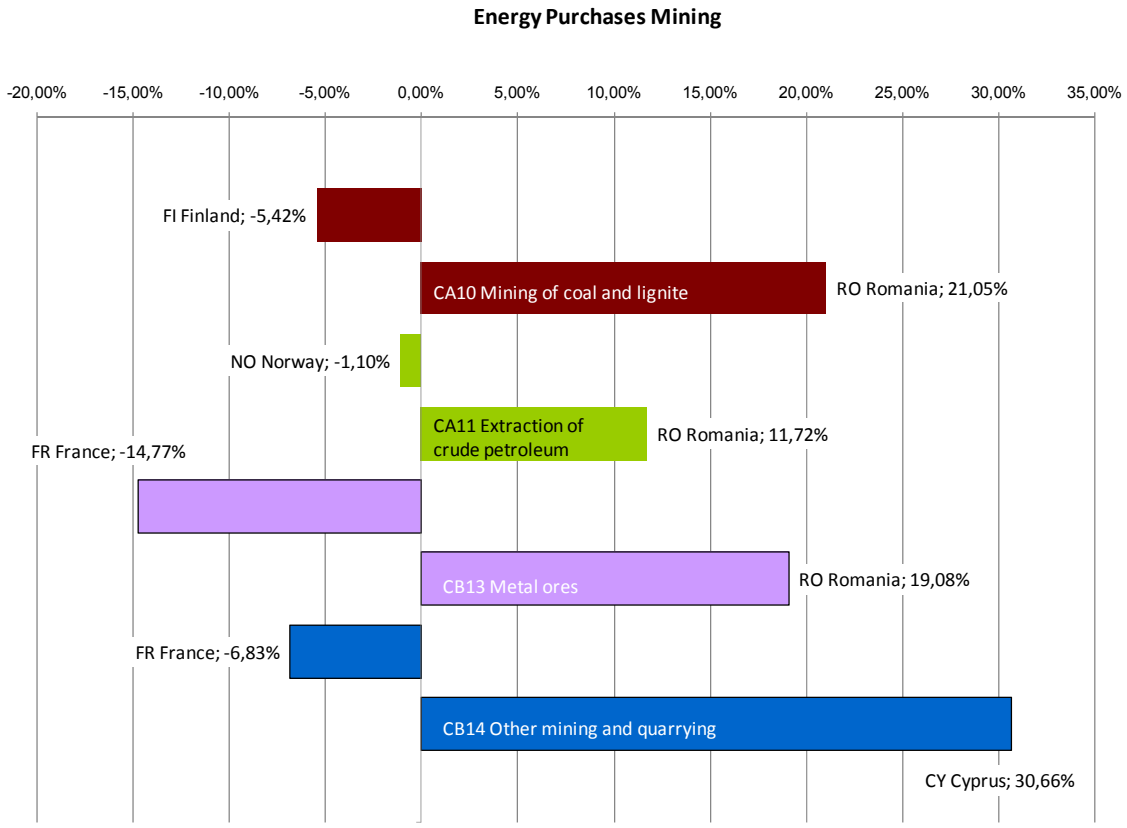
3.4. Country Comparison

3.4.1. Comparison of energy purchases by country and sector (NACE 2 digit)

In terms of competitiveness, it is important for companies to know if their energy costs are higher than those of their competitors. For this reason, we have carried out further analysis on how the different national sectors perform with regard to the average EU spending. As shown below, differences between the EU countries are considerable.

Divergence in energy spending are especially great in the mining industry, with Romania spending up to 20% more on energy purchases than the sector on EU average, while France and Finland fare considerably better than the rest of EU countries with mining activities:

Graph N° 12 Country Comparison: Energy Purchases in the Mining Sector



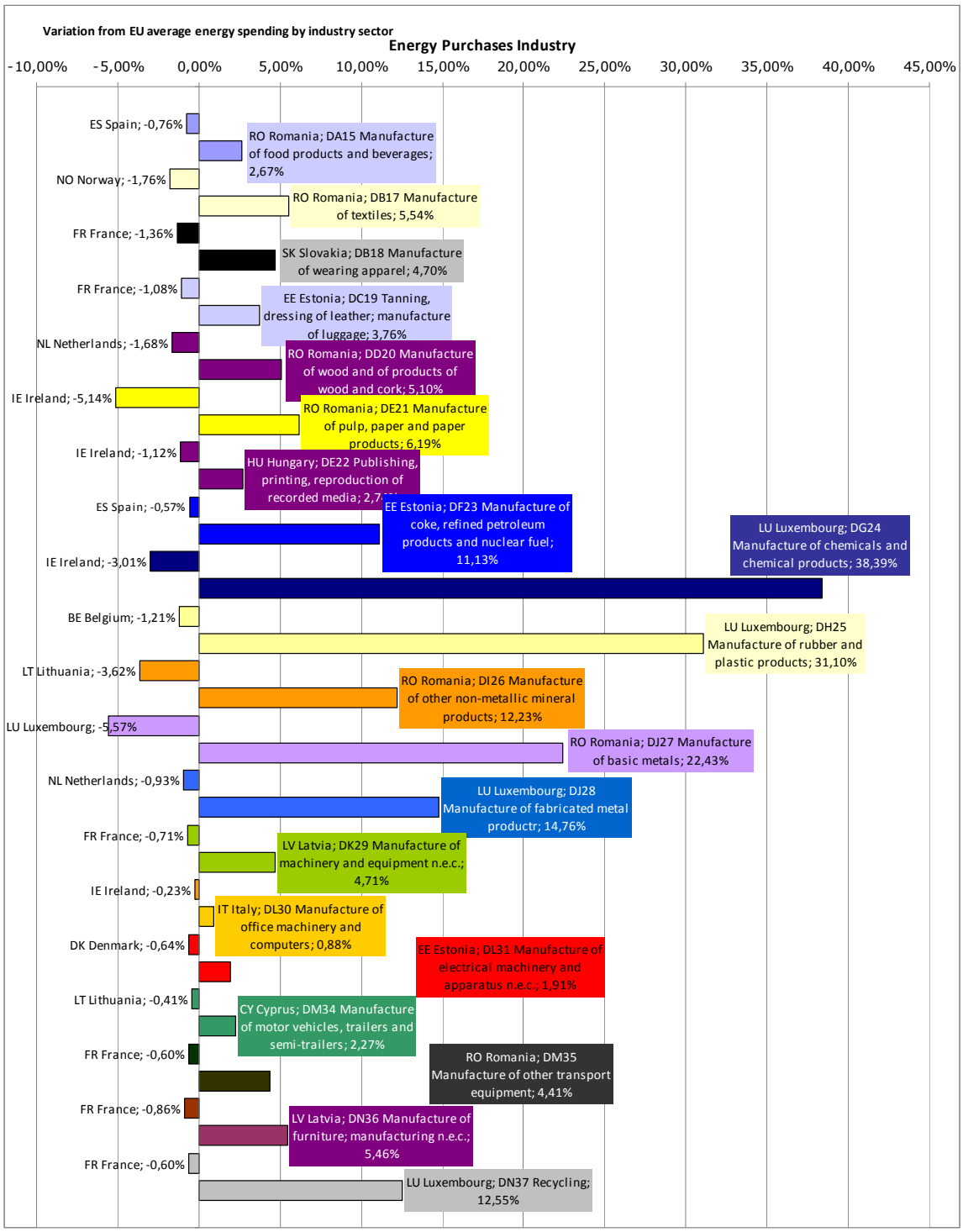
Source: Own elaboration based on Structural Business Statistic

Differences in energy spending (as % of total purchases) are also considerable in industry, as shown in the next graph. For example, the chemical industry in Luxemburg spends almost 40% more on energy purchases than the EU average, but the country performs much better in the manufacture of basic metals.

However, in order to obtain a full understanding of how important these differences are for the competitiveness of regions, it is necessary to take into account how much the industries in questions contribute to the wealth creation in the region and how many employments depend on their performance. These questions will be addressed in chapter 3.5. "Regional breakdown" of this report.

Graph N° 13 Country Comparison: Lowest and Highest Energy Spending, by Sector

(Energy purchases as % of total purchases, EU average = 0)



Source: Own elaboration based on Structural Business Statistic

The comparison between countries clearly shows that the competitive position of Romania, Luxembourg, and Cyprus is weak in a number of sectors. The list can be enlarged by Estonia and Latvia, while the only other Eastern European country included in the survey, Lithuania, stands out positively in two sectors, along with France, Norway, Ireland and the Netherlands.

The comparatively high spending on energy purchases in some Member States may be explained by three factors:

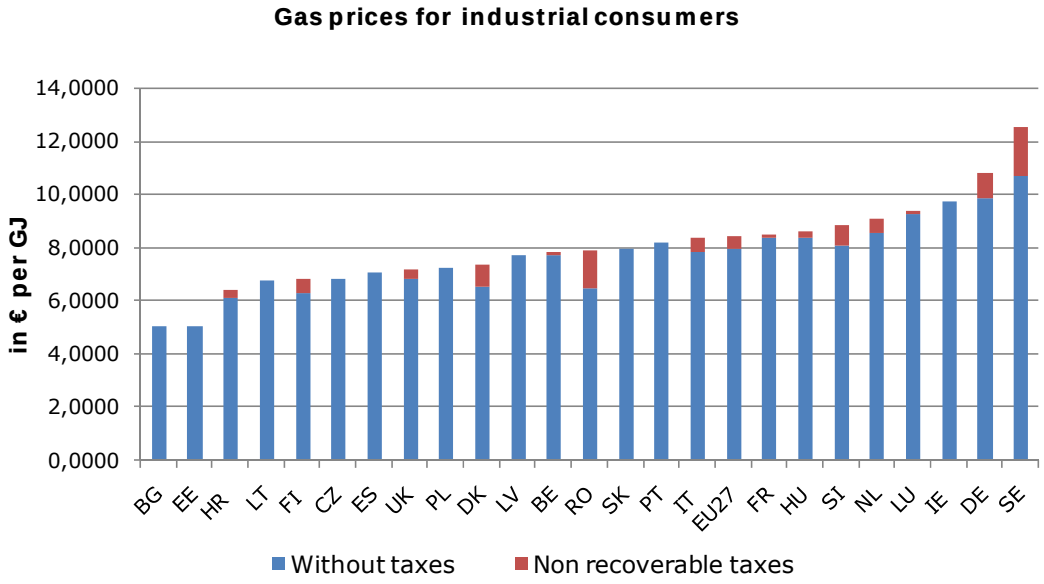
1. High costs of energy
2. Low cost of other purchases
3. Inefficient use of energy

The first two of these possible explanations can be checked against data collected by Eurostat, permitting to establish some hypothesis on how efficiently energy is used by the national industries.

3.4.1.1. In-depth analysis of countries with highest energy purchases per sector

First of all, we might consider that energy prices are higher in the five countries that perform worse in the EU comparison. The following two figures show the industrial prices for gas and electricity in the European Union[13].

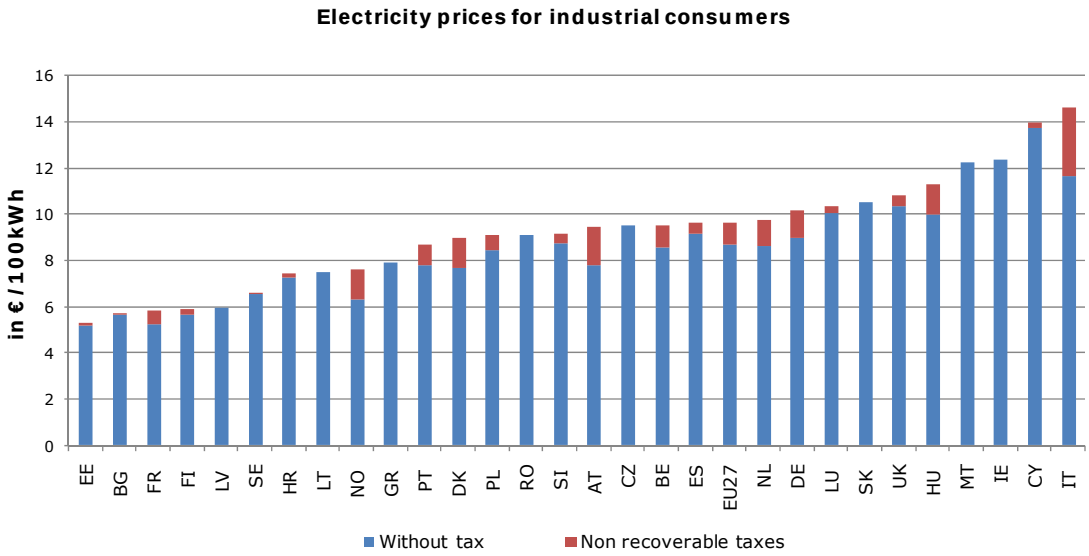
Graph N° 14 Gas Prices for Industrial Consumers, 2007



Source: Own elaboration based on Eurostat data

[13] 2007 figures have been used for price comparison, since Eurostat improved its methodology this year.

Graph N° 15 Electricity Prices for Industrial Consumers, 2007



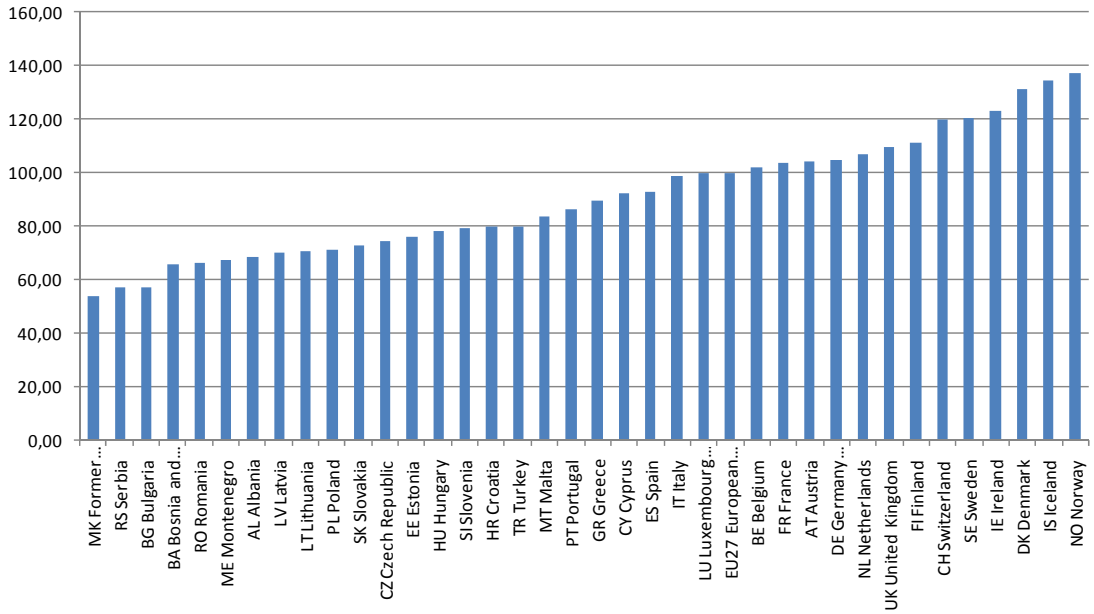
Source: Own elaboration based on Eurostat data

Romania, Latvia and Estonia have lower gas prices than the EU-27 average. Gas prices in Luxembourg are higher, while Cyprus has no access to gas.

With regard to industrial electricity prices, we see that Romania, Latvia and Estonia have low prices in comparison to the EU average, while Luxembourg and Cyprus have higher than average prices. In these two countries, differences in energy purchases might therefore be a consequence of higher energy prices, but this factor can not explain the performance of Romania, Latvia and Estonia.

Another factor that might be affecting differences in industrial performance among countries is the level of prices of the goods and services purchased in each country. As shown in the following figure, all five countries analysed in this section have lower prices than the EU average with regard to the purchases of goods: Romania, Luxembourg, Latvia, Estonia and Cyprus. With regards to services, Luxembourg is the only country with higher prices than the EU average.

Graph N° 16 Comparative Price Index for the Purchase of Goods, 2005



Source: Own elaboration based on Eurostat data

The fact that companies in the analysed countries spend less on other goods and services may explain the greater importance of energy purchases, but after applying the comparative price index of goods purchases as a correction factor, it has to be concluded that the variation in prices is not large enough to explain the difference in performance.

The sectors within the countries that should be subjected to in-depth analysis, because the increase of energy prices may worsen their competitive position, are described in detail in Annex II.

3.5. Regional Breakdown

3.5.1. Regions with a high share of employment in sectors with high energy spending

The analysis of the sectors, which spend most in absolute terms on energy purchases at the country level (, can be broken down to regional level by associating the corresponding employment on NACE 2-digit level.

As a result, we obtain a list of 9 regions, in which more than 50% of *industrial* employment depends on these sectors, plus the countries of Cyprus and Latvia.

Table N° 5 Ranking of Regions by Industrial Employment in Sectors with High Energy Spending

NUTS Code	Region	% of employment in industrial sectors with high energy spending (NACE sectors D+E)
UKI1	Inner London	68.90%
BE31	Prov. Brabant Wallon	63.83%
CY00	Cyprus	60.11%
ES63	Ciudad Autónoma de Ceuta (ES)	58.82%
ES12	Principado de Asturias	58.80%
PT15	Algarve	53.31%
ES70	Canarias (ES)	52.97%
GR41	Voreio Aigaio	51.87%
GR21	Ipeiros	51.74%
NL32	Noord-Holland	50.58%
LV00	Latvia	50.55%

Source: Own elaboration based on Eurostat data

However, this picture changes considerably if we calculate the percentage of *total* employment that may be seriously affected by rising energy prices, since some of the regions cited above have a strong tertiary sector.

