GHK

In association with

Cambridge Econometrics

Institute for European Environmental Policy

Links between the environment, economy and jobs

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DG Environment

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PART A: INTRODUCTION AND SUMMARY OF RESULTS

1 ECONOMY-ENVIRONMENT LINKAGES

Man shapes himself through decisions that shape his environment.

Rene Dubos

Socialism failed because it couldn't tell the economic truth; capitalism may fail because it couldn't tell the ecological truth.

Lester Brown, Fortune Brainstorm Conference, 2006

The technologies which have had the most profound effects on human life are usually simple. A good example of a simple technology with profound historical consequences is hay. Nobody knows who invented hay, the idea of cutting grass in the autumn and storing it in large enough quantities to keep horses and cows alive through the winter. All we know is that the technology of hay was unknown to the Roman Empire but was known to every village of medieval Europe. Like many other crucially important technologies, hay emerged anonymously during the so-called Dark Ages. According to the Hay Theory of History, the invention of hay was the decisive event which moved the centre of gravity of urban civilization from the Mediterranean basin to Northern and Western Europe. The Roman Empire did not need hay because in a Mediterranean climate the grass grows well enough in winter for animals to graze. North of the Alps, great cities dependent on horses and oxen for motive power could not exist without hay. So it was hay that allowed populations to grow and civilizations to flourish among the forests of Northern Europe. Hay moved the greatness of Rome to Paris and London, and later to Berlin and Moscow and New York.

Freeman Dyson, Infinite in All Directions, Harper and Row, New York, 1988, p 135

1.1 The Purpose of the Study

The main purpose of the study has been to evaluate the economic significance of the environment in terms of European jobs, output (turnover) and GVA associated with the range of activities that make use of, or contribute to, environmental resources.

The European Commission recently issued a Working Document on ‘The links between employment policies and environment policies”, which set out the importance of the links between the environment and jobs. This document, and others, have recognised that the environment clearly acts as one input into the economy and, as such, supports a number of jobs and economic activity. However, whilst these links clearly exist, there have been relatively few statistical studies on such aspects.

Many of the studies that have been carried out have followed the OECD/Eurostat (1998) eco-industries classification[1]. Considerable effort has also gone into collecting expenditure statistics using the Eurostat definition of environmental protection expenditure. Closely linked to this definition, a number of studies have estimated the number of jobs supported by the ‘eco-industry’, which generally show that the eco-industries account for around 1 to 2% of GDP and a similar percentage of jobs in the economy.

Whilst studies based on the OECD/Eurostat definition have the virtue of having relatively clear statistical boundaries, they do not by any means include all jobs and economic activity dependent on the environment. In particular, by concentrating on prevention and treatment of pollution it excludes jobs for which the environment is a key input into the

[1] Please see Annex A for more details.

production process. These jobs and their associated economic activity may be considerable and include examples such as traditional tourism and agriculture that depend on the environment for their economic activities.

The purpose of this study has therefore been to examine a broader range of economic activities concerned with the environment. The study included three types of environment-economic activities:

1. Activities where the environment is a **primary natural resource** or input into the economic process – Agriculture, forestry, mining, electricity generation and water supply
2. Activities concerned with **protection and management** of the environment – Waste recycling, pollution & sewage control, environmental management[2]
3. Activities dependent on **environmental quality** – Environment related tourism

The purpose of the study was also to assess direct **and indirect** effects on the economy. In addition to the direct economic impacts of environment related activities the study has quantified the value of economic linkages between the direct economic activities dependent on the environment and the general economy. Input-output tables for each Member State (MS) have been used to estimate the indirect and hence **total economic impacts** of defined activities that are linked with the use of, or improvement in, environmental resources. The main results of this analysis are presented in Part B of the report.

The study has also considered the linkages between environmental policy and the economy, by examining selected examples of policy intervention directed to improved resource efficiency (e.g. water, energy, waste) and assessing the direct and indirect economic impacts. Policy scenarios are described as the basis for defining and estimating the scale of potential economic impacts. The results of this analysis are presented in Part C of the report.

Finally, in recognition that there remain a number of significant environment related economic activities that can not be fully quantified, Part D of the report describes a number of linkages not contained in the fully quantified analysis in Part B.

1.2 The Nature of Environment- Economy Linkages

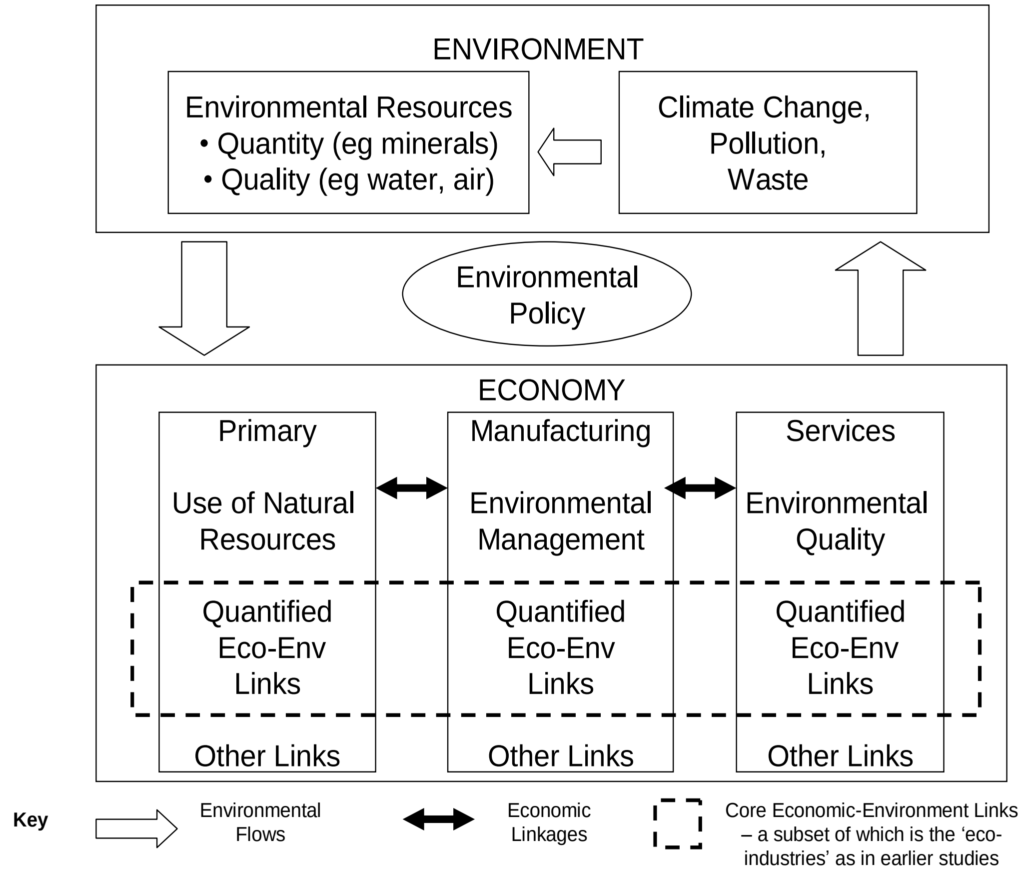
The size and structure of the economy is fundamentally shaped by the environment. This is true for a local or national economy as much as for the global economy. Economic activity in turn changes the environment through the use of resources and generation of pollution and wastes (Figure 1.1). At one level the economic significance of the environment can be measured by the size of the economy.

However, to manage the relationship between the economy and the environment such that the overall stock of natural capital is not depleted over time has short-term adjustment costs for the economy, even if they are necessary for sustainable development. These costs do however have compensating benefits in the form of eco-industries that provide goods and services that enable environmental management. Furthermore the value of economic activities that make direct use of environmental resources (such as agriculture, energy or tourism) provides a first indication of the economic importance of continuing to work to maintain the quantity and quality of environmental resources.

[2] OECD/Eurostat (1998) Eco-industries definition. We have relocated renewable energy under primary resources

This study seeks to quantify the value of economic activities that directly use and manage environmental resources.

Figure 1.1: A General Framework of Economy Environment Linkages



These economic activities that are directly associated with the use and management of environmental resources also have 'knock-on' (so called 'multiplier') effects on the rest of the economy. For example, spending on pollution control generates a demand for components, which in turn generates a demand for raw materials. These knock-on effects can be calculated based on input-output tables that show the inputs that each industry needs to produce its own output. The multiplier effects which are based on these economic linkages capture the economic value generated by the direct use and management of the environment as it affects the rest of the economy, i.e. the indirect effect.

To better understand the inter-linkages between the economy and the environment Table 1.1 provides an illustration of linkages associated with the use and management of environmental resources, (including that associated with the quality as well as the quantity of environmental resources) for the three main sections of the economy (primary, manufacturing, services).

As a first approximation, the use of natural resources is most obviously reflected in the primary sector, although there are clear uses in other sectors. The need for strong environmental management and the generation of demand for environmental management products is generally associated with manufacturing industries, although other activities also have a requirement for environmental management. The economic value of the maintenance and enhancement of environmental quality is perhaps most easily understood in terms of tourism activities, but is obviously integral to all aspects of economic behaviour (and debated for example in terms of the attraction of inward investment).

Table 1.1: Examples of Directly Observable / Measurable Environment – Economy Linkages

	Environmental Resources		
Economy	**Use of Natural Resources**	**Environmental Management**	**Environmental Quality**
Primary	Sunlight, water, soil, minerals for energy, agriculture	Mining, energy sector pollution control & waste management	Organic farming, sustainable forestry, rehabilitation of quarries
Manufacturing	Water, minerals for industrial production	Industrial pollution control & waste management	
Services	Tourism related use of water	Waste and resource management / nature protection	Environmentally related tourism, natural risk management

1.3 From Eco-Industries to Environment Related Economic Activities

As Figure 1.1 indicates, there have been previous attempts to define those economic activities that owe their existence to environmental policy and the maintenance of natural capital. This has traditionally been based on estimates of pollution control and waste management expenditure, or market assessments of the value of relevant products. These so called 'eco-industries' have been defined as the basis of previous studies using a typology produced by the OECD and Eurostat. This typology has formed the basis of previous studies (which are discussed further below). It has also been subject to occasional revision, as other activities that are considered to exist because of environmental policy, are identified, including for example renewable energy.

However, whilst it is clear that these eco-industries are defined on the basis that they exist because of environmental policy and the need for environmental management, it is also clear that as a measure of the economic significance of the environment they are too limited. However, since measurement is based on typology; and the typology is a matter of judgement as to what constitutes an environment related economic activity, it is sensible to use a range of definitions and associated estimates, and allow the user to select the appropriate definition and related measure.

The European Commission have previously produced two reports[3] describing 'eco-industries' activities i.e. economic activities that produce goods and services to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This definition refers mainly to pollution control and resource management. It excludes economic activities that depend on environmental resources and quality and without which the economy

[3] Analysis of the EU Eco-industries, their employment and export potential," Ecotec, 2002 and Study on Eco-industry, its size, employment, perspectives and barriers to growth in an enlarged EU final report, August 2006, Ernst &Young.

would be smaller. The studies also focus mainly on the direct value added and employment associated with these activities, and exclude any systematic assessment of the indirect and induced economic consequences of these activities.

The overall approach to the study has been to build on these previous studies but to extend the coverage of economic activities included in the analysis, and to deepen the analysis to include a systematic assessment of the indirect and induced (multiplier) effects of these activities.

We have therefore used an extended typology of linkages between the economy and the environment (Section 1.4 below) and sought to measure the economic activities as part of the system of national accounts and which are taken into account when measuring levels and changes in GDP. These impacts may relate to the use of environmental resource in economic production, or to the economic activities undertaken to protect the environment.

This study is based on a description of the economy based on the sectors and sectoral linkages as defined in input-output tables[4]. Combining definitions of the relevant activities with input-output tables for each of the EU-27 enables the measurement of the direct and indirect impact of environment related activities on the economy.

Other forms of study have examined the external costs of environmental pollution, the monetary value of biodiversity services or the willingness to pay for environmental improvements. These studies can be used to supplement the results of this study.

1.4 A New Typology of Linkages

The general consideration of economy – environment linkages, including the various drivers for environmentally related economic activities, reference to available literature and examination of the sectoral definitions used as the basis of national accounts establishes the basis of a comprehensive and operational typology of environment - economy links. The typology has two levels: a high level of three broad classes and a low level comprising sub-divisions of the three classes into more specific linkages.

The high level typology distinguishes between:

1. the environment as a resource input to economic activity;
2. economic activities related to the management of the environment (including environment protection and resource management)
3. economic activities dependent on environmental quality

These three classes can be further broken down (Table 1.2) to describe a full set of economy-environment links. This includes linkages which might be contested as being too broad, but which are relevant to a comprehensive description of linkages. We have also outlined the main economic sectors / sub-sectors and activity and products associated with each linkage and compared the linkages with those covered in previous studies.

[4] Please see Annex C for more details on Input-Output tables

Table 1.2: Environment-Economy linkages

	Main heading	Linkages	Environment related (sector / subsector / products / activity)	CORE OECD/Eurostat classification	Ecotec Report	E&Y Report
1	**Econ based on Natural resources (Non renew.)**	Natural resource based activities – non-renewable natural resources	Energy (coal, oil, gas), mining & quarrying (minerals)		No	No
2	**Econ based on Natural resources (Renew.)**	Natural resource based activities – renewable resources	Agriculture, timber, fisheries, renewables, water supply, pharma (natural drugs)	Water supply and renewables	Only water supply	Water supply and renewables
3	**Econ based on Natural resources (EcoSP)**	Ecologically sustainable production	Organic farming, Sustainable forestry, sustainable fisheries, biofuels; subset of '2'	Sustainable agri, fisheries and forestry	No	No
4	**Environmental Management (EM)**	Greening of the general economy - process and appliance and building efficiency	Energy efficiency in appliances, process efficiencies		No	No
5	**Environmental Management (PCM)**	Historically core Eco-industries – pollution control expenditure	SWM (inc direct recycling), WWT, APC, GPA, PEM, RCS, NVC, ERD & EMI	All	**Yes**	**Yes**
6	**Environmental Management (RM)**	History core- eco-industries – natural resource management	Recycled Materials, Nature protection / conservation, natural risk mgmt.	All	Recyled materials and nature protection	Recyled materials, nature protection & eco-construction
7	**Environmental Management (GP)**	Green products - green procurement	Eco-labels, sustainable construction (eg passive houses inc. heat/energy saving and mgmt), Zero Emission Vehicles, ethical investment funds	only indoor air pollution control & heat/energy saving & mgmt	No	No
8	**Environmental Quality (EQ)**	Economic activities dependent on environmental quality	Tourism; recreation; livelihood; culture value and identity, health		No	No
9	**Environmental Quality (ERT)**	Economic activities dependent on environmental quality - subset	Env. Related Tourism (ERT), inward investment, house prices; subset of 8	eco-tourism	No	No
10	**Environmental Quality (NRM)**	Natural risk management (NRM) - Avalanches, droughts, floods, fire, earthquakes, etc	Residual not captured in 6 - Insurance, protection of assets, rebuilding		No	No

contested definition of environment
covered by Eurostat/OECD eco-industry definition
linkages documented in the literature for explicit env-eco activities

We summarise the nature of the economic activities, under each of the three high level classes.

We also provide a review of the relationship between each of the 10 environment-economy linkages and each of the drivers in Annex B.

1.4.1 Activities where the environment is a primary resource or input into the economic process

There are three types of environment-economy linkage under this definition of environment related economic activities:

a) Natural resource based activities – non-renewable natural resources - These activities are based on the use of non-renewable resources such as fossil fuels, metals and minerals.

b) Natural resource based activities – renewable resources – activities include agriculture, timber, fisheries, renewables, water supply, biodiversity based resources for pharmaceuticals (natural drugs).

c) Ecologically sustainable production – this is a subset of the above natural resource based activities and include organic farming, sustainable forestry, and renewable energy.

We have also disaggregated the core environmental activities from the broader sector. The core sectors as given in Table 1.2 are consistent with the OECD/Eurostat environmental goods and services industry definition[5] shown by the grey cells, but are a subset of the broader sector.

Table 1.3: Broad and Core Sector for Activities Where the Environment is a Primary Resource

Broad sector	Core sector
Agriculture	Sustainable agriculture (organic farming)
Forestry	Sustainable forestry (certified forests)
Fishing (except recreation, which is covered under tourism)	No core sector (but might include sustainable fisheries in future analysis)
Mining and quarrying	No core sector
Electricity generation	Renewables
Water	Water extraction and supply

Core sector: Sustainable agriculture (organic farming)

Organic farming as a sub-set of agriculture has become an important aspect of European agri-environmental policy. Since the implementation of EC Reg. 2078/92, the EU promotes organic farming based explicitly on its positive effects to the environment. Recent reports and studies have highlighted the positive impacts of organic farming on both the environment, in the form of quality of the soil, ecosystem, ground and surface water and on the economy, in terms of greater employment and business diversification[6].

Core sector: Sustainable forestry (certified forests)

Forestry is further split into sustainable forests, defined as forests certified by third party institutions[7]. Certified forest products (CFPs) have received attention from Governments in new procurement policies for wood and paper products, which aim to ensure that purchases come from sustainable, managed legal sources. Independent, third-party certification for environmentally and socially sustainable management of forests has led to vital, measurable improvements in the protection of forests, wildlife, and stakeholder rights worldwide as well as to the long-term economic viability of forestry operations[8]

[5] The complete environmental goods and services industry classification is provided in Annex A

[6] FAO, UN (1999), UK Soil Association (2006) and Offermann and Nieberg (20000

[7] Such as FSC (Forest Stewardship Council), PEFC (Programme for the Endorsement of Forest Certification Schemes), CSA (Canadian Standards Association system (endorsed by PEFC in 2005), SFI (Sustainable Forestry Initiative (endorsed by PEFC in 2005) and ATFS (American Tree Farm System)

[8] UNECE/FAO, 2005-2006, Forest Products Annual Market Review

Core sector: Renewable energy

A sub-set of the electricity generation sector is the electricity produced from renewable energy sources (RES). Policy objectives are driven by Directive 2001/77/EC for the promotion of electrical energy production from RES and Directive 2003/54/EC which seeks to increase capacity for production of heat and electricity from RES and the replacement of fossil fuels and to decrease the load on the environment.

1.4.2 Activities concerned with management of the environment

There are four types of environment-economy links under this definition of environment related economic activities.

a) Greening of the general economy - process and appliance and building efficiency – this includes technical change in production processes and products to use less energy and produce fewer emissions, including modern construction practices in buildings to reduce carbon and energy footprints.

b) Pollution control and management activities, usually defined by the levels of expenditure made on the goods and services produced (Table 1.4). These have formed part of the formal definition of eco-industries.

Table 1.4: Pollution Control and Management[9]

Solid Waste Management & Recycling (SWM)
Waste Water Treatment (WWT)
Air Pollution Control (APC)
General Public Administration (GPA)
Private Environmental Management (PEM)
Remediation & Clean Up of Soil & Groundwater (RCSG)
Noise & Vibration Control (NVC)
Environmental Research & Development (ERD)
Environmental Monitoring & Instrumentation (EMI)

c) Natural resource management, again usually measured by levels of expenditure and included in the formal definition of eco-industries (Table 1.15).

Table 1.5: Resource management[10]

Recycled materials
Natural risk management
Nature protection/conservation (inc. activities for preventing impact of natural disasters)
Eco construction
Eco-tourism

d) Green products - green procurement – this definition includes products with eco-labels, sustainable construction such as zero carbon residential and commercial

[9] [10] See Annex A2 for definition of these activities. This is the same definition as used in the DG Environment report “Analysis of the EU Eco-industries, their employment and export potential,” Ecotec, 2002 and “Study on Eco-industry, its size, employment, perspectives and barriers to growth in an enlarged EU final report, August 2006, E&Y.

developments (includes passive houses/buildings and heat/energy saving and management), Zero Emission Vehicles (ZEVs), ethical banking and investment funds.

1.4.3 Activities dependent on environmental quality

There are two types of environment-economy linkages under this definition of environment related economic activities.

- Economic activities dependent on environmental quality – environmental quality affects economic activities such as tourism and recreation, and provides cultural identity and health benefits. Environmental quality can affect activities defined in a number of other sectors. Specific linkages include:
  - Environment related tourism (ERT), defined as activities where the natural environment (not the built environment) is responsible for influencing the choice of destination for the tourism activity. This includes:
    - Visits to hills, mountains, hills, coasts, farmland, woods, forests, springs, lakes and wildlife
    - Activities: fishing (sea, game and coarse), walking, climbing, golfing, skiing, cycling, bathing/swimming, etc.
  - Recreation (reflected in health costs/savings) involving exercise/health benefits attributed to the natural environment (parks, air quality, clean drinking & bathing water)
  - Inward investment, defined as the attraction of new businesses into an area where the quality of the environment is a major determining factor in the investment decision.
  - House-building in response to higher house prices that are affected by the quality of the environment. Green spaces, less noise and pleasant views all add a premium to house prices.
- Natural risk management (NRM) – this extends the natural resource management definition in Table 1.5 and includes insurance services to safeguard against natural disasters (avalanches, droughts, floods, fire, coastal erosion, earthquakes and tsunamis), additional expenditure on environmental (esp. flood) protection of immovable assets and costs of rebuilding after the occurrence of natural disasters.

1.5 Approach to the Quantification of Economic Impacts

Having established the typology and the related economic sectors, using the sectoral definitions contained within the national input-output tables, the work required allocation of the previous eco-industry analysis to the appropriate activities (see Table 1.2) and then the calculation of the indirect and induced impacts.

The input-output tables allow the estimation of the economic consequences, or knock-on effects, of environment related activities by tracing impacts through supply chains and income effects. These supply and income effects are captured by 'multipliers'. These indicate the ratio of knock-on effects on the rest of the economy, to the direct impact.

Knock-on effects arise as a result of the purchases made (indirect effects) and the spending by those in receipt of incomes (induced effects) paid by the defined economic activities and their suppliers. A detailed description of the use of input-output tables and Type I (indirect) and Type II (indirect and induced) multipliers is provided in Annex C.

The approach to quantification has also made use of the E3ME economic model developed by Cambridge Econometrics, which allows the available input-output (I-O) tables to be integrated with data on the national economies of the EU to allow the I-O links to be related to the size of national and the EU economy. It also enables the manipulation of the I-O tables in order to assess the economic impact of policy scenarios.

The calculation of multipliers provides a useful tool for policy makers, because it provides a 'ready reckoner' to calculate the economic impacts of a policy proposal, where the direct impacts can be approximately estimated such as the additional investment cost, or a change in prices or quantities (e.g. of a given resource) attributable to the policy intervention.

To test this tool, we have examined the economic impact of selected policy scenarios – using conventional impact assessment methods, i.e. defining a policy intervention and estimating the total economic impact (i.e. including multiplier effects). The tool can also be used to take into account other issues such as economic displacement, as the basis of estimates of the net additional economic impact.

1.6 Structure of the Report

The next section (2.0) provides an overall summary of the findings of the study.

Detailed analysis and results are contained in the rest of the report, and are structured into three parts:

- Part B – presents the detailed results of the quantification of the economic significance of environment related activities. This is presented for each of the linkages defined in the expanded typology, and includes both the direct and indirect impacts.
- Part C – presents selected policy scenarios relevant to current environmental policy debates and provides an indicative economic impact assessment of each scenario, using the input-output framework used to quantify the linkages in Part B. These impact assessments are themselves quite basic, but they are intended to demonstrate the importance of indirect impacts and hence the value of the analytical framework developed for the study
- Part D – presents a number of other economy-environment linkages which, because of their character and the difficulty of capturing their significance in quantitative terms can not be fully captured in the analyses used in Part B. These includes analysis of the significance of bio-diversity and related eco-systems for economic activity and specific economic sectors.

A number of Annexes present further detail and explanation of the approaches taken and provide more detailed results. These are presented in a separate report.

