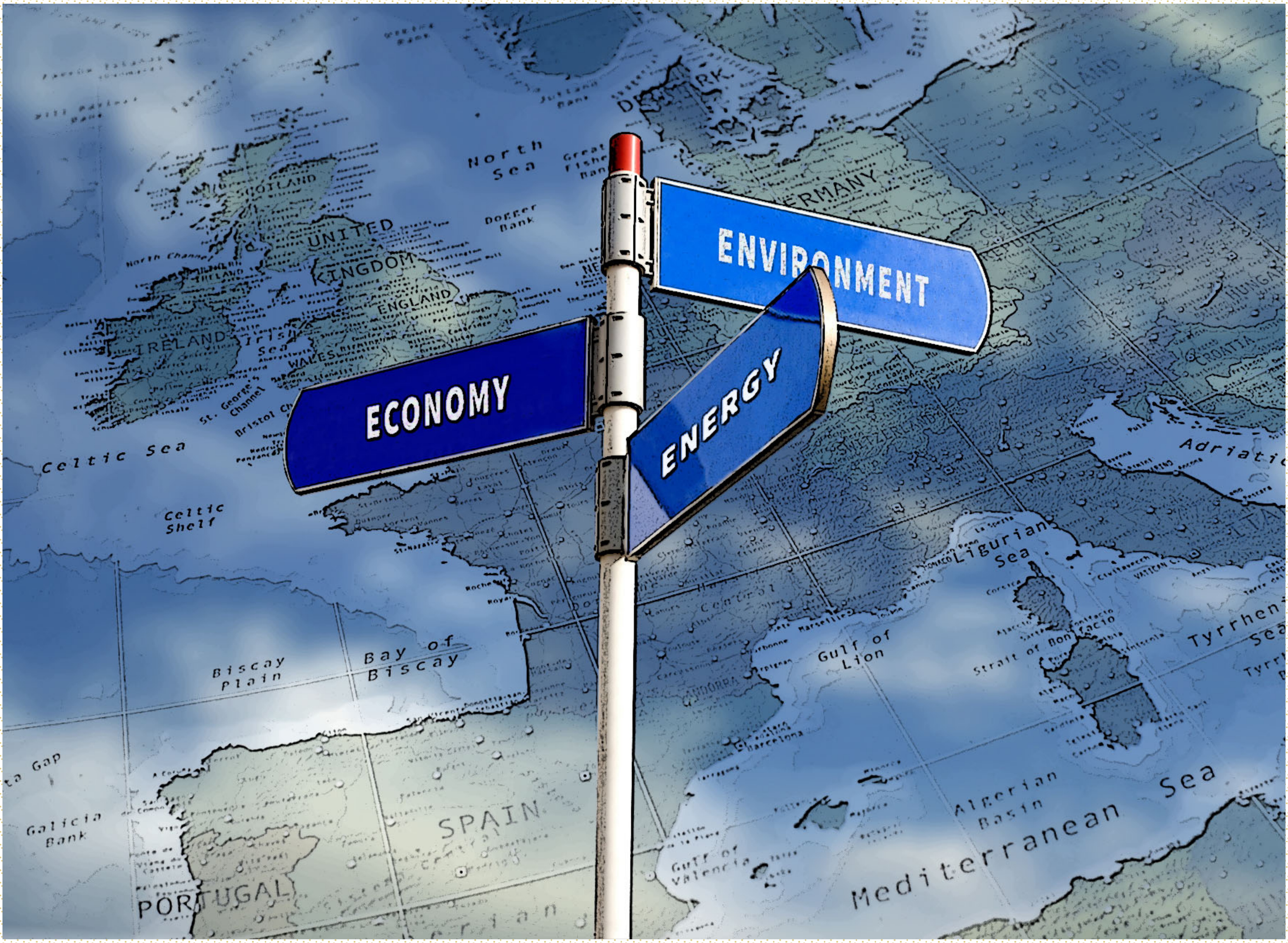


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# Energy and CO2 Emissions in the EU's Economies

Master in Energy for Sustainability

2014

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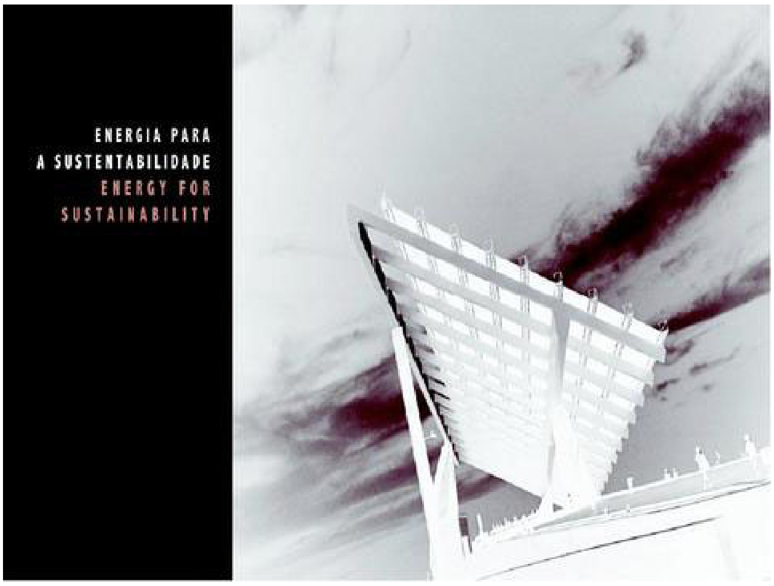
Universidade de Coimbra

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# Energy and CO2 Emissions in the EU's Economies

Dissertation submitted for the degree of Master's in Energy for Sustainability

*Supervisor:* Professor Luís Cruz

2014

UNIVERSIDADE DE COIMBRA

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## Abstract

Sustainability has been traditionally focused in the three pillar model - Economy, Ecology and Society - all considered to be interconnected and mutually enforcing pillars. One of today's major challenges is to tune environmental sustainability with economic growth and welfare by decoupling resources use and environmental degradation from the growth of the economy. However, the continuous growing demand for energy and resources - to sustain human needs and economic growth - and corresponding consequences on climate change are challenging this objective.

The main aim of this work is to assess these energy-economy-environment interactions by focusing on the analysis of energy and CO2 emissions intensities through a comparative examination of their recent progress in the EU countries, using data from the World Input Output Database (WIOD). The analysis of the progresses achieved in these indicators will be performed both by assessing whether resources use and/or environmental degradation are decoupling from the growth of the economies, and by the decomposition of the overall rates of change of energy and CO2 emissions into the different explanatory effects contributing to such progression (using a LMDI-Logarithmic Mean Divisia Index approach).

One of the major contributions expected from this work is to derive policy recommendations from the analysis of energy and CO2 emissions intensity trends, with a greater geographical and temporal focus than prior studies (by exploiting the international dimension of the WIOD).

Assessing decoupling became evident that to accomplish the important move towards more energy (resource) and CO2 emissions (impact) efficient economies there are still many improvements to be made. All countries have increased Gross Domestic Product (GDP) but a noteworthy number of them are still increasing energy use and/or CO2 emissions. Further, although the less developed EU regions (East) are registering interesting structural improvements they still have a long way to go until reaching the higher stages of development. Accordingly, if the economic activity growth in the East countries is particularly desirable to get closer to the richest EU countries, it reinforces the governments and the EU institutions' need to analyze the other explanatory effects in order to improve the intensity indicators in this European region. To this, there is the need to combine the already interesting results in terms of the intensity effects with improvements to be achieved by moving to less energy (and CO2 emissions) intensive structures of these economies.



***Keywords:*** Sustainability, Energy Policy; Energy Intensity, CO2 Emissions Intensity; Decoupling; Decomposition Analysis.

## Resumo

A sustentabilidade é geralmente associada à interligação e reforço mútuo de três pilares – a Economia, a Ecologia e a Sociedade. Um dos maiores desafios da sociedade atual é o de conciliar sustentabilidade ambiental com crescimento económico e bem-estar humano, utilizando os recursos de forma eficiente e protegendo o ambiente. No entanto, a crescente procura de energia e recursos - para satisfazer as necessidades humanas e o crescimento económico - e correspondente impacto em termos de alterações climáticas têm colocado em causa este desafio.

O principal objetivo deste trabalho é o de estudar as interações energia-economia-ambiente através de uma análise comparativa da evolução recente das intensidades (energética e das emissões de CO2) nos países da UE, usando dados da *World Input Output Database (WIOD)*. A avaliação do progresso destes indicadores será concretizada analisando, por um lado se o uso de recursos e/ou a degradação ambiental seguem a mesma tendência do crescimento das economias e, por outro através da decomposição das taxas de variação do uso de energia e das emissões de CO2 em fatores explicativos dessa evolução (usando a abordagem *LMDI-Logarithmic Mean Divisia Index*). A partir desta avaliação, com um foco geográfico e temporal mais alargado que estudos anteriores (explorando a dimensão internacional da WIOD) procede-se à derivação de recomendações de política.

Comparando a evolução das intensidades com o crescimento do Produto Interno Bruto (PIB), torna-se evidente que para atingir uma UE mais eficiente há ainda um longo caminho a percorrer. Todos os países viram crescer o PIB, mas há um número considerável de países onde o uso de energia e/ou as emissões de CO2 ainda continuam a aumentar. Assinala-se igualmente que as regiões menos desenvolvidas (Leste) da UE, apesar de estarem a alcançar resultados interessantes ao nível da estrutura da economia, estão ainda longe de atingir os níveis de desenvolvimento de outras regiões. Deste modo, e sendo o crescimento da atividade económica particularmente desejável nestes países (de forma a convergirem para os patamares dos mais desenvolvidos), sai reforçada a necessidade dos governos nacionais e das instituições Europeias se focarem na evolução de outros fatores explicativos, de modo a melhorar os indicadores de intensidade desta região europeia. Para o efeito há necessidade de combinar os já razoavelmente bons resultados em termos de eficiência energética com melhorias a alcançar ao nível da transição para uma estrutura das economias menos intensiva no uso de energia (recursos) e na geração de emissões de CO2 (impactos).

***Palavras-chave:*** Sustentabilidade, Política Energética, Intensidade Energética, Intensidade das Emissões de CO2; Análise de Decomposição.

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# I. Introduction

The Paris Summit of the European Economic Community (Community, 1972) is often used to spot the beginning of the European Union's (EU) environmental policy. The environmental policy has developed remarkably in the past four decades, becoming an essential area of European politics (Baldock, 2013). From 1973 to 2012, many of the ideas behind "sustainable development" have been emerging in the six Environmental Action Programs (EAP) meanwhile adopted. Today, the EU has some of the most progressive environmental policies in the world.

Initially, EU environmental policy was rather inner looking. More recently, however, the Union has demonstrated a growing leadership in global environmental governance. The role of the EU in securing the ratification and entry into force of the Kyoto Protocol (in the face of US opposition), as well as the EU's leader role in its successor – the Copenhagen Accord (UNFCCC, 2009) – are examples in this regard. Accordingly, one of the top priorities of EU environmental policy is fighting climate change, and this makes the environmental and the energy policies even more interconnected than before.

In 2007, the member states agreed that, by 2020, the EU is to use 20% renewable energy, to reduce carbon dioxide (CO2) emissions by at least 20% compared to 1990 levels, and 10% of the overall fuel quantity used by cars and trucks should be running on renewable energy such as biofuels (EREC, 2013). This is considered to be one of the most ambitious moves of an important industrialized region to fight climate change. Further, on December 2011, through the Communication "Energy Roadmap 2050" (European Commission, 2011), the EU has committed to reducing greenhouse gas emissions to 80-95% below 1990 levels by 2050 (in the context of necessary reductions by developed countries as a group). In this "Energy Roadmap 2050" the European Commission explores the challenges posed by delivering the EU's decarbonization objective while at the same time ensuring security of energy supply and competitiveness. This clearly reinforces the guidance of the EU energy policy throughout the last decades by the continuous search for a balanced management amid the opportunity costs of three critical goals: energy security, environmental protection and economic growth (Cruz and Barata, 2011).

Fighting climate change thus requires putting together and exploring the interconnections between energy, environmental and economic policies and, thus, is much in line with the pursuance of sustainability.

Sustainability has been traditionally focused in the three pillar model - Economy, Ecology and Society - all considered to be interconnected and mutually enforcing pillars. Indeed, the Sustainable development approach considers the integration of economic development, social progress and environmental protection (often measured through Gross Domestic Product (GDP) analysis, employment and impacts on Greenhouse Gas (GHG) emissions, respectively).

One of today's major challenges is to tune environmental sustainability with economic growth and welfare by decoupling resources use and environmental degradation from the growth of the economy. However, the continuous growing demand for energy and resources - to sustain human needs and economic growth - and corresponding consequences on climate change are challenging this objective.

Further, improving energy efficiency has received growing attention as a key component of sustainable development that would tackle energy security and poverty while addressing climate change concerns. E.g., at the EU level, in 2012 was adopted the Energy Efficiency Directive in reaction to the fact that EU Member States were not on track with the 20% reduction of primary energy consumption by 2020 (EEA, 2013a). According to the IEA (2012), efficiency improvements in the use of energy could alone achieve the 31% of the emission reduction necessary to halve emissions by 2050 compared to 2009 levels. This study intends to add to the analysis of energy and CO2 emissions intensities through a comparative examination of their recent progress in the EU countries.

Accordingly, the main aim of this research is to contribute to raising the level of general awareness of the complex interactions between energy, economic and environmental issues. For this, the energy use and the CO2 emissions embodied in the economic activity, as well as the corresponding energy and emission intensities, will be assessed for the 27 EU countries, using data from the World Input Output Database (WIOD). Further, through the analysis of corresponding trends, this study also intends to analyze whether resources use and/or environmental degradation are decoupling from the growth of the economies, as well as to estimate the explanatory effects of the rates of change of aggregate energy use and CO2 emissions.

Accordingly, one of the major contributions expected from this work is to provide an analysis of energy and emission intensity trends, with a greater geographical and temporal focus than prior studies, by exploiting the international dimension of the WIOD database. The processed information has the potential to help police makers to make better-informed decisions.

To fulfill its objectives, this study is structured as follows: In Chapter 2 there is a discussion on energy use, CO2 emissions released and corresponding intensities, as well as on the analysis of their changes, particularly through the concepts of Decoupling and Decomposition Analysis. Chapter 3 encloses the crucial information on how the empirical analysis is performed and provides a brief review of the theory and methods, as well as a description of the calculation procedures and data treatment requirements. Chapter 4 presents the main results and its discussion, firstly by analyzing energy and emission intensity trends and secondly by decomposing the different explanatory effects contributing to such progression, for each of the 27 EU countries. Chapter 5 concludes with a summary of the most important findings and the derivation of corresponding policy recommendations.

# II. Energy-economy-environment interactions: Scope of analysis

Several of the earth's crucial environmental problems derive from the energy demand to sustain human needs and economic growth. Indeed, all goods and services produced in an economy are directly or indirectly associated with energy use and, as current energy production and use patterns rely heavily on the combustion of fossil fuels, also to $CO_2$ emissions (Cruz, 2002). Therefore, this work intends to assess these energy-economy-environment interactions by focusing on the analysis of energy and $CO_2$ emissions intensities and their trends in the 27 EU member states. The analysis of the progresses achieved in these indicators will be performed both by assessing (resource and impact) decoupling and by the decomposition of the rates of change of energy and CO2 emissions in their main explanatory effects.

## 1. Energy and CO2 intensities

Energy efficiency improvements are generally considered as (one of) the best strategy to reduce CO2 emissions, to limit the energy dependence and to alleviate the effects of oil price increase. Most EU countries have been implementing energy efficiency programs and there is the need to monitor the energy performance achieved in order to evaluate the impact of these policies and to tune them for the near future. Besides the assessment of each countries' case it is also particularly relevant to compare the experience – both in terms of policy measures and in terms of results – of the different countries (Medener, 2013).

Economy-wide energy efficiency indicators have been developed and applied for evaluating, monitoring and explaining country comparisons in energy performance. Energy efficiency occurs when the level of service is maintained with reduced amounts of energy used. However, at the level of the aggregate economy, energy efficiency is not a meaningful concept because of the heterogeneous nature of the output. Accordingly, when multiple technologies or multiple products underlie what is being compared it is crucial to distinguish between energy intensity and energy efficiency. Indeed, while it would not be sensible to compare e.g. the energy efficiency of steel production with the energy efficiency of ethanol production, it is possible to compare the energy intensity for all the industry sectors.

Therefore, it is not surprising that energy intensity has been a particularly relevant issue in many energy studies and the focus of many policy programs to lower anthropogenic CO2 emissions and thus combat climate change (Liddle, 2012). Assumptions about energy intensity and how it changes often form the backbone of energy use and CO2 emissions projections. Policies to decrease energy intensity are generally recognized as an important means to reduce energy-related CO2 emissions and save exhaustible fossil fuel resources - coal, oil and natural gas (Farla and Blok, 2001), while simultaneously promoting economic growth (Wang, 2013).

In general terms, energy intensity is measured as the quantity of energy required per unit of output or activity, so that using less energy to produce a product reduces its intensity. Thus, high (low) energy intensities indicate a higher (lower) cost of converting energy into wealth.

Energy intensity is a ratio and thus there are several variants of the indicator, taking into consideration different elements in the numerator and/or in the denominator of the ratio. Nevertheless the most common measure of energy intensity is drawn from the International Energy Agency's (IEA), namely total primary energy supply (TPES)[1] divided by GDP. Largely, both the principles of analysis and the procedures to estimate energy intensities can be applied almost straightforward to (energy-related) CO2 emissions intensities.

## 2. The analysis of Decoupling

The analysis of energy and CO2 intensities through time is closely interconnected with the concept of decoupling. The OECD was the first international body to adopt the concept of resource decoupling, treating it as one of its main objectives in the 'OECD Environmental Strategy for the First Decade of the 21st Century'. Since then the term decoupling has been applied in several situations and to innumerous subjects, generally to translate the idea of using less resources per unit of economic output and/or of breaking the link between "environmental bads" and "economic goods" (UNEP, 2011).

[1] TPES accounts for all the energy consumed within a country (including energy imports and excluding energy exports); in addition, it adjusts for the energy consumed in producing electricity and, as such, is different from delivered energy (also called net energy or total final consumption (TFC)). Thus, TPES measures the total amount of energy used by a country in that country's economic activity. Because of the energy losses incurred in generating electricity and the increased use of electricity as a final energy supply, TFC is less than TPES, although the ratio of TFC to TPES has been declining in OECD countries to an average of 0,72 (Liddle, 2012).

In this work it is first considered the distinction between resource and impact decoupling, and then between relative and absolute decoupling.

On the one hand, resource decoupling means reducing the rate of use of resources (e.g. energy use) per unit of economic activity (GDP) and thus could be referred to as increasing resource productivity. On the other hand, impact decoupling requires increasing economic output while reducing negative environmental impacts (e.g. CO2 emissions), and thus could be referred to as increasing eco-efficiency.

Figure 1 (UNEP, 2011) illustrates the two types of decoupling, applied to sustainable development, namely resource decoupling and impact decoupling.

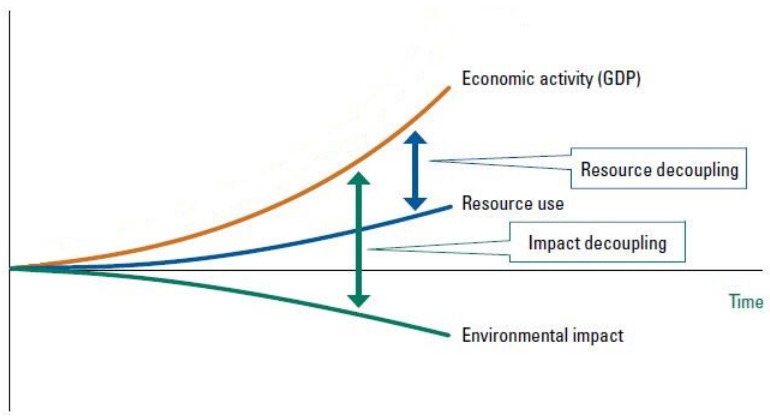



**Figure 1 - Resource and Impact Decoupling**

Indeed, to grow without damaging the environment, economies need to decouple from its ecological impact. This can result from technological progress (e.g. by moving from heavy industry to services, using renewable energy, recycling or increasing energy and material efficiency, and thus decreasing the amount of CO2 emissions released into the atmosphere) and social development (which may reduce anthropogenic CO2 emissions by having a more educated society with higher awareness of the climate concerns). If an economy is growing, then efficiency gains have to happen faster than the growth.

Further, when an economy is growing it is particularly relevant to distinguish between relative and absolute decoupling. Relative decoupling (of resources or impacts) means that the growth rate of the environmentally relevant parameter (resources used or some measure of environmental impact) is lower than the growth rate of a relevant economic indicator (e.g. GDP). Absolute decoupling, in contrast, means that resource use (or environmental impact) declines, despite of the growth rate of the economic driver.

## 3. Energy and CO2 emissions changes: Decomposition Analysis

The analysis of energy use and CO2 emissions changes are also meaningful as it has potential to highlight signals of human development and progress, namely through its connection with changes in the economic structure, fuel mix, and/or the technological level of a country (Sun, 2002). E.g., the IEA (2004) reports that the energy intensity of final consumption of the OECD countries has declined by a third between 1973 and 1998, due to declines in sub-sectoral energy intensities - manufacturing, households, transportation and services (which accounted for approximately 80% of the energy intensity reduction), and to structural changes in consumption (accounting for the remaining reduction).

Decomposition Analysis provides important insights regarding trends in both energy use and energy intensity changes. Changes in aggregate energy intensity are usually decomposed into a structural effect (the impact associated with the output structure of an economy) and an intensity effect (the impact associated with changes in sectoral energy intensity) (Wang, 2013). Further, this type of analysis allows for an extension to the trends in CO2 emissions and CO2 emissions intensity. When analyzing the changes in aggregate emission intensity two additional effects are measured; energy-mix effect (the impact associated with changes in the sectoral energy mix) and emission-factor effect (the impact associated with changes in the carbon emission factors).

Such decomposition analysis is particularly relevant when comparing countries, as they typically have and use different energy (re)sources, diverse degrees of economic specialization, and present different sizes (both in terms of the overall population and of the overall scale of the economy), and thus it is important to distinguish how much of the overall evolution of an aggregate is due to the progress of specific components.

# III. Methodological background and Data

In this chapter the methods and data used are described. First with the fundamental concepts (IO tables and environmental extensions) behind WIOD. Secondly with the explanation of the data treatment necessary. Finally the different methods used to perform the analysis are explained.

## 1. National Accounts

The System of National Accounts (SNA) is a standardized accounting system representing all economic activities in a given national economy. Its origin dates back to the 1920s, but it was first after World War II that a standardized system of national accounts was established internationally, under the auspices of the United Nations. The first version was published in 1953, followed by revisions in 1968, 1993 and 2008, and it is under continuous development. The European System of Accounts (ESA), updated in 2010, is the equivalent system used by the EU member countries (EEA, 2013b). This kind of structured and comprehensive data framework, comprising sectoral data for both domestic and external consumption and production, allows for the derivation of several macro-economic indicators (such as, e.g.: Gross Domestic Product (GDP), National Income, Gross Value Added of industry branches, Trade Balance and Net Savings) as well as for performing comparisons between countries and/or regions. It is also important to notice that this data framework allows for the derivation of those indicators, but often specific measures (as, e.g., the GDP) are not just directly taken, rather there is the need to follow some procedures in order to estimate it. Further, specific procedures are also needed regarding e.g. currencies conversion and/or adjustments to measure at constant or at current prices, in order to then allow for comparisons between countries or for the analysis of the progress through time within a specific country. Some details on the adjustments needed for particular purpose will be presented in a following section regarding the needs for the empirical assessment proposed in this work.

## 2. The classic Input-Output modelling framework

The SNA also provides the detailed data required for the implementation of Input-Output (IO) approaches. In an IO approach the economic structure is defined in terms of sectors, and this provides a modelling framework for asking specific questions about the relationship between economic structure and economic action. Moreover, extensions of the traditional input-output model can be performed, making particularly explicit the link between the level of economic activity in a country, its corresponding impact on the environment, and/or the corresponding energy interactions. Thus, such an approach provides a consistent and systematic tool to evaluate impacts of measures regarding the achievement of both pollution control and sustainable development (Cruz, 2002).

The simplest way to represent a national economy is breaking it down into a two sector model, only with industries on one side and households on the other. The two establish connections via transactions, physical and monetary flows. Households represent the largest final user of products, industries represents the production of those.

Figure 2 (EEA, 2013b) represents a closed economy, thus the production of goods and services and its final use are closely related.

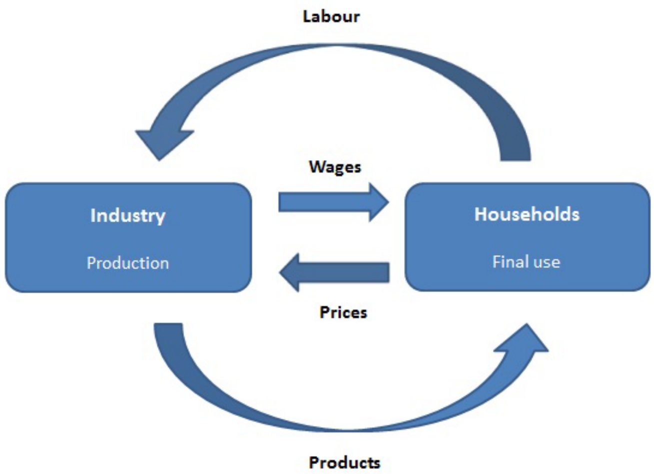



**Figure 2 - Simplified 2-sector model of a national economy**

A more disaggregated way to present the flows shown above is through a T-account table (Table 1), in which on the left is represented the production of goods and services and on the right the use of those products.

**Table 1 - Simple T-account for domestic production**

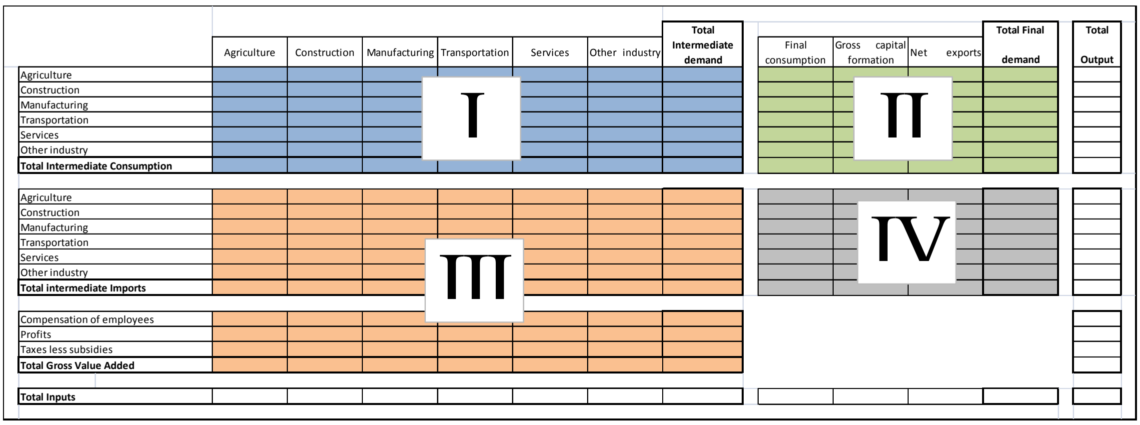
| Inputs | | Outputs |
|---|---|---|
| • Intermediate products supplied for domestic production | | • Intermediate products used for domestic production |
| • Imported intermediate products | | |
| • Gross Value Added | | • Final use of domestic production |
| ☐ Compensation of employees | | ☐ Final consumption expenditure |
| ☐ Profits | | ☐ Gross capital formation |
| ☐ Taxes less subsidies | | ☐ Exports |
| ***Input for domestic production*** | = | ***Output from domestic production*** |

*Source: Adapted from EEA (2013b)*

The total value of inputs for domestic production should be exactly balanced with the value of the outputs from domestic production, as everything which is produced is used, either as a final or as an intermediate good.

