GREECO
Territorial Potentials for a Greener Economy

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Sector Report

Vol. 3.1. Sector Synthesis

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

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

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This basic report exists only in an electronic version.

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Volume 3. Synthesis of sector reports: A cross sector investigation of the green economy

1. Introduction

In the GREECO project a series of sector investigations of the green economy has been carried out with the purpose to understand the green growth process within each sector, the current state and greening performance, and to identify sector-specific drivers and enabling conditions for a green growth. The sector analysis also studied the territorial relations of the sectors, identified the communalities, and the most important linkages and interdependencies between the sectors studied.

The six sectors under analysis in GREECO are: Bio-economy (Agriculture, Forestry and Fishery), Manufacturing, Renewable Energy, Tourism and Transport. Three additional sectors, which crosscut the above sectors and possess clear territorial dimensions, have also been considered. These include: water and waste management, building/construction and green research activities including the implementation of clean technologies such as carbon capture technologies.

There are several reasons for carrying out a sector analysis of the green economy. Despite the communalities and cross cutting linkages existing between the economic sectors, some of the green economy aspects, drivers and enablers are sector specific. Even the definition of 'greening' is different for each sector. Therefore some experience and knowledge cannot be transferred from one sector to another. Sector conceptualization enables to look into a more complex background and to perform a more comprehensive investigation of the green economy.

Moreover, the policies, national programmes and research are often framed sectorally. Methodologically GREECO project also relied heavily on sector specific reports (literature reviews, sustainability concepts within the sector, OECD sector sustainability reviews, etc.).

The report starts with introducing the rationale for definition and selection of the sectors and shortly describes the structure of the sector analysis. In Chapter 3 the conceptual elements and the most profound features of the green economy from the sector perspectives are summarized, followed by a description of the current state and greening performance of the sectors (Chapter 4). Chapter 5 highlights the main drivers and enablers for greening of the sectors. In Chapters 6 and 7 the linkages between the sectors are discussed and some general conclusions are drawn.

2. Rationale and structure of the analysis

This section introduces the sectors that are under investigation by GREECO. This includes a rationale for the inclusion and organization of the sectors, as well as how the sectors were defined - both from a statistical and a conceptual perspective. Discussion also demonstrates how the sector analyses relate to the regional performance assessment (subtask 2.2.3), drivers and enablers analysis (subtask 2.2.4), an assessment of regional potentials for a transition to the green economy (subtask 2.2.5) and for the overall policy analysis (task 2.5).

2.1 Presentation and rationale of sector structure

The sectors under analysis in GREECO project are directly linked to the commentary of the ESPON Specification (Version 18, published January 2011). It was asked that any application "shall focus on the following 6 sectors, to which a large part of cohesion policy investment in environment is allocated..." (pag.7). As already mentioned in the Introduction, the nine sectors identified in the specification were considered by GREECO and were carried forward by GREECO as sectors to be investigated on an equal footing. They are:

- The bioeconomy (forestry, fisheries and agriculture)
- Energy
- Manufacturing
- Transport (mobility and trade)
- Tourism
- Water Management
- Waste Management
- Building / construction
- Green research and eco-innovation

In a policy perspective, the rationale for including these sectors in the GREECO analysis was first and foremost due to the fact that each sector has strong implications for meeting the EU's policy goals of Smart, Sustainable and Inclusive growth. For example, in a Smart perspective, it is clear that Europe will continue to rely on a growth economy, and one that operates in the context of globalization and global competition. As such, Europe needs to rely on its existing strengths, research and innovation-led production, consumption and export of goods and services. In a Sustainable perspective, it is obvious that the management of energy, buildings and construction, transport, water and waste management, and the bioeconomy have explicit connections to the way we consume a host of key natural resources. And in an Inclusive perspective it was already mentioned that these sectors are a strong focus of future Cohesion policy investment for the environment. Furthermore, these are sectors which have strong territorial aspects, either on their own, or equally important and novel, in terms of linkages to each other. Deciphering these linkages and understanding how the territorial impacts of these linkages can be used to advance development of the green economy will be an important contribution of this project.

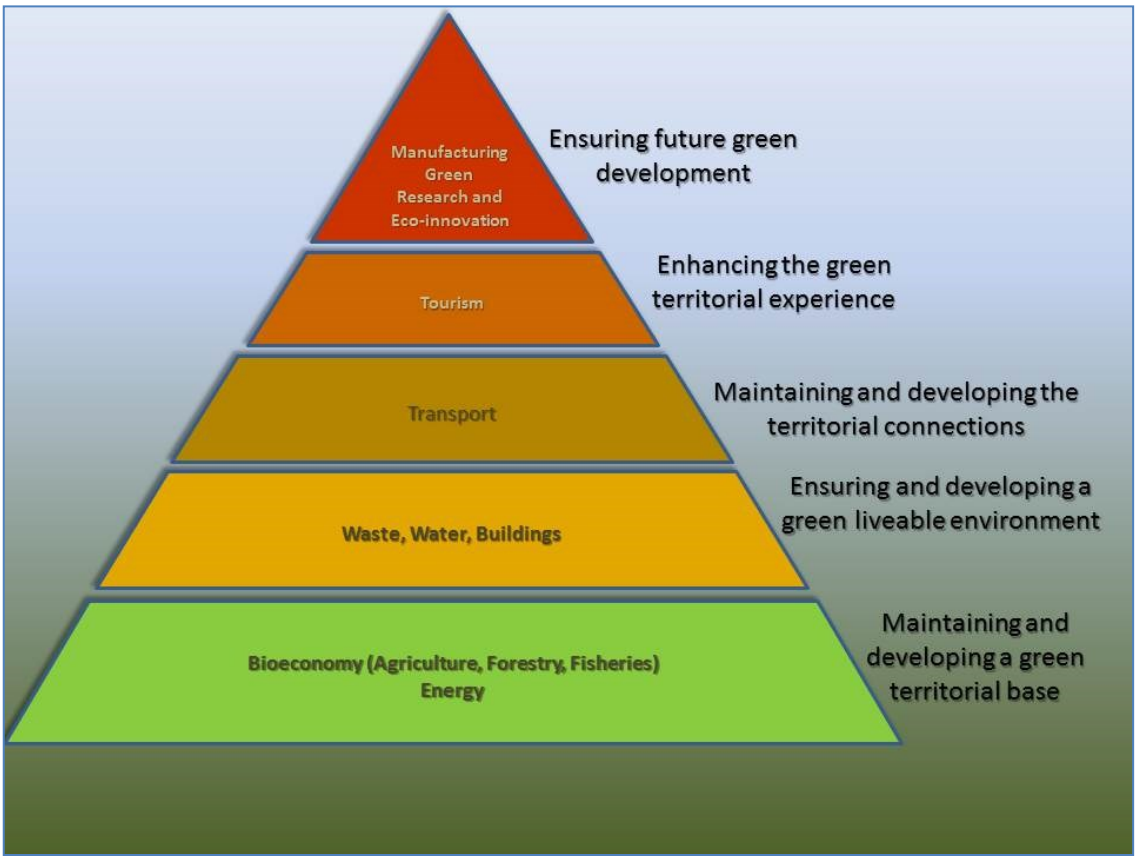


Figure 1: Territorially relevant sectors in the green economy

At the same time, the relevance of the chosen sectors for GREECO can be conceived in relation to the importance of territory when considering regional performance and potential of the green economy. To achieve this, we view the sectors in a "hierarchy" of territorial-bound "building blocks". This hierarchy perceives the basic needs and principles of land and resources as a point of departure, and moves all the way to the role of ensuring a sustainable future. In doing so, Figure 1 comprehensively accounts for the most important activities that allow us to merge goals of growth and the environment. This hierarchy of sectors is characterized as follows:

1. Maintaining and developing a green territorial base: The Bioeconomy (forestry, fisheries and agriculture) and Energy.
2. Ensuring and developing a green livable environment: Building / construction, Waste and Water.
3. Maintaining and developing the territorial connections: Transport (mobility and trade)
4. Promoting and enhancing the green territorial experience : Tourism
5. Ensuring a future green development: Manufacturing, Green research and eco-innovation

The bioeconomy and energy sectors are at the bottom of the sector hierarchy triangle, which shows that these sectors have the strongest ties to the territory, as they are making direct use of natural resources and are highly dependent on the available land resources, climatic conditions and territorial characteristics. At the top of the pyramid are the manufacturing and eco-innovation sectors with the lowest territorial bounds.

With this collection of sectors GREECO covers a broad spectrum of economic activities that account for a majority of the interactions between society and economy, and the environment. However,

selected sectors with large economic contributions are not directly considered. For example, the finance sector is not explicitly acknowledged, but the reason for this is that its main resource input and output is in relation to resource consumption for electricity and heating/cooling. This perspective is taken up explicitly in the building and construction sector. One resource intensive sector not considered is the mining of non-energy products and there are multiple rationales for not including it. First, it is not an activity that, by nature, is either green at present or has the potential to become significantly greener in the future. Second, the policy and governance perspectives of advancing efficiency in mining is almost exclusively driven by the ongoing development of the European Emissions Trading Scheme (ETS), which makes it rather uninteresting to investigate comprehensively. Third, given that such a large share of mineral extraction are used as inputs into other sectors (especially buildings and infrastructure), it is assumed that green interventions to reduce input demand de facto improves resource performance of mining by reducing demand for such resources.

2.2 Reason for deviating from the specification

There are a number of small differences between the final list that GREECO proposes and the division of sectors in the specification. Perhaps the most important of which is the fact that GREECO includes the 6 main sectors and the 3 "cross-cutting" sectors on an equal footing. There are two reasons for this: first, all identified sectors have irreplaceable implications for achieving a balanced and green economy in their own right. Perhaps no better example exists than for the building/ construction sector. Not only does 40% of final energy consumption take place in buildings (EC, 2011a), but the construction of buildings (and infrastructure) is the second largest consumer of raw materials in the EU - where construction and demolition activities alone account for 33% of our annual waste (EEA, 2010a). With that being said, the Roadmap for moving to a competitive low carbon economy in 2050 (EC, 2011b) states that greenhouse gases (GHG) emissions from buildings can be reduced by roughly 90% by 2050. This clearly shows an example of a "cross-cutting" sector that has an incredible potential in its own right.

A second reason for the equal footing of all sectors is to ensure that all the important connections (both mutual reinforcements and potential conflicts) between sectors are discovered and analyzed by GREECO. Further, this responds to the fact that even though this is a sector analysis, emphasizing the territorial dimension often comes from looking beyond the box of sector specific issues. As such, we believe that discovering the connections between sectors, as well as their associated territorial dimensions, is conceptually most straightforward when all sectors are considered vis-à-vis one another.

The remainder of the differences are mainly related to issues of grouping and nomenclature:

- Water and Waste Management have been separated. While some perspectives of greening these sectors can be considered together (for instance waste water and waste can be harvested for energy production) their territorial perspectives and policy relevance are, for the most part, very separate perspectives.
- Agriculture and Food, Fisheries and Forestry are grouped as Bioeconomy. They will be largely investigated individually, but are grouped together because they are each "traditional" land and water based resource sectors that, for the most part, operate mutually exclusively in spatial terms.
- Renewable Energy is broadened to Energy because of the critical importance of energy efficiency for meeting the EU's policy goals. Efficiency of energy transmission will be taken up here while efficiency issues linked to other sectors will be investigated as such.

- Green research activities (or the implementation of clean technologies) is consolidated to Green Research and Eco-Innovation because of the European research and policy focus garnered by the principles of Eco-Innovation, which is a term used for innovation across the spectrum of key economic sectors in Europe.

2.3 Method for Sector analysis

As highlighted in the Sector Guidelines, the sector analyses combine quantitative analysis - on the regional performance of each sector, and on the future potential it has to become a contributor to the green economy – with qualitative analysis on drivers and enablers, and their associated territorial dimensions.

For the quantitative analysis of current performance, each sector was first defined using NACE codes. Our own expertise combined with relevant sector reports were used to define each sector in this NACE perspective. The classification used for defining employment and GVA from a quantitative perspective is shown in Appendix A. This provided a regionalized (or national due to lack of data) understanding of the importance of each sector in terms of key structural business statistics (SBS) such as gross value added (GVA) and employment. This analysis was undertaken at the NUTS1 or NUTS2 level depending on data availability. From here, the process of developing a quantitative analysis of regional potential of the green economy was sector specific. Due to a lack of relevant regionalized data, regression techniques with proxy data were used for some sectors. For other sectors this approach was not possible and discussion on future potential was mainly qualitative – oriented towards drivers and enablers, especially those with a territorial dimension.

A quantitative overview of each sector further defined the production (of goods and services) and consumption (of natural resources) characteristics of each sector. This was a first step in identifying the linkages with other sectors and society; for instance between agriculture and forestry as providing inputs into the production of the energy sector, which in turn serves as an input into key energy consuming sectors. Some of these investigations into linkages benefited from an approach where case study investigations were used to a large extent since it became apparent that European or global investigations did not seem to be available or fruitful to work with. For instance, for the "Experience Economy" the approach was based on specific investigations into one or more of these topics in a narrower sense, both when it comes to sub-sets of the sector and to specific geographical areas.[1]

Qualitatively speaking, identifying the drivers, enablers and their relevant territorial dimensions revolved around a clear and operational concept of what the green economy meant to each sector. To achieve this, it was considered important to provide some background into the notion of how the green economy was distinguished from what could be considered the "brown" economy for each sector. This naturally lent itself to a problem statement, which stated what the main problems (trends) in each sector were and to what extent the EU expected these sectors to be greened in the upcoming decades. This was based on literature reviews of the sustainability concepts for each sector (i.e. via OECD sector sustainability reviews, EU policy documents, existing research reports). This could be considered the "core" of the sector analysis, as a comprehensive understanding of the greening process of the sectors, as well as a policy overview, was the main ingredient for identifying drivers and enablers.

[1] The case studies were performed to learn more about the territorial dimension of green economy/growth, but they also focused on governance issues, policy and other drivers. As such, these case studies were a vital component into the sector analysis and provided a possibility to focus on specific sectors that were important in each region and could provide more explicit examples of issues discovered in the desk based research.

Obviously the key value added of the sector analyses was the “territorial glasses” that were worn throughout their production. In the policy perspective this included a reflection on how EU territorial policies that administer structural funds acknowledged each sector, as well as a scoping of the most important governance principles (transnational networks, agencies, institutions, etc.) that supported the development of each sector. The territorial dimension was also emphasized in the quantitative analysis through the aforementioned regionalization (i.e. changing the geographical scale of analysis) of indicators of green economy potential for at least some sectors. This is an important undertaking of the project and will provide state of the art spatial interpretations of green growth potential.

However, we had to go further than this to truly identify which territorial dimensions that were drivers and enablers of green growth for the different sectors. In this connection, the territorial dimension of the green economy was described in Section 3.3.3 of the Interim report, but in short, it is clear that each sector must consider the implication of key territorial issues such as territorial assets, settlement structure and urban-rural connection, transport flows and infrastructures, and not least land use. In this regard, sector specific findings were utilised from existing ESPON projects such as TRACC, LUPA, LIVELAND, ReRisk and EDORA, among others. This analysis provided a base for analysing how each sector could contribute (has a potential to contribute) to regional green growth based on territorial “conditions”. This can be seen as the main way in which the sector analysis fed into the analysis of regional performance, as well as potential, in relation to a green economy.

2.4 A short introduction of the GREECO sectors

Bioeconomy

The Bioeconomy is important from a territorial perspective since it is dependent on the geographic distributions of land- and water-based biological resources as input to production; as well as being dependent on many “brown” inputs like fuels and chemicals. At the same time bioeconomy activities offer possibilities for economic activity in rural places, and use skills that are based on intrinsic/tacit knowledge and resources. Likewise, bioeconomy also provides inputs to many other green activities of the economy, such as energy, tourism or building material, and it helps mitigate climate change through its role as a carbon sink. But there are great challenges for the bioeconomy in providing food, timber and energy for a growing and developing global population, and some say that a green bioeconomy is the only way to do so without depleting these critical resources.

Water Management

Water can be considered as the single most important natural resource input for human wellbeing, but it also has a direct and indirect impact to virtually all economic sectors through its ecosystem services. For instance, in addition to supplying household water requirements, the energy, agriculture, industrial and tourism sectors all depend on reliable freshwater resources. The role of water in the green economy can be defined through the European Environmental Agency's definition, which states, ”Managing water sustainably in a 'green' economy means using water more efficiently in all sectors and ensuring that ecosystems have the quantity and quality of water needed to function effectively” (EEA, 2012).

A large part of managing water sustainably involves the manner in which different types of waste and storm water can be separated and re-used accordingly. In a territorial perspective this is especially important given the incredible differences in the spatial distribution of freshwater in Europe, which naturally influences the meaning green water management for different regions.