2 SUMMARY OF RESULTS

2.1 Economic Significance of Environment Related Activities

This study builds on two eco-industry reports for DG Environment - 'Analysis of the EU Eco-Industries, their Employment and Export Potential' (2002) by ECOTEC and more recently a Study on Eco-industry, its size, employment, perspectives and barriers to growth in an enlarged EU' (2006) by Ernst & Young. Both reports measured jobs and output in environment related sectors defined partly by the OECD/Eurostat Eco-industry sectors (See Annex A for more details on the OECD/Eurostat Eco-industry definition).

This study expands the previous economic assessments (Table 2.1), by extending the range of activities and using input-output tables to deepen the economic analysis of indirect impacts. It also includes for the first time induced impacts of direct environment related economic activities.

Table 2.1: Comparison of Related Studies

	Definition of Environment related activities	Direct impact (jobs & output)	Indirect impact (jobs and output)	Induced impact (jobs & output)
ECOTEC report	OECD/Eurostat Eco-industries	✓	✓ only jobs	✕
E&Y report	OECD/Eurostat Eco-industries[a]	✓	✓ only jobs	✕
GHK, CE & IEEP report	OECD/Eurostat Eco-industries & Additional	✓	✓	✓

Notes: [a] The definition of the eco-industry sector differ from the ECOTEC (2002) study and Eurostat in the following respects: renewable energy production and eco-construction have been added as new resource management categories and the general public administration and private environmental management categories correspond to items in "other secondary domains" in the environmental expenditures data from Eurostat

The findings of this study can be compared to the E&Y report based on the OECD/Eurostat eco-industries definition. Figure 2.1a and Figure 2.1b chart the various developments included in this study compared to the E&Y report.

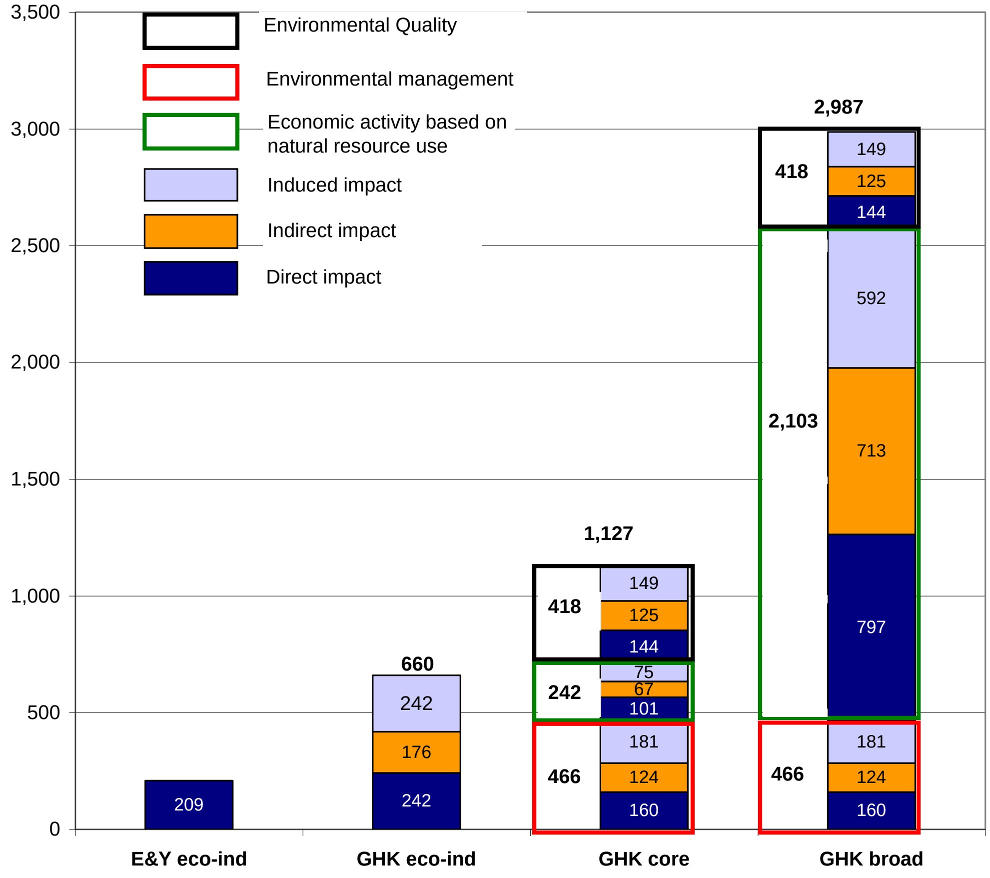
The direct output using the eco-industry definition in Figure 2.1a is more or less the same, allowing for geographic coverage and filling missing data for renewable output from the E&Y study. The GHK study has also calculated the induced impact of jobs and output for the eco-industries sector, which adds approximately €400 billion of output and 1.6 million more jobs.

Extending the range of environment-economic activities to include core[11] and broad[12] natural resource based activities gives rise to additional jobs and output.

[11] Organic farming, sustainable forestry, renewable electricity and water supply.

[12] Agriculture, forestry, fishing, mining and quarrying, renewable and non-renewable energy and water extracting and supply.

Figure 2.1a Output by environment related economic activity, € billion (2000 prices)

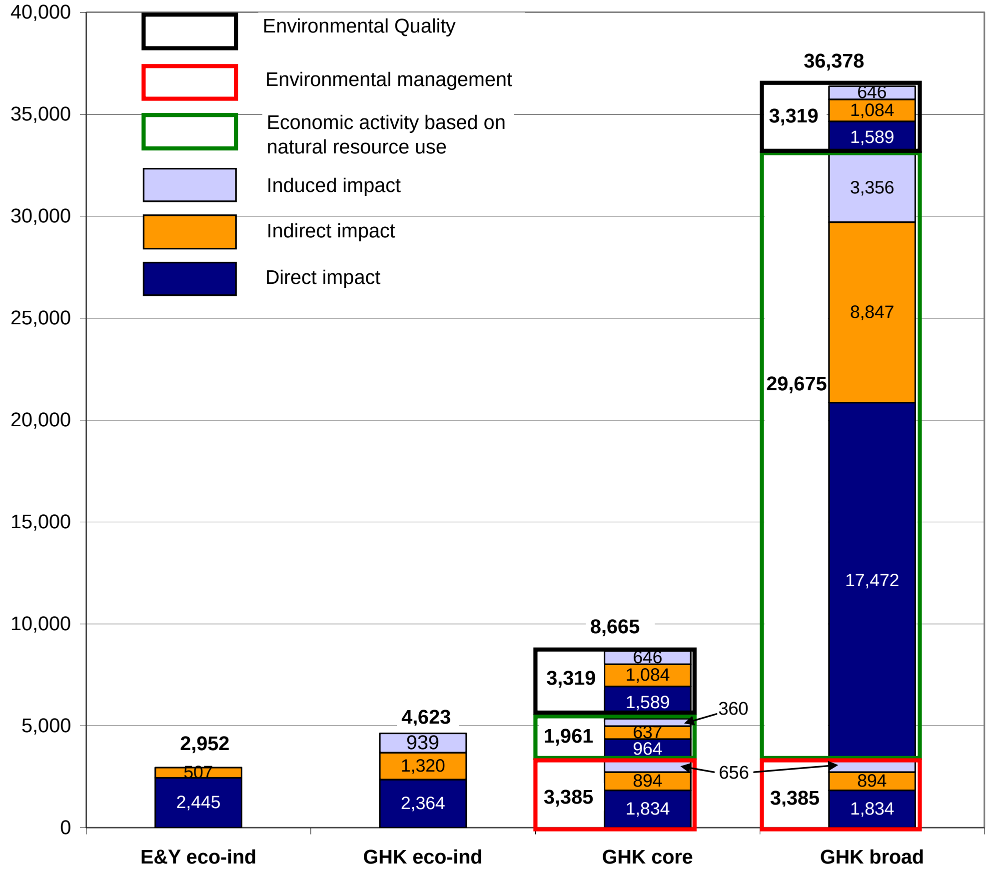


Notes:

E&Y eco-ind.	Output estimate is based on eco-industry turnover in pollution management and resource management sectors for EU-25 from the Eurostat New Cronos database. There were missing data mainly for renewable energy. Indirect impact was not calculated.
GHK et. al eco-ind.	Output estimate is based on eco-industry turnover as defined in the E&Y report. The estimates of direct output include data for Bulgaria and Romania (EU-27) and estimates for the previously missing data using E3ME model. Indirect and induced impacts were also included using the E3ME model.
GHK core	The range of environment-economic activities was expanded to include core natural resource based activities (organic farming and sustainable forestry). In addition environment related tourism was included. Renewable energy and water supply have been reclassified as core natural resource based activities.
GHK broad	The range of environment-economic activities was further expanded to include all natural resource based activities (all forms of farming, forestry, fishing renewable and non-renewable energy, mining and quarrying and water extraction and supply).

Figure 2.1b provides estimates for employment in environment related activities based on the OECD/Eurostat eco-industries definition.

Figure 2.1b Employment by environment related economic activity, FTE '000s (2000)



Notes:

E&Y eco-ind.	Direct employment was estimated using wage rates and labour cost shares of total expenditure. Indirect employment was estimated by other expenses (mostly operating expenditure) that stimulate employment in sectors that provide intermediate inputs to eco-industries.[13]
GHK et. al eco-ind.	Direct employment was estimated using data from E&Y report. The estimates of direct jobs include data for Bulgaria and Romania (EU-27) and estimates for the previously missing data using E3ME employment/output ratios. Indirect and induced impacts were also included using the E3ME model.
GHK core	The range of environment-economic activities was expanded to include core natural resource based activities (organic farming and sustainable

[13] Employment estimates were calculated using the engineering analysis method from the Ecotec report (2002) engineering analysis. No new modelling assumptions were made.

	forestry). In addition environment related tourism was included. Renewable energy and water supply have been reclassified as core natural resource based activities.
GHK broad	Jobs from environment-economic activities was further expanded to include broad natural resource based activities (all forms of farming, forestry, fishing renewable and non-renewable energy, mining and quarrying and water extraction and supply).

2.2 Sectoral Importance of Environment Related Activities

The importance of environment related activities varies between economic sectors. The analysis at sectoral level has been undertaken as the basis of the aggregate results above using input-output analysis. The sectoral significance is shown in Table 2.2 for each of the 46 industrial sectors used in the E3ME model. The table also includes an attempt to capture the significance of biodiversity related activities for economic sectors, and the possible significance of 'Green' public procurement (GPP) (and elaborated in Part D).

The table clearly shows that the environment plays a key role or a growing role in most industrial sectors of the economy.

Table 2.2: Economic Significance of Environment Related Activity, by Sector

	E3ME Industry Name	NACE Categories	Share of environment related output	Share of environment related employment	Biodiversity & eco-system services**	Green Public Procurement
			(From Part B		(from Part D)	
1	Organic Agriculture	1	100%	100%	>50%	Yes
2	Other Agriculture (in broad definition)	1	100%	100%	>50%	Yes
3	Sustainable Forestry	2	100%	100%	>50%	Yes
4	Other Forestry	2	100%	100%	>50%	Yes
5	Fishing	5	100%	100%	>50%	Yes
6	Coal	10	100%	100%	<1% or >50%*	
7	Oil & Gas etc	11,12	100%	100%	<1 or >50%*	
8	Other Mining	13,14	100%	100%	<1%	
9	Food, Drink & Tobacco	15,16	0%	0%	>50%	Yes
10	Textiles, Clothing & Leather	17,18,19	0%	0%	<25%	Yes
11	Wood & Paper	20,21	0%	0%	>50%	Yes
12	Printing & Publishing	22	0%	0%	<1%	
13	Manufactured Fuels	23	0%	0%	<25% growing	
14	Pharmaceuticals	24.4	0%	0%	<25% growing	Yes
15	Chemicals nes	24(ex24.4)	0%	0%	<25% growing	Yes
16	Rubber & Plastics	25	0%	0%	<5% growing	Yes
17	Non-Metallic Mineral Products	26	0%	0%	<5%	
18	Basic Metals	27	0%	0%	<1%	
19	Metal Goods	28	0%	0%		
20	Mechanical Engineering	29	0%	0%		
21	Electronics	30,32	0%	0%		Yes
22	Electrical Engineering & Instruments	31,33	5%	2%		Yes
23	Motor Vehicles	34	0%	0%		Yes
24	Other Transport Equipment	35	0%	0%		
25	Manufacturing nes	36,37	13%	10%		

	E3ME Industry Name	NACE Categories	Share of environment related output	Share of environment related employment	Biodiversity & eco-system services**	Green Public Procurement
			(From Part B)		(from Part D)	
26	Renewable electricity	40.1	100%	100%	>50%	Yes
27	Non-renewable electricity	40.1	100%	100%	<5%	Yes
28	Gas Supply	40.2,40.3	0%	0%	<1%	
29	Water Supply	41	100%	100%	>50%	Yes
30	Construction	45	0%	0%	<5%	Yes
31	Distribution	50,51	0%	0%	<1%	
32	Retailing	52	0%	0%	<5%	
33	Hotels & Catering	55	12%	7%	<25%	Yes
34	Land Transport etc	60,63	7%	7%	<1%	Yes
35	Water Transport	61	10%	25%	<5%	
36	Air Transport	62	19%	25%	<1%	
37	Communications	64	0%	0%	<1%	
38	Banking & Finance	65,67	0%	0%	<1%	Yes
39	Insurance	66	0%	0%	<25%	
40	Computing Services	72	0%	0%	<1%	
41	Professional Services	70,71,73,74.1 -74.4	0%	0%	<5%	
42	Other Business Services (inc. environment related services)	74.5-74.8	0.5%	0.7%	<1%	
43	Public Administration & Defence	75	1%	1%	<5% growing	Yes
44	Education	80	0%	0%	<5%	
45	Health & Social Work	85	0%	0%	<5%	
46	Miscellaneous Services*	90 to 93,95,99	19%	13%	<25%	Yes
	Total		**7%**	**10%**		

Note: Miscellaneous services include collection and treatment of waste/sewage, recreation, culture, nature reserve activities, sports, etc.

* coal, oil and gas are shown as being '<1% or >50%'. These industries build on fossil fuels, which come originally from biodiversity (plants and animals). They are therefore arguable very significantly linked to the environment (hence the '>50%) though the link is in past geological times and hence less obvious today (hence the '<1%')

** The importance of the link between the sector and the environment is presented to show the level of significance. '>50%' underlines that most of the activity in the sector is related to the environment. Where the link is significant and substantial, but not determining the nature of the sector, the value of '<25%' is used. Where there is occasional, or local significance (for example for a discrete set of applications in the sector), but that this remains focused, the value of '<5%' is used. Where there is little importance at all, '<1%' is used. The numbers should be seen as indicators of significance rather than as empirical analysis based results; they relate more to expert judgment by the team, backed up by some analysis of the sectors by a short literature review. The Terms of Reference did not ask that such an analysis be done, but the team considered it useful to clarify the links and effectively clarify a possible future area for analysis.

In terms of the analysis of the three broad classes of environment related activities at the sectoral level, primary industries are wholly classified to environment related activities. The significance for manufacturing industries varies and largely reflects the activities associated with pollution control, whilst the service sectors reflect the importance of environment related tourism.

In the case of bio-diversity the importance of the link between environment and economic activities was assessed more qualitatively. One-third of all industrial sectors have significant environmental links in terms of biodiversity and eco-system services and GPP[14].

2.3 Economic Impacts of Selected Policy Scenarios

The analysis of selected policy scenarios provided an opportunity to examine the economic impacts of some key environmental policy options using the I-O framework in the E3ME model developed for the quantification of environment-economy linkages; and especially to examine the indirect effects of suggested policy changes.

Whilst the scenarios are fairly simple and the economic assessment only indicative nevertheless they indicate that whilst direct effects of policy options may be neutral or small (reflecting quite often the substitution from 'less green' to 'greener' options), the indirect effects are often much larger and generally indicate that the EU economy would gain, especially in employment terms, from the introduction of environmental polices that change current production systems. This is true for policies that would encourage the switch to organic agriculture, renewable energy and resource efficient technologies (Table 2.3).

Table 2.3: The Economic Impacts of Selected Policy Scenarios

Policy Scenario	Net Direct Impact		Net Indirect Impact		Total Net Impact	
	Output (€ m)	Jobs (FTE)	Output (€ m)	Jobs (FTE)	Output (€ m)	Jobs (FTE)
A switch of 10% by value in raw material inputs to the steel sector from virgin materials to recycled materials	0	1,900	200	1,800	200	3,600

[14] Industrial sectors with scores of over 25%, in terms of importance of biodiversity and eco-system services for inputs and/or sector activity. Linking GPP to main industrial sectors, to derive a broad sense of which sectors have the most potential to be affected by GPP.

Policy Scenario	Net Direct Impact		Net Indirect Impact		Total Net Impact	
	Output (€ m)	Jobs (FTE)	Output (€ m)	Jobs (FTE)	Output (€ m)	Jobs (FTE)
A switch of 10% by value from conventional to organic agricultural production	0	66,000	550	-22,200	550	43,800
A saving of 10% by value of water, invested in water saving technologies	0	700	980	4,800	980	5,500
A saving of 10% by value of energy, invested in energy efficient technologies	0	122,200	480	14,600	480	137,200
A switch of 10% by value to biofuels from conventional transport fuels	0	108,100	1,500	31,400	1,500	139,500
A switch of 10% by value to renewables from conventional electricity generation	0	0	8,610	58,200	8,610	58,200

Note: Totals may not sum due to rounding

The analysis has also begun to consider the effects of policies that although designed to mover to 'greener' options have the effect of raising prices (for example in relation to the use of renewables or the switch to energy saving technologies). Whilst the study has not been able to examine the effects of these price rises (requiring considerably greater modelling than is available within this study) the scenarios allow some indication of the scale of negative economic impacts of higher prices that would be needed were they to outweigh the positive effects of the policy.

The policy scenarios are also able to allow some examination of the types of energy fuel price rises necessary to reduce the carbon intensity of production, when combined with available price elasticities. Two scenarios have been examined. The first considered the price rise necessary to reduce carbon intensity by 1%. This was estimated to be approximately 8% using short-run fuel elasticities and 2.7% using long-run fuel elastcities. The second compared the reduction on carbon intensity from changes in demand of different fuels due to a 10% increase in individual fuel prices. This indicated that price changes in motor spirits had the greatest capacity to reduce carbon intensity.

Finally the scenarios allow, through the multipliers implicit within the I-O framework, analysis of the multiplier effects of environmental investment. The scenario examined the multiplier effects of investment using structural funds to invest in water and waste management infrastructure. This found that employment multipliers were in the order of 1.8 (i.e. the total impact is 1.8 times the direct impact) and the output multiplier was 2.4.

These scenarios are discussed in more detail in Part C.

2.4 The Changing Economic Significance of Environment Related Activities

The quantification of the economic significance of environment related activities in this study is arguably, within a given typology of activities, likely to under-estimate the economic value associated with the linkages. This is because:

- There is often an important non-payment for services and hence implicit subsidies to the economy. Resources can be under priced as can services (e.g. high value biodiversity). This suggests that national accounts (and hence GDP values), and input-output models do not take full account of environmental resource values.
- There is not full resource pricing. There is a need to move to greater use of resource pricing to help build the value of the resource into economic decision making and make the market work more efficiently.
- Inadequate payments for environmental services. In recent years, the recognition of environmental services and their value has led to efforts to internalise environmental services in the functioning of markets through direct payments for environmental services (PES). The idea of PES consists of beneficiaries of ecosystem services making direct, contractual and conditional payments to local landholders and users providing the services, e.g. farmers sustainably managing the landscapes or beekeepers / honey producers for pollination of crops etc. Existing examples on the use of PES suggest that such payments can be a promising tool for internalising the values of biodiversity and related ecosystem services into different economic sectors. However, despite the benefits PES should not be considered as a “standard fix” to all situations.
- There is often no liability for negative impacts and hence the price signals in the market do not do fully reflect the cost implications of inappropriate resource allocations or loss of undervalued resources or services. There is clearly scope for better application of EIA and liability rules
- There are many economy-economy trade-offs that arise via the interlinkages to biodiversity and ecosystem services. This suggests decision making needs upgrading and that opportunities for greater use of strategic environment assessments (SEAs) and impact assessment to take into account issues not picked up by market prices be taken.

It is to be expected that the interlinkages between the economy and the environment will change. There are, for example, growth areas – biofuels, bioplastics and biochemicals, which will increase the economic value of environment related activities. There is also an ongoing loss of genetic materials and hence primary genetic materials for biochemicals, medicines, food crops that might reduce opportunities for development in the future.

2.5 Further developments – next steps

The study has provided some interesting insights regarding the links between the environment and economy. Quantifying the links in monetary terms is limited by data availability. We also discussed the importance of biodiversity and eco-system services. We were unable to quantify these services due to the non-existence of market values for these services. Moreover, we have only looked at the economic impact of environmental activities and it will be worthwhile to also consider the environmental impact of economic activities. We have suggested some tasks below as possible next steps to further develop this study.

2.5.1 *Refining the policy scenarios*

The policy scenarios provided useful indications for looking at the impact of some 'what if' scenarios. The substitution from 'less green' to 'greener' options showed positive benefits to the EU economy. This was mainly due to the longer supply chain and higher labour intensity of the more environmentally-friendly sectors. However, this exercise did not model the impact of resource substitution at higher prices. This would invariably be the case for most environmental policy encouraging structural change. Especially in the short run when businesses and consumers have to adjust to the structural change.

The input-output model can be developed further to capture the effect of higher prices on profits and output for any sector when substituting inputs from a less environment intensive sector. By using cost-pass through assumptions from the E3ME model we can calculate the subsequent impact of the high cost of inputs through to the product prices for the consumers of the sector in question.

The net effect of the positive impacts of resource allocation and negative impacts of the high cost of inputs and product prices will determine the final impact on the economy.

Lastly, the policy scenarios can be more realistic than hypothetical. In other words they can be based on the actual programmes and policies. Some examples include – detailed structural fund expenditure, using renewable targets from the EU Climate Change Programme and using sector specific studies from the Environmental Technologies Action Plan (ETAP).

2.5.2 *Forecasting*

The input-output table is a static model. It shows the interactions between various sectors at that point in time. It will be useful to see the change in environment related jobs and output over time both historical and future.

By using employment, population and GDP projections from other sources we can forecast the economic impacts of environmental activities. The model can be further developed by researching the future production trends for each sector. This can be then used to adjust the coefficients in the input-output tables along with the employment, population and GDP projections. Domestic and international trade projections can also be used to chart the trend in environment related jobs and output for the EU.

The above analysis will also provide insights into the competitiveness aspects of environment related sectors.

2.5.3 *Incorporating material flow analysis and environmental impact*

The productive use of resource inputs is central to the concept of sustainable development. The Eurostat Production and Consumption sustainable development indicators are based on materials flow indicators. The E3ME model is being developed to calculate total material resources consumed by a sector in the economy[15], to complement its existing energy submodel. The environmental impact in terms of waste, emissions and water use can also be calculated. This is shown in the figure below.