Among the fundamental information used in input-output analysis figures the flow of products from each industrial sector, considered as a producer, to itself and to each of the other sectors, considered as (intermediate) consumers. This representation can be also named as an inter-industry transactions table - Quadrant I in Table 2.

**Table 2 - Input-Output Transactions table**




*Source: Adapted from* Miller and Blair (1999)

In Table 2 each economic activity is represented simultaneously in a column and a row. Reading by rows, on the left hand side (Quadrant I) there are the intermediate products for use by the other sectors of the economy, while the right hand side (Quadrant II) shows the end destination (households, government and export) of final products from each economic activity (e.g., electricity is sold both to businesses in other sectors as an input to their production but also to residential consumers as a final product). Reading by columns, Quadrant I shows the domestically produced intermediate goods that are inputs to each economic activity, and Quadrant III shows the imported (intermediate goods) inputs, as well as the non-industrial inputs (mentioned as the Gross Value Added) required by a particular industry to produce its output. Finally, the monetary values of products imported directly for final use are added in underneath the final use matrix (Quadrant IV).

In its most basic form, an input–output model consists of a system of linear equations, each one describing the distribution of an industry's product throughout the economy. The corresponding description, below, follows very closely the form used by Cruz (2009).

The total output of a sector i ($X_i$) can be delivered for intermediate or for final demand by the following equation:

$$X_i = \sum_j X_{ij} + Y_i$$

**Equation 1- Output**

in which $X_{ij}$ represents the value of input from sector *i* to sector *j* and $Y_i$ represents the total final demand for sector *i*. Considering constant returns to scale, the output equation of one generic sector becomes:

$$X_i = \sum_j a_{ij} X_{ij} + Y_i$$

**Equation 2 - Output with returns to scale**

where the coefficients $a_{ij}$, defined as the delivery from sector *i* to *j* per unit of sector's *j* output, are known as the technical or technological coefficients.

To represent a nation's productive system there is a system of *n* linear simultaneous equations, each one describing the distributions of one sector's product through the economy. In matrix form one can represent it as:

$$\mathbf{A}x + y = x$$

**Equation 3 - Production**

in which **A** is the matrix of the technological coefficients, $y$ is the vector of final demand and $x$ is the vector of corresponding total outputs.

Using the basic concepts of matrix algebra, with **I** as the unit matrix, the expression can be reorganized to give:

$$x = (\mathbf{I} - \mathbf{A})^{-1} y$$

**Equation 4 - Fundamental matrix representation of IO analysis**

This corresponds to the fundamental matrix representation of input-output analysis, and the inverse matrix $(\mathbf{I} - \mathbf{A})^{-1}$ is known as the Leontief inverse matrix, whose elements are denoted by $\alpha_{ij}$, representing the total amount of commodity $i$ required both directly and indirectly to deliver one unit of final demand of commodity $j$.

The basic Leontief input–output model is generally constructed from observed economic data for a specific geographic region or country. In practice, the number of industries considered may vary from only a few to hundreds or even thousands.

## 3. Environmental extensions of the Input-Output framework

Briefly stated, monetary input-output (IO) tables give insight into the value of economic transactions between different sectors in an economy, including output for exports, capital formation and final government and private consumption. They allow the calculation of the value added that each sector contributes to the final output of an economy.

Most of the extensions to the basic input–output framework are introduced to incorporate additional detail of economic activity, such as over time or space, to accommodate limitations of available data or to connect input–output models to other kind of economic analysis tools. E.g., such monetary IO tables can be 'extended' with environment related information for each sector, such as its emissions or resource use, then having the potential to provide powerful tools for environmental related policy analysis.

Indeed, since the late 1960s the input–output framework has been extended by many researchers to account for natural resources use and environmental pollution generation and abatement associated with inter-industry activity. These studies can be considered as benchmarks of an approach that would be further developed by some energy analysts during the 1970s and the 1980s, extending the use of I-O analysis to consider energy-economy interactions.

Over time, the modeling approaches have become more and more complex, to allow, for example, the consideration of global environmental issues such as the greenhouse effect and the resulting climate change problem. This had led to the development of numerous theoretical models and empirical studies that combine both perspectives, making it hard to distinguish between environment and energy models, and therefore it become usual to talk about 'energy-economy-environment' models (Cruz et al., 2005).

Table 3 represents schematically an Environmentally Extended IO Table.

**Table 3 - Schematic representation of an environmentally-extended IO table**

| | Agriculture | Construction | Manufacturing | Transportation | Services | Other industry | **Total Intermediate demand** | Final consumption expenditure | Gross capital formation | Net exports | **Total Final demand** | **Total Output** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Agriculture | | | | | | | | | | | | |
| Construction | | | | | | | | | | | | |
| Manufacturing | | | | I | | | | | II | | | |
| Transportation | | | | | | | | | | | | |
| Services | | | | | | | | | | | | |
| Other industry | | | | | | | | | | | | |
| **Total Intermediate Consumption** | | | | | | | | | | | | |
| Agriculture | | | | | | | | | | | | |
| Construction | | | | | | | | | | | | |
| Manufacturing | | | | | | | | | IV | | | |
| Transportation | | | | | | | | | | | | |
| Services | | | | | | | | | | | | |
| Other industry | | | | III | | | | | | | | |
| **Total intermediate Imports** | | | | | | | | | | | | |
| Compensation of employees | | | | | | | | | | | | |
| Profits | | | | | | | | | | | | |
| Taxes less subsidies | | | | | | | | | | | | |
| **Total Gross Value Added** | | | | | | | | | | | | |
| **Total Inputs** | | | | | | | | | | | | |
| Coal | | | | | | | | | | | | |
| Oil | | | | | | | | | | | | |
| Gas | | | | | | | | | | | | |
| Nuclear | | | | V | | | | | VI | | | |
| Electricity | | | | | | | | | | | | |
| CO2 Emissions | | | | | | | | | | | | |
| **Total Environmental pressures** | | | | | | | | | | | | |

*Source: Adapted from Miller and Blair (2009)*

As before, columns are inputs required for production and rows are the outputs of that activity.

Departing from Table 2, Quadrants V and VI are added right below the economic matrices in order to extend an IO table now with environmental pressures. It represents environmental inputs to, and outputs from, the economic branches (Quadrant V) and environmental pressures resulting directly from final use (Quadrant VI).

Further, such tables allow for the analysis from two complementary perspectives: production and consumption. As Cruz and Barata (2011) present, according to the 'components' of the (total) final demand considered, it is possible to distinguish environmental pressures attributable to the domestic consumption of goods and services produced in a country, from that attributable to exports, as well as to estimate the levels of environmental inputs or impacts ‘embodied’ in the country’s imports. Regarding the production perspective, the environmental intensity (which is the environmental pressure per monetary unit of output) of different economic sectors can be compared. On the other hand, from the consumption perspective, the products that indirectly cause the majority of environmental pressures can be identified and the environmental performance of different product groups compared. This is a key piece of analysis in today's global economy where a large proportion of pressures caused by our consumption are being released overseas.

## 4. The World Input Output Database

The main data source to be used in this work is the World Input Output Database (WIOD). This database is built on national accounts data, which was developed within the Seventh Framework Programme (FP7) of the European Commission. It has two main advantages with respect to previously available data sources. First, throughout the data collection effort, harmonization procedures were applied to ensure international comparability of the data. This ensures data quality and minimizes the risk of measurement errors which are rather unlikely to occur. Moreover, since the data collection is consistent and fully comparable across countries, it allows one to describe and analyze efficiency gains at the sectoral and global level.

The core of the database is a set of harmonized national input-output tables, linked together with bilateral trade data in goods and services. National tables are typically only available for benchmark years and often not comparable over time but WIOD allow that comparisons. The results provide international tables at current (and previous) year prices, 35 industries by 59 products, for 41 regions in the world. Based on this, annual world input-output tables are derived for the period from 1995 to 2009 (Timmer, 2012).

The environmental satellite data are defined such as to cover the broadest range of environmental themes as reasonably achievable while maintaining a data quality that is well grounded in the empirical availability of primary data. In general terms, the variables cover: use of energy; emission of main greenhouse gases; emissions of other main air pollutants; use of mineral and fossil resources; land use; and water use.

Most if not all environmental variables that are needed to fill the data framework derive from sources (e.g. energy statistics, water statistics, etc.) that use a different framework, not compatible with national accounts. Data transformations were therefore necessary to achieve conceptual consistency.

For this study, the database assessed displays a time series with the information detailed in Table 4, below, for the 27 EU countries.

**Table 4 - WIOD data assessed**

| | |
|---|---|
| **National Input-Output Tables (NIOT)** | • National Input-Output tables (NIOT) at current prices (35 industries by 35 industries) |
| **Socio-Economic Accounts (SEA)** | • Industry output, value added, at current and constant prices (35 industries) |
| **Environmental Accounts** | • Gross energy use by sector and energy commodity<br>• $CO_2$ Emissions modeled by sector and energy commodity |

*Source: Timmer (2012)*

The 27 EU member countries considered in this study are presented in Table 5.

**Table 5 - The 27 EU member countries considered**

| | | | | | | |
|---|---|---|---|---|---|---|
| Austria | Czech Republic | France | Ireland | Luxembourg | Portugal | Spain |
| Belgium | Denmark | Germany | Italy | Malta | Romania | Sweden |
| Bulgaria | Estonia | Greece | Latvia | Netherlands | Slovak Republic | United Kingdom |
| Cyprus | Finland | Hungary | Lithuania | Poland | Slovenia | |

*Source: Timmer (2012)*

It is worth to mention that since July 2013 the EU was enlarged to 28 member countries with the accession date of Croatia, but this country is not here considered for reasons of data (un)availability.

Table 6 presents a list of the energy commodities aggregation used for this study and the WIOD codes provided in the database.

Table 6 - Energy commodities

| | WIOD Code | Flow |
|---|---|---|
| **Coal** | HCOAL | Hard coal and derivatives |
| | BCOAL | Lignite and derivatives |
| | COKE | Coke |
| **Oil** | CRUDE | Crude oil, NGL and feedstock's |
| | DIESEL | Diesel oil for road transport |
| | GASOLINE | Motor gasoline |
| | JETFUEL | Jet fuel (kerosene and gasoline) |
| | LFO | Light Fuel oil |
| | HFO | Heavy fuel oil |
| | NAPHTA | Naphtha |
| | OTHPETRO | Other petroleum products |
| **Gas** | NATGAS | Natural gas |
| | OTHGAS | Derived gas |
| **Nuclear** | NUCLEAR | Nuclear |
| **Electricity** | ELECTR | Electricity |
| **Renewables** | BIOGASOL | Biogasoline |
| | BIODIESEL | Biodiesel |
| | BIOGAS | Biogas |
| | OTHRENEW | Other combustible renewables |
| | HEATPROD | Heat |
| | HYDRO | Hydroelectric |
| | GEOTHERM | Geothermal |
| | SOLAR | Solar |
| | WIND | Wind power |

*Source: Timmer (2012)*

Finally, the level of industry disaggregation is presented in Table 7.

**Table 7 - WIOD industry disaggregation (35)**

| |
|---|
| Agriculture, Hunting, Forestry and Fishing |
| Mining and Quarrying |
| Food, Beverages and Tobacco |
| Textiles and Textile Products |
| Leather, Leather and Footwear |
| Wood and Products of Wood and Cork |
| Pulp, Paper, Paper , Printing and Publishing |
| Coke, Refined Petroleum and Nuclear Fuel |
| Chemicals and Chemical Products |
| Rubber and Plastics |
| Other Non-Metallic Mineral |
| Basic Metals and Fabricated Metal |
| Machinery, Nec |
| Electrical and Optical Equipment |
| Transport Equipment |
| Manufacturing, Nec; Recycling |
| Electricity, Gas and Water Supply |
| Construction |
| Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel |
| Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles |
| Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods |
| Hotels and Restaurants |
| Inland Transport |
| Water Transport |
| Air Transport |
| Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies |
| Post and Telecommunications |
| Financial Intermediation |
| Real Estate Activities |
| Renting of M&Eq and Other Business Activities |
| Public Admin and Defence; Compulsory Social Security |
| Education |
| Health and Social Work |
| Other Community, Social and Personal Services |
| Private Households with Employed Persons |

*Source: Timmer (2012)*

## 5. Data treatment

As one of the most widely cited macroeconomic indicators for measuring sustainability through estimates of the decoupling effect, the Energy/GDP (or energy intensity) ratio has been the focus of a significant number of published studies. In this study it is also analyzed the progress of another indicator, the $CO_2$ emissions/GDP (or CO2 emissions intensity) ratio.

Data for the $CO_2$ emissions and energy use is available in Gigagrams (Gg) and Terajoule (TJ) respectively, with no manipulation needed. Thus, such information is directly taken from the WIOD.

Regarding the economic dimension, for the purposes of our analysis some preliminary adjustments and calculus are required regarding the way the relevant information is compiled in the WIOD. Indeed, there is the need to define the GDP estimation approach to follow, and to allow comparative analysis it is also required to express GDP at constant prices and also to perform some currency conversions, as follows.

### 5.1 Approaches to derive GDP from the IO Tables

The GDP is the final result of the economic activity of residents in a specified area within a given period of time. In order to calculate the GDP using the WIOD data some manipulation is needed, but first it is important to frame the concept and the different approaches to determine it. E.g., if one simply sums the total output of an economy there will be problems of double counting and the value obtained would be much higher than the actual GDP.

There are three different ways to calculate the GDP. These are the income, product, and expenditure approaches.

In the income approach, GDP is the sum of the incomes of all the individuals, taxes less subsidies on production and imports and gross operating surplus. However, the information available in the WIOD does not provide enough detail to calculate the GDP using this approach.

For the product approach, GDP is obtained through the sum of the gross value added ($VA$) (i.e. gross output ($GO$) minus intermediate consumption ($IC$)) at basic prices of the different industries, plus taxes ($T$) less subsidies ($S$) on products.

$$GDP = VA + (T - S)$$

**Equation 5 - GDP - product approach**

Finally, for the expenditure approach, GDP is the sum of the final consumption expenditure of resident families and non-profit institutions serving households (usually designated as the private consumption - $C$), and of public authorities (in this case commonly designated as public consumption - $G$) with the investment ($I$) and net exports ($XP$) to imports ($M$).

$$GDP = C + G + I + (XP - M)$$

**Equation 6 - GDP - expenditure approach**

Both of these last two approaches can be performed using the information available in the WIOD. As the main purpose of this study is focused on the energy (and CO2 emissions) intensity assessment, and this is more adequately done through the analysis of the input requirements to generate a given level of output (the columns analysis of the IO tables) the option is to follow the product approach.

As mentioned, gross value added (*VA*) is the sum of gross output (*GO*) minus intermediate consumption (*IC*).

$$VA = GO - IC$$

**Equation 7 - Value added**

Assessing the WIOD Socio Economic Accounts (SEA) one has in different sheets the values for *GO*, Intermediate Inputs (*II*) and *VA* for the different economies in the different local currencies. In this case *VA* is also the result of the subtraction of *II* to the *GO*.

$$VA_{SEA} = GO_{SEA} - II_{SEA}$$

**Equation 8 - Value Added from the WIOD**

The GDP calculation is not direct because *II* is different from *IC*, as in *II* is included the taxes (*T*) less subsidies (*S*) on products and International Transport Margins (*ITM*).

$$II = IC + (T - S) + ITM$$

**Equation 9 - Intermediate inputs**

Taxes less Subsidies on products and International Transport Margins can be found in the National Input Output Tables (NIOT) of the WIOD, but unlike the previously mentioned SEA, these tables are expressed in dollars. Thus, there is the needed to convert these values into the local currencies, which can be done using the exchange rates (*exc*) provided by the WIOD.

Consequently, in order to get *IC* one needs to subtract taxes less subsidies on products and International Transport Margins.

$$IC = II_{SEA} - [(T - S) + ITM]_{NIOT}$$

**Equation 10 - Intermediate consumption**

Decomposing Value Added, one gets:

$$VA_{SEA} = GO_{SEA} - IC$$

$$\Leftrightarrow VA_{SEA} = GO_{SEA} - \ [II_{SEA} - [(T - S) + ITM]_{NIOT}]$$

**Equation 11 - Value Added decomposition**

Using the product approach, all the components needed to calculate the nominal GDP value of each economy are then defined, as follows.

$$GDP = VA + (T - S)$$

$$\Leftrightarrow GDP_{nominal} = GO_{SEA} - \ [II_{SEA} - [(T - S) + ITM]_{NIOT}] + \ (T - S)_{NIOT}$$

$$\Leftrightarrow GDP_{nominal} = GO_{SEA} - II_{SEA} + (2 * (T - S) + ITM)_{NIOT}$$

$$\Leftrightarrow GDP_{nominal} = VA_{SEA} + 2 * (T - S)_{NIOT} + ITM_{NIOT}$$

**Equation 12 – GDP from the WIOD**

## 5.2 Converting monetary values at current prices into constant prices

Further, to estimate the trends in energy and CO2 emissions intensities it is important to use GDP values at constant prices, instead of current (or nominal) as the data provided by the WIOD. In this way, the effects of price fluctuations (inflation or deflation) are removed and one analyzes the real growth of the economy.

In theory, there are two alternative methods to convert nominal into constant values. On the one hand, using the NIOT at current and previous year prices and on the other hand using the value added price index provided in the SEA. However, while this study was being done, the WIOD removed the access to the NIOT at previous year prices[2]. Therefore, in practice, only the second method could be performed.

[2] Indeed, when contacted by succeeding emails, one of the managers of the WIOD (namely prof. F.R. Gouma, from the University of Groningen) gave the following justifications :

> *The website is no longer under construction, but the tables are. At this point we are still experimenting with alternative deflation methods of the WIOTs since earlier results were not satisfactory. Unfortunately, at this point there is no definitive deadline when new tables will be uploaded.*
>
> *Friday, December 06, 2013 10:15:02 AM*

The price index of the VA provided on the SEA uses 1995 as the base year. The base year preferred for this analysis and assessment is 2005, and therefore this requires a change in the base year. In order to perform that change two fundamental steps are required: first to calculate the price index deflator and then to employ that deflator to determine the new index.

The deflator for each year is the ratio between the price index (*PI*) of that year and the one of the previous year.

$$deflator_n = \frac{PI_n}{PI_{n-1}}$$

**Equation 13 - Deflator**

With this deflator it is relatively straightforward to put up an Index, being *t* the base year 2005. Indeed:

i. To calculate the Index after the base year one use the following equation:

$$Index_{t+n} = \left(\sum_{t+1}^{t+n} deflator\right) - (n-1)$$

**Equation 14 – Deflator - Index after the base year**

ii. In order to compute the values before the base year, a different equation has to be used:

$$Index_{t-n} = \left(\sum_{t-n}^{t} \frac{1}{deflator}\right) - (n-1)$$

**Equation 15 – Deflator - Index before the base year**

iii. The Index of the base year (2005) is 1.

Thus, in order to transform nominal values into 2005 constant prices one divides the nominal GDP values with the correspondent year Index.

---

*The tables that have been online in previous years' prices have been removed due to the fact that the construction methods leads to unsatisfactory results for total value added volumes (i.e. constant prices). We deflated the input output tables row-wise using gross output deflators of the exporting country. Value Added in PYP is then calculated as a residual. The problem is that the resulting VA figures do not closely match the volume Value Added Growth observed from the National Accounts. This is why we have taken the tables offline until we find a better method of deflating the tables while preserving Value Added (or GDP) growth rates as published in the National Accounts."*
*Tuesday, December 10, 2013 9:18:20 AM*

### 5.3 Currencies' conversion

GDP values expressed in US dollars at the WIOD were converted into each country's currencies, using the exchange rates provided by the WIOD. In order to compare intensity values amongst countries (instead of each country trends), it is necessary to use a single currency - Euro.

The Eurozone, or Euro area, is an economic and monetary union (EMU) of 17 EU member states (see Table 8) that from 1999 have adopted the Euro (€) as their common currency.

**Table 8 - Eurozone countries**

| Country | Euro's adoption date |
|---|---|
| Austria | 1999 |
| Belgium | 1999 |
| Cyprus | 2008 |
| Estonia | 2011 |
| Finland | 1999 |
| France | 1999 |
| Germany | 1999 |
| Greece | 2001 |
| Ireland | 1999 |
| Italy | 1999 |
| Luxembourg | 1999 |
| Malta | 2008 |
| Netherlands | 1999 |
| Portugal | 1999 |
| Slovakia | 2009 |
| Slovenia | 2007 |
| Spain | 1999 |

Thus, the 10 other countries considered in this study do not use the Euro, but rather specific currencies, as presented in Table 9.

**Table 9 - EU member states' currencies outside the Eurozone**

| Country | Currency |
|---|---|
| Bulgaria | lev |
| Czech Republic | koruna |
| Denmark | krone |
| United Kingdom | pound sterling |
| Hungary | forint |
| Lithuania | litas |
| Latvia | lats |
| Poland | zloty |
| Romania | leu |
| Sweden | krona |

For these 10 cases the European Central Bank's statistics provided the nominal effective exchange rate (which is a summary measure of the external value of a currency *vis-á-vis* the currencies of the most trading partners (ECB, 2013)).

Thus, even though the different currencies used, it is possible to compare the progression of energy and CO2 emissions intensities among the 27 member states.

## 6. Decomposition analysis of energy and CO2 emission changes

As mentioned in Chapter 2, the analysis of energy use and CO2 emissions changes, namely through the analysis of its decomposition into specific explanatory effects is particularly relevant to analyze both the progress of the indicator in a specific country and comparing the trends between countries.

There are two broad categories of decomposition techniques (Hoekstra and Bergh, 2003): using input–output techniques — structural decomposition analysis (SDA) and with disaggregation techniques — index decomposition analysis (IDA). Table 10 present the main characteristics of each of these decomposition techniques.

**Table 10 – Comparison of IDA with SDA decomposition techniques**

| | Application | Scope | Time series | Decomposition form | Factors included | Data needed | Effects studied |
|---|---|---|---|---|---|---|---|
| **IDA** | Flexible | Specific sector or economy wide | Annual time series | Additive and multiplicative | From two to eleven | Data with high or low aggregation | Only direct effect |
| **SDA** | Restricted to availability of IO tables | Whole of the economy | Benchmark years | Additive | Same number of factors | IO tables | Direct and indirect effects |

*Source: Adapted from Su and Ang (2012)*

The SDA approach is based on input–output coefficients and final demand from input–output tables, while the IDA framework uses aggregate input and output data that are typically at a higher level of aggregation than input–output tables. This basic difference also determines the main advantages and disadvantages of the two methods.

One advantage of SDA is that the input–output model includes indirect demand effects – demand for inputs from supplying sectors that can be attributed to the downstream sector's demand – so that SDA can differentiate between direct and indirect energy demands. The IDA model is incapable of capturing indirect demand effects.

The advantage of the IDA framework is that it can readily be applied to any available data at any level of aggregation. While input–output tables may only be available sporadically, IDA can be applied to data available in time series form (Ma and Stern, 2008). SDA is used primarily by researchers who are familiar with input–output (I–O) analysis and wish to extend it to study changes in energy consumption or emissions in the economy. In contrast, IDA studies are normally for a sector of energy consumption, such as transportation, industry or household, or its energy-related emissions (Su and Ang, 2012)[3].

As previously mentioned, in the due course of this study, some tables were removed from the WIOD, due to unsatisfactory results on the deflation process. These database problems made impossible the initial intention of computing a structural decomposition analysis (SDA) (precisely taking advantage of the time series for the NIOT at that time available in the WIOD). Accordingly, the disaggregation technique computed in this work is an index decomposition analysis (IDA).

An IDA begins with defining a governing function relating the aggregate to be decomposed to a number of pre-defined factors of interest. With the governing function defined, various decomposition methods can be formulated to quantify the impacts of changes of these factors on the aggregate (Ang, 2004). There are two main decomposition approaches: Divisia and Laspeyres index, to which a number of different

[3] The simplicity of IDA allows considerable flexibility in problem formulation. Many decomposition schemes designed to cater for different types of aggregates and decomposition methods have been proposed. In contrast, the fact that SDA is linked to the I–O tables reduces its flexibility but helps to introduce some special features that are not applicable to IDA. Other than the second-stage decomposition, such features include multi-regional SDA by considering the interregional feedback effects, having both demand-side and supply-side viewpoints, and linkages with neoclassical functions when analyzing input technology changes (Su and Ang, 2012).

methods have been proposed by researchers[4]. Laspeyres index measures the percentage change in some feature of a group of items over time, using weights based on values in some base year. The Divisia index is a weighted sum of logarithmic growth rates, where the weights are the components shares in total value, given in the form of a linear integral. In simple terms, the building block of methods linked to the Laspeyres index is based on the familiar concept of percentage change whereas the building block of methods linked to the Divisia index is based on the concept of logarithmic change (Ang, 2004). Ang (2004) classifies the IDA methods and recommends the use of a Logarithmic Mean Divisia Index (LMDI). Accordingly, this is the method chosen in this study to track economy-wide energy and CO2 emissions efficiency trends. The LMDI method description below follows very closely the one proposed by Ang (2005) .

Changes in industrial energy consumption ($D_{tot}$) may be studied by quantifying the impacts of changes in three different factors:

i. The overall industrial activity (activity effect - $D_{act}$);
ii. The activity mix (structure effect - $D_{str}$);
iii. The sectoral energy intensity (intensity effect - $D_{int}$).

Thus, energy consumption ($E$) can be presented as:

$$E = \sum_i E_i = \sum_i X \frac{X_i}{X} \frac{E_i}{X_i} = \sum_i X\, S_i I_i$$

**Equation 16 - Energy consumption decomposition**

In which $i$ represents the sectors, $X$ the overall output level, $S_i$ the activity share and $I_i$ the energy intensity of each sector.

There are two methods to calculate these effects, the additive and the multiplicative. In this study the chosen one is the multiplicative because it presents the effect variations in percentages, which allows for a better comparison between countries. Accordingly, with

[4] In the late 1970's and early 1980's, the methods used were based on the Laspeyres index while a decade later related studies proposed the Divisia index approach as an alternative. Thereafter, extensions and refinement of both methods have been made and the reported studies using the two approaches are now about equal in number. According to Ang (2004), there is no simple answer to which is the preferable method as some may be easily explained theoretically while others are more directly applied, each having its strengths and weaknesses. Generally, researchers and analysts need to consider at least four issues in method selection: theoretical foundation, adaptability, ease of use, and ease of understanding and result presentation.

the multiplicative decomposition the variation of $E$ is the ratio between the final energy consumption level and the initial one:

$$D_{tot} = E^T/E^0$$

**Equation 17 - Energy consumption change**

And can be broke down in the three effects mentioned (overall activity level, activity structure and sectoral energy intensity):

$$D_{tot} = D_{act}\, D_{str}\, D_{int}$$

**Equation 18 - Energy change decomposition’s effects**

These effects can be calculated as:

$$D_{act} = exp\left[\sum_i w_i \left(\ln\frac{X^T}{X^0}\right)\right]$$

$$D_{str} = exp\left[\sum_i w_i \left(\ln\frac{S_i^T}{S_i^0}\right)\right]$$

$$D_{int} = exp\left[\sum_i w_i \left(\ln\frac{I_i^T}{I_i^0}\right)\right]$$

$$w_i = \left[\frac{(E_i^T - E_i^0)\Big/(\ln E_i^T - \ln E_i^0)}{(E^T - E^0)\Big/(\ln E^T - \ln E^0)}\right]$$

**Equation 19 - Energy change explanatory effects’ calculation**

This analysis can be further extended in order to assess energy-related $CO_2$ emissions. For that, two more factors are added to the previously mentioned, namely:

iv. Sectoral energy mix (energy-mix effect - $D_{mix}$);

v. $CO_2$ emission factors (emission-factor effect - $D_{emf}$).