Waste Management

Similar to water, waste management is a sector that naturally cross-cuts with almost all economic and domestic activities. Avoiding waste generation is the main goal of green economy. However, as long as Europe is far from being a zero-waste economy, waste collection, separation, recycling and incineration are all green economy activities with a big potential for GVA and job generation while avoiding environmental harm.

Manufacturing

According to UNEP (2011), manufacture is one of the most polluting economic sectors, representing 20 per cent of total world emissions and accounting for one third of global energy consumption and over a quarter of primary resource extraction. In 2005, this sector contributed with 27.3% of the workforce and 30.4% of value added in the EU (Eurostat, 2008). In such context, greening the manufacturing sector implies a structural change shifting from the traditional brown industry to an environmental friendlier manufacturing, which according to IEA scenarios, will lead to a considerable energy efficiency improvement by 2050, virtually decoupling energy use and economic growth. Furthermore, manufacture also comprises the production of environmental goods, creating new green jobs (15% more jobs than *business-as-usual* scenario in 2050, according to UNEP, 2011).

Green Research and Eco-Innovation

Green research and Eco-innovation activities are not just sector specific, but have a potential impact in all the remaining sectors. Indeed, Eco-innovation is, by definition, a cross-cutting sector which includes companies, research organisations and eco-innovation activities imbricated within vertical sectors. Green products sell well, these products are set to double by 2015 (EC, 2011c). All in all, the eco-industry sector represents about 2.5% of Europe's Gross Domestic Product and it has expanded by around 7% every year since 2000. From the employment perspective, it is estimated that sector created 600.000 jobs between 2004 and 2008 and nowadays employs around 1.5% of EU workforce (EC, 2011c).

Tourism

The experience economy is a rapidly growing sector around the world with many countries being dependent on it as the dominant driver of economic growth and development. This sector holds a unique territorial relationship with the green economy because of the environmental paradox it insinuates; where, on one hand, it relies on the preservation of natural (as well as social and cultural) capital for its survival, but, on the other hand, touristic infrastructure is the dominant contributor to land take for many regions in Europe. Another key territorial issue is the experience economy's dependency on the spatial distribution of the natural environment, coastal areas, lakes and rivers, forest, and not least, particular climatic conditions.

Growth of the experience economy is naturally linked on the consumption of natural resources in other sectors, not least in terms of buildings, transport and water and waste management. As such, it is linked to significant environmental challenges including GHG emissions from transport and accommodations, water and waste consumption, and loss of biodiversity – both on land and in water.

Building and Construction

Green building and construction is about meeting Europe's building demands in a way that promotes economic growth and produces a more resource efficient building stock. In terms of operational emissions alone, it is the EU's goal to create a roughly 90% reduction by 2050 (EC, 2011a). This is exceptionally high considering that buildings represent upwards of 40% of Europe's total energy consumption (EC, 2011b). But for most people green building and construction is mainly about producing buildings that demand less energy. Yet we can go beyond only energy to deliver a valid understanding of just how sustainable Europe's building stock can become. This perspective makes the distinction between resources consumed during the construction process and those consumed by

the day-to-day use of buildings. Together they deliver a complete life-cycle perspective to the building and construction sector.

Naturally, the resource performance of buildings is cross-sectoral; where industries such as tourism and public services use buildings as a key interface to operate their affairs. And in a territorial perspective, there is an obvious connection between the location of demand for new buildings and underlying processes of urbanization that dominate migration patterns in Europe. As such, key territorial-bound issues arise in terms of: building density, integrated building and transport development, urban renewal, renovation of existing buildings, and not least, the importance of local planning institutions.

Energy

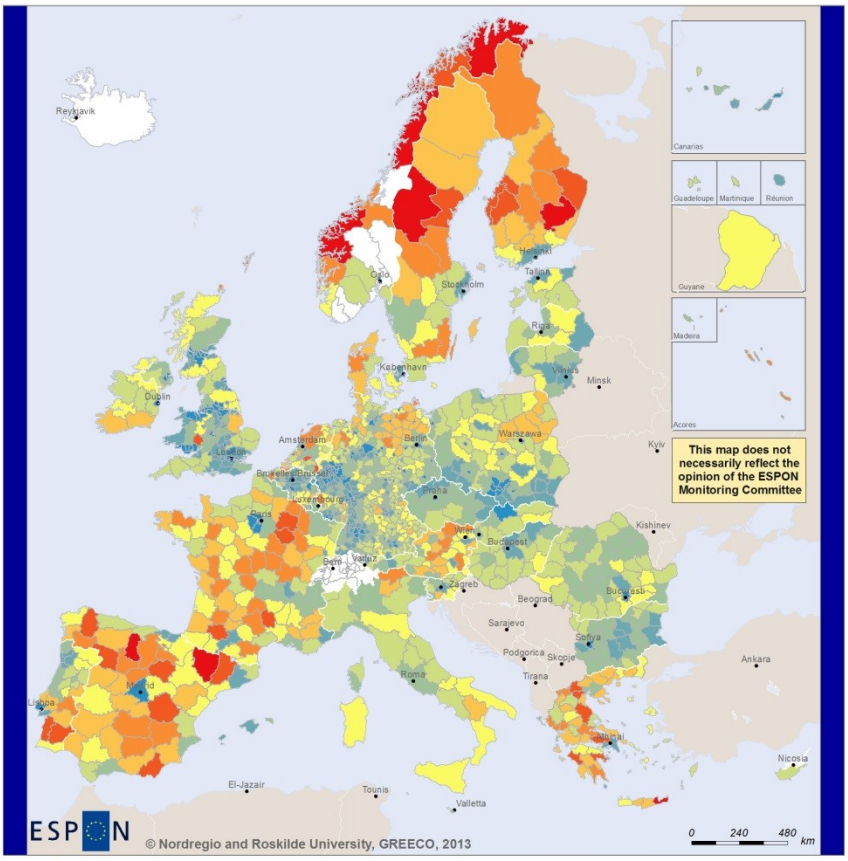
Taking the energy sector as a whole it has historically played a fundamental role in the development of all sectors in modern economies. This is because all sectors are completely dependent of a reliable and affordable input of energy to be able to function. This suggests that the energy sector will conceive the backbone for a future green economy. Furthermore, the dimensions in the 'green economy' concept are clearly reflected in the three pillars of European energy policy, specifically security of supply, ensuring competitiveness and promoting sustainability, and combating climate change. The long term character embedded within the green economy concept, referring specifically to the long term availability of basic resources, is in-line with contemporary concepts of security of supply adopted by the energy sector in many Member States. The recycling dimension in the green economy concept is further reflected both in security of supply and energy efficiency as these strategies seek among others to utilize residual materials as a source of energy, and the recovering and reduction of process energy. Ultimately the green economy concept brings up the creation of new jobs and value added in the energy sector. The fact that Renewable Energy Systems (RES) today not only have a strong position in national economies but also show greater potentials in the future implies that RES deployment will play a fundamental role as pillar in green economies. This implies that RES ultimately create new markets that reconcile limited use of natural resources with economic growth.

2.5 Spatial distribution of sectors in Europe

An overview of the spatial distribution of the sectors is shown on the maps 1-6. The maps show the intensity of the six selected sector categories measured through the generated GDP/CAP in the different regions. The sectors included on the map 1 are agriculture, forestry and fishing; the map 2 consists of selected NACE sectors: B (mining and quarrying), C (manufacturing), D (electricity, gas, steam and air conditioning supply) and E (water supply, sewerage, waste management and remediation activities), which are referred to as industrial branches. The map 3 includes construction and the map 4 consists of professional services (including financial and insurance activities): K (financial and insurance activities), L (real estate activities), M (professional, scientific and technical activities) and N (administrative and support service activities). The map 5 includes G (wholesale and retail trade), H (transporting and storage), I (accommodation and food service activities) and J (information and communication) activities. Finally, the map 6 combines the GVA per capita of all GREECO braches presented on the maps 1-5.

Regional ecomomic specialisation
-GVA per capita-

Sector A: Agriculture, forestry and fishing



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Regional level: NUTS 3, Except Italy: NUTS 2
Source: Eurostat, 2013
Origin of data: Eurostat, 2010
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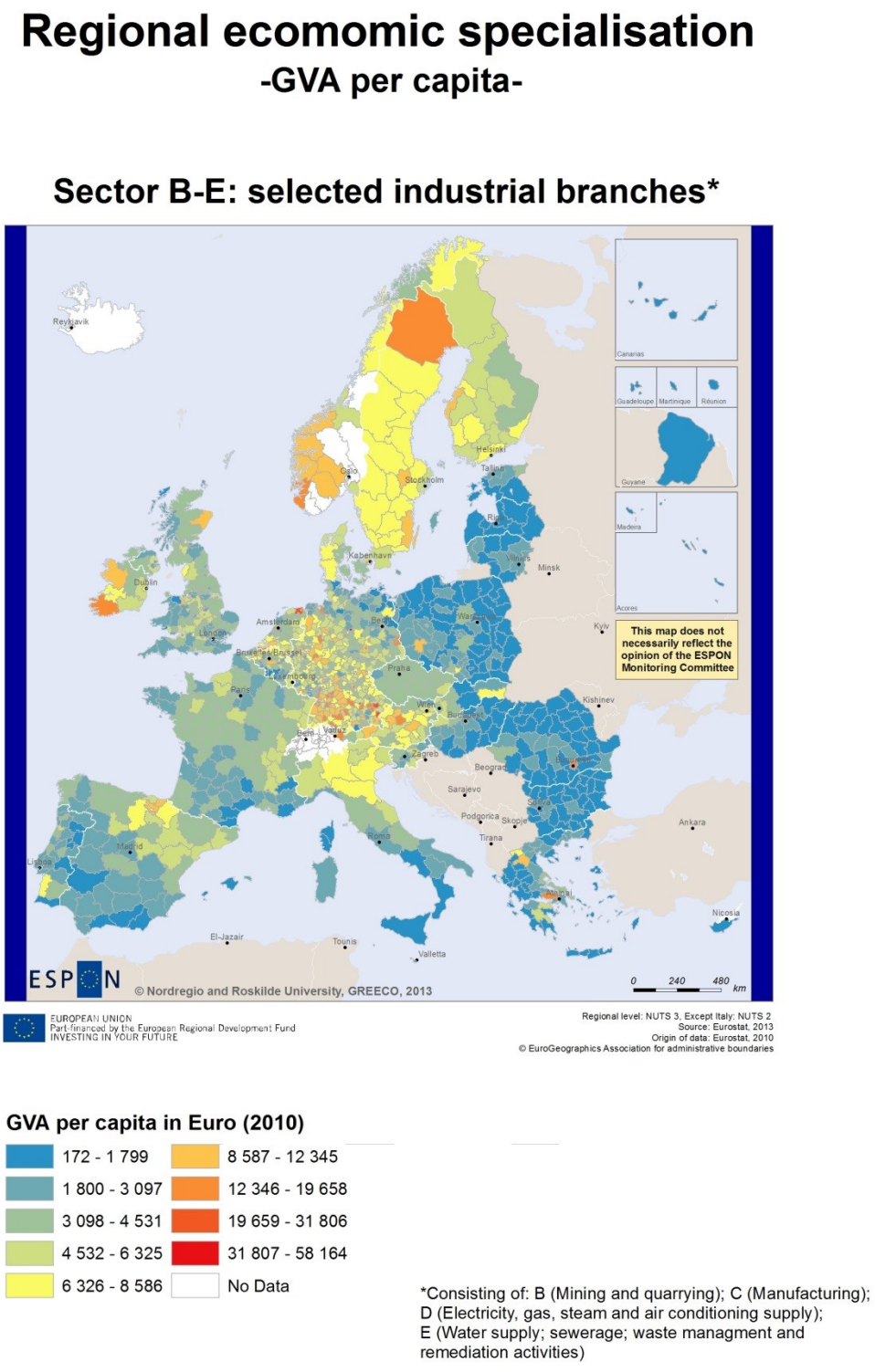
GVA per capita in Euro (2010)

0 - 87	751 - 1 048
88 - 200	1 049 - 1 469
201 - 345	1 470 - 2 221
346 - 522	2 222 - 4 535
523 - 750	No Data

Map 1. GVA per capita in Euro (2010) of agriculture, forestry and fishing.

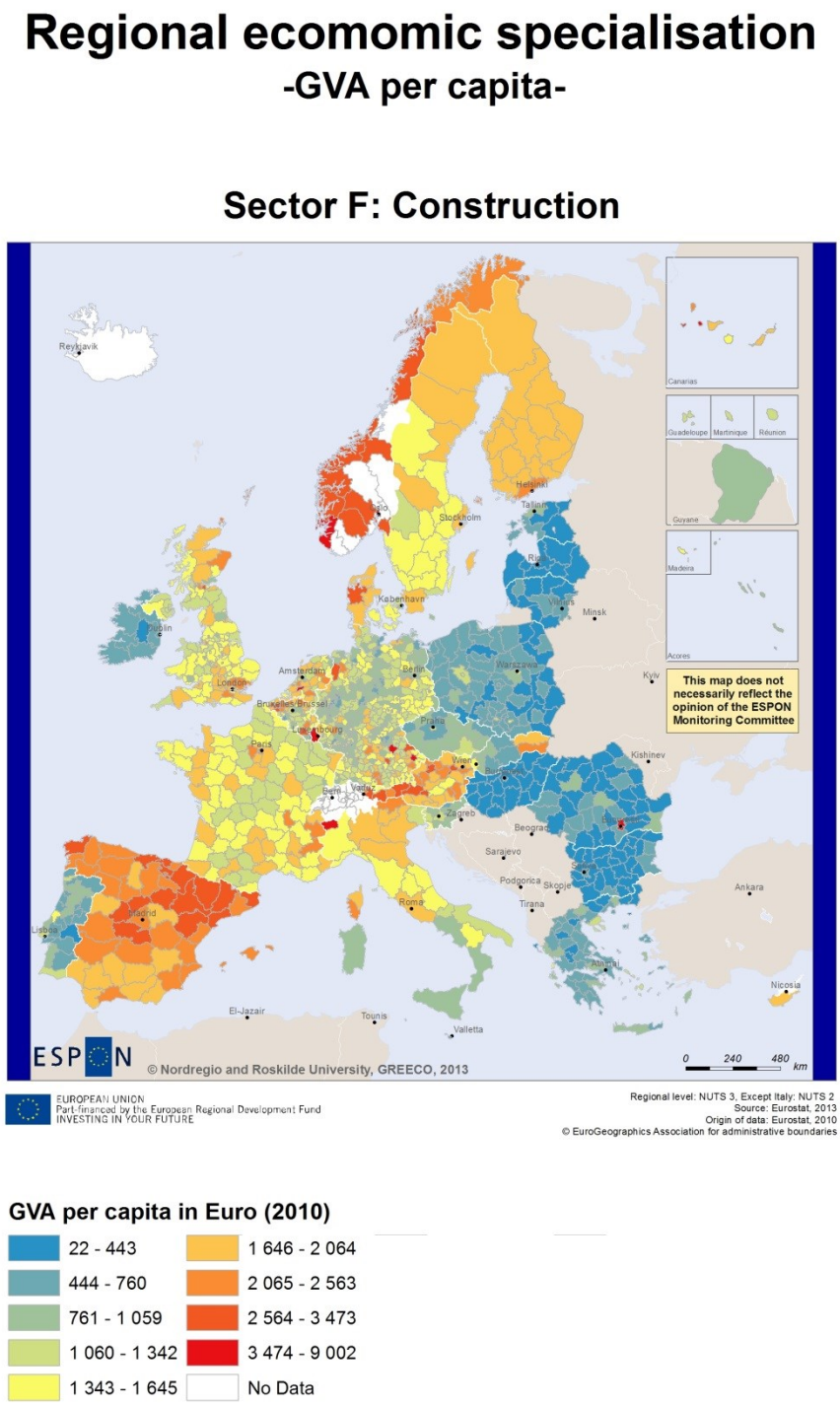
Map 1 shows the GVA of the agriculture, forestry and fisheries sectors in the EU Member States. Looking at the territorial distribution of the bioeconomy sector, one can see that the Nordic countries and Southern Europe stand out in terms of high GVA of the sector. The largely uninhabited and sparsely populated northern regions have huge forest areas, which favour the development of the forestry sector there. Also fishing along the coastline and fish farming in Norway are important

activities here. A distinctive feature of Southern Europe is production of high value agricultural products, such as olive and wine, fruit and vegetables. Although the bioeconomy sector is well-developed in the eastern regions as well, the GVA of the sector is significantly lower in comparison to the rest of Europe. The lowest contribution of the bioeconomy sector to the GVA is in the capital regions across all EU member states due the expansion of urban land use.



Map 2. GVA per capita in Euro (2010) of selected industrial branches.