Table N° 6 Ranking of Regions by Total Employment in Sectors with High Energy Spending (Group 1)

NUTS Code	Region	Employment in industries with high energy purchases / total employment (%)	Total employment 2005
CZ08	Moravskoslezsko	14.23%	535600,00
ITD5	Emilia-Romagna	13.91%	1872400,00
CZ07	Střední Morava	12.75%	545400,00
CZ05	Severovýchod	12.52%	693900,00
ITD4	Friuli-Venezia Giulia	12.50%	503600,00
ITC4	Lombardia	12.37%	4193900,00
SE31	Norra Mellansverige	12.14%	376200,00
ITD3	Veneto	12.09%	2063200,00
CZ04	Severozápad	11.49%	502200,00
CZ06	Jihovýchod	11.33%	750600,00
ITC1	Piemonte	10.95%	1828800,00
ITE3	Marche	10.41%	634600,00

It should be noted that 5 of the 8 existing regions in the Czech Republic have unfavourable industrial structures in terms of energy purchases. When taking a closer look on how the Czech industries perform with regard to the EU average spending on energy purchases in each of the sectors, we find that even though the divergence is minor, special attention should be paid to the "Manufacture of other non-metallic mineral products", since energy purchases represent a considerable cost factor in this industry and the value of purchases is slightly higher than the EU median value.

Table N° 7 Performance of Czech Sectors with High Energy Purchases

Sectors with highest overall energy purchases CZ Czech Republic	Energy purchases as % of total purchases	Divergence from EU average spending
DG24 Manufacture of chemicals and chemical products	4.83%	0.92%
DI26 Manufacture of other non-metallic mineral products	9.71%	1.35%
DJ27 Manufacture of basic metals	5.51%	-1.22%
DJ28 Manufacture of fabricated metal products, except machinery and equipment	2.74%	0.26%
DK29 Manufacture of machinery and equipment n.e.c.	2.58%	1.24%

Source: Own elaboration based on Structural Business Statistics

In the case of Italy, this problem affects some of the largest regional production centres in the country, which, combined, represent close to 50% of total employment. It is necessary to remind that the selection of industries with high overall spending in Italy is quite different from the rest of the EU countries. The performance of these sectors is indicated in the table below:

Table N° 8 Performance of Italian Sectors with High Energy Purchases

Sectors with highest overall energy purchases IT Italy	Energy purchases as % of total purchases	Divergence from EU average spending
DH25 Manufacture of rubber and plastic products	3.85%	0.58%
DI26 Manufacture of other non-metallic mineral products	8.67%	0.31%
DJ27 Manufacture of basic metals	5.36%	-1.37%
DJ28 Manufacture of fabricated metal products, except machinery and equipment	2.79%	0.32%
DK29 Manufacture of machinery and equipment n.e.c.	1.53%	0.18%

Source: Own elaboration based on Structural Business Statistics

The good news is that energy purchases in four of these sectors in Italy are quite similar to the EU average, and in the case of "manufacture of basic

metals", spending on energy purchases is considerably lower, despite of the elevated energy prices in the country.

In the second group of regions, in which 7 – 10 % of employment depends on industries with high energy purchases, we find some belonging to countries that fare worse in the EU comparison of spending on energy purchases: Romania (Centru), and Hungary (Észak-Magyarország and Dél-Alföld), as well as Estonia and Latvia. Table nº 9 contains the employment data for the regions with the most unfavourable economic structure in terms of industrial energy spending.

The percentage of total employment in sectors with high energy spending can therefore be considered as an indicator of regional "economic vulnerability", which has been displayed graphically in Map Nº 1.

Map Nº 1 Regional Employment in Industries with High Energy Spending

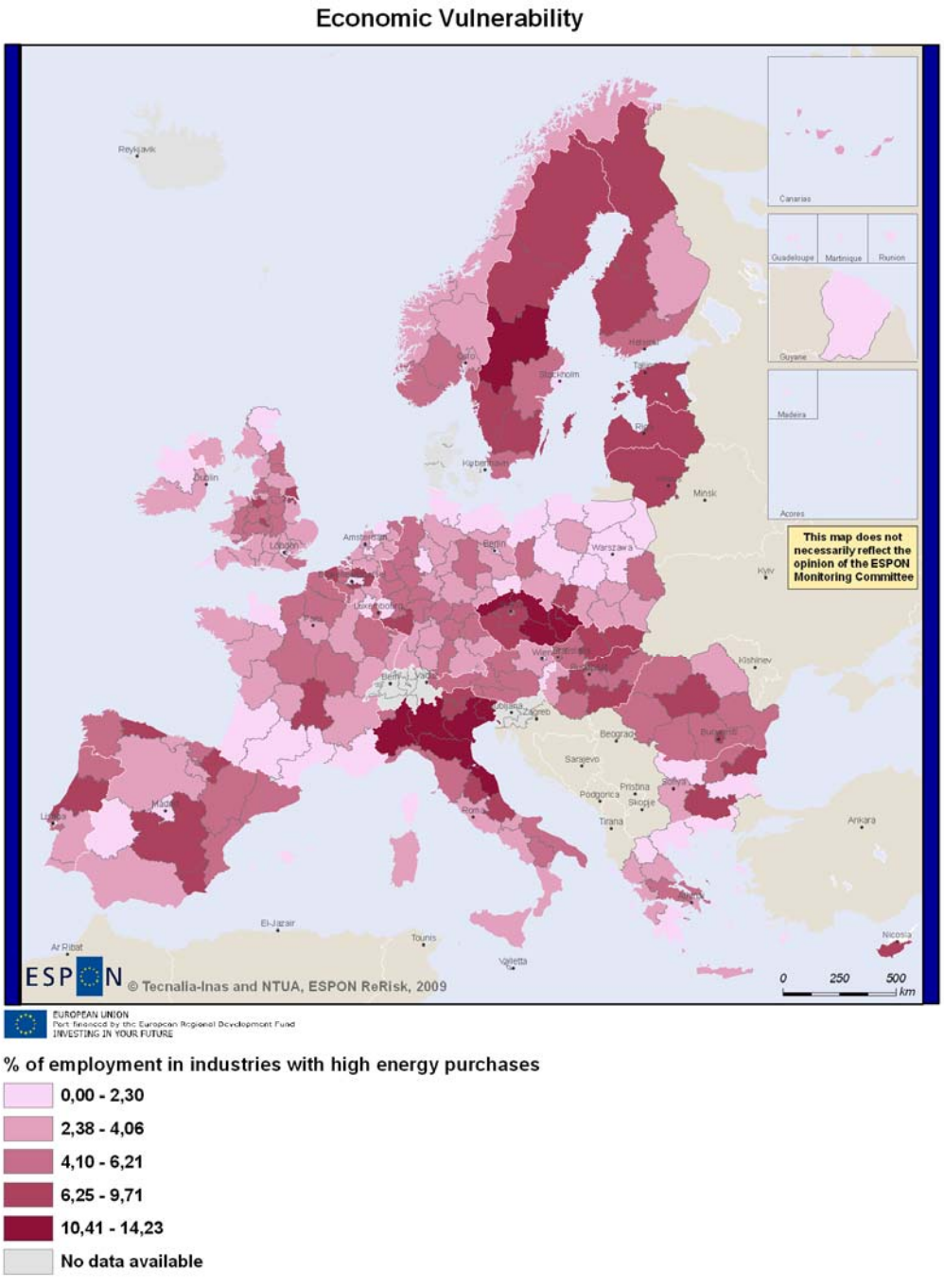


Table N° 9 Ranking of Regions by Total Employment in Sectors with High Energy Spending (Group 2)

NUTS Code	Region	Total employment 2005	Employment in industries with high energy purchases / total employment (%)
CZ03	Jihozápad	570500	9.71%
EE00	Estonia	607400	9.24%
CZ02	Střední Cechy	550600	9.19%
ES22	Comunidad Foral de Navarra	274400	9.05%
LV00	Latvia	1033700	8.95%
SE23	Västsverige	877800	8.88%
HU31	Észak-Magyarország	418700	8.76%
ITE2	Umbria	345500	8.72%
SE21	Småland med öarna	393100	8.44%
BG42	Yuzhen tsentralen	584900	8.16%
RO12	Centru	981500	8.14%
HU33	Dél-Alföld	487800	8.07%
BE21	Prov. Antwerpen	704500	7.87%
BG33	Severoiztochen	389300	7.80%
BE31	Prov. Brabant Wallon	144700	7.72%
BE25	Prov. West-Vlaanderen	486600	7.51%
ITF1	Abruzzo	492100	7.41%
LT00	Lithuania	1473900	7.40%
PT16	Centro (PT)	1273900	7.32%
ITD2	Provincia Autonoma Trento	216600	7.31%
ES42	Castilla-la Mancha	763700	7.30%
BE22	Prov. Limburg (B)	336700	7.27%
UKE1	East Yorkshire and Northern Lincolnshire	384500	7.25%
SK03	Stredné Slovensko	529600	7.24%
SE33	Övre Norrland	235200	7.13%

Source: Own elaboration based on Structural Business Statistics

3.5.2. Regional Gross Added Value in Industries with high energy spending

A second relevant aspect of regional competitiveness is the capacity of wealth creation, measured as Gross Value Added (GVA). By comparing the GVA produced in the five sectors with highest energy spending with the total GVA, we can identify a set of regions, which depend heavily on these industries. In the fourteen regions listed in the table below, more than 15% of GVA proceeds from sectors with high energy spending:

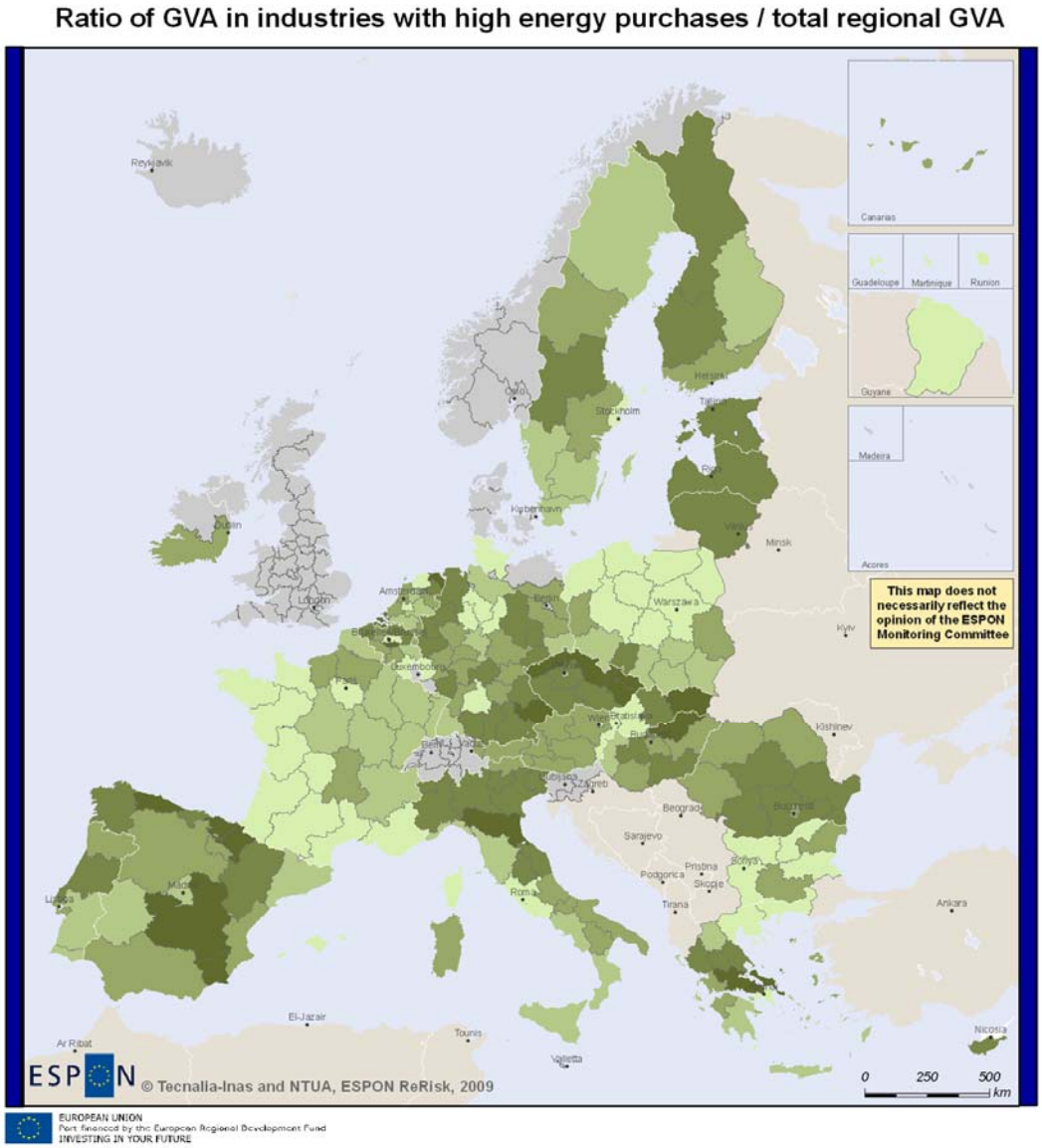
Table N° 10 Ranking of Regions by Gross-Added Value in Industries with High Energy Spending

NUTS2_2006	Region	GVA of industries with high energy spending / total regional GVA (%)
CZ08	Moravskoslezsko	25.13%
NL11	Groningen	22.36%
ES12	Principado de Asturias	21.02%
CZ04	Severozápad	20.37%
ES21	Pais Vasco	18.40%
ES22	Comunidad Foral de Navarra	17.82%
DE22	Niederbayern	16.84%
ES42	Castilla-la Mancha	16.76%
BE31	Prov. Brabant Wallon	16.44%
ITD5	Emilia-Romagna	16.25%
CZ07	Střední Morava	16.04%
GR24	Sterea Ellada	15.79%
NL34	Zeeland	15.71%
CZ05	Severovýchod	15.64%

Source: Own elaboration based on Eurostat data

There are some differences to the results on industrial employment, since in this case, three Spanish regions, which had not been identified in the employment analysis, reveal to depend heavily on industries with high energy spending: Asturias, the Basque Country and Navarre. Also, the Dutch provinces of Groningen and Zeeland, Niederbayern in Germany and the Greek Sterea Ellada show a high level of vulnerability to rising energy prices, due to their industrial structure.

Map N° 2 Regional GVA in Industries with High Energy Spending

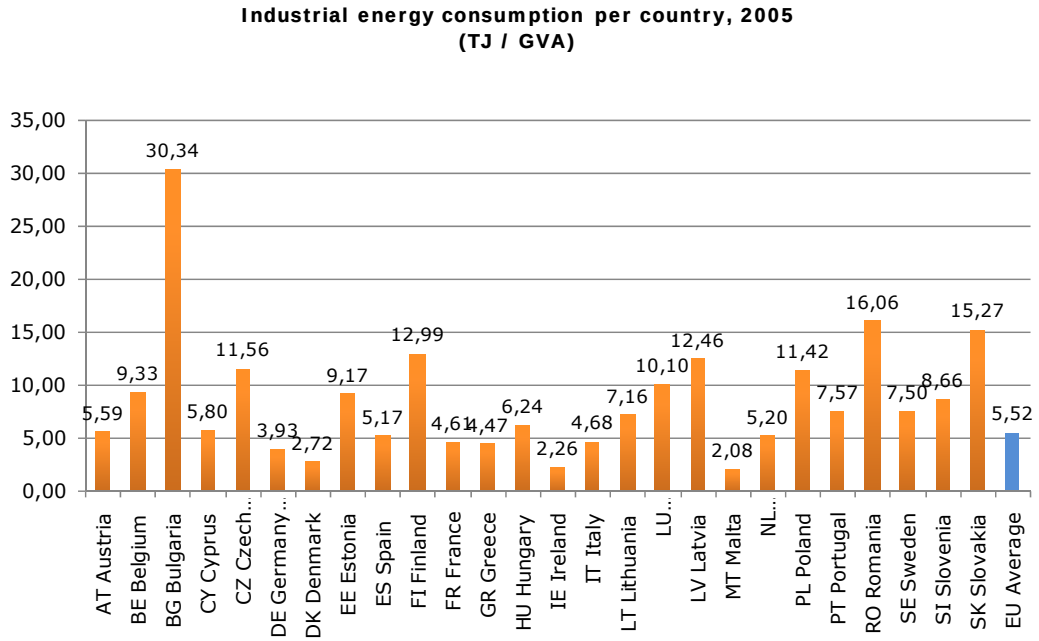


For further analysis, it is important to understand if high levels of industrial energy spending can be used as an indicator for actual industrial energy consumption in the regions and this can be checked by carrying out the statistical correlation analysis, as described in the next chapter.

3.5.3. Correlation between industrial energy consumption and energy purchases

The lack of comparable data on regional energy consumption has been one of the major obstacles for the ReRisk project. On national level, however, industrial energy consumption can be compared, relating it to gross value added (industrial output):

Graph N° 17 Comparison of Industrial Energy Consumption by Country



Source: Own elaboration based on Eurostat data

The available data on industrial energy consumption seems to confirm the hypothesis that energy is not efficiently used in at least four of the countries analysed here. We find that, after Bulgaria, Romania is the country that employs the largest amount of energy per million € of GVA (16.06 TJ), followed by Latvia (12.46 TJ), Luxembourg (10.10), Estonia (9.17 TJ) and Cyprus (5.80 TJ).