Therefore, total energy-related $CO_2$ emissions (*CO*), can be presented as:

$$CO = \sum_{if} CO_{if} = \sum_{if} X\frac{X_i}{X}\frac{E_i}{X_i}\frac{E_{if}}{E_i}\frac{CO_{if}}{E_{if}} = \sum_{ij} X\, S_i I_i M_{if} U_{if}$$

**Equation 20 - CO2 emissions decomposition**

In which $C_{if}$ represents the CO2 emissions arising from fuel $f$ in industrial sector $i$, $E_{if}$ is the consumption of fuel $f$ in industrial sector $i$, $M_{if}$ is the fuel-mix variable and $U_{if}$ is the $CO_2$ emission factor.

Consequently, the variation of $CO$ is the multiplication of the 5 different factors mentioned:

$$D_{tot} = D_{act}\, D_{str}\, D_{int}\, D_{mix}\, D_{emf}$$

**Equation 21 - CO2 emissions change decomposition's effects**

This can be calculated from:

$$D_{act} = exp\left[\sum_i w_{if}\left(\ln\frac{X^T}{X^0}\right)\right]$$

$$D_{str} = exp\left[\sum_i w_{if}\left(\ln\frac{S_i^T}{S_i^0}\right)\right]$$

$$D_{int} = exp\left[\sum_i w_{if}\left(\ln\frac{I^T}{I^0}\right)\right]$$

$$D_{mix} = exp\left[\sum_i w_{if}\left(\ln\frac{M_{if}^T}{M_{if}^0}\right)\right]$$

$$D_{emf} = exp\left[\sum_i w_{if}\left(\ln\frac{U_{if}^T}{U_{if}^0}\right)\right]$$

$$w_{if} = \left[\frac{(CO_{if}^T - CO_{if}^0)\Big/(\ln CO_{if}^T - \ln CO_{if}^0)}{(CO^T - CO^0)\Big/(\ln CO^T - \ln CO^0)}\right]$$

**Equation 22 - CO2 emissions change explanatory effects' calculation**

This decomposition method is used to study, for the 27 EU member states, the variation in energy and CO2 emissions from 1999 (*0*) to 2009 (*T*). Using the index method previously explained, the variation of the Output level (*X*) is considered in real terms (i.e. without the inflation/deflation effect).

# IV. Results and Discussion

This chapter presents and discusses the main results of this study. Firstly, regarding the estimates of energy use and CO2 emissions released, as well as the corresponding intensities. The analysis of energy and GDP trends also supports the assessment of each country's performance regarding (absolute or relative) resource decoupling, while the analysis of CO2 emissions and GDP trends indicates each country's successfulness achieving (absolute or relative) impact decoupling. Then, in subsection 2, there is the analysis of the LMDI decomposition of energy use and CO2 emissions released into their main explanatory effects.

Before such detailed analysis it is worth to establish an overview comparing the energy intensities for the 27 EU countries considered for 2009 (the most recent data available, and with the GDP for all the countries expressed in the same currency, namely Euro), as shown in Figure 3.

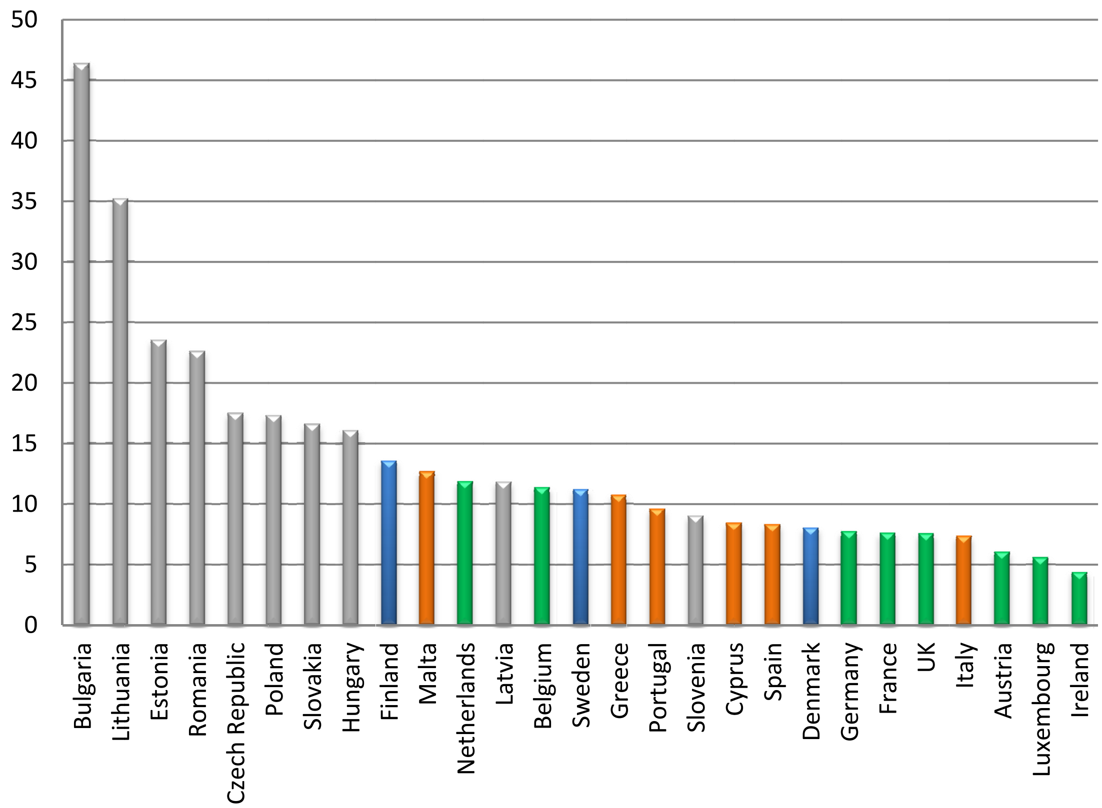



Figure 3 - Energy Intensity in the EU 27 (Tj/millions of Euro)

The observation of Figure 3 makes clear the wide range of values for the Energy Intensity (Tj/Euro) in the 27 EU countries, varying from 4.4 in Ireland to 46.4 in

Bulgaria. Further, into some extent, it is possible to identify some groups of countries taking into account on the one hand their position in the energy intensity “ranking”, and on the other hand their geographical proximity, similar weather patterns and expected level of technological progress within Europe. Accordingly, and as the comparative analysis and discussion of the results can be better structured with a subdivision of the 27 EU countries, it is considered as appropriate, for purposes of the analysis in this chapter, to consider 4 groups of countries, as presented in Table 11.

**Table 11 - EU 27 groups**

| Group | Countries |
|---|---|
| **East** | Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia |
| **South** | Cyprus, Greece, Italy, Malta, Portugal and Spain |
| **North** | Denmark, Finland and Sweden |
| **Center** | Austria, Belgium, France, Germany, Ireland, Luxembourg, Netherlands and UK |

The generality of the most energy intensive countries are comprised in the East group (which were not expected to have levels of productivity particularly high and most of them usually facing harsh climate conditions). Followed by the countries considered here as the North group, in which the weather patterns are ruthless (but in some part compensated by higher productivity). Next is the South group which in terms of energy needs is the more beneficiated (at least during winter) by the weather (mild) conditions. Finally, as the least energy intensive countries (with the exception of the northern countries of this group) one can find those here categorized in the Center group, which are expected to have the best combination between weather patterns and industries productivity.

## 1. Intensity and trends

In this subsection, energy use and CO2 emissions released and corresponding intensity trends of all the 27 EU members are assessed. Summary tables, with the main results analyzed in this Chapter, for each of the 27 EU countries, are presented in Appendix A and B.

### 1.1 Energy and Resource Decoupling

Figures 4 to 7 display, for the different groups of countries, the progress of energy use (expressed in Tj) and GDP (expressed in the local currencies of each country), as well as of the corresponding ratio, i.e. the energy intensity (Tj/Euro), from 1999 to 2009.

#### *a) The South countries*

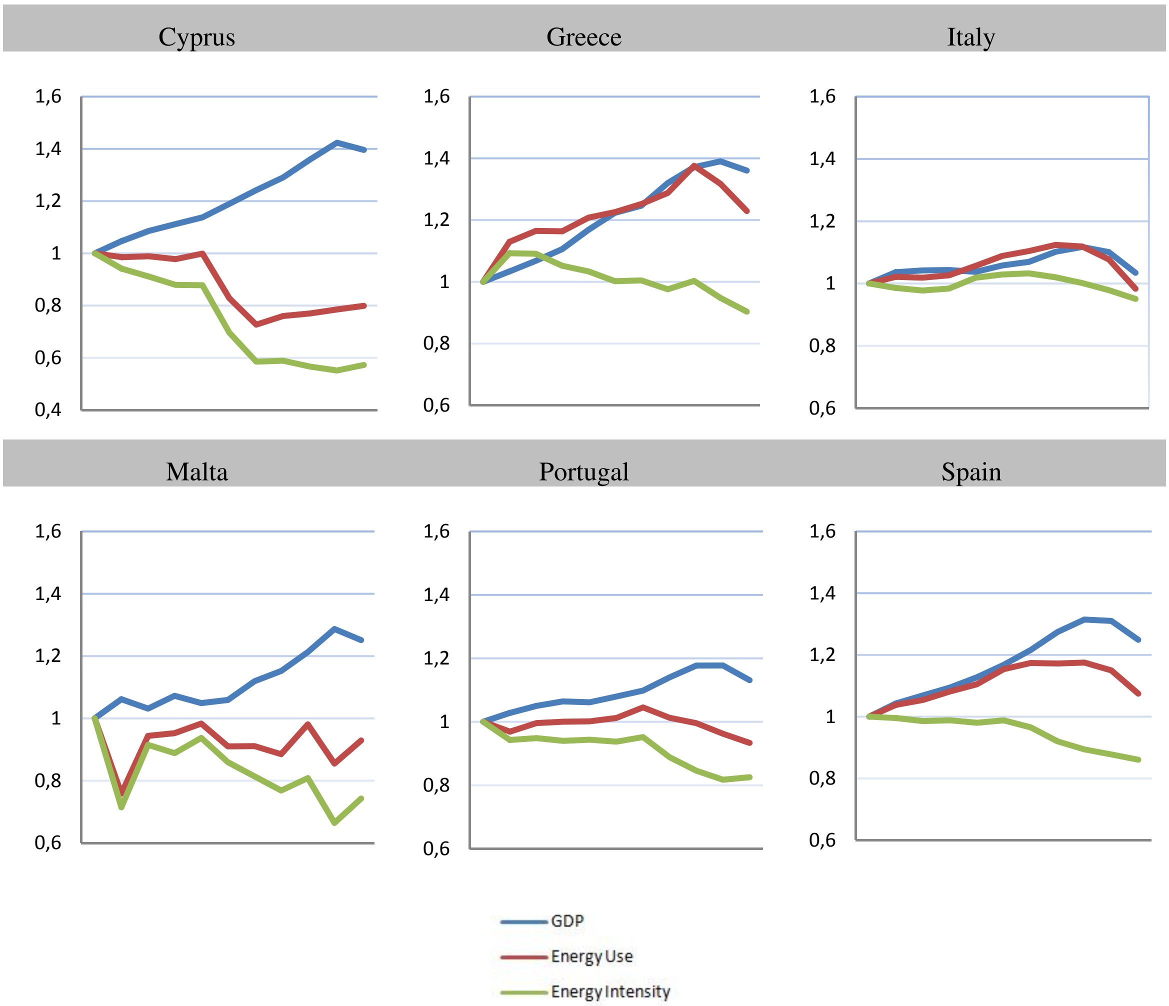



Figure 4 - Energy intensity in South countries (1999-2009)

The GDP, at constant (2005) prices, has grown in all the six countries of the South group in the period considered. The largest growth occurred in Cyprus and Greece, with rates over 30% through in this 11 year period. Malta and Spain had very similar rates of growth, around 25%. The two countries with lower growth were Portugal (with 13.1%) and Italy (with 3.4%).

Regarding energy use, only in two countries the amount of energy used in 2009 is higher than the one used in 1999, namely Greece and Spain. Accordingly, these can be considered as the only two countries in which there is no absolute resource decoupling. Actually Greece has severely increased energy use by 22.9% while on the opposite situation one can find Cyprus (decreasing 20.1%). Even though, all the six countries have reduced its energy intensity. The two greater reductions happened in the smallest consumers - Cyprus and Malta, followed by Portugal (17.5%), Spain (14%), Greece (9.6%) and finally Italy (4.9%).

### *b) The Center countries*

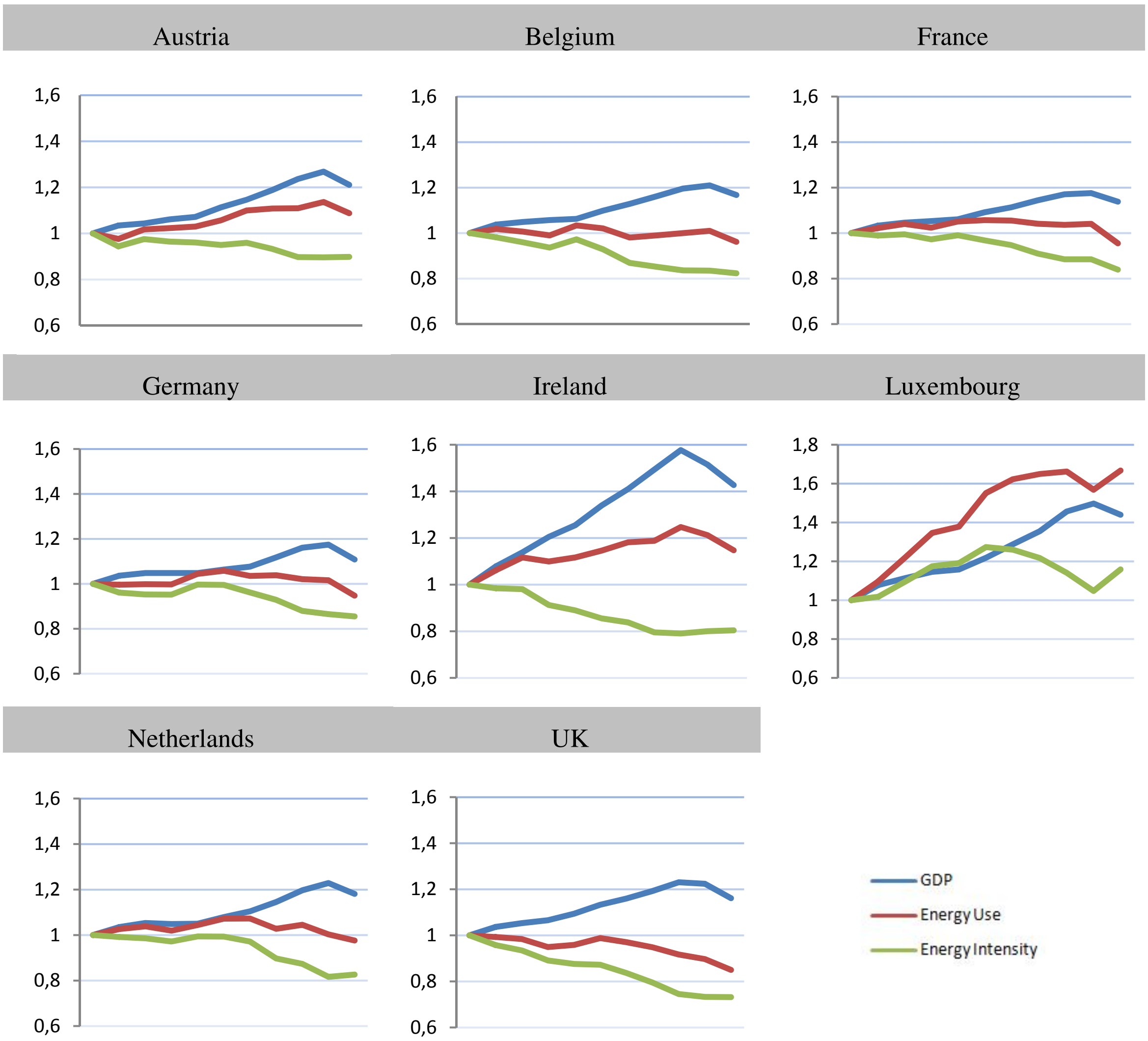



**Figure 5 - Energy intensity in Center countries (1999-2009)**

The highest growth on GDP (over 40%) is found in Luxembourg and Ireland. All the other grew positively, although at a smaller pace. On the other hand, Luxembourg increased dramatically the quantity of energy used (66.7%) and this makes this country to be the only in this group with no (absolute or relative) resource decoupling. Two other countries have also increased the energy use- Ireland and Austria, which lead them to achieve only relative resource decoupling. The five remaining countries have decreased the quantities of energy used, especially the UK (15%). Accordingly, the largest energy intensity reduction took place in the UK (26.8%) and the only country in which this indicator grew was the Luxembourg (15.8%).

### *c) The East countries*

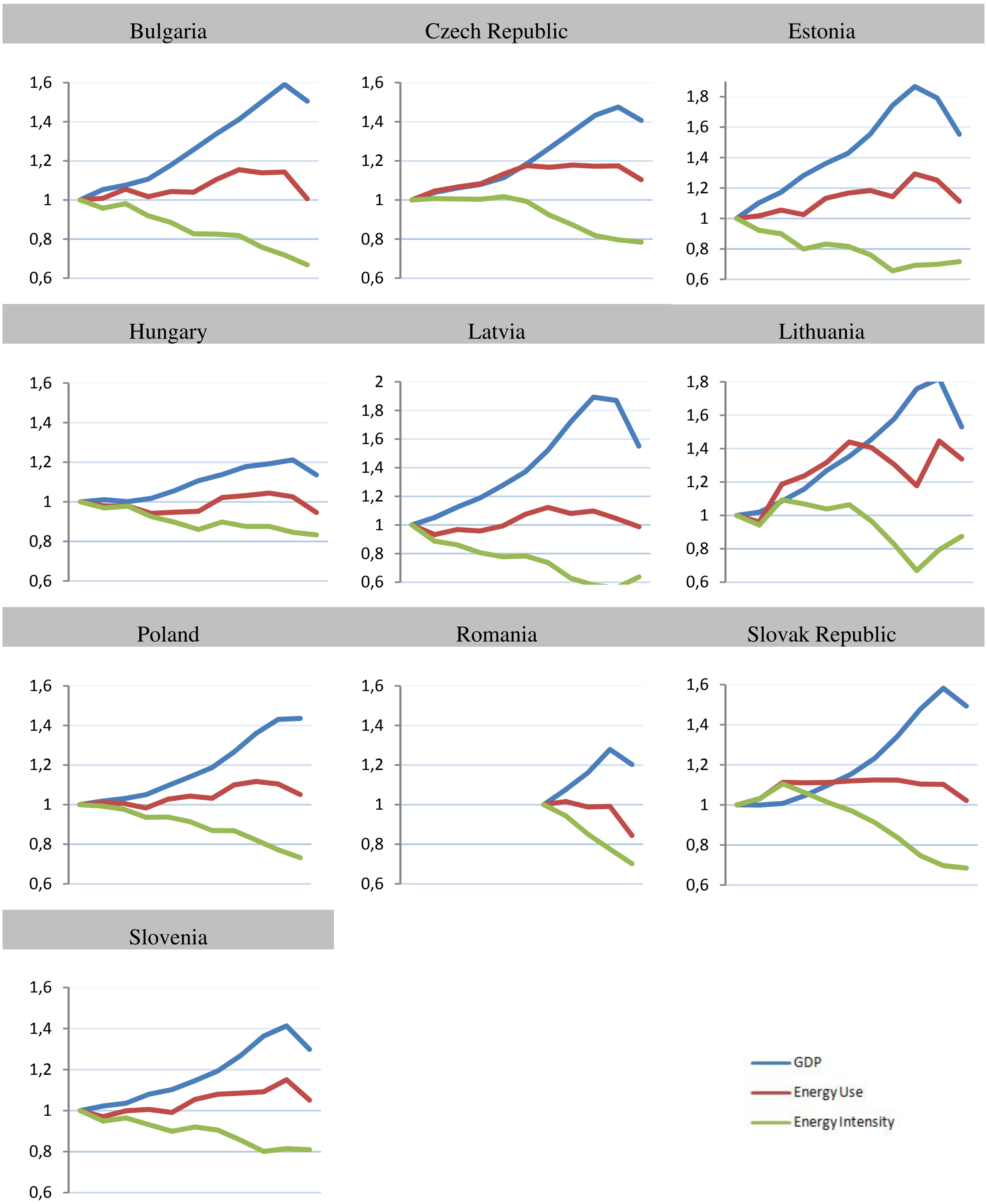



**Figure 6 - Energy intensity in East countries (1999-2009)**

The GDP growth rates in the East group of countries were substantially higher than in the other groups. Only Hungary had less than 20% (more precisely, 13.6%). Over the 50% mark one can find Estonia, Latvia, Lithuania and Bulgaria. Also unlike the other groups previously analyzed, only three out of these ten countries managed to reduce its energy use from 1999 to 2009. Latvia, Hungary and Romania[5] were then the only recording absolute resource decoupling. The seven remaining countries achieved relative resource decoupling. Despite the growth in the amount of energy used in the majority of the countries, the GDP growth compensated such increase, with the entire group presenting improvements in the energy intensity indicator. Latvia, Bulgaria and Slovakia with the highest intensity reductions, and Slovenia, Hungary and Lithuania on the other end.

### d) *The North countries*

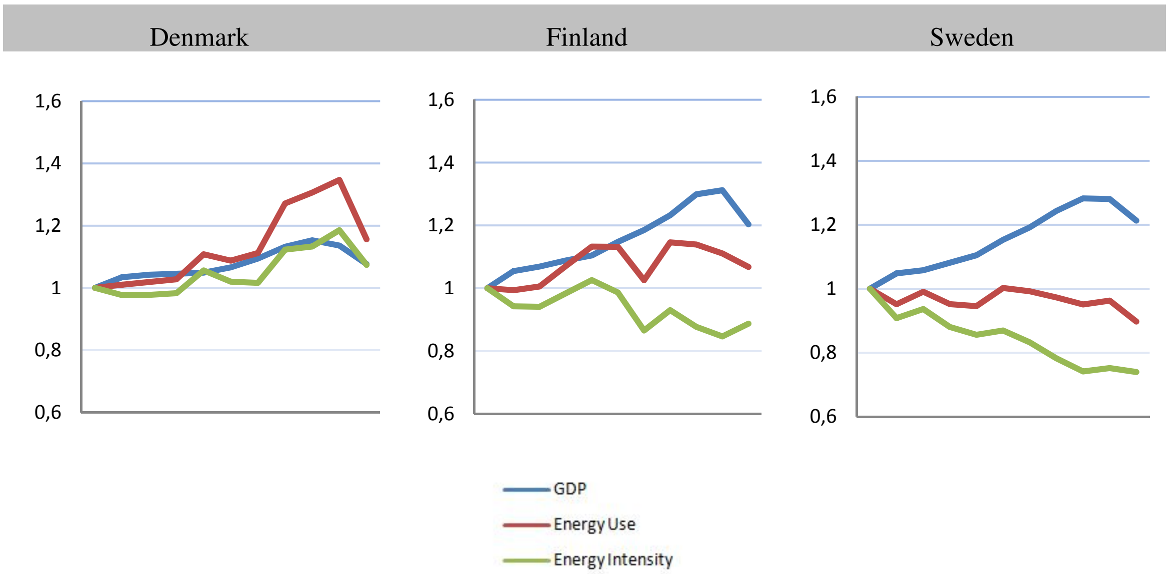



**Figure 7 - Energy intensity in North countries (1999-2009)**

Sweden and Finland have had similar GDP growth rate patterns (21.3% and 20.3%, respectively) while Denmark grew noticeably less (7.7%). Sweden and Finland showed improvements in the energy intensity indicator (26% and 11.3%, respectively) while Denmark decreased (in 7.4%) its energy intensity. In terms of resource decoupling the three countries achieved different results: Denmark increased the energy use in 15.6%, and thus it had no absolute or relative resource decoupling; Finland also increased the

[5] It is important to notice that the observation period considered for Romania (namely from 2005 to 2009) is smallest than the one considered for the other 26 countries, for reasons of data (un)availability and (un)consistency problems. The discussion of the results for Romania should, therefore, take this into account.

amount of energy used (6.8%) resulting in a situation of relative resource decoupling; and Sweden reduced its energy use in more than 10%, therefore being successful in terms of achieving a situation of absolute resource decoupling.

#### *e) The EU 27*

In summary, all the 27 countries have increased its GDP throughout this 1999-2009 period. The smallest growth (bellow 10%) happened in Italy and Denmark while the higher growth (over 50%) was experienced in the East countries. The majority of the East and North groups' countries have increased its energy use. Further, although more than half of the countries have increased the energy used from 1999 to 2009, only Denmark and Luxembourg did not achieved either relative or absolute resource decoupling. Thus, also only these two countries did not showed improvements in terms of the energy intensity indicator.

### 1.2 CO2 emissions and Impact Decoupling

Figures 8 to 11 show, for the different groups of countries, the progress of energy-related CO2 emissions released (expressed in Gg) and GDP (expressed in the local currencies of each country), as well as of the corresponding ratio, i.e. the CO2 emissions intensity (Gg/Euro), from 1999 to 2009.