The highest GVA of the industrial branches is in the north of Sweden due to mining activities, the south of Germany due to the development of automobile industry, Norway and Scotland thanks to oil and gas industry (Map 2). Also in some regions of the central Europe the GVA of the industries is quite high. In contrast to these regions, the Eastern and South-Eastern countries have a significantly lower GVA of the selected industrial branches, except for Bucharest in Romania and some regions in Greece (including Athens).



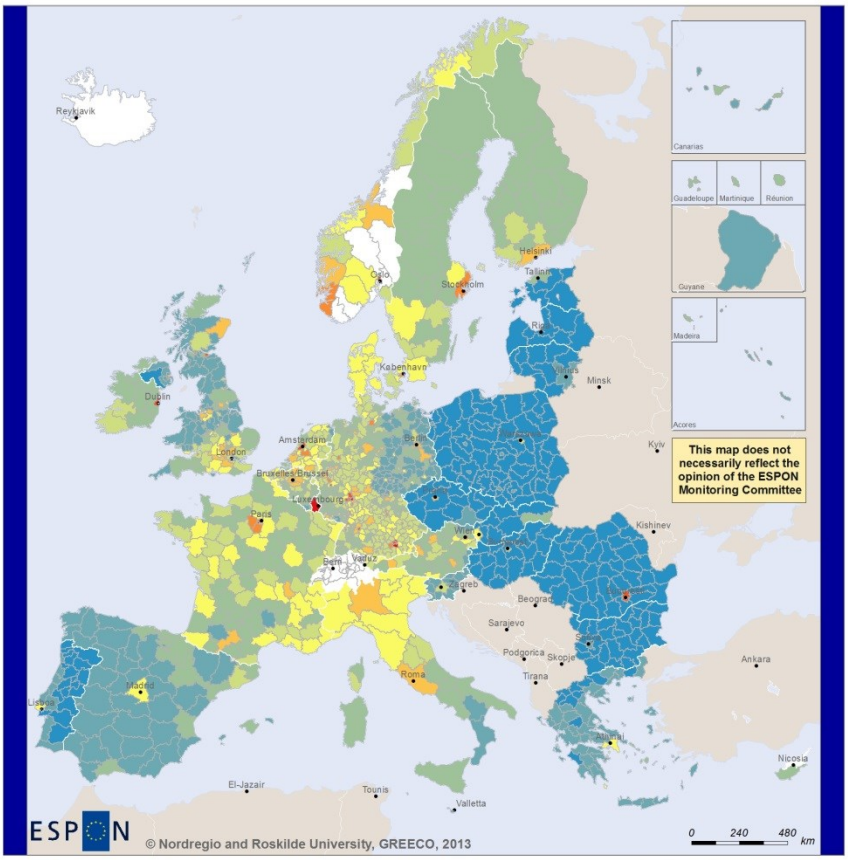
Map 3. GVA per capita in Euro (2010) of construction activities.

Looking at all EU Member States, the GVA of construction activities in 2010 was the highest in the Nordic countries (especially Norway), Spain and some regions in the central Europe. In case of Norway the big investments in the oil sector contribute to the GVA. Large investments are distributed to infrastructure and construction projects related to oil sector along the coastline from South-West to the North. A lot of support has also been provided to housing development in rural Norway. Moreover, the Norwegians tend to spend a lot of money on their housing. In Spain a focus on building and infrastructure development has been policy driven during the late 1990's and 2000's. Although the seven New Member States (Hungary, Romania, Bulgaria, Slovakia, Cyprus and Latvia) have the highest relative size of their construction sector due to national investment and the additional availability of European funds, the GVA of the sector is still relatively low in comparison to Northern and Western Europe.

In many capital regions across the EU the GVA of the construction sector is quite high, which indicates that the urbanization process is taking place and creates a high demand for new buildings. In some cases the GVA of the construction sector tends to be higher outside the capital cities, which shows that the urban areas are growing beyond the city borders (e.g. Paris, London).

Regional ecomomic specialisation
-GVA per capita-

Sector K-N: Financial and insurance activities*



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Regional level: NUTS 3, Except Italy: NUTS 2
Source: Eurostat, 2013
Origin of data: Eurostat, 2010
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GVA per capita in Euro (2010)

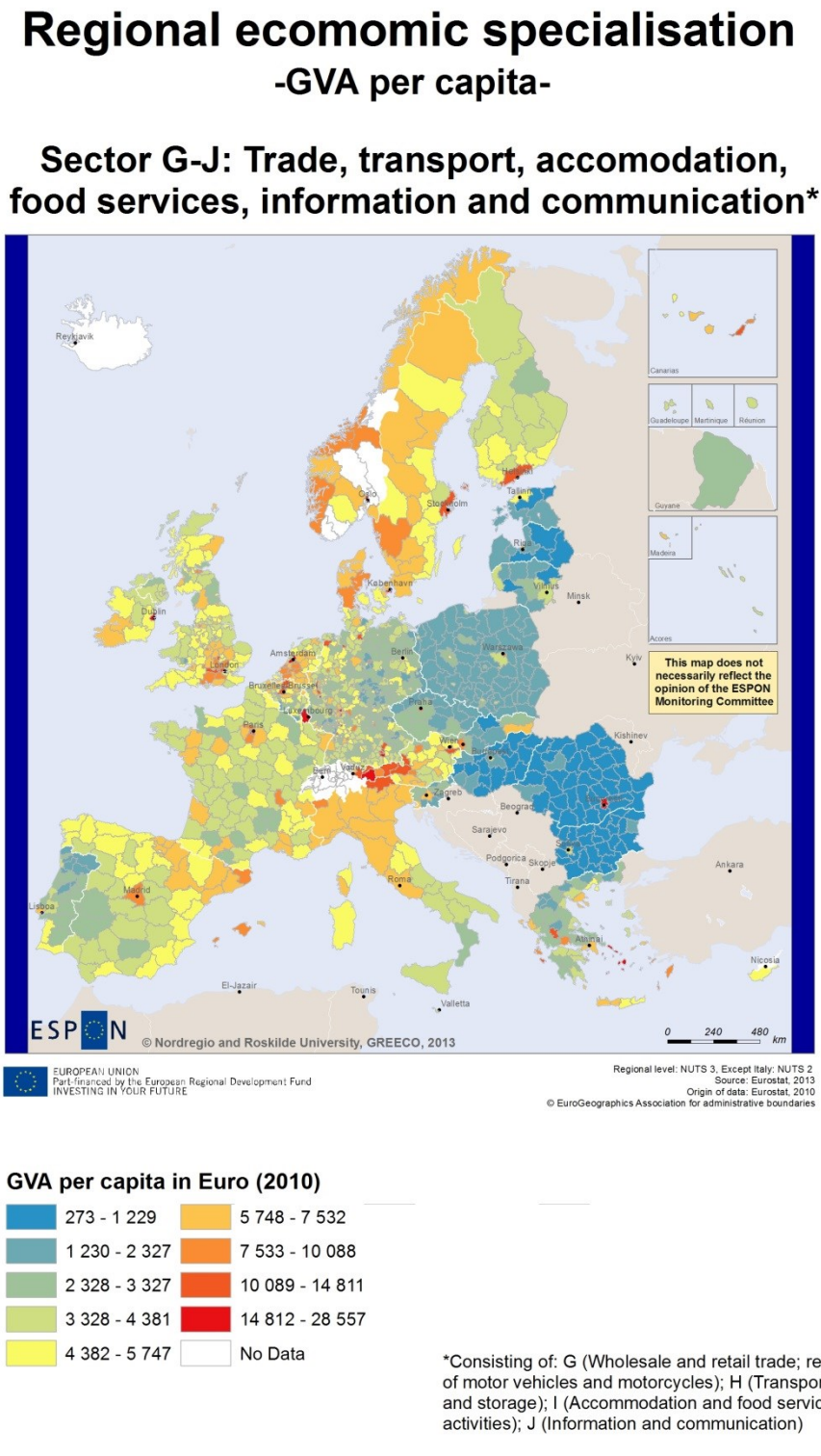
274 - 1 854	8 063 - 10 839
1 855 - 3 614	10 840 - 16 970
3 615 - 4 993	16 971 - 27 549
4 994 - 6 282	27 550 - 76 223
6 283 - 8 062	No Data

'Consisting of: K (Financial and insurance activities); L (Real estate activities); M (Professional, scientific and technical activities); N (Administrative and support service activities)

Map 4. GVA per capita in Euro (2010) of professional services (financial and insurance activities, etc.).

Map 4 shows that the GVA of the professional services, including financial and insurance activities, real estate, professional, scientific and technical activities, as well as administrative and support service activities is the highest in the capital regions across the EU Member States. The value added of

these activities is also fairly high in the regions of the central and Southern Europe, which indicates the development of the tertiary sector of the economy here.

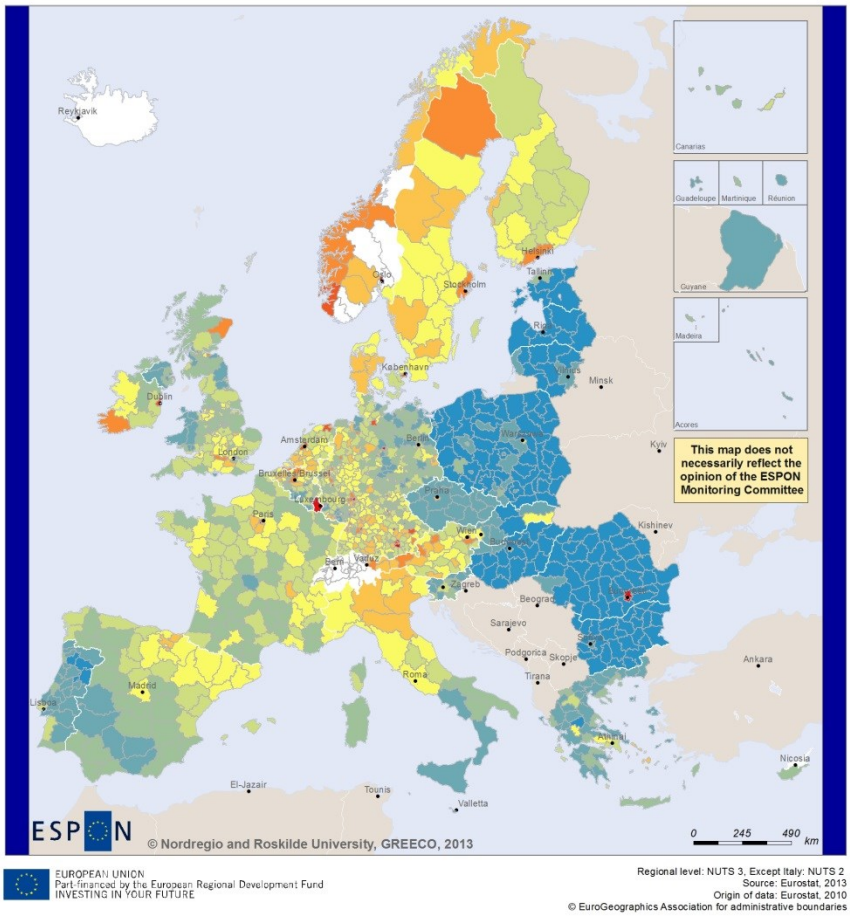


Map 5. GVA per capita in Euro (2010) of trade, transport, accommodation, food services, information and communication.

Overall, the GVA of the trade, transport, accommodation, food services and information and communication sectors is quite high across the regions in the EU due to openness of the economies, high levels of accessibility, well developed ICT etc. (Map 5). The capital regions have particularly high GVA of the sectors, followed by the regional transport hubs (e.g. seaports) and attractive tourism destination (along the Mediterranean coast and Southern Europe in general). Also in the Northern regions the GVA of these sectors is quite high, even though the importance of these activities should be lower here due large uninhabited areas and low population density. This can be explained by overall high GVA in the Nordic countries in comparison to the New Member States in the East.

Regional ecomomic specialisation
-GVA per capita-

All sector branches



GVA per capita in Euro (2010)

1 318 - 6 500	22 321 - 28 289
6 501 - 10 861	28 290 - 36 597
10 862 - 14 336	36 598 - 50 919
14 337 - 17 939	50 920 - 109 648
17 940 - 22 320	No Data

Map 6. GVA per capita in Euro (2010) of all sector branches included in Map 1 – 5.

Looking at Map 6 which combines all sector branches included in Maps 1–5, an East-West economic divide can be noticed. The New Member States in the East are generally poorer, developing economies with significantly lower GVA compared to innovative and more advanced neighbours in the North and West. Norway stands out amongst the EU countries due to a high GVA per capita of all sector branches, which is due to progressive growth of the Norwegian oil and gas industry.

Besides the East-West divide, there is a clear pattern of the economic activities' distribution depending on the urban development and population dynamics. In the capital regions the GVA of the building and construction sector is quite high, whereas the GVA of the bioeconomy sector is low, which is a consequence of a high economic activity, the urbanization process and urban sprawl. The capital regions are also the most dynamic regions when it comes to the development of the professional services, knowledge-intensive sector, transport, accommodation etc. In this regard the peripheral regions in many countries are lagging behind and often have a lower GVA of the economic activities.

3. Conceptual elements of the green economy from a sector perspective

In this section a major framework for how the greening of each sector has been conceptualised is presented. The main aspects, processes, elements included in the greening of the sectors are discussed. The most profound features for the characterisation of the sector, such as e.g. input use, impact on natural resources and environment, market structures, actors/knowledge, products, consumer choices, etc. are being described. The main conceptual elements for each sector are also visualized with the help of hexagons, which will be explained further in the text.

The key concepts with regard to greening of the **agriculture** sector are the use of inputs, management practices and supply side measures. The focus is on reducing the input, improving efficient use of resources (energy, fossil fuels, water, pesticides etc.) and substituting with the new types of input (more sustainable, renewable or re-usable resources – improved seeds, organic fertilizers and biopesticides). Greening of agriculture also refers to management and farming practices aimed at ensuring sustainable land use and conservation of biodiversity. A very important element is reducing food spoilage and loss.

Greening of **forestry** is framed more in the way wood products can be used as substitutes for non-renewable resources, and how forests can be utilised in climate change mitigation measures (carbon sinks). Sustainable forestry becomes much more about changing management practices and certification, types of forests planted, interaction with other sectors (such as biofuels) and similar aspects.

The physical inputs in forestry are marginal in comparison to agriculture. The main inputs are related to transportation and logging activities. The value is rather created from the biological processes and from capital investments.

Agriculture is a major source of greenhouse gases emissions. Therefore reducing the emissions from agriculture is an essential element for greening of the sector. Emission reductions can be achieved through minimizing the direct and indirect energy use, improving the production methods and producing renewable energy from crops and manure. Agriculture can also provide new sinks to GHG but its carbon sequestering capacity is much lower than of forests. Forests play a more important role in climate change mitigation efforts than agriculture due to their enormous carbon storage capacity and biomass resource for energy production.

In green agriculture and forestry, developing of people and skills is important since it requires high skilled labour to adapt new technologies and management practices. Since a large share of forests in the EU is privately owned, training and awareness raising of the private forest owners is especially important.

Awareness raising is an important issue for all sectors of the green economy. Consumer choices are considerably more important in driving the demand for green agricultural products than green forestry. Changing the food habits of the population towards less dairy and meat products can significantly reduce the environmental impact of the sector and contribute to climate change mitigation efforts.

Graphs 1 and 2 illustrate the main conceptual elements in greening of the agriculture and forestry sectors. In the centre of each hexagon is a core element (the base) of the green economy development for the sector. The six shapes around the base present other important greening aspects of the agriculture and forestry sectors. The same principle applies to other 10 hexagons presented below.

The colours of the hexagons' parts also matter, as each part stands for a specific topic. The red shape at the top of each hexagon relates to the key environmental relations of the sector. The green shape refers to the sector's responsiveness to the global challenges. The sector –energy relation is brought up in the shape coloured in purple. At the bottom of each sector hexagon are issues related to management and planning (light- blue colour). Orange shape stands for the "green footprint" of the sector, which refers to a visible impact and an outcome of changes. Finally, the violet shape illustrates the user behaviour component. It shows what is requested from users in connection with greening of the sector.

Graph 1. A hexagon presenting the main concepts with regard to greening of the agriculture sector.

Graph 2. A hexagon presenting the main concepts with regard to greening of the forestry sector.

Greening of the **fisheries sector** and aquaculture incorporates a number of both supply and demand side measures. There are significant regional differences both in fishing technology, fishing economy and fishing cultures. Thus the approaches may differ between countries and may not fit all types of fisheries, which adds complexity to the management process.

In general greening of the fisheries sector entails a responsible approach to the ecosystems – a substitution towards more sustainable, renewable or re-usable resources in the entire production process. In practice greening of the sector is based on the regulatory mechanisms and management approaches, which promote sustainable and responsible harvesting methods, providing good conditions for the fish resources (i.e. good water quality and accessibility), minimizing the impact of fishing on marine environment (i.e. using green infrastructure), minimizing energy use (i.e. focusing on aquaculture species which are less energy dependent and changes in equipment towards more energy efficient), maintaining biodiversity (i.e. avoiding overexploitation of the stock, rebuilding overfished and depleted fish stocks, tighter controls of invasive alien species), as well as increased community involvement in managing the fisheries.