For the UK, France and Italy, we have been able to retrieve information on industrial consumption on NUTS 2 level, even though, in the case of Italy, the reference year is not 2005, but 2004. Establishing the same relation between industrial consumption, employment and GVA, we find a set of regions, in which this ratio is above EU-average, although, unfortunately, no regional data on GVA is available for the UK:

Table N° 11 Regional Industrial Energy Consumption and Employment in Industries with High Energy Spending

NUTS2_2006	NAME	GVA / Industrial energy consumption (Mill € / ktoe)	Employment in industries with high energy spending / manufacturing employment	Employment in industries with high energy spending / total employment	GVA in industries with high energy spending / total regional GVA
UKE1	East Yorkshire and Northern Lincolnshire	6.87	41.44%	7.2%	No data
FR63	Limousin	8.20	18.42%	2.48%	3.91%
UKD1	Cumbria	11.68	24.56%	3.20%	No data
UKC1	Tees Valley and Durham	11.90	39.36%	4.85%	No data
ITF4	Puglia	12.23	37.11%	5.37%	8.43%
UKL1	West Wales and The Valleys	13.15	30.99%	3.85%	No data
UKD2	Cheshire	14.07	47.26%	6.47%	No data
FR62	Midi-Pyrénées	16.08	13.85%	1.74%	2.68%
UKC2	Northumberland, Tyne and Wear	16.43	35.79%	4.33%	No data
UKM2	Eastern Scotland	16.51	26.22%	0.82%	No data
ITE2	Umbria	16.90	40.91%	8.72%	11.22%
UKL2	East Wales	17.14	36.11%	5.38%	No data
FR41	Lorraine	17.88	27.25%	4.29%	6.90%
FR23	Haute-Normandie	18.06	34.10%	5.41%	9.90%
ITD4	Friuli-Venezia Giulia	18.12	47.54%	12.50%	16.25%
UKH3	Essex	19.00	34.49	3.15%	No data
FR30	Nord - Pas-de-Calais	19.58	28.83	4.30%	6.91%

Source: Own elaboration based on Eurostat data and national statistics[14]

[14] **Francia**: Direction générale de l'énergie et du climat→ Les statistiques sur l'énergie →Base de donees PEGASE y Définitions, unités, équivalences→ http://www.industrie.gouv.fr/energie/statisti/f1e_stats.htm

Italia: Instituto Superiore per la Protezione e la Ricerca Ambientale →Banca dati indicatori ambientali-Annuario →Annuario dei dati ambientali-Edizione 2007 → http://annuario.apat.it/annuarioDoc.php

In table nº 11, regions are ranked by their capacity of wealth creation per industrial energy input (ktoe), indicating the worst performing regions. The median value for the French, British and Italian regions is 37,88 million € per ktoe, but Calabria, Lazio or Île de France achieve values far above 100 million €. The situation is especially complicated in regions, such as East Yorkshire and Northern Lincolnshire, Cheshire, Umbria or Friuli-Venezia Giulia, in which more than 5% of total employment and a considerable share of industrial employment depends on sectors with high energy spending.

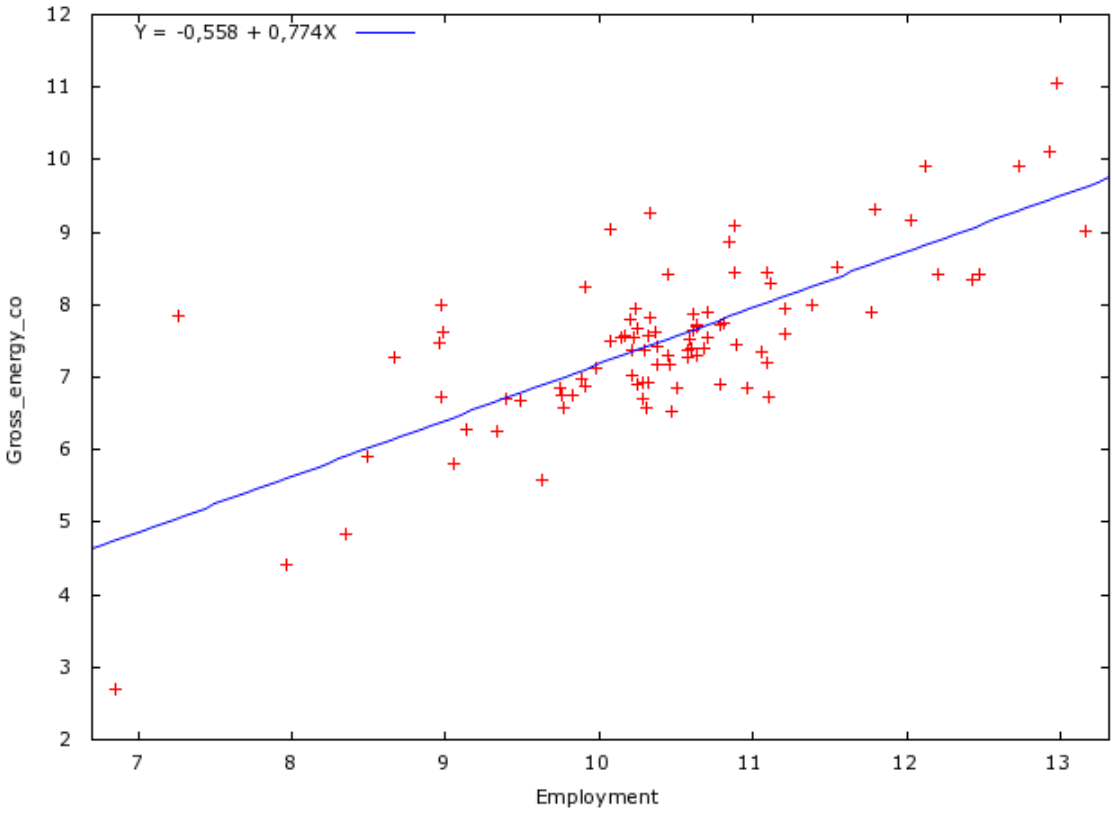
In the British and the Italian regions, there seems to be quite a clear relationship between industrial energy consumption and employment in industries with high energy spending, but this does not hold true for two of the French regions included in the list: Limousin and Midi-Pyrénées. Unless there is some error in the French data on industrial consumption, the exceptionally high values for these two regions should be further investigated.

Germany had to be analyzed separately, due to the fact that the consumption data available was compiled only for the Länder (NUTS 1), so that it is difficult to relate to the employment data and GVA on NUTS 2 level. Nevertheless, we find a clear correlation between employment in industries with high energy spending and the percentage of national consumption which corresponds to each Land (NUTS 1). Detailed information on the German industrial consumption can be found in Annex III.

By applying an OLS (Ordinary Least Squares) analysis to the combined data on energy consumption and employment for the Germany, Italy, France and UK, it can be demonstrated that there is a high correlation between these two values. However, the analysis should be completed with additional information on actual energy consumption in EU regions, before estimating industrial energy consumption for all regions in the EU 27.

UK: Department for Business Enterprise and Regulatory Reform (BERR)→ Energy →Statistics →Regional Consumption Statistics→ http://www.berr.gov.uk/energy/statistics/regional/total-final/page36187.html/statistics/regional/total-final/page36187.html

Graph N° 18 Correlation Analysis between Regional Energy Consumption and Employment in Industries with High Energy Spending



Source: Own elaboration based on national statistics

3.6. Usefulness of Results for Regional Policy-Making

By combining the results of this sequence of analysis on industrial energy spending, wealth creation and regional employment, it is possible to identify those industrial processes, which should be subject to an in-depth analysis on regional level, with the objective of reducing energy consumption and, therewith, the industry's vulnerability to rising energy prices. Some examples can be given for the regions with the most unfavourable industry structure in Italy, the Czech Republic and Hungaria.

In the above-mentioned Italian regions of Emilia-Romagna, Lombardia, and Veneto, special attention should be paid to the manufacture of cement (NACE class DI2651), since in this branch, energy purchases represent more than 30% of total purchases and energy spending is almost 10% higher than the EU average. A second critical sector is the "Manufacture of glass fibres" (DI2614), in which more than 18% of purchases are dedicated to energy and energy spending is 8.6% above the average level of spending in the EU. The sector of "Manufacture of other non-metallic mineral products", to which both cement production and manufactured of glass fibres belong, employs more than 30,000 people in Lombardia and Veneto and more than 46,000 in Emilia-Romagna. Although cement production is regionally oriented and is therefore not exposed to international competition, analysing energy use in this industry may help to reduce the elevated level of industrial consumption in these regions:

Table N° 12 Employment and Industrial Energy Consumption in Italian Regions

Region	Employment in Sectors with High Energy Spending (nº of persons)					Industrial Energy consumption 2004 (in toe)
	DG24 - Manufacture of chemicals and chemical products	DI26 - Manufacture of other non-metallic mineral products	DJ27 - Manufacture of basic metals	DJ28 - Manufacture of fabricated metal products, except machinery and equipment	DK29 - Manufacture of machinery and equipment n.e.c.	
ITC1 Piemonte	13,307	13,947	13,192	78,140	67,035	4.544,2
ITC4 Lombardia	95,949	32,600	48,690	20,2514	16,2037	8.140,7
ITD3 Veneto	13,178	32,731	13,023	97,064	81,240	4.226,6
ITD 4 Friuli-Venezia Giulia	1,967	6,369	5,083	20,450	26,439	1.563,9
ITD 5 Emilia-Romagna	13,532	46,227	7,645	84,930	102,532	4.572,3
ITE 3 Marche	3,397	6,300	2,242	24,109	24,220	838,5
ITF 4 Puglia	1,503	10,763		23,922	10,993	4.621,9

Source: Own elaboration based on Eurostat data and national statistics

In the Czech region of Severovýchod, processes in the "Manufacture of other non-metallic mineral products" should be analyzed, since energy spending in this sector is 10% above EU average on national level and companies in this branch employs 21,564 persons in Severovýchod. Moravskoslezsko has a very high level of employment (28,388 persons) in the basic metals industry and should pay special attention to processes related to "Forging, pressing, stamping and roll forming of metal; powder metallurgy" (DJ284), for which energy spending is about 5% higher than the EU average and represents 7.65% of total purchases. The region consumes 88% of all hard coal used in the Czech Republic and also ranks high in electricity consumption, confirming again the correlation between regional energy spending and consumption15. Additionally, Moravskoslezsko ranks first with regard to wealth creation in sectors with high energy-spending, with more than 25% of regional GVA proceeding from these industries.

All of the above-mentioned regions in the Czech Republic (Moravskoslezsko, Střední Morava, Severovýchod, Severozápad and Jihovýchod) should analyze the performance of one branch of the chemical industry (DG2411 Manufacture of industrial gases), since energy spending in this sector is 10% above EU average and energy represents close to 20% of total purchases. Employment levels in the chemical sector range from 4,225 in Moravskoslezsko to 7,943 in Severozápad.

In the case of Hungary, decision-makers from Észak-Magyarország should take a close look at the "Manufacture of fertilizers and nitrogen compounds" (DG2415), since, on national level, this industry spends 40% more on energy purchases than the industry on EU average and energy purchases amount to almost 60% of total purchases. Észak-Magyarorszá ranks second among the Hungarian regions in employment in the chemical sector (6,215 employees), after Közép-Magyarország with 15,073 employees. Differences in energy spending with regard to Europe are also considerable in the "Manufacture of starches and starch products" (DA1562; >12%) and this may especially affect the region of Dél-Alföld, where 25,444 persons work in the food-processing industry.

The data collected here therefore permits to identify potential weaknesses in regional economies derived from higher than average levels of energy spending and therefore may shed some light on the hitherto obscure question of industrial energy use in the European regions.

[15] The Czech data on regional energy consumption is organized by fuel consumed, not by uses (industrial, household, etc.)

3.7. Transport Dependence

3.7.1. Methodology

Eurostat compiles a series of statistics on regional transport and mobility, some of which have been useful to estimate the transport-dependence of the regional economies. The available data has been related either to the total population or total employment in order to obtain comparable values for the regions, but it has not been necessary in this case to derive indicators from national values.

The following indicators have been considered most appropriate for the ReRisk project:

1. Employment in the transport sector as % of total employment
2. Spending on transport fuel for freight as % of GDP
3. Population commuting to other regions / population working in the same region
4. Age of car park
5. Nº of passengers travelling by air / total population

Data is, however, again incomplete, in most cases. There are considerable gaps in the regional employment figures on some of the transport subsectors in many countries. Commuting can not be tracked in Denmark, Slovenia and Switzerland, Scotland and the Greek island regions (with very few exceptions). Air travel data is available for all EU member states, plus Switzerland and Norway. The age of the car park is presented for some countries on NUTS 2 level and for others on NUTS 1 (for example Germany and the UK), and we decided to combine the available statistics, since the size of the region should not have major relevance in this case.

It should be noted that the data on commuting will be weighted as part of the clustering exercise by the regional surface in order to estimate the distances travelled in each region.

3.7.2. Results

3.7.2.1. Regional employment in the transport sector

Employment in the transport sector may be as affected by rising energy prices as jobs in energy-intensive industries. Also, these figures complete the screening of the regional economies presented above and will be useful for the clustering exercise to be carried out later.

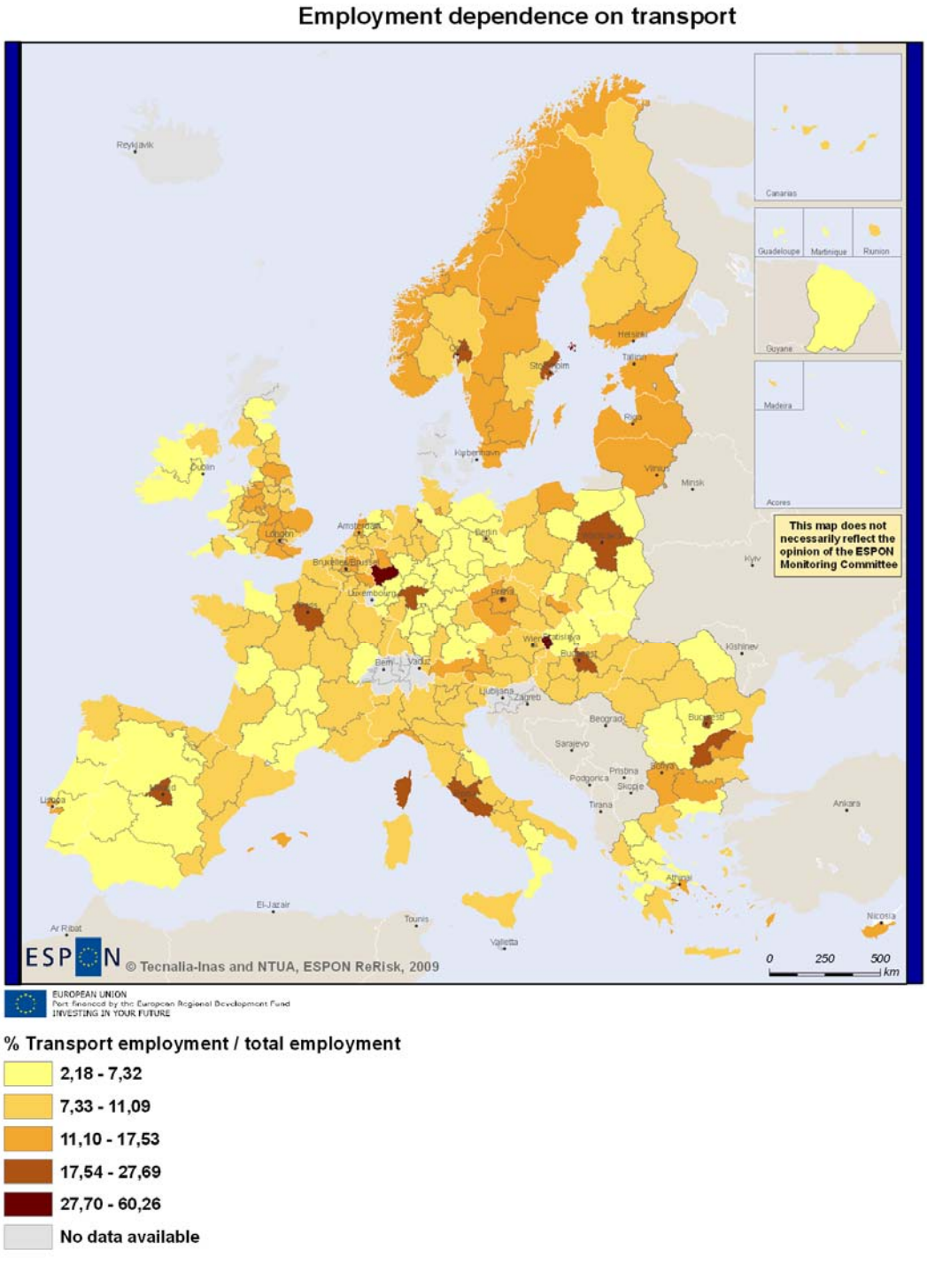
Table N° 13 Ranking of Regions by Employment in Transport Sector

NUTS2_2006	NAME	Transport employment / total employment (%)
FI20	Åland	60.26 %
DEA2	Köln	45.78 %
SK01	Bratislavský kraj	38.22 %
FR10	Île de France	27.69 %
BE10	Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest	26.07 %
ES30	Comunidad de Madrid	25.45 %
DE50	Bremen	25.25 %
DE71	Darmstadt	24.20 %
PL12	Mazowieckie	24.09 %
UKI1	Inner London	23.88 %
CZ01	Praha	23.64 %
HU10	Közép-Magyarország	23.60 %
FR83	Corse	21.24 %
ITE4	Lazio	21.22 %
NO01	Oslo og Akershus	20.66 %
RO32	Bucuresti - Ilfov	20.05 %

Source: Own elaboration based on Eurostat data

The employment statistics neatly identify the regions specialized in logistics, such as Cologne, and the large centres of freight and passenger transport in Europe (Île de France, Madrid, Darmstadt and Inner London). Special attention should be paid to the two island regions with high employment rates in transport: Åland and Corse.