*a) The South countries*

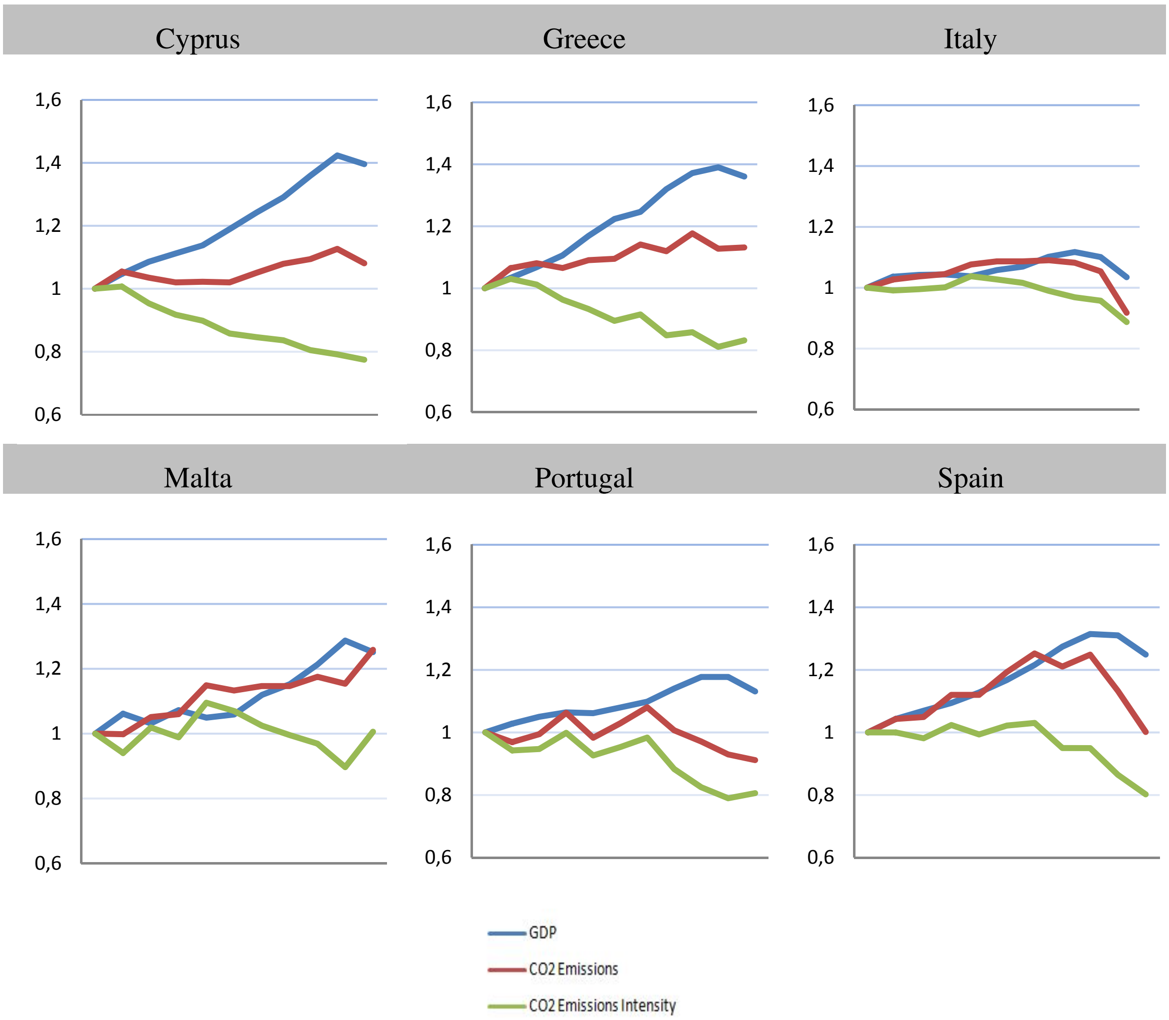



**Figure 8 – CO2 emissions intensity in South countries (1999-2009)**

Only in two countries the CO2 emissions have decreased throughout this period, namely Italy and Portugal. This means that these were the only countries where absolute impact decoupling occurred. Greece, Cyprus and Spain can be considered to have achieved relative impact decoupling, although they have registered CO2 emissions' increase. Malta saw its emissions growing by more than a quarter, with no decoupling at all from GDP. Malta is also the only country in which CO2 emissions intensity grew through this period. The highest CO2 emissions intensity reductions were found in Cyprus (22.6%), followed by Spain (19.8%), Portugal (19.4%), Greece (16.8%) and then Italy (11.3%).

### b) *The Center countries*

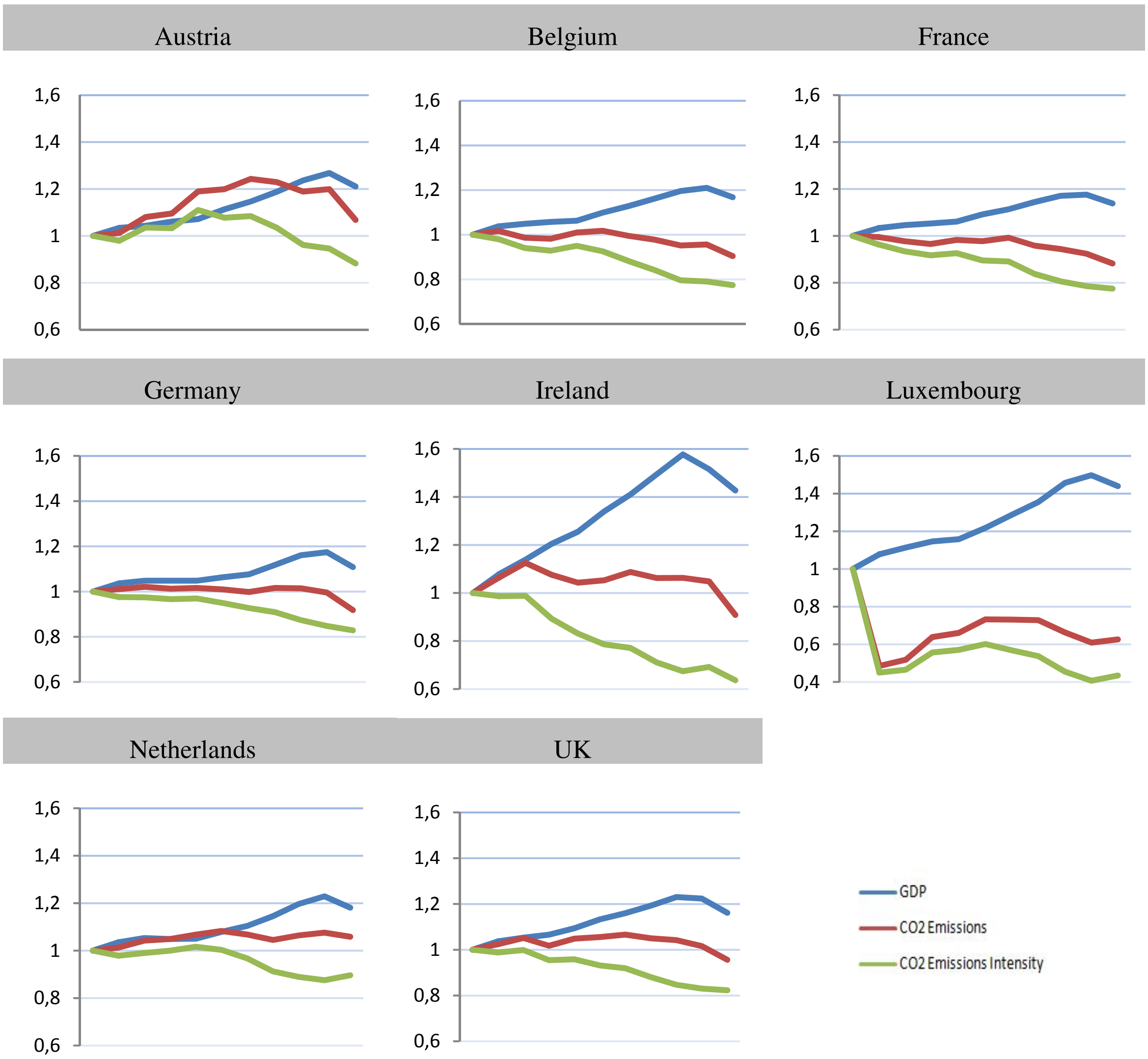



**Figure 9 - CO2 emissions intensity in Center countries (1999-2009)**

Only in two out of the eight countries the emissions grew from 1999 to 2009, namely Austria and Netherlands, although reporting a situation of relative impact decoupling. From the six cases of absolute impact decoupling, Luxembourg was the one that reduced CO2 emissions the most (by almost 40%). The entire group has reported CO2 emissions intensity reduction over the period, more significantly in Luxembourg and Ireland.

### c) *The East countries*

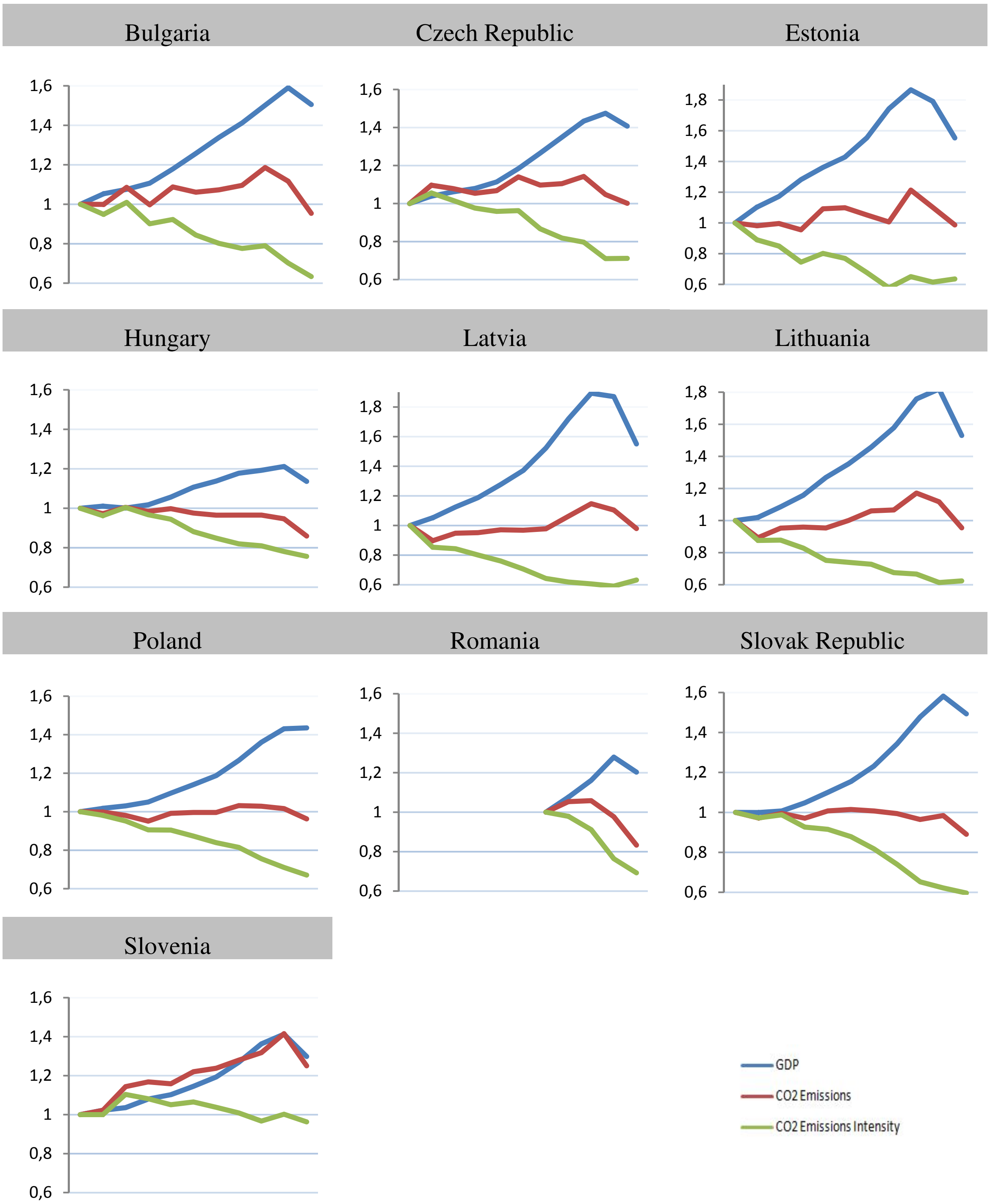



**Figure 10 - CO2 emissions intensity in East countries (1999-2009)**

CO2 emissions grew only in two out of the ten East countries, more precisely in Czech Republic (0.1%) and Slovenia (25%), the former achieving relative impact decoupling and the later was unsuccessful to decouple CO2 emissions from GDP. The eight other countries achieved a situation of absolute resource decoupling.

All the countries improved in terms of the CO2 emissions intensity indicator (the majority of them more than 30%, and. Slovenia with a poor performance - a 3.7% improvement).

### *d) The North countries*

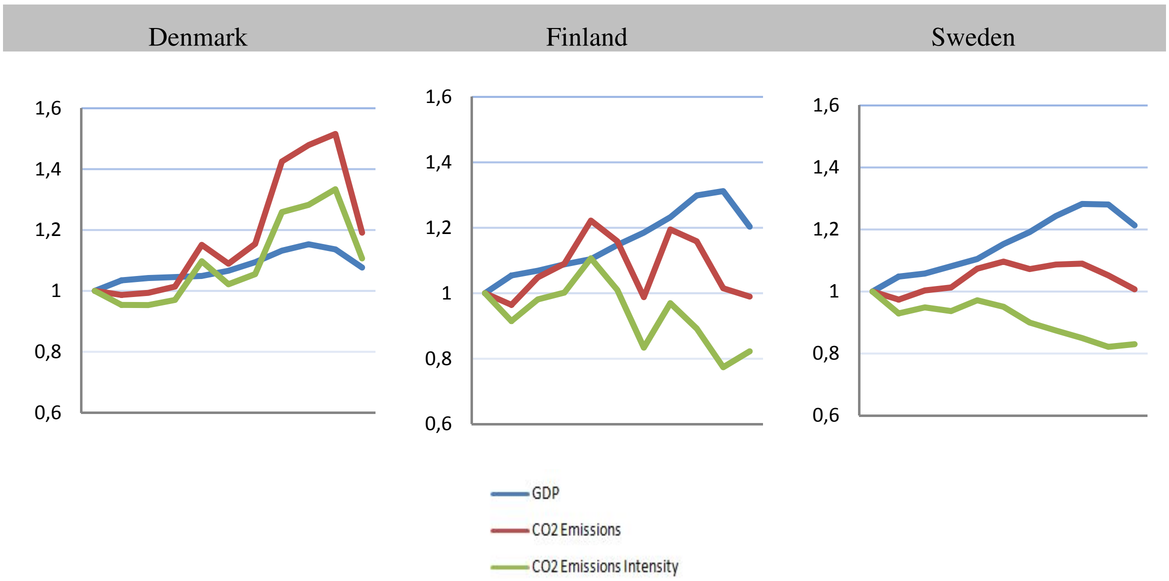



**Figure 11 - CO2 emissions intensity in North countries (1999-2009)**

Only Finland managed to reduce CO2 emissions in the period, thus achieving a situation of absolute impact decoupling. Sweden and Denmark increased emissions (0.7% and 19.1%), the former achieving relative impact decoupling and the later was unsuccessful to decouple CO2 emissions from GDP. Regarding CO2 emissions intensity, Sweden and Finland had similar decreases (17% and 17.7% respectively) and Denmark increased 10.7%.

### *e) The EU 27*

To sum up, a larger number of countries have been successful in achieving absolute impact decoupling (17) than those reaching resource decoupling (13). Three countries have not 'decoupled' at all, namely Denmark, Slovenia and Malta. Even though, Slovenia managed to reduce its CO2 emissions intensity. From the countries that have increased CO2 emissions, the group more represented is the one of the South countries while the East and Center groups are the most representative in terms of CO2 emissions reductions.

## 2. Index Decomposition Analysis

The LMDI decomposition that follows in subsection 2.1 presents the variation in the amount of energy used and how this amount would progress considering the activity, structure or intensity explanatory effects alone (i.e. a *ceteris paribus* analysis). Then, in subsection 2.2, follows a similar approach regarding the CO2 emissions released.

### 2.1 Energy Use

Table 12 summarizes the results for the energy decomposition exercise (according to the methodology presented in subsection III.6). After this overall presentation of the values estimated follows the analysis by groups of countries with the support of the corresponding graphs.

**Table 12 - Energy Decomposition explanatory effects**

| *Group* | *Country* | **Energy use change** (1999-2009) (Tj) | **Total Change** (%) $D_{tot}$ | **Activity** (%) $D_{act}$ | **Structure** (%) $D_{str}$ | **Intensity** (%) $D_{int}$ |
|---|---|---|---|---|---|---|
| South | Cyprus | -29885,6 | -20,1 | 47,2 | -38,8 | -11,3 |
| | Greece | 412126,1 | 22,9 | 38,3 | 11,9 | -20,6 |
| | Italy | -171854,5 | -1,7 | 7,2 | -14,5 | 7,2 |
| | Malta | -4995,7 | -7,1 | 37,7 | 4,8 | -35,6 |
| | Portugal | -105749,0 | -6,7 | 15,4 | -9,7 | -10,5 |
| | Spain | 541166,5 | 7,5 | 39,3 | 1,1 | -23,7 |
| | *Total/Average* | *640807,9* | *-0,9* | *30,8* | *-7,5* | *-15,7* |
| Center | Austria | 126505,3 | 8,7 | 29,5 | 4,8 | -19,9 |
| | Belgium | -145734,0 | -3,8 | 15,7 | 3,9 | -19,9 |
| | France | -630112,6 | -4,5 | 29,7 | 22,2 | -39,7 |
| | Germany | -990301,2 | -5,3 | 11,3 | 12,1 | -24,1 |
| | Ireland | 92610,9 | 14,7 | 67,9 | 38,6 | -50,7 |
| | Luxembourg | 74843,7 | 66,7 | 72,1 | -8,5 | 5,9 |
| | Netherlands | -160457,9 | -2,4 | 18,0 | 2,4 | -19,2 |
| | UK | -1909056,8 | -15,0 | 21,5 | -17,8 | -14,9 |
| | *Total/Average* | *-3541702,7* | *7,4* | *33,2* | *7,2* | *-22,8* |
| East | Bulgaria | 6978,1 | 0,6 | 131,2 | 15,9 | -62,5 |
| | Czech | 211856,6 | 10,4 | 62,1 | -26,2 | -7,8 |
| | Estonia | 25723,3 | 11,3 | 60,7 | -13,8 | -19,6 |
| | Hungary | -73316,4 | -5,4 | 36,0 | -19,2 | -13,8 |
| | Latvia | -1896,8 | -1,2 | 76,7 | -18,4 | -31,5 |
| | Lithuania | 186947,6 | 33,8 | 64,9 | 13,4 | -28,4 |
| | Poland | 245237,6 | 5,1 | 67,3 | 6,5 | -41,0 |
| | Romania | -116521,3 | -6,0 | 208,5 | -20,8 | -61,5 |
| | Slovakia | 21699,3 | 2,2 | 86,8 | -39,1 | -10,2 |
| | Slovenia | 13682,1 | 5,1 | 47,5 | 1,4 | -29,7 |
| | *Total/Average* | *520389,8* | *5,6* | *84,2* | *-10,0* | *-30,6* |
| North | Denmark | 217043,2 | 15,6 | 20,4 | -3,4 | -0,6 |
| | Finland | 137677,1 | 6,8 | 32,0 | -12,9 | -7,1 |
| | Sweden | -354511,5 | -10,3 | 20,9 | -2,5 | -23,9 |
| | *Total/Average* | *209* | *4,0* | *24,4* | *-6,3* | *-10,5* |
| ***EU 27 Total/Average*** | | *-2380296,0* | *4,5* | *50,6* | *-3,9* | *-22,8* |

### *a) The South countries*

Figure 12 highlight Greek and Spanish contributions to the South group's overall energy use increase through the period.

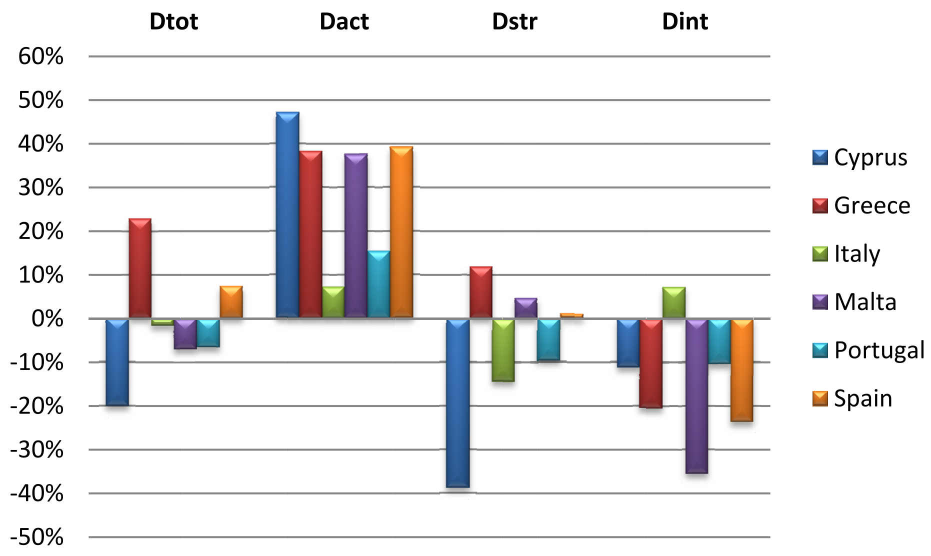



**Figure 12 - Energy decomposition explanatory effects in South countries**

The Portuguese industrial energy consumption decreased in the period considered. If only the activity effect were considered (i.e. the growth of economic activity) the Portuguese energy consumption would have grown 15.4% in this period. But the decrease (9.7%) in the structure effect (move to an economy with a sectoral structure less energy intensive) and (10.5%) in the intensity effect (sectoral energy efficiency improvements) exceeded the activity effect.

Further, as shown in Figure 13, changes in the output of each sector reinforce the results provided by the decomposition concerning the move to less energy intensive industries.

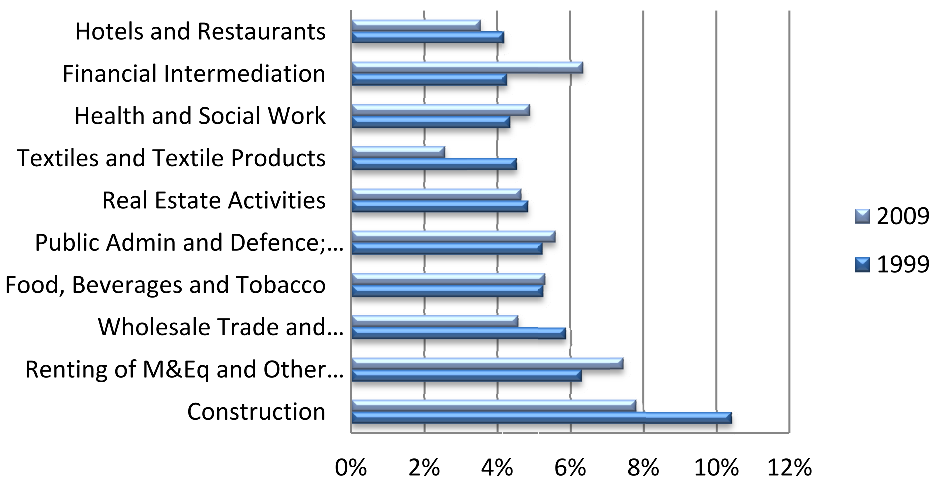



**Figure 13 - Share of the total output in Portuguese industries**

Indeed, e.g. there are two dominant cutbacks, Construction and Textile, and a significant raise in the Financial Intermediation sectors. The global industry output also grew more than 15% in the period.

As it was previously analyzed, only Greece and Spain did not manage to reduce energy use. Greece increased it in almost 23% and Spain in 7.5%. Even so, in both countries there were significant improvements in energy efficiency.

In relative terms, Cyprus had the best performance in the group, reducing energy use in more than 20%. Although the significant increase in the structure effect (47.2%) the achievements in the economic structure (38.8%) and in the energy efficiency (11.3%) allowed such reduction. As shown in Figure 14, this move to a less energy intensive structure can be significantly explained with the 'disappearance' of the Coke industry.

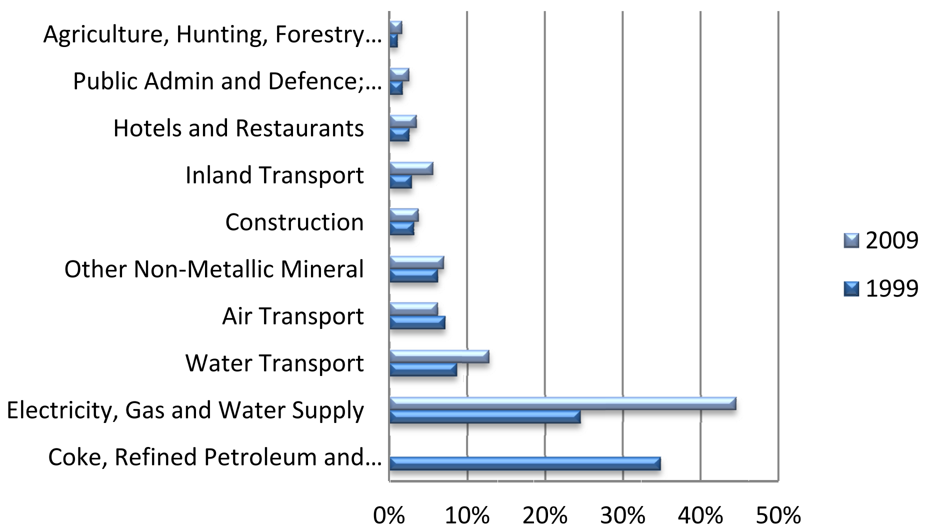



**Figure 14 - Share of the total energy use in Cyprus industries**

Italy was the only country which did not improve energy efficiency and Malta was the one that ameliorated the most.

Regarding the structure effect, Cyprus, Italy and Portugal moved to a less energy intensive structure while Spain, Malta and Greece did the opposite. In Greece and Malta the growth in energy use on the Water transport sector and in Spain in the Air transport sector might be the main responsible. These last three countries also had similar results regarding the activity effect.

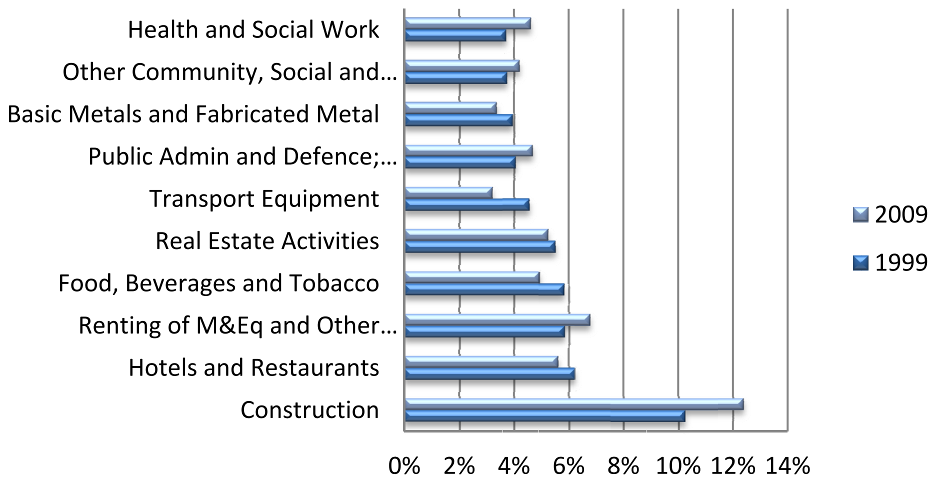



**Figure 15 - Share of the total output in Spanish industries**

It is also notable that the growth in the Construction sector in Spain represented the largest output increase amongst all industries.

### *b) The Center countries*

Figure 16 makes evident the UK's contribution to the Center group's overall energy use reduction.

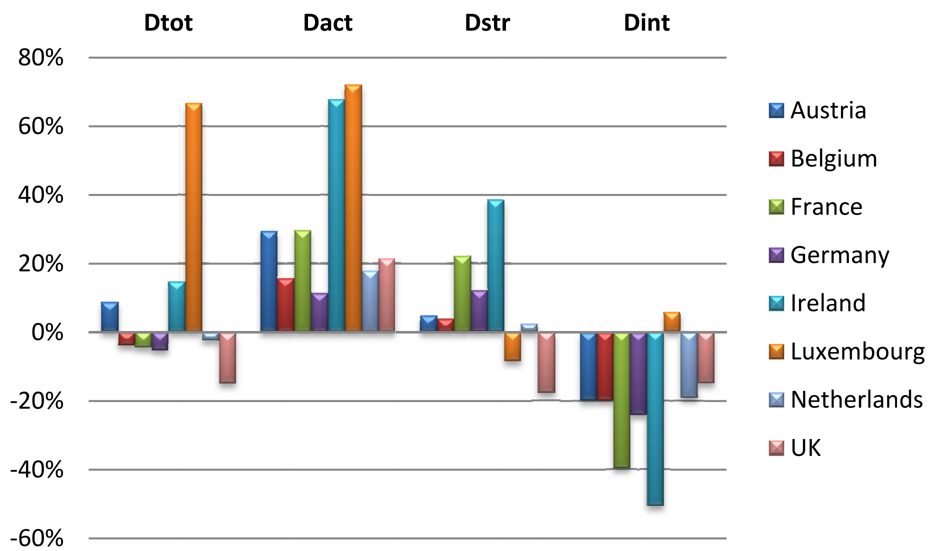



**Figure 16 - Energy decomposition explanatory effects in Center countries**

Among the Center countries it is noticeable that Luxembourg increased its energy use in 66.7%. One of the main reasons to justify this increase is the growth in the output. From 1999 to 2009 it grew from 16.1% to 53.1% in the top-5 most energy intensive industries and a total of 72.1% in all industries. Luxembourg has made improvements regarding a move to a less energy intensive structure but it is the only country within this group with a regression in terms of energy efficiency.