Ecosystem Approach to Fisheries and Aquaculture (EAF/EAA) has a key role in improving fisheries sustainability through ensuring exploitation of specific species below the carrying capacity existing in the ecosystem habitat.

Graph 3. A hexagon presenting the main concepts with regard to greening of the fisheries sector.

Building and construction sector is among the largest contributors to GHG emissions, and is the single largest consumer of energy. Its connection to economic growth is also crucial, especially given that it employs more people than any other sector in Europe.

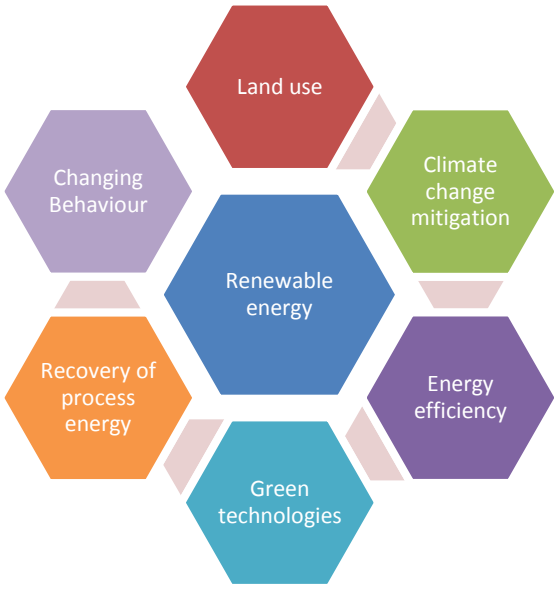
Greening of the sector is mainly about achieving growth and development while reducing the consumption of physical, natural and energy resources, in both the construction (embodied resources) and the use (operational resources) of building. Consequently, this reduces the environmental impact during the whole life cycle of buildings.

Furthermore, the notion of physical resources mentioned above emphasis the important aspect of land as resource that consumed by greenfield development. As such, more effective spatial planning is necessary to limit land consumption, but also for creating linkages with resource efficiency in other sectors, such as transport. This promotes planning concepts such as compact city development; as well as close collaborations between planning, construction and housing sector as important spatial dimensions of green building and construction. It also emphasizes the crucial importance of retrofitting existing building to become more energy efficient, rather than only focussing on the potentials related to constructing new green buildings.

Graph 4. A hexagon presenting the main concepts with regard to greening of the building/construction sector.

The conceptual elements of the green economy in the **energy** sector are the substitution of fossil fuels with renewable energy sources (particularly biomass, wind energy, solar energy, hydropower, solar energy and wave and tide energy), increasing materials and energy flow productivity (energy efficiency) and residue recycling in the process of energy production (i.e. through recycling of biomass from municipal and industrial waste and recovering of process energy). Increasing energy efficiency in the process of energy production refers to the measures that minimize energy losses, enabling the distribution of renewable energy and deployment of efficient technologies for transforming of primary energy into electricity and other energy carriers.

Another important aspect with regard to greening of the sector is its potential to contribute to climate change mitigation through reduction in GHG emissions. Behavioural changes play an important role when it comes to reducing energy use by the consumers.



Graph 5. A hexagon presenting the main concepts with regard to greening of the energy sector.

Green research and eco-innovation is about any form of innovation resulting in or contributing to the progress towards a greener economy and a more sustainable development through increasing economic competitiveness while at the same time helping to safeguard the environment, increasing resource productivity and efficiency across the whole lifecycle.

The innovation can take a form of product (goods or services), process, marketing, organisational innovation, social and system innovation. Unlike other sectors, eco-innovation is not a sector, which should become greener in order to enable the transition to a greener economy. Development of the sector is a prerequisite for the transition to a greener economy by other sectors.

Eco-innovation is not only about the environmental benefits to be achieved. An equally important aspect of eco-innovation is its ability to enhance the competitiveness of the companies and save costs.

Graph 6. A hexagon presenting the main concepts with regard to the green research and eco-innovation sector.

Since the manufacture sector is highly resource intensive, **green manufacture** refers primarily to the management practices and technological innovations that help to reduce the environmental impact of the sector and increase resource-efficiency during the whole life cycle of the product. Simply speaking, it is about how to 'produce more with less'. In greener manufacture, waste is increasingly recognized as an important resource that can be re-utilised. Other aspects include sustainable waste management, more efficient transport and logistics, etc. Therefore it combines the greening efforts of several sectors together. Besides that, social development and health security are also among the important elements of green manufacturing. Hence green manufacturing touches upon all three pillars of sustainable development.

Graph 7. A hexagon presenting the main concepts with regard to greening of manufacture sector.

The key elements with regard to greening of the **transport** sector are transformations within vehicle production (low carbon and less polluting), a shift towards less harmful modes of transport (public and non-motorised transport for passenger travel and rail and water transport for freight) and promotion of access instead of mobility (avoid or reduce trips through better land use and transport planning). Therefore greening of the sector implies technological, managerial, planning aspects and behavioural changes which result in reduced energy use and GHG emissions, as well as more sustainable (compact) land use.

Graph 8. A hexagon presenting the main concepts with regard to greening of the transport sector.

Tourism is a highly cross-sectorial activity, which puts additional pressure on the natural environment. Greening of the sector implies combined efforts in all sectors related to tourism. Tourism is particularly related to transport sector, accommodation (building & construction sector), food (agriculture sector), water and waste management, and energy. The elements and guidelines of sustainable tourism are applicable to all forms of tourism, including mass tourism and niche tourism.

When it comes to the key aspects, tourism in a greener economy includes a broad spectrum of issues – from changing management practices (sustainable water and waste management) to increasing energy and resource efficiency, better land-use planning in destinations to protect the qualities attracting tourists (e.g. nature, culture), addressing supply and demand-side measures.

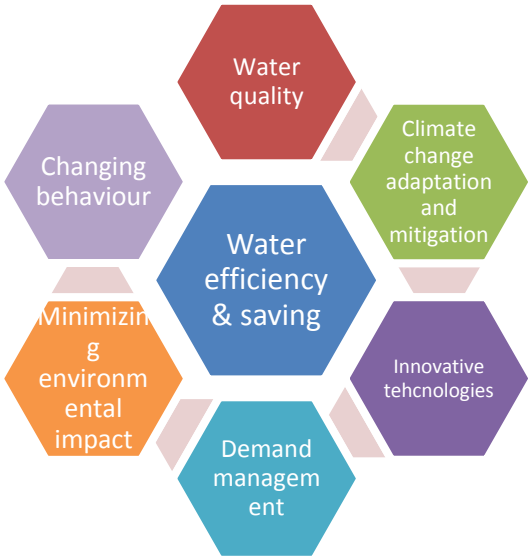
There are three key principles of sustainable tourism: making optimal use of environmental resources that constitute a key element in tourism development and helping to conserve natural resources and biodiversity; showing respect and conserve the socio-cultural authenticity of host communities; ensuring viable, long-term economic operations and socio-economic benefits to all stakeholders.

Graph 9. A hexagon presenting the main concepts with regard to greening of the tourism sector.

The key aspects of greening of the **waste sector** are waste prevention, minimization and promoting of re-use, recycling and recovery during the whole life-cycle of the product. A more sustainable waste sector is about optimizing the industrial processes, but also design and packaging in order to reduce the material input needed for production. Changing of consumer and producer behaviour is of utmost importance in the processes of waste reduction, waste collection and recycling. The preferred waste treatment follows the waste hierarchy, when the most desirable option is waste prevention, followed by re-use, recycling, energy recovery and disposal.

Graph 10. A hexagon presenting the main concepts with regard to greening of the waste sector.

The main aspects with regard to greening of the **water** sector are water efficiency in all water consuming sectors (i.e. energy, agriculture, public water supply, industry and tourism), so that less water is being distributed, consumed and treated, as well as water demand management. Decoupling water use from economic activity and environmental impacts is an important process in fostering sustainability of the water sector. Greening of the sector implies adopting innovative (waste)water management practices and technological innovations that encourage an efficient and equitable use of water resources, their conservation and protection.



Graph 11. A hexagon presenting the main concepts with regard to greening of the water sector.

Table 1 presents a synthesis of the important elements and features for greening of the sectors (some of them also act as enablers). The first column in the table makes a comparison across the GREECO sectors on the importance of reducing input use for greening of the sectors. The second column looks into the importance of emissions reduction, while the remaining columns question the importance of

consumers and choices, developing people and skills, as well as capital investment for greening of the sectors.

Table 1. Synthesis table of some conceptual elements and features for the greening of the sectors

	What is the importance of input use?	**What is the importance of emissions?**	**What is the importance of consumers and choices?**	**What is the importance of developing people and skills?**	**What is the importance of capital investment?**
Bioeconomy – Agriculture	- Reducing the physical inputs, such as water, energy, fertilizers and pesticides is a key aspect of greening the sector. - Also protecting its key input – land – from further greenfield urban development.	- GHG emissions reduction can be achieved as a side-effect of reducing direct and indirect energy consumption in greener agriculture (i.e. using more energy efficient machinery, avoiding pesticides, changing diet to lower meet consumption) - Greener agriculture contributes to climate change mitigation through bioenergy production from the energy crops.	- Highly important as consumers steer the demand for greener agricultural production. - Consumers also contribute to greener agriculture throughout the consumption chain (i.e. changing the diet to vegetarian and organic and minimizing food waste). -The challenge is that low prices from conventional agricultural and irresponsible meet production may override the goals of ensuring sustainable development	- Capacity building of rural enterprises and farmer training are highly important for fostering the application of more sustainable agriculture practices. But this is difficult to implement in practice because of the tacit, traditional skills and learning methods applied in the sector. - There is a need for skilled labor to apply and work with new farming technologies.	- Capital investment in new machinery, education etc. is among the most important factors that contribute to popularization of sustainable farming practices.
Bioeconomy – Forestry	- Of minor importance. Relevant only in case of logging and transport (energy input)	- Highly important aspect of sustainable forestry. GHG reductions are achieved through carbon sequestration and biomass for energy production	- Relatively unimportant. Mainly influenced by national legislation and market demand for timber.	- Skills and knowledge building in sustainable forestry (about sustainable management and certification) is particularly important in case of private forest owners	-Important, since capital investments are needed in such fields as new and more efficient forest machinery, forest infrastructure development etc.
Bioeconomy – Fisheries	-Greening of the fisheries sector and aquaculture entails a substitution of input use towards more sustainable, renewable or re-usable resources.	-Not that important in case of fisheries. -GHG emission reductions can be achieved through limiting energy consumption and more efficient and	- Highly important as consumers are becoming concerned and more demanding about the quality (freshness) as well the origin and management (=responsibility) of fisheries.	-Important to develop fishermen's knowledge and skills to encourage choosing more selective fishing gear, diversifying their activities and playing a more active role in helping to manage and conserve Europe's marine	- Financial incentives via EU and national policies and funding schemes are crucial for fostering the fishermen to adapt their fishing activities.

	-It is not a simple task as different types of fisheries are based on different inputs -Especially relevant in case of aquaculture where reducing an input of energy in production process is an important element of greening	sustainable transport	-Making the customers aware of alternatives to unfair and non-green trade may result in a greening of the fish sector. -The challenge is that low prices from irresponsible production may override the goals of ensuring sustainable development	biodiversity	
Building and construction	- Highly important. Reducing the natural resource input and energy consumption are the main elements of greening of the sector.	- The sector generates a large share of emissions. Significant reductions in GHG emissions can be achieved in a process of greening of the sector, primarily due to increasing energy efficiency.	- Very important, since changes require conscious investment choices that trade off higher upfront costs with an expected future savings. - Consumers must be educated and aware of the array of economic, social and health benefits of greener buildings.	- Knowledge development of construction companies and capacity building of workers about sustainable construction are utterly important.	- The initial costs of investments in improvements are high. Hence, support for capital investment, mainly via EU and national policies and funding schemes, is an irreplaceable prerequisite for fostering green building practices.
Energy	- Greening of the energy sector mainly refers to the reduction of dependency on fossil fuel sources of energy via substitution with RES and increased energy efficiency. However, the latter of which is mainly attributed to developments within the applicable, energy consuming sectors.	- Highly important, as increased application of RES and improvements in energy efficiency in all energy consuming sectors directly contribute to GHG emissions reduction.	- Important when it comes to energy saving in households and small scale generation of RES. - Individual possibilities to decide upon the type of energy consumed are limited due to high dependency of the energy sector on the political will.	- Highly important. Green energy sector requires continuous R&D, technological advancements, development of high-skilled workers, as well as awareness raising among individuals to foster energy saving practices.	- Investments in RES generation plants and technology development are costly but crucial for the transition to a green economy.
Green research and eco-innovation	- Developing new or upgrading the existing products and services can lead to reduced input of energy	- Highly important. Some of the eco-innovations tackle emissions reduction by developing cleaner, more	- Important. Customer demand for eco-innovative products and services (i.e. green and sustainable) is foreseen to speed up in	- Research and eco-innovation application in practice requires new skills development. - Some of innovations	- Eco-innovation related research, as well as application of new technologies is costly; requires government investments

	and other resources. - Can be among the goals or side-effects of eco-innovations. - Depends on the economic sector.	efficient products and processes.	the coming years.	require significant changes in business practices, product design or packaging, which requires training of many people involved.	
Manufacturing	- Highly important. Reducing the input of the resources (energy and raw materials) is a key to greening of the sector. -'Producing more with less'	- The sector accounts for a large share of emissions. - Significant GHG reductions can be achieved in green manufacturing due to increased energy efficiency and alternative production methods (i.e. through investment in industrial symbiosis via spatial clustering of manufacturing activities.	- Important, as the sector attempts to satisfy customers' needs and requirements. - With increasing environmental awareness of the consumers the green performance requirements imposed on manufacture will grow.	- Highly important, as fostering green manufacturing requires high-skilled workers in a wide range of fields from process management and product development (eco-innovations) to sustainable transportation.	- Capital investment in R&D, product development and process optimization are quite high but utterly important in advancing green manufacturing sector.
Transport	- Reducing an input of land through developing of more compact or mass transit corridors is among the goals of greening the transport sector. - Input reduction can also be achieved through improvement of vehicles towards higher resource efficiency - Shift to biofuels decreases the input of fossil fuels.	- Reducing GHG emissions is among the major goals with regard to greening of the sector (e.g. through shift to biofuels, promoting public transportation and cycling).	- Highly important for enabling the shift towards greener modes of transport, choosing more environmentally-friendly vehicles and promoting access instead of mobility.	- Highly important, as the shift to greener transportation requires advanced knowledge in transport planning, continuous skills development to enable application of green transport technology. - Raising awareness and developing people and skills is crucial to achieve changes in the public's habits regarding sustainable transport.	- Highly important since the changes require significant investments in public transportation, infrastructure for walking and cycling and vehicle efficiency improvements.

Tourism	- More sustainable practices in tourism can reduce input of resources (water, energy consumption). - Reducing input of land-based resources and land consumption in order to avoid further tourism pressure especially on rural areas is an important issue with regard to greening of the sector.	- Emissions reduction can be achieved as side-effects of increased energy and resource efficiency in accommodation establishments, choosing less carbon intensive transport modes, carbon neutral dietary choices of tourists.	- Highly important since consumers steer the demand for green product and services within tourism sector; - The changes require conscious investment by tourism businesses (i.e. green building measures, waste & water management, choosing eco etc.)	- Highly important. Most tourism businesses are SMEs or microenterprises and often lack of knowledge to undertake processes of greening their operations and are not aware of the opportunities related to greening.	- The initial costs of investments in improvements can be high (e.g. more energy efficient buildings and facilities, energy saving opportunities). - Support for capital investment, mainly via EU and national policies and funding schemes, is an irreplaceable prerequisite for fostering greener tourism practices. - Other measures often do not require high capital investments but high awareness level is needed (e.g. recycling, water saving devices, choosing organic food, promoting cycling etc.)
Waste	- Not applicable in case of waste sector, given that the idea of greener waste sector is to minimize the input of resources which then end up as waste.	- Important. Sustainable waste management generates less GHG emissions and other pollutants (through minimizing landfilling and using more efficient waste treatment technologies, reducing waste quantities etc.) - Using waste for energy production contributes to climate change mitigation	- Changing behaviour of individuals is central in supporting recycling culture and waste minimization from households.	- Improving knowledge, raising awareness, building capacities of the industries and public on the environmental impact of waste and good management practices (recycling, buying light packaged goods, composting etc.) help to minimize and prevent waste generation, as well as improve the efficiency of waste management.	- Capital investment in waste prevention measures (cleaner technologies, eco-design, eco-efficient production), waste treatment technologies and education plays a crucial role in facilitating the progress toward a green waste sector.
Water	- Reducing the input of water in all water consuming sectors and processes is among the main goals associated with greening of the sector.	- Not addressed directly but GHG emissions can be reduced due to reducing the energy consumption during the process of water distribution, consumption and treatment.	- Important for water consuming sectors and on individual level. - Significant water conservation can be achieved in public water supply systems.	- Raising water conservation awareness and improving knowledge amongst the water consuming sectors and general public are highly important from a green economy perspective – especially in regions prone to seasonal water scarcity.	- Capital investment is a highly important component of green water management. - Water and wastewater treatment technologies are highly costly, as well as related water infrastructure.