Map Nº 3 Employment Dependence on Transport



3.7.2.2. Spending on transport fuel for freight

The importance of transport within the regions can also be measured by the spending on fuel for freight transport and this has been done recently by DG Regio for the Regions 2020 study. [16]

Table N° 14 Regional Spending on Transport Fuel

NUTS 2003/ 2006	Region	Fuel cost 2005 (mill €)	Fuel costs as % of GDP 2005
BG32	Severen tsentralen	300,802977	14.22 %
BG34	Yugoiztochen	246,216121	8.18 %
PL33	Swietokrzyskie	492,560081	7.99 %
BG33	Severoiztochen	175,777345	7.16 %
BG42	Yuzhen tsentralen	226,656897	6.72 %
PL43	Lubuskie	388,883406	6.67 %
PL34	Podlaskie	375,076895	6.59 %
BG31	Severozapaden	132,823754	6.39 %
CZ02	Střední Cechy	650,82361	6.27 %
ES62	Región de Murcia	1439,5845	6.13 %
PL62	Warminsko-Mazurskie	413,683992	5.91 %
ES42	Castilla-la Mancha	1775,67078	5.69 %
PL52	Opolskie	313,331108	5.63 %
ITF1	Abruzzo	1444,18667	5.62 %
CZ04	Severozápad	487,830072	5.55 %
PL61	Kujawsko-Pomorskie	615,795979	5.33 %
CZ07	Střední Morava	499,335498	5.31 %
RO11	Nord-Vest	502,53145	5.25 %
PT16	Centro (PT)	1451,47344	5.11 %
PL31	Lubelskie	484,63412	5.08 %
PL41	Wielkopolskie	1156,42317	5.01 %
PL32	Podkarpackie	463,540839	5.00 %

Source: Own elaboration based on data facilitated by DG Regio

As can be seen from the ranking, fuel costs are a major concern for the Polish and Bulgarian regions, but also for two agricultural areas of Spain with high export levels: Murcia and Castilla-la Manche.

[16] European Commission (2008): *Commission Staff Working Document: Regions 2020. An assessment of future challenges for EU regions*. European Union-Regional Policy

3.7.2.3. Commuting in the regions

With respect to commuting, extreme differences between the European regions can be observed, as shown in table nº 15.

Table N° 15 Commuting between Regions

Region	Working in the region (1000 persons)	Working outside the region (1000 persons)	Persons working outside the region / inside the region (%)
BE31 Prov. Brabant Wallon	71,7	73	98.22 %
UKI2 Outer London	938,8	1214,6	77.29 %
BE24 Prov. Vlaams Brabant	197,4	270,7	72.92 %
NL23 Flevoland	62,8	103,6	60.62 %
AT11 Burgenland (A)	42,3	83,5	50.66 %
DE93 Lüneburg	235,6	487,4	48.34 %
BE35 Prov. Namur	55,1	122	45.16 %
BE34 Prov. Luxembourg (B)	31,6	70	45.14 %
UKH2 Bedfordshire, Hertfordshire	221,3	595,3	37.17 %
AT12 Niederösterreich	195	537,3	36.29 %
DE41 Brandenburg - Nordost	126,4	365,5	34.58 %
UKG1 Herefordshire, Worcestershire and Warks	159,5	472	33.79 %
BE23 Prov. Oost-Vlaanderen	147,8	462,9	31.93 %
UKD2 Cheshire	117,4	369,2	31.80 %
DE42 Brandenburg - Südwest	149,1	471,9	31.60 %
UKH2 Bedfordshire, Hertfordshire	221,3	595,3	37.17 %

Source: Own elaboration based on Eurostat data

Mobility related to work is extremely high in four Belgian regions and in the outskirts of London, where the City concentrates the major part of the employment. A special need for commuting is also present in more rural regions, such as Burgenland and Lüneburg, with economic centres at reasonable distance (Vienna, Lower Austria or Styria, in the case of Burgenland and Hamburg, Bremen and Hannover in the case of Lüneburg).

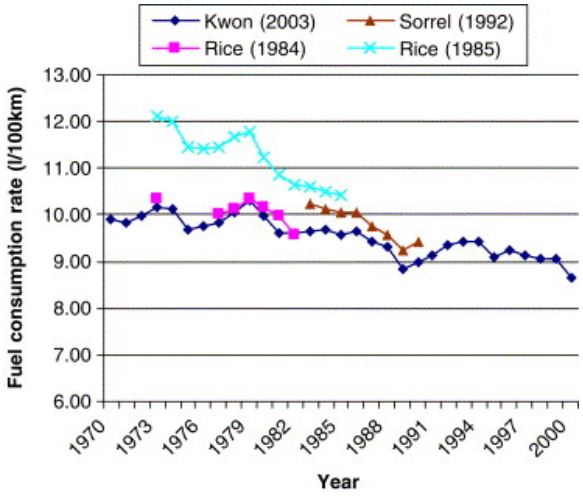
The results are very similar if we compare the number of commuters to the total population, which indicates that activity rates are similar in these regions. They are slightly higher in the UK, so Outer London and Bedfordshire

occupy higher places in the ranking, and Essex enters the list of regions with greater mobility associated to work.

3.7.2.4. Age of regional car parks

The age of car park is the next indicator useful for the analysis on energy poverty in the regions, since car efficiency has improved over the last decades. According to British data, efficiency in petrol cars from 1970 to 2000 improved continuously, with major progress after the 1970's oil shock.

Graph N° 19 Development of Fuel Efficiency in Petrol Cars 1970 - 2000



Source: Kwon 2005[17]

Not surprisingly, the oldest car parks are found in the Eastern Countries, with Latvia, the Polish regions, Estonia and the Czech Republic heading the list, according to quite recent data (2007, in most cases).

Table N° 16 Age of Regional Car Parks (Group 1)

NUTS 1 and 2	Region	Age of car park (in years)	Year of data collection
LV00	Latvia	16,17	2007
PL42	Zachodniopomorskie	14,39	
PL43	Lubuskie	14,38	
PL51	Dolnoslaskie	14,21	
PL52	Opolskie	13,74	
PL11	Lódzkie	13,71	2003
EE00	Estonia	11,63	Jan. 2007
CZ0	Czech Republic	10,9	2007

[17] Kwon, Tae-Hyeong (2005), *The determinants of the changes in car fuel efficiency in Great Britain (1978–2000)*, Energy Policy Volume 34, Issue 15, October 2006, Pages 2405-2412

The second group of regions, in which the age of the car park ranges from 8 to 10 years, comprises numerous Dutch provinces, some of the German Länder (and not necessarily from the Eastern part of the country), as well as three Norwegian regions:

Table N° 17 Age of Regional Car Parks (Group 2)

NUTS 1 and 2	Region	Age of car park (in years)	Year of data collection
CY00	Chypre	9,79	2007
NL42	Limburg (NL)	9,2	
NO02	Hedmark og Oppland	9,15	
DK0	Danemark	9,1	2007
NO07	Nord-Norge	8,93	
NL12	Friesland	8,73	
MT00	Malte	8,68	31.12.2003
NL11	Groningen	8,61	1.1.2007
NL34	Zeeland	8,57	
NO06	Trøndelag	8,4	
DE4	Brandenburg	8,3	
NL13	Drenthe	8,29	
NL21	Overijssel	8,26	
NL22	Gelderland	8,25	
DE3	Berlin	8,2	
DE9	Niedersachsen	8,2	
DEB	Rheinland-Pfalz	8,2	
DE1	Baden-Württemberg	8,1	1.1.2008
DE5	Bremen	8,1	
DEF	Schleswig-Holstein	8,1	
DEA	Nordrhein-Westfalen	8	
DEC	Saarland	8	
NO03	Sør-Østlandet	8	

Source: Own elaboration based on Eurostat data

It should be mentioned that the newest car parks are also found in Norway and the Netherlands: Oslo og Akershus (4.7 years) and Flevoland (4.86 years). Ireland and Scotland also have quite modern car parks, with a median age of about 6 years.

These findings imply that the efficiency gains that can be obtained by the modernization of the car park will be greater in the Polish regions than, for example, in Ireland and Scotland, as long as the saving in litre per km are not offset by greater travel distances and a higher number of trips.

3.7.2.5. Importance of air travel in the regions (passengers)

Statistics on air travel are relevant in this context because they describe the specific problems of island regions, which may be affected by rising energy prices in a double way: on the one hand, the costs of imports and exports increase, and, on the other, tourist-oriented islands could experience reduced income from this economic activity.

Table Nº 18 Regional Air Travel (Passengers), 2005

NUTS 2006	Region	Nº of passengers / total population (%)
ES53	Illes Balears	28.60 %
GR42	Notio Aigaio	19.44 %
CH03	Nordwestschweiz	17.54 %
NL32	Noord-Holland	16.93 %
ES70	Canarias (ES)	15.78 %
BE24	Prov. Vlaams Brabant	15.32 %
UKI2	Outer London	15.00 %
GR22	Ionia Nisia	14.85 %
DE71	Darmstadt	13.71 %
UKH3	Essex	13.27 %
UKJ2	Surrey, East and West Sussex	12.58 %
NO01	Oslo og Akershus*	12.21 %
PT15	Algarve	11.47 %
GR43	Kriti	10.73 %
AT12	Niederösterreich	10.03 %
SE11	Stockholm	10.00 %
PT30	Região Autónoma da Madeira (PT)	9.66 %
CZ 01	Praha	9.11 %
CY00	Cyprus*	8.94 %
UKD3	Greater Manchester	8.68 %
FR83	Corse	8.33 %

NUTS 2006	Region	Nº of passengers / total population (%)
IE02	Southern and Eastern	7.74 %
NO07	Nord-Norge*	7.40 %
IS00	Iceland	7.11 %
ES30	Comunidad de Madrid	7.09 %

Source: Own elaboration based on Eurostat data

The ranking in table Nº 18 also comprises the regions, in which the major European airports are located and some of the most peripheral areas in Europe.

The costs of commuting or those associated to other car uses directly affects the budget of households, while increased costs for freight in the region will affect the general price level of goods, with further negative effects on available income. Additionally, households will have to face higher heating and electricity bills, so that the total energy expense may become a serious burden for families, which already struggle to make ends meet, due to low income or high indebtedness. This third dimension of "energy poverty" will be addressed in the next chapter.

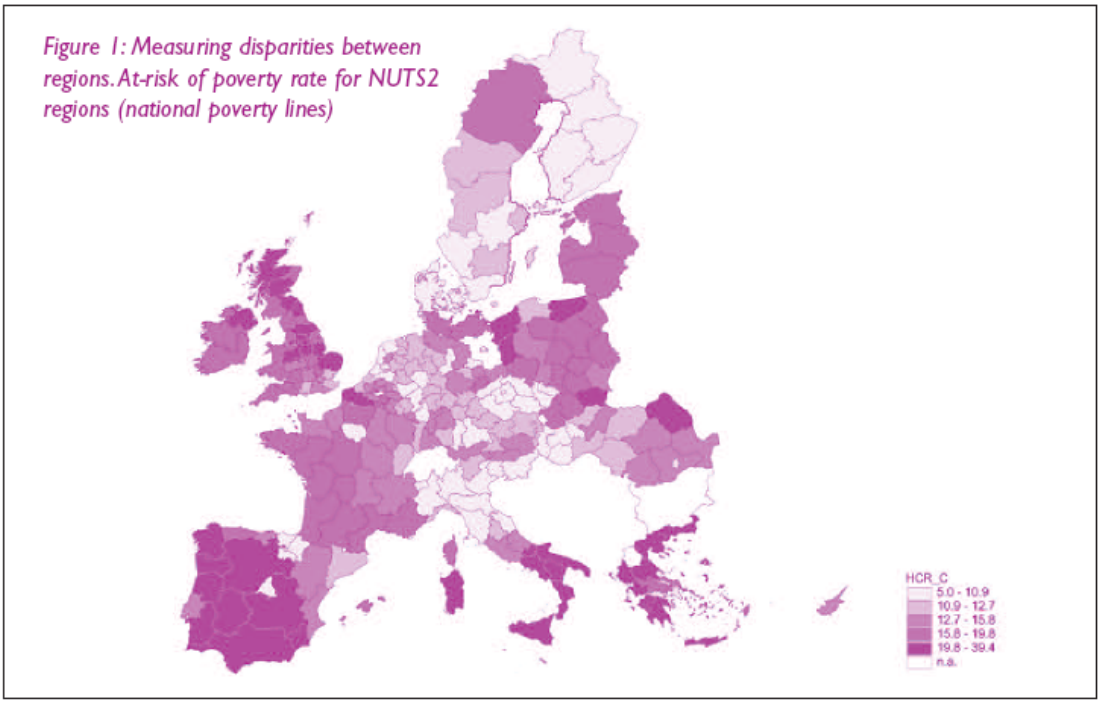
3.8. The Social Dimension of Energy Poverty in the Regions

3.8.1. Methodological Approach

The poverty indicator presented here has been compiled by using a set of indicators, which are the cause of poverty[18], according to research carried out on national level. It has been necessary to combine several indicators, since there is no single explanation why households slide into poverty, as explained in detail below.

Some pioneering work for defining the right indicators for measuring poverty on **regional level** has been done for the Community Action Programme on Social Exclusion[19], showing that there is a need for measuring poverty not only with respect to the national poverty lines, but also within the NUTS 2 regions.

Map N° 4 At-Risk-of-Poverty-Rate for NUTS 2 (national poverty lines)



Source: Community Action Programme on Social Exclusion (2005), "Regional indicators to reflect social exclusion and poverty", Policy Studies Findings, European Commission, Directorate for Employment and Social Affairs

[18] European Commission Directorate-General for Employment, Social Affairs and Equal Opportunities / Eurostat (2006), "The social situation in the European Union 2005-2006"

[19] Lemmi, A. et al (2003), "Regional Indicators to reflect social exclusion and poverty VT/2003/43, Final Report". European Commission, Directorate-General for Employment, Social Affairs and Equal Opportunities

The study carried out by researchers from the University of Siena recommends "using regional poverty rates with national and regional poverty lines as two separate indicators (see map nº 4 and 5). Interestingly, this illustrates that specific regions, such as capital city areas (Paris, Madrid), appear to count fewer poor people in relation to the national poverty line, but are characterised by greater inequalities within the region itself.

Map N° 5 At-Risk-of-Poverty-Rate for NUTS 2 (regional poverty lines)

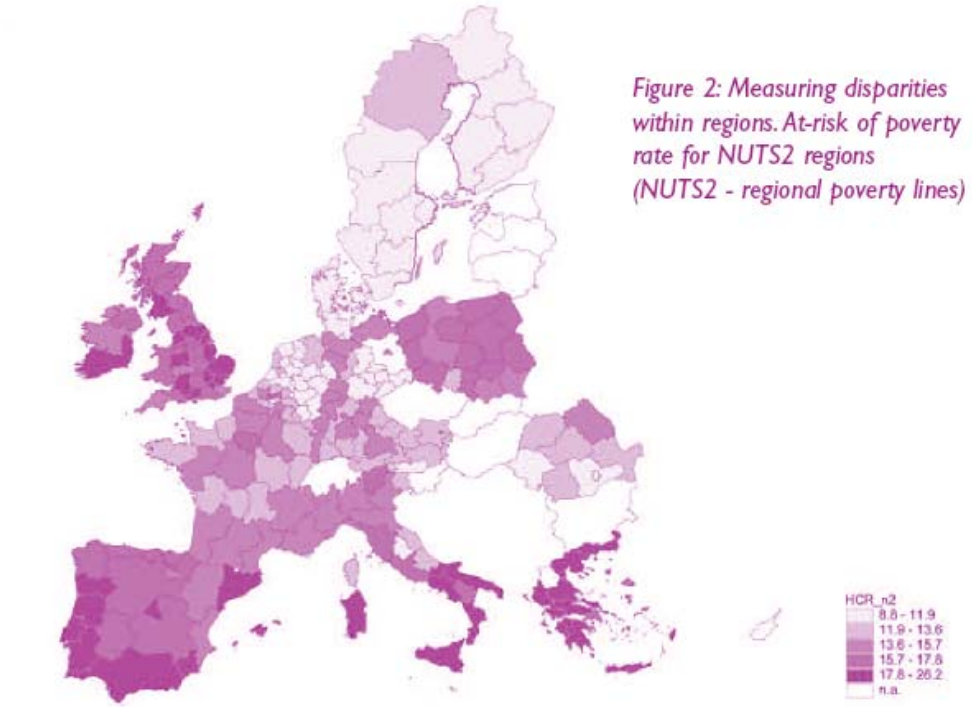


Figure 2: Measuring disparities within regions. At-risk of poverty rate for NUTS2 regions (NUTS2 - regional poverty lines)

Source: Community Action Programme on Social Exclusion (2005), "Regional indicators to reflect social exclusion and poverty", Policy Studies Findings, European Commission, Directorate for Employment and Social Affairs

The extensive calculations carried out in the context of the abovementioned study could not be reproduced in the more limited scope of the ReRisk project. Instead, the data behind the at-risk-of-poverty rate has been analyzed in detail on national level, based on Eurostat data from 2003 / 2004, with the following results:

Unemployment, although important, can not fully explain the poverty level, because 27% of the poor population in Europe is working. In the Eastern Countries, the number of "working poor" tends to be much higher, for example, 44% in Lithuania. The unemployed only make up 12% of the poor population in the EU 27, although this percentage is much higher (above 30%) in the Czech Republic or Denmark. The different forms of "inactivity"

(unemployed, retired and other inactivity), however, have a strong influence on the risk of poverty, as 73% of the poor population in Europe is affected by this situation.