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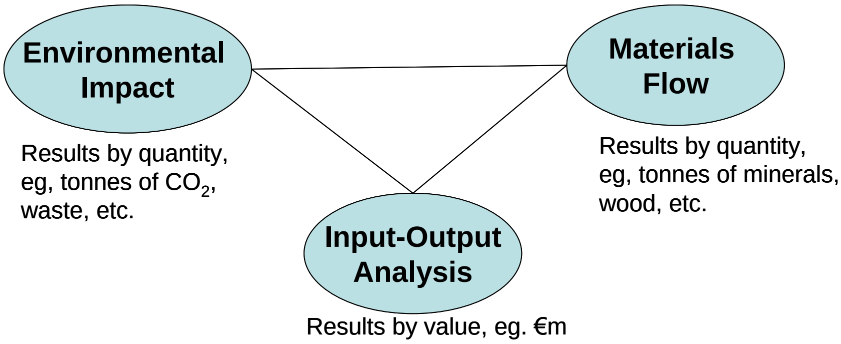
[15] Please see Extending E3ME to include analysis of materials flow: A scoping report for the Anglo-German Foundation for WP3, February 2007. http://www.camecon.com/suite_economic_models/e3me/pdf%20files/Material_Flows.pdf



In order to fully model material demands in the context of the wider economy, it is necessary to link these materials to specific industries in E3ME. Preliminary links are shown in the table below and can be extended for other materials. It should be noted that waste is slightly different to the other materials in that it has a negative economic value and the demand it to dispose of waste rather than to use it as part of a production process.

Relationship between materials and E3ME sector classification

Material	E3ME industry (number)
Food	Food, Drink and Tobacco (5)
Feed	Agriculture, etc (1)
Forestry	Agriculture, etc (1)
Construction minerals	Non-metallic minerals (13), Basic Metals (14)
Industrial minerals	Chemicals (10), Basic metals (14)
Ores	Non-energy mining (4)
Water	Water Supply (24)
Waste	-

The primary data source for the six agricultural and mineral materials is a dataset produced by Eurostat/IFF 2004[16]. This is a comprehensive set of annual time series for each of the EU-15 member states covering the period1990-2001. It is due to be updated in mid-2007 to include a wider set of European countries and include data up to 2005.

2.5.4 Natural resource pricing and valuing eco-system services

The value of biodiversity and ecosystem services to our economies and societies are either completely unpriced or only partially integrated in the price. Resources can be under priced as can services (e.g. high value biodiversity). National accounts (and hence GDP values), and the associated input-output models therefore do not take into account or represent the range of values from the resources and the different ecosystem services provided by biodiversity.

The result of this non pricing or under-pricing is that there is, from an economic perspective, a suboptimal allocation of resources. In social terms this may lead to a loss of (future) availability of resources or services. In environmental terms it leads to an over exploitation of resources, running down of natural capital resources and disruption or destruction of some ecosystem services.

[16] Economy-wide Materials Flow Accounts and Indicators of Resource Use for the EU-15: 1970-2001; Weisz et al (2004), Eurostat and Institute for Social Ecology, Faculty for Interdisciplinary Studies (IFF), Klagenfurt University, Vienna.

Example of where under-pricing often occurs, include:

- Provisioning services: eg biochemicals, natural medicines, and pharmaceuticals and also of Natural resource: fresh water
- Regulating services: eg Water regulation - flood prevention, aquifer recharge, erosion control, water purification, biological control and pollination, storm and avalanche protection, fire resistance
- Cultural services: eg cultural diversity, educational values, aesthetic values, social relations, sense of place and identity, cultural heritage values
- Supporting services: eg nutrient cycling and soil formation.

To address these shortcomings a series of next steps are needed:

- Further analysis of ecosystem functions, services and associated values to our economies and societies - to understand their contributions to the true wealth of nations and wellbeing of societies. To understand what values we forget or omit to value in market prices. This could usefully be done both at a national level, and sectoral level.
- Further analysis of natural resource values, building in social and opportunity cost and resource scarcity issues.
- Development of natural resource accounts and material flows analysis to ensure that the natural capital stock and its links to the economy are understood better and integrated into policy thinking.
- Policies to 'get the prices right' to ensure that the invisible hand of the market leads to fewer inefficient allocation of resources. There is a need to move to greater use of resource pricing to help build the value of the resource into economic decision making and make the market work more efficiently.
- One promising area for the application of pricing is that of 'payments for environmental services' (PES). The idea of PES consists of beneficiaries of ecosystem services making direct, contractual and conditional payments to local landholders and users providing the services, e.g. farmers sustainably managing the landscapes or beekeepers / honey producers for pollination of crops etc. The PES approach should be applied where it can prove workable and constructive.
- There is a need for greater application of liability rules and compensation mechanisms. There is often no liability for negative impacts and hence the price signals in the market do not do full justify the cost implications of inappropriate resource allocations or loss of undervalued resources or services.
- There are many economy-environment trade-offs that arise via the interlinkages to biodiversity and ecosystem services and in practice decision making has sometimes led to trade-offs that run against the ambitions for sustainable development. Additional effort is need to look at tools that support decision making and explore whether/how they need upgrading to ensure that valuation, ecosystem service issues and trade-offs are suitably integrated. There are opportunities and need for greater use of strategic environment assessments (SEAs) and impact assessment to take into account issues not picked up by market prices.

There is also a need to look at both a global level and an eco-system level to understand the links between an economy/society and the ecosystem(s) within which they exist and with which they interact. This will make clearer the importance of certain planning and investment decisions (eg housing development) and the factors that these need to take into account. Locational quality is directly linked to available of natural resources - including, for example, water supply availability (short and long term), ability to accept waste water discharges, temperature, salinity, risk from flooding or sea level rise.

PART B: ECONOMIC IMPACT OF ENVIRONMENT RELATED ACTIVITIES

3 APPROACH TO THE ESTIMATION OF ECONOMIC IMPACTS

3.1 Introduction

This section of the report presents the approach to the assessment of the economic scale of environment related activities. Section 4.0 presents the results of the assessment.

The main aim of the approach was to indicate the economic impact associated with a comprehensive definition of the environment – economy linkages, using a broad typology and building on previous and existing analyses and data sets:

- **A: Environment as a resource input to economic activity** – figures on employment, output and GVA are available from Eurostat for most of the sectors given in Table 3.1. Employment and output estimates of the share of the broad sector in the core sector (such as organic farming and sustainable forestry) were derived from the literature review.
- **B: Management of the environment** – the direct scale of these activities was based on the EU eco-industry data including data on the consumption of eco-products for the household sector. This was further divided into pollution and resource management using the environmental protection expenditure data from the Eurostat Cronos database.
- **C: Activities dependent on environmental quality** – the economic activities that can be defined as being based on environmental quality and which can be adequately quantified is tourism, and the share considered to be environmentally related tourism (ERT). This analysis makes use of available estimates of tourism activity including associated multiplier effects.

Those linkages that can be quantified (a subset of the linkages in the full typology) and the principal data sources are summarised in Table 3.1.

Table 3.1: Principal Data Sources for the Different Linkages

	Environment Related Economic Activities	Principal Data Sources
A	**ACTIVITIES BASED ON NATURAL RESOURCES**	
i	Agriculture	OECD, Eurostat
ii	Core: Organic farming	Estimated
iii	Forestry	OECD, Eurostat
iv	Core: Sustainable forestry	Estimated
v	Fishing (except recreation, which is covered under tourism)	OECD, Eurostat
vi	Mining, extraction and quarrying	OECD, Eurostat
vii	Non-renewable electricity generation	OECD, Eurostat
viii	Core: Renewable electricity generation	OECD, Eurostat
ix	Core: Water extraction and supply	Eurostat
B	**ENVIRONMENTAL MANAGEMENT**	
B1	**Pollution management**	
i	Solid Waste Management & Recycling (SWM)	Eurostat
ii	Waste Water Treatment (WWT)	Eurostat
iii	Air Pollution Control (APC)	Eurostat
iv	General Public Administration (GPA)	Eurostat

	Environment Related Economic Activities	Principal Data Sources
v	Private Environmental Management (PEM)	Eurostat
vi	Remediation & Clean Up of Soil & Groundwater (RCSG)	Eurostat
vii	Noise & Vibration Control (NVC)	Eurostat
viii	Environmental Research & Development (ERD)	Eurostat
ix	Environmental Monitoring & Instrumentation (EMI)	Eurostat
B2	**Resource management**	
i	Recycled materials	Eurostat
ii	Nature protection	Eurostat
C	**ENVIRONMENT QUALITY**	
i	Environment related tourism	Estimated

Note: Described in detail in Annex C, E and F.

3.2 Estimating the Economic Impact of Environment Related Activities

The economic impact was estimated in two stages. In the first stage the existing estimates of the scale of the eco-industries were used to indicate the direct impacts. To this was added the direct impact associated with additional activities specified by the expanded typology. In the second stage the analysis estimated the indirect and induced impacts by using a combination of the OECD and Cambridge Econometrics' (CE) E3ME Input-Output Tables[17]. These tables were expanded to include the core environmental related economic activities as given in Table 3.1.

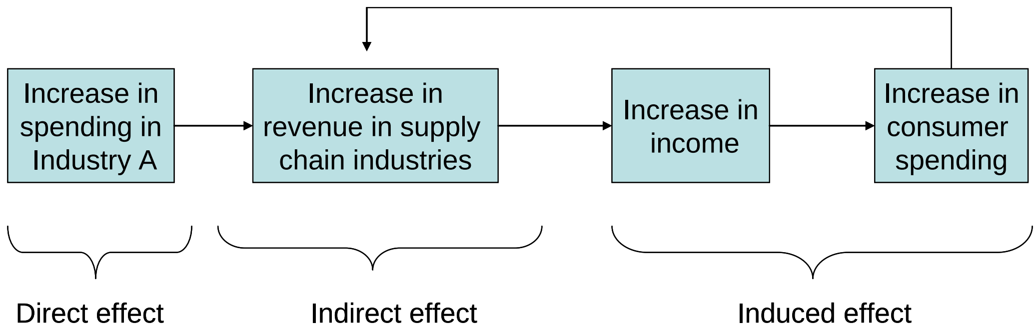
The CE E3ME model[18] with an input-output structure for 27 European regions, including the EU25 (as of 2006), Norway and Switzerland, contains data for industry output, investment, prices, exports, imports, employment and intermediate demand at a 42-industry level (including 16 service industries) and includes 28 categories for consumers' expenditure. It also contains energy demand data based on 19 fuel user groups and 12 fuels and estimates of environmental emissions. The E3ME model has been used for the policy scenarios in Section 6.

The Input-Output (I-O) Tables provide a detailed description (model) of the linkages between sectors, and between intermediate demand (purchases made by economic sectors) and final demand (the purchases made by consumers and government and exports). It enables estimates of the effect of changes in one sector on other sectors and the effects of changes in final demand from households, government, and foreign buyers on the economy. These effects are reflected in multipliers. Multipliers indicate the effect on the economy due to a change in one sector because of its sales to and purchases from other sectors (Figure 3.1). The ratio of the direct, indirect and induced income effect to the direct effect is termed a Type II output multiplier. A Type I output multiplier excludes the induced effects, i.e. it is ratio of direct and indirect to direct effects.

[17] Please see Annex C for more details on input-output tables.

[18] Please see www.e3me.com and Annex C for details on the CE E3ME model.

Figure 3.1: Multiplier Effects



To better understand the impact of environment related activities on the economy we divided three (parent) sectors into its environmental and non-environmental parts. This was done for Agriculture (further split into organic farming), Forestry (further split into sustainable forestry), and Electricity (further split into renewables). Annex F provides more details on the scope, importance and growth of these sectors over time.

The environment-economy linkages in Table 3.1 provided the basis for estimating the full time equivalent (FTE) employment and output directly associated with environment related activities.

To estimate the indirect and induced impacts, the economic activities were classified according to the sectors used in input-output tables (NACE sectors), seeking to separate the environmental sub-sectors from the broader (parent) sector.

The parent sector and the nature of the jobs identified in the various environment related sub-sectors were used to estimate the impact of environment related activities on the economy based on the purchases made by these activities[19] (and final demand) and the sales to other sectors[20].

The input-output analysis provides estimates for direct, indirect and induced impacts of environment related activities, measured by:

1. Employment (Full-Time Equivalents)
2. Output (€ billion) – turnover
3. GVA (€ billion) – value added (turnover less purchases of intermediate products)
4. Disposable income[21] - to labour from environment related economic activities

The multipliers from the I-O table can also be used to calculate the economic consequences of changes in these activities (e.g. because of a change in environmental policy)[22] by tracing impacts through supply chains and income effects.

Please see Annex C for a detailed description of I-O tables in the context of this study.

[19] Shown by the columns in an I-O matrix.

[20] Shown across the rows in an I-O matrix.

[21] Disposable income is income after deducting direct taxes.

[22] Main focus issues – sustainable consumption and production (SCP), market liberalisation, ETAP, Climate change, etc.

3.2.1 Year and Spatial Coverage of the Analysis

The analysis uses the latest data on eco-industries, as previously defined and assessed, as the starting point. This data is now available from 1999-2003[23] and is presented in 2000 prices in order for it to be consistent with the I-O tables. The I-O tables used in the analysis also relate to 2000 (even though these are the latest tables and were only published in 2007). The analysis is therefore describing the scale of environment related activities as they existed in 2000. We have continued to present data in 2000 prices to aid comparison with previous analyses. However, some of the headline figures have been inflated to 2006 prices. All values are thus in 2000 prices unless explicitly stated in the table or figure.

The available data covered most of the EU-25. Data for the Czech Republic and Malta was missing – we have estimated this from other reports. In addition data for Bulgaria and Romania has been added to provide a full EU-27 analysis[24]. In the case of resource management (B2 in Table 3.1) only data for the original EU15 was available. Czech Republic pollution management employment numbers have been derived from EU15 average productivity. Pollution management figures for Malta, Bulgaria and Romania were obtained from the ECOTEC candidate countries supplementary study.

We have not attempted to extrapolate estimates from the EU15 given the likely error. For comparisons with earlier analyses, adjustments for geographic coverage are required.

3.2.2 Modelling the economic impact of environment related tourism

To quantify the economic impact attributable to environmental quality, the study has examined as a first approximation the economic impact of environment related tourism. This is difficult because tourism (the parent sector) is itself not a discrete sector within the NACE classification (and therefore I-O sectors). Tourism activities are divided between different sectors such as retail, hotels and restaurant and transport. We have therefore used a combined demand and supply-side approach to measure the economic impact of tourism (see Annex E for more details), prior to assessing the share of sectoral activity that can be related to environmental quality.

For the purposes of this study we have estimated the tourism sector by attaching 'tourism intensity' weights to the main tourism sectors such as hotels and restaurants, transportation and tour operators, to indicate their significance in the parent sector (e.g. transport, hotels). We have also used estimates of the scale of the tourism sector for EU-27 produced by the World Tourism and Travel council (WTTC), which is based on a system of Tourism Satellite Accounts (TSA) (see Annex E). Environment related tourism is measured as a proportion of overall tourism.

Defining Environment related tourism

In the literature Eco-tourism and sustainable tourism are the most frequently used terms linking environment, environmental quality and sustainability to tourism. However, there

[23] Analysis of the EU Eco-Industries, their Employment and Export Potential' (2002) by ECOTEC and Study on Eco-industry, its size, employment, perspectives and barriers to growth in an enlarged EU' (2006) by Ernst & Young

[24] Data available for the 10 new member states from the previous 'Analysis of the size and employment of the eco-industries of the candidate countries report are not directly comparable due to differences in sources, perimeter and extrapolation method.

are a wide range of descriptions that might be used to define environment related tourism (Table 3.2).

Even though the importance of eco-tourism[25] and sustainable forms of tourism have increased significantly in recent times, it has been difficult to find actual statistics on the economic profile of environmental based tourism compared to other forms of leisure tourism. Most national and European annual tourism surveys ask travellers about travel motives and main destinations but these are not detailed enough to reveal the importance of the environment to holiday makers.

For the purposes of this study we have used eco-tourism, nature tourism, country or rural tourism as the basis of a measure of environment related tourism. Sun and sand holidays are not included under this definition.

In applying this definition use has been made of a number of studies looking at tourism trends, visitor and resident surveys, eco-tourism and nature tourism reports and market findings from international tourism organisations.

Table 3.2 Typology of Environment Related Tourism

Tourism Activity	Description of Tourism Activity
Adventure tourism	A form of nature-based tourism that incorporates an element of risk, higher levels of physical exertion, and the need for specialized skill.
Ecotourism	Responsible travel to natural areas that conserves the environment and improves the welfare of local people.
Geotourism	Tourism that sustains or enhances the geographical character of a place-its environment, heritage, aesthetics, and culture and the well-being of its residents.
Mass tourism	Large-scale tourism typically associated with ‘sea, sand, sun’ resorts and characteristics such as trans - national ownership, minimal direct economic benefit to destination communities, seasonality, and package tours.
Nature-based tourism	Any form of tourism that relies primarily on the natural environment for its attractions or settings.
Pro-poor tourism	Tourism that results in increased net benefit for the poor.
Responsible tourism	Tourism that maximizes the benefits to local communities minimizes negative social or environmental impacts, and helps local people conserve fragile cultures and habitats or species.
Experiential tourism	Tourism that encompasses ecotourism, nature, heritage, cultural, soft adventure tourism as well as sub-sectors such as rural and community tourism.
Sustainable Tourism	Tourism the meets the needs of present tourist and host regions while protecting and enhancing opportunities for the future.

Source: The International Eco-tourism society

Our findings from the literature review suggest that environment related tourism accounts for 25% to 35% of overall tourism (Annex E provides further details). To reflect the general uncertainty over the definition and measurement we have used this range, i.e environment related tourism accounts for between 25% of overall tourism (lower

[25] Eco-Tourism has been widely discussed in the literature and refers to forms of tourism such as sports, health, beach, cultural or adventure tourism

estimate) and 35% (upper estimate). In some cases we have taken the mid-point as the estimate.

4 ECONOMIC IMPACTS OF ENVIRONMENT RELATED ACTIVITIES

4.1 Introduction

In Section 2, we discussed the main findings based on the OECD/Eurostat eco-industries definition in the E&Y and GHK study. In this section we present the economic impacts in terms of jobs, output and GVA by member state and environmental sector. The total economic impact estimates in most tables are shown for the three main environment-economy linkages. This has been further presented by the core and broad definition of natural resource based activities.

4.2 Summary of the Overall Impact

The GHK and E&Y studies are essentially based on the Ecotec (2002) report, a comparison of findings from all three studies is given in Table 4.1. The limited geographic coverage of the Ecotec report (EU-15) means that comparison is not appropriate.

In Table 4.1, the findings have been inflated to 2006 prices though the actual data and input-output tables relate to 2000. In addition to direct and indirect impacts on jobs and output, this study has also extended the analysis to include induced effects. Indirect effects are the additional jobs and output generated in supplying goods and services generated by the demand for goods and services in the defined economic activities. The induced effect is the further economic impact as a result of the spending of income received as a consequence of the direct and indirect employment[26]. Thus the total economic impact of eco-industries was around 4.6 million jobs and €660 billion in output in 2000.

Table 4.1: Summary of Direct, Indirect and Induced Employment and Output Impacts based on Eco-industries Definition, 2000

		Ecotec report (EU-15) 2002	E&Y report (EU-25) 2006		GHK report (EU-27) 2007	
Year of data		**1999**		**2004[b]**	**2000[c]**	
Jobs ('000s)	Direct	2,086		2,445	2,364	
	Indirect	582		507	1,320	
	Induced	n.a		n.a	939	
	Total	**2,668**		**2,952**	**4,623**	
Price base		**1999 prices**	**2000 prices[a]**	**2004 prices[b]**	**2000 prices[c]**	**2006 prices[d]**
Output/turn over (Bil €)	Direct	183	209	227	242	274
	Indirect	n.a	n.a	n.a	176	199
	Induced	n.a	n.a	n.a	242	274
	Total	**183**	**209**	**227**	**660**	**748**

Note: Data for 2000 includes some items of data from 2001 and 2002
n.a – not available

[26] The indirect and induced effect for jobs and output is described in more details in section 4.2 and 4.3.

a E&Y output figures have been deflated using deflators from the E&Y dataset
b Estimates from original E&Y report, based on 2004 wage rates and 2000 labour intensity ratios (share of labour costs in total costs) from the Ecotec study. Capex related employment has not been included here for comparison with GHK study.
c Estimates from E3ME/I-O model
d 2000 prices have been inflated using EU producer price output indices for 2006.

Extending the range of activities, to include activities based on intensive users of natural resources and environment related tourism gives rise to additional jobs and output (Table 4.2a and 4.2b). As described in Section 2 intensive users of natural resources are categorised as core[27] and broad[28] activities. Using the broad natural resource activities definition of environmental related economic activities effectively increases the associated scale of direct economic activity by a factor of 9 for employment and a factor of 5 for output compared to the E&Y findings. The core natural resource based activities definition increases environment related employment and output by a factor of 2 compared to the E&Y findings.

Table 4.2a: Comparison of direct economic Impacts by type of environment activity

	Direct Employment ('000s) FTE			Direct Output (€ Bil)		
	GHK, CE & IEEP report (EU-27) 2007		E&Y report (EU-25) 2004	GHK, CE & IEEP report (EU-27) 2007		E&Y report (EU-25) 2004
Year of Data	**2000**		**2004**	**2000**		**2004**
	Core	**Broad**		**Core**	**Broad**	
Eco. activity based on natural resource use	964	17,472	n.a	101	797	n.a
Environmental Management	1,834	1,834	2,445	160	160	227
Environmental Quality	1,589	1,589	n.a	144	144	n.a
Total	**4,387**	**20,894**	**2,445**	**405**	**1,102**	**227**

Note: Impacts associated with renewable energy and water supply have been reclassified from environmental management (in E&Y) to natural resource use (in GHK)

The scale of total economic activity is even higher if indirect and induced effect of this wider range of environmental activities is taken into consideration (Table 4.2b). Output and jobs increase by a factor of 3 and 5 respectively using the core definition. Whereas the broad natural resource activities definition effectively increases the associated scale of direct economic activity by a factor of 12 for employment and a factor of 13 for output compared to the E&Y findings.

[27] Organic farming, sustainable forestry, renewable electricity and water supply.

[28] Agriculture, forestry, fishing, mining and quarrying, renewable and non-renewable energy and water extracting and supply.

Table 4.2b: Comparison of total economic Impacts by type of environment activity

	Total Employment ('000s) FTE			Total Output (€ Bil)		
	GHK, CE & IEEP report (EU-27) 2007		E&Y report (EU-25) 2004	GHK, CE & IEEP report (EU-27) 2007		E&Y report (EU-25) 2004
Year of Data	2000		2004	2000		2004
	Core	Broad		Core	Broad	
Eco. activity based on natural resource use	1,961	29,675	n.a	243	2,103	n.a
Environmental Management	3,385	3,385	2,952	466	466	227
Environmental Quality	3,319	3,319	n.a	418	418	n.a
Total	**8,665**	**36,378**	**2,952**	**1,127**	**2,987**	**227**

The analysis also extends the assessment to define the impacts of environment related economic activities on GVA and disposable income from environment related economic activities. This is shown for both broad and core definition in Table 4.3 and Table 4.4 respectively.

Table 4.3: Economic Impact of Environment Related Activities, EU-27, 2000 (2006 prices) including broad natural resource based activities

	Direct	Indirect	Induced	Total	Total (Direct) % of EU	Total (Indirect & Induced) % of EU
Employment ('000s)	20,894	10,826	4,658	36,378	10%	17%
Output (€ billion)	1,248	1,091	1,045	3,384	7%	18%
GVA (€ billion)	619	530	239	1,388	7%	14%
Disposable income (€ billion)	172	171	82	425	5%	11%

Note: Employment in full-time equivalent (FTE), Output, GVA and Disposable income in 2006 prices

The environment related activities attributed to broad natural resources, environmental management and environmental quality directly support over 21 million jobs in the EU-27 (Table 4.3). This is over 10% of total EU employment. Taking into account indirect and induced effects brings the total number of jobs supported by environment related activities in EU-27 in 2000 to over 36 million (FTE), accounting for 17% of total EU employment. The environment related activities generated €1,388 billion of GVA (around 14% of EU-27 GVA) and €425 billion per annum in disposable income, in 2006 prices (Table 4.3).

Economic impact of environment related activities based on core natural resources, environmental management and environmental quality support a total of 8.6 million jobs. This is around 4% of total EU employment. These environmental activities generated €1,277 billion worth of EU output and €506 billion worth of GVA.