4. The current state and performance

In recent years, the Member States have turned to sustainable farm and land management practices which had a positive impact on greening of the **agriculture sector**. Most of the measures are aiming at reducing the pressure on the natural resources (land, water, marine ecosystems, fish stocks, forests and biological diversity), as well as increasing resource efficiency and reducing waste during all stages of the agricultural production –from field to fork.

The progress towards green growth in agriculture is difficult to track, as greening of the sector is a complex issue and the existing indicators are not sufficient. The available indicators illustrate such issues as land use, biodiversity, GHG emissions, use of inputs (fertilizers, pesticides, water, etc.) and nutrient balance, mainly at the national level. Another important indicator of the greening of agriculture is a growth in organic production.

Likewise in other sectors of the green economy, the current situation for the conceptual elements of the greening of the agriculture sector is quite different among the Member States. It is highly influenced by the environmental, economic, cultural and other factors. In general, the old Member States tend to have a better performance of the green economy sectors, compared to the new Member States.

In overall, the following tendencies have been observed with regard to greening of **agriculture and forestry** sectors:

- Biodiversity has declined over the years due to unsustainable land use (increased livestock density, mono-cultivation, etc.) and input structures. Green agriculture contributes to biodiversity preservation through establishing Natura 2000 sites on farmland and in the forests. Currently about 10% of the agricultural area and 21% of forest area in EU 27 belong to Natura 2000 sites.
- Water use in agriculture has increased over the past decades in southern Member States. At the same time a decrease in water use has been observed in some of the EU countries due to more effective irrigation techniques.
- The share of renewable energy in on-farm energy consumption is still relatively small. Petrol and diesel are still prevalent. On-farm energy consumption decreased in some of the EU countries, while an increase was observed in others, which is mainly attributed to more intensive agricultural production, mechanization and increased use of machinery.
- A decline in the GHG emissions and the use of environmentally harmful inputs was observed coupled to increases in the overall productivity, decline in cattle numbers and improvement of farm management practices.
- Land use pressure is growing in many Member States, as the amount of agricultural land has diminished while production intensity increased.
- A rapid growth in organic farming was observed. In some EU countries the area under organic agriculture is more than 9%. At the same time the share of organic sector in the market is still small.
- Despite increase in the overall awareness level of the population, about 30% of all food produced in developed countries is wasted.
- In forestry, the main indicators of greening of the sector are the area under Natura 2000 conservation and the share of certification schemes (PEFC). Today 21% of the total forest

area in the EU belongs to Natura 2000 sites. The share of PEFC certified forest ranges from 0% in Hungary, Greece and Romania to more than 90% in Norway and Finland.

When it comes to the **fisheries** sector, the EU's fisheries have been exposed to first increases and later on declines during the 60 years. The trend varies among different categories of fish species and is clearly related to the territorial characteristics. Overall, the coastal zones are the major producers while inland habitations are major and important consumers of fish products. Increase in consumption levels was notices in the majority of the EU countries from 2001-2009. The top producer in fisheries is Denmark, followed by Ireland, Estonia and Latvia.

Most of Europe's commercial fish stocks remain over-exploited. Both the quantity and the technical and physical power of the fleet are seen as a main factor in exhausting of the individual fish stocks. Moreover, vessels also have a negative impact on the bottom of the sea which affects spawning, for instance. According to the data from 2002, an average three out of four stocks were overfished, varying from as much as 82% in the Mediterranean to 63% in the Atlantic. Another issue impacting the sustainability of the fisheries today is a high rate of discards – dumping of dead, unwanted, undersized fish and other marine organisms due to inconsistencies in current regulations.

Aquaculture production increased about six times from 1950 until today. Farmed salmon has been responsible for a major part of this development. A substantial increase in aquaculture has moved the focus away from large scale off-shore fisheries for consumer fisheries towards industrial fisheries producing fodder for aquaculture. In EU aquaculture the top producer is Ireland, followed closely by Greece.

When measuring the current performance of the **building sector** with regard to greening, such aspects as energy consumption, land use and emissions production were analysed. Other important factors, e.g. living comfort, aesthetics, accessibility to a range of socio-economic groups etc. are currently not taken into account when measuring a greening performance of the sector.

Variations in terms of energy and resource performance of the buildings are significant in the European countries. Energy performance of the buildings is influenced by such factors as climate, building age, type of the buildings, construction quality, ownership, as well as economic wealth. Slovakia, Malta, the U.K. Iceland and Belgium have managed to reduce their final residential energy consumption by more than 10% between 2000 and 2009. An increase in residential energy consumption was observed in the Baltic States due to colder climate and low quality of building stock. At the same time in some countries, such as Denmark and Germany, the residential per capita energy consumption increased despite the application of energy efficiency measures.

Regional disparities in residential energy consumption are also quite substantial in some of the countries. Surprisingly almost no correlation, even a slightly negative correlation, was found between higher building density and lower per capita energy residential consumption. This appears to indicate the importance of building age as being an important factor dictating energy efficiency in Europe's larger, more established urban centres where a majority of old or very old buildings are located. Thins in turn implicates the importance of retrofitting of existing buildings above construction of the new ones. Unfortunately however, there is no data available on the extent of retrofitting activities in the Member States.

Emissions production from the building sector vary greatly among the countries, which is mainly attributed to the fuel type used. Regions with less carbon intensive fuel type used in the residential

heat and energy supply, such as Norway, Sweden, Croatia and France, consequently produce less emissions. At the same time Norway and Sweden are among the highest per capita energy consumers, which diminishes their overall performance. The worst performance in the building sector with regard to greening is in the countries with high emissions and high energy consumption, such as Poland, Czech Republic and Latvia.

The lack of data was pointed out as a significant drawback limiting a comprehensive understanding of regional variations in the building sector performance. More specifically, there is a lack of European data at the national and regional level on construction activities, building characteristics (dwelling type, age, ownership, etc.) and energy demand characteristics in the building sector.

When it comes to the **energy** sector, a significant growth of the RES industry and increasing energy efficiency has been observed since the beginning of the 90's. In general, energy intensity of the economies in the EU 27 decreased by about 10% between 2000 and 2010. Although coal, gas and oil fuels still account for more than 70% of the gross energy consumption in many European countries, their consumption has been slightly decreasing over the last decades. The GHG emissions from the energy sector are higher in the countries with big economies and/or high dependence on the fossil fuels, such as Estonia, Malta, Bulgaria, Greece and Poland.

The share of RES in the primary energy consumption grew by 143% from 1990 to 2010 and it corresponds to about 10% in the EU 27 today. Norway, Latvia, Sweden, Austria and Finland are the countries with the highest share of RES in the gross inland energy consumption.

Among the different types of RES the consumption of biomass has increased the fastest since 1990, accounting for 69% in the EU 27 today. From all types of biomass used for energy generation, the use of wood and wood waste has increased the most, accounting for 71% today. Wind power has experienced the second fastest increase and it constitutes 7% of all renewables today. An increase in hydropower has not taken place but it still constitutes 18% of a total share of all renewables in the EU27. An increase in wave and tide energy has not been observed and it still accounts for a small share in the EU.

The progress towards the EU 2020 targets in the share of renewables in gross final energy consumption and the share of biofuels in the transport sector is different among the Member States. Some of the countries, such as Sweden, Finland, Spain and Germany are expected to generate RES energy far beyond their EU targets, while for other countries meeting the 2020 targets may be challenging.

Eco-innovation sector in Europe is growing relatively rapidly, especially when it comes to eco-industry sector (mainly environmental technology). Eco-industries have been growing by around 8 % a year.

Measurement and monitoring of eco-innovation is challenging, as eco-innovation does not correlate with NACE Rev. 2 codes and identification of "green" or "environmentally-friendly" data on R&D and innovation faces analytical and empirical shortcomings.

In general, eco-innovation tends to be higher in core-regions and systematically lower in lagging regions. The reasons for this are twofold. On the input side, core regions provide greater potential diversity of specialization opportunities and greater potential home market. On the output side, they provide higher level of connectedness. When it comes to patents in environmental technologies,

despite a medium-low support to general research and innovation in some regions (such as Andalusia and Catalonia in Spain), the number of patents here is higher than expected.

The Regional Innovation Scoreboard (RIS) and the Eco-Innovation Scoreboard (Eco-IS) are the available methodologies used to picture the innovative and eco-innovative performance of the countries with a regional and national focus respectively. Both methodologies capture the enablers of (eco-) innovation, firm activities (eco-) innovation at firm level) and (eco-) innovation outputs. In addition, Eco-IS considers the environmental and socio-economic outcomes dimensions.

According to the RIS, the top regional performers are located in Austria, Belgium, Denmark, France, Germany and Finland while the moderate and modest innovators are in Eastern and Southern Europe. When it comes to the change in performance, French and Portuguese regions are currently boosting their innovative performance. In general, most countries have regions at different levels of performance, with higher innovation patterns in core-regions and lower in lagging regions. According to the Eco-IS ranks, eco-innovation top performance leaders today are Finland, Denmark and Sweden.

An improvement in eco-innovation performance was observed in Bulgaria and Romania, whereas Latvia, Malta and Hungary dropped their positions due to performance decrease in the eco-innovation inputs and environmental outcomes. An interesting observation is that the eco-innovation performance increased in the countries which have undergone the bailout process in 2010 -2012. Only a moderate correlation was found between high eco-innovation performance and achieving higher environmental performance.

The **manufacturing** industries have multiple benefits associated with greening of the production, such as increasing competitiveness and corporate image, as well as lowering costs of the production, increasing productivity and innovation. Already today many companies seize the opportunities related to a more sustainable production and are improving their environmental performance.

In general, the environmental performance of the manufacture sector has greatly improved over the last decades. Significant investments were made in the environmental protection measures (i.e. prevention and treatment of air pollution, waste water treatment and waste management) in the EU 27. In 2008, the environmental protection expenditure of the manufacturing sector was the highest in Germany, France, the U.K., Spain and Italy. The pollution control investments account for the largest share of investments (57%), followed by the cleaner technology investments (mainly preventive approaches of pollution control).

A greening progress of the manufacturing sector is greatly attributed to the combined efforts and improvements in the other sectors, such as energy and waste. Delinking sector growth from depletion of resources is among the main principles of a greener development of the sector. Such indicators as energy use, GHG emissions and waste generation are used to analyze the delinking progress of the manufacture. A positive indication is when final energy consumption, generation of GHG emissions and waste grow less than GVA of the sector.

For the period 2000-2009 a delinking of final energy consumption with GVA growth occurred in most of the EU 15 countries, as well as in the new Member States. Absolute delinking was achieved in Finland, Ireland, the Netherlands and Sweden between 2000 and 2009. Final energy consumption of the EU industry decreased by 4% between 1995 and 2008 which also resulted in reduction of the GHG emissions.

Delinking of the manufacturing sector's waste generation from the economic growth was achieved in all EU 15 countries except for Germany, as well as in the most of the new Member States in the period 2004-2010. Despite an overall increase in performance, the total waste generation from the manufacturing sector increased slightly (by 2%) from 2004 to 2008. The subsectors generating the largest amount of waste are metals and food.

The market niche for the environmental technologies is developing rapidly. Due to an increased adoption of cleaner technologies, eco-design and promoting of more eco-efficient production and consumption patterns, the resource efficiency in the manufacture sector has improved.

Passenger travel and freight **transport** accounts for one third of European energy consumption. Of this, road transport is responsible for more than 80 percent of the energy consumption. Biofuels are currently only about 6 percent of all energy.

Transport sector's GHG emissions have increased by one third from 1990 and account for about 26% of all GHG emissions in the EU 27 today. The increase is mainly due to strong increases in road transport and also in civil aviation. The transport sector generates emissions of different pollutants and noise. Whereas emissions of pollutants are being gradually reduced through EU regulations, traffic noise continues to be a problem especially in urban areas, and related health effects are the outcome.

There are enormous environmental risks induced through the transportation of hazardous goods. Accidents of oil tankers or other ships, lorries or freight trains occur every now and then in Europe and might cause huge damage to the environment.

The development of a more sustainable **tourism** has been increasingly prioritized in the EU. The progress towards a greater sustainability in tourism is difficult to track, as the greening initiatives are driven by various sectors. Separating tourism from other activities require calculations. The existing measures of the performance of the tourism industry at national and EU-level are primarily of the socio-economic aspects, while environmental aspects and overall 'greenness' of the tourism sector do not appear to be systematically measured.

The number of international tourist arrivals rose from 25 million in 1950 to 980 million in 2011. Moreover, it was estimated that tourism-related emissions contributed 4.95% of the global anthropogenic CO2 emissions in 2005. Most emissions come from transport but also from accommodation (21%) and activities.

At the same time studies comparing green growth scenarios with a BAU scenario (Business As Usual) up to 2050 find that under the alternative greener investment scenarios tourism can grow steadily within the next decades while saving significant amounts of resources and enhancing its sustainability. Furthermore, the growth in GDP in the greener tourism growth scenario is 3-7% above the BAU scenario (UNEP & UNWTO 2012).

Some segments of tourists are becoming more environmentally aware and engaging in ecotourism and other niche-products, and an increasing demand for more sustainable tourism is reported. According to the International Ecotourism Society, ecotourism has an annual growth of 15%, which is four times faster than traditional forms of tourism.

Mainly the larger hotel chains are establishing the programs to improve their environmental performance, whereas SMEs and microenterprises, which represent the majority of the tourism businesses have limited resources (finances, time, knowledge) to get involved. Overall, the

ecolabeling programs for the tourism businesses are used to a relatively little extent. In some labeling programs, a number of businesses drop out after having gained the initial benefits of greening their operations, due to high fees and a perceived limited marketing effect.

Looking at the current state of the **waste sector** with regard to greening, it can be noted that a positive development has taken place over the last decades. The share of waste being recycled and reused, composted and incinerated has been increasing. Due to avoided landfilling the reduction in GHG emissions and other environmental benefits have been achieved. At the same time landfilling still accounts for the largest share of the municipal waste management practices in the EU as a whole and in the new Member States in particular.

Waste generation rates have slightly slowed down (most likely, due to a slow increase in population in Europe) but the quantities of waste are still increasing. That shows that despite an increased application of more sustainable waste management practices, the development is insufficient. Significant efforts should be directed to waste reductions from all sectors, including the households. Currently a lot of resources and energy are being wasted due to shortcoming in the production process, product design, as well as unsustainable consumption patterns. It is also notable that there is a strong correlation between the quantities of waste generated and the GVA. Wealthier countries tend to consume more resources and generate more waste.

The general public is becoming more aware of the environmental impacts of waste and how they can contribute to waste free society. However, there is still a long way to go to changing the production and consumption patterns in Europe.

In case of **water sector**, water exploitation index is used to illustrate water resource efficiency. It shows the total abstraction compared to the available resources. In five of the EU countries (mainly southern Europe), the total water abstraction exceeds 40 % of the total available annual resources, which is an indicator of being under extreme water stress. In general, water abstraction rates have been reduced by 35-40% in Central Europe and by 15% in Northern and Western Europe during the past 15 years, whereas water abstraction has increased in the Southern Europe. In future the demand for water in Europe is expected to rise by 50 % from 2005 to 2010-2030 due to the population growth and higher living standards.

Water productivity is another indicator of sustainability of economic activities with regard to water use. The higher the value is (ratio between GDP/m3 of abstracted water), the more efficiently water is consumed during the industrial activities. Luxemburg, Denmark and Ireland had the highest water productivity in the EU in 2012, whereas Romania, Portugal, Lithuania and Bulgaria had the lowest performance in terms of water productivity. In general, water stressed areas often have lower water productivity than areas with low water abstraction, which implies that there is a great potential in improving water efficiency measures in production.

Over the past 25 years a significant progress has been achieved in improving the ecological status of the water bodies due to reducing the pollution, improving waste water treatment, reducing industrial discharges, and reduction in the use of fertilisers. However, the Water Framework Directive (WFD) argues that the progress should take place at a faster pace in order to be able to meet the targets set by the WFD. Rivers are the most effected surface water bodies in Europe.

Less than 1% of citizens in Europe have inadequate water supply today, which applies also to the new Member States. That means that almost all citizens have direct access to public water supply in Europe.