Both, unemployment and activity level can be measured directly by available indicators, and can be completed with the old-age dependency ratio, which highlights the percentage of older people whose well-being depends on the generation that is presently active in the labour market.

Finally, data on available income in the regions can be used to assess the overall "richness" of the population and their capacity to promote social justice.

This was the set of indicators used for analysing the vulnerability of regions in social terms:

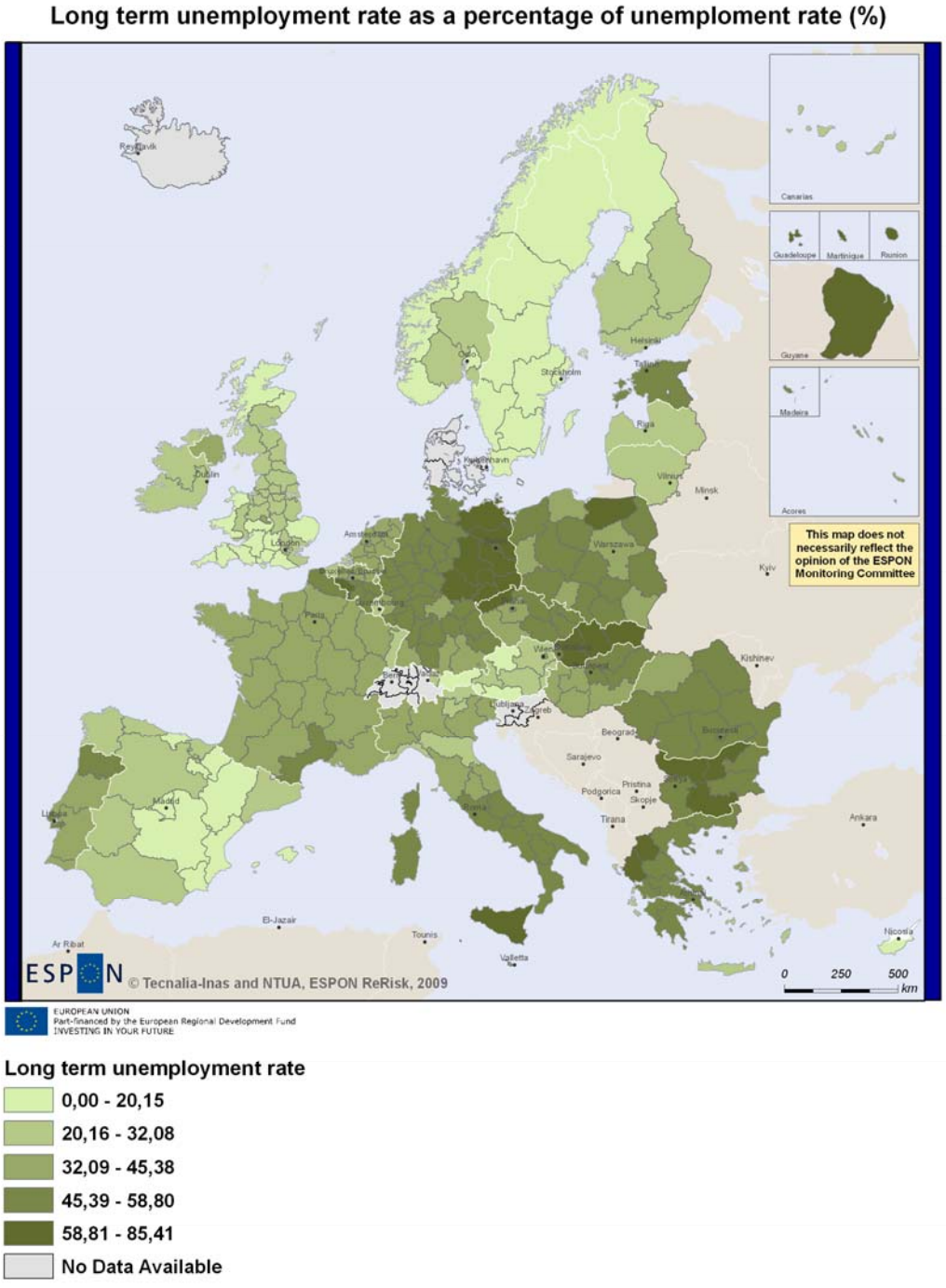
1. Long term unemployment at NUTS 2 level
2. Activity rate at NUTS 2 level
3. Old-age dependency ratio on NUTS 2 level
4. Disposable income in power purchase parities, NUTS 2 level

3.8.2. Results

In 2007, 16 regions in Europe, plus the French overseas territories, had a long-term unemployment rate above 60% (of total unemployment). The list comprises a number of regions in Eastern Germany, as well as three regions in Bulgaria and two of the four Slovakian regions: Stredné Slovensko and Západné Slovensko.

Map N° 6 Regional Long-term Unemployment Rates, 2007

(% of total unemployment)



Map Nº 6 clearly shows strong spatial inequalities in the long term unemployment rate. Structural problems are greatest in the Eastern and Southern extremes of Europe, and on the islands.

Table Nº 19 Regions with the Highest Long-term Unemployment

NUTS 2006	Region	Long-term unemployment rate 2007 (%)
FR92	Martinique (FR)	85.41 %
FR91	Guadeloupe (FR)	80.75 %
SK04	Východné Slovensko	79.47 %
FR94	Reunion (FR)	75.18 %
SK03	Stredné Slovensko	74.84 %
SK02	Západné Slovensko	69.75 %
FR93	Guyane (FR)	67.02 %
BG42	Yuzhen tsentralen	65.39 %
DED3	Leipzig	65.37 %
BG31	Severozapaden	65.34 %
BG32	Severen tsentralen	65.22 %
DED1	Chemnitz	64.55 %
DEE0	Sachsen-Anhalt	64.07 %
DEG0	Thüringen	63.92 %
DE30	Berlin	63.17 %
GR13	Dytiki Makedonia	62.97 %
DE50	Bremen	61.99 %
CZ04	Severozápad	61.06 %
ITG1	Sicilia	60.87 %
BE32	Prov. Hainaut	60.78 %
DE80	Mecklenburg-Vorpommern	60.75 %

Source: Own elaboration based on Eurostat data

Activity rates below 50% are frequent in the Southern regions in Italy, and in four regions in Hungary: Észak-Magyarország, Észak-Alföld, Dél-Alföld and Dél-Dunántúl. Severozapaden in Bulgaria also belongs to the group of regions with the lowest level of economic activity (less than 43%) and another three regions from this country (Severen tsentralen, Severen tsentralen and Yuzhen tsentralen) follow closely. A bit further down in the ranking we find three Greek regions (Voreio Aigaio, Ipeiros, Dytiki Makedonia

and Dytiki Ellada). Corse, Asturias in Spain and the Belgian region of Hainaut have considerably lower activity levels than the rest of the regions in these countries and stay far behind of the, mainly Nordic, regions, in which activity rates climb to 70 - 80%.

Table N° 20 Regions with the Lowest Rates of Economic Activity

NUTS 2006	Region	Economic Activity Rate, 2005 (%)
ITF6	Calabria	41.7
ITF4	Puglia	42.1
ITG1	Sicilia	42.1
BG31	Severozapaden	42.9
ITF3	Campania	42.9
ITF2	Molise	43.0
ITF5	Basilicata	43.8
HU31	Észak-Magyarország	45.0
HU32	Észak-Alföld	45.6
ITC3	Liguria	46.7
FR83	Corse	46.9
GR41	Voreio Aigaio	47.2
HU33	Dél-Alföld	47.3
BG32	Severen tsentralen	47.4
ES12	Principado de Asturias	47.7
HU23	Dél-Dunántúl	47.7
ITF1	Abruzzo	47.8
ITG2	Sardegna	48.1
GR21	Ipeiros	48.2
BG34	Severen tsentralen n	48.3
BG42	Yuzhen tsentralen	48.8
GR13	Dytiki Makedonia	49.0
FR92	Martinique (FR)	49.2
ITE2	Umbria	49.2
BE32	Prov. Hainaut	49.3
MT00	Malta	49.5
GR23	Dytiki Ellada	49.9

Source: Own elaboration based on Eurostat data

Low activity rates can be explained by a high proportion of elderly people in a region (ageing), who may or may not be exposed to the risk of poverty, depending on the level of pensions in each country. Theoretically, it could also be negatively influenced by a large percentage of young people still in education, but this situation is not relevant in the EU 27. It should be noted here that with the exception of Cyprus, the elderly are generally less at risk in the new Member States than they are in the former EU 15 countries[20]. A third factor influencing the activity rate decisively is the percentage of women in the labour market. With regard to the risk of poverty, labour

[20] **European Commission** Directorate-General for Employment *op cit(

conditions for female workers are decisive, because they define the right to and the level of pension payments. Poverty levels are known to be considerably higher among elderly women then elderly men[21], but this gender division cannot be documented on regional level. What can be analysed is the non-gender specific age dependency ratio:

Table N° 21 Regions with the Highest Age Dependency Ratio

NUTS 2006	Region	Age Dependency Ratio 2005, %
ITC3	Liguria	42,38
FR63	Limousin	36,99
ITE2	Umbria	36,15
PT18	Alentejo	35,78
ITE1	Toscana	35,69
GR25	Peloponnisos	35,13
ITD5	Emilia-Romagna	34,94
ITE3	Marche	34,65
ES41	Castilla y León	34,25
GR41	Voreio Aigaio	34,03
ITC1	Piemonte	33,76
ITD4	Friuli-Venezia Giulia	33,69
ITF2	Molise	33,63
GR21	Ipeiros	33,45
BG31	Severozapaden	32,75
UKK2	Dorset and Somerset	32,43
DED1	Chemnitz	32,30
FR53	Poitou-Charentes	32,23
ITF1	Abruzzo	32,19
GR22	Ionia Nisia	32,13
ES12	Principado de Asturias	32,03
SE32	Mellersta Norrland	31,81
GR24	Sterea Ellada	31,72
ES11	Galicia	31,49
FR72	Auvergne	31,43
ES24	Aragón	31,37
SE31	Norra Mellansverige	31,32
GR13	Dytiki Makedonia	30,96
GR14	Thessalia	30,79
FR26	Bourgogne	30,66
BE25	Prov. West-Vlaanderen	30,43
PT16	Centro (PT)	30,41
UKK3	Cornwall and Isles of Scilly	30,40
GR11	Anatoliki Makedonia, Thraki	30,28
DEC0	Saarland	30,05
FR61	Aquitaine	30,00

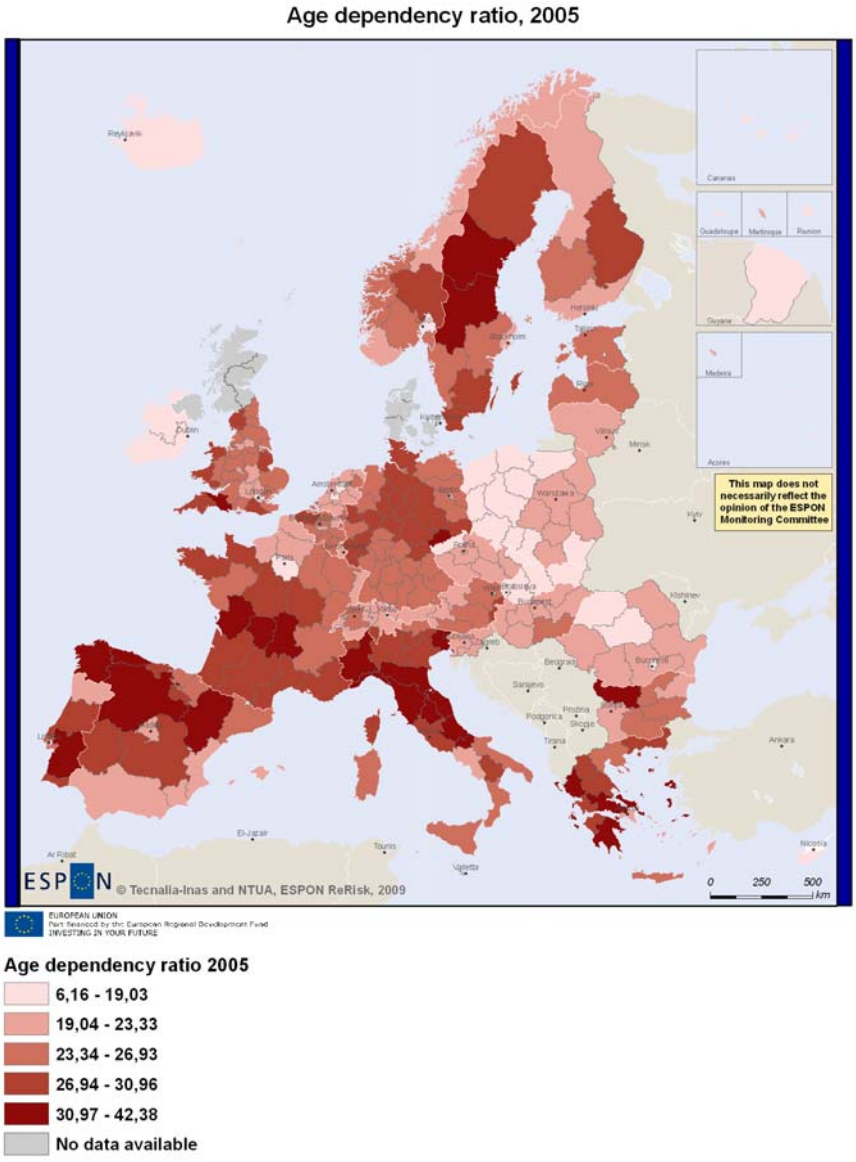
Source: Own elaboration based on Eurostat data

It is easy to see that there is a strong correlation between the economic activity rate and the old-age dependency ratio, which confirms the

[21] **European Commission** Directorate-General for Employment *op cit(

problematic situation in many of the Italian and some of the Greek regions. However, the selection of "ageing" regions also covers a number of French and two German regions, in which the activity rate has not yet plummeted so low. Saarland, Chemnitz, but also Aquitaine and Bourgogne in France or Alentejo in Portugal have activity rates in the range of 50 to 60%, which means that the negative effects of the population ageing are softened by a higher proportion of women in the labour market.

Map N° 7 Age Dependency Ratio, 2005



Source: Own elaboration based on Eurostat data

In terms of income, there is a strong East-West divide in the EU 27, even taking into account differences in consumer prices. The poorest region is North East Romania, with an average income per capita of 3146 ppp, while the richest is Hamburg (22102,7 ppp). This means that people living in the poorest region in Romania only earn 14% of the average income in Hamburg, whereas differences in electricity prices for households, for example, are much smaller. According to data from 2007, the average electricity price for households in Romania was 11.41 € / 100 kWh, while a German household pays an average price of 21.05 € / 100 kWh, which means that Romanians pay 54% of the German average price. This comparison shows that energy prices pose a more serious strain on households in poorer regions. Most of these belong to the Eastern countries of Romania, Hungary and Poland, as shown in table nº 22:

Table N° 22 Regions with the Lowest Disposable Income

NUTS 2006	Region	Disposable income per cápita 2005 (in ppp)
RO21	Nord-Est	3146
RO31	Sud - Muntenia	3549,6
RO41	Sud-Vest Oltenia	3612,7
RO22	Sud-Est	3733,8
RO12	Centru	3874,5
RO11	Nord-Vest	3904,7
RO42	Vest	4543,7
PL32	Podkarpackie	5148,2
HU32	Észak-Alföld	5457,6
PL31	Lubelskie	5462,8
PL52	Opolskie	5681,2
PL34	Podlaskie	5720,9
PL62	Warminsko-Mazurskie	5775,9
LV00	Latvia	5794,8
HU31	Észak-Magyarország	5813,8
PL33	Swietokrzyskie	5842,2
HU33	Dél-Alföld	5898,7