Table 4.4: Economic Impact of Environment Related Activities, EU-27, 2000 (2006 prices) including core natural resource based activities

	Direct	Indirect	Induced	Total	Total (Direct) % of EU	Total (Indirect & Induced) % of EU
Employment ('000s)	4,387	2,615	1,663	8,665	2%	4%
Output (€ billion)	459	359	459	1,277	3%	8%
GVA (€ billion)	227	176	102	506	3%	6%
Disposable income (€ billion)	92	101	37	192	3%	6%

Note: Employment in full-time equivalent (FTE), Output, GVA and Disposable income in 2006 prices

4.3 Employment Impacts from Environment Related Activities

The estimated employment associated directly with environment related activities has been estimated separately for each of the three broad linkages and for each of the specific linkages (Table 4.5). Economic activities based on natural resources accounts for 84% of all employment related to the environment. Jobs in environmental management and environment related tourism (ERT) account for 8% each.

Table 4.5: Employment ('000 full-time equivalent) in Environment Related Activities, EU27, 2000

		Direct	Indirect	Induced	Total
A	**Econ based on Natural resources**	**17,472**	**8,847**	**3,356**	**29,675**
i	Agriculture (non-organic)	13,970	4,630	1,189	19,788
ii	Organic farming	300	151	48	499
iii	Forestry (other)	405	124	67	595
iv	Sustainable forestry	133	61	30	224
v	Fishing (except recreation, which is covered under tourism)	247	85	47	379
vi	Mining, extraction and quarrying	901	1,082	607	2,591
vii	Non-renewable Electricity generation	985	2,289	1,086	4,360
viii	Renewable electricity	131	121	101	353
ix	Water extraction and supply	399	304	182	886
B	**Environmental Management**	**1,834**	**894**	**656**	**3,385**
B1	**Pollution management**	**1,544**	**656**	**524**	**2,723**
i	Solid Waste Management & Recycling (SWM)	846	342	260	1,449
ii	Waste Water Treatment (WWT)	428	173	132	733
iii	Air Pollution Control (APC)	39	45	31	116
iv	General Public Administration (GPA)	104	31	48	182
v	Private Environmental Management (PEM)	82	30	29	142
vi	Remediation & Clean Up of Soil & Groundwater (RCSG)	22	9	7	38
vii	Noise & Vibration Control (NVC)	21	25	17	63
viii	Environmental Research & Development (ERD)	n/a	n/a	n/a	n/a
ix	Environmental Monitoring & Instrumentation (EMI)	n/a	n/a	n/a	n/a
B2	**Resource management**	**291**	**239**	**133**	**662**
i	Recycled materials**	223	211	112	546
ii	Nature protection**	68	28	21	116
C	**Environment Quality**				
i	Environment related Tourism	1,589	1,084	646	3,319
	Total	**20,894**	**10,826**	**4,658**	**36,378**

** EU15

Table 4.6a provides estimates of the total employment in environment related activities (and Table 4.6b provides estimates of the direct employment) by Member State, for the broad classes of environmental activity. Excluding broad natural resource based activities[29] makes a major difference to the estimated impact, reducing the estimated total employment[30] to 8.6 million and direct employment to 4.3 million for EU-27.

Total and direct employment for each environmental sector by country is given in Annex G.

[29] Agriculture (non-organic), forestry (other), fishing, mining and non-renewable electricity.

[30] Including in-direct and induced effects.

Table 4.6a: Total Employment, ('000s), by Broad Environment Related Class, by Member State, 2000, FTE

	Econ based on Natural resources	Environmental Management		Environment Quality	Total (exc. main env. primary sectors)
	Core	Pollution management	Resource management		
EU-27	**1,961**	**2,723**	**662**	**3,319**	**8,665**
Belgium	10	36	31	49	126
Denmark	15	70	19	33	136
Germany	310	550	111	501	1,472
Greece	17	14	12	65	108
Spain	92	95	20	298	505
France	221	432	180	313	1,146
Ireland	7	11	3	23	43
Italy	185	78	44	297	605
Luxembourg	1	2	2	4	9
Netherlands	26	175	10	105	316
Austria	91	132	5	68	296
Portugal	72	30	15	71	188
Finland	44	16	1	28	89
Sweden	59	29	10	50	149
UK	154	196	112	543	1,004
Czech Republic	89	3	0	59	152
Estonia	8	12	0	10	31
Cyprus	1	1	0	8	9
Latvia	26	9	0	16	51
Lithuania	7	7	0	12	26
Hungary	44	85	0	42	171
Malta	0	2	0	3	6
Poland	161	293	0	123	577
Slovenia	11	24	0	12	47
Slovakia	32	40	0	21	93
Bulgaria	82	44	0	39	165
Romania	133	221	0	68	423

	Econ based on Natural resources	Total (exc. main env. primary sectors)	Total employment
	Broad (exc. Core)		
EU-27	**27,713**	**8,665**	**36,378**
Belgium	191	126	318
Denmark	203	136	338
Germany	2,179	1,472	3,651
Greece	875	108	983
Spain	1,708	505	2,213
France	1,888	1,146	3,034
Ireland	175	43	218
Italy	1,481	605	2,086
Luxembourg	7	9	16
Netherlands	546	316	862
Austria	663	296	959
Portugal	651	188	838
Finland	232	89	321
Sweden	175	149	324
UK	1,772	1,004	2,776
Czech Republic	617	152	769
Estonia	113	31	144
Cyprus	24	9	33
Latvia	223	51	275
Lithuania	396	26	422
Hungary	547	171	717
Malta	9	6	14
Poland	5,182	577	5,759
Slovenia	168	47	215
Slovakia	295	93	387
Bulgaria	1,405	165	1,571
Romania	5,444	423	5,867

Table 4.6b: Total Direct Employment, ('000s), by Broad Environment Related Class, by Member State, 2000, FTE

	Econ based on Natural resources	Environmental Management		Environment Quality	Total (exc. main env. primary sectors)
	Core	Pollution management	Resource management		
EU-27	**964**	**1,544**	**291**	**1,589**	**4,387**
Belgium	5	25	17	28	75
Denmark	8	44	11	19	82
Germany	150	357	53	295	855
Greece	13	11	9	41	74
Spain	44	69	13	168	294
France	83	261	84	167	595
Ireland	5	9	2	17	33
Italy	108	57	23	180	368
Luxembourg	1	2	1	3	6
Netherlands	11	104	6	61	182
Austria	61	83	3	39	186
Portugal	36	22	9	37	105
Finland	26	10	0	16	53
Sweden	33	19	6	27	85
UK	72	97	52	276	498
Czech Republic	44	2	n/a	34	80
Estonia	5	8	n/a	5	17
Cyprus	0	0	n/a	6	6
Latvia	17	5	n/a	7	29
Lithuania	4	5	n/a	7	16
Hungary	30	56	n/a	28	113
Malta	0	1	n/a	2	3
Poland	81	165	n/a	63	309
Slovenia	6	12	n/a	6	24
Slovakia	18	24	n/a	12	54
Bulgaria	31	21	n/a	18	70
Romania	68	77	n/a	28	174

	Econ based on Natural	Total (exc. main env. primary sectors)	Total employment
	Broad (exc. Core)		
EU-27	**16,508**	**4,387**	**20,894**
Belgium	121	75	196
Denmark	108	82	190
Germany	1,171	855	2,027
Greece	707	74	780
Spain	1,084	294	1,378
France	1,040	595	1,635
Ireland	138	33	171
Italy	1,114	368	1,482
Luxembourg	5	6	11
Netherlands	293	182	476
Austria	508	186	694
Portugal	462	105	567
Finland	130	53	183
Sweden	119	85	203
UK	616	498	1,114
Czech Republic	298	80	378
Estonia	56	17	73
Cyprus	20	6	26
Latvia	135	29	164
Lithuania	291	16	307
Hungary	302	113	415
Malta	6	3	9
Poland	2,996	309	3,306
Slovenia	114	24	138
Slovakia	140	54	194
Bulgaria	828	70	898
Romania	3,706	174	3,880

Note: Core includes organic farming, sustainable forestry, renewable energy and water supply

The proportion of total jobs in each of the environment related economic activity category in Table 4.6a is expressed as proportion of total environment related jobs and shown in Table 4.7. Bulgaria and Romania have a high proportion of jobs in the core and broad sector due to disproportionately greater share of both conventional and organic farming[31].

Main findings for environment related output as a proportion of total environment output excluding the broad natural resources based activities are -

- Denmark and Netherland have over 50% of jobs in pollution management activities,
- UK, Cyprus, Spain, Ireland, Greece and Malta have more than 50% of environment related jobs in environment related tourism.

Table 4.7 Share of Total Environment Related Employment by Broad Class, by MS, 2000

	Econ based on Natural resources	Environmental Management		Environment Quality	Econ based on Natural resources	Total (exc. main env. primary sectors)
	Core	Pollution management	Resource management		Broad (exc. core)	
EU-27	**23%**	**31%**	**8%**	**38%**	76%	24%
Belgium	8%	29%	25%	39%	60%	40%
Denmark	11%	51%	14%	24%	60%	40%
Germany	21%	37%	8%	34%	60%	40%
Greece	16%	13%	11%	60%	89%	11%
Spain	18%	19%	4%	59%	77%	23%
France	19%	38%	16%	27%	62%	38%
Ireland	15%	26%	6%	53%	80%	20%
Italy	31%	13%	7%	49%	71%	29%
Luxembourg	8%	24%	21%	47%	44%	56%
Netherlands	8%	55%	3%	33%	63%	37%
Austria	31%	45%	2%	23%	69%	31%
Portugal	38%	16%	8%	38%	78%	22%
Finland	49%	18%	1%	32%	72%	28%
Sweden	40%	20%	6%	34%	54%	46%
UK	15%	19%	11%	54%	64%	36%
Czech Republic	59%	2%	n/a	39%	80%	20%
Estonia	26%	40%	n/a	33%	79%	21%
Cyprus	8%	7%	n/a	85%	73%	27%
Latvia	51%	17%	n/a	31%	81%	19%
Lithuania	29%	26%	n/a	45%	94%	6%
Hungary	26%	50%	n/a	25%	76%	24%
Malta	9%	34%	n/a	57%	61%	39%
Poland	28%	51%	n/a	21%	90%	10%
Slovenia	23%	52%	n/a	25%	78%	22%
Slovakia	35%	43%	n/a	23%	76%	24%
Bulgaria	49%	27%	n/a	24%	89%	11%
Romania	32%	52%	n/a	16%	93%	7%

Note: The shares are based on the two total columns in Table 4.6a. Eg. For core natural resources – 1,961/8,665 is 23%.

The estimated direct employment for each of the environment related activities (Table 4.5) was assigned to NACE sectors as defined in I-O tables, enabling estimates of the indirect and induced employment. This was used to calculate employment multipliers for each country and environmental sector (Table 4.8). Employment multiplier for each environmental sector by member state is given in Annex G.

[31] Organic farming share in Romania and Bulgaria is estimated form EU-10 data.

Table 4.8: Estimated Type 1 and Type II Employment Multipliers by Broad Environment-Economy Linkage, by MS, 2000

	Econ based on Natural resources				Environmental Management				Environment Quality	
	Core		Broad		Pollution management		Resource management			
	Type I	Type II	Type I	Type II	Type I	Type II	Type I	Type II	Type I	Type II
EU-27	1.66	2.04	1.46	1.62	1.44	1.78	1.79	2.24	1.69	2.13
Belgium	1.75	2.16	1.49	1.58	1.31	1.41	1.64	1.80	1.61	1.74
Denmark	1.47	1.71	1.62	1.86	1.36	1.64	1.31	1.57	1.46	1.75
Germany	1.75	2.13	1.56	1.82	1.34	1.56	1.67	2.00	1.47	1.69
Greece	1.05	1.09	1.22	1.24	1.19	1.25	1.18	1.24	1.52	1.59
Spain	1.51	1.81	1.46	1.59	1.23	1.40	1.56	1.80	1.53	1.77
France	2.19	2.80	1.58	1.81	1.37	1.65	1.76	2.15	1.54	1.88
Ireland	1.08	1.23	1.18	1.25	1.13	1.25	1.16	1.30	1.18	1.31
Italy	1.52	1.58	1.28	1.32	1.33	1.38	1.68	1.76	1.57	1.65
Luxembourg	1.17	1.36	1.41	1.51	1.21	1.34	2.01	2.26	1.36	1.54
Netherlands	1.91	2.52	1.64	1.86	1.42	1.64	1.34	1.56	1.44	1.73
Austria	1.20	1.31	1.27	1.30	1.36	1.61	1.37	1.61	1.52	1.73
Portugal	2.14	2.85	1.32	1.39	1.24	1.42	1.36	1.55	1.63	1.89
Finland	1.47	1.64	1.66	1.79	1.35	1.58	1.48	1.72	1.52	1.75
Sweden	1.53	1.80	1.35	1.48	1.35	1.56	1.48	1.72	1.60	1.86
UK	1.69	2.09	2.16	2.69	1.58	2.02	1.67	2.13	1.58	1.96
Czech Republic	1.68	1.81	1.86	2.06	1.60	1.75	n/a	n/a	1.60	1.74
Estonia	1.36	1.49	1.86	2.09	1.37	1.55	n/a	n/a	1.90	2.22
Cyprus	1.47	1.62	1.21	1.25	1.40	1.60	n/a	n/a	1.25	1.37
Latvia	1.40	1.52	1.61	1.66	1.60	1.71	n/a	n/a	2.26	2.44
Lithuania	1.23	1.39	1.32	1.35	1.32	1.46	n/a	n/a	1.51	1.67
Hungary	1.30	1.40	1.70	1.81	1.43	1.53	n/a	n/a	1.42	1.52
Malta	1.31	1.59	1.31	1.71	1.30	1.72	n/a	n/a	1.37	1.92
Poland	1.76	1.97	1.65	1.72	1.63	1.80	n/a	n/a	1.74	1.95
Slovenia	1.23	1.39	1.39	1.47	1.48	1.82	n/a	n/a	1.81	2.11
Slovakia	1.60	1.70	1.98	2.09	1.49	1.57	n/a	n/a	1.62	1.72
Bulgaria	1.82	2.41	1.39	1.64	2.53	3.17	n/a	n/a	1.27	1.55
Romania	1.65	1.87	1.44	1.48	2.43	2.84	n/a	n/a	2.09	2.41

The employment multiplier is the ratio of direct plus indirect (plus induced for type II multipliers) to direct employment. Multipliers can be used to estimate the impact of specific events or shocks on the economy, such the injection of new funds in a particular sector. For example, if a new waste water plant is opened in Belgium employing 100 people on a full-time equivalent basis, then the impact of the new company will have an effect on:

- **The suppliers of goods and services to this type of activity (indirect employment effect)** – multiplying the direct increase in jobs by the 'pollution management' Type I employment multiplier gives: 100 × 1.31 = **131** direct and indirect new full-time equivalent (FTE) jobs. Subtracting the initial direct job increase gives the additional indirect increase in jobs throughout the Belgium economy as **31** (FTE).
- **Increased household expenditure (induced employment effects)** – in addition to the effect of increased employment, we would expect to see an increase in household expenditure among the people who have gained employment through the direct and indirect employment effects. This is the induced effect and is estimated using the Type II multipliers, which give: 100 × 1.41 = **141** direct, indirect and induced jobs. As we have already calculated a direct and indirect increase in employment 131 (FTE), another **10** (FTE) jobs will be created as a result of this induced demand.

It should be noted that the multipliers calculated for the EU27 as a whole are higher than those produced by traditional multiplier studies. The reason for this is that trade between EU countries is not counted as a leakage from the system. As intra-EU trade accounted for something in the region of 60% of total EU imports in 2000, this dramatically reduces leakages from the system. Hence the calculated multipliers are higher than they would be if calculated at a national level. The individual country multipliers should be used as much as possible to examine the overall impact of increasing employment in environmental related activities.

The Type I employment multiplier for EU-27 for all environment related activities taken together is 1.49, i.e. for every 100 FTE jobs in activities relating to the environment, another 49 are supported elsewhere in EU-27 (Table 4.9). The equivalent Type II multiplier is 1.70, another 21 (70-49) FTE jobs are supported in the EU-27 attributed to the induced impact of every 100 FTE jobs in activities related to the environment (Table 4.9).

Table 4.9: Environment Related Employment, Output and GVA Multipliers, 2000

	Employment multiplier		Output multiplier		GVA multiplier	
	Type I	Type II	Type I	Type II	Type I	Type II
EU-27	**1.49**	**1.70**	**1.85**	**2.68**	**1.81**	**2.19**
Belgium	1.48	1.60	1.68	2.13	1.57	1.68
Denmark	1.50	1.75	1.51	2.12	1.46	1.69
Germany	1.50	1.74	1.68	2.51	1.71	2.03
Greece	1.22	1.25	1.38	1.68	1.35	1.40
Spain	1.44	1.60	1.67	2.22	1.58	1.78
France	1.57	1.84	1.72	2.46	1.70	2.02
Ireland	1.17	1.26	1.29	1.68	1.27	1.39
Italy	1.35	1.40	1.55	1.88	1.49	1.55
Luxembourg	1.32	1.45	1.49	1.98	1.47	1.68
Netherlands	1.54	1.78	1.60	2.10	1.58	1.79
Austria	1.29	1.38	1.53	2.12	1.56	1.76
Portugal	1.37	1.48	1.71	2.24	1.67	1.87
Finland	1.59	1.74	1.70	2.25	1.66	1.86
Sweden	1.41	1.59	1.53	2.15	1.47	1.66
UK	1.83	2.37	1.94	2.66	1.93	2.27
Czech Republic	1.79	1.97	1.92	2.42	1.84	2.02
Estonia	1.72	1.93	1.68	2.23	1.85	2.09
Cyprus	1.22	1.29	1.31	1.58	1.29	1.36
Latvia	1.63	1.69	1.82	2.13	1.86	1.96
Lithuania	1.32	1.36	1.47	1.83	1.64	1.77
Hungary	1.61	1.72	1.76	2.23	1.80	1.95
Malta	1.32	1.75	1.23	1.75	1.22	1.49
Poland	1.66	1.74	1.91	2.44	1.93	2.10
Slovenia	1.41	1.52	1.59	2.18	1.57	1.80
Slovakia	1.83	1.94	1.96	2.35	2.44	2.62
Bulgaria	1.42	1.56	1.74	2.31	1.55	1.77
Romania	1.45	1.50	1.77	2.12	1.64	1.77

In Table 4.9, the Type I multipliers range from around 1.3 to around 1.9. This reflects not only the different structures of the environmental sectors in each country, but also the structure of the national economy. For example multipliers will be higher where environmental activities require inputs from a wide range of sectors.

In the UK for example, Type I multipliers are much larger than in Greece. A closer inspection reveals that the environmentally-related sectors in the UK have greater links to other sectors (buys more input from other sectors) compared to Greece. Moreover the UK's import to output ratio in these sectors is relatively lower than the ratio in Greece. This means that when shocks are entered to the environmentally-related sectors, more are passed on to other sectors domestically within the UK than the amounts that get passed on domestically in Greece.

The Type II multipliers are larger than the Type I multipliers and range from around 1.6 to around 2.6. This is because Type II multipliers include wage income which is counted as part of 'leakages' in the Type I multipliers. Otherwise, the patterns of the Type II multipliers very much follow the Type I multipliers.

As described above, the EU27 multipliers are larger than country level multipliers. This is because the EU27 IO table includes import within EU. These imports are counted as leakages.

4.4 Output Impacts from Environment Related Activities

The direct value of turnover (output) from activities relating to the environment was €1,102 billion in EU-27, in 2000. As a result of the resources required to produce this output from other sectors, subsequent income and spending generated an additional €1,900 billion output in EU-27. This brings the total output of environment related activities in 2000 to around €3,000 billion (Table 4.10).

Table 4.10: Output (€ million) in Environment Related Sectors for EU27, 2000

		Direct	Indirect	Induced	Total
A	**Econ based on Natural resources**	**797,488**	**713,127**	**592,340**	**2,102,954**
i	Agriculture (non-organic)	327,073	311,221	225,067	863,361
ii	Organic farming	11,796	10,701	8,961	31,458
iii	Forestry (other)	14,842	9,452	12,596	36,889
iv	Sustainable forestry	6,654	4,718	5,719	17,092
v	Fishing (except recreation, which is covered under tourism)	10,554	8,966	8,853	28,374
vi	Mining, extraction and quarrying	124,689	98,754	92,519	315,962
vii	Non-renewable Electricity generation	219,597	217,511	178,344	615,452
viii	Renewable electricity	32,307	12,493	18,271	63,071
ix	Water extraction and supply	49,976	39,311	42,010	131,296
B	**Environmental Management**	**159,978**	**124,229**	**181,417**	**465,625**
B1	**Pollution management**	**132,131**	**93,956**	**150,492**	**376,579**
i	Solid Waste Management & Recycling (SWM)	47,494	32,567	53,226	133,286
ii	Waste Water Treatment (WWT)	47,604	32,643	53,350	133,597
iii	Air Pollution Control (APC)	15,200	15,789	17,550	48,538
iv	General Public Administration (GPA)	10,319	5,261	15,524	31,104
v	Private Environmental Management (PEM)	5,025	2,598	3,508	11,131
vi	Remediation & Clean Up of Soil & Groundwater (RCSG)	4,648	3,188	5,210	13,046
vii	Noise & Vibration Control (NVC)	1,840	1,912	2,125	5,877
viii	Environmental Research & Development (ERD)	n/a	n/a	n/a	n/a
ix	Environmental Monitoring & Instrumentation (EMI)	n/a	n/a	n/a	n/a
B2	**Resource management**	**27,847**	**30,273**	**30,925**	**89,046**
i	Recycled materials	22,666	26,720	25,118	74,503
ii	Nature protection	5,182	3,553	5,807	14,542
C	**Environment Quality**				
i	Environment related Tourism	144,309	125,308	148,834	418,452
	Total	**1,101,775**	**962,664**	**922,591**	**2,987,031**

Table 4.11a provides estimates of the total output in environment related activities (and Table 4.11b provides estimates of the direct output) by Member State, for the broad classes of environmental activity. The UK has the highest direct output of all member states in broad economic activities based on natural resources (€136 billion) and 'environment related tourism' (€28 billion). Germany on the other hand has the highest output in 'environmental management activities' with around €50 billion. France had the highest output in core economic activities based on natural resources with nearly €20 billion.

Total output and direct output if excluding the broad economic activities based on natural resources (e.g. Conventional agriculture, mining, forestry, etc.) is around €1,126 billion and €405 billion respectively for EU-27. Core natural resource based activities (organic farming, sustainable forestry, water supply and renewables) account for 22%, environmental management accounts for a further 42% and ERT another 37% of total output of €405 billion (Table 4.12).

Total and direct output for each environmental sector by country is given in Annex G.