Significant improvements have been made with regard to the connection to wastewater treatment since the beginning of the 1990s. About 80% of the population in Europe is connected to some kind of wastewater treatment in northern and southern European countries. This number is significantly lower in Southern, South-Eastern and Eastern Europe. The secondary and tertiary wastewater treatment is already quite widespread in Northern and Central Europe and is in the development stage in South-Eastern Europe.

A synthesis table showing data which has been used to describe the sectors under the study and aspects of the green economy in relation to these sectors can be found in Appendix B.

5. Drivers and enablers

Drivers and enablers are the policies, physical and non-physical assets, market conditions and other factors that can be thought to activate the concepts and improve current greening performance in each sector. The main drivers and conditions which impact on the evolution of green economy within the sectors researched in GREECO project are summarized in this chapter.

There are multiple drivers and enablers for a greener **agriculture and forestry**, which include such dimensions as policies, technology and innovation, human resources, economic and to some extent territorial dynamics.

Being the most influential agricultural policy in the EU for the past 60 years, the Common Agricultural Policy (CAP) is a major driving force for the green agriculture. Since the introduction of the Agenda 2000 a focus on the environmental concerns has become stronger. The following adjustments of the CAP in 2003 and 2008 promoted market-oriented, sustainable agriculture.

The environmental concerns are integrated into the CAP through the agri-environment measures, which are designed to encourage the farmers to adopt the environmentally friendly farming practices that go beyond legal obligations. The examples of such practices include organic agriculture, management of low-intensity pasture systems, preservation of habitats with high value, etc. Farmers receive a monetary compensation for the associated additional costs.

Within the CAP pillar II, the Member States are obliged to develop the Rural Development Programmes, which contain a package of measures grouped around 4 axes. Funding is allocated towards improving the competitiveness of the agricultural and forestry sector, improving the environment and the countryside, quality of life in rural areas and diversification of the rural economy and LEADER measures. The measures under these priority axes are given a varying priority in different Member States.

Besides the CAP, there are several EU Roadmaps and Thematic strategies in the field of soil protection; Communication “European Action Plan for Organic Food and Farming"; Directives in the field of water policy, protection of waters against pollution from agricultural sources, which drive the development of the green agriculture. Water policy promotes more efficient irrigation and agricultural practices that improve water quality, as well as training and knowledge-sharing programmes for farmers on more efficient water management. Organic farming policies are targeting both the production and demand side. A strong emphasis is placed on information sharing regarding all aspects of organic production, supporting the development of market for organic products and capacity building in developing countries.

In addition to policies, the development and an increased uptake of new technologies and innovation play an important role in fostering the transition to more sustainable agricultural practices. Among the examples of environment favouring innovation are new science and generic technologies, farming system innovations and post farm innovations.
Other enabling conditions include:

- Development of bioeconomy opens up the new opportunities for the agricultural and forestry sectors through development of new food processing, bio-based industries and bioenergy production. On the one hand, it can be regarded as a driver to the green agriculture and forestry, as it encourages a sustainable increase in primary production, greener production and consumption patterns and contributes to green jobs generation. On the other hand, such a development can create conflicts. For example, the competition for land between food crops and bioenergy production and deepen food security concerns. The enabling conditions for the development of bioeconomy include further advancements in research and innovation, support from public funding and private investment and development of skilled labour.

- Human resources development has been identified as an important enabler for a greener agriculture. Labour and skills development in renewable energy production, retrofitting measures in the buildings, organic farming etc. are essential for restructuring of the agricultural sector.

- Capital investments in farmer and forest owners training, extension services and demonstration projects are important for promoting greener practices in the agriculture and forestry sectors.

- The rapid development of organic sector in the EU is primarily attributed to the support provided under the CAP, but also to the increasing awareness level and a demand for organic production. The demand for organic products is steadily increasing in most EU countries, regardless the current difficult economic situation. However, there is no certainty and stability, as in some Member States (especially the new ones) and sub-sectors the situation may be challenging. Therefore a proper attention to the market demand should be paid when drawing up the support measures. It was pointed out that in promotion of organic products the demand-pull strategies (i.e. communication about the organic products) play a highly important role.

- The demand changes and increasing the consumer awareness are among the most important drivers of a greener agriculture. More sustainable behaviour of the population would contribute to reducing food waste and choosing less dairy/meat based diet.

There is no common **forest** policy in the EU, as in case of agriculture. Forest policies are formulated by the Member States themselves. An important driver to sustainable forestry at the EU level is the Rural Development Policy, which highlights the multifunctionality and sustainability of forests and is adding value to the implementation of the forest programmes of the Member States. Other important policies are the EU Forestry Strategy, the Forest action plan, Communication "Addressing the challenges of deforestation and forest degradation to tackle climate change and biodiversity loss" and Communication on innovative and sustainable forest-based industries in the EU. In addition, several EU sector policies promote sustainable forest management, those related to climate change, biodiversity and energy.

Increased role of forest certification schemes and eco-labelling have been among the most important drivers to sustainable forest management.

The EU **fisheries** sector is highly influenced by the global policies and regulations. The main policy determining the access rights to fishing waters and regulations in relation to fish stock is the Law of the Sea (1982). Within the agreement there are principles set regarding the conservation and management of 'highly migratory' species. In the 80s' and 90's the EU regulated the fishing capacity of the important commercial species through setting Total Allowable Catches (TACs).

The EU's Common Fisheries Policy (CFP) revision of 2002 promoted the reduction of fisheries capacity to an adequate size defined by the fish resource and increased involvement of fishers in the management. In the forthcoming CFP revision 2013 a special emphasis is placed on improving the management of fished stocks (addressing the practice of discards) and promoting a more coherent ecosystem-based approach for all fisheries (based on "maximum sustainable yield" (MSY). A new funding mechanism will be set up for 2014-2020 called the European Maritime and Fisheries Fund (EMFF). At the EU level biodiversity and overfishing challenges are also dealt within the EU 2020.

In increasing the demand for **green buildings**, market is the main driving force, which is influenced by cost/benefit perspective. In this regard, the most important enabling conditions are the cost of energy, the general development of Europe's energy sector and the policy conditions. In general, higher energy prices favour the proliferation of green buildings, as the benefits associated with green building investments are becoming weightier while the cost of doing nothing increases. At the same time, policies that work to reduce the capital intensity of greening existing buildings (thus balancing the initial cost versus the expected future benefit) are essential.

The main EU policies that drive the demand for green buildings are the EU Roadmaps (EU 2020 Strategy, a Resource Efficient Europe & a Roadmap for moving to a low carbon economy in 2050) and the Thematic strategies (Energy 2020, Energy Efficiency Plan 2011 (EEP) and Energy Roadmap 2050). The EPP emphasizes the key role of the public authorities in facilitating the construction of greener buildings and implementing the retrofitting measures in the existing buildings, and promotion of GPP.

The EU Directive 2010/31 for improving the operational efficiency of resources (energy) of buildings promotes setting minimum energy performance requirements of new and existing buildings in the EU Member States and increasing the number of nearly zero-energy buildings. The policies are directed to creating favourable framework conditions, reducing the cost of investments and knowledge development of the public sector and private actors.

Funding for developing energy improvement initiatives in buildings is allocated through the European Regional Development Fund (ERDF) and the Cohesion Funds. Funding is allocated to supporting the individual projects through direct grants or low interest loans/interest rate subsidies, as well as to enhancing the energy efficiency in public buildings, district heating infrastructure, education and training activities in the building sector etc.

A majority of financial incentives are rooted in the national policy schemes – mainly in the form of subsidies, grants, tax credits and local building regulations. These policies need to be further developed among the EU Member States and become more consistent and long-term.

Other key enablers for increasing the supply of green building products and services are the actions that reduce materials and resource consumption in the construction process and increase the resource efficiency of the construction process itself. For example, the material reductions are achievable through optimizing urban mining, reduced land take and Brownfield Development, increasing retrofitting and reducing demolition.

In addition, skills development among the constructors is an essential enabler of a more resource efficient construction.

The major drivers for a greener **energy** sector are the EU legislation and policies and the energy technology development. Policies steer the development of the energy sector in a greener direction through pursuing security of supply and environmental protection but also economic growth through value added and job creation in the field of energy. The two headline policies with regard to greening the energy sector are Energy 2020 and the Energy Roadmap 2050, which set the 20-20-20 targets (namely 20% of final energy consumption from RES, 20% reduction on GHG emissions and 20% reduction in primary energy consumption by 2020).

At the European level the RES deployment is supported mainly through the RES Directive and the European Emission Trading Scheme. RES are also supported through several EU funding programmes, including Structural and Cohesion funds, the FP7 and the Intelligent Energy Europe programme. Other important policy documents, directives and regulations with regard to a green development of the energy sector are the Renewable energy progress report COM(2013)175, Energy Efficiency Plan COM(2011)109, Directive 2009/28/EC, Directive 2012/27/EU, Regulation (EU) No 347/2013. These policy documents focus on renewable energy, energy efficiency and energy infrastructure.

At the national level, the financial mechanisms, national targets and place-based action plans are in place to overcome the economic barriers and increase the competitiveness of the RES. The most common support instruments for renewables are feed-in tariffs, feed-in premiums, quota obligation systems and their combinations.

Energy price is an important enabler to alternative energy sources deployment, as with increasing prices on conventional energy the RES are becoming more competitive. Availability of land is another enabler, since the production of energy, including the RES, can occupy significant amount of land. Behaviour changes among the industries and individuals could significantly contribute to reducing the energy consumption in general.

From an economic perspective, an access to technological, human and economic capital is among the key enablers for the development of a more sustainable energy sector. Technological capital includes technologies for extraction and collection of energy, transformation and transmission and utilization by the end users. The development of a human capital is essential for fostering the technology transition and increasing the innovation capacity.

The environmental legislation has been the engine of **eco-innovation**. Since the prices hardly reflect the real value of natural resources, the policy support is essential for adjusting the economic and fiscal framework to provide incentives to become more resource efficient. At the same time it was stressed that a non-flexible regulatory framework may also be counter-productive and create barriers to eco-innovation.

At the EU level, the concrete policy incentives that contribute to fostering eco-innovation are the EC's Environmental Technologies Action Plan (2004), the Eco-Innovation Action Plan (Eco-AP) (2011) and the EU 2020 strategy. The Knowledge and Innovation Communities is another EU initiative that was highlighted for its valuable contribution to promoting eco-innovation.

In addition to traditional policy tools, different types of market-based instruments are increasingly recognized as efficient tools for fostering eco-innovation. Subsidies for greening the industry and cleaner technologies, voluntary environmental schemes (e.g. the EU Ecolabel) and public procurement play an important role in driving the demand for eco-innovation.

Overall, economic and market conditions, such as expected future increases in energy and material prices can perform as drivers to boosting eco-innovation. Moreover, among other motives for an increased uptake of eco-innovation are to gain first mover advantages and sell solutions, to answer to a demand side, to capture new markets through raising competitiveness and improving corporate image, as well as to comply with regulations.

Among other important enablers is supplying finance tailored to relevant research and different stages of technology development and using the demand-side instruments, such as standards and public procurement.

For **manufacturing** sector as a whole, rising energy prices and resources scarcity are among the strongest drivers for the companies to undertake initiatives towards greater resource efficiency. In addition to cost reduction and maximizing the production, increasing resource efficiency reduces the risk derived from fuel dependency and resource scarcity.

Among other important drivers for greening of the sector are policies that promote greater resource efficiency and emission reductions, limiting environmental damage of manufacturing activities, as well as creating and securing quality jobs. Besides that, there are various policies in the field of waste and energy that are also highly relevant to the manufacturing sector. Overall, the regulatory framework in the EU is already fairly strict with regard to the most polluting industries.

Market based instruments (price-based, rights-based and market friction) and voluntary agreements (e.g. EMS, EMAS and eco-label) are among the significant drivers for improving the environmental performance of the companies. In general, increasing the environmental awareness of the companies and rising consumer demands put a pressure on the industries to increase sustainability of the operations.

Finally, further investment in R&D and innovation are crucial in sustaining the progress in greening the manufacturing sector.

There are several EU policies at work for fostering greening of the **transport** sector. The White Paper Roadmap to a Single European Transport Area is among the most important policy documents as it sets the environmental targets to be reached. In addition, there are several EU directives, regulations and initiatives for greening the transport sector.

The policies at the national and regional level in the field of infrastructure, spatial planning, speed limits, road pricing etc., play an important role in fostering greener transportation. Among the non-policy drivers are energy scarcity / oil peak, raising the awareness of the population and changes in the public's habits regarding sustainable transport.

There is limited number of **tourism** related policies and/or programmes in the Commission. A key tourism policy is the 2010 Tourism Communication titled "Europe, the world's No 1 tourist destination – a new political framework for tourism in Europe", which aims to stimulate competitiveness in the European tourism sector; promote the development of sustainable, responsible and high-quality tourism; consolidate the image and profile of Europe as a collection of sustainable and high quality destinations, and maximise the potential of EU financial policies and instruments for developing tourism. A number of policies in other areas have an effect on tourism and drive the sector's development towards more sustainable.

It appears that a more sustainable development of the tourism industry is not strongly driven neither by the industry nor the customers today. SMEs and microenterprises dominating the tourism industry often lack the time, finances and knowledge to pursue greening activities. Therefore the public sector and EU initiatives play a crucial role in stimulating the interest and investments in more sustainable practices and technologies in tourism.

Considering the high number of SMEs and microenterprises in tourism and difficulties to reach out such a wide variety of small businesses, sharing of information, knowledge and tools (such as CSR) are among very important enabling conditions for engaging the industry in greening. Moreover, the single greatest limiting factor for SMEs in moving toward greener tourism is lack of access to capital for this type of investments. Green investments must be seen as value-added investment and made on their economic and financial merits, without prejudice. This will require greater private sector awareness of the value of green investment, and also policy coordination with Ministries of Finance and regulatory authorities.

Although the awareness of the climate change and environmental challenges among the tourists is growing, which contributes to travellers' choices in demanding environmentally sustainable destinations, the average consumers tend not to be very aware of the impacts caused by tourism. Raising consumer awareness of tourists is highly relevant in relation to the green economy. Particularly changing demands of transport towards greener modes is relevant.

Other drivers for fostering sustainability in tourism sector are related to destination planning and (sustainable) development strategies, government investment in public goods and services, supplier awareness and involvement in greening of tourism and consumer awareness and changing demands.

The policies and targets in the field of **waste** are among the major drivers for a more sustainable waste management. The Thematic strategy on the Prevention and Recycling of waste sets an overarching goal for the EU to become a recycling society.

Waste Framework Directive 2008/98/EC and the Directive on Waste 2006/12/EC encourage the use of waste as a source of energy, the development of resource-efficient clean-technologies, impose the 'polluter pays principle'. Other directives are more specific and address different waste management methods (i.e. waste landfill, waste incineration) and waste types (i.e. packaging, glass, electrical, electronic equipment, construction and demolition). These policies encourage alternative waste treatment operations which are higher in waste hierarchy and set the performance requirements and targets for specific types of waste. Funding through the Cohesion policy has been a key driver for the construction of sanitary landfills in the new Member States. In general, the development of waste treatment infrastructure is highly dependent on the policy drivers and availability of funding.

Other than policies, the drivers of a greener waste sector include the technological innovations, economic instruments, knowledge-related activities and higher awareness level of the population. Technical preparedness (e.g., availability of waste treatment infrastructure, waste resource capacity) and market development for waste products are the prerequisites for introduction of alternative waste treatment technologies.

Another driver for greening the waste sector is the development of the administrative capacity and competency of staff in the field of waste management, which could be achieved through an increased application of the voluntary instruments and tools, such as EMS and EMAS, eco-labels, CSR.

The implementation of the policies would not be successful without knowledge development and raising an awareness level of the industries, stakeholders and the consumers on waste aspects. The importance of increased cooperation with other stakeholders and multi-level governance was emphasized in relation to greening of the waste sector.

Last but not least, the economic instruments (i.e. landfill taxes and fees, penalties to municipalities for not meeting the targets) are significant drivers for stimulating the certain waste treatment options high on the waste hierarchy, recycling and reuse of materials.

The key driver for the greener development of the **water sector** is the EU legislation. During the last two decades the EU legislation has contributed to reaching a high level of public water supply of good quality and a high level of sanitation.

The EU multi-sector policies, such as Europe 2020 Strategy's Flagship Initiative on Resource Efficiency and a Roadmap to a resource efficient Europe recognize the vital function of water for the European economy. Water saving measures and water efficiency are the central priorities, as well as getting the water price right. Improving the water management and developing the adaptation measures to climate change are addressed in the EC White Paper on Adapting to Climate Change.

The most important EU legislation with regard to water management is the Water Framework Directive. A number of EU Directives and Communications contribute to a green economy in the water sector, such as the Groundwater Directive, Urban Waste Water Directive, Drinking Water Directive, Floods Directive and a Blueprint to safeguard Europe's Water Resources. The policies promote green investments in water management and contribute to establishing a sound regulatory framework.