Source: Own elaboration based on Eurostat data

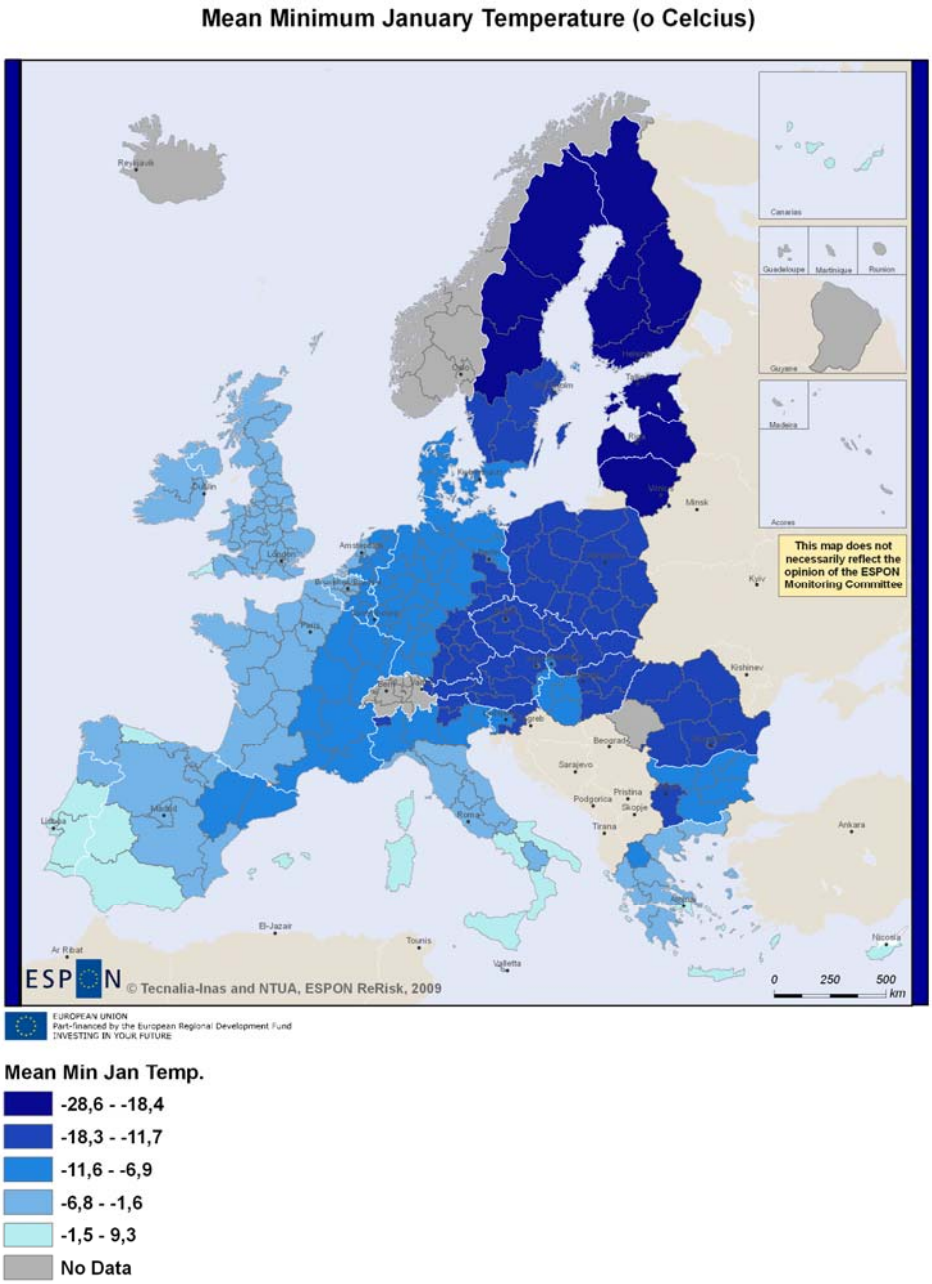
Latvia and Estonia (6096,6 ppp) also have a very low average income, followed closely in the ranking by the Slovakian and Czech regions. Only one region of the former EU 15, Ionia Nisia in Greece, is in a similar situation, with an average income of 7210,9 ppp. So, there is again a clear East – West and South – North division with respect to monetary poverty in Europe.

3.8.3. Conclusions

Rising energy prices could become a serious social problem in an area, which extends from Eastern Germany to the New Member States, especially those with a very low disposable income, such as Romania, Hungary and Poland. Energy costs represent a much more important cost item for households in these regions, which additionally have a high demand for heating in the

winter time, as shown in map nº 8, which reflects the mean minimum temperature in January over the last 15 years.

Map N° 8 Mean Minimum January Temperature, NUTS 2 level



Source: Own elaboration based on data facilitated by the Joint Research Centre

3.9. The Special Situation of Island Regions

Islands may face a specific risk of energy poverty, due to two main factors. First, many of them are not connected to the physical infrastructure at the mainland (grids) and therefore have to rely on smaller and more expensive production systems, generally based on imported fuels. According to the Directive 96/92/EC of the European Parliament and of the Council of 19 December 1996 concerning common rules for the internal market for electricity, islands can be defined as small isolated systems[22], which means that they are subject to a singular regulation, due to their specific characteristics. Moreover, and also due to this lack of connection to the mainland, they have a great dependence on air or maritime transport. This special situation of the major islands in the EU will be analysed in the following paragraphs.

First of all, it is important to define what an island is in statistical terms and how this relates to the NUTS classification. Eurostat defines an island using the following five criteria[23]:

1. The island's surface has to be at least one km^2
2. The minimum distance between the island and the mainland has to be at least one kilometer
3. The island's permanent population has to be at least 50 inhabitants
4. There is no permanent link between the island and the mainland
5. The capital city cannot be located in the island

According to this definition, 286 insular territories have been defined for the EU, of which 188 are archipelagoes and 98 are isolated. 10 archipelagoes can be considered as NUTS II regions:

Table Nº 23 NUTS II Island Regions

NUTS II	Region	Number of Islands
FR83	Corse	1
ES53	Illes Balears	4
FI20	Aland	11
ITG1	Sicilia	5
ITG2	Sardegna	15
GR22	Ioania Nisia	12
GR 41	Voreio Aigaio	10
GR 42	Notio Aigaio	42
GR 43	Kriti	2

Source: Planistat[24]. Own elaboration

[22] "Small isolated system" shall mean any system with consumption of less than 2500 GWh in the year 1996, where less than 5 % of annual consumption is obtained through interconnection with other systems (Directive 96/92/EC)

[23] Planistat Europe and Bradley Dunbar Ass. (2003):"*Analyse des régions insulaires et des régions ultrapériphériques de l'Union européenne: Les territoires et les régions insulaires*"

[24] In ultraperipherical regions the risk of poverty index is higher than in insular regions.

In addition, we will consider for this analysis Cyprus and Malta, which also face a very special situation, even though they cannot be analysed on NUTS 2 level.

In terms of economic vulnerability, insular regions, in general, are not dependent on industries with high energy spending, as they are serviced-based economies. Nevertheless, Cyprus performs worse, due to its specialization in the processing of food products.

Table N° 24 Economic Vulnerability of Island Regions

NUTS II	Region	Employment in industries with high energy spending / total employment (%)	Ranking
CY00	Cyprus	6.66 %	43
ITG2	Sardegna	3.38 %	159
ITG1	Sicilia	3.03 %	177
GR43	Kriti	2.42 %	212
GR41	Voreio Aigaio	2.27 %	218
GR42	Notio Aigaio	1.86 %	237
FI20	Åland	1.74 %	242
GR22	Ionia Nisia	1.60 %	244
ES53	Illes Balears	1.39 %	250
FR83	Corse	1.25 %	252

Source: Own elaboration based on Structural Business Statistics

In terms of social poverty, we find two classes of island regions: those with relatively low long-term unemployment and an average activity rate and those which perform worse on both indicators. Sicilia, Corse, Sardegna, Voreio Aigaia and also Malta belong to the group of socially vulnerable islands, while the Balearic Islands and Cyprus lead the group of well-situated island regions with high economic activity rates and low long-term unemployment in 2005.

Table N° 25 Social Vulnerability of Island Regions

NUTS II	Region	Long-term unemployment rate 2005 (%)	Ranking	Activity rate 2005 (%)	Ranking
ITG1	Sicilia	60.87	18	42.1	268
FR83	Corse	46.42	99	46.9	259
ITG2	Sardegna	46.41	100	48.1	252
ES53	Illes Balears	40.88	131	61.8	58
GR41	Voreio Aigaio	21.86	221	47.2	258
MT00	Malta	41.05	129	49.5	244
GR43	Kriti	28.74	186	57.2	139

GR22	Ionia Nisia	27.91	190	53.9	196
GR42	Notio Aigaio	21.86	221	55.8	167
FI20	Åland	0	281	56.1	159
CY00	Cyprus	18.59	238	63.2	40

The islands' greater vulnerability derives mainly from their dependence on transport, both in terms of employment and with regard to air traffic. Nevertheless, the islands perform better on indicators related to road or train transport (commuting and fuel costs of freights).

Table N° 26 Transport Dependence of Island Regions

NUTS II	Region	Transport employment / total employment (%)	Ranking in employment dependence	Commuting: % another region / the same region	Ranking in commuting	Air passengers/ population (%)	Ranking in air passengers	Fuel costs freight (% GDP)	Ranking in fuel costs
CY00	Cyprus	13.60	41			8.95	19	1.08	221
ES53	Illes Balears	14.79	28	0.62	235	28.60	1	0.48	249
FI20	Åland	60.26	1	3.85	151	1.78	84	1.60	182
FR83	Corse	21.24	13	2.85	178	8.33	21	0.32	257
GR22	Ionia Nisia	8.83	122	0.22	249	14.86	8	1.02	226
GR41	Voreio Aigaio	9.19	119			6.14	31	0.53	244
GR42	Notio Aigaio	14.55	35			19.44	2	0.43	252
GR43	Kriti	8.85	133			10.74	14	1.00	228
ITG1	Sicilia	7.83	172	2.24	197	1.87	82	1.75	170
ITG2	Sardegna	8.98	129	1.28	224	2.99	61	1.35	204
MT00	Malta					6.83	27	1.00	229

Source: Own elaboration based on Eurostat data

The situation is especially critical in the Nordic archipelago of Åland, where more than 60% of employment is related to the different transport sectors.. The Balearic Islands, as well as Notio Agaio, Ionia Nisia and Kriti in Greece face special problems due to their great dependence on air travel.

4. Description of Further Proceeding towards the Draft Final Report

The data collection phase of the ReRisk project has now finalized. Additionally to the data presented in this report, the following indicators are available to measure the regions' vulnerability to rising energy prices and their potential to cope with these challenges:

- Mean maximum July temperature

  This indicator is relevant for identifying the regions with high cooling demand in the summer time and will become more important as temperatures rise as a consequence of climate change. All temperature-related data was facilitated by JRC Ispra - IPSC - MARS Unit.

- PV Potential

  The regional potential for produce electricity from PV panels has been calculated and supplied by the Joint Research Centre's Sunbird data base, which forms part of the SOLAREC action at the JRC Renewable Energies Unit. The data refers to the yearly total of estimated solar electricity generation (for horizontal, vertical, optimally-inclined planes) [kWh] within the built environment.

- Wind Potential

  This data on wind intensity in the regions was prepared in GIS format by the European Topic Centre on Air and Climate change (ETC/ACC), led by PBL the Netherlands, on request of the EEA (EEA, 2009). It has been converted to NUTS 2 level by the NTUA researchers, who collaborate in the ReRisk project and the help of the ESPON database project. It identifies those regions in Europe, which have the highest potential for producing electricity from wind power. However, the EEA has introduced some restrictions when calculating the maximum potential, mainly due to environmental reasons. ReRisk has followed these recommendations, using the "restrained" wind potential for the regional analysis.

This additional data has been used in the clustering analysis, the results of which are presented in a separate report. Likewise, the progress towards formulating policy recommendations through an enquiry to regional energy agencies, case studies and the scenario exercise are documented in a separate report. The implications of climate change for regional energy planning are addressed in a discussion paper, which will feed into the final policy recommendations.

Annex I Total Purchases and Energy Purchases by Sector and Country and Comparison to EU Average Value

Table Nº 27 Selection of Sectors with Highest Energy Spending, per Country

NACE Sectors with highest energy purchases	Total purchases	Energy purchases	Energy purchases as % of total Purchases	Divergence EU
EU Average				
DA15 Manufacture of food products and beverages	21167,492	548,192	2.59%	
DE21 Manufacture of pulp, paper and paper products	4962,965	392,487	7.91%	
DG24 Manufacture of chemicals and chemical products	20053,779	784,829	3.91%	
DI26 Manufacture of other non-metallic mineral products	6032,142	504,333	8.36%	
DJ27 Manufacture of basic metals	10749,925	723,421	6.73%	
AT Austria				
DA15 Manufacture of food products and beverages	9310,10	296,00	3.18%	0.59%
DE21 Manufacture of pulp, paper and paper products	3796,30	335,50	8.84%	0.93%
DG24 Manufacture of chemicals and chemical products	5811,20	282,80	0.95%	0.95%
DI26 Manufacture of other non-metallic mineral products	3718,30	317,50	8.54%	0.18%
DJ27 Manufacture of basic metals	8297,90	974,40	11.74%	5.01%
BE Belgium				
DA15 Manufacture of food products and beverages	24242,50	571,50	2.36%	-0.23%
DE21 Manufacture of pulp, paper and paper products	3868,60	468,30	12.11%	4.20%
DG24 Manufacture of chemicals and chemical products	27082,60	1691,90	6.25%	2.33%
DI26 Manufacture of other non-metallic mineral products	5533,60	419,60	7.58%	-0.78%
DJ27 Manufacture of basic metals	14288,10	942,00	6.59%	-0.14%
CY Cyprus				
DA15 Manufacture of food products and beverages	914,50	40,50	4.43%	1.84%
DD20 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	119,90	4,30	3.59%	0.37%
DE22 Publishing, printing, reproduction of recorded media	84,30	2,80	3.32%	1.99%
DG24 Manufacture of chemicals and chemical products	123,10	3,80	3.09%	-0.83%
DI26 Manufacture of other non-metallic mineral products	340,90	62,90	18.45%	10.09%

NACE Sectors with highest energy purchases	Total purchases	Energy purchases	Energy purchases as % of total Purchases	Divergence EU
CZ Czech Republic				
DG24 Manufacture of chemicals and chemical products	4209,00	203,40	4.83%	0.92%
DI26 Manufacture of other non-metallic mineral products	3468,80	336,70	9.71%	1.35%
DJ27 Manufacture of basic metals	6341,10	349,40	5.51%	-1.22%
DJ28 Manufacture of fabricated metal products, except machinery and equipment	6038,50	165,30	2.74%	0.26%
DK29 Manufacture of machinery and equipment n.e.c.	6726,10	173,50	2.58%	1.24%
DE Germany				
DA15 Manufacture of food products and beverages	112975,00	3078,60	2.73%	0.14%
DG24 Manufacture of chemicals and chemical products	109676,30	4641,00	4.23%	0.32%
DI26 Manufacture of other non-metallic mineral products	25582,70	2177,60	8.51%	0.15%
DJ27 Manufacture of basic metals	63250,70	4576,60	7.24%	0.51%
DM34 Manufacture of motor vehicles, trailers and semi-trailers	255311,80	2090,30	0.82%	0.02%
DK Denmark				
DA158 Manufacture of other food products	2657,20	93,80	3.53%	-0.44%
DG24 Manufacture of chemicals and chemical products	5326,70	122,60	2.30%	-1.61%
DI26 Manufacture of other non-metallic mineral products	1797,60	137,60	7.65%	-0.71%
DJ28 Manufacture of fabricated metal products, except machinery and equipment	3683,40	91,00	2.47%	0.00%
DK29 Manufacture of machinery and equipment n.e.c.	6465,40	101,30	1.57%	0.22%
EE Estonia				
DA15 Manufacture of food products and beverages	882,60	34,30	3.89%	1.30%
DD20 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	816,30	46,60	5.71%	2.49%
DG24 Manufacture of chemicals and chemical products	306,60	16,60	5.41%	1.50%
DI26 Manufacture of other non-metallic mineral products	256,70	19,30	7.52%	-0.84%
DN36 Manufacture of furniture; manufacturing n.e.c.	303,10	18,60	6.14%	4.54%

NACE Sectors with highest energy purchases	Total purchases	Energy purchases	Energy purchases as % of total Purchases	Divergence EU
ES Spain				
DA15 Manufacture of food products and beverages	71755,90	1313,40	1.83%	-0.76%
DE21 Manufacture of pulp, paper and paper products	8381,10	500,50	5.97%	-1.94%
DI26 Manufacture of other non-metallic mineral products	22629,70	1766,30	7.81%	-0.56%
DJ27 Manufacture of basic metals	21162,80	1211,30	5.72%	-1.01%
DJ28 Manufacture of fabricated metal products, except machinery and equipment	27508,10	512,10	1.86%	-0.61%
FI Finland				
DD20 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	4650,10	155,60	3.35%	0.13%
DE21 Manufacture of pulp, paper and paper products	10423,20	1002,60	9.62%	1.71%
DG24 Manufacture of chemicals and chemical products	4679,00	243,30	5.20%	1.29%
DI26 Manufacture of other non-metallic mineral products	1933,50	127,10	6.57%	-1.79%
DJ27 Manufacture of basic metals	6370,80	308,80	4.85%	-1.88%
FR France				
DE21 Manufacture of pulp, paper and paper products	14598,10	892,30	6.11%	-1.80%
DG24 Manufacture of chemicals and chemical products	94594,80	2174,00	2.30%	-1.62%
DH25 Manufacture of rubber and plastic products	29483,50	639,40	2.17%	-1.10%
DI26 Manufacture of other non-metallic mineral products	19317,90	1082,30	5.60%	-2.76%
DJ27 Manufacture of basic metals	26322,10	1302,40	4.95%	-1.78%
GR Greece				
DA15 Manufacture of food products and beverages	7606,30	225,30	2.96%	0.37%
DF23 Manufacture of coke, refined petroleum products and nuclear fuel	8294,60	244,80	2.95%	1.99%
DG24 Manufacture of chemicals and chemical products	2124,40	56,40	2.65%	-1.26%
DI26 Manufacture of other non-metallic mineral products	2002,40	301,30	15.05%	6.69%
DJ27 Manufacture of basic metals	3591,50	306,20	8.53%	1.80%
HU Hungary				
DA15 Manufacture of food products and beverages	7559,60	344,30	4.55%	1.96%
DG24 Manufacture of chemicals and chemical products	4002,80	254,40	6.36%	2.44%
DI26 Manufacture of other non-	1645,60	182,60	11.10%	2.74%