Ireland and Austria are the other two countries that have increased energy consumption. Ireland had remarkable improvements in energy efficiency but the high growth in the economic activity and the poor performance in terms of the structure effect exceeded the first positive effect. In Austria one of the main justifications comes from the growth in energy use in the Construction industry and the output growth in the Electricity sector.

France combined a considerable growth in the activity effect (29.7%) and a deterioration in terms of its structure (22.2%), but these were compensated by improvements in the energy efficiency (39.7%) to achieve an overall reduction (-4.5%) in energy use.

Netherlands, Belgium and Germany had similar results in the three explanatory effects, namely recording decreases in energy use, growth in the economic activity, more energy intensive industries and improvements in energy efficiency.

In terms of the structure explanatory effect, it is notorious that the UK (together with Luxembourg) moved to less energy intensive industries, as shown in Figure 17.

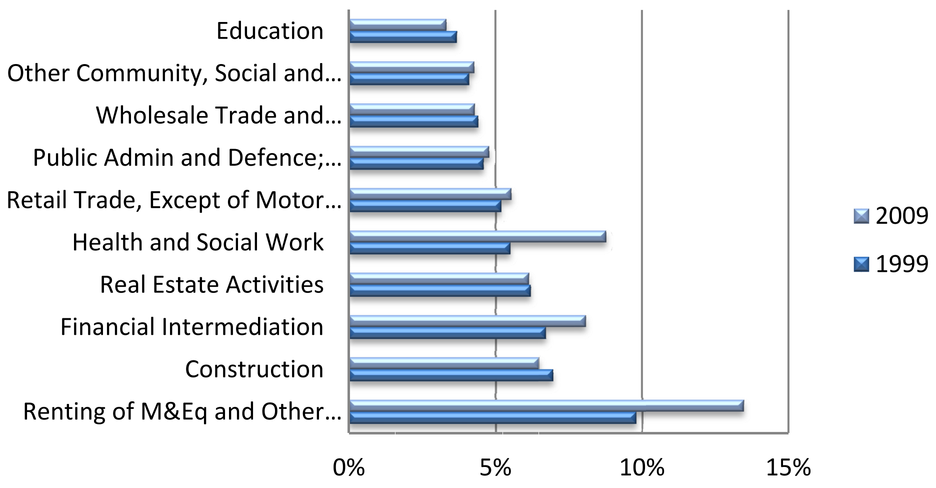



**Figure 17 - Share of the output in the UK's industries**

Indeed, the growth in the output of industries such as Health and Social Work and Renting are among the explanations for this shift.

### *c) The East countries*

Figure 18 show that all the countries from the East group observed an increase in the economic activity and improvements in terms of energy intensity.

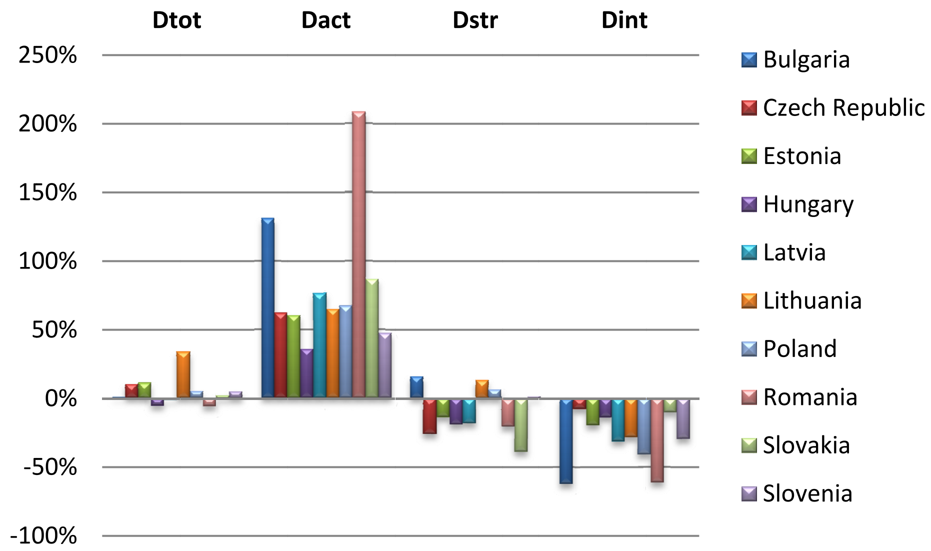



**Figure 18 - Energy decomposition explanatory effects in East countries**

Although only three of the ten East countries did manage to reduce energy use, all of them have reported improvements in energy efficiency and the majority had also improved in terms of the structure. Another particularity of this group is the remarkable expansion in the economic activity with eight out of the ten countries growing more than 60%.

Romania and Bulgaria are the two countries that have increased the most its economic activity. They have also had similar results in terms of energy efficiency improvements. Considering the results from the structure effect, Romania reduced its energy use while Bulgaria did not.

Poland, Slovenia and Lithuania had similar results in the three effects considered, increasing overall energy use, the economic activity, more energy intensive industries and improvements in energy efficiency.

Czech Republic and Slovakia were the two countries more successfully moving to less energy intensive structures. Although they have also improved energy efficiency, the final result was an increase in the overall energy use. Likewise, Estonia, although showing improvements in the structure and intensity effects, have increased its energy use (because of the 60% output growth from 1999 to 2009).

Latvia and Hungary have both reduced its energy use because of changes in the economic structure and improvements in energy efficiency, although the economic activity growth.

### d) The North countries

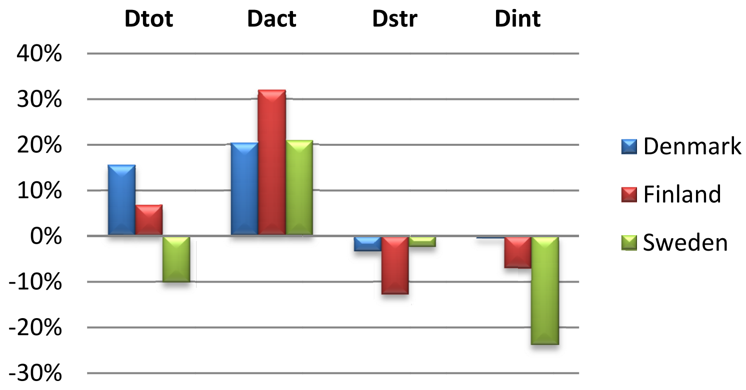



**Figure 19 - Energy decomposition explanatory effects in North countries**

All the three North countries have registered growth in the economic activity, a less energy intensive structure and improvements in energy efficiency. Even though, only one (Sweden) did manage to reduce its overall energy use, mainly because of the greater enhancement in energy efficiency.

### e) The EU 27

The European Union has decreased its total energy use through the period mainly because of the progress in the Center countries (as the other three groups of countries increased their energy use).

The UK is the country who decreased the most its energy use, both in relative and absolute terms. Center countries (with the exception of the northern countries within the group) have the best performances in terms of energy use reduction. On the other hand Spain and Greece (unlike the rest of the South group) present poor performances. Clearly, the East group needs to change its energy use increasing trend.

Regarding the activity effect, with the exception of the East Group, the other groups registered similar values (South 30.8%, Center 33.2%, North 24.4% and East 84.2%). Accordingly, this increase in energy use can be in part explained by the large improvement in the activity effect occurred in the East group.

The groups that moved to less energy intensive structure were the South, East and North (7.5%, 10% and 6.3% respectively) while Center countries have deteriorated in this indicator (moving to a more energy intensive structure (7.2%)). The majority of the countries (14) improved in terms of this indicator.

Regarding sectoral energy efficiency improvements, all the groups have made improvements. Especially the East (30.6%), followed by the Center (22.8%), and then by the South (15.7%) and the North (10.5%). Only Italy and Luxembourg deteriorated in this time period.

Overall, the EU 27 have reduced the energy use, as a “counter-balance” of the increase because of the growth in the economic activity (a 50.6% effect), with the moving to a less energy intensive structure (3.9%) and of improving sectoral energy efficiency (22.8%).

### 2.2 CO2 emissions released

The decomposition of energy-related CO2 emissions presents the change in the amount of emissions released according to the same explicative effects considered regarding energy use and two extra effects, namely the energy-mix and the emission-factor effects, as shown in Table 13.

Table 13 - CO2 emissions decomposition explanatory effects

| *Group* | *Country* | **Emissions released Change** (1999-2009) (Gg) | **Total Change** (%) $D_{tot}$ | **Activity** (%) $D_{act}$ | **Structure** (%) $D_{str}$ | **Intensity** (%) $D_{int}$ | **Energy-mix** (%) $D_{mix}$ | **Emission-factor** (%) $D_{emf}$ |
|---|---|---|---|---|---|---|---|---|
| South | Cyprus | 1217,1 | 18,9 | 56,7 | 12,4 | -32,6 | -0,1 | 0,0 |
| | Greece | 19158,6 | 23,5 | 37,9 | 12,2 | -19,2 | -3,2 | 0,2 |
| | Italy | -17894,8 | -5,8 | 7,0 | -5,5 | -1,2 | 3,7 | -2,9 |
| | Malta | -416,9 | -8,8 | 37,7 | 4,9 | -37,0 | 0,0 | 0,0 |
| | Portugal | -5302,0 | -10,3 | 14,9 | 20,7 | -34,4 | -0,1 | 0,1 |
| | Spain | 6063,4 | 2,8 | 37,1 | 3,3 | -20,6 | -18,2 | -1,3 |
| | *Total/Average* | *2825,4* | *3,4* | *31,9* | *8,0* | *-24,2* | *-3,0* | *-0,7* |
| Center | Austria | 1370,4 | 3,7 | 29,1 | 6,8 | -25,3 | -1,3 | -0,5 |
| | Belgium | -16468,2 | -18,9 | 15,0 | -7,9 | -16,7 | -5,2 | -5,1 |
| | France | -31914,4 | -12,3 | 29,1 | 0,4 | -32,6 | -3,4 | -0,1 |
| | Germany | -92724,2 | -13,4 | 11,3 | 10,2 | -27,6 | -3,3 | 0,3 |
| | Ireland | 3402,9 | 11,2 | 64,9 | 27,7 | -46,3 | -2,5 | 0,5 |
| | Luxembourg | 4716,3 | 74,0 | 69,5 | -5,1 | 6,3 | -0,8 | 0,0 |
| | Netherlands | -35215,0 | -18,8 | 17,7 | 0,5 | -18,7 | -0,3 | 0,0 |
| | UK | -54123,3 | -13,5 | 21,3 | -15,1 | -13,0 | -0,5 | -3,3 |
| | *Total/Average* | *-220955,5* | *1,5* | *32,2* | *2,2* | *-21,7* | *-2,2* | *-1,0* |
| East | Bulgaria | 3278,4 | 8,5 | 129,0 | -24,5 | -38,2 | 3,1 | 0,3 |
| | Czech | 1161,9 | 1,3 | 61,4 | -25,9 | -18,9 | 2,0 | 2,4 |
| | Estonia | -141,0 | -1,0 | 60,1 | -14,8 | -23,2 | 3,0 | -4,3 |
| | Hungary | -10951,4 | -24,3 | 35,2 | -11,8 | -32,1 | -4,2 | 0,5 |
| | Latvia | -650,3 | -10,3 | 70,3 | 3,6 | -44,9 | -2,0 | -0,1 |
| | Lithuania | -729,5 | -6,8 | 61,2 | 3,2 | -40,6 | 1,3 | 0,0 |
| | Poland | -15824,5 | -5,9 | 66,6 | -13,1 | -34,1 | -5,5 | 1,1 |
| | Romania | -10200,6 | -14,5 | 199,1 | -21,6 | -64,4 | 20,7 | -2,4 |
| | Slovakia | -3336,9 | -12,1 | 82,1 | -32,7 | -32,1 | 2,9 | 0,3 |
| | Slovenia | 784,7 | 7,2 | 47,9 | 3,0 | -30,1 | -2,7 | 1,6 |
| | *Total/Average* | *-36609,2* | *-5,8* | *81,3* | *-13,4* | *-35,9* | *1,9* | *-0,1* |
| North | Denmark | 13716,1 | 22,2 | 20,1 | 9,0 | -7,7 | 2,0 | 0,0 |
| | Finland | 1039,0 | 2,2 | 30,6 | -10,4 | -6,4 | 0,1 | -6,9 |
| | Sweden | -8570,0 | -19,2 | 20,0 | -8,4 | -22,4 | 0,6 | 0,0 |
| | *Total/Average* | *6185* | *1,7* | *23,6* | *-3,3* | *-12,2* | *0,9* | *-2,3* |
| **EU 27 Total/Average** | | *-248554,2* | *-0,8* | *49,4* | *-2,9* | *-26,4* | *-0,5* | *-0,7* |

### a) *The South countries*

Although half of the South countries' group have decreased its emissions, the group's total emissions have increased.

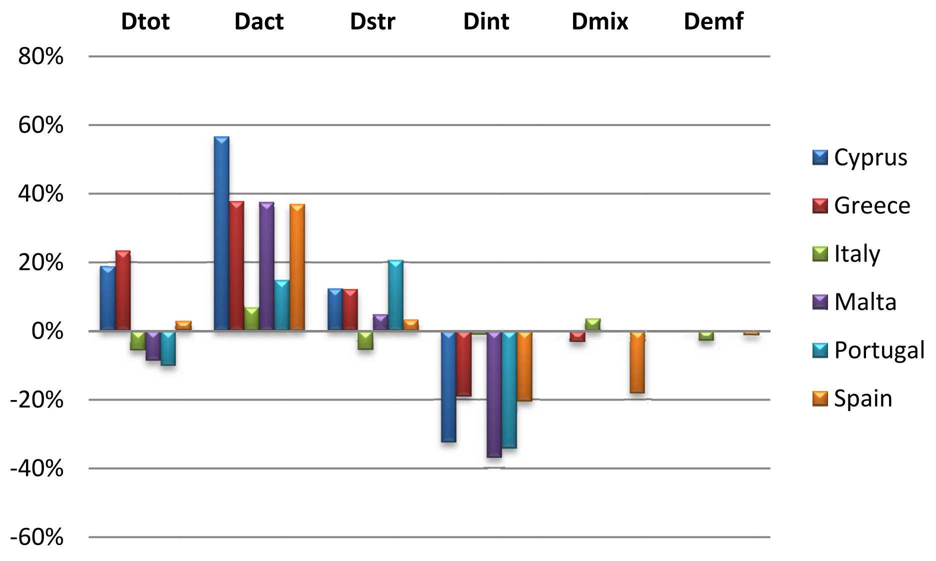



Figure 20 - CO2 emissions decomposition explanatory effects in South countries

As shown in Figure 20, all the countries had increased emissions because of the economic activity and decreased emissions due to improvements in terms of intensity.

Portugal and Malta had similar results in the five explanatory effects recording a decrease in the total emissions released. Both had moved to more CO2 emission intensive structures, present analogous improvements in CO2 emissions efficiency and negligible results regarding the energy-mix and emission-factor effects.

Italy emerged has the only country that moved to a less CO2 emissions intensive structure but it is also the one in which the activity effect was the smallest and where the energy-mix deteriorated the most. From 1999 to 2009 Italy only reduced Coal consumption in 0.2% which might help explain why it deteriorated.

Regarding the energy-mix effect, Spain had a remarkable improvement of 18.2%.

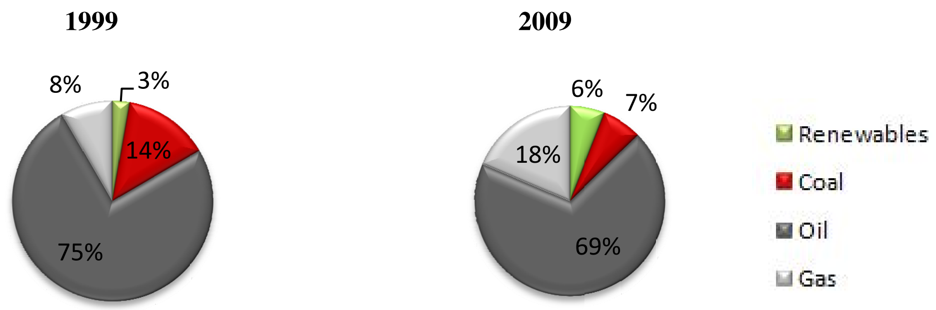



Figure 21 - Fuel use mix evolution in Spain

As represented in Figure 21, Spain have increased Renewables use as a fuel in 3.2%, reduced Oil use in 6.4% and registered the largest raise in Gas consumption (10.3%) and the largest reduction in Coal use (7.1%).

Cyprus and Greece have both substantially increased emissions due to the activity effect, and present similar results in terms of the structure, energy-mix and emission-factor effects. The Cyprus economy's improvement in terms of CO2 emissions efficiency was higher than in Greece.

### b) The Center countries

The Center countries group's overall emissions decreased, although an increase in three of the countries (namely Austria, Ireland and Luxemburg).

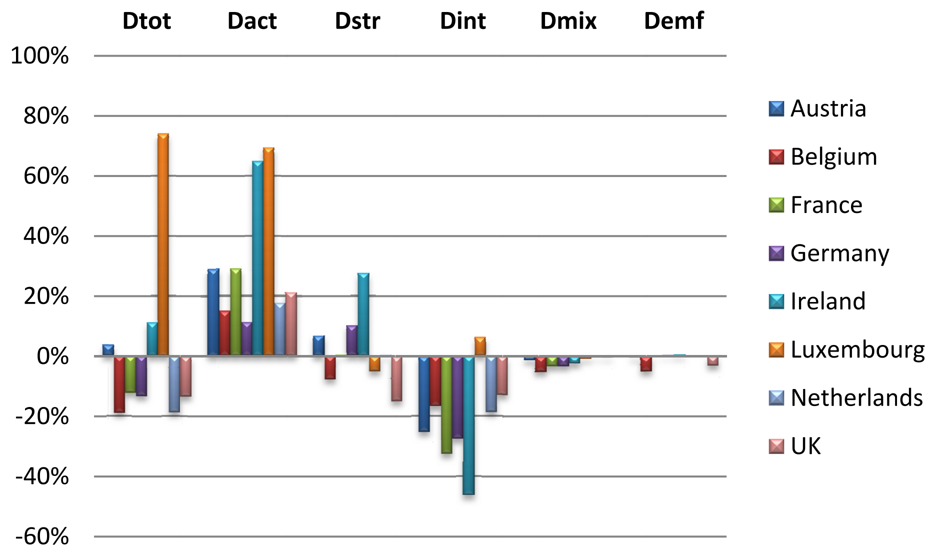



**Figure 22 - CO2 emissions decomposition explanatory effects in Center countries**

As illustrated in Figure 22, all the countries have increased their emissions because of the activity effect and decreased due to the energy-mix effect.

Luxembourg has improved the economic structure (to a less CO2 emissions intensive) but has deteriorated in terms of CO2 emissions efficiency, which combined with the large activity effect, led to a high increase in emissions. Ireland has also increased its emissions but in this case with improvements in efficiency and deterioration in the structure.

France and Austria had similar values in three effects, except for the structure (France poorer) and the energy-mix (France a little better) effects. As a result, France decreased and Austria increased their total emissions. This might indicate that a slightly better energy-mix can avoid more emissions than a better structure.

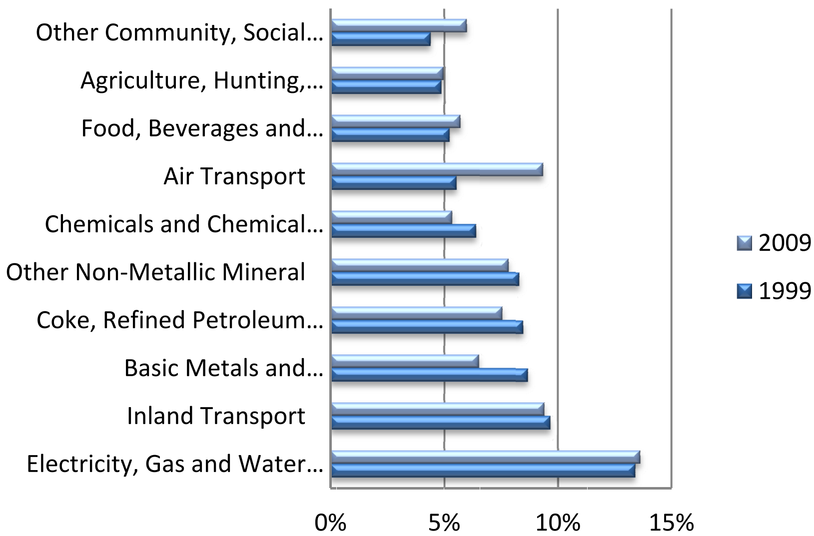



**Figure 23 - Share of total CO2 emissions in French industries**

Figure 23 denotes that in the case of France the deterioration in the structure can be partially explained by the 3.8% increase in $CO_2$ emissions on the Air transport sector.

UK and Belgium (together with Luxembourg) moved to an economy with a less $CO_2$ emission intensive structure. In the UK case (as seen in Figure 17), this move results from the greater share of total output in less energy intensive sectors, such as Financial Intermediation, Health and Social Work and Renting of Machinery. Additionally only in these two countries the results of the emission-factor effect are not negligible, rather denoting considerable improvements.

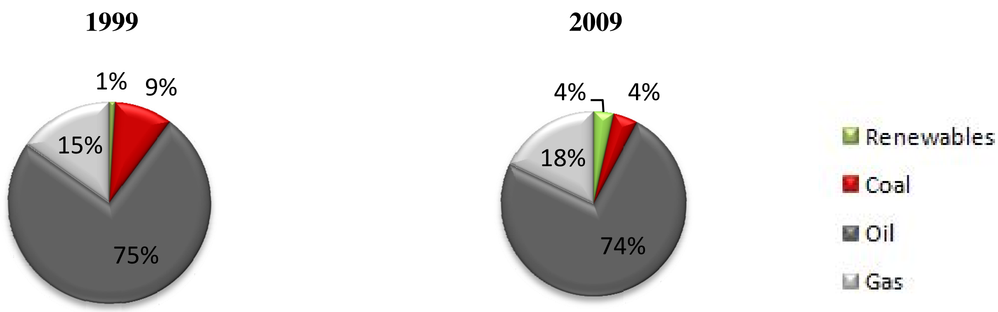



**Figure 24 - Fuel use mix evolution in Belgium**

Belgium has also reported the largest improvement in terms of energy-mix effect. As represented in Figure 24, this is explained by the reduction in the use of Coal, compensated with the increased use of Gas and Renewables.

### *c) The East countries*

The majority (7) of the (10) countries have decreased the emissions released. Consequently the group managed to reduce total CO2 emissions in the period.

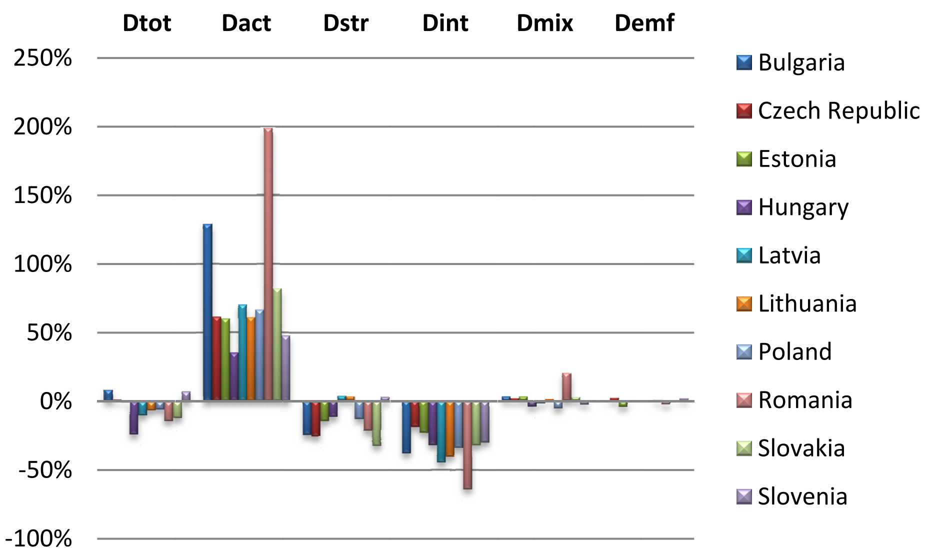



**Figure 25 - CO2 emissions decomposition explanatory effects in East countries**

The entire group has increased emissions because of the activity effect, but simultaneously decreased due to the sectoral CO2 emissions enhanced efficiency. Only three countries (Latvia, Lithuania and Slovenia) deteriorated in terms of moving into a more CO2 emission intensive structure. From these, only Slovenia did not reduce the emissions released, probably because its improvements in terms of CO2 emissions efficiency are more than ten per cent lower than in the two other countries. Lithuania had the worst performance on the energy-mix effect (Renewables use increased marginally (0.5%) and Oil increased (2.6%)).

Bulgaria, Czech Republic and Slovakia have all depreciated in terms of the energy-mix effect (all of them have increased Oil consumption, while the Czech Republic even reduced the use of Renewables). Accordingly, Bulgaria and Czech Republic have increased the total amount of CO2 emissions released over the period.

Hungary and Poland have decreased significantly emissions explained by the energy-mix (particularly because of increasing Renewables and decreasing Oil use, while Estonia and Romania deteriorated (both increased Coal's consumption).

### *d) The North countries*

Sweden decreased the emissions released (mainly because of enhanced CO2 emissions efficiency), but this was not enough to decrease the North countries group's total emissions over the period.

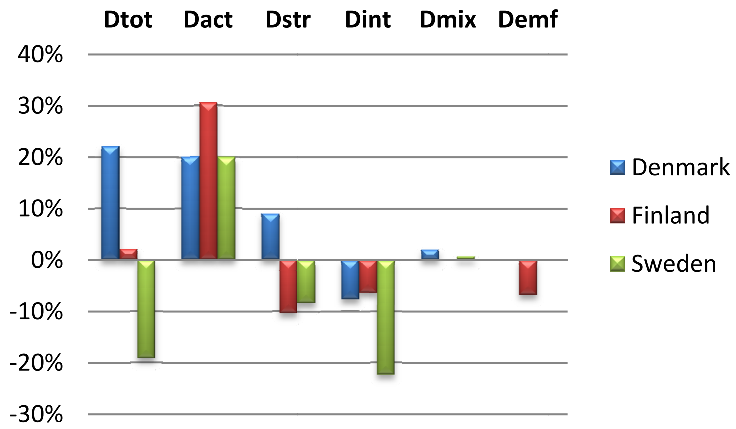



**Figure 26 - CO2 emissions decomposition explanatory effects in North countries**

Figure 26 shows that all the countries increased their economic activity, enhanced CO2 emissions because of the efficiency and deteriorated due to the energy-mix effects.

In Finland, improvements in the economic structure and CO2 emissions efficiency were not enough to reduce total emissions. Denmark, mainly due to the move to a more CO2 emissions intensive structure had the worst performance.

In terms of the energy-mix all three countries have increased the use of Renewables and reduced Coal use, but only Sweden reduced Oil use.

### *e) The EU 27*

The EU has reduced the energy-related CO2 emissions released in the period considered almost entirely due to Center group's action (decreased six times more than the East group, while the South and the North countries total emissions even increased).