Significant investments into green economy in the water sector are provided through the EU Cohesion policy. The main areas of investments are the infrastructure projects, such as wastewater treatment plants, and better water management and governance across the regions.

Other drivers to a greener development of the water sector include the economic instruments (i.e. tariffs, taxes, subsidies, tradable permit schemes), regulatory approaches (i.e. standards for water quality, environmental impact assessment, abstraction and discharge permits), information instruments (i.e. metering of water use, eco-labelling and certification, awareness raising). Water pricing is an effective instrument used by the Member States to signal water scarcity and promote water efficiency across the sectors and raise awareness. The effectiveness of these instruments is highly dependent on the regional circumstances and the specific needs.

Greening of the water sector requires good institutional capacity and the governance system, which ensures an effective stakeholder dialogue also at the local level.

The sustainability of the water sector is also influenced by the socio-economic changes. Such aspects as demography, population densities, income and consumer behaviour influence the public demand for water. Thus, long term and forward thinking urban planning and integrated spatial planning are important drivers to pursuing a sustainable water management.

The so called 'soft measures', such as education and awareness raising on sustainable water management measures are also highly important. Voluntary agreements, such as the European Water Stewardship and the European Water Label, are among the effective tools for promoting water efficiency and pursuing a more sustainable water management.

Green innovation and technology development play a significant role in the process of greening of the water sector. Through the uptake of innovation the efficiency in the water management could be significantly increased.
When it comes to drivers and enablers to a green growth, many similarities can be observed across the sectors (Figure 2).

Figure 2. The main drivers and enablers in the green economy.

Table 2 demonstrates the relations of the GREECO sectors to the sector hierarchy triangle, which have been presented and explained earlier in the report. Here the sectors are also grouped into five 'building blocks', which show their territorial relevance. The sectors with the strongest territorial bounds are presented in the columns on the left side of the table and the territorial bounds are getting weaker towards the right side of the table. Moreover, the seven rows in the table correspond to the key topics presented earlier in the hexagrams.

6. Connections between the sectors

Green economy is about finding and making best use of complementarities (and potential conflicts) between the economic sectors. There are multiple interconnections between the sectors, which often result in positive spin-offs or developments. Energy, water and waste sectors have cross cutting linkages with all sectors of the economy since almost any activity requires energy, consumes water and generates waste. Moreover, greening of the sectors relies heavily on eco-innovation. Eco-innovation is among the key factors which enable the transition to the green economy within all sectors investigated. The most important linkages between the sectors will be discussed in this chapter.

From a supply perspective the **energy sector** closely relates to all sectors in economies as these are completely dependent of energy for performing their activities. From a social perspective the availability and affordability of energy carriers such as electricity and gas is a critical element of quality of life. In a transition to a green economy the consumption of RES is increasing. Agriculture and forestry are becoming providers of energy sources (biomass). Waste from agriculture and forestry, as well as from industrial processes is increasingly used for energy production (waste incineration, biogas). Moreover, the greener development of energy sector is dependent on the availability of knowledge, technology and eco-innovation.

Moreover, the energy sector is becoming more dependent on access to land necessary for the deployment of RES infrastructure such as wind turbines and solar installations. Therefore landowners as well as enterprises related to forestry and agriculture are becoming new important actors in the energy sector.

Practically all economic sectors are direct consumers of **water** and impact on water resources. Water is an essential element for agriculture, farming and livestock. Agriculture is the main consumer and polluter of water, followed by industry (especially pulp and paper, chemical, food and textile) and other sectors. When it comes to fishing sector, clean water is an essential element for sustaining the life of fish. As the status of commercial fishing activities is directly related to the health of the stock of commercially exploitable fish species, poor water quality can result in increased fishing costs and prices for fish (OECD, 2011b, p. 71).

The link between energy and water is twofold. On the one hand, water is a crucial element in energy generation, notably for hydropower and as a coolant for energy production (power stations). Wastewater treatment plants also have a big potential for production of biogas. On the other hand, water supply and sanitation sector is also a large energy consumer itself, as it requires large amounts of energy in pumping, transporting and water treatment (UNEP, 2011). When it comes to drinking water, the amount of energy and resources needed for treatment depends on the quality of water and the distribution systems. Desalination of water is another highly energy demanding process.

In addition, land-use issues and water sector are also interlinked. Decisions about land-use and development are influenced by the availability of water resources and facilities for wastewater disposal. At the same time changes in land use can also affect the water sector. So, the extensive loss of farmlands due to a transition to a more intensive large-scale agriculture system, where high-nature value farming areas supporting biodiversity are increasingly abandoned, impact the water sector. Removal of agricultural lands for urban development is another factor leading to higher pollution burdens on water bodies.

Tourism is another water intensive sector. Tourism services and leisure activities demand a lot of water, in particular in southern European coastal areas. The availability of good quality water is a

prerequisite for tourism development. In several regions, non-compliance with norms for bathing water quality leads to the closure of beaches and lakes for recreational purposes, which influences strongly the local tourism economy (OECD, 2011b). When it comes to building sector, increasing water efficiency in buildings is an important issue for many European countries. Such measures as water saving devices, water-efficient construction, design and renovations are becoming more widely introduced.

All types of economic activities generate **waste**. Thus, better management of waste is among the important dimensions of greening of all sectors of the green economy. Although the sectors have different approaches and focuses, the common goals for all sectors are waste avoidance, reduction and re-use. With regard to the bioeconomy sector, the main focus is on the agricultural and food manufacturing sector's waste reductions through pursuing better post-harvest storage handling, processing equipment, as well as improving market access infrastructure. Another important issue is waste reduction from the households.

Waste and energy are linked in several ways. On the one hand, waste is being generated during the energy production process, mainly in case of non-renewable energy sources (mining, extraction activities, electricity supply etc.). On the other hand, certain types of waste can be used for electricity and heat production. This is valid for any incineration with energy recovery and biogas production. Energy production from wood and municipal biomass waste is constantly growing.

Significant waste reductions from the manufacturing, building/ construction and transport sectors can be already achieved during the production stage through improved material efficiency, including the secondary utilization of material (e.g. Construction and Demolition (C&D). Green research (material research, research targeting treatment measures, prevention approaches, product design, etc.) is particularly relevant in this regard, as it contributes to a decrease in the material input for production. Industrial sector generates the largest quantities of waste in the world. The main challenge of the waste management efforts in manufacturing sector today is to achieve absolute delinking between GVA growth in industry and waste generation. In the tourism sector, the environmental management, increased recycling and consumer awareness are amongst the handful tools for achieving better waste management.

Building sector also has many linkages with other sectors. Sustainable urban development incorporates the development of green buildings, non-car transport solutions, local waste and energy infrastructure. More effective urban planning involving settlement structure, reductions of land take and the development of more sustainable transport connections impact on the built environment as contributors to resource efficiency. These are the key issues in the city's built environment and should be planned together.

As to the building sector connection with energy and waste sectors, bioenergy can be effectively used for heating both private houses in rural areas as well as apartment buildings in urban centers. The link between the construction and waste sectors can be found in example where incinerated waste is used for heating of the buildings. The need to more efficiently take advantage of throughputs (waste, residual heat, etc.) means that urban areas must look within to take advantage of available resource inputs around them.

Eco-innovations which contribute to improving the resource and energy efficiency in buildings play an essential role in greening of the sector. These include measures relating to: insulation, windows, doors, heating and electrical systems, building automation and decentralized renewable energy production. Manufacturing sector is linked with the building/construction sector through providing the construction materials. Furthermore, given that the tourism sector is such an important consumer

of buildings, there is a clear connection between tourism growth, the demand for buildings, and thus the opportunity to make them greener. As such, regional accessibility is a driver of tourism, which is in turn a driver of the potential for creating greener buildings. Finally, green building and construction is about producing buildings that demand less energy, particularly for heating and cooling. Therefore there is a strong connection between green buildings and energy.

The **transport sector** has connection to most of the GREECO sectors, as all sectors have transport demand. Transportation makes raw materials and waste available to producers (energy sector, waste and water management, building and construction sector), enables the distribution of product and also provides the link between jobs and workers. For the tourism sector the question is more how to get people from their place of residence to the travel destination. The bioeconomy sector is linked to the transport sector through producing biofuels for the vehicles. Moreover, distribution of fresh fish relies on fast and flexible transport systems.

As noted above, **eco-innovation** is a key sector in delivering the transition towards the green economy. Eco-innovation is linked to all GREECO sectors in a way that the sectors will benefit from the sector specific green research (new vehicle technologies, water treatment alternatives etc.) and with the application of the innovations become 'greener'. When it comes to the transport sector, for example, it will benefit from research into new vehicle materials and technologies, into new more sustainable forms of transport operation and into transport logistics and new forms of transport demand management. Eco-innovation in the manufacturing, energy, waste and water management sectors are targeting at improving resource-efficiency, reducing environmental impact while at the same time increasing the competitiveness.

Tourism is an experience based cross-sectorial activity, which is related to many of the sectors in GREECO project. Since tourism involves being away from the regular home environment, it is closely related to transport sector – through transport to and from the destination as well as transport within the destination and hereby using different types of transport. Tourism is also linked to the building and construction sector through the accommodation establishments and hereby construction and operation of buildings. During the visit, tourists consume food and drink (agricultural and fisheries sector) and tourists use water, energy, produce wastewater and waste and put pressure on local resources and habitats (water, energy, waste, and biodiversity sectors). At the same time, these natural resources, biodiversity and landscape assets are also key attraction factors for tourism along the cultural attractions and sustaining these is highly relevant for tourism. So, the fresh fish and seafood products become an attraction for tourists and constitute an important part of the local cultural heritage.

7. Concluding remarks

The sector analysis showed that all sectors studied are moving in a greener direction and that positive transformations have already occurred in a number of sectors. The analysis also revealed that there are considerably more opportunities than challenges in relation to greening in the long run.

The development of the economic sectors has to adapt to the global challenges, such as depletion of resources and the climate change, by choosing a development direction that is not as resource-intensive and is more sustainable. Moreover, the consumers' demand for sustainable products and services is also growing, which steers a greener development of the sectors.

Having in mind that the sectors studied are likely to remain a backbone of the EU economies, a greening process is inevitable. At the same time it is difficult to estimate whether greening is occurring fast enough to be able to effectively address the current and future challenges.
Overall, the support and commitment from the EU over the last decades has been quite high to a green economy development in the sectors studied. The current greening performance, however, differs significantly across the EU Member States. As discussed in the ESPON ReRisk report on regions at risk of Energy Poverty – in a situation with rising energy prices the dependency on fossil fuels has been resulting in a situation where countries with economies based on exploitation of substantial national resources of fossil fuels such as coal, oil and gas tend to be more hesitant to shift their energy supply to renewable resources. Therefore it is highly important to highlight and promote green initiatives as development opportunities for such countries/regions for their potential to make the traditional sectors more competitive; and by doing so, changing the overall perception that greener practices are affordable only for the rich and highly developed countries.

The analysis also showed the importance increased knowledge sharing and cooperation between a range of actor at the local, regional and national level– from the decision-makers to businesses and individuals. Only through joint efforts of all groups of the society the green transition is possible. The proactive local (municipal or regional) authorities are a prerequisite for the greener development of many sectors studied.

Job creation is an important argument in favour of the green economy development, especially in the peripheral regions which are struggling with demographic challenges and outmigration. Looking at the sectors studied, the EU's bioeconomy sector is projected to have the highest potential in terms of green jobs creation. Today the sector accounts for more than 22 million jobs and approximately 9% of the workforce. Significant growth is expected to arise from sustainable primary production, food processing and industrial biotechnology, as well as new bio-based industries. Other sectors studied are also expected to generate an increasing number of green jobs in future, which would require new skills development and training to meet labour demands.

Among the limitations identified during the sector analysis was a lack of regional data or comprehensive indicators that could measure a greening performance and track the progress towards green growth. This issue has been particularly emphasized in case of the tourism and building/ construction sectors.

In the current study the focus has been on greening of existing activities and their production patterns. Another important dimension of green economy is greening of *future* activities in old and new sectors, which would require different drivers and enablers. The development of a green economy might put added pressure on the linkages between sectors. Agriculture and forestry sectors,

for instance, are competing for the provision of inputs for biofuels, while the development of hydropower might have a negative impact on biodiversity and farmers' livelihoods. Finding trade-offs between the sectors and the ways to organize the multifunctional land use, the competition for resources and the production of food vs. production of fibre/energy become important issues in a green economy.

At the same time greening should not be achieved at the expense of other countries or regions. With increased globalisation, rigid legislation and societal pressure in the home countries the major polluters choose to move their production to the Third world countries and pollute there instead. While many countries in the EU are decoupling the economic growth from the CO_2 emissions, the import of the emissions continues through importing the commodities. These countries are becoming clean service economies but their actual 'footprint' is larger. These processes and associated problems of the backside of greening in a regional or national perspective have not been addressed in the project. There are a number of issues that need to be addressed in a green economy going beyond the sectoral perspective.

Appendix A. The classification used for defining employment and GVA from a quantitative perspective.

NACE Code	Bioeconomy (forestry, fish, agriculture, biomass raw materials)	Energy		Creative, arts and entertainment activities; libraries, archives, museums and other cultural activities; gambling and betting activities	
A	Agriculture, forestry and fisheries	B05	Mining of coal and lignite	R90	Libraries, archives, museums and other cultural activities
A01	Crop and animal production, hunting and related service activities	B06	Extraction of crude petroleum and natural gas	R91	Gambling and betting activities
A02	Forestry and logging	B09	Mining support service activities	R92	Sports activities and amusement and recreation activities
A03	Fishing and aquaculture	C19	Manufacture of coke and refined petroleum products	R93	Sports activities and amusement and recreation activities
Buildings management and construction		D	Electricity, gas, steam and air conditioning supply	**Green research and eco-innovation**	
F41	Construction of buildings	**Experience economy (leisure, tourism, recreation)**		M	Professional, scientific and technical activities
F43	Specialised construction activities	H51	Air transport	M70	Activities of head offices; management consultancy activities
L	Real estate activities	I	Accommodation and food service activities	M71	Architectural and engineering activities; technical testing and analysis
L68	Real estate activities	I55	Accommodation	M72	Scientific research and development
M71	Architectural and engineering activities; technical testing and analysis	I56	Food and beverage service activities	M73	Advertising and market research
N81	Services to buildings and landscape activities	N79	Travel agency, tour operator reservation service and related activities	M74	Other professional, scientific and technical activities

NACE Code	Manufacturing, mineral products		Transport (mobility and trade)		Land transport and transport via pipelines
C	Manufacturing	C29	Manufacture of motor vehicles, trailers and semi-trailers	H50	Water transport
C20	Manufacture of chemicals and chemical products	C30	Manufacture of other transport equipment	H51	Air transport
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	C33	Repair and installation of machinery and equipment	H52	Warehousing and support activities for transportation
C22	Manufacture of rubber and plastic products	F42	Civil engineering	H53	Postal and courier activities
C24	Manufacture of basic metals	G	Wholesale and retail trade; repair of motor vehicles and motorcycles	**Water and waste management**	
C25	Manufacture of fabricated metal products, except machinery and equipment	G45	Wholesale and retail trade and repair of motor vehicles and motorcycles	E	Water supply; sewerage, waste management and remediation activities
C26	Manufacture of computer, electronic and optical products	G451	Sale of motor vehicles	E36	Water collection, treatment and supply
C27	Manufacture of electrical equipment	G452	Maintenance and repair of motor vehicles	E37	Sewerage
C28	Manufacture of machinery and equipment n.e.c.	G453	Sale of motor vehicle parts and accessories	E38	Waste collection, treatment and disposal activities; materials recovery
C31	Manufacture of furniture	G454	Sale, maintenance and repair of motorcycles and related parts and accessories	E39	Remediation activities and other waste management services
C32	Other manufacturing	G473	Retail sale of automotive fuel in specialised stores		
C33	Repair and installation of machinery and equipment	H	Transportation and storage		

Appendix B. Synthesis table of the data which has been used to describe the sectors under study and aspects of the green economy in relation to these sectors