Table 4.11a: Total Output, (€ million) by Broad Environment Related Class, by Member State, 2000

€ million	Econ based on Natural resources	Environmental Management		Environment Quality	Total (exc. main env. primary sectors)
	Core	Pollution management	Resource management		
EU-27	**242,917**	**376,579**	**89,046**	**418,452**	**1,126,993**
Belgium	4,292	5,980	3,289	10,598	24,159
Denmark	2,268	14,423	1,298	6,879	24,869
Germany	38,850	100,894	20,270	64,057	224,071
Greece	1,235	2,271	326	4,749	8,580
Spain	13,246	12,607	1,689	33,510	61,051
France	45,858	67,469	15,859	53,311	182,497
Ireland	1,080	1,660	411	2,184	5,336
Italy	19,740	17,146	6,346	46,045	89,276
Luxembourg	99	413	156	857	1,526
Netherlands	8,167	23,161	3,035	14,374	48,737
Austria	12,780	20,283	1,092	8,275	42,430
Portugal	7,315	2,140	971	4,744	15,171
Finland	6,590	3,178	443	4,506	14,717
Sweden	11,719	7,235	1,603	10,246	30,804
UK	24,362	31,086	11,993	83,385	150,827
Czech Republic	2,806	655	637	2,647	6,745
Estonia	261	284	42	487	1,073
Cyprus	96	69	39	581	786
Latvia	669	129	55	631	1,484
Lithuania	358	319	139	646	1,461
Hungary	1,158	2,236	154	1,561	5,109
Malta	41	232	n/a	185	458
Poland	6,230	8,053	1,403	4,593	20,279
Slovenia	867	970	278	814	2,928
Slovakia	1,255	656	80	959	2,950
Bulgaria	962	618	n/a	695	2,276
Romania	2,614	1,826	n/a	1,444	5,884

€ million	Econ based on Natural resources	Total (exc. main env. primary sectors)	Total output
	Broad (exc. core)		
EU-27	**1,860,038**	**1,126,993**	**2,987,031**
Belgium	32,281	24,159	56,440
Denmark	33,280	24,869	58,149
Germany	256,326	224,071	480,396
Greece	24,611	8,580	33,192
Spain	126,522	61,051	187,573
France	253,458	182,497	435,954
Ireland	11,962	5,336	17,298
Italy	130,874	89,276	220,150
Luxembourg	974	1,526	2,500
Netherlands	81,263	48,737	129,999
Austria	21,546	42,430	63,976
Portugal	21,044	15,171	36,215
Finland	21,049	14,717	35,766
Sweden	23,055	30,804	53,858
UK	356,622	150,827	507,449
Czech Republic	25,855	6,745	32,600
Estonia	3,652	1,073	4,726
Cyprus	1,423	786	2,209
Latvia	2,991	1,484	4,474
Lithuania	7,736	1,461	9,197
Hungary	18,832	5,109	23,942
Malta	571	458	1,029
Poland	75,920	20,279	96,200
Slovenia	4,312	2,928	7,241
Slovakia	10,908	2,950	13,858
Bulgaria	9,930	2,276	12,206
Romania	27,128	5,884	33,013

Table 4.11b: Total Direct Output, (€ million) by Broad Environment Related Class, by Member State, 2000

€ million	Econ based on Natural resources	Environmental Management		Environment Quality	Total (exc. main env. primary sectors)
	Core	Pollution management	Resource management		
EU-27	**100,733**	**132,135**	**27,847**	**144,309**	**405,024**
Belgium	1,949	2,584	1,567	4,453	10,552
Denmark	1,064	6,071	532	3,462	11,130
Germany	16,913	42,716	7,817	23,956	91,403
Greece	612	1,169	169	2,670	4,620
Spain	6,450	4,844	653	14,657	26,605
France	19,773	24,498	5,592	19,312	69,175
Ireland	502	791	217	1,104	2,614
Italy	10,677	8,090	2,728	21,301	42,796
Luxembourg	53	219	53	417	741
Netherlands	4,051	9,420	1,228	6,063	20,762
Austria	7,515	8,460	477	3,528	19,980
Portugal	3,451	879	403	1,875	6,609
Finland	3,520	1,331	190	1,919	6,960
Sweden	6,416	2,887	625	4,125	14,053
UK	10,400	11,086	4,286	28,556	54,329
Czech Republic	1,167	305	331	1,163	2,966
Estonia	126	125	22	226	499
Cyprus	62	35	18	308	422
Latvia	402	60	20	282	765
Lithuania	184	164	69	321	738
Hungary	486	1,021	83	667	2,257
Malta	27	98	n/a	80	204
Poland	2,420	3,785	609	2,220	9,035
Slovenia	441	397	119	318	1,275
Slovakia	636	296	38	444	1,414
Bulgaria	361	206	n/a	242	809
Romania	1,074	598	n/a	640	2,312

€ million	Econ based on Natural resources	Total (exc. main env. primary sectors)	Total output
	Broad (exc. Core)		
EU-27	**696,755**	**405,024**	**1,101,779**
Belgium	15,942	10,552	26,494
Denmark	17,027	11,130	28,157
Germany	100,341	91,403	191,744
Greece	15,371	4,620	19,991
Spain	57,978	26,605	84,583
France	107,895	69,175	177,070
Ireland	7,707	2,614	10,321
Italy	74,214	42,796	117,009
Luxembourg	501	741	1,243
Netherlands	41,308	20,762	62,070
Austria	10,152	19,980	30,132
Portugal	9,546	6,609	16,155
Finland	9,052	6,960	16,012
Sweden	11,177	14,053	25,230
UK	136,347	54,329	190,676
Czech Republic	10,515	2,966	13,481
Estonia	1,628	499	2,127
Cyprus	961	422	1,383
Latvia	1,340	765	2,105
Lithuania	4,302	738	5,040
Hungary	8,529	2,257	10,785
Malta	351	204	555
Poland	30,456	9,035	39,490
Slovenia	2,050	1,275	3,325
Slovakia	4,501	1,414	5,915
Bulgaria	4,465	809	5,274
Romania	13,100	2,312	15,413

The main findings for environment related output as a proportion of total environment output excluding the broad natural resources based activities are -

- In Portugal, Finland and Latvia over 45% of total output came from core natural resource based activities
- In Denmark, 63% of output came from the environmental management sector
- Over 50% of output came from ERT in Greece, Spain, Italy, UK and Cyprus.

Table 4.12: Share of Environment Related Total Output, by Broad Class, by MS, 2000

	Econ based on Natural resources	Environmental Management		Environment Quality
	Core	Pollution management	Resource management	
EU-27	**22%**	**33%**	**8%**	**37%**
Belgium	18%	25%	14%	44%
Denmark	9%	58%	5%	28%
Germany	17%	45%	9%	29%
Greece	14%	26%	4%	55%
Spain	22%	21%	3%	55%
France	25%	37%	9%	29%
Ireland	20%	31%	8%	41%
Italy	22%	19%	7%	52%
Luxembourg	6%	27%	10%	56%
Netherlands	17%	48%	6%	29%
Austria	30%	48%	3%	20%
Portugal	48%	14%	6%	31%
Finland	45%	22%	3%	31%
Sweden	38%	23%	5%	33%
UK	16%	21%	8%	55%
Czech Republic	42%	10%	0	39%
Estonia	24%	26%	0	45%
Cyprus	12%	9%	0	74%
Latvia	45%	9%	0	43%
Lithuania	24%	22%	0	44%
Hungary	23%	44%	0	31%
Malta	9%	51%	n/a	40%
Poland	31%	40%	0	23%
Slovenia	30%	33%	0	28%
Slovakia	43%	22%	0	33%
Bulgaria	42%	27%	n/a	31%
Romania	44%	31%	n/a	25%

	Econ based on Natural resources	Total (exc. main env. primary sectors)
	Broad (exc. core)	
EU-27	62%	38%
Belgium	57%	43%
Denmark	57%	43%
Germany	53%	47%
Greece	74%	26%
Spain	67%	33%
France	58%	42%
Ireland	69%	31%
Italy	59%	41%
Luxembourg	39%	61%
Netherlands	63%	37%
Austria	34%	66%
Portugal	58%	42%
Finland	59%	41%
Sweden	43%	57%
UK	70%	30%
Czech Republic	79%	21%
Estonia	77%	23%
Cyprus	64%	36%
Latvia	67%	33%
Lithuania	84%	16%
Hungary	79%	21%
Malta	56%	44%
Poland	79%	21%
Slovenia	60%	40%
Slovakia	79%	21%
Bulgaria	81%	19%
Romania	82%	18%

Note: The shares are based on the two total columns in Table 4.11a. Eg. For core natural resources – 242,917/1,126,993 is 22%.

Another useful measure to look at the importance of environment related activities is to analyse the per capita output in each of the 3 main categories. Table 4.13a and 4.13b summarise the environmental related direct and total output per capita respectively, for each of the member states. Denmark has the highest direct output per capita in broad economic activities based on natural resources with around €3,200. Austria has the highest total direct and total output per capita at around €5,302 and €2,500 when broad natural resource based activities are excluded.

Main findings for environment related direct and total output per capita -

- Austria (€1,600), Sweden (€1,322) and Finland (€1,274) have the highest total output per capita in core natural resource based activities.
- Denmark and Austria have the highest output per capita in environmental management activities and environment related tourism.

Table 4.13a: Direct Output per Capita, (€ per capita) by Broad Environment Related Class, by Member State, 2000

	Econ based on Natural resources	Environmental Management		Environment Quality	Total (exc. main env. primary sectors)
€ per capita	Core	Pollution management	Resource management		
EU-27	**210**	**275**	**58**	**300**	**843**
Belgium	190	252	153	435	1,031
Denmark	200	1,139	100	650	2,088
Germany	206	520	95	292	1,112
Greece	56	107	15	245	424
Spain	161	121	16	366	664
France	336	416	95	328	1,176
Ireland	133	209	58	292	692
Italy	188	142	48	374	752
Luxembourg	122	505	122	961	1,710
Netherlands	255	594	77	382	1,309
Austria	939	1,057	60	441	2,497
Portugal	339	86	40	184	648
Finland	681	257	37	371	1,346
Sweden	724	326	71	465	1,586
UK	177	189	73	486	924
Czech Republic	114	30	32	113	289
Estonia	92	91	16	165	363
Cyprus	89	51	26	445	612
Latvia	169	25	9	119	321
Lithuania	52	47	20	91	210
Hungary	48	100	8	65	221
Malta	70	257	n/a	210	537
Poland	63	98	16	57	234
Slovenia	222	200	60	160	641
Slovakia	118	55	7	82	262
Bulgaria	44	25	n/a	30	99
Romania	49	27	n/a	29	105

	Econ based on Natural resources	Total (exc. main env. primary sectors)	Total output
€ per capita	Broad (exc. Core)		
EU-27	**1,450**	**843**	**2,293**
Belgium	1,557	10,552	2,588
Denmark	3,195	11,130	5,283
Germany	1,221	91,403	2,334
Greece	1,410	4,620	1,833
Spain	1,448	26,605	2,112
France	1,834	69,175	3,010
Ireland	2,040	2,614	2,732
Italy	1,304	42,796	2,055
Luxembourg	1,156	741	2,866
Netherlands	2,604	20,762	3,913
Austria	1,269	19,980	3,765
Portugal	936	6,609	1,585
Finland	1,750	6,960	3,096
Sweden	1,261	14,053	2,847
UK	2,319	54,329	3,244
Czech Republic	1,023	2,966	1,312
Estonia	1,187	499	1,550
Cyprus	1,391	422	2,003
Latvia	563	765	884
Lithuania	1,225	738	1,435
Hungary	834	2,257	1,055
Malta	924	204	1,460
Poland	788	9,035	1,022
Slovenia	1,031	1,275	1,673
Slovakia	834	1,414	1,096
Bulgaria	545	2,685	644
Romania	597	7,725	703

Table 4.13b: Total Output per Capita, (€ per capita) by Broad Environment Related Class, by Member State, 2000

€ per capita	Econ based on Natural resources: Core	Environmental Management: Pollution management	Environmental Management: Resource management	Environment Quality	Total (exc. main env. primary sectors)
EU-27	**506**	**784**	**185**	**871**	**2,345**
Belgium	419	584	321	1,035	2,359
Denmark	426	2,706	244	1,291	4,666
Germany	473	1,228	247	780	2,727
Greece	113	208	30	436	787
Spain	331	315	42	837	1,524
France	780	1,147	270	906	3,103
Ireland	286	439	109	578	1,412
Italy	347	301	111	809	1,568
Luxembourg	229	953	360	1,977	3,519
Netherlands	515	1,460	191	906	3,072
Austria	1,597	2,535	136	1,034	5,302
Portugal	718	210	95	465	1,488
Finland	1,274	615	86	871	2,846
Sweden	1,322	816	181	1,156	3,476
UK	414	529	204	1,418	2,566
Czech Republic	273	64	62	258	656
Estonia	190	207	30	355	782
Cyprus	139	100	57	842	1,138
Latvia	281	54	23	265	623
Lithuania	102	91	40	184	416
Hungary	113	219	15	153	500
Malta	107	611	n/a	486	1,205
Poland	161	208	36	119	525
Slovenia	436	488	140	409	1,473
Slovakia	232	122	15	178	546
Bulgaria	117	76	n/a	85	278
Romania	119	83	n/a	66	268

€ per capita	Econ based on Natural resources: Broad	Total (exc. main env. primary sectors)	Total output
EU-27	**3,871**	**2,345**	**6,216**
Belgium	3,153	2,359	5,512
Denmark	6,244	4,666	10,910
Germany	3,120	2,727	5,847
Greece	2,257	787	3,044
Spain	3,159	1,524	4,684
France	4,309	3,103	7,411
Ireland	3,166	1,412	4,579
Italy	2,299	1,568	3,867
Luxembourg	2,246	3,519	5,765
Netherlands	5,122	3,072	8,195
Austria	2,693	5,302	7,995
Portugal	2,064	1,488	3,552
Finland	4,070	2,846	6,916
Sweden	2,602	3,476	6,078
UK	6,067	2,566	8,632
Czech Republic	2,516	656	3,172
Estonia	2,663	782	3,445
Cyprus	2,061	1,138	3,199
Latvia	1,256	623	1,879
Lithuania	2,203	416	2,619
Hungary	1,842	500	2,342
Malta	1,502	1,205	2,707
Poland	1,964	525	2,489
Slovenia	2,169	1,473	3,642
Slovakia	2,020	546	2,567
Bulgaria	1,212	278	1,490
Romania	1,237	268	1,505

The estimated direct output for each of the environment related activities (Table 4.10) was assigned to NACE sectors as defined in I-O tables, enabling estimates of the indirect and induced employment and subsequent output related multipliers (Table 4.14). Output multiplier for each environmental sector by member state is given in Annex G.

Table 4.14: Environment Related Output Multipliers by Broad Environment-Economy Linkages, by Member State, 2000

	Econ based on Natural resources				Environmental Management				Environment Quality	
	Core		Broad		Pollution management		Resource management			
	Type I	Type II	Type I	Type II	Type I	Type II	Type I	Type II	Type I	Type II
EU-27	1.67	2.41	1.89	2.62	1.71	2.85	2.09	3.20	1.87	2.92
Belgium	1.49	2.20	1.66	2.02	1.62	2.31	1.67	2.10	1.84	2.38
Denmark	1.51	2.13	1.51	1.93	1.47	2.37	1.46	2.44	1.40	1.99
Germany	1.60	2.30	1.75	2.56	1.50	2.36	1.72	2.56	1.77	2.67
Greece	1.30	2.02	1.36	1.58	1.35	1.95	1.34	1.93	1.46	1.78
Spain	1.50	2.05	1.71	2.16	1.50	2.59	1.85	2.68	1.63	2.29
France	1.62	2.32	1.74	2.35	1.63	2.75	1.91	2.84	1.75	2.76
Ireland	1.31	2.15	1.28	1.56	1.29	2.13	1.28	1.91	1.37	1.98
Italy	1.58	1.85	1.47	1.77	1.61	2.04	1.98	2.41	1.71	2.16
Luxembourg	1.18	1.88	1.56	1.93	1.34	1.90	2.17	2.96	1.50	2.06
Netherlands	1.45	2.02	1.60	1.97	1.63	2.48	1.59	2.53	1.58	2.37
Austria	1.28	1.70	1.68	2.12	1.53	2.39	1.53	2.29	1.59	2.35
Portugal	1.52	2.12	1.82	2.21	1.57	2.43	1.69	2.45	1.78	2.53
Finland	1.46	1.87	1.82	2.33	1.55	2.43	1.73	2.51	1.64	2.35
Sweden	1.36	1.83	1.53	2.06	1.58	2.52	1.80	2.77	1.70	2.48
UK	1.69	2.34	2.02	2.62	1.68	2.82	1.77	2.84	1.81	2.92
Czech Republic	1.89	2.40	1.96	2.46	1.69	2.16	1.65	2.08	1.78	2.28
Estonia	1.56	2.07	1.71	2.25	1.53	2.29	1.54	2.13	1.63	2.15
Cyprus	1.41	1.56	1.28	1.45	1.48	1.91	1.30	1.98	1.36	1.89
Latvia	1.34	1.66	1.94	2.21	1.73	2.13	2.04	2.51	1.87	2.24
Lithuania	1.32	1.94	1.46	1.79	1.43	1.94	1.67	2.14	1.56	2.01
Hungary	1.67	2.38	1.78	2.21	1.66	2.20	1.60	2.11	1.73	2.34
Malta	1.32	1.53	1.21	1.66	1.33	2.38	n/a	n/a	1.34	2.31
Poland	1.86	2.57	1.96	2.49	1.67	2.13	1.87	2.36	1.62	2.07
Slovenia	1.38	1.97	1.60	2.10	1.58	2.47	1.60	2.38	1.78	2.56
Slovakia	1.62	1.97	2.05	2.42	1.72	2.23	1.77	2.20	1.76	2.16
Bulgaria	1.97	2.64	1.70	2.22	2.17	2.98	n/a	n/a	1.79	2.87
Romania	1.97	2.42	1.74	2.07	2.16	3.05	n/a	n/a	1.75	2.25

The output multiplier is measured in a similar way to the employment multiplier. It is a reflection of the domestic purchasing linkages of the sector in question.

Using the same example of a new waste water plant in Belgium, if the new plant generated total output of €5million then again there will be two effects:

- Effect on suppliers (Indirect output effect) – to estimate the indirect effect on this plant's suppliers, multiply the direct impact (€5m) by the Type I output multiplier for this industry, which gives: €5m × 1.62 = **€8.12m** total direct plus indirect impact.
- Effect on households (induced output effects) – we would expect the direct and indirect increases in output to lead to increased employment in the plant's suppliers and subsequently to an increase in household consumption. Multiplying the direct impact (€5m) by the Type II output multiplier gives: €5m × 2.33 = **€11.7m** of increased output (including direct, indirect and induced effects).

Table 4.9 previously summarised aggregate employment and output multipliers for all environment related sectors by EU-27 member states. The overall Type I output multiplier for EU-27 is 1.85 (indirect effect only), i.e. for every €100 of output generated by activities relating to the environment, another €85 of output is supported elsewhere in

EU-27. Taking into account type II output multiplier (2.68) [32], another €183 (€268 - €85) of output is supported in the EU-27 attributed to the induced impact of every €100 of output in environment related activities.

4.5 GVA Impacts from Environment Related Activities

The direct impact of GVA from environment related activities was around €550 billion for EU-27 in 2000 prices (Table 4.15). Indirect and induced effects of these activities added a further €680 billion, which took the total GVA of environment related activities to over €1200 billion.

Table 4.15: GVA (€ million) from Environment Related Activities, EU-27, 2000

		Direct	Indirect	Induced	Total
A	**Econ based on Natural resources**	**395,462**	**345,051**	**137,543**	**878,056**
i	Agriculture (non- organic)	162,191	138,817	49,821	350,829
ii	Organic farming	5,850	4,420	1,634	11,904
iii	Forestry (other)	7,360	4,465	2,770	14,594
iv	Sustainable forestry	3,300	2,291	1,254	6,844
v	Fishing (except recreation, which is covered under tourism)	5,234	3,596	1,863	10,693
vi	Mining, extraction and quarrying	61,831	27,635	14,289	103,756
vii	Non-renewable Electricity generation	108,895	137,972	52,105	298,972
viii	Renewable electricity	16,020	7,199	4,518	27,737
ix	Water extraction and supply	24,782	18,656	9,290	52,728
B	**Environmental Management**	**79,331**	**61,513**	**39,088**	**179,932**
B1	**Pollution management**	**65,522**	**43,888**	**30,230**	**139,640**
i	Solid Waste Management & Recycling (SWM)*	23,551	14,670	10,218	48,440
ii	Waste Water Treatment (WWT)*	23,606	14,705	10,242	48,553
iii	Air Pollution Control (APC)*	7,537	8,870	4,957	21,364
iv	General Public Administration (GPA)*	5,117	1,928	2,559	9,604
v	Private Environmental Management (PEM)*	2,492	1,206	653	4,351
vi	Remediation & Clean Up of Soil & Groundwater (RCSG)*	2,305	1,436	1,000	4,741
vii	Noise & Vibration Control (NVC)*	913	1,074	600	2,587
viii	Environmental Research & Development (ERD)	n/a	n/a	n/a	n/a
ix	Environmental Monitoring & Instrumentation (EMI)	n/a	n/a	n/a	n/a
B2	**Resource management**	**13,809**	**17,625**	**8,858**	**40,292**
i	Recycled materials*	11,240	16,024	7,743	35,007
ii	Nature protection*	2,570	1,601	1,115	5,285
C	**Environment Quality**				
i	Environment related Tourism	71,498	61,190	34,655	167,343
	Total	**546,291**	**467,754**	**211,286**	**1,225,332**

Table 4.16a and Table 4.16b summarise total and direct GVA respectively, by the broad classes of environment related activities and by member state in 2000. Environment related GVA by member states has the same pattern as output.

Excluding broad natural resource based activities makes a major difference to the estimated impact, reducing the estimated total GVA[33] to €446 billion and direct GVA to €200 billion.

Total and direct GVA for each environmental sector by country, are given in Annex G.

[32] The overall EU-27 multiplier is calculating by aggregating all 27 MSs input-output tables and thus have a larger multiplier effect as the linkages will feed through all sectors in each of the member states. The EU level multiplier is also large as trade between EU countries is not counted as a leakage from the system. The individual country multipliers should be used as much as possible to see the overall impact increasing output (or employment) in environmental related activities. Please see Annex C for details on multipliers.

[33] Including in-direct and induced effects.