The majority of the countries (16) have decreased their total emissions, despite all of them have faced increasing emissions due to the activity effect (South 31.9%, Center

32.2%, North 23.6% and East 81.3%). Regarding the structure effect, the South and Center groups have deteriorated (8% and 2.2% respectively) while the East and North groups have improved, moving to less CO2 emission intensive structures (13.4% and 3.3% respectively). Concerning the sectoral energy efficiency effect, only Luxembourg deteriorated, with improvements in all groups, especially in the East (24.2%, 21.7%, 35.9% and 12.2% in the South, Center, East and North groups respectively). In relation to the energy-mix effect, the South and the Center groups have improved (3% and 2.2%, respectively), while the East and the North groups have deteriorated (1.9% and 0.9%, respectively). It is also noticeable that many of the East and North countries have increased the use of Oil, while the South and Center countries have reduced its use. Finally, in what concerns to the emission-factor effect, all of them have improved, especially the North group.

To sum up, overall, the EU 27 have decreased total CO2 emissions, moving to less CO2 emissions intensive structures (2.9%) and improving also in terms of the sectoral energy efficiency (26.4%), of the energy-mix (0.5%) and of the emission-factor (0.7%) effects. Contrarily, the activity effect (49.4%) counteracted those effects. Regarding the fuel-mix, it is relevant to note that the use of Renewables and Gas increased over the period (2.5% and 0.6%, respectively) while the use of Coal and Oil decreased (1.8% and 1.3%, respectively).

## V. Conclusions and Recommendations

Fighting climate change is one of today's top priorities of EU environmental policy. This makes the environmental and the energy policies even more interconnected than before and reinforce the guidance of the EU energy policy by the continuous search for a balanced management amid energy security, environmental protection and economic growth, thus much in line with the pursuance of sustainability. Further, as the implementation of the "Energy Roadmap 2050" and the "Energy Efficiency Directive" denote, improving energy efficiency has received EU's growing attention as a key component of sustainable development that would tackle energy security while addressing climate change concerns.

Accordingly, the main aim established for this research was to raise the level of general awareness of the complex interactions between energy, economic and environmental issues bearing in mind that international comparisons can help in identifying the potential for (energy and related CO2 emissions) intensity reductions and accordingly improving knowledge on how such potential can be used both for defining national policies to reduce energy intensity  and for designing international actions to curb the threats of climate change. This has been accomplished through a comparative assessment of the changes in energy and CO2 emission intensities in the EU's countries, using data from the WIOD. The analysis of the progresses achieved in these indicators was performed both by assessing whether resources use and/or environmental degradation are decoupling from the growth of the economies, and by the decomposition of the overall rates of change of energy and CO2 emissions into the different explanatory effects contributing to such progression (using a LMDI approach). Nevertheless, our study of this progress was into some extent limited by the problems with the WIOD, since the database developers had removed information regarding NIOT in previous year prices (has they did not get satisfactory results and are still experimenting alternative deflation methods) in the course of this dissertation's elaboration.

Regarding the Energy Intensity components (energy use and GDP) trends from 1999 to 2009, the majority (14) of the EU's countries have increased energy use and all have increased the GDP throughout the period. Half of the countries where energy use increased are East countries while the ones where energy use decreased are mainly Center and South countries. It is also worth to remind that the largest GDP's growth occurred in the East countries. In relation to the Energy Intensity indicator itself, only Luxembourg and Denmark have deteriorated over the period, while the major improvements occurred in the East countries. With reference to resource decoupling, the same two countries (Luxembourg and Denmark) did not manage to achieve either relative or absolute decoupling. From the remaining, 12 have reached a situation of relative decoupling (mostly the East countries) and 13 attained absolute decoupling (mainly the Center and South countries).

As regards to CO2 emissions, 10 countries (mostly South countries, with the exception of Italy and Portugal) could not manage to reduce CO2 emissions over the period, and the largest reductions occurred in the Center and East countries. Analysing the CO2 emissions intensity, only Denmark and Malta were not able to reduce it over the period, and the largest enhancements occurred in the East countries. Moreover, three countries (Denmark, Malta and Slovenia) did not achieve neither relative nor absolute impact decoupling. From the other countries, 7 of them have reached relative while the majority (17) attained absolute decoupling (predominantly East and Center countries).

Thus, it is critical to move towards more energy (resource) and CO2 emissions (impact) efficient economies. Resource or impact decoupling comes mostly from energy or CO2 emissions intensity reductions. As the results made evident, in terms of the reduction of energy use there are still many improvements to be made (only the Center group have reduced it) as well as in the CO2 emissions intensity (in which 10 countries increased emissions over the period).

Analyzing the energy decomposition explanatory effects, one observed that the EU, as a whole, has decreased its energy use through the period and the driver of this effect was the Center group of countries, with the East group reporting the poorest performance. This can be partly explained with the increasing energy needs as a result of the activity effect, in which this last group has registered significantly larger values than the remaining. 14 countries (mainly East and North countries) have succeeded in terms of moving into a less energy intensive structure, while the remaining 13 (mostly Center countries) register, at the end of the period, more energy intensive structures than in the beginning. In terms of the energy efficiency explanatory effect, it is noticeable that only Italy and Luxembourg deteriorated, with the largest improvements occurring in the East countries. Overall, the EU 27 have reduced total energy use by moving into less energy intensive structures and improving sectoral energy efficiency, although the contrarious results of the activity effect.

Assessing the CO2 emissions decomposition effects, one realized that the EU has reduced total CO2 emissions released and, once more, almost entirely due to the Center group's action. Nevertheless, all the countries have increased emissions as a result of the economic activity growth, mainly the ones from the East group. In terms of moving to less energy intensive structures the results are similar to the ones for the energy decomposition and regarding the energy efficiency explanatory effect, only Luxembourg has deteriorated. In relation to the energy-mix effect, the South and Center groups have improved, while the East and North groups have worsened. Concerning the emission-factor effect the worst performance is found in the East countries. Overall, although the growth in the economic activity, the EU 27 have decreased CO2 emissions by moving to less carbon intensive structures and by improving the sectoral energy efficiency, the energy-mix and the emission-factor.

On the context of sustainable development in developing countries, the concept of leapfrogging is being used as a way to induce development by skipping inferior, less efficient, more expensive or more polluting technologies and industries and move directly to more advanced and cleaner ones. The idea is that through this process developing countries avoid environmentally harmful stages of development (unlike the now industrialized countries did in the past). At this level, it is important to highlight that when the most developed EU countries outsource heavy industries to outside their economies (mainly to the East EU countries) instead of investing on eco-efficiency improvements they are doing exactly the opposite from what they should to help those countries leapfrog.

Being energy intensity a measure of energy efficiency, the study of the energy decomposition explanatory effects is significant. Indeed, increases in the energy efficiency can be due to the use of more efficient production technologies and newer vintages of capital equipment or to changes in the structural composition of the economy (i.e. a shift towards less energy-intensive sectors). When technology (intensity) effects are the major driver, policies encouraging technology transfers, economies of scale, and learning-by-doing effects could aim at replicating similar trends in less developed regions, which still display higher-than-average energy intensity levels. This could also have implications for the negotiations of international environmental agreements and policy design since agreements with emphasis on technology transfers might turn out to be more acceptable than new regulatory frameworks that promote the participation of developing countries. Conversely, if the decline in energy intensity is obtained simply as a result of structural improvements and increasing imports of energy-intensive goods, the observed pattern would not be replicable in other, less developed regions (Voigt et al, 2013).

On energy use matters, the more developed (South, Center and North) EU's countries are not registering structural improvements, and although the less developed regions (East) are, they still have a long way to go until reaching the higher stages of development. The significantly better structure explanatory effects registered in the East (developing) countries in opposition to the others (more developed) might suggest that, as the departing situation by the end of the last century was still very poor, such improvements happened because they still have much room for improvement. Accordingly, if the economic activity growth in the East countries is particularly desirable to get closer to the richest EU countries, it reinforces the governments and the EU institutions' need to analyze the other explanatory effects in order to improve the energy intensity indicator in this European region. These countries have already presented interesting results in terms of the intensity effects, and this can be considered as the best way to help them to 'leaprog' the armful stages of development by encouraging technology transfers. But, at the medium-term, this needs to be combined with improvements to be achieved by moving to less energy (and CO2 emissions) intensive structures of these economies. Regarding the progress in terms of energy-related CO2 emissions, the two extra explanatory effects considered are related to the fuel mix of an economy (energy-mix) and to the carbon content of those fuels (emission-factor). In this regard, the East and North groups (by increasing Oil use and decreasing the use of Gas) deteriorated in terms of the fuel mix, while in terms of the emissions' carbon content all the groups have improved. Consequently, a better fuel mix (decreasing Oil use while investing in Renewables) would be particularly helpful to the East region. However, this is now a huge challenge for national and EU's policy makers as the current period of austerity has imposed tight constraints on national budgets, with some countries reverting energy policy measures like the ones directed for promoting clean energy technologies.

# Appendix A

## Summary of Energy and CO2 emissions progress (1999-2009) by country

### Austria

| Austria | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most Energy Intensive Industries | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -10,2% | Coke, Refined Petroleum and Nuclear Fuel | 518884,9 | 35,8% | 35,8% | 0,7% | 0,7% |
| | | Electricity, Gas and Water Supply | 308483,9 | 21,3% | 57,1% | 3,0% | 3,7% |
| | | Basic Metals and Fabricated Metal | 80609,0 | 5,6% | 62,7% | 4,1% | 7,8% |
| GDP | 21,1% | Pulp, Paper, Paper , Printing and Publishing | 77621,9 | 5,4% | 68,1% | 2,8% | 10,5% |
| | | Chemicals and Chemical Products | 76031,5 | 5,3% | 73,3% | 1,6% | 12,1% |
| | | 2009 | | | | | |
| Energy Use | 8,7% | Coke, Refined Petroleum and Nuclear Fuel | 468305,1 | 29,7% | 29,7% | 0,6% | 0,6% |
| | | Electricity, Gas and Water Supply | 369587,2 | 23,5% | 53,2% | 5,4% | 6,0% |
| Resource Decoupling | | Basic Metals and Fabricated Metal | 101159,4 | 6,4% | 59,6% | 3,8% | 9,8% |
| | | Pulp, Paper, Paper , Printing and Publishing | 85694,3 | 5,4% | 65,1% | 2,2% | 12,0% |
| Relative | | Chemicals and Chemical Products | 81633,7 | 5,2% | 70,3% | 2,2% | 14,2% |

| Austria | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most CO2 Intensive Industries | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -11,8% | Electricity, Gas and Water Supply | 10187,3 | 22,7% | 22,7% | 3,0% | 3,0% |
| | | Basic Metals and Fabricated Metal | 9207,3 | 20,5% | 43,2% | 4,1% | 7,0% |
| | | Other Non-Metallic Mineral | 4931,2 | 11,0% | 54,2% | 1,4% | 8,4% |
| GDP | 21,1% | Inland Transport | 3060,2 | 6,8% | 61,0% | 3,0% | 11,4% |
| | | Pulp, Paper, Paper , Printing and Publishing | 2366,4 | 5,3% | 66,3% | 2,8% | 14,2% |
| | | 2009 | | | | | |
| Emissions CO2 | 6,8% | Basic Metals and Fabricated Metal | 10261,4 | 21,4% | 21,4% | 3,8% | 3,8% |
| | | Electricity, Gas and Water Supply | 9557,6 | 19,9% | 41,4% | 5,4% | 9,2% |
| Impact Decoupling | | Other Non-Metallic Mineral | 5494,9 | 11,5% | 52,8% | 1,2% | 10,3% |
| | | Inland Transport | 4206,5 | 8,8% | 61,6% | 2,5% | 12,8% |
| Relative | | Air Transport | 3355,9 | 7,0% | 68,6% | 0,5% | 13,3% |

### Belgium

| Belgium | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most Energy Intensive Industries | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -17,6% | Coke, Refined Petroleum and Nuclear Fuel | 1468694,1 | 38,7% | 38,7% | 1,9% | 1,9% |
| | | Electricity, Gas and Water Supply | 846566,2 | 22,3% | 61,0% | 2,0% | 3,9% |
| | | Chemicals and Chemical Products | 368624,2 | 9,7% | 70,7% | 4,9% | 8,8% |
| GDP | 16,8% | Basic Metals and Fabricated Metal | 247910,0 | 6,5% | 77,2% | 4,3% | 13,1% |
| | | Air Transport | 193954,6 | 5,1% | 82,3% | 0,9% | 13,9% |
| | | 2009 | | | | | |
| Energy Use | -3,8% | Coke, Refined Petroleum and Nuclear Fuel | 1421456,5 | 38,9% | 38,9% | 0,5% | 0,5% |
| | | Electricity, Gas and Water Supply | 879685,1 | 24,1% | 63,0% | 5,2% | 5,8% |
| Resource Decoupling | | Chemicals and Chemical Products | 407840,9 | 11,2% | 74,2% | 2,2% | 8,0% |
| | | Basic Metals and Fabricated Metal | 127636,5 | 3,5% | 77,7% | 3,8% | 11,8% |
| Absolute | | Inland Transport | 111884,8 | 3,1% | 80,8% | 2,6% | 14,3% |

| Belgium | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most CO2 Intensive Industries | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -22,6% | Electricity, Gas and Water Supply | 22010,6 | 21,9% | 21,9% | 2,0% | 2,0% |
| | | Basic Metals and Fabricated Metal | 15776,8 | 15,7% | 37,5% | 4,3% | 6,3% |
| | | Chemicals and Chemical Products | 10516,6 | 10,4% | 48,0% | 4,9% | 11,2% |
| GDP | 16,8% | Other Non-Metallic Mineral | 10400,7 | 10,3% | 58,3% | 1,3% | 12,5% |
| | | Inland Transport | 9450,0 | 9,4% | 67,7% | 2,4% | 14,9% |
| | | 2009 | | | | | |
| Emissions CO2 | -9,6% | Electricity, Gas and Water Supply | 22619,4 | 24,8% | 24,8% | 5,2% | 5,2% |
| | | Inland Transport | 10326,6 | 11,3% | 36,2% | 2,6% | 7,8% |
| Impact Decoupling | | Chemicals and Chemical Products | 8903,6 | 9,8% | 46,0% | 2,2% | 10,0% |
| | | Other Non-Metallic Mineral | 8864,5 | 9,7% | 55,7% | 1,3% | 11,3% |
| Absolute | | Air Transport | 8700,6 | 9,6% | 65,3% | 0,6% | 11,9% |

## Bulgaria

| Bulgaria | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most Energy Intensive Industries** | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -31,6% | Electricity, Gas and Water Supply | 483346,1 | 43,3% | 43,3% | 5,8% | 5,8% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 286902,9 | 25,7% | 68,9% | 3,9% | 9,6% |
| | | Chemicals and Chemical Products | 85302,9 | 7,6% | 76,6% | 2,5% | 12,2% |
| GDP | 47,1% | Basic Metals and Fabricated Metal | 69502,2 | 6,2% | 82,8% | 4,0% | 16,1% |
| | | Inland Transport | 30415,9 | 2,7% | 85,5% | 4,5% | 20,6% |
| | | 2009 | | | | | |
| Energy Use | 0,6% | Electricity, Gas and Water Supply | 531566,1 | 47,3% | 47,3% | 5,9% | 5,9% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 317914,1 | 28,3% | 75,6% | 2,5% | 8,4% |
| Resource Decoupling | | Inland Transport | 52301,3 | 4,7% | 80,2% | 2,8% | 11,3% |
| | | Chemicals and Chemical Products | 44079,4 | 3,9% | 84,1% | 2,6% | 13,8% |
| Relative | | Other Non-Metallic Mineral | 22435,0 | 2,0% | 86,1% | 1,6% | 15,4% |

| Bulgaria | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most CO2 Intensive Industries** | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -35,1% | Electricity, Gas and Water Supply | 23081,7 | 52,8% | 52,8% | 5,8% | 5,8% |
| | | Basic Metals and Fabricated Metal | 6169,4 | 14,1% | 66,9% | 4,0% | 9,8% |
| | | Chemicals and Chemical Products | 3454,4 | 7,9% | 74,8% | 2,5% | 12,3% |
| GDP | 47,1% | Other Non-Metallic Mineral | 1856,9 | 4,2% | 79,1% | 1,4% | 13,7% |
| | | Inland Transport | 1619,4 | 3,7% | 82,8% | 4,5% | 18,2% |
| | | 2009 | | | | | |
| Emissions CO2 | -4,6% | Electricity, Gas and Water Supply | 28233,5 | 67,7% | 67,7% | 5,9% | 5,9% |
| | | Inland Transport | 2330,4 | 5,6% | 73,3% | 2,8% | 8,8% |
| Impact Decoupling | | Other Non-Metallic Mineral | 2141,8 | 5,1% | 78,5% | 1,6% | 10,4% |
| | | Construction | 1334,8 | 3,2% | 81,7% | 4,6% | 15,0% |
| Absolute | | Chemicals and Chemical Products | 1149,6 | 2,8% | 84,4% | 2,6% | 17,5% |

## Cyprus

| Cyprus | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most Energy Intensive Industries** | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -42,7% | Coke, Refined Petroleum and Nuclear Fuel | 51819,2 | 34,8% | 34,8% | 1,2% | 1,2% |
| | | Electricity, Gas and Water Supply | 36484,5 | 24,5% | 59,4% | 2,0% | 3,1% |
| | | Water Transport | 12838,9 | 8,6% | 68,0% | 1,0% | 4,1% |
| GDP | 39,6% | Air Transport | 10664,2 | 7,2% | 75,2% | 2,2% | 6,3% |
| | | Other Non-Metallic Mineral | 9261,1 | 6,2% | 81,4% | 1,5% | 7,8% |
| | | 2009 | | | | | |
| Energy Use | -20,1% | Electricity, Gas and Water Supply | 52943,5 | 44,6% | 44,6% | 5,7% | 5,7% |
| | | Water Transport | 15194,4 | 12,8% | 57,3% | 0,0% | 5,7% |
| Resource Decoupling | | Other Non-Metallic Mineral | 8310,5 | 7,0% | 64,3% | 1,4% | 7,1% |
| | | Air Transport | 7356,1 | 6,2% | 70,5% | 0,5% | 7,7% |
| Absolute | | Inland Transport | 6635,6 | 5,6% | 76,1% | 2,0% | 9,6% |

| Cyprus | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most CO2 Intensive Industries** | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -22,6% | Electricity, Gas and Water Supply | 2773,1 | 44,6% | 44,6% | 2,0% | 2,0% |
| | | Other Non-Metallic Mineral | 844,2 | 13,6% | 58,2% | 1,5% | 3,5% |
| | | Construction | 696,0 | 11,2% | 69,4% | 8,5% | 12,0% |
| GDP | 39,6% | Inland Transport | 315,6 | 5,1% | 74,5% | 0,8% | 12,9% |
| | | Electrical and Optical Equipment | 223,7 | 3,6% | 78,1% | 0,2% | 13,1% |
| | | 2009 | | | | | |
| Emissions CO2 | 8,1% | Electricity, Gas and Water Supply | 4010,8 | 59,7% | 59,7% | 5,7% | 5,7% |
| | | Other Non-Metallic Mineral | 769,7 | 11,5% | 71,2% | 1,4% | 7,1% |
| Impact Decoupling | | Inland Transport | 567,5 | 8,4% | 79,6% | 2,0% | 9,1% |
| | | Construction | 285,6 | 4,3% | 83,9% | 7,2% | 16,3% |
| Relative | | Food, Beverages and Tobacco | 133,4 | 2,0% | 85,9% | 3,4% | 19,7% |

## Czech Republic

| Czech Republic | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most Energy Intensive Industries** | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -21,3% | Electricity, Gas and Water Supply | 843184,1 | 41,3% | 41,3% | 5,4% | 5,4% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 323543,0 | 15,8% | 57,1% | 0,9% | 6,2% |
| | | Basic Metals and Fabricated Metal | 201166,5 | 9,8% | 66,9% | 5,8% | 12,0% |
| GDP | 40,2% | Chemicals and Chemical Products | 134072,3 | 6,6% | 73,5% | 2,4% | 14,4% |
| | | Mining and Quarrying | 66845,4 | 3,3% | 76,8% | 1,2% | 15,7% |
| | | 2009 | | | | | |
| Energy Use | 10,4% | Electricity, Gas and Water Supply | 995534,5 | 44,1% | 44,1% | 5,1% | 5,1% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 405105,7 | 18,0% | 62,1% | 0,6% | 5,6% |
| Resource Decoupling | | Chemicals and Chemical Products | 155247,8 | 6,9% | 69,0% | 2,3% | 7,9% |
| | | Basic Metals and Fabricated Metal | 141527,6 | 6,3% | 75,2% | 3,8% | 11,7% |
| Relative | | Mining and Quarrying | 64927,4 | 2,9% | 78,1% | 0,3% | 12,1% |

| Czech Republic | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most CO2 Intensive Industries** | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -28,6% | Electricity, Gas and Water Supply | 55199,6 | 57,1% | 57,1% | 5,4% | 5,4% |
| | | Basic Metals and Fabricated Metal | 9915,6 | 10,3% | 67,4% | 5,8% | 11,1% |
| | | Chemicals and Chemical Products | 6159,1 | 6,4% | 73,7% | 2,4% | 13,5% |
| GDP | 40,2% | Inland Transport | 3748,5 | 3,9% | 77,6% | 3,3% | 16,8% |
| | | Mining and Quarrying | 3500,3 | 3,6% | 81,2% | 1,2% | 18,0% |
| | | 2009 | | | | | |
| Emissions CO2 | 0,1% | Electricity, Gas and Water Supply | 53785,1 | 55,6% | 55,6% | 5,1% | 5,1% |
| | | Basic Metals and Fabricated Metal | 10396,4 | 10,7% | 66,3% | 3,8% | 8,9% |
| Impact Decoupling | | Chemicals and Chemical Products | 6945,1 | 7,2% | 73,5% | 2,3% | 11,2% |
| | | Inland Transport | 4849,0 | 5,0% | 78,5% | 2,7% | 13,9% |
| Relative | | Mining and Quarrying | 3607,6 | 3,7% | 82,2% | 0,3% | 14,2% |

## Denmark

| Denmark | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most Energy Intensive Industries** | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | 7,6% | Electricity, Gas and Water Supply | 397013,6 | 28,6% | 28,6% | 1,8% | 1,8% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 353236,8 | 25,4% | 54,0% | 0,5% | 2,3% |
| | | Water Transport | 209627,3 | 15,1% | 69,1% | 2,9% | 5,2% |
| GDP | 7,5% | Agriculture, Hunting, Forestry and Fishing | 51800,6 | 3,7% | 72,8% | 3,1% | 8,4% |
| | | Air Transport | 37614,4 | 2,7% | 75,5% | 0,8% | 9,2% |
| | | 2009 | | | | | |
| Energy Use | 15,6% | Water Transport | 477321,2 | 29,7% | 29,7% | 0,0% | 0,0% |
| | | Electricity, Gas and Water Supply | 391957,9 | 24,4% | 54,1% | 4,8% | 4,8% |
| Resource Decoupling | | Coke, Refined Petroleum and Nuclear Fuel | 348217,2 | 21,7% | 75,8% | 0,4% | 5,2% |
| | | Agriculture, Hunting, Forestry and Fishing | 47998,1 | 3,0% | 78,8% | 2,1% | 7,3% |
| No Decoupling | | Air Transport | 38883,8 | 2,4% | 81,2% | 0,6% | 7,9% |

| Denmark | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most CO2 Intensive Industries** | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | 10,8% | Electricity, Gas and Water Supply | 26393,6 | 40,2% | 40,2% | 1,8% | 1,8% |
| | | Water Transport | 16064,3 | 24,5% | 64,7% | 2,9% | 4,7% |
| | | Other Non-Metallic Mineral | 3657,3 | 5,6% | 70,2% | 1,0% | 5,7% |
| GDP | 7,5% | Air Transport | 2698,9 | 4,1% | 74,3% | 0,8% | 6,5% |
| | | Mining and Quarrying | 2675,4 | 4,1% | 78,4% | 1,0% | 7,5% |
| | | 2009 | | | | | |
| Emissions CO2 | 19,1% | Water Transport | 36720,8 | 46,9% | 46,9% | 0,0% | 0,0% |
| | | Electricity, Gas and Water Supply | 20950,0 | 26,8% | 73,7% | 4,8% | 4,8% |
| Impact Decoupling | | Air Transport | 2786,5 | 3,6% | 77,3% | 0,6% | 5,5% |
| | | Inland Transport | 2745,9 | 3,5% | 80,8% | 2,6% | 8,0% |
| No Decoupling | | Agriculture, Hunting, Forestry and Fishing | 2312,9 | 3,0% | 83,8% | 2,1% | 10,1% |

## Estonia

| Estonia | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most Energy Intensive Industries | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -28,3% | Electricity, Gas and Water Supply | 137559,5 | 60,6% | 60,6% | 3,7% | 3,7% |
| | | Chemicals and Chemical Products | 19611,6 | 8,6% | 69,2% | 1,2% | 4,9% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 7030,4 | 3,1% | 72,3% | 0,2% | 5,1% |
| GDP | 55,3% | Water Transport | 6964,7 | 3,1% | 75,4% | 2,1% | 7,2% |
| | | Inland Transport | 6275,1 | 2,8% | 78,1% | 4,2% | 11,4% |
| | | 2009 | | | | | |
| Energy Use | 11,3% | Electricity, Gas and Water Supply | 142004,6 | 56,2% | 56,2% | 4,2% | 4,2% |
| | | Chemicals and Chemical Products | 33546,8 | 13,3% | 69,4% | 1,6% | 5,9% |
| Resource Decoupling | | Water Transport | 7694,7 | 3,0% | 72,5% | 0,0% | 5,9% |
| | | Inland Transport | 6595,3 | 2,6% | 75,1% | 2,1% | 7,9% |
| Relative | | Coke, Refined Petroleum and Nuclear Fuel | 5979,0 | 2,4% | 77,4% | 0,4% | 8,3% |

| Estonia | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most CO2 Intensive Industries | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -36,4% | Electricity, Gas and Water Supply | 12155,5 | 84,2% | 84,2% | 3,7% | 3,7% |
| | | Inland Transport | 515,8 | 3,6% | 87,8% | 4,2% | 7,9% |
| | | Other Non-Metallic Mineral | 397,9 | 2,8% | 90,5% | 1,1% | 9,0% |
| GDP | 55,3% | Chemicals and Chemical Products | 370,7 | 2,6% | 93,1% | 1,2% | 10,1% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 327,4 | 2,3% | 95,4% | 0,2% | 10,3% |
| | | 2009 | | | | | |
| Emissions CO2 | -1,3% | Electricity, Gas and Water Supply | 10061,8 | 70,6% | 70,6% | 4,2% | 4,2% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 1834,3 | 12,9% | 83,5% | 0,4% | 4,6% |
| Impact Decoupling | | Inland Transport | 602,1 | 4,2% | 87,7% | 2,1% | 6,7% |
| | | Other Non-Metallic Mineral | 349,8 | 2,5% | 90,2% | 1,2% | 7,9% |
| Absolute | | Construction | 261,0 | 1,8% | 92,0% | 6,8% | 14,7% |