NACE Sectors with highest energy purchases	Total purchases	Energy purchases	Energy purchases as % of total Purchases	Divergence EU
metallic mineral products				
DJ27 Manufacture of basic metals	2345,50	257,20	10.97%	4.24%
DJ28 Manufacture of fabricated metal products, except machinery and equipment	2515,80	120,30	4.78%	2.31%
IE Ireland				
DA155 Manufacture of dairy products	2865,00	82,50	2.88%	0.83%
DG24 Manufacture of chemicals and chemical products	18518,80	167,80	0.91%	-3.01%
DI26 Manufacture of other non-metallic mineral products	1459,70	162,60	11.14%	2.78%
DJ27 Manufacture of basic metals	403,10	98,20	24.36%	17.63%
DL32 Manufacture of radio, television and communication equipment and apparatus	1683,70	56,30	3.34%	2.59%
IT Italy				
DH25 Manufacture of rubber and plastic products	29025,50	1116,80	3.85%	0.58%
DI26 Manufacture of other non-metallic mineral products	29643,30	2571,00	8.67%	0.31%
DJ27 Manufacture of basic metals	40710,00	2180,30	5.36%	-1.37%
DJ28 Manufacture of fabricated metal products, except machinery and equipment	59762,30	1667,00	2.79%	0.32%
DK29 Manufacture of machinery and equipment n.e.c.	76729,60	1171,20	1.53%	0.18%
LT Lithuania				
DA15 Manufacture of food products and beverages	1756,30	38,30	2.18%	-0.41%
DD20 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	560,60	21,70	3.87%	0.65%
DG24 Manufacture of chemicals and chemical products	480,80	15,30	3.18%	-0.73%
DI26 Manufacture of other non-metallic mineral products	263,40	12,50	4.75%	-3.62%
DL32 Manufacture of radio, television and communication equipment and apparatus	258,00	12,70	4.92%	4.17%
LU Luxembourg (Grand-Duché)				
DG24 Manufacture of chemicals and chemical products	346,10	146,40	42.30%	38.39%
DH25 Manufacture of rubber and plastic products	1199,80	412,30	34.36%	31.10%
DI26 Manufacture of other non-metallic mineral products	441,50	53,70	12.16%	3.80%
DJ27 Manufacture of basic metals	12457,00	145,00	1.16%	-5.57%

NACE Sectors with highest energy purchases	Total purchases	Energy purchases	Energy purchases as % of total Purchases	Divergence EU
DJ28 Manufacture of fabricated metal products, except machinery and equipment	497,30	85,70	17.23%	14.76%
LV Latvia				
DA15 Manufacture of food products and beverages	1063,50	51,10	4.80%	2.22%
DD20 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	930,00	54,40	5.85%	2.63%
DI26 Manufacture of other non-metallic mineral products	184,40	25,00	13.56%	5.20%
DJ27 Manufacture of basic metals	262,10	24,10	9.19%	2.47%
DN36 Manufacture of furniture; manufacturing n.e.c.	164,50	11,60	7.05%	5.46%
NL Netherlands				
DE21 Manufacture of pulp, paper and paper products	4353,90	235,90	5.42%	-2.49%
DF23 Manufacture of coke, refined petroleum products and nuclear fuel	29163,00	685,70	2.35%	1.39%
DG24 Manufacture of chemicals and chemical products	39484,70	2127,20	5.39%	1.47%
DI26 Manufacture of other non-metallic mineral products	4046,90	254,10	6.28%	-2.08%
DJ27 Manufacture of basic metals	5127,50	630,60	12.30%	5.57%
NO Norway				
DD20 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	2341,10	51,40	2.20%	-1.03%
DE21 Manufacture of pulp, paper and paper products	1520,50	193,40	12.72%	4.81%
DG24 Manufacture of chemicals and chemical products	4623,10	314,80	6.81%	2.90%
DI26 Manufacture of other non-metallic mineral products	1686,50	83,70	4.96%	-3.40%
DJ27 Manufacture of basic metals	8656,80	620,80	7.17%	0.44%
PT Portugal				
DA15 Manufacture of food products and beverages	9390,70	240,40	2.56%	-0.03%
DE21 Manufacture of pulp, paper and paper products	1619,20	183,40	11.33%	3.42%
DG24 Manufacture of chemicals and chemical products	3264,50	163,10	5.00%	1.08%
DI26 Manufacture of other non-metallic mineral products	3429,10	351,30	10.24%	1.88%
DJ28 Manufacture of fabricated metal products, except machinery and equipment	3366,20	102,00	3.03%	0.56%

NACE Sectors with highest energy purchases	Total purchases	Energy purchases	Energy purchases as % of total Purchases	Divergence EU
RO Romania				
DA15 Manufacture of food products and beverages	6552,90	344,60	5.26%	2.67%
DG24 Manufacture of chemicals and chemical products	2153,10	404,00	18.76%	14.85%
DI26 Manufacture of other non-metallic mineral products	1422,40	292,90	20.59%	12.23%
DJ27 Manufacture of basic metals	3606,20	1051,50	29.16%	22.43%
DK29 Manufacture of machinery and equipment n.e.c.	1549,00	126,90	8.19%	6.85%
SE Sweden				
DD20 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	6467,40	193,50	2.99%	-0.23%
DE21 Manufacture of pulp, paper and paper products	9288,60	1039,00	11.19%	3.28%
DG24 Manufacture of chemicals and chemical products	9394,20	327,90	3.49%	-0.42%
DJ27 Manufacture of basic metals	11027,00	581,50	5.27%	-1.46%
DM34 Manufacture of motor vehicles, trailers and semi-trailers	24796,60	151,90	0.61%	-0.18%
SK Slovakia				
DE21 Manufacture of pulp, paper and paper products	801,80	111,50	13.91%	6.00%
DG24 Manufacture of chemicals and chemical products	949,00	126,00	13.28%	9.36%
DI26 Manufacture of other non-metallic mineral products	872,20	175,10	20.08%	11.71%
DJ27 Manufacture of basic metals	2615,50	563,90	21.56%	14.83%
DK29 Manufacture of machinery and equipment n.e.c.	1628,50	57,30	3.52%	2.18%
UK United Kingdom				
DE21 Manufacture of pulp, paper and paper products	12829,60	745,20	5.81%	-2.10%
DG24 Manufacture of chemicals and chemical products	49194,90	2357,50	4.79%	0.88%
DI26 Manufacture of other non-metallic mineral products	10778,70	1057,40	9.81%	1.45%
DJ27 Manufacture of basic metals	18530,90	1122,10	6.06%	-0.67%
DJ28 Manufacture of fabricated metal products, except machinery and equipment	22540,80	770,40	3.42%	0.95%

Annex II Performance of Sectors in Countries with Higher than Average Energy Spending

Table Nº 28 Countries with Highest Levels of Energy Spending and Performance of Sectors

Sector	Difference with EU average (%)
Romania	
CA10 Mining of coal and lignite; extraction of peat	21.05%
CA11 Extraction of crude petroleum and natural gas	11.72%
CB13 Mining of metal ores	19.08%
DA15 Manufacture of food production	2.67%
DF17 Manufacture of textiles	5.54%
DD20 Manufacture of wood and of product of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	5.10%
DE21 Manufacture of pulp, paper and paper products	6.19%
DI26 Manufacture of other non-metallic mineral products	12.23%
DJ27 Manufacture of basic metals	22.43%
Luxembourg	
DG24 Manufacture of chemicals and chemical products	38.39%
DH25 Manufacture of rubber and plastic products	31.10%
DJ28 Manufacture of fabricated metal products, except machinery and equipment	14.76%
DN37 Recycling	12.55%
F45 Construction	4.50%
Estonia	
DC19 Tanning, dressing of leather; manufacture of luggage	3.76%
DF23 Manufacture of coke, refined petroleum products and nuclear fuel	11.13%
DL31 Manufacture of electrical machinery and apparatus n.e.c.	1.91%
Latvia	
DK29 Manufacture of machinery and equipment	4.71%
DN36 Manufacture of furniture	5.46%
CB14 Other mining and quarrying	30.66%
DM34 Manufacture of motor vehicles, trailers and semi-trailers	2.27%

Annex III Validation of Derived Indicators Based on Actual Industrial Energy Consumption in the European Regions

In the context of the ReRisk project, different research strategies had to be applied to obtain estimates of energy use in the regions, due to the lack of harmonized data on regional energy consumption. However, during the first year of the project, some data could be collected from national and regional sources, and can be used to check the validity of the derived indicators. Also, the actual consumption data can help to fill some gaps in the analysis of vulnerability for countries, for which Eurostat data was not available. This is the double purpose of the present annex.

The results of the process of data gathering are summarized in table 29:

Table N° 29 Overview of Regional Energy Consumption Data

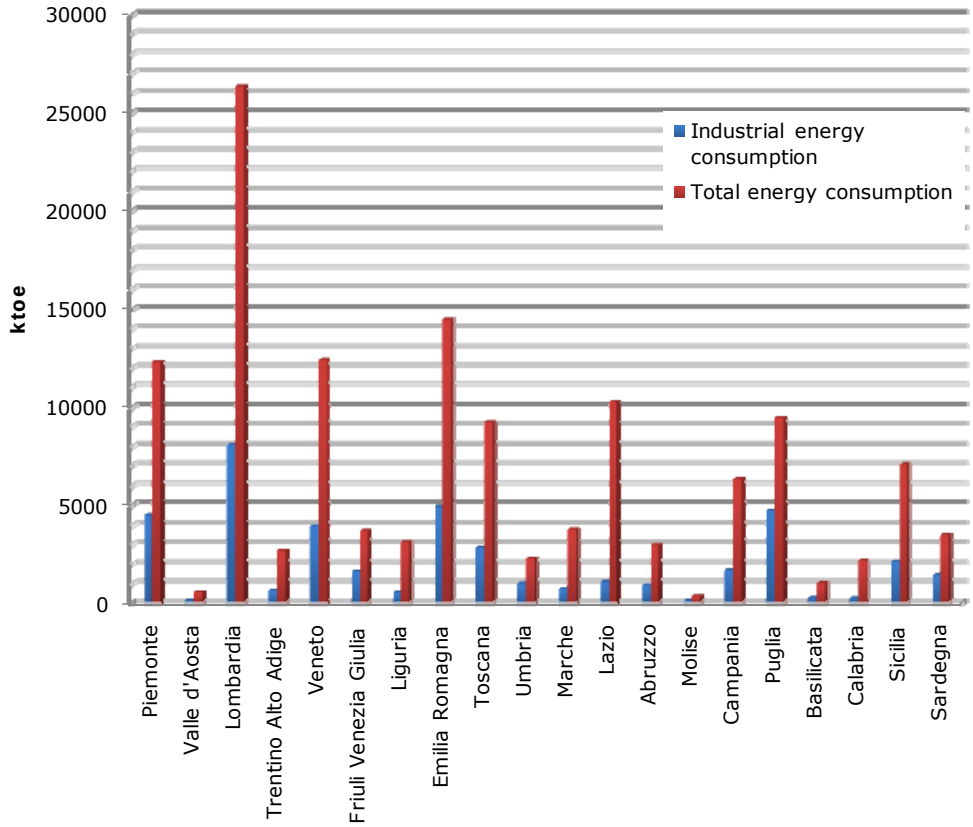
Country	NUTS level	Year	Units	Sectors
Austria	2 (AT 12 and AT 32)	1988 - 2007	TJ	AT 12: Industry (detailed), transport (detailed), public services, households, agriculture; AT 32: by fuel in TJ, total only)
Belgium	1	2005	ktoe	Industry, Transport, Services, Housing
Czech Republic	3	2007	Tonnes, GJ, 1000 m3, MWh	By fuel, no total
Estonia	0	2005	Tonnes, GJ, , GWh	Industry, agriculture and fishing transport, commercial and public service, households
Greece	2	2005	1000 kWh	Electricity use only for domestic, commercial, industrial, agricultural use, public and municipal authorities, street lightning
France	2	2005	ktoe	Industry, household, services, agriculture, transport
Germany	1	2005	TJ	Agriculture and forestry, fishing, industry, services, private households
Iceland	0	2005	Petajoules	Manufacturing and Mining, transport, households, agriculture, trade etc
Italy	2	2005	ktoe	Agriculture, industry, households, services, transport
Latvia	0	2005	TJ	Transport, industry, commercial and public sector, households; agriculture, forestry, hunting; fishing

Country	NUTS level	Year	Units	Sectors
Lithuania	0	2005	Ktoe and TJ	Industry, construction, transport, agriculture, Commercial and public services, households
Luxemburg	0	2005	Mill toe	Industry, transport, others
Malta	0	2005/ 2006	'000 kilowatt hour	Electricity consumption only for industrial, commercial, domestic, street lighting
Norway	2	2005	TJ	Industry, services, households, transport
Poland	2	2005	Gwh	Industry, energy, transport, households, agriculture
Portugal	2 (2001 classification)	2005	Kwh, kwh/cons,; tep / inhabitants, Nm^3 (thousands)	Only for electricity uses: domestic, non-domestic, industry, agriculture, illumination of the public ways; interior illumination of state buildings
Slovakia	3	2007	TJ, tons, MWh, 1000 m3	Only industry (2-digit NACE), by fuels
Slovenia	0	2005	1000 toe	Energy, manufacturing and construction, transport, households, other
Spain	2	2005	1000 €	By fuel only
Switzerland	3 (selection of cantons)	2005	kWh / inhab.	Total

As shown in the table, the data is extremely heterogeneous and therefore difficult to compare on EU level. However, comparative national data con be used in some cases to verify the estimates made by ReRisk on industrial energy spending. This verification will focus on those regions, which are likely to be most vulnerable to rising energy prices.

In the case of the Italian regions of Emilia-Romagna, Lombardia and Veneto, energy spending by industry is clearly related to the high level of industrial energy consumption. The exceptionally high industrial energy consumption in Puglia, however, was not fully grasped when analysing **employment** in industries with high energy spending, but became apparent when associating **regional GVA** to these industries.

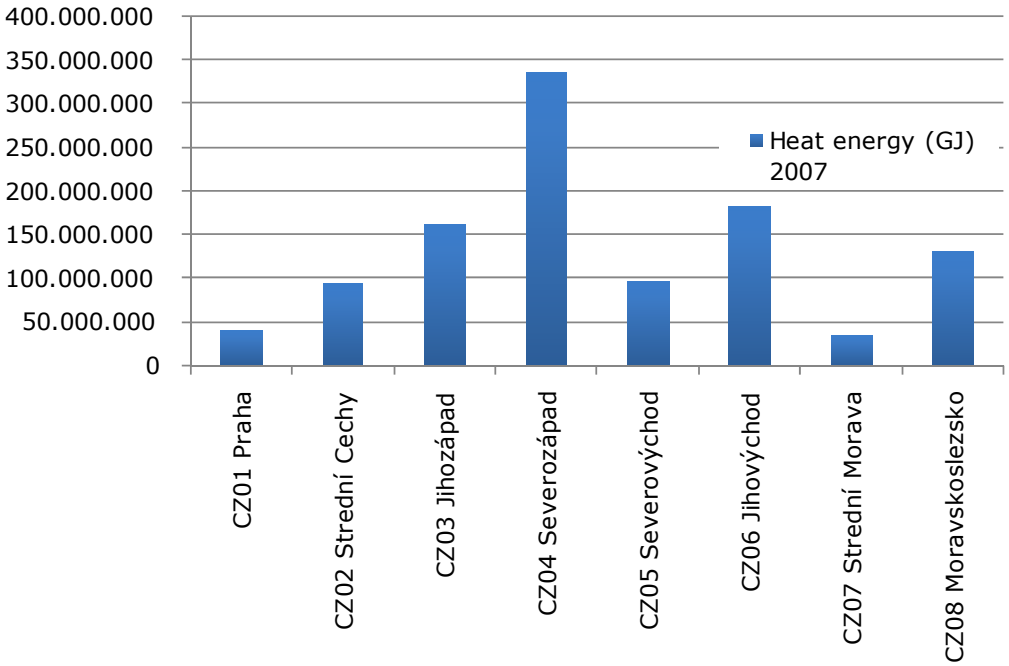
Graph N° 20 Energy Consumption in Italian Regions, 2005



Instituto Superiore per la protezione e la Ricerca Ambientale- Banche dati- Banca dati indicatori ambientali- Annuario- Edizione 2008

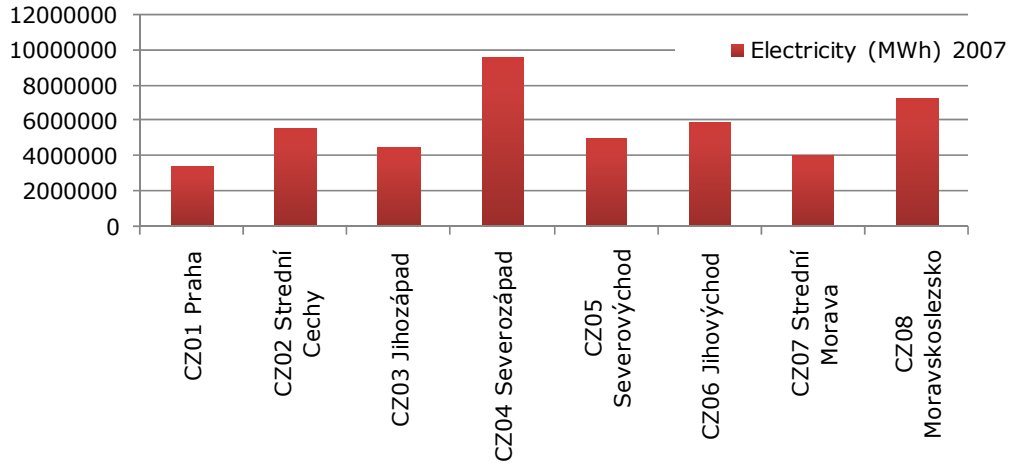
For the Czech regions, it is more difficult to confirm the findings on the industry structure, since data on industrial consumption is not available. Looking, however, on total regional energy consumption for heat and electricity, it can be confirmed that there are specific problems in the regions of Severozápad and Moraskolslezsko, and, to a lesser extent, in Jihovýchod.