Table 4.16a: Total GVA (€ million) by Broad Environment Related Class, by Member State, 2000

€ million	Econ based on Natural resources	Environmental Management		Environment Quality	Total (exc. main env. primary sectors)
	Core	Pollution management	Resource management		
EU-27	**99,213**	**139,640**	**40,292**	**167,343**	**446,488**
Belgium	456	2,185	1,648	4,673	8,962
Denmark	1,456	5,561	468	3,273	10,758
Germany	13,525	36,858	9,295	26,475	86,153
Greece	308	834	117	1,965	3,225
Spain	5,232	4,495	815	12,351	22,893
France	18,347	24,315	7,345	20,552	70,558
Ireland	208	607	163	845	1,824
Italy	11,119	6,950	3,413	19,184	40,665
Luxembourg	16	172	70	328	586
Netherlands	1,589	9,527	1,203	5,924	18,243
Austria	10,151	7,406	425	3,227	21,209
Portugal	2,984	817	435	2,078	6,314
Finland	4,933	1,203	201	1,733	8,070
Sweden	7,453	2,719	838	4,371	15,381
UK	6,387	11,782	4,923	33,404	56,496
Czech Republic	625	302	349	1,105	2,380
Estonia	122	95	51	210	479
Cyprus	0	29	15	229	272
Latvia	375	47	26	294	743
Lithuania	130	119	73	303	624
Hungary	53	954	78	628	1,714
Malta	0	97	0	73	170
Poland	1,638	3,245	673	1,912	7,469
Slovenia	419	362	117	342	1,239
Slovakia	964	269	33	438	1,704
Bulgaria	304	291	0	267	862
Romania	911	705	0	540	2,156

	Econ based on Natural resources	Total (exc. main env. primary sectors)	Total output
	Broad (exc. Core)		
EU-27	**778,843**	**446,488**	**1,225,332**
Belgium	13,031	8,962	21,993
Denmark	13,841	10,758	24,599
Germany	110,413	86,153	196,567
Greece	10,068	3,225	13,293
Spain	50,924	22,893	73,817
France	109,048	70,558	179,607
Ireland	5,013	1,824	6,837
Italy	53,008	40,665	93,673
Luxembourg	553	586	1,139
Netherlands	39,119	18,243	57,363
Austria	9,376	21,209	30,584
Portugal	9,725	6,314	16,039
Finland	8,675	8,070	16,745
Sweden	9,359	15,381	24,740
UK	382,272	56,496	438,768
Czech Republic	10,841	2,380	13,221
Estonia	2,314	479	2,792
Cyprus	621	272	894
Latvia	1,492	743	2,235
Lithuania	3,630	624	4,254
Hungary	8,286	1,714	9,999
Malta	247	170	417
Poland	33,294	7,469	40,763
Slovenia	1,835	1,239	3,074
Slovakia	7,680	1,704	9,384
Bulgaria	4,209	862	5,071
Romania	12,083	2,156	14,239

Table 4.16b: Direct GVA (€ million) by Broad Environment Related Class, by Member State, 2000

€ million	Econ based on Natural resources	Environmental Management		Environment Quality	Total (exc. main env. primary sectors)
	Core	Pollution management	Resource management		
EU-27	**49,952**	**65,522**	**13,809**	**71,498**	**200,781**
Belgium	277	1,281	777	2,206	4,541
Denmark	834	3,010	264	1,715	5,823
Germany	7,395	21,181	3,877	11,869	44,322
Greece	221	580	84	1,323	2,207
Spain	3,079	2,402	324	7,262	13,067
France	8,063	12,148	2,773	9,568	32,552
Ireland	132	392	108	547	1,179
Italy	6,894	4,012	1,353	10,553	22,812
Luxembourg	12	109	26	207	354
Netherlands	790	4,671	609	3,004	9,074
Austria	6,868	4,195	237	1,748	13,047
Portugal	1,571	436	200	929	3,136
Finland	3,079	660	94	951	4,784
Sweden	5,238	1,431	310	2,044	9,023
UK	2,846	5,497	2,125	14,148	24,616
Czech Republic	330	151	164	576	1,221
Estonia	66	62	11	112	251
Cyprus	0	17	9	152	179
Latvia	275	30	10	140	455
Lithuania	77	82	34	159	351
Hungary	29	506	41	330	907
Malta	0	48	n/a	40	88
Poland	733	1,877	302	1,100	4,012
Slovenia	263	197	59	157	676
Slovakia	393	147	19	220	778
Bulgaria	124	102	n/a	120	346
Romania	364	296	n/a	317	977

	Econ based on Natural resources	Total (exc. main env. primary sectors)	Total output
	Broad (exc. Core)		
EU-27	**345,510**	**200,781**	**546,291**
Belgium	8,148	4,541	12,689
Denmark	7,979	5,823	13,802
Germany	50,777	44,322	95,099
Greece	7,292	2,207	9,498
Spain	28,363	13,067	41,430
France	55,281	32,552	87,833
Ireland	3,736	1,179	4,915
Italy	36,037	22,812	58,849
Luxembourg	251	354	604
Netherlands	20,616	9,074	29,690
Austria	4,945	13,047	17,993
Portugal	5,275	3,136	8,411
Finland	4,369	4,784	9,153
Sweden	5,678	9,023	14,701
UK	66,562	24,616	91,178
Czech Republic	5,250	1,221	6,471
Estonia	781	251	1,031
Cyprus	473	179	652
Latvia	677	455	1,131
Lithuania	2,040	351	2,391
Hungary	4,157	907	5,064
Malta	175	88	263
Poland	14,867	4,012	18,879
Slovenia	1,029	676	1,705
Slovakia	2,192	778	2,970
Bulgaria	2,175	346	2,521
Romania	6,387	977	7,365

Core natural resource based activities (organic farming, sustainable forestry, water supply and renewables) account for 22%, environmental management accounts for a further 40% and ERT another 37% of total output of €446 billion (Table 4.17).

The main findings for environment related GVA as a proportion of total environment GVA excluding the broad natural resources based activities are -

- In Austria, Portugal, Finland and Sweden, core natural resources based activities account for over 45% of GVA.
- Environmental management accounts for the highest share of GVA in Denmark (56%), Germany (54%), Netherlands (59%) and Hungary (61%).
- In Greece, Spain, Belgium, UK and Cyprus ERT accounts for over 50% of GVA.

Table 4.17: Proportion of Environment Related GVA by MS, 2000

	Econ based on Natural resources	Environmental Management		Environment Quality
	Core	Pollution management	Resource management	
EU-27	**22%**	**31%**	**9%**	**37%**
Belgium	5%	24%	18%	52%
Denmark	14%	52%	4%	30%
Germany	16%	43%	11%	31%
Greece	10%	26%	4%	61%
Spain	23%	20%	4%	54%
France	26%	34%	10%	29%
Ireland	11%	33%	9%	46%
Italy	27%	17%	8%	47%
Luxembourg	3%	29%	12%	56%
Netherlands	9%	52%	7%	32%
Austria	48%	35%	2%	15%
Portugal	47%	13%	7%	33%
Finland	61%	15%	2%	21%
Sweden	48%	18%	5%	28%
UK	11%	21%	9%	59%
Czech Republic	26%	13%	15%	46%
Estonia	25%	20%	11%	44%
Cyprus	0%	10%	5%	84%
Latvia	51%	6%	4%	40%
Lithuania	21%	19%	12%	49%
Hungary	3%	56%	5%	37%
Malta	0%	57%	n/a	43%
Poland	22%	43%	9%	26%
Slovenia	34%	29%	9%	28%
Slovakia	57%	16%	2%	26%
Bulgaria	35%	34%	n/a	31%
Romania	42%	33%	n/a	25%

	Econ based on Natural resources	Total (exc. main env. primary sectors)
	Broad (inc. core)	
EU-27	**64%**	**36%**
Belgium	59%	41%
Denmark	56%	44%
Germany	56%	44%
Greece	76%	24%
Spain	69%	31%
France	61%	39%
Ireland	73%	27%
Italy	57%	43%
Luxembourg	49%	51%
Netherlands	68%	32%
Austria	31%	69%
Portugal	61%	39%
Finland	52%	48%
Sweden	38%	62%
UK	87%	13%
Czech Republic	82%	18%
Estonia	83%	17%
Cyprus	70%	30%
Latvia	67%	33%
Lithuania	85%	15%
Hungary	83%	17%
Malta	59%	41%
Poland	82%	18%
Slovenia	60%	40%
Slovakia	82%	18%
Bulgaria	83%	17%
Romania	85%	15%

Note: The shares are based on the two total columns in Table 4.16a. Eg. For core natural resources – 99,213/446,488 is 22%.

The estimated GVA for each of the environment related activities (Table 4.15) was assigned to NACE sectors as defined in I-O tables, to calculate GVA multipliers (Table 4.18). GVA multipliers for each environmental sector by member state are given in Annex G.

Table 4.18: Environment Related GVA Multipliers by Broad Environment-Economy Linkages, by Member State, 2000

	Econ based on Natural resources				Environmental Management				Environment Quality	
	Core		Broad		Pollution management		Resource management			
	Type I	Type II	Type I	Type II	Type I	Type II	Type I	Type II	Type I	Type II
EU-27	1.66	1.66	1.85	1.85	1.64	1.64	2.21	2.21	1.86	1.86
Belgium	1.47	1.47	1.50	1.50	1.53	1.53	1.90	1.90	1.93	1.93
Denmark	1.53	1.53	1.43	1.43	1.47	1.47	1.42	1.42	1.55	1.55
Germany	1.59	1.59	1.83	1.83	1.45	1.45	1.93	1.93	1.84	1.84
Greece	1.41	1.41	1.34	1.34	1.33	1.33	1.32	1.32	1.43	1.43
Spain	1.52	1.52	1.63	1.63	1.45	1.45	2.05	2.05	1.49	1.49
France	1.75	1.75	1.71	1.71	1.57	1.57	2.11	2.11	1.72	1.72
Ireland	1.23	1.23	1.25	1.25	1.28	1.28	1.28	1.28	1.35	1.35
Italy	1.48	1.48	1.40	1.40	1.60	1.60	2.29	2.29	1.72	1.72
Luxembourg	1.16	1.16	1.73	1.73	1.32	1.32	2.20	2.20	1.37	1.37
Netherlands	1.61	1.61	1.55	1.55	1.65	1.65	1.58	1.58	1.61	1.61
Austria	1.35	1.35	1.72	1.72	1.51	1.51	1.54	1.54	1.60	1.60
Portugal	1.53	1.53	1.69	1.69	1.56	1.56	1.80	1.80	1.90	1.90
Finland	1.44	1.44	1.78	1.78	1.51	1.51	1.77	1.77	1.57	1.57
Sweden	1.28	1.28	1.45	1.45	1.57	1.57	2.12	2.12	1.81	1.81
UK	1.56	1.56	2.02	2.02	1.68	1.68	1.81	1.81	1.86	1.86
Czech Republic	1.75	1.75	1.86	1.86	1.80	1.80	1.89	1.89	1.75	1.75
Estonia	1.57	1.57	1.99	1.99	1.36	1.36	3.05	3.05	1.68	1.68
Cyprus	1.55	1.55	1.28	1.28	1.41	1.41	1.41	1.41	1.36	1.36
Latvia	1.38	1.38	2.08	2.08	1.44	1.44	2.24	2.24	1.97	1.97
Lithuania	1.77	1.77	1.65	1.65	1.34	1.34	1.94	1.94	1.76	1.76
Hungary	1.64	1.64	1.82	1.82	1.75	1.75	1.73	1.73	1.73	1.73
Malta	1.17	1.17	1.19	1.19	1.34	1.34	n/a	n/a	1.36	1.36
Poland	2.02	2.02	2.00	2.00	1.59	1.59	1.97	1.97	1.60	1.60
Slovenia	1.36	1.36	1.59	1.59	1.53	1.53	1.62	1.62	1.83	1.83
Slovakia	2.24	2.24	3.05	3.05	1.52	1.52	1.63	1.63	1.87	1.87
Bulgaria	2.03	2.03	1.59	1.59	2.32	2.32	n/a	n/a	1.71	1.71
Romania	2.18	2.18	1.67	1.67	2.04	2.04	n/a	n/a	1.55	1.55

4.6 Multiplier Effects of the Tourism Sector from WTTC TSA

According to Eurostat the number of employees in the tourism sector in EU-27 in 2001 was nearly 7 million[34], whereas according to the report of the High Level Group on Tourism and Employment tourism employs directly[35] nearly 12 million people in the European Union[36]. The 7 million jobs estimate is based on aggregate jobs in tourism intensive sectors such as hotels, restaurants, and travel and tour operators. It is not based on a share of tourism related jobs from these sectors. The 12 million job estimate is based on a system of Tourism Satellite Accounts (TSA) as developed by the World Tourism and Travel Council (WTTC).

If 'indirect employment' in other sectors is taken into account, more than 20.6 million jobs could be recorded[37].

The TSA provide estimates of both direct and indirect employment and output effects for the tourism sector (Table 4.19), but exclude induced effects. The TSA encapsulates a

34 This figure takes into account the sub sectors of hotels, restaurants and cafes as well as tour operators and travel agencies. Source: Statistics in Focus, 6/2003, 11.2.2003, title page. http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-NP-03-006/EN/KS-NP-03-006-EN.PDF

35 According to the WTTC definition 'travel and tourism direct employment' or 'tourism industry, employment' shows the number of people directly employed in the travel and tourism industry. This generally includes those jobs with face-to-face contact with visitors, such as workers in airlines, hotels, car rental, restaurants, retail, and entertainment. Source: World Travel and Tourism Council, see Annex A1 on page 69.

36 High Level Group on Tourism and Employment, final report, October 1998, p. 5

37 WTTC Tourism satellite accounts

wider set of sectors from the whole economy to quantify jobs and output related to tourism. Some of the sectors are not tourism intensive and have thus been given a lower weight for measuring overall tourism related employment and GDP.

Table 4.19: WTTC TSA Employment, FTE ('000s) and GDP (€ billion), 2001

	employment ('000)			GDP (€ Billion)		
	Direct	indirect	Total	Direct	indirect	Total
EU-27	**11,759**	**9,548**	**21,307**	**528**	**554**	**1,083**
Austria	335	270	605	16.0	17.4	33.3
Belgium	230	146	376	13.2	15.2	28.3
Bulgaria	n/a	n/a	n/a	n/a	n/a	n/a
Cyprus	87	62	148	1.9	1.3	3.2
Czech Republic	204	333	537	3.2	5.1	8.3
Denmark	122	130	252	7.9	8.4	16.3
Estonia	38	61	99	0.5	0.8	1.4
Finland	117	88	205	6.6	7.7	14.3
France	1,847	1,289	3,136	94.7	94.0	188.6
Germany	1,888	1,430	3,318	91.9	113.3	205.2
Greece	471	263	734	12.9	8.5	21.4
Hungary	239	204	443	3.7	3.2	6.9
Ireland	64	55	118	4.7	5.7	10.3
Italy	1,430	933	2,363	75.2	67.9	143.1
Latvia	19	31	50	0.2	0.3	0.5
Lithuania	39	63	101	0.5	0.7	1.2
Luxembourg	11	7	17	1.1	1.3	2.3
Malta	34	12	47	0.8	0.3	1.1
Netherlands	295	222	517	19.2	22.4	41.6
Poland	396	645	1,041	6.3	10.2	16.5
Portugal	503	323	826	10.4	9.6	20.0
Romania	n/a	n/a	n/a	n/a	n/a	n/a
Slovakia	99	161	259	1.2	2.0	3.2
Slovenia	47	56	103	0.7	1.1	1.8
Spain	1,728	1,109	2,837	67.2	61.5	128.7
Sweden	166	198	364	9.2	11.1	20.3
UK	1,350	1,459	2,809	79.1	85.5	164.6

The estimates from the WTTC TSA are significantly higher than the OECD-E3ME Input-Output[38] tables used for this study. This is more apparent for employment, due to the difference in definition of the tourism sector and the intensity of tourism in all other sectors of the economy (Table 4.20). WTTC TSA, using surveys, have estimated tourism consumption shares for a wide range of economic activities. Sectors such as travel agencies, tour operators, hotels and restaurants, travel companies, adventure parks were designated 50-100% tourism share. Complementary and ancillary services such as wholesale and retail, landscape maintenance/farming, entertainment and communication constitute tourism were given a share of 25-50%.

[38] As described in section 3.2

Table 4.20: Overall Tourism Employment, FTE (‘000s) and GDP (€ billion) in EU-27, 2000

	Employment ('000)			GDP (€ Billion)		
	Direct	Indirect	Total	Direct	Indirect	Total
WTTC TSA (2001)	11,759	9,548	21,307	528	554	1,083
OECD/E3ME I-O Tables (2000)	5,525	3,769	9,294	236	202	438

Note: OECD/E3ME are GVA estimates not GDP. The link between GVA and GDP is that GVA plus taxes on products minus subsidies on products is equal to GDP.

Environment related tourism is estimated to account for between 25-35% of total tourism[39]. Employment in environment related tourism, taking into account indirect and induced effect, could be anything between 2.3 million to 7.5 million depending on the definition of the tourism sector and dataset used (Table 4.21). Depending on the definition of the sector the share of tourism employment in total EU employment varies between 4 and 12 %. Similarly GDP estimates from environment related tourism can range from €109 to €380 billion (Table 4.21).

Table 4.21: Environment Related Employment, FTE (‘000s) and GDP (€ Billion), EU-27

		Employment ('000)			GDP (€ Billion)		
		Direct	Indirect	Total	Direct	Indirect	Total
WTTC TSA (2001)	25% estimate	2,940	2,387	5,327	132	139	271
	35% estimate	4,116	3,342	7,457	185	194	379
OECD/E3ME I-O Tables (2000)	25% estimate	1,381	942	2,324	59	50	109
	35% estimate	1,934	1,319	3,253	83	71	153

Note: The indirect impact for the WTTC TSA (2001) is from its own TSA model and not calculated using OECD/E3ME I-O model.

Findings from the WTTC data should be used independently of the findings from the OECD-E3ME I-O model as the two models are based on different data sources and methodology.

The ratio of total employment and output from the WTTC TSA enabled us to calculate Type 1 (indirect effect) employment and GDP multipliers for EU-27 in 2001 (Table 4.22). Multipliers in Table 4.22 can be compared with the ‘environment quality’ multipliers in Table 4.8 and Table 4.18. Since the WTTC TSA takes into account a wider range of sections in the economy to measure the tourism sector the multipliers are generally higher than the ‘environmental quality’ multipliers in Table 4.8 and Table 4.18 respectively.

39 Please see Annex E for more details on the proportion of environment related tourism.

The employment multiplier effect for EU-27 in Table 4.22 suggests that on average every 100 FTE jobs in environment related tourism supports another 81 jobs elsewhere in the EU-27.

Table 4.22 Employment and GDP multipliers (Type I only) from WTTC TSA, 2001

	Employment multiplier	GDP multiplier
EU-27	1.81	2.05
Austria	1.81	2.09
Belgium	1.64	2.15
Bulgaria	n/a	n/a
Cyprus	1.71	1.71
Czech Republic	2.63	2.63
Denmark	2.06	2.06
Estonia	2.63	2.61
Finland	1.75	2.17
France	1.70	1.99
Germany	1.76	2.23
Greece	1.56	1.65
Hungary	1.86	1.86
Ireland	1.85	2.22
Italy	1.65	1.90
Latvia	2.63	2.63
Lithuania	2.63	2.63
Luxembourg	1.59	2.20
Malta	1.36	1.36
Netherlands	1.75	2.17
Poland	2.63	2.63
Portugal	1.64	1.92
Romania	n/a	n/a
Slovakia	2.63	2.63
Slovenia	2.20	2.63
Spain	1.64	1.91
Sweden	2.20	2.20
UK	2.08	2.08

PART C: ECONOMIC IMPACTS OF SELECTED POLICY SCENARIOS

5 INTRODUCTION, APPROACH AND POLICY SCENARIOS

5.1 Background

Economic activity is influenced by, and influences, the environment through the use of, and impact on, environmental resources in both quantitative and qualitative ways. The two-way economy-environment linkage means that an efficient economy requires an efficient use of environmental resources (such that resources are used up to the point where the marginal social costs approximate to the marginal social benefits from their use). However, because the environment is often a public good establishing the social costs and benefits is very difficult. By most common consent, current and previous levels of resource use have exceeded their marginal social costs – environmental policy is therefore seeking to reduce the use of environmental resources compared to previous levels. Environmental policy has therefore a direct economic efficiency gain, although often the only effects that can be quantified are direct economic impacts associated with a given policy intervention. Of course any particular intervention may be inefficient having marginal costs in excess of marginal benefits, and the role of impact assessment is to establish on a case by case basis that measures are economically efficient.

This study has sought to better define and describe economy - environment linkages, and in particular to quantify the direct and indirect economic impacts of environmental policy interventions. This has been defined in aggregate terms with reference to spending on the use of resources and environmental management. However, to assist policy makers to understand the marginal direct and indirect impacts of policy the study has also investigated the economic impacts of specific interventions. These interventions have, for the purposes of analysis been described in the form of simple scenarios describing the nature of the intervention. These scenarios have been used to examine their marginal economic impacts using the input-output tables also used for the aggregate analysis. The results provide an illustration of a specific economy – environment linkage. They also provide the basis of a simple 'rule of thumb' calculation for policy makers when scoping out possible actions (mindful that depending on the nature or scale of intervention that non-marginal changes are possible). The analysis is clearly not intended to provide a detailed policy impact assessment.

The scenario analysis shows the impact on the economy of a specified policy intervention which changes the nature and/or costs of inputs (such as higher fuel costs or changes in current technology) to a sector (or group of sectors) and the subsequent impacts on the economy in terms of output and employment attributable to the intervention. The aim is to demonstrate the economic impact of the change towards a more sustainable mix of inputs, directly on the firms subject to the intervention, and indirectly on the economy as a whole.

Of course any intervention will have some impact compared to a 'steady state' situation where there is no additional intervention, since it implies, at the margin, a reallocation of resources from those sectors and actors financing the intervention and facing costs to those sectors and actors who benefit from the intervention. The scenario analysis therefore helps to understand the structural change in the economy due to policy drivers. For example, the change in the economy attributed to a 1% increase in energy efficiency of the manufacturing sector as a result of policy measures. The impacts can therefore be defined in both gross terms (ignoring the 'do nothing') and net terms (taking into account the impact were the costs of the intervention to be otherwise invested in the status quo, i.e. the counterfactual). For example an intervention that leads to an investment of €1 Million in new energy efficiency technology might be assumed to have otherwise been invested in technology with higher capital returns as indicated by current investment patterns.

In a closed domestic economy with no leakages (no taxes, exogenous injections (such as public investment) and trading) any change in activity (shown by an increase in output and prices) in one sector will not lead to any overall change in value added of the whole economy, but it will lead to a change in per sector output, wages, employment and profits. However, in an open economy, with trade, investment and taxes, the impacts of a policy intervention will impact on overall output according to sector productivity and export/import propensities, as well as sectoral output. By definition a positive impact on output is correlated with a positive impact on GDP and/or GVA.

5.2 Calculation of Quantity Effects

The quantity effect attempts to model the substitution of inputs from one sector for another. The policies are designed assuming that the sectors substituting provide less environmental intensive inputs (e.g. Recycled material sector for virgin material).

The quantity substitution effect is estimated within the Input-Output (I-O) analysis by changing the appropriate I-O coefficients according to each scenario. The new I-O table is then used to calculate multipliers (both output and employment), giving results that are directly comparable to the baseline scenario. The impact on output and employment is based on type II multipliers, which account for both direct and indirect effects of changes or shocks to the I-O table[40]. Employment estimates are based on full-time equivalent (FTE).

The estimated impact of the policy scenarios is given as an absolute impact in millions of euros. The reason for this is that the behavioural changes caused by the policy will have immediate impacts on output. The output estimate is used to estimate employment levels using employment-output ratios from the CE E3ME model[41]. These changes are entered as shocks and the indirect effects are subsequently calculated based on sector multipliers.

The methodology is shown in Figure 5.1, where a sector substitutes inputs from one sector for the other. This change is incorporated in the I-O table in the Sector C column by lowering the coefficient for Sector C by X% and increasing the coefficient of sector B by the same amount. This calculation assumes that sector B inputs cost the same as Sector C, leaving costs unchanged, but with indirect effects on the rest of the economy caused by the substitution.

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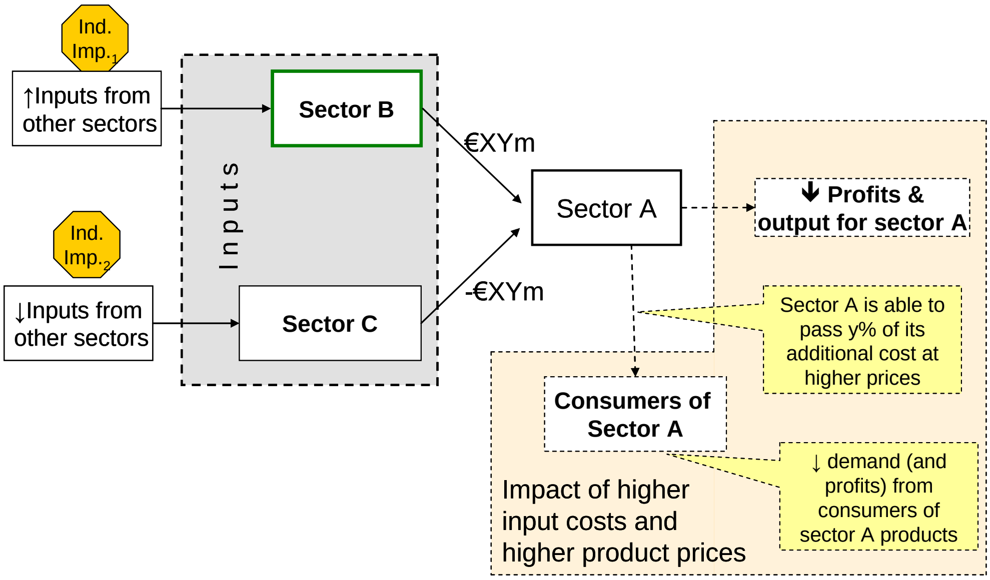
[40] Described in detail in Section 3.2.