## Finland

| Finland | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most Energy Intensive Industries | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -11,3% | Coke, Refined Petroleum and Nuclear Fuel | 597891,3 | 29,3% | 29,3% | 1,1% | 1,1% |
| | | Electricity, Gas and Water Supply | 573789,6 | 28,2% | 57,5% | 1,9% | 3,0% |
| | | Pulp, Paper, Paper , Printing and Publishing | 270853,3 | 13,3% | 70,8% | 7,7% | 10,7% |
| GDP | 20,3% | Basic Metals and Fabricated Metal | 90520,4 | 4,4% | 75,2% | 4,1% | 14,7% |
| | | Chemicals and Chemical Products | 84621,5 | 4,2% | 79,4% | 2,0% | 16,7% |
| | | 2009 | | | | | |
| Energy Use | 6,8% | Electricity, Gas and Water Supply | 671971,4 | 30,9% | 30,9% | 4,6% | 4,6% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 602763,1 | 27,7% | 58,6% | 0,5% | 5,1% |
| Resource Decoupling | | Pulp, Paper, Paper , Printing and Publishing | 263694,7 | 12,1% | 70,7% | 2,2% | 7,2% |
| | | Chemicals and Chemical Products | 91825,2 | 4,2% | 74,9% | 2,2% | 9,4% |
| Relative | | Basic Metals and Fabricated Metal | 81088,7 | 3,7% | 78,7% | 3,9% | 13,3% |

| Finland | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most CO2 Intensive Industries | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -17,7% | Electricity, Gas and Water Supply | 20359,3 | 36,5% | 36,5% | 1,9% | 1,9% |
| | | Basic Metals and Fabricated Metal | 6249,0 | 11,2% | 47,7% | 4,1% | 5,9% |
| | | Pulp, Paper, Paper , Printing and Publishing | 4302,6 | 7,7% | 55,4% | 7,7% | 13,6% |
| GDP | 20,3% | Coke, Refined Petroleum and Nuclear Fuel | 3657,0 | 6,6% | 62,0% | 1,1% | 14,7% |
| | | Inland Transport | 3262,3 | 5,9% | 67,8% | 2,5% | 17,2% |
| | | 2009 | | | | | |
| Emissions CO2 | -1,0% | Electricity, Gas and Water Supply | 22462,6 | 40,7% | 40,7% | 4,6% | 4,6% |
| | | Air Transport | 4835,3 | 8,8% | 49,5% | 0,6% | 5,2% |
| Impact Decoupling | | Basic Metals and Fabricated Metal | 4638,1 | 8,4% | 57,9% | 3,9% | 9,1% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 4191,0 | 7,6% | 65,5% | 0,5% | 9,6% |
| Absolute | | Pulp, Paper, Paper , Printing and Publishing | 3212,5 | 5,8% | 71,3% | 2,2% | 11,7% |

## France

| France | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most Energy Intensive Industries | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -16,1% | Electricity, Gas and Water Supply | 5174885,7 | 36,8% | 36,8% | 2,0% | 2,0% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 3976835,2 | 28,3% | 65,1% | 1,1% | 3,1% |
| | | Chemicals and Chemical Products | 878396,1 | 6,3% | 71,4% | 3,1% | 6,2% |
| GDP | 13,8% | Basic Metals and Fabricated Metal | 490452,8 | 3,5% | 74,9% | 3,3% | 9,5% |
| | | Inland Transport | 405494,5 | 2,9% | 77,7% | 2,1% | 11,5% |
| | | 2009 | | | | | |
| Energy Use | -4,5% | Electricity, Gas and Water Supply | 5618148,9 | 41,9% | 41,9% | 5,7% | 5,7% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 3453312,1 | 25,7% | 67,6% | 0,8% | 6,5% |
| Resource Decoupling | | Chemicals and Chemical Products | 678701,5 | 5,1% | 72,6% | 2,6% | 9,1% |
| | | Inland Transport | 388721,4 | 2,9% | 75,5% | 2,4% | 11,5% |
| Absolute | | Basic Metals and Fabricated Metal | 294101,0 | 2,2% | 77,7% | 3,6% | 15,1% |

| France | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most CO2 Intensive Industries | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -22,5% | Electricity, Gas and Water Supply | 39512,6 | 13,4% | 13,4% | 2,0% | 2,0% |
| | | Inland Transport | 28489,6 | 9,7% | 23,0% | 2,1% | 4,1% |
| | | Basic Metals and Fabricated Metal | 25535,0 | 8,7% | 31,7% | 3,3% | 7,4% |
| GDP | 13,8% | Coke, Refined Petroleum and Nuclear Fuel | 24930,8 | 8,4% | 40,1% | 1,1% | 8,5% |
| | | Other Non-Metallic Mineral | 24439,5 | 8,3% | 48,4% | 0,9% | 9,3% |
| | | 2009 | | | | | |
| Emissions CO2 | -11,8% | Electricity, Gas and Water Supply | 35408,4 | 13,6% | 13,6% | 5,7% | 5,7% |
| | | Inland Transport | 24455,8 | 9,4% | 23,0% | 2,4% | 8,0% |
| Impact Decoupling | | Air Transport | 24313,6 | 9,3% | 32,3% | 0,6% | 8,6% |
| | | Other Non-Metallic Mineral | 20323,1 | 7,8% | 40,1% | 1,1% | 9,7% |
| Absolute | | Coke, Refined Petroleum and Nuclear Fuel | 19608,6 | 7,5% | 47,7% | 0,8% | 10,5% |

## Germany

| Germany | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most Energy Intensive Industries | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -14,5% | Coke, Refined Petroleum and Nuclear Fuel | 5895999,4 | 31,3% | 31,3% | 0,7% | 0,7% |
| | | Electricity, Gas and Water Supply | 5822265,1 | 30,9% | 62,3% | 2,0% | 2,8% |
| | | Chemicals and Chemical Products | 1355040,5 | 7,2% | 69,5% | 3,1% | 5,9% |
| GDP | 10,8% | Basic Metals and Fabricated Metal | 988339,6 | 5,3% | 74,7% | 3,9% | 9,7% |
| | | Air Transport | 403275,2 | 2,1% | 76,9% | 0,5% | 10,2% |
| | | 2009 | | | | | |
| Energy Use | -5,3% | Electricity, Gas and Water Supply | 5925762,0 | 33,2% | 33,2% | 4,8% | 4,8% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 5427330,1 | 30,4% | 63,7% | 0,5% | 5,4% |
| Resource Decoupling | | Chemicals and Chemical Products | 1422168,3 | 8,0% | 71,7% | 2,1% | 7,4% |
| | | Basic Metals and Fabricated Metal | 786528,4 | 4,4% | 76,1% | 3,6% | 11,0% |
| Absolute | | Air Transport | 458835,0 | 2,6% | 78,7% | 0,6% | 11,6% |

| Germany | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most CO2 Intensive Industries | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -17,2% | Electricity, Gas and Water Supply | 331088,8 | 47,8% | 47,8% | 2,0% | 2,0% |
| | | Basic Metals and Fabricated Metal | 63806,9 | 9,2% | 57,0% | 3,9% | 5,9% |
| | | Other Non-Metallic Mineral | 43723,7 | 6,3% | 63,3% | 1,1% | 7,0% |
| GDP | 10,8% | Chemicals and Chemical Products | 33065,0 | 4,8% | 68,0% | 3,1% | 10,1% |
| | | Air Transport | 25926,3 | 3,7% | 71,8% | 0,5% | 10,6% |
| | | 2009 | | | | | |
| Emissions CO2 | -8,2% | Electricity, Gas and Water Supply | 324063,2 | 50,9% | 50,9% | 4,8% | 4,8% |
| | | Basic Metals and Fabricated Metal | 47986,8 | 7,5% | 58,5% | 3,6% | 8,4% |
| Impact Decoupling | | Other Non-Metallic Mineral | 34559,4 | 5,4% | 63,9% | 1,2% | 9,6% |
| | | Air Transport | 33799,5 | 5,3% | 69,2% | 0,6% | 10,2% |
| Absolute | | Chemicals and Chemical Products | 32075,0 | 5,0% | 74,3% | 2,1% | 12,3% |

## Greece

| Greece | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most Energy Intensive Industries | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -9,3% | Coke, Refined Petroleum and Nuclear Fuel | 765968,9 | 42,6% | 42,6% | 1,5% | 1,5% |
| | | Electricity, Gas and Water Supply | 465486,3 | 25,9% | 68,5% | 2,2% | 3,8% |
| | | Water Transport | 155561,6 | 8,7% | 77,2% | 2,8% | 6,6% |
| GDP | 35,5% | Agriculture, Hunting, Forestry and Fishing | 54427,5 | 3,0% | 80,2% | 6,3% | 12,9% |
| | | Other Non-Metallic Mineral | 49558,7 | 2,8% | 83,0% | 1,4% | 14,3% |
| | | 2009 | | | | | |
| Energy Use | 22,9% | Coke, Refined Petroleum and Nuclear Fuel | 879000,4 | 39,8% | 39,8% | 0,5% | 0,5% |
| | | Electricity, Gas and Water Supply | 560988,9 | 25,4% | 65,2% | 5,7% | 6,3% |
| Resource Decoupling | | Water Transport | 293509,7 | 13,3% | 78,5% | 0,0% | 6,3% |
| | | Inland Transport | 57323,7 | 2,6% | 81,0% | 2,5% | 8,8% |
| Relative | | Agriculture, Hunting, Forestry and Fishing | 44738,8 | 2,0% | 83,1% | 2,0% | 10,8% |

| Greece | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most CO2 Intensive Industries | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -16,5% | Electricity, Gas and Water Supply | 50199,1 | 60,6% | 60,6% | 2,2% | 2,2% |
| | | Food, Beverages and Tobacco | 9008,5 | 10,9% | 71,4% | 6,7% | 9,0% |
| | | Mining and Quarrying | 6980,9 | 8,4% | 79,9% | 0,4% | 9,4% |
| GDP | 35,5% | Inland Transport | 3388,2 | 4,1% | 84,0% | 1,6% | 11,1% |
| | | Agriculture, Hunting, Forestry and Fishing | 2754,9 | 3,3% | 87,3% | 6,3% | 17,4% |
| | | 2009 | | | | | |
| Emissions CO2 | 13,2% | Electricity, Gas and Water Supply | 55118,1 | 58,8% | 58,8% | 5,7% | 5,7% |
| | | Food, Beverages and Tobacco | 9194,1 | 9,8% | 68,6% | 3,6% | 9,3% |
| Impact Decoupling | | Mining and Quarrying | 7305,5 | 7,8% | 76,4% | 0,4% | 9,6% |
| | | Air Transport | 5920,0 | 6,3% | 82,7% | 0,5% | 10,2% |
| Relative | | Inland Transport | 3672,8 | 3,9% | 86,6% | 2,5% | 12,6% |

## Hungary

| Hungary | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most Energy Intensive Industries | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -16,8% | Electricity, Gas and Water Supply | 501239,3 | 36,9% | 36,9% | 3,8% | 3,8% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 399045,4 | 29,4% | 66,3% | 2,0% | 5,8% |
| | | Chemicals and Chemical Products | 90465,4 | 6,7% | 72,9% | 2,4% | 8,2% |
| GDP | 13,8% | Basic Metals and Fabricated Metal | 43978,9 | 3,2% | 76,2% | 3,2% | 11,4% |
| | | Inland Transport | 36030,5 | 2,7% | 78,8% | 3,0% | 14,3% |
| | | 2009 | | | | | |
| Energy Use | -5,4% | Electricity, Gas and Water Supply | 445735,1 | 34,7% | 34,7% | 4,3% | 4,3% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 370711,9 | 28,8% | 63,5% | 0,4% | 4,7% |
| Resource Decoupling | | Chemicals and Chemical Products | 108205,5 | 8,4% | 71,9% | 1,7% | 6,5% |
| | | Inland Transport | 45044,9 | 3,5% | 75,4% | 2,3% | 8,8% |
| Absolute | | Basic Metals and Fabricated Metal | 34525,1 | 2,7% | 78,1% | 4,0% | 12,8% |

| Hungary | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most CO2 Intensive Industries | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -24,5% | Electricity, Gas and Water Supply | 24515,4 | 50,6% | 50,6% | 3,8% | 3,8% |
| | | Inland Transport | 5518,4 | 11,4% | 62,0% | 3,0% | 6,7% |
| | | Basic Metals and Fabricated Metal | 3103,9 | 6,4% | 68,4% | 3,2% | 9,9% |
| GDP | 13,8% | Other Non-Metallic Mineral | 3015,1 | 6,2% | 74,6% | 1,1% | 11,0% |
| | | Chemicals and Chemical Products | 1998,9 | 4,1% | 78,8% | 2,4% | 13,4% |
| | | 2009 | | | | | |
| Emissions CO2 | -14,1% | Electricity, Gas and Water Supply | 15001,4 | 36,1% | 36,1% | 4,3% | 4,3% |
| | | Inland Transport | 9526,0 | 22,9% | 59,0% | 2,3% | 6,6% |
| Impact Decoupling | | Chemicals and Chemical Products | 2702,0 | 6,5% | 65,4% | 1,7% | 8,3% |
| | | Basic Metals and Fabricated Metal | 2636,2 | 6,3% | 71,8% | 4,0% | 12,4% |
| Absolute | | Other Non-Metallic Mineral | 2194,5 | 5,3% | 77,1% | 1,5% | 13,8% |

## Ireland

| Ireland | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most Energy Intensive Industries** | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -19,6% | Electricity, Gas and Water Supply | 211778,8 | 33,7% | 33,7% | 0,9% | 0,9% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 133593,6 | 21,2% | 54,9% | 0,4% | 1,3% |
| | | Inland Transport | 35659,2 | 5,7% | 60,6% | 2,8% | 4,0% |
| GDP | 42,7% | Chemicals and Chemical Products | 31327,8 | 5,0% | 65,6% | 9,8% | 13,9% |
| | | Air Transport | 24583,2 | 3,9% | 69,5% | 1,8% | 15,7% |
| | | 2009 | | | | | |
| Energy Use | 14,7% | Electricity, Gas and Water Supply | 213804,3 | 29,6% | 29,6% | 7,9% | 7,9% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 144589,1 | 20,0% | 49,7% | 1,1% | 9,0% |
| Resource Decoupling | | Air Transport | 88007,4 | 12,2% | 61,9% | 0,5% | 9,5% |
| | | Basic Metals and Fabricated Metal | 27454,1 | 3,8% | 65,7% | 5,6% | 15,1% |
| Relative | | Food, Beverages and Tobacco | 20657,8 | 2,9% | 68,6% | 4,5% | 19,6% |

| Ireland | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most CO2 Intensive Industries** | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -36,3% | Electricity, Gas and Water Supply | 15427,9 | 50,8% | 50,8% | 0,9% | 0,9% |
| | | Inland Transport | 2642,7 | 8,7% | 59,5% | 2,8% | 3,7% |
| | | Basic Metals and Fabricated Metal | 1528,2 | 5,0% | 64,6% | 1,3% | 5,0% |
| GDP | 42,7% | Other Non-Metallic Mineral | 1439,3 | 4,7% | 69,3% | 1,0% | 6,0% |
| | | Food, Beverages and Tobacco | 1421,4 | 4,7% | 74,0% | 6,6% | 12,6% |
| | | 2009 | | | | | |
| Emissions CO2 | -9,2% | Electricity, Gas and Water Supply | 12660,6 | 45,9% | 45,9% | 7,9% | 7,9% |
| | | Inland Transport | 3430,7 | 12,4% | 58,4% | 2,4% | 10,3% |
| Impact Decoupling | | Basic Metals and Fabricated Metal | 1609,8 | 5,8% | 64,2% | 5,6% | 15,9% |
| | | Other Non-Metallic Mineral | 1608,0 | 5,8% | 70,0% | 1,7% | 17,6% |
| Absolute | | Food, Beverages and Tobacco | 1015,1 | 3,7% | 73,7% | 4,5% | 22,1% |

## Italy

| Italy | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most Energy Intensive Industries** | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -4,9% | Coke, Refined Petroleum and Nuclear Fuel | 4465031,5 | 43,1% | 43,1% | 1,0% | 1,0% |
| | | Electricity, Gas and Water Supply | 1828041,2 | 17,6% | 60,7% | 2,2% | 3,1% |
| | | Basic Metals and Fabricated Metal | 768300,7 | 7,4% | 68,1% | 4,7% | 7,8% |
| GDP | 3,4% | Chemicals and Chemical Products | 601300,1 | 5,8% | 73,9% | 2,9% | 10,8% |
| | | Other Non-Metallic Mineral | 339287,0 | 3,3% | 77,2% | 1,5% | 12,3% |
| | | 2009 | | | | | |
| Energy Use | -1,7% | Coke, Refined Petroleum and Nuclear Fuel | 3961646,3 | 38,9% | 38,9% | 0,4% | 0,4% |
| | | Electricity, Gas and Water Supply | 2307476,4 | 22,6% | 61,5% | 4,5% | 5,0% |
| Resource Decoupling | | Basic Metals and Fabricated Metal | 558916,6 | 5,5% | 67,0% | 3,8% | 8,8% |
| | | Chemicals and Chemical Products | 484620,7 | 4,8% | 71,8% | 2,3% | 11,1% |
| Absolute | | Inland Transport | 457429,5 | 4,5% | 76,2% | 2,6% | 13,7% |

| Italy | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most CO2 Intensive Industries** | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -11,3% | Electricity, Gas and Water Supply | 121134,0 | 33,8% | 33,8% | 2,2% | 2,2% |
| | | Other Non-Metallic Mineral | 44650,2 | 12,4% | 46,2% | 1,5% | 3,7% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 28056,9 | 7,8% | 54,0% | 1,0% | 4,7% |
| GDP | 3,4% | Inland Transport | 18983,9 | 5,3% | 59,3% | 3,5% | 8,2% |
| | | Basic Metals and Fabricated Metal | 18325,1 | 5,1% | 64,4% | 4,7% | 12,9% |
| | | 2009 | | | | | |
| Emissions CO2 | -8,2% | Electricity, Gas and Water Supply | 113538,0 | 34,5% | 34,5% | 4,5% | 4,5% |
| | | Other Non-Metallic Mineral | 34122,8 | 10,4% | 44,8% | 1,3% | 5,8% |
| Impact Decoupling | | Coke, Refined Petroleum and Nuclear Fuel | 24053,2 | 7,3% | 52,1% | 0,4% | 6,2% |
| | | Inland Transport | 23960,0 | 7,3% | 59,4% | 2,6% | 8,8% |
| Absolute | | Basic Metals and Fabricated Metal | 14812,5 | 4,5% | 63,9% | 3,8% | 12,7% |

## Latvia

| Latvia | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most Energy Intensive Industries** | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -34,7% | Electricity, Gas and Water Supply | 73224,9 | 47,5% | 47,5% | 4,3% | 4,3% |
| | | Inland Transport | 8303,3 | 5,4% | 52,9% | 4,1% | 8,4% |
| | | Food, Beverages and Tobacco | 7262,7 | 4,7% | 57,6% | 6,0% | 14,5% |
| GDP | 51,2% | Agriculture, Hunting, Forestry and Fishing | 6989,0 | 4,5% | 62,1% | 5,3% | 19,8% |
| | | Wood and Products of Wood and Cork | 6309,4 | 4,1% | 66,2% | 4,2% | 24,0% |
| | | 2009 | | | | | |
| Energy Use | -1,2% | Electricity, Gas and Water Supply | 61065,5 | 40,1% | 40,1% | 4,8% | 4,8% |
| | | Wood and Products of Wood and Cork | 12005,6 | 7,9% | 48,0% | 1,4% | 6,2% |
| Resource Decoupling | | Inland Transport | 10209,0 | 6,7% | 54,7% | 3,0% | 9,1% |
| | | Real Estate Activities | 7832,6 | 5,1% | 59,8% | 6,4% | 15,5% |
| Absolute | | Agriculture, Hunting, Forestry and Fishing | 6954,7 | 4,6% | 64,4% | 1,8% | 17,3% |

| Latvia | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most CO2 Intensive Industries** | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -35,3% | Electricity, Gas and Water Supply | 2980,8 | 40,6% | 40,6% | 4,3% | 4,3% |
| | | Inland Transport | 959,3 | 13,1% | 53,7% | 4,1% | 8,4% |
| | | Food, Beverages and Tobacco | 540,4 | 7,4% | 61,1% | 6,0% | 14,5% |
| GDP | 51,2% | Basic Metals and Fabricated Metal | 411,7 | 5,6% | 66,7% | 2,2% | 16,7% |
| | | Agriculture, Hunting, Forestry and Fishing | 399,1 | 5,4% | 72,1% | 5,3% | 22,0% |
| | | 2009 | | | | | |
| Emissions CO2 | -2,1% | Electricity, Gas and Water Supply | 2074,8 | 28,9% | 28,9% | 4,8% | 4,8% |
| | | Inland Transport | 1515,1 | 21,1% | 50,0% | 3,0% | 7,7% |
| Impact Decoupling | | Air Transport | 576,2 | 8,0% | 58,0% | 0,7% | 8,4% |
| | | Agriculture, Hunting, Forestry and Fishing | 433,8 | 6,0% | 64,1% | 1,8% | 10,2% |
| Absolute | | Other Non-Metallic Mineral | 402,2 | 5,6% | 69,7% | 1,3% | 11,5% |

## Lithuania

| Lithuania | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most Energy Intensive Industries** | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -14,5% | Electricity, Gas and Water Supply | 213801,6 | 38,6% | 38,6% | 4,9% | 4,9% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 213634,4 | 38,6% | 77,2% | 3,2% | 8,1% |
| | | Chemicals and Chemical Products | 30069,0 | 5,4% | 82,7% | 1,9% | 10,0% |
| GDP | 56,5% | Inland Transport | 12359,0 | 2,2% | 84,9% | 4,1% | 14,1% |
| | | Water Transport | 9671,4 | 1,7% | 86,6% | 0,5% | 14,5% |
| | | 2009 | | | | | |
| Energy Use | 33,8% | Coke, Refined Petroleum and Nuclear Fuel | 393390,4 | 53,1% | 53,1% | 0,5% | 0,5% |
| | | Electricity, Gas and Water Supply | 203297,9 | 27,5% | 80,6% | 6,2% | 6,6% |
| Resource Decoupling | | Chemicals and Chemical Products | 38987,2 | 5,3% | 85,8% | 1,4% | 8,1% |
| | | Inland Transport | 14756,1 | 2,0% | 87,8% | 2,1% | 10,1% |
| Relative | | Water Transport | 9406,2 | 1,3% | 89,1% | 0,0% | 10,2% |

| Lithuania | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most CO2 Intensive Industries** | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -39,0% | Electricity, Gas and Water Supply | 4949,4 | 41,0% | 41,0% | 4,9% | 4,9% |
| | | Inland Transport | 1968,2 | 16,3% | 57,3% | 4,1% | 9,0% |
| | | Chemicals and Chemical Products | 1156,0 | 9,6% | 66,9% | 1,9% | 10,9% |
| GDP | 56,5% | Coke, Refined Petroleum and Nuclear Fuel | 996,7 | 8,3% | 75,1% | 3,2% | 14,1% |
| | | Other Non-Metallic Mineral | 869,9 | 7,2% | 82,3% | 1,1% | 15,2% |
| | | 2009 | | | | | |
| Emissions CO2 | -4,5% | Electricity, Gas and Water Supply | 2969,4 | 25,8% | 25,8% | 6,2% | 6,2% |
| | | Inland Transport | 2347,8 | 20,4% | 46,1% | 2,1% | 8,3% |
| Impact Decoupling | | Coke, Refined Petroleum and Nuclear Fuel | 1890,8 | 16,4% | 62,5% | 0,5% | 8,7% |
| | | Chemicals and Chemical Products | 1400,6 | 12,2% | 74,7% | 1,4% | 10,1% |
| Absolute | | Other Non-Metallic Mineral | 638,0 | 5,5% | 80,2% | 1,4% | 11,5% |

## Luxembourg

| Luxembourg | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most Energy Intensive Industries** | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | 15,8% | Air Transport | 36183,5 | 32,3% | 32,3% | 1,8% | 1,8% |
| | | Basic Metals and Fabricated Metal | 20863,3 | 18,6% | 50,9% | 5,4% | 7,2% |
| | | Other Non-Metallic Mineral | 7193,4 | 6,4% | 57,3% | 1,1% | 8,4% |
| GDP | 43,9% | Inland Transport | 5802,0 | 5,2% | 62,5% | 1,9% | 10,3% |
| | | Construction | 4985,4 | 4,4% | 66,9% | 5,8% | 16,1% |
| | | 2009 | | | | | |
| Energy Use | 66,7% | Air Transport | 66280,4 | 35,4% | 35,4% | 0,7% | 0,7% |
| | | Electricity, Gas and Water Supply | 23777,1 | 12,7% | 48,2% | 5,2% | 5,9% |
| Resource Decoupling | | Basic Metals and Fabricated Metal | 16002,1 | 8,6% | 56,7% | 3,1% | 9,0% |
| | | Financial Intermediation | 9347,4 | 5,0% | 61,7% | 3,7% | 12,6% |
| No Decoupling | | Inland Transport | 8680,5 | 4,6% | 66,4% | 3,2% | 15,9% |

| Luxembourg | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most CO2 Intensive Industries** | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -56,5% | Air Transport | 1188,3 | 24,5% | 24,5% | 1,8% | 1,8% |
| | | Other Non-Metallic Mineral | 1086,7 | 22,4% | 46,8% | 1,1% | 3,0% |
| | | Basic Metals and Fabricated Metal | 736,4 | 15,2% | 62,0% | 5,4% | 8,4% |
| GDP | 43,9% | Inland Transport | 396,6 | 8,2% | 70,2% | 1,9% | 10,3% |
| | | Financial Intermediation | 258,9 | 5,3% | 75,5% | 42,7% | 52,9% |
| | | 2009 | | | | | |
| Emissions CO2 | -37,4% | Electricity, Gas and Water Supply | 1164,1 | 38,3% | 38,3% | 5,2% | 5,2% |
| | | Other Non-Metallic Mineral | 812,7 | 26,7% | 65,0% | 1,3% | 6,5% |
| Impact Decoupling | | Financial Intermediation | 286,3 | 9,4% | 74,5% | 3,7% | 10,1% |
| | | Construction | 217,8 | 7,2% | 81,6% | 7,3% | 17,4% |
| Absolute | | Other Community, Social and Personal Services | 107,9 | 3,6% | 85,2% | 3,0% | 20,5% |

## Malta

| Malta | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most Energy Intensive Industries** | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -25,7% | Air Transport | 36341,0 | 51,6% | 51,6% | 2,8% | 2,8% |
| | | Electricity, Gas and Water Supply | 23549,6 | 33,5% | 85,1% | 4,0% | 6,9% |
| | | Water Transport | 1731,1 | 2,5% | 87,5% | 0,6% | 7,4% |
| GDP | 25,0% | Inland Transport | 1126,4 | 1,6% | 89,1% | 1,4% | 8,8% |
| | | Other Supporting and Auxiliary Transport Activities; A | 695,2 | 1,0% | 90,1% | 3,0% | 11,9% |
| | | 2009 | | | | | |
| Energy Use | -7,1% | Air Transport | 28392,4 | 43,4% | 43,4% | 0,6% | 0,6% |
| | | Electricity, Gas and Water Supply | 26016,7 | 39,8% | 83,2% | 5,8% | 6,4% |
| Resource Decoupling | | Water Transport | 2630,8 | 4,0% | 87,2% | 0,0% | 6,4% |
| | | Construction | 1282,6 | 2,0% | 89,2% | 8,1% | 14,5% |
| Absolute | | Other Community, Social and Personal Services | 1054,6 | 1,6% | 90,8% | 3,5% | 18,0% |

| Malta | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most CO2 Intensive Industries** | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | 0,7% | Electricity, Gas and Water Supply | 1269,4 | 63,5% | 63,5% | 4,0% | 4,0% |
| | | Inland Transport | 486,0 | 24,3% | 87,9% | 1,4% | 5,4% |
| | | Hotels and Restaurants | 61,4 | 3,1% | 90,9% | 7,5% | 12,9% |
| GDP | 25,0% | Basic Metals and Fabricated Metal | 42,0 | 2,1% | 93,0% | 0,7% | 13,6% |
| | | Public Admin and Defence; Compulsory Social Securit | 40,9 | 2,0% | 95,1% | 4,6% | 18,2% |
| | | 2009 | | | | | |
| Emissions CO2 | 25,8% | Electricity, Gas and Water Supply | 1479,4 | 58,9% | 58,9% | 5,8% | 5,8% |
| | | Inland Transport | 446,7 | 17,8% | 76,6% | 2,6% | 8,4% |
| Impact Decoupling | | Basic Metals and Fabricated Metal | 419,7 | 16,7% | 93,3% | 4,1% | 12,5% |
| | | Mining and Quarrying | 38,0 | 1,5% | 94,8% | 0,4% | 12,9% |
| No Decoupling | | Hotels and Restaurants | 22,4 | 0,9% | 95,7% | 3,9% | 16,8% |