Graph N° 21 Heat Consumption in the Czech Regions, 2007



Source; Czech Statistical Office- Publications - Industry, Energy, Construction

Graph N° 22 Electricity Consumption in the Czech Regions, 2007



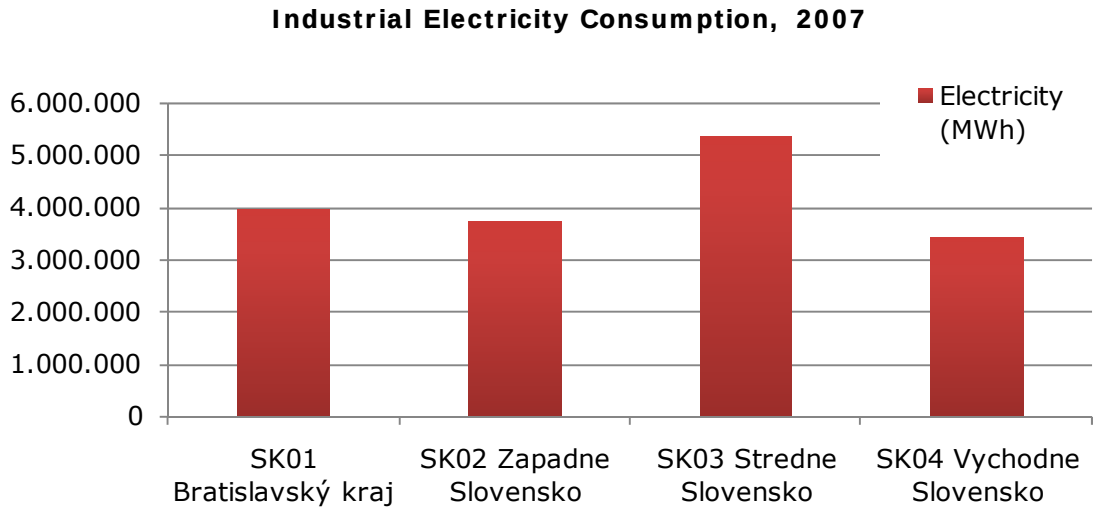
Source; Czech Statistical Office- Publications - Industry, Energy, Construction

The Slovakian data on industrial energy consumption is very detailed and collected on NUTS 3 level, so energy consumption patterns in industry can be further explained. According to the ReRisk analysis, the Slovakian region with the most unfavourable industry structure in terms of energy spending is

Stredne Slovensko. This region, along with Zapadne Slovensko, also has a high level of long-term unemployment.

The regional statistics on energy consumption confirm this result with respect to electricity consumption, as documented in graph nº 23.

Graph Nº 23 Total Industrial Electricity Consumption in the Slovakian Regions, 2007

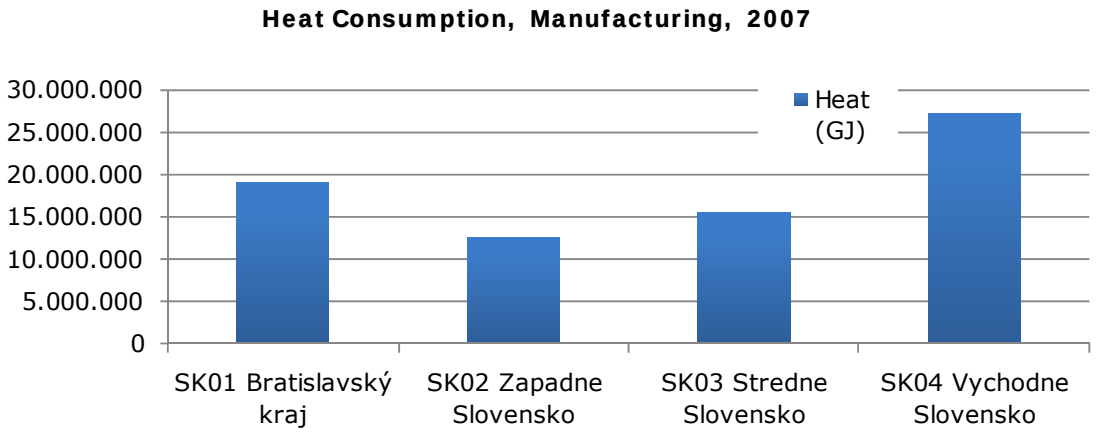


Source: Statistical Office of the Slovak Republic

In the case of heat, however, the region of Vychodne Slovensko has a much higher consumption level, as shown in graph nº 24. This may indicate that the ReRisk analysis of vulnerable regions highlights industrial regions that make great use of **expensive** energy sources and may therefore be influenced by important price differences between fuels in some regions. However, this remains a hypothesis, since comparable data on energy prices for industry is not available[25].

[25] This has been confirmed by contacts in the Bratislava Energy Agency.

Graph N° 24 Heat Consumption of Manufacturing Industry in the Slovakian Regions, 2007

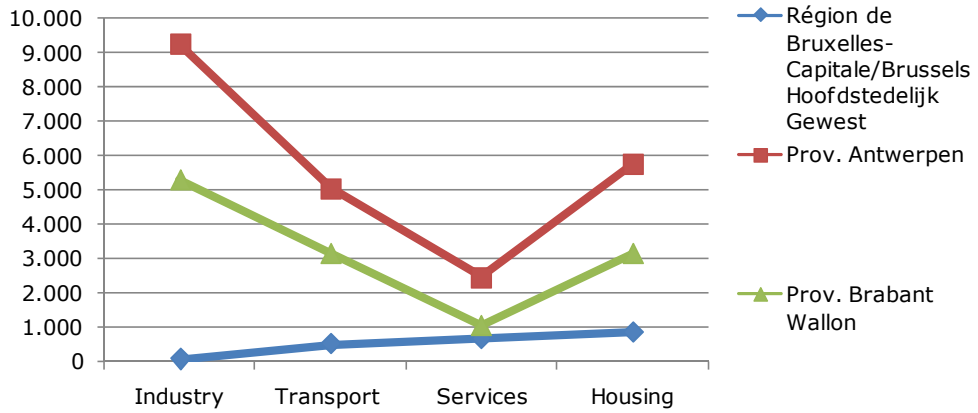


Source: Statistical Office of the Slovak Republic

A closer look at the consumption data in Stredne Slovensko reveals that the high level of electricity consumption derives from the manufacture of basic metals in Žilina and Banská Bystrica (NUTS 3 regions), and, to a lesser extent, from the manufacture of pulp and paper in Žilina.

The **Belgian** statistics on energy consumption only cover the three NUTS 1 areas in the country. Although they reflect the great variations in the country's economic structure, they are not helpful for further analysing the situation of the NUTS 2 regions of Antwerpen, Brabant Wallon, West-Vlaanderen and Limburg, which have a considerable share of employment in industries with high energy spending.

Graph N° 25 Energy consumption in Belgian Provinces, 2005 (in ktoe)



Source : Bruxelles-Environnement - IBGE, Emis (RFl), DGTRE (RW), SPF Economie (Belgique)

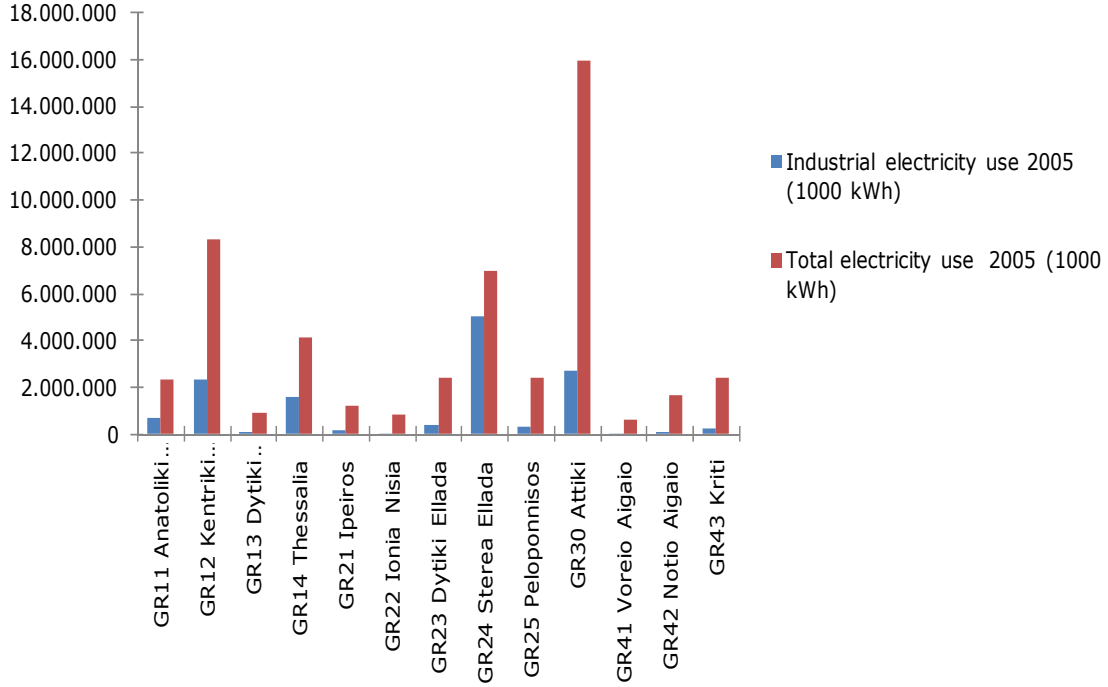
In the case of **Greece**, the ReRisk analysis revealed that in the regions of Thessalia, Ipeiros and Sterea Ellada, more than 10% of regional GVA proceeds from industries with high energy spending, as shown in the table below.

Table N° 30 Economic Vulnerability of Greek Regions

NUTS 2	Region	Regional GVA derived from industries with high energy spending
GR11	Anatoliki Makedonia, Thraki	3,37%
GR12	Kentriki Makedonia	3,71%
GR13	Dytiki Makedonia	6,01%
GR14	**Thessalia**	**12,99%**
GR21	**Ipeiros**	**10,73%**
GR22	Ionia Nisia	5,33%
GR23	Dytiki Ellada	9,21%
GR24	**Sterea Ellada**	**15,79%**
GR25	Peloponnisos	7,05%
GR30	Attiki	4,49%
GR41	Voreio Aigaio	7,75%
GR42	Notio Aigaio	5,65%
GR43	Kriti	6,06%

These results can only partially be confirmed, since regional statistics are limited to data on electricity consumption. As shown in graph nº 26, both Sterea Ellada and Thessalia have a high level of industrial consumption (72% and 39% of total electricity consumption, respectively), but the value for Ipeiros is much lower (13%).

Graph N° 26 Industrial and Total Electricity Consumption in Greek Regions, 2005 (in 1000 kWh)



Source: General Secretariat of the National Statistical Service of Greece – Industry – Energy - Electric energy consumption by great geographic area, region and department and by category of use. 1993-2008

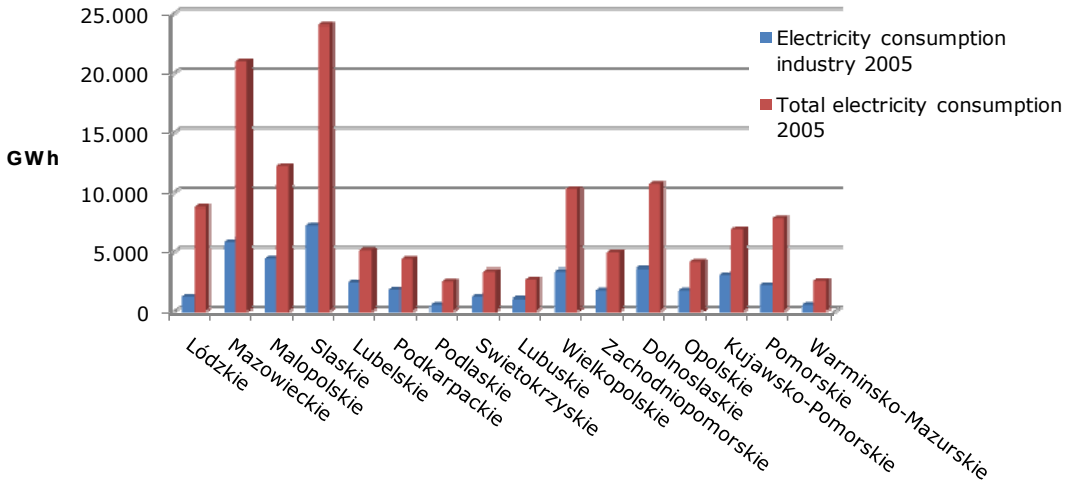
The results for the vulnerable regions identified in Sweden (Norra Mellansverige, Västsverige and Småland med öarna) and Hungary (Észak-Magyarország and Dél-Alföld), could not yet be confirmed, since regional energy consumption data has not been received so far.

Closing the gaps

For some countries, Eurostat data was incomplete, so that either the economic or the social vulnerability of the regions could not be estimated. This was the case for Poland and Slovenia (no data on industrial energy spending), as well as Denmark.

In the case of **Poland**, information is available on **electricity** consumption in the region. The highest level of consumption by industry corresponds to the regions of Slaskie and Mazowieckie, as shown in graph nº 27:

Graph N° 27 Electricity Consumption in the Polish Regions, 2005



Source: Central Statistical Office of Poland - Regional Data Bank - Fuel, energy and material markets

However, the regions with the highest **percentage** of electricity consumption in the industrial sector (compared to total electricity consumption) are Lubelskie (46.97%), Kujawsko-Pomorskie (44.68%), Opolskie (41.93%) and Podkarpackie (40.95%).

According to the analysis on fuel costs, carried out by DG Regio, the Polish regions are among the hardest hit, but this can obviously not be confirmed with data on electricity consumption only, since this is not the most widely used energy source in transport.

Denmark is not collecting data on regional energy consumption anymore, due to the change in municipal and administrative structure, which took part a few years ago, and due to the detachment of production and consumption sites as a consequence of the market liberalization.

Conclusions

- Where detailed information on industrial energy consumption is available, the ReRisk estimates of the regional industrial energy spending can largely be confirmed. Some slight distortion with regard to the actual industrial energy demand in the region may occur in countries with large price differences for the fuels used by industry.
- As a consequence of market liberalization, comparable data on prices and consumption on regional level is even more difficult to obtain than before, which constitutes a serious problem for sectoral and regional policy initiatives aimed at reducing energy demand.

Table N° 31 Industrial Energy Consumption in Germany (NUTS 1), 2004

NUTS 1	Employment in industries with high energy spending / total employment (%)	Industrial consumption on in TJ (2004)	Industrial consumption NUTS 1 / total industrial consumption country (%)	Employment in industries with high energy spending / industrial employment (%)
DE1 Baden-Württemberg	6.59%	843831	5.99%	
DE11 Stuttgart				10.99%
DE12 Karlsruhe				14.21%
DE13 Freiburg				15.98%
DE14 Tübingen				14.79%
DE2 Bayern	6.94%	1029958	7.31%	
DE21 Oberbayern				22.67%
DE22 Niederbayern				18.32%
DE23 Oberpfalz				22.57%
DE24 Oberfranken				21.18%
DE25 Mittelfranken				19.97%
DE26 Unterfranken				20.46%
DE27 Schwaben				24.60%
DE3 Berlin	2.05%	67067	0.48%	
DE4 Brandenburg	2.72%	441145	3.13%	
DE41 Brandenburg - Nordost				37.86%
DE42 Brandenburg - Südwest				34.92%
DE5 Bremen	0.55%	105796	0.75%	3.03%
DE6 Hamburg	0.99%	86083	0.61%	
DE7 Hessen	6.00%	397288	2.82%	
DE71 Darmstadt				44.56%
DE72 Gießen				28.62%
DE73 Kassel				16.04%
DE8 Mecklenburg-Vorpommern	0.79%	60853	0.43%	
DE9 Niedersachsen	5.39%	834369	5.92%	

DE91 Braunschweig				8.24%
DE92 Hannover				16.06%
DE93 Lüneburg				31.20%
DE94 Weser-Ems				43.16%
DEA Nordrhein-Westfalen	5.67%	2658496	18.86%	
DEA1 Düsseldorf				42.53%
DEA2 Köln				44.12%
DEA3 Münster				35.43%
DEA4 Detmold				11.98%
DEA5 Arnsberg				25.24%
DEB Rheinland-Pfalz	7.26%	465324	3.30%	
DEB1 Koblenz				34.61%
DEB2 Trier				7.88%
DEB3 Rheinhessen-Pfalz				40.04%
DEC Saarland	12.32%	194606	1.38%	
DED Sachsen	2.92%	367014	2.60%	
DED1 Chemnitz				34.70%
DED2 Dresden				17.73%
DED3 Leipzig				45.05%
DEE Sachsen-Anhalt	4.99%	295561	2.10%	47.72%
DEF Schleswig-Holstein	1.88%	354044	2.51%	19.01
DEG Thüringen	4.78%	94185	0.67%	33.34
Germany		14093712	100.00%	

Source: Own elaboration based on data compiled by the Working Group on Environmental Economic Accounting of the Länder's Statistical Offices and on the Structural Business Statistics

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