[41] As described in section 3.

Figure 5.1 Quantity and price effects



5.2.1 *Quantity and price effects*

If the substitution were to lead to an increase in the costs of inputs from the sector substituting then this would be reflected in the cost structure of Sector A and partly paid by users of Sector A products. Output and profits of Sector A would be expected to fall due to higher costs of its products. The elasticity of demand for its products and cost pass through ability will determine how much of the increase in costs can be passed on to its consumers.

The model as it currently stands is unable to calculate the multiplier effects of the increased profits for sector B when providing inputs to sector A at higher prices. It also cannot compute the contracting multiplier effect of the fall in output and profits of Sector A due to the higher prices of its products.

Please see Annex D for more details on the policy effect scenario methodology.

5.3 Policy Scenarios

A range of environmental policy interests can be identified, which can be used to frame the policy scenarios. These interests range from a broad concern with improving the sustainability of consumption and production patterns, to specific interests in relation to the use of greener technologies and in climate change and energy efficiency.

The policy scenarios are constructed to demonstrate the economic effect of a policy intervention in the structure of the economy as a result of changes in the use of different goods and services (a quantity effect – for example substituting raw materials with recycled materials).

The impact assessment of each scenario will indicate the net effects on jobs and output as well as highlighting any significant structural changes between sectors in the economy. The net impact of the structural change and reallocation of resources is mainly affected by the length of the supply chain, labour intensity and net-profit margins. Switching to inputs from a sector with higher labour intensity and a longer supply chain would thus have a positive impact on the economy. Increased spending attributed to new jobs would lead to additional output thus creating a ripple effect in the economy. A smaller supply chain on the other hand has less leakage in profits and taxes, resulting in a lower multiplier effect.

5.3.1 Sustainable Consumption and Production

Three scenarios have been described:

- Scenario 1: Steel production with increased substitution of recycled materials
- Scenario 2: Agricultural production with an increase in output from the organic sector
- Scenario 3: Reducing water consumption

5.3.2 Environmental Technology – ETAP

Two scenarios have been described.

- Scenario 4a: Increased energy efficiency in the manufacturing sector due to increased use of more efficient production technologies
- Scenario 4b: Increased energy efficiency in the Energy Intensive Industries[42] (subset of Manufacturing)
- Scenario 5: Increase in bio-fuels in transport

5.3.3 Climate Change

Two scenarios have been described.

- Scenario 6: Increase in electricity generation from renewable energy technologies
- Scenario 7: Reducing the carbon intensity of all sectors of the economy

5.3.4 Structural Funds

- Scenario 8: Increased use of Structural Funds for environmental infrastructure

The following sectors from the E3ME-OECD Input-output model have been used for the policy scenarios. The sectors in the policy scenarios are referenced using the I-O classification as given in the table below.

[42] Manufacture of pulp, paper and paper products; publishing and printing (DE), Manufacture of chemicals, chemical products and man-made fibres (DG), Manufacture of rubber and plastic products (DH), Manufacture of other non-metallic mineral products (includes cements and lime, glass) (DI), Manufacture of basic metals and fabricated metal products (includes ferro-alloys, steel and non-ferrous metals) (DJ).

1 Organic Agriculture	25 Manuf. nes
2 Other Agriculture	26 Renewable Electr.
3 Sustainable Forestry	27 Non-Renewables
4 Other Forestry	28 Gas Supply
5 Fishing	29 Water Supply
6 Coal	30 Construction
7 Oil & Gas etc	31 Distribution
8 Other Mining	32 Retailing
9 Food, Drink & Tob.	33 Hotels & Catering
10 Text., Cloth. & Lea	34 Land Transport
11 Wood & Paper	35 Water Transport
12 Printing & Publish	36 Air Transport
13 Manuf. Fuels	37 Communications
14 Pharmaceuticals	38 Banking & Finance
15 Chemicals nes	39 Insurance
16 Rubber & Plastics	40 Computing Serv
17 Non-Met. Min.	41 Prof. Services
18 Basic Metals	42 Other Bus. Serv
19 Metal Goods	43 Public Ad & Def.
20 Mech. Engineering	44 Education
21 Electronics	45 Health & Social
22 Elec. Eng. & Instr.	46 Misc. Services
23 Motor Vehicles	47 Unallocated
24 Oth. Transp. Equip.	48 Household

6 ECONOMIC IMPACTS OF THE POLICY SCENARIOS

6.1 Scenario 1: Steel Production with Increased Substitution of Recycled Material

6.1.1 Scenario Description

Steel production uses a combination of primary raw materials and recycled materials. This scenario considers the impact of substituting primary raw material with recycled materials in the steel sector.

The scenario is based on a substitution of 10% by value (€) of inputs from the mining sector with the same value of inputs from the waste recycling sector, with no effect on overall input costs

The scenario allows an appreciation of the effects of input substitution in terms of the wider knock-on effects on overall output and employment.

6.1.2 Results

A substitution of 10% (by value) of inputs from the mining sector (I-O 08: Other Mining) by inputs from the recycling sector (I-O 25: Manufacturing nes) for the production of steel (I-O 18: Basic Metals).

Direct impact	• ↓ Loss of outputs from virgin material sector (-€489m) • ↓ Loss of jobs in virgin material sector (-4,092)	• ↑ Gain output from recycled material sector (€489) • ↑ Gain in jobs in recycled material sector (5,952)
Indirect impact	Fall in demand for inputs to the virgin material sector and subsequent fall in output from suppliers to the virgin material sector.	Increase in demand for inputs to the recycled materials sector and subsequent increase in demand from various sectors.

↓

Direct impact: No net change in output of the steel sector.

Net increase of (5,952 – 4,092) 1,860 jobs

↓

The net effect of the two indirect impacts will determine total net impacts on output and employment in the whole EU-27 economy.

↓

Indirect Impacts	Output (€m)	Jobs (FTE)
Increase in demand of the recycled materials sector inputs of €489m	280	2,534
Reduction in demand of virgin material sector inputs of €489m	-83	-753
Net Indirect Impact	**197**	**1,781**

Summary Results

	Overall change in:	
	Output €m	Jobs
Net direct impact	0	1,860
Net indirect impact	197	1,781
Total impact	**197**	**3,641**

The initial direct impact is neutral as the reduction in output from one sector is met by an increase in output from another sector. However, the net indirect (including induced) impact of this substitution leads to an increase in output of nearly €197m and an extra 1,781 jobs. Adding the direct and indirect effects indicates that this substitution would add €197m of output and 3,641 (1,860 direct and 1,781 indirect) jobs. The net positive impact on jobs and output is mainly due to the supply chain effect of the recycled materials sector. The recycled materials sector uses inputs from many other sectors thus creating more jobs and wealth. The mining sector has high profit margins and fewer inputs from other sectors, which leads to smaller net indirect effect on jobs and output.

If the substitution were to lead to an increase in the costs to the steel sector because of inputs from recycled materials sector cost more than virgin materials then this would be reflected in the cost of steel and paid by users of steel. Output and profits of the steel sector would be expected to fall due to higher costs of steel products. The elasticity of demand for steel and cost pass through ability of the steel sectors will determine how much of the increase in costs can be passed on to its consumers. According to estimated parameters from the E3ME model, the steel sector is able to pass on 45% of its unit costs to its customers and would have to absorb the rest as reduced profits.

6.2 Scenario 2: Agricultural Production with an Increase in Output from the Organic Sector

6.2.1 Scenario description

There is an increasing demand for products from the organic farming sector. The sector has different inputs compared to conventional agriculture, and the change in demand will have wider economic impacts, e.g. less demand for pesticides and fertilisers from the chemical sector and increased demand for labour. The scenario examines a loss of output of 10% by value (€) of outputs from the conventional agricultural sector with an equivalent increase in the value of output from the organic agriculture sector, with no overall change in input costs.

The scenario illustrates the effect of input substitution in terms of the wider knock-on effects of changes in the purchases of inputs by the agricultural sector. Impacts are descried in terms of changes in output and employment. No account is taken of implied changes in land requirements.

6.2.2 Results

The scenario describes a reduction of 10% by value (€) of conventional agriculture (I-O 02: Other Agriculture). This is assumed to lead to a loss and associated knock-on effects on the demand for inputs to conventional agriculture (all of which is assumed to be from the chemical sector (fertilisers and pesticides, I-O 15: Chemical nes). There is an equivalent increase in output from the organic agricultural sector (I-O 01: Organic Agriculture) to the same value also with a knock-on effect on suppliers. Induced effects are taken into account.

Direct impact	• Loss of output from conventional agriculture ↓ (-€20,465m) • Loss of employment of ↓ -886,571	• Increase in output from organic agriculture ↑ (€20,465m) • Gain in employment of ↑ 952,583
Indirect impact	Fall in demand for inputs to conventional agriculture with subsequent fall in output from chemicals sector	Increase in demand for inputs to organic sector, and subsequent increases in demand from various sectors

No net change in total agriculture output

Net increase of (952,583 – 886,571) 66,012 jobs

The net effect of the two indirect impacts above will determine total net impacts on output and employment in the whole EU-27 economy.

Indirect Impacts	**Output (€m)**	**Jobs '000s (FTE)**
Increase in demand of the organic sector inputs of €20,465m	2,341	14,116
Reduction in demand of conventional agriculture inputs of -€20,465m	-1,787	-36,294
Net Indirect Impact	**554**	**-22,178**

Summary of results

	Overall change in:	
	Output €m	**jobs**
Net direct impact	0	66,012
Net indirect impact	554	-22,178
Total impact	**554**	**43,834**

The initial direct impact is neutral as the reduction in output from one sector is met by an increase in output from another sector. However, the net indirect impact of this substitution leads to an increase in output of nearly €554m but a loss of 22,178 jobs. The sum of the direct and indirect impacts is an extra €554m of output and 43,834 (66,012 direct less 22,718 indirect) jobs[43]. The net positive effect is mainly due to the direct increase in employment from the shift to organic agriculture which is more labour-intensive. This causes an increase in output through, the induced effect, the wage related spending from the direct jobs. If the effects of additional spending are ignored (ie type-I multiplier) output falls, mainly due to the lower output in the chemicals sector.

Input costs are generally higher for organic farming compared to conventional farming. This is mainly due to higher prices for organically produced inputs (e.g. Foodstuffs, seeds, etc). Some fixed costs, such as wages and salaries are higher. Purchase of alternative machinery (eg. mechanical weed control and tillage) also leads to higher costs. Stricter rules on livestock housing are likely to increase depreciation figures for buildings. Additional investments may be necessary for processing and marketing activities. Overall organic farming is expected to enjoy lesser economics of scale due to lower yields (tonnes per hectare) compared to conventional farming.

If prices of organic inputs were higher than conventional agriculture then this would reflect in the cost structure of industries like the Food, Drink and Tobacco (FDT) which use inputs from the organic sector. However, the FDT sector, according to estimated

[43] To take account of the lack of data on organic farming in the EU12, the scenario uses employment-output ratios taken from EU15.

parameters from the E3ME model, is able to pass on 15% of its unit costs to its customers.

6.3 Scenario 3: Reducing water consumption

6.3.1 Scenario description

The scenario assumes that near market water saving technologies exist for all water using sectors to reduce water use, such that investment costs are no greater than prevailing technologies. The scenario explores the use of such technologies to reduce the demand for water by value of 10%. The investment costs are assumed to be equal to the value of water saved, i.e. no increase in costs in water using sectors. The loss of output of 10% by value (€) of output from the water supply sector is offset by an equivalent increase by value in the output of sectors producing water saving technology (mechanical engineering, construction and professional services).

6.3.2 Results

The scenario describes a reduction of 10% by value (€) of output from the water sector (I-O 29) and an increase in output from sectors proving water saving technologies (I-O 20 Mechanical Engineering, I-O 30 Construction and I-O 41 Professional Services).

Direct impact	• Loss of output from water supply sector ↓ (-€3,258) • Loss of employment of ↓-28,636	• Increase in output from Mechanical Engineering, Construction and Professional Services ↑ (€3,258) • Gain in employment of ↑ 29,310
Indirect impact	• Fall in demand for inputs to the water supply sector	Increase in demand for inputs to Mechanical Engineering, Construction and Professional Services

⇩

No net direct change in total output of all sectors

Net direct increase of (29,310 – 28,636) 675 jobs

⇩

The net effect of the two indirect impacts above will determine total net impacts on output and employment in the whole EU-27 economy.

⇩

Indirect Impacts	Output (€m)	Jobs (FTE)
Increase in demand of the Mechanical Engineering, Construction and Professional Services inputs of €3,258m	1,492	11,378
Reduction in demand of water supply inputs of -€3,258m	-516	-6,563
Net Effect	**976**	**4,815**

Summary of results

	Overall change in:	
	Output €m	**jobs**
Net direct impact	0	675
Net indirect impact	976	4,815
Total impact	**976**	**5,490**

The initial direct impact on output is neutral as the reduction in output from one sector is met by an increase in output from other sectors. However, the net indirect impact of this substitution leads to an increase in output of €976 m and an extra 4,815 jobs. The total impact is an increase in output of €976 m and 5,490 (675 direct and 4,815 indirect) jobs. The net positive impact on output and jobs is due the longer supply chain and higher labour intensity in the Mechanical Engineering, Construction and Professional Services sector. The water supply sector on the other hand has a smaller supply chain, lower labour intensity and high profit margins.

6.4 Scenario 4a: Increased energy efficiency in the manufacturing sector

6.4.1 Scenario Description

The scenario examines the effect of substituting energy consumption with investment in more energy efficient technologies in the manufacturing sector.

The scenario assumes that near market technologies for manufacturing sectors to reduce energy use exist, such that investment costs are no greater than energy savings. The scenario explores the reduction in purchases of 10% by value (€) of inputs from the energy sector[44]

[44] Energy sectors: 06.Coal, 07. Oil & Gas, 13. Manufactured Fuels, 26. Renewable Electricity, 27. Non-Renewable Electricity, and 28.Gas Supply. Output in all sectors assumed to fall by the same proportion.

6.4.2 Results

A reduction in purchases of 10% by value (€) of inputs from the energy sector for all manufacturing sectors. The cost savings are assumed to be invested in proportion to the current investment pattern.

Direct impact	• Inputs from energy sectors ↓ (-€19,229m) • Loss of jobs in energy sectors ↓ (-56, 486)	• Inputs from all other sectors of the economy attributed to increase in investment in all sectors ↑ (€19,229m) • Increase in jobs in all sectors ↑ (179,100)
Indirect impact	Fall in demand for inputs to the energy sector and subsequent fall in output from suppliers to the energy sector	Increase in demand for inputs for all other sectors of the economy due to investment of €19,229 from the manufacturing sectors.

↓

No net change in output of the energy and manufacturing sectors
Increase in employment of (179,100 – 56,486) 122,614 jobs

↓

The net effect of the two indirect impacts above will determine total net impacts on output and employment in the whole EU-27 economy.

↓

Indirect Impacts	**Output (€m)**	**Jobs (FTE)**
Increase in demand of all sectors (except energy sectors) inputs €19,229m	5,716	46,532
Reduction in demand of energy sector inputs of -€19,229m	-5,234	-31,975
Net Effect	**482**	**14,557**

Summary of results

	Overall change in:	
	Output €m	**jobs**
Net direct impact	0	122,164
Net indirect impact	482	14,557
Total effect	**482**	**137,171**

A reduction in energy inputs to the manufacturing sector invested in proportion to current investment patterns leads to a net increase in output of nearly €482m with a gain of 137,171 jobs. The large positive employment impact is mainly because the energy sectors are less labour intensive with low employment-output ratios. Like the water supply sector, the energy sector also has a small supply chain. The manufacturing sectors producing the energy efficient technologies use inputs from a number of other sectors. This leads to a higher multiplier effect for both jobs and output.

6.5 Scenario 4b: Increased energy efficiency in the manufacturing sector

6.5.1 Scenario description

This scenario examines the impact of the take-up of energy efficiency and low carbon investment technologies by Energy Intensive Industries[45] (EIIs). This scenario assumes that investment costs for new technologies are greater than the conventional technologies.

Quantity and price effect – a reduction by value (€) of inputs from the energy sector with the cost savings assumed to finance higher investment costs. In addition the scenario assumes a further 10% increase in these investment costs, financed by higher prices and reduced profits in the EIIs.

This scenario attempts to capture the effects of input substitution in terms of wider knock on effects of a shift in production inputs from the energy sector to the manufacturing sector (purchase of energy efficient capital equipment). The impact of the additional 10% increase in investment provides a de minimis positive effect, which the negative effects of the higher prices must exceed for there to be a net overall decrease in EU output.

The results from Scenario 4b are not directly comparable to the quantity effect in Scenario 4a because Scenario 4a assumes energy efficiency in all the manufacturing sectors while Scenario 4b assumes energy efficiency in the energy-intensive manufacturing sectors.

[45] 11: Wood and Paper, 12: Printing and Publishing, 14: Pharmaceuticals, 15: Chemicals nes, 16: Rubber and Plastics, 17:Non-Metallic Minerals Product, 18: Basic Metals, and 19: Metal Goods

6.5.2 Results

The substitution of energy purchases with investment in energy efficient technologies, with a 10% increase in these investment costs has been examined.

Direct impact	• Inputs from energy sectors ↓ (-€8,004m) • Loss of jobs in energy sectors ↓ (-29,559)	• Inputs from all other sectors of the economy attributed to higher investment costs of energy saving technologies ↑ (€9,015) • Increase in jobs in all sectors ↑ (83,494)
Indirect impact	• Fall in demand for inputs to the energy sector and subsequent fall in output from suppliers to the energy sector • Fall in demand from consumers of EII products due to higher prices driven by higher investment costs (over energy savings)	Increase in demand for inputs from all other sectors of the economy due to investments by the EII

↓

No change in EII output. Increase in net output of energy supply and technology supply sectors of €1,011 million

Net increase in employment of (83,494 – 29,559) 53,935 jobs

↓

The net effect of the two indirect impacts from substitution will determine total net impacts on output and employment in EU-27, excluding the effects of higher costs for the EII.

The third indirect effect, a fall in the outputs and profits of the EIIs due to higher costs and related higher prices has not been calculated. However the positive effect of the additional investment provides a benchmark against which the negative effects of higher costs can be compared. If the negative effects of higher costs are less than the calculated direct and indirect effects then there will be an overall net positive impact.

↓

Indirect Impacts	**Output (€m)**	**Jobs (FTE)**
Increase in demand from all sectors (except energy sectors) inputs of €9,015m	10,278	52,389
Reduction in demand of energy sector inputs from EII of -€8,004m	-2,351	-15,409
Total net effect	**7,927**	**36,980**

Summary of results

	Overall change in:	
	Output €m	**jobs**
Net direct impact	1,011	53,935
Net indirect impact	7,927	36,980
Total impact	**8,938**	**90,915**

Overall, a 10% reduction in energy inputs for the EIIs substituted with an increase in investment in energy efficient technologies of energy savings plus 10% increase in these investment costs lead to nearly €9 billion increase in output and 91,000 jobs.

We have not been able to calculate the multiplier effect of higher EII costs and prices and associated reductions in demand and profits of EIIs. Output and profits of EIIs would be expected to fall due to higher costs of its inputs and products. The elasticity of demand for its products and cost pass through ability will determine how much of the increase in costs can be passed on to its consumers.

The model as it currently stands is unable to calculate the multiplier effects of the increased profits for sectors providing inputs to EIIs at higher prices. It also cannot compute the contracting multiplier effect of the fall in output and profits of EIIs due to the higher prices of its products. Similarly, the model does not capture the effect of fall in output and profits of consumers of EII products due to higher EII product prices.

However, as long as these negative effects are same or less than the total impact on output and employment above, the substitution of energy purchases with investment in energy saving technologies would still have a positive impact on GDP and jobs.

The model does allow an estimate of the share of any cost increase that would be passed through by EIIs to customers in higher prices:

Cost Pass-through Ability of EIIs (Share (%) of cost increases in Prices)

	%
Wood & Paper	46
Printing & Publishing	25
Pharmaceuticals	46
Chemicals nes.	8
Rubber & Plastics	21
Non-Met. Min. Prods.	26
Basic Metals	45
Metal Goods	35

Notes: Figures presented are short-term estimates of cost pass-through for selected sectors in the EU15, derived from historical time series covering the period 1975-2004 using Cambridge Econometrics' software.

Source: E3ME, Cambridge Econometrics

6.6 Scenario 5 Increase in bio-fuels in transport

6.6.1 Scenario description

The scenario examines the effect of a given increase in the use of bio-fuels by the transport sector as a substitution for conventional transport fuels (petrol / diesel). A given substitution to bio-fuels increase will be reflected in an increase in output from the conventional agricultural sector and a decrease in output from the transport fuel sector. The scenario is based on a substitution of 10% by value (€) of inputs from the transport fuel sector with the same value of inputs from the agriculture sector, with no effect on overall input costs. The effects on land and the supply of agricultural products attributable to the competition for agricultural inputs attributable to bio-fuels are not included.

6.6.2 Summary of results

A substitution of 10% by value (€) of inputs from the transport fuel sector (I-O 13: Manufactured fuels) with the same value of inputs from the agriculture sector (I-O 02: Other Agriculture)

Direct impact	• Loss of outputs from manufactured fuel sector ↓ (-€2,514m) • Loss of employment of ↓ -2,263	• Increase in outputs from agriculture sector ↑ (€2514m) • Increase in employment of ↑ 110,379
Indirect impact	Fall in demand for inputs to the manufactured fuel sector and subsequent fall in output from suppliers to the manufactured fuel sector	Increase in demand for inputs to the agriculture sector and subsequent increase in demand from various supply sectors

↓

No net change in output - fuel consumption of transport sector remains the same

Net increase of (110,379 – 2,263) 108,116 jobs

↓

The net effect of the two indirect impacts above will determine total net impacts on output and employment in EU-27

↓

Indirect Impacts	**Output (€m)**	**Jobs (FTE)**
Increase in demand of agriculture sector inputs of €2514m	2,309	33,117
Reduction in demand of manufactured fuel sector inputs of -€2,514m	-810	-1,708
Net Effect	**1,499**	**31,409**

Summary results

	Overall change in:	
	Output €m	**jobs**
Net direct impact	0	108,116
Net indirect impact	1,499	31,409
Total impact	**1,499**	**139,525**

The 10% substitution of bio-fuels for manufactured fuels leads to a €1.5 billion increase in EU27 output and 139,525 new jobs (108,116 direct plus 31,409 indirect). This is mainly due to the labour-intensity of the agriculture sector and the industries that supply it. Again net positive impact on jobs and output is positive due to the supply chain and labour intensity factor. Manufactured Fuels inputs are all from the oil and gas sector, with very few inputs from other sectors. Moreover neither the oil and gas sector nor the sectors providing inputs to it are labour-intensive. Agriculture does not have much of a supply chain (more than manufactured fuels though) but it is very labour intensive. Hence there is a large direct boost to employment and subsequently on output due to the induced effect of higher income.

If the cost of bio-fuels for the transport sector was higher than the substituted manufactured fuel then there would be a negative impact on profits and output of the transport sectors. Any cost increase would be absorbed as losses or passed on to its customers. According to estimated parameters from the E3ME model, the land transport and water transport sectors are able to pass on 12% and 48% respectively of their unit costs to their customers.

6.7 Scenario 6a: Increase in Electricity Generation from Renewable Energy Technologies

6.7.1 Scenario description

The inputs required by renewable energy technologies differ from that of conventional power generation technologies. The scenario describes the impact of a given increase in output of electricity from the renewables sector, with a commensurate reduction, by value in output from the non-renewable sector.