## Netherlands

| Netherlands | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most Energy Intensive Industries | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -17,3% | Coke, Refined Petroleum and Nuclear Fuel | 2828153,0 | 41,8% | 41,8% | 1,4% | 1,4% |
| | | Chemicals and Chemical Products | 1069429,0 | 15,8% | 57,6% | 3,9% | 5,3% |
| | | Electricity, Gas and Water Supply | 749118,3 | 11,1% | 68,7% | 2,6% | 7,9% |
| GDP | 18,1% | Mining and Quarrying | 308142,7 | 4,6% | 73,2% | 1,2% | 9,2% |
| | | Agriculture, Hunting, Forestry and Fishing | 271302,5 | 4,0% | 77,2% | 2,9% | 12,1% |
| | | 2009 | | | | | |
| Energy Use | -2,4% | Coke, Refined Petroleum and Nuclear Fuel | 2508982,3 | 38,0% | 38,0% | 0,5% | 0,5% |
| | | Chemicals and Chemical Products | 1289217,2 | 19,5% | 57,5% | 2,2% | 2,6% |
| Resource Decoupling | | Electricity, Gas and Water Supply | 929289,3 | 14,1% | 71,6% | 4,6% | 7,3% |
| | | Mining and Quarrying | 270435,9 | 4,1% | 75,7% | 0,3% | 7,5% |
| Absolute | | Air Transport | 219444,7 | 3,3% | 79,0% | 0,7% | 8,2% |

| Netherlands | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most CO2 Intensive Industries | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -10,4% | Electricity, Gas and Water Supply | 47341,6 | 30,2% | 30,2% | 2,6% | 2,6% |
| | | Chemicals and Chemical Products | 15920,0 | 10,1% | 40,3% | 3,9% | 6,5% |
| | | Air Transport | 12070,5 | 7,7% | 48,0% | 0,9% | 7,5% |
| GDP | 18,1% | Coke, Refined Petroleum and Nuclear Fuel | 11907,5 | 7,6% | 55,6% | 1,4% | 8,9% |
| | | Agriculture, Hunting, Forestry and Fishing | 10427,9 | 6,6% | 62,2% | 2,9% | 11,8% |
| | | 2009 | | | | | |
| Emissions CO2 | 5,9% | Electricity, Gas and Water Supply | 55361,2 | 33,3% | 33,3% | 4,6% | 4,6% |
| | | Air Transport | 20243,3 | 12,2% | 45,5% | 0,7% | 5,3% |
| Impact Decoupling | | Other Community, Social and Personal Services | 11170,5 | 6,7% | 52,2% | 3,4% | 8,7% |
| | | Agriculture, Hunting, Forestry and Fishing | 10497,6 | 6,3% | 58,5% | 1,9% | 10,6% |
| Relative | | Chemicals and Chemical Products | 10466,3 | 6,3% | 64,8% | 2,2% | 12,8% |

## Poland

| Poland | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most Energy Intensive Industries | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -26,7% | Electricity, Gas and Water Supply | 1781814,7 | 37,1% | 37,1% | 3,5% | 3,5% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 1022921,3 | 21,3% | 58,4% | 1,3% | 4,8% |
| | | Basic Metals and Fabricated Metal | 343952,6 | 7,2% | 65,5% | 3,2% | 8,0% |
| GDP | 43,5% | Chemicals and Chemical Products | 275397,5 | 5,7% | 71,2% | 2,0% | 10,1% |
| | | Agriculture, Hunting, Forestry and Fishing | 246328,0 | 5,1% | 76,4% | 5,7% | 15,8% |
| | | 2009 | | | | | |
| Energy Use | 5,1% | Electricity, Gas and Water Supply | 1784373,7 | 35,3% | 35,3% | 4,1% | 4,1% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 1305401,1 | 25,8% | 61,2% | 1,0% | 5,1% |
| Resource Decoupling | | Inland Transport | 327201,6 | 6,5% | 67,6% | 2,3% | 7,5% |
| | | Chemicals and Chemical Products | 297750,0 | 5,9% | 73,5% | 2,8% | 10,3% |
| Relative | | Agriculture, Hunting, Forestry and Fishing | 174757,2 | 3,5% | 77,0% | 1,7% | 12,1% |

| Poland | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most CO2 Intensive Industries | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -32,9% | Electricity, Gas and Water Supply | 159996,5 | 56,0% | 56,0% | 3,5% | 3,5% |
| | | Basic Metals and Fabricated Metal | 19750,5 | 6,9% | 62,9% | 3,2% | 6,7% |
| | | Agriculture, Hunting, Forestry and Fishing | 17185,8 | 6,0% | 68,9% | 5,7% | 12,4% |
| GDP | 43,5% | Other Non-Metallic Mineral | 16863,0 | 5,9% | 74,8% | 1,6% | 14,0% |
| | | Chemicals and Chemical Products | 14549,5 | 5,1% | 79,9% | 2,0% | 16,0% |
| | | 2009 | | | | | |
| Emissions CO2 | -3,7% | Electricity, Gas and Water Supply | 154031,6 | 56,0% | 56,0% | 4,1% | 4,1% |
| | | Inland Transport | 18954,2 | 6,9% | 62,9% | 2,3% | 6,4% |
| Impact Decoupling | | Other Non-Metallic Mineral | 14809,3 | 5,4% | 68,3% | 1,6% | 8,1% |
| | | Chemicals and Chemical Products | 12950,4 | 4,7% | 73,0% | 2,8% | 10,9% |
| Absolute | | Agriculture, Hunting, Forestry and Fishing | 12665,6 | 4,6% | 77,6% | 1,7% | 12,6% |

## Portugal

| Portugal | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most Energy Intensive Industries | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -17,5% | Coke, Refined Petroleum and Nuclear Fuel | 611935,9 | 38,6% | 38,6% | 1,0% | 1,0% |
| | | Electricity, Gas and Water Supply | 326559,2 | 20,6% | 59,2% | 2,9% | 3,9% |
| | | Chemicals and Chemical Products | 89002,9 | 5,6% | 64,8% | 1,6% | 5,5% |
| GDP | 13,1% | Other Non-Metallic Mineral | 88296,4 | 5,6% | 70,4% | 2,1% | 7,6% |
| | | Inland Transport | 67160,3 | 4,2% | 74,6% | 1,8% | 9,3% |
| | | 2009 | | | | | |
| Energy Use | -6,7% | Coke, Refined Petroleum and Nuclear Fuel | 502682,3 | 34,0% | 34,0% | 0,2% | 0,2% |
| | | Electricity, Gas and Water Supply | 327064,3 | 22,1% | 56,1% | 6,1% | 6,3% |
| Resource Decoupling | | Inland Transport | 73138,5 | 4,9% | 61,0% | 3,1% | 9,4% |
| | | Pulp, Paper, Paper , Printing and Publishing | 69572,9 | 4,7% | 65,7% | 2,1% | 11,5% |
| Absolute | | Other Non-Metallic Mineral | 67111,5 | 4,5% | 70,2% | 1,6% | 13,1% |

| Portugal | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most CO2 Intensive Industries | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -19,4% | Electricity, Gas and Water Supply | 22236,6 | 38,8% | 38,8% | 2,9% | 2,9% |
| | | Other Non-Metallic Mineral | 8483,8 | 14,8% | 53,7% | 2,1% | 5,0% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 2999,7 | 5,2% | 58,9% | 1,0% | 6,0% |
| GDP | 13,1% | Inland Transport | 2878,7 | 5,0% | 63,9% | 1,8% | 7,8% |
| | | Chemicals and Chemical Products | 2861,0 | 5,0% | 68,9% | 1,6% | 9,3% |
| | | 2009 | | | | | |
| Emissions CO2 | -8,9% | Electricity, Gas and Water Supply | 17430,3 | 33,4% | 33,4% | 6,1% | 6,1% |
| | | Other Non-Metallic Mineral | 7176,2 | 13,8% | 47,2% | 1,6% | 7,8% |
| Impact Decoupling | | Inland Transport | 3920,4 | 7,5% | 54,7% | 3,1% | 10,8% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 3599,7 | 6,9% | 61,6% | 0,2% | 11,0% |
| Absolute | | Air Transport | 2552,7 | 4,9% | 66,5% | 0,7% | 11,7% |

## Romania

| Romania | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most Energy Intensive Industries | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -182,9% | Electricity, Gas and Water Supply | 759662,7 | 38,9% | 38,9% | 7,3% | 7,3% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 535827,7 | 27,4% | 66,3% | 2,5% | 9,8% |
| | | Basic Metals and Fabricated Metal | 163979,8 | 8,4% | 74,7% | 3,5% | 13,3% |
| GDP | -213,4% | Chemicals and Chemical Products | 114572,4 | 5,9% | 80,6% | 2,1% | 15,4% |
| | | Mining and Quarrying | 63576,4 | 3,3% | 83,9% | 2,4% | 17,9% |
| | | 2009 | | | | | |
| Energy Use | -6,0% | Electricity, Gas and Water Supply | 683164,7 | 37,2% | 37,2% | 5,6% | 5,6% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 561722,2 | 30,6% | 67,8% | 0,8% | 6,4% |
| Resource Decoupling | | Chemicals and Chemical Products | 160079,2 | 8,7% | 76,5% | 2,3% | 8,7% |
| | | Basic Metals and Fabricated Metal | 71157,5 | 3,9% | 80,4% | 4,0% | 12,7% |
| No Decoupling | | Inland Transport | 48063,8 | 2,6% | 83,0% | 2,7% | 15,4% |

| Romania | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most CO2 Intensive Industries | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -183,0% | Electricity, Gas and Water Supply | 48356,2 | 59,2% | 59,2% | 7,3% | 7,3% |
| | | Inland Transport | 7811,1 | 9,6% | 68,8% | 4,7% | 12,0% |
| | | Basic Metals and Fabricated Metal | 5667,2 | 6,9% | 75,8% | 3,5% | 15,5% |
| GDP | -213,4% | Other Non-Metallic Mineral | 5240,4 | 6,4% | 82,2% | 1,4% | 17,0% |
| | | Construction | 4673,7 | 5,7% | 87,9% | 5,7% | 22,7% |
| | | 2009 | | | | | |
| Emissions CO2 | -5,9% | Electricity, Gas and Water Supply | 42719,6 | 55,6% | 55,6% | 5,6% | 5,6% |
| | | Inland Transport | 14398,5 | 18,7% | 74,4% | 2,7% | 8,3% |
| Impact Decoupling | | Other Non-Metallic Mineral | 5361,2 | 7,0% | 81,3% | 1,3% | 9,6% |
| | | Basic Metals and Fabricated Metal | 4016,4 | 5,2% | 86,6% | 4,0% | 13,6% |
| No Decoupling | | Construction | 3392,8 | 4,4% | 91,0% | 8,1% | 21,7% |

## Slovak Republic

| Slovak Republic | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most Energy Intensive Industries** | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -34,1% | Electricity, Gas and Water Supply | 357987,6 | 35,8% | 35,8% | 6,2% | 6,2% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 237031,4 | 23,7% | 59,5% | 2,2% | 8,3% |
| | | Basic Metals and Fabricated Metal | 118333,0 | 11,8% | 71,3% | 6,5% | 14,8% |
| GDP | 55,0% | Chemicals and Chemical Products | 60235,6 | 6,0% | 77,3% | 2,2% | 17,1% |
| | | Other Non-Metallic Mineral | 27715,5 | 2,8% | 80,1% | 1,6% | 18,6% |
| | | 2009 | | | | | |
| Energy Use | 2,2% | Electricity, Gas and Water Supply | 318110,1 | 31,1% | 31,1% | 3,2% | 3,2% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 295446,5 | 28,9% | 60,0% | 0,4% | 3,6% |
| Resource Decoupling | | Basic Metals and Fabricated Metal | 123814,5 | 12,1% | 72,2% | 4,0% | 7,7% |
| | | Chemicals and Chemical Products | 65007,8 | 6,4% | 78,5% | 3,1% | 10,8% |
| Relative | | Inland Transport | 50514,9 | 4,9% | 83,5% | 2,2% | 12,9% |

| Slovak Republic | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most CO2 Intensive Industries** | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -42,6% | Electricity, Gas and Water Supply | 9312,3 | 25,0% | 25,0% | 6,2% | 6,2% |
| | | Basic Metals and Fabricated Metal | 7001,6 | 18,8% | 43,7% | 6,5% | 12,7% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 4086,8 | 10,9% | 54,7% | 2,2% | 14,8% |
| GDP | 55,0% | Chemicals and Chemical Products | 3664,0 | 9,8% | 64,5% | 2,2% | 17,1% |
| | | Other Non-Metallic Mineral | 3257,8 | 8,7% | 73,2% | 1,6% | 18,6% |
| | | 2009 | | | | | |
| Emissions CO2 | -11,0% | Electricity, Gas and Water Supply | 8375,4 | 25,2% | 25,2% | 3,2% | 3,2% |
| | | Basic Metals and Fabricated Metal | 6911,0 | 20,8% | 46,0% | 4,0% | 7,3% |
| Impact Decoupling | | Coke, Refined Petroleum and Nuclear Fuel | 4286,7 | 12,9% | 58,9% | 0,4% | 7,7% |
| | | Other Non-Metallic Mineral | 2979,5 | 9,0% | 67,9% | 1,5% | 9,2% |
| Absolute | | Chemicals and Chemical Products | 2488,5 | 7,5% | 75,4% | 3,1% | 12,3% |

## Slovenia

| Slovenia | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most Energy Intensive Industries** | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -16,6% | Electricity, Gas and Water Supply | 124644,0 | 46,7% | 46,7% | 2,6% | 2,6% |
| | | Basic Metals and Fabricated Metal | 14313,4 | 5,4% | 52,1% | 5,2% | 7,8% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 13987,3 | 5,2% | 57,3% | 0,2% | 8,0% |
| GDP | 26,0% | Inland Transport | 10342,8 | 3,9% | 61,2% | 2,8% | 10,8% |
| | | Chemicals and Chemical Products | 10001,2 | 3,7% | 65,0% | 3,1% | 13,9% |
| | | 2009 | | | | | |
| Energy Use | 5,1% | Electricity, Gas and Water Supply | 154091,8 | 55,0% | 55,0% | 5,3% | 5,3% |
| | | Inland Transport | 23007,1 | 8,2% | 63,2% | 2,5% | 7,8% |
| Resource Decoupling | | Basic Metals and Fabricated Metal | 12307,9 | 4,4% | 67,5% | 4,5% | 12,3% |
| | | Chemicals and Chemical Products | 10853,0 | 3,9% | 71,4% | 2,5% | 14,8% |
| Relative | | Pulp, Paper, Paper , Printing and Publishing | 8239,9 | 2,9% | 74,4% | 2,3% | 17,1% |

| Slovenia | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | **Most CO2 Intensive Industries** | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -0,8% | Electricity, Gas and Water Supply | 5188,1 | 49,7% | 49,7% | 2,6% | 2,6% |
| | | Other Non-Metallic Mineral | 1108,0 | 10,6% | 60,4% | 1,5% | 4,1% |
| | | Sale, Maintenance and Repair of Motor Vehicles and | 1014,7 | 9,7% | 70,1% | 1,9% | 6,0% |
| GDP | 26,0% | Inland Transport | 820,6 | 7,9% | 78,0% | 2,8% | 8,8% |
| | | Pulp, Paper, Paper , Printing and Publishing | 554,9 | 5,3% | 83,3% | 2,8% | 11,6% |
| | | 2009 | | | | | |
| Emissions CO2 | 25,0% | Electricity, Gas and Water Supply | 6132,4 | 47,0% | 47,0% | 5,3% | 5,3% |
| | | Inland Transport | 3495,8 | 26,8% | 73,8% | 2,5% | 7,8% |
| Impact Decoupling | | Other Non-Metallic Mineral | 1044,6 | 8,0% | 81,8% | 1,3% | 9,1% |
| | | Sale, Maintenance and Repair of Motor Vehicles and | 598,4 | 4,6% | 86,4% | 1,6% | 10,6% |
| No Decoupling | | Pulp, Paper, Paper , Printing and Publishing | 409,2 | 3,1% | 89,6% | 2,3% | 12,9% |

# Spain

| Spain | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most Energy Intensive Industries | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -14,0% | Coke, Refined Petroleum and Nuclear Fuel | 2756887,7 | 38,0% | 38,0% | 1,2% | 1,2% |
| | | Electricity, Gas and Water Supply | 1767005,8 | 24,3% | 62,3% | 2,3% | 3,5% |
| | | Chemicals and Chemical Products | 412802,7 | 5,7% | 68,0% | 2,6% | 6,1% |
| GDP | 24,9% | Inland Transport | 299529,3 | 4,1% | 72,1% | 2,7% | 8,8% |
| | | Basic Metals and Fabricated Metal | 287884,1 | 4,0% | 76,1% | 3,9% | 12,7% |
| | | 2009 | | | | | |
| Energy Use | 7,5% | Coke, Refined Petroleum and Nuclear Fuel | 2629732,5 | 33,7% | 33,7% | 0,6% | 0,6% |
| | | Electricity, Gas and Water Supply | 2065933,2 | 26,5% | 60,2% | 5,6% | 6,2% |
| Resource Decoupling | | Chemicals and Chemical Products | 381928,0 | 4,9% | 65,1% | 2,2% | 8,4% |
| | | Inland Transport | 359873,3 | 4,6% | 69,7% | 2,5% | 10,9% |
| Relative | | Other Non-Metallic Mineral | 284190,3 | 3,6% | 73,4% | 1,4% | 12,2% |

| Spain | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most CO2 Intensive Industries | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -19,8% | Electricity, Gas and Water Supply | 85056,6 | 36,9% | 36,9% | 2,3% | 2,3% |
| | | Other Non-Metallic Mineral | 43572,2 | 18,9% | 55,8% | 1,8% | 4,1% |
| | | Inland Transport | 18848,3 | 8,2% | 64,0% | 2,7% | 6,8% |
| GDP | 24,9% | Coke, Refined Petroleum and Nuclear Fuel | 18573,2 | 8,1% | 72,1% | 1,2% | 8,0% |
| | | Basic Metals and Fabricated Metal | 12274,9 | 5,3% | 77,4% | 3,9% | 11,9% |
| | | 2009 | | | | | |
| Emissions CO2 | 0,2% | Electricity, Gas and Water Supply | 74188,7 | 32,2% | 32,2% | 5,6% | 5,6% |
| | | Other Non-Metallic Mineral | 37115,0 | 16,1% | 48,2% | 1,4% | 6,9% |
| Impact Decoupling | | Inland Transport | 22641,6 | 9,8% | 58,1% | 2,5% | 9,4% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 18638,0 | 8,1% | 66,1% | 0,6% | 10,0% |
| Relative | | Air Transport | 12637,7 | 5,5% | 71,6% | 0,4% | 10,4% |

# Sweden

| Sweden | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most Energy Intensive Industries | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -25,9% | Electricity, Gas and Water Supply | 1309252,3 | 37,9% | 37,9% | 1,9% | 1,9% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 927182,9 | 26,9% | 64,8% | 0,7% | 2,7% |
| | | Pulp, Paper, Paper , Printing and Publishing | 259118,9 | 7,5% | 72,3% | 4,0% | 6,7% |
| GDP | 21,1% | Chemicals and Chemical Products | 136056,8 | 3,9% | 76,3% | 2,4% | 9,1% |
| | | Basic Metals and Fabricated Metal | 129660,0 | 3,8% | 80,0% | 3,8% | 13,0% |
| | | 2009 | | | | | |
| Energy Use | -10,3% | Electricity, Gas and Water Supply | 1125474,0 | 36,3% | 36,3% | 4,5% | 4,5% |
| | | Coke, Refined Petroleum and Nuclear Fuel | 869492,7 | 28,1% | 64,4% | 0,5% | 5,0% |
| Resource Decoupling | | Pulp, Paper, Paper , Printing and Publishing | 288259,4 | 9,3% | 73,7% | 2,0% | 6,9% |
| | | Basic Metals and Fabricated Metal | 106285,3 | 3,4% | 77,2% | 3,4% | 10,3% |
| Absolute | | Inland Transport | 77627,0 | 2,5% | 79,7% | 2,3% | 12,7% |

| Sweden | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most CO2 Intensive Industries | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -16,9% | Electricity, Gas and Water Supply | 8362,9 | 17,8% | 17,8% | 1,9% | 1,9% |
| | | Basic Metals and Fabricated Metal | 6116,1 | 13,0% | 30,8% | 3,8% | 5,8% |
| | | Water Transport | 5406,1 | 11,5% | 42,3% | 0,7% | 6,5% |
| GDP | 21,1% | Inland Transport | 3389,3 | 7,2% | 49,5% | 2,8% | 9,3% |
| | | Other Non-Metallic Mineral | 3233,9 | 6,9% | 56,4% | 0,5% | 9,9% |
| | | 2009 | | | | | |
| Emissions CO2 | 0,7% | Electricity, Gas and Water Supply | 8834,2 | 18,7% | 18,7% | 4,5% | 4,5% |
| | | Water Transport | 6758,1 | 14,3% | 32,9% | 0,0% | 4,5% |
| Impact Decoupling | | Air Transport | 4062,1 | 8,6% | 41,5% | 0,6% | 5,1% |
| | | Basic Metals and Fabricated Metal | 3569,9 | 7,5% | 49,0% | 3,4% | 8,4% |
| Relative | | Inland Transport | 3185,6 | 6,7% | 55,8% | 2,3% | 10,8% |

## UK

| UK | | Energy Use | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most Energy Intensive Industries | TJ | % | Accu | % | Accu |
| | | 1999 | | | | | |
| Energy Intensity | -23,9% | Coke, Refined Petroleum and Nuclear Fuel | 4512217,8 | 35,5% | 35,5% | 0,7% | 0,7% |
| | | Electricity, Gas and Water Supply | 3469543,3 | 27,3% | 62,8% | 2,8% | 3,5% |
| | | Chemicals and Chemical Products | 775389,5 | 6,1% | 68,9% | 2,5% | 5,9% |
| GDP | 11,6% | Basic Metals and Fabricated Metal | 477539,9 | 3,8% | 72,6% | 2,4% | 8,4% |
| | | Air Transport | 403132,9 | 3,2% | 75,8% | 0,6% | 9,0% |
| | | 2009 | | | | | |
| Energy Use | -15,0% | Coke, Refined Petroleum and Nuclear Fuel | 3641568,5 | 33,7% | 33,7% | 0,6% | 0,6% |
| | | Electricity, Gas and Water Supply | 3174212,6 | 29,4% | 63,1% | 4,3% | 4,9% |
| Resource Decoupling | | Chemicals and Chemical Products | 448401,1 | 4,1% | 67,2% | 1,9% | 6,8% |
| | | Basic Metals and Fabricated Metal | 358148,6 | 3,3% | 70,5% | 4,5% | 11,3% |
| Absolute | | Agriculture, Hunting, Forestry and Fishing | 344665,8 | 3,2% | 73,7% | 1,7% | 12,9% |

| UK | | Emissions CO2 | | | | Total Output | |
|---|---|---|---|---|---|---|---|
| 1999 - 2009 | | Most CO2 Intensive Industries | Gg | % | Accu | % | Accu |
| | | 1999 | | | | | |
| CO2 Intensity | -14,4% | Electricity, Gas and Water Supply | 150534,7 | 34,1% | 34,1% | 2,8% | 2,8% |
| | | Basic Metals and Fabricated Metal | 36086,2 | 8,2% | 42,2% | 2,4% | 5,2% |
| | | Air Transport | 33423,7 | 7,6% | 49,8% | 0,6% | 5,8% |
| GDP | 11,6% | Inland Transport | 27096,0 | 6,1% | 55,9% | 2,4% | 8,2% |
| | | Mining and Quarrying | 24987,7 | 5,7% | 61,6% | 1,6% | 9,7% |
| | | 2009 | | | | | |
| Emissions CO2 | -4,4% | Electricity, Gas and Water Supply | 153861,8 | 36,4% | 36,4% | 4,3% | 4,3% |
| | | Air Transport | 61140,3 | 14,5% | 50,9% | 0,6% | 4,9% |
| Impact Decoupling | | Inland Transport | 25924,0 | 6,1% | 57,1% | 2,6% | 7,5% |
| | | Mining and Quarrying | 20809,4 | 4,9% | 62,0% | 0,3% | 7,8% |
| Absolute | | Basic Metals and Fabricated Metal | 20226,9 | 4,8% | 66,8% | 4,5% | 12,2% |

# Appendix B

## Summary of the fuel use mix changes (1999-2009) by country

| | *Country* | **Renewables (%)** | **Coal (%)** | **Oil (%)** | **Gas (%)** |
|---|---|---|---|---|---|
| South | Cyprus | 0,2 | 0,0 | -0,2 | 0,0 |
| | Greece | 0,7 | -2,8 | -0,2 | 2,4 |
| | Italy | 4,1 | -0,2 | -7,5 | 3,6 |
| | Malta | 0,1 | 0,0 | -0,1 | 0,0 |
| | Portugal | 5,6 | -2,0 | -9,9 | 6,4 |
| | Spain | 3,2 | -7,1 | -6,4 | 10,3 |
| | *Average* | *2,3* | *-2,0* | *-4,1* | *3,8* |
| Center | Austria | 6,6 | -1,9 | -5,8 | 1,1 |
| | Belgium | 2,5 | -4,9 | -0,4 | 2,8 |
| | France | 3,3 | -1,7 | -2,1 | 0,6 |
| | Germany | 5,7 | -2,6 | -3,6 | 0,5 |
| | Ireland | 2,2 | -4,0 | -3,5 | 5,2 |
| | Luxembourg | 1,7 | -3,2 | -1,5 | 3,0 |
| | Netherlands | 0,2 | 0,2 | 0,6 | -1,0 |
| | UK | 1,3 | -0,3 | -2,5 | 1,6 |
| | *Average* | *2,9* | *-2,3* | *-2,4* | *1,7* |
| East | Bulgaria | 2,6 | 0,6 | 0,7 | -3,9 |
| | Czech | -0,3 | -1,4 | 4,3 | -2,7 |
| | Estonia | 1,6 | 5,3 | -6,1 | -0,8 |
| | Hungary | 3,1 | -4,9 | 2,4 | -0,6 |
| | Latvia | 4,8 | -1,4 | -10,2 | 6,8 |
| | Lithuania | 0,5 | -0,1 | 2,6 | -2,9 |
| | Poland | 1,7 | -10,6 | 6,7 | 2,2 |
| | Romania | -1,4 | 1,6 | 5,9 | -6,1 |
| | Slovakia | 3,8 | -3,7 | 5,6 | -5,7 |
| | Slovenia | 3,3 | 2,9 | -5,0 | -1,3 |
| | *Average* | *2,0* | *-1,2* | *0,7* | *-1,5* |
| North | Denmark | 2,5 | -4,2 | 6,7 | -5,0 |
| | Finland | 1,8 | -2,5 | 1,2 | -0,5 |
| | Sweden | 5,2 | -0,4 | -5,4 | 0,6 |
| | *Average* | *3,2* | *-2,4* | *0,8* | *-1,6* |
| ***EU 27 Average*** | | 2,5% | -1,8 | -1,3 | 0,6 |

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