	Scale	Coverage of the EU	Time frame
Bioeconomy			
GVA in the bioeconomy	NUTS 1	EU 27	
Employment in the bioeconomy	NUTS 1	EU 27	
Change in employment in the bioeconomy	NUTS 1	EU 27	2000-2009
Labour productivity in the bioeconomy	NUTS 1	EU 27	2009
The importance of agriculture in GVA in Europe (million euro and share)	NUTS 1 and NUTS 2	EU 27	2007, 2008, 2009
Agriculture and forestry employment	NUTS 2	EU 27	2007
Share of agricultural holdings with another gainful activity	NUTS 1	EU 27	2007
Forest and other wooded area cover as percentage of total land area	NUTS 1	EU 27	2005
Employment in forestry and forest-based industry	NUTS 1	EU 27	2008, 2009
GVA in forestry and logging	NUTS 1	EU 27	2009
Public and private ownership in different EU countries	NUTS 1	EU 27	2005
Wood removal in the EU (industrial roundwood and wood fuel)	NUTS 1	EU 27	2005
Share of primary agriculture (land area, water use, E consumption, GHG emissions, ammonia)	EU total	EU15	2002-2004
OECD indicators on agri-environmental trends (farmland bird's indexes, gross agricultural GHG emissions, ammonia emissions from agriculture, agricultural area, arable and permanent crops, permanent pasture)	EU total	EU 15	1990-2004
Environmental Performance of Agriculture (pesticide use, on-farm energy consumption, gross nitrogen & phosphorus balance, agriculture production volume)	EU total	EU 15	1990-2004
Intensity level of agriculture and change	NUTS 2	EU 15	2000, Change from 1990 to 2000
Specialized and mixed farming systems (to illustrate biodiversity)	NUTS 1	EU 27	
Share of crop and livestock specialist holdings (indicator of the pressure of farming on the environment)	NUTS 1	EU 27	2007
Cropland as a share of land cover	NUTS 2	EU 27	2009
Total livestock density and livestock density of grazing animals	NUTS 2	EU 27	2007
Consumption of manufactured fertilizers (nitrogen, potassium, phosphorus)	NUTS 1	EU 27	2009
Total agriculture water use, change in water use and share of agriculture in water use	NUTS 1	EU 15	1990 - 2003
Share of irrigated utilised agricultural area	NUTS 2	EU 27	2007
Gross nitrogen balance	NUTS 1	EU 27	2000-2004, 2005-2008
Direct on-farm energy consumption, change in consumption and share in national total energy consumption	NUTS 1	EU 15	1990-1992, 2002 -2004
Energy cost as a fraction of agricultural output value	NUTS 2	EU 27	2007
Share of agricultural GHG emissions in total EU emisions and in countries' total emissions	NUTS 1	EU 15	2007
GHG emissions in agriculture by country and changes in GHG emissions	NUTS 1	EU 27	2001-2010
C02 (equivalents) emissions in relation to production value	NUTS 1	EU 27	2009

Change in the amount of hectare with organic crop	NUTS 1	EU 27	2006-2010
Share of agricultural land area under certified organic farm management	NUTS 1	OECD countries	1993-1995, 2002-2004
Share of organic area in total	NUTS 2	EU 27	2007
Consumption of meat per capita	NUTS 1	EU 27	
Share of Natura 2000 areas in the forest sector	NUTS 1	EU 15	2002
Share of PEFC certified forests	NUTS 1	EU 27	2012
Building and construction			
Construction related employment	NUTS 1	EU 27	2009
Changes in construction related employment	NUTS 1	EU 27	2000-2009
Share of regional employment in the construction sector	NUTS 2	EU 27	2009
Construction related gross value added by related activity and as a share of total GVA	NUTS 1	EU 27	2009
Share of regional GVA in the construction sector	NUTS 2	EU 27	2009
LUPA's land use change typology (level of urban expansion)	NUTS 2	EU 27	1990-2006
Growth of urban residential areas and economic areas	NUTS 1	EU 27 (except for FI and SE)	1990-2000, 2000-2006
Residential energy consumption per capita and change in final residential energy consumption	NUTS 1	EU 27	2009, 2000-2009
Energy consumption in residential buildings and regional disparities in residential energy consumption	NUTS 2	Austria, Bulgaria, Croatia, England, Hungary, Italy, Norway, Sweden	2009
Climatic based demand of energy for heating of buildings	NUTS 2	EU 27	2009
Distribution of single family and apartment buildings (single family houses & apartments)	NUTS 1	EU 27	
Impact of population density on residential energy consumption	NUTS 1	Austria, Bulgaria, Croatia, England, Hungary, Italy, Norway, Sweden	
Age structure of residential floor space	NUTS 1	EU 27	<1919...>2000
Number of financial instruments in place supporting green building	NUTS 1	EU 27	2012
CO2 emissions per useful floor area	NUTS 1	EU 27	2011
Total residential energy consumption NUTS2 regions, corrected for heating degree days	NUTS 2	EU 27	2009
CO2 emissions from heat generation in the residential buildings	NUTS 2	EU 27	2008
Energy			
The energy sector's GVA and its activities in European countries	NUTS 1	EU 27	2009
The energy sector's GVA as a share of the GDP	NUTS 1	EU 27	2009
Change GVA in the energy sector in European countries 2002-2006	NUTS 1	EU 27	2000-2009
Number of persons employed in the energy sector and change in number of persons employed	NUTS 1	EU 27	2007; 2002-2006
Share of the energy sector in the total employment in European countries	NUTS 1	EU 27	2007
Productivity (GVA/employed person) in the energy sector and change in productivity	NUTS 1	EU 27	2009; 2000-2009
Value added at factor cost in the electricity, gas, steam and air conditioning supply sector in European countries	NUTS 1	EU 27	2009
Number of persons employed in the electricity, gas, steam and air conditioning supply sector in European countries	NUTS 1	EU 27	2009

and the sector's share of the total employment			
Productivity in the in electricity, gas, steam and air conditioning supply sector	NUTS 1	EU 27	2009
Relative regional labour importance of the electricity, gas, steam and air conditioning supply sector	NUTS 2	EU 27	2009
Share of the total regional GVA of the electricity gas, steam and air conditioning supply sector	NUTS 2	EU 27	2009
RES related gross economic and employment impacts in EU Member States	NUTS 1	EU 27	2005
Gross inland energy consumption by fuel in the EU27	EU total	EU 27	1990-2005
Gross inland energy consumption by fuel type	NUTS 1	EU 27	2010
Energy mix in the gross energy consumption in European countries	NUTS 1	EU 27	2010
Energy intensity of the economy	NUTS 1	EU 27	2010
Energy intensity of the economy	EU total	EU 27	2000-2010
Gross inland consumption of renewable energy	EU total	EU 27	1990-2010
Gross inland consumption of renewable energy	NUTS 1	EU 27	2010
Share of renewable energy in final energy consumption	NUTS 1	EU 27	2010
Gross inland consumption of biomass and renewable	NUTS 1	EU27	1990-2010
Achievement of 2020 targets in RE in gross final energy consumption and targets in RE in the transport sector	NUTS 1	EU 27	2010
Greenhouse gas emissions from the energy sector	NUTS 1	EU 27	2010
Sector's share in total greenhouse gas emissions in European countries	NUTS 1	EU 27	2010
CO2 emissions in the energy sector	NUTS 1	EU 27	2009
Green research and eco-innovation			
Share of Employment in eco-innovation related activities (% of total workforce)	NUTS 1	EU 27	2008
Governments environmental and energy R&D appropriations and outlays (% of GDP); percentage of change	NUTS 1	EU 27	2004, 2007, 2011; 2004-2011
Regions registered in the Smart Specialization Platform (S3 platform)	NUTS 2	EU 27	2012
Planned investment of Cohesion Policy in RTD, innovation, enterprise environment	NUTS 2	EU 27	2007-2013
Patents in selected environmental technologies; …and their share as a percentage of total patents 2010.	NUTS 2	EU 27	2010
Regional Innovation Scoreboard …and percentage of change	NUTS 2	EU 27 (except for Cyprus, Estonia, Latvia, Lithuania, Luxembourg and Malta)	2012; 2007-2011
Overall Eco-innovation Performance according to Eco-innovation scoreboard (Eco-IS); …percentage of change in Eco-innovation Performance	NUTS 1	EU 27 (except for Latvia)	2012; 2010-2012
Eco-innovation Scoreboard 2012: the overall index	NUTS 1	EU 27	2012
Manufacturing			
Share of Manufacturing GVA as percentage of total	EU total	EU 27	2000 and 2009
Manufacturing sector's GVA by country	NUTS 1	EU 27	2009
Manufacturing sector's change in GVA and employment by country and by sub-sector	NUTS 1	EU 27	2000 – 2009
Labour productivity in Manufacturing by country and by sub-sector	NUTS 1	EU 27	2000 and 2009
Environmental Protection Expenditure of Manufacturing as a whole	EU total	EU 27	2008 – 2010
Environmental Protection Expenditure of Manufacturing	NUTS 1	EU 27	2008 – 2010
Environmental protection expenditure by type of investment (pollution control and clean tech)	NUTS 1	EU27	2009

Environmental protection expenditure by environmental domain (air, waste, wastewater, other)	NUTS 1	EU27	2009
Decoupling of final energy consumption from GVA	EU total	EU 27	1990-2010
Delinking behaviour of each country in the period with regard to energy	NUTS 1	EU 27	2000-2009
Decoupling of waste generation from GVA	NUTS 1	EU 27	2004 - 2010
Manufacturing sector's change in waste generation by sub-sector	EU total	EU27	2004 - 2008
Transport			
GVA shares in manufacturing of motor vehicles, trailers and semi-trailers (C29)	NUTS 2	EU 27	2009
GVA shares of transport operation and storage (H)	NUTS 2	EU 27	2009
GVA shares of water transport (H 50)	NUTS 2	EU 27	2009
GVA shares of air transport (H 51)	NUTS 2	EU 27	2009
GVA shares of land transport (H 49)- land transport and transport via pipelines	NUTS 2	EU 27	2009
Employment shares in manufacturing of motor vehicles, trailers and semi-trailers (C29)	NUTS 2	EU 27	2009
Employment shares of transport operation and storage (H)	NUTS 2	EU 27	2009
Employment shares of land transport (H 49)	NUTS 2	EU 27	2009
Employment shares of water transport (H 50)	NUTS 2	EU 27	2009
Employment shares of air transport	NUTS 2	EU 27	2009
Employment shares of manufacturing of other transport equipment	NUTS 2	EU 27	2009
Production sites of automotive industry	NUTS 1	EU 27	2012
GVA shares of manufacturing of other transport equipment (C 30)	NUTS 1	EU 27	2009
Motorisation rate (passenger cars per 100 inhabitants)	NUTS 2	EU 27	2010
Transport development (passengers, goods and GDP)	EU total	EU 27	1995-2009
Tourism			
Forecasted growth of tourism until 2020	EU total		1950-2020
The predicted numbers for international tourist arrivals by European regions (based on numbers from the WTO 2020 vision).	EU regions: East-Mediterranean, Southern, Central Eastern, Western, Northern		1985-2020
Average per visitor day Carbon Footprint of staying visitors, day visitors, and residents in the South West of the UK compared to the UK 2050 target	U.K.		
Accommodation facilities labeled with the EU Flower	EU total	EU 27	
Natures Best – labeling of nature tours	NUTS 1	Sweden	
The Europarc certification	EU total	EU 27	up till 2013
Number of certified Pan Parks	EU total	EU 27	2013
Trends in number of trips, nights spent and average duration of the trips made by EU-27 residents	EU total	EU 27	2005-2011
Holiday trips made by EU residents, 2011 compared with 2010; by country	EU total; NUTS 1	EU 27	2010 and 2011
Share of holiday trips of EU residents by main means of accommodation	EU total	EU 27	2011
Number of nights spent in collective tourist accommodation	EU total	EU 27	2001-2011
The number of tourists overnight stays (domestic + international tourists) per	NUTS 2	EU 26	2001
Nights spent in hotels and similar establishments	EU total	EU 27	2000-2011

Outbound travels by EU27 residents in 2011 in percentage of trips, nights spent and expenditure on domestic, EU27 and non-EU27 countries	EU total	EU 27 and non-EU	2011
The social tourism intensity measured as tourists in % of total peak season population (residents + tourists)	NUTS 2	EU 24	2000
Number of bed places in hotels	NUTS 3	EU 27	2009
Nights spent in hotels and campsites	NUTS 2	EU 27	2009
The average & prime direction of tourism flows within the EU 25	NUTS 1	EU 25	2001
Breakdown of holidays by mode of transport used	NUTS 1	EU 25	1997, 2001
Breakdown of holidays by duration	NUTS 1	EU 25	2000, 2001
The collective tourist bed places by country, based on calculations in the SENSOR project	NUTS 1	EU 25	2004
Earnings and spendings on International tourism	NUTS 1	EU 27	2003
Employment in hotels, restaurants and catering category (HORECA) (in 1000)	NUTS 1	EU 25	2004
Share of employment in hotels, restaurants and catering category (HORECA) in the economy (%)	NUTS 1	EU 25	2006
Share of women employed in hotels, restaurants and catering category (HORECA) in the economy (%)	NUTS 1	EU 25	2006
Share of 15-34 year olds employed in the hotel, restaurant and catering category (HORECA) (%)	NUTS 1	EU 25	2006
The number of tourism bed places per square kilometre	NUTS 2	EU 25	2001
The peak population density (residents + tourists measured in bed capacity) per square kilometre	NUTS 2	EU 25	2000
The social tourism intensity measured as Tourists in % of total peak season population (residents + tourists)	NUTS 2	EU 25	2000
Predicted tourist bed densities from SENSOR-project	NUTS 2	> EU 25	2001
Nights spent in hotels and campsites, average annual change rate in %	NUTS 2	EU 27	2000-2006
Waste sector			
Total waste generation by country and by economic activity	NUTS 1	EU 27	2008
Total waste generation in the by source	EU total	EU, EFTA, Turkey and Croatia	2009
Generation of waste by economic activity (manufacturing, agriculture and forestry, construction and demolition, energy sector)	NUTS 1	EU 27	2008
Municipal waste generation and treatment, by type of treatment method (landfilling, composting, incineration)	NUTS 1	EU 27	2008
Percentage of municipal waste incinerated	NUTS 1	EU 27	1995 and 2007
Recycled amounts of waste, by waste type	EU total	EU 27	2006-2007
Total waste treatment by country and operation (energy recovery, incineration without energy recovery etc.)	NUTS 1	EU 27	2008
Development of municipal waste management (landfilled, recycled, composted, incinerated, other)	EU total	EU 27	1995-2010
Paper and board, metal packaging, plastic, glass, end-of-life vehicles, electrical and electronic equipment recycling rate	NUTS 1	EU 27	2008, 2011 - 2015
WEEE collection and recycling rate	NUTS 1	EEA countries	2011 (?)
Recycling of construction and demolition waste in % and tonnes per capita	NUTS 1	18 countries from EU 27	2005-2006
Amount of BMW recycled per capita	NUTS 1	21 countries from EU 27	2011 (?)
Water			
Employment index in water sector	EU total	EU 27	2003-2011
Employment, % of total employment	NUTS 1	EU 27	2009
Employment in water collection, treatment and supply sector	NUTS 1	EU 27	2000 and 2009

GVA of the Water sector	EU total and NUTS 1 for 2009	EU 27	1993 – 2011 and
Changes in GVA in the water collection, treatment and supply sector	NUTS 1	21 countries from EU 27	2000 – 2009
Change in labour productivity	NUTS 1	20 countries from EU 27	2000 – 2009
Groundwater and surface water abstraction	NUTS 1	EU 27	1999-2009
Freshwater resources per capita – long-term average	NUTS 1	EU 27	2009
Water Exploitation index, regional level	NUTS 1 or NUTS 2	EU 27	1996 – 2009 (various years for different countries)
Water productivity (GDP/m3 of abstracted water), water abstraction/capita and GDP/capita	NUTS 1	EU 27	
Water productivity (euro/m3) and water exploitation index (%) in EU river basins and river basin districts		EU 27 river basins	2007
Proportion of classified surface water bodies in different RBDs in less than good ecological status or potential		EU 27 surface water bodies	2012
Population connected to public water supply	NUTS 2	The majority of EU 27	
Population connected to waste water treatment	NUTS 2	The majority of EU 27	
Changes in wastewater treatment in regions of Europe between	north, central, south, east, south-east countries	EU 27	1990 - 2009

The following Sector Reports provide an overview of the different sectors assessed in GREECO project:

Volume 3.1. Sector Synthesis provides an overview of the different sectors assessed in GREECO project. The synthesis has been produced by Nordregio (Sweden)

Volume 3.2. Bio-economy - Subsector forestry and agriculture by Nordregio (Sweden)

Volume 3.3. Bio-economy - Subsector fisheries and aquiculture by Nordregio (Sweden)

Volume 3.4. Green building and construction by Nordregio (Sweden)

Volume 3.5. Green research and eco-innovation by TECNALIA Research & Innovation (Spain)

Volume 3.6. Manufacturing by TECNALIA Research & Innovation (Spain)

Volume 3.7. Renewable energy by Nordregio (Sweden)

Volume 3.8. Tourism by Nordregio (Sweden)

Volume 3.9. Transport by Spiekermann & Wegener - Urban and Regional Research (S&W) (Germany)

Volume 3.10. Waste management by Regional Environmental Center - REC (Hungary):

Volume 3.11. Water management by Regional Environmental Center - REC (Hungary):

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