The scenario is based on a 10% increase by value (€) in electricity from renewables with a commensurate reduction by the same value from non-renewables. The scenario examines the effect of the changes in inputs associated with the substitution of electricity generating technologies assuming that renewables are no more expensive. This scenario takes into consideration inputs required for design and installation of renewable energy infrastructure.

6.7.2 Results

A substitution of 10% by value (€) of inputs from the non-renewable electricity sector with the same value of inputs from the renewable sector.

Direct impact	• Loss of output from non-renewable electricity sector ↓ (-€16,022m) • Loss of employment of ↓ -64,088	• Increase in outputs from renewable sector ↑ (€16,022m) • Increase in employment of ↑ 64,088
Indirect impact	Fall in demand for inputs to the non-renewable electricity sector and subsequent fall in output from suppliers of non-renewable electricity sector.	Increase in demand for inputs to the renewable electricity sector and subsequent increase in demand from various sectors.

↓

No net change in total electricity production.

No net change in employment – assumes that employment/output ratio is the same for renewables and non-renewables sectors.

↓

The net effect of the two indirect impacts above will determine total net impacts on output and employment in the whole EU-27 economy.

↓

Indirect Impacts	**Output (€m)**	**Jobs (FTE)**

Increase in demand of renewable electricity sector inputs of €16,022m	14,817	118,621
Reduction in demand of non-renewable electricity sector inputs of -€16,022m	-6,203	-60,409
Net Indirect Impact	**8,613**	**58,212**

Summary results

	Overall change in:	
	Output €m	jobs
Net Direct effect	0	0
Net indirect effect	8,613	58,212
Total effect	**8,613**	**58,212**

The 10% substitution of non-renewable electricity by renewable electricity leads to an increase of EU27 output and jobs of €8.6 billion and 58,212 respectively. The economic impacts are positive because renewable energy require inputs from a number of sectors at the design and installation stage. However, they require fewer inputs from other sectors (mainly fuels) and labour once they are up and running.

6.8 Scenario 6b: Increase in Electricity Generation from Renewable Energy Technologies at Higher Costs

6.8.1 Scenario description

The scenario examines the same substitution of electricity from renewables for non-renewables but assumes that the substitution leads to a 10% increase in electricity prices to reflect the assumed higher cost of supply from renewables. The overall effects from this scenario will include the greater income to the renewables sector, higher costs to energy users and knock-on effects from the effects of higher energy costs on users.

The additional cost of renewables leads to a higher income to the renewables sector and its suppliers. The scenario also assumes that the additional income is invested in other sectors of the economy according to the current pattern of investment. This means that there is a positive shock to sectors producing capital goods, such as producers of construction and engineering products. Conversely the higher costs lead to higher electricity prices which has a negative effect on the economy. The prefect of higher prices can not be calculated at the present time, but the de minimis size of this price effect necessary for there to be an overall net positive effect is set by the positive effect of high spending by the renewables sector.

6.8.2 Results

The scenario has calculated the positive effects of increased investment in renewables, taking into account the reduced demand for electricity from non-renewables. This provides a benchmark against which the negative effects of higher energy costs can be compared.

Direct impact	• Loss of outputs from Non-renewable electricity sector ↓ (-€16,022m) • Loss of employment of ↓ -64,088.	Increase in output from renewable sector ↑ (€25,223m) reflects the 10% increase in the costs of renewables Increase in employment of ↑ 100,892
Indirect impact	• Fall in demand for inputs to the non-renewable electricity sector and subsequent fall in output from suppliers of non-renewable electricity sector • Fall in output and employment as a result of higher electricity prices and knock-on effects on energy users	Increase in demand for inputs to the renewable electricity sector and subsequent increase in demand for various supply sectors such as construction and engineering sectors

↓

Net direct increase in output of €9,201m.

Net direct increase in employment of (100,892 – 64,088) 36,804 jobs

↓

The net effect of the two indirect impacts from substitution will determine total net impacts on output and employment in EU-27, excluding the effects of higher energy costs.

The third indirect effect, a due to higher electricity costs and related higher price has not been calculated. However the positive effect of the additional investment in renewables provides a benchmark against which the negative effects of higher costs can be compared. If the negative effects of higher costs are less than the calculated direct and indirect effects then there will be an overall net positive impact.

↓

Indirect Impacts	Output (€m)	Jobs (FTE)
Increase in demand of renewable electricity sector inputs of €25,223m	19,856	81,173
Reduction in demand of non-renewable electricity sector inputs of -€16,022m	-6,203	-59,362
Total net effect	**13,653**	**21,811**

Summary results

	Overall change in:	
	Output €m	jobs
Net direct effect	9,201	36,804
Net indirect effect	13,653	21,811
Total effect	**22,854**	**58,615**

The total effect of the quantity substitution and 10% increase in the investment in renewables leads to an increase in output of €23 billion. There is also a net increase of 58,615 jobs.

As before the higher price of electricity would have a negative impact on profits and output for electricity consumers. The negative effects of higher energy prices would need to exceed this impact for there to be an overall net loss in GDP and employment. The cost of the extra investment represents approximately an increase in electricity prices of 6%.

6.9 Scenario 7: Reducing the Carbon / Energy Intensity of All Sectors of the Economy

6.9.1 Scenario description

The overall aim of climate change programmes is to achieve a lower carbon economy through higher costs for carbon emitting inputs (especially energy). The scenario examines the required increase in the price of carbon based fuels (electricity from non-renewables, gas and oil) to achieve an overall reduction of 1% in CO2 intensity (CO2 emissions per € output) for the whole economy. This is based on the price elasticity of demand for carbon based energy sources[46]. The scenario describes the change in carbon/energy intensity of each sector attributed to the increase in price of carbon fuels to reduce carbon intensity by 1% for the whole economy and the attendant changes in overall economic structure and levels of output and employment.

[46] Fuel elasticities: both long run and short run price elasticities of fuel are taken from E3ME's fuel equations. The short-run elasticities have restricted limits of -0.1 and -1.3. In the long run, fuel price elasticities are based from empirical studies.

6.9.2 *Summary of Results*

Scenario 7 differs from other price-effect scenarios as it looks at the impact of price increases of the carbon-based fuel on the overall level of CO2 emissions. The aim of this scenario is to find out how much energy prices would need to increase to reduce CO2 emission intensity by 1%. An increase in the price of carbon-based fuel will lead to reductions in demand of the fuel through the price-elasticity effect (estimated from E3ME fuel equations).

There are two sets of results from Scenario 7 using short run and long run fuel price elasticities, and based on the existing energy mix:

1. Price increase required to reduce CO2 intensity by 1%
2. Impact of a 10% price increase in each fuel type (separately) on the overall carbon intensity of the EU27 economy

6.9.3 *Price increase required to reduce CO2 intensity by 1%.*

The overall energy price increase required to reduce CO2-intensity by 1% is 8% using short-run fuel price elasticities[47]. CO2 intensity as a result of the energy price increase in 2000 was 163 tonnes per million € of output[48]. Around 37,917 tonnes of CO2 can be saved by an 8% price increase and assocated1% reduction in CO2 intensity.

A series of interactions takes place in the I-O tables as a result of the higher energy prices. An increase in the price of carbon-based fuel will lead to reductions in demand of the fuel through the price elasticity effect (estimated from E3ME fuel elasticities, given in Annex D). In common with much of the research in this field, the short-term price elasticities have been found to be zero or close to zero in many of the sectors examined. This is mainly due to difficulties in switching fuels or production techniques in machinery that is typically designed to last many years.

The input-output tables compare input costs against final output and are measured in current prices. Thus when energy costs increase it affects the relative costs of all the industries that use energy as an input in its production process. The I-O coefficients across the entire row for the energy sectors are revised upwards. The multiplier effects of all sectors also change which gives us the net impact on total output due to the energy price increase. CO2 intensity is then calculated by dividing total CO2 emissions (using emission factors for each fuel type) by total output.

Data for CO2 emissions, disaggregated by fuel and fuel user group, were taken from the E3ME model and converted into the same classification as the input-output tables. Fixed proportions were used to determine fuel purchases and emissions. For example, emissions by the power generation sector are calculated as a linear function of its purchases of coal, oil, gas and manufactured fuels (ie four points in the column for power generation in the I-O table). In the model, CO2 intensity will therefore fall if these coefficients are reduced due to increase in energy prices.

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[47] This result is not surprising given the assumption that the non-significant elasticities have been set to -0.1 (if they were all 10% the required price increase would be not much more than 10). If the estimation system came up with a significant elasticity greater than -0.1 (eg -0.05) this was used. Not unexpectedly, this is often the case in the sectors that appear at the top of the list in the above table. Please see Annex D for more details on fuel price elasticities.

[48] 3,538,810 thousand tonnes of CO2 divided by €12.1 trillion output. The figure 3,538,810 tonnes of CO2 is only emissions from energy use. The total value, which includes CO2 from industrial processes and some other miscellaneous processes, is about 5% higher.

Thus, the CO_2 intensity reduction due to the 8% increase in energy price varies for each industrial sector depending on the sensitivity of CO_2 intensity to energy prices. The ability for a sector to reduce CO_2 intensity is determined by a combination of various factors:

- the sector's price elasticities for the various fuels,
- its relative fuel shares,
- the amount of CO_2 produced by each fuel input,
- its cost pass-through ability, and
- its production structure.

For example, a sector that is heavily dependent on the most carbon-intensive fuel, coal, and has a high price elasticity of demand for coal, will be likely to reduce CO_2 emissions by a greater amount for a given change in fuel prices. Also a sector, with a flexible production structure i.e. the ability to substitute other factors of production (labour, capital and materials) for energy will be more likely to reduce CO_2 emissions.

CO2 Intensity Reduction by Industrial Sector Attributed to an 8% Increase in Energy Price

	CO2 intensity reduction
Water Transport	-0.23%
Non-Renewable Electricity	-0.28%
Land Transport etc	-0.55%
Pharmaceuticals	-0.65%
Gas Supply	-0.65%
Coal	-0.68%
Air Transport	-0.69%
Fishing	-0.71%
Construction	-0.83%
Distribution	-0.92%
Computing Services	-1.02%
Other Bus. Services	-1.03%
Food, Drink & Tob.	-1.04%
Sustainable Forestry	-1.04%
Retailing	-1.05%
Misc. Services	-1.05%
Household	-1.07%
Public Admin. & Def.	-1.07%
Insurance	-1.08%
Hotels & Catering	-1.09%
Banking & Finance	-1.09%
Other Forestry	-1.10%
Health & Social Work	-1.10%

	CO2 intensity reduction
Communications	-1.12%
Motor Vehicles	-1.12%
Prof. Services	-1.13%
Education	-1.15%
Mech. Engineering	-1.17%
Elec. Eng. & Instrum.	-1.18%
Oth. Transp. Equip.	-1.18%
Chemicals nes	-1.23%
Printing & Publishing	-1.24%
Electronics	-1.29%
Basic Metals	-1.31%
Rubber & Plastics	-1.43%
Other Agriculture	-1.44%
Organic Agriculture	-1.49%
Manuf. nes	-1.53%
Oil & Gas etc	-1.82%
Manuf. Fuels	-1.94%
Metal Goods	-2.34%
Text., Cloth. & Leather	-2.40%
Wood & Paper	-3.22%
Other Mining	-3.44%
Water Supply	-3.49%
Non-Met. Min. Prods.	-4.17%

The top five sectors with the least sensitive CO_2 intensity to energy prices are:

- Water transport, non-renewable electricity, land transport, pharmaceuticals and gas supply.

Water and land transport are sectors that are almost completely dependent on manufactured fuels. Both sectors have very low estimated short-run price elasticities so it is not surprising that CO_2 intensities do not change much in response to price changes. Non-renewable electricity also has very small reactions to price changes in the short run, due to the time it takes to build new plant. This is an important finding as both power generation and land transport are among the most heavily-polluting sectors.

The top five sectors with the most sensitive CO2 intensity to energy prices are:

- Textile, clothes and leather, wood and paper, other mining, water supply and non-metallic mineral products.

At the other end of the scale Wood & Paper, Other Mining and Non-Metallic Mineral Products are relatively dependent on coal, but with high price elasticities for coal inputs. This means that a fairly small change in prices can reduce CO2 emissions quite significantly. Water Supply and Metal Goods also appear to be heavily dependent on coal but this is partly due to underlying data assumptions: according to the input-output tables Water Supply is the only services sector to use coal as an input and Metal Goods is the only engineering sector to use coal as an input. Hence when converting from E3ME's more aggregate fuel user classification these sectors have been allocated all CO2 emissions resulting from coal combustion in the fuel user group. A high estimated elasticity means these sectors can reduce coal consumption quite easily, and also therefore (an exaggerated level of) emissions.

The price increase required to reduce CO2-intensity by 1% using long-run elasticities was found to be 2.7%, reflecting higher long-run elasticities (in absolute terms) than the short-run elasticities.

6.9.4 *Impact of a 10% price increase in each fuel type (separately) on the overall carbon intensity of the EU27 economy*

When considering the fuels individually, a 10% price increase was considered in each fuel, under short and long run elasticities. The results using short run fuel price elasticities are shown below. The results are dependent on: the shares of each fuel in total emissions (which itself is dependent on fuel use and relative carbon content); the estimated price elasticities; and the input-output linkages. For example, coal has a smaller share in total fuel use, but has high carbon content, while electricity consumption produces no direct CO2 emissions, but has strong links to the other fuel sectors that do.

A 10% increase in the price of coal only will lead to a 0.37% reduction in carbon-intensity for the EU-27 economy. Similarly, a 10% increase in oil prices only leads to a 0.08% reduction in carbon intensity for the EU-27 economy.

Impact on CO2 Intensity of Increasing Individual Fuel Prices (Short-run elasticities)

Fuel	Share of Total Fuel Use in Baseline	Share of CO2 Emissions in Baseline	Total Reduction in CO2-Intensity from a 10% Price Increase (%)
Coal	17.2%	28.7%	0.37
Oil	12.8%	6.8%	0.08
Motor Spirits	26.4%	34.5%	0.32
Electricity	13.3%	0.0%	0.31
Natural Gas	22.6%	30.0%	0.26

Note(s): Motor Spirits is defined as E3ME's Manufactured Fuels sector. All figures are for the year 2000.

Source(s) : E3ME, Cambridge Econometrics

The results using long-run fuel price elasticities are shown below. Again the results are dependent on the shares of each fuel in total emissions (which itself is dependent on fuel use and relative carbon contents); the estimated price elasticities and the input-output linkages.

Impact on CO2 Intensity of Increasing Individual Fuel Prices (Long-run elasticities)[49]

Fuel	Share of Total Fuel Use in Baseline	Share of CO2 Emissions in Baseline	Total Reduction in CO2-Intensity from a 10% Price Increase (%)
Coal	17.2%	28.7%	0.44
Oil	12.8%	6.8%	0.09
Motor Spirits	26.4%	34.5%	2.02
Electricity	13.3%	0.0%	0.30
Natural Gas	22.6%	30.0%	0.68

Note(s): Motor Spirits is defined as E3ME's Manufactured Fuels sector. All figures are for the year 2000.
Source(s) : E3ME, Cambridge Econometrics

A 10% increase in price of motor spirit produces the biggest reduction in CO2 intensity. This is mainly because the price elasticity of road transport fuel-user is very large (-0.7). This value is taken from previous research by Franzen and Sterner (1995)[50] and Johansson and Schipper (1997)[51].

6.10 Scenario 8: Increased Use of Structural Funds for Environmental Infrastructure

6.10.1 Scenario description

The scenario examines the economic impact of an exogenous injection of €7.08 bil[52] per annum to the EU economy invested in environmental infrastructure. Environmental infrastructure is taken to be water (75%) and waste management (25%) based on

[49] See E3ME manual at www.e3me.com

[50] Franzén, M. and T. Sterner (1995), Long-run Demand Elasticities for Gasoline, in Barker, T., N. Johnstone and P. Ekins (eds.), Global Warming and Energy Elasticities, Routledge.

[51] Johansson and Schipper, 1997 Olof Johansson and Lee Schipper, Measuring the long-run fuel demand of cars. Separate estimations of vehicle stock, mean fuel intensity, and mean annual driving distance, Journal of Transport Economics and Policy 31 (1997), pp. 277–292.

[52] DG regio Policy – Allocation to Environmental protection and risk prevention is around € 50 billion for 2007-2013, which is €7.08 bil per year over 7 years.

recent environmental programmes[53] and economy-wide infrastructure based on agreed programme allocations (excluding environmental investment).

We have calculated the multiplier effect of this injection by using a top-down and bottom-up approach. The top down approach calculates the impact on jobs and output using aggregated EU level multipliers. As mentioned earlier EU-27 level multipliers as a whole are higher than those produced by traditional multiplier studies. The reason for this is that trade between EU countries is not counted as a leakage from the system.

The bottom approach is based on the multiplier effect of the share of structural fund monies to each member state. This is a more accurate way of estimating as the economic structure and trade patterns of each country are taken into consideration.

6.10.2 *Results from the top-down approach*

The EU Structural fund injection to the tune of €5.3 bil and €1.7 bil for water supply and waste management would boost output by €20 bil and jobs by nearly 170,000 per annum in the EU-27.

	Direct effect		Indirect effect		Total	
	Output €m	**Jobs**	**Output €m**	**Jobs**	**Output €m**	**Jobs**
Water supply	5,316	50,502	8,652	64,247	13,968	114,749
Waste management	1,772	32,854	4,049	19,330	5,821	52,184
Total	**7,088**	**83,356**	**12,701**	**83,577**	**19,789**	**166,933**

The output and employment multiplier effect using the top-down approach is 2.8 and 2 respectively.

6.10.3 *Results from the bottom-up approach*

The €7.08 billion can be allocated to Structural Fund recipient member states based on share of investment in water supply (WS), waste water treatment (WWT) and waste management (MSW). This was done using the analysis of environmental infrastructure investment priorities as estimated by GHK et. al (2007)[54]. The summary of findings using the bottom-up approach is given in the table below.

	Direct effect		Indirect effect		Total	
	Output €m	**Jobs**	**Output €m**	**Jobs**	**Output €m**	**Jobs**
Water supply	5,316	50,502	7,759	42,463	13,075	92,965
Waste management	1,772	32,854	2,454	22,866	4,226	55,721
Total	**7,088**	**83,356**	**10,213**	**65,329**	**17,301**	**148,685**

The EU Structural fund injection to the tune of €5.3 bil and €1.7 bil for water supply and waste management would boost output by €17 bil and jobs by nearly 150,000 per annum in the EU-27.

[53] This approximates form the actual programmes, which will also include small amounts of investment in renewables and risk management

[54] GHK et. al (2007), 'Environmental Investment Needs and Priorities. DG Regio.

The output and employment multiplier effect using the bottom-up approach is 2.4 and 1.78 respectively. Using the bottom-up approach gives more realistic multipliers. This is because the multipliers are based on economic structure of each country. The trade effects are also captured using individual country I-O tables.

Structural Fund share of environmental infrastructure by MS (Direct output), € million

Member States	WS	WWT	MSW	Total
Bulgaria	264	22	16	302
Cyprus	-	3	7	10
Czech	259	112	33	404
Estonia	104	11	5	120
Greece	284	46	46	377
Hungary	769	152	93	1,013
Latvia	341	58	21	420
Lithuania	126	31	13	170
Malta	7	5	5	17
Poland	328	331	89	747
Portugal	718	81	55	854
Romania	726	122	36	885
Slovakia	137	96	11	244
Slovenia	167	40	22	228
Spain	1,085	83	129	1,297
EU-15	**5,316**	**1,192**	**580**	**7,088**

Spain, Hungary and Romania are the largest recipients. This initial injection would also create additional direct jobs in these three sectors, which can be calculated using employment-output ratios. This is shown below:

Additional direct jobs attributed to environmental infrastructure injection

Member States	WS	WWT	MSW	Total
Bulgaria	2,511	429	252	3,192
Cyprus	-	62	116	178
Czech	2,463	2,219	521	5,204
Estonia	990	228	73	1,291
Greece	2,702	919	740	4,360
Hungary	7,304	3,003	1,479	11,786
Latvia	3,237	1,150	342	4,729
Lithuania	1,197	616	201	2,014
Malta	63	99	80	242
Poland	3,116	6,549	1,413	11,077
Portugal	6,820	1,600	876	9,296
Romania	6,902	2,418	575	9,894
Slovakia	1,302	1,896	175	3,373
Slovenia	1,586	783	349	2,719
Spain	10,310	1,642	2,050	14,001
EU-15	**50,502**	**23,611**	**9,243**	**83,356**

The €7 billion injection in environmental infrastructure would lead to the creation of 83,356 direct jobs. Most of the jobs will be in Spain, Hungary and Poland. The I-O tables also allow us to calculate indirect impact on employment and output of this injection. This is shown below:

Additional indirect jobs attributed to environmental infrastructure injection

Member States	WS	WWT	MSW	Total
Bulgaria	1,808	328	193	2,328
Cyprus	n/a	8	16	24
Czech	3,748	1,914	450	6,111
Estonia	701	121	39	861
Greece	1,181	217	175	1,573
Hungary	3,420	1,659	817	5,896
Latvia	3,979	742	221	4,942
Lithuania	1,867	256	83	2,206
Malta	37	62	50	150
Poland	3,293	4,609	995	8,897
Portugal	n/a	608	333	941
Romania	8,844	4,619	1,099	14,563
Slovakia	676	1,010	93	1,779
Slovenia	683	592	264	1,539
Spain	12,226	575	718	13,519
EU-15	**42,463**	**17,320**	**5,546**	**65,329**

The injection will have an impact on the suppliers of goods and services to these three sectors and lead to the creation of 65,329 indirect jobs. The employment multiplier effect of the increase in jobs is 1.78 (83,356 direct jobs plus 65,329 indirect jobs = 148,685 jobs, divided by direct jobs 83,356).

Indirect impact on output attributed to environmental infrastructure investment (€ million)

Member States	WS	WWT	MSW	Total
Bulgaria	511	45	33	589
Cyprus	-	1	2	4
Czech	391	162	47	600
Estonia	108	16	6	130
Greece	391	43	43	478
Hungary	1,074	196	120	1,390
Latvia	388	59	22	468
Lithuania	126	29	12	167
Malta	3	10	10	24
Poland	489	359	96	944
Portugal	1,096	119	81	1,295
Romania	1,236	262	77	1,576
Slovakia	196	145	17	357
Slovenia	230	59	33	322
Spain	1,520	137	212	1,870
EU-15	**7,759**	**1,642**	**812**	**10,213**

Through indirect effects, the initial €7.08 billion would boost output by another €10 billion per annum in the EU-27. The output multiplier effect of the initial €7.08 billion is 2.4 (Direct output €7.08 billion plus indirect output €10.2 = €17.3 billion, divided by direct output €7.08 billion).

PART D: LINKS TO BIODIVERSITY AND OTHER AREAS NOT CURRENTLY AMENABLE TO ASSESSMENT USING INPUT-OUTPUT APPROACHES

7 INTRODUCTION TO PART D

Part B of this study looked at the following links between the environment, economy and jobs:

1. Activities where the environment is a **primary resource** or input into the economic process – Agriculture, forestry, mining, electricity generation (excl. renewables) and water supply
2. Activities concerned with **protection and management** of the environment – such as waste recycling, renewable energy, pollution and sewage control, and environmental management.[55]
3. Activities dependent on **environmental quality** – Environment related tourism

This analysis quantified environmental related activities in terms of jobs and output Both direct and indirect economic impacts were presented using input-output tables.

Part C used a number of environmental policy scenarios to explore how different policies would affect the economy taking into account the indirect effects.

This part (Part D) examines a range of other linkages between the economy and the environment, which are potentially important but which, are more difficult to quantify with existing levels of data and which are less amenable to the application of the quantitative approach, based on the Input-Output (I-O) framework used in the rest of the study.

It starts with a discussion of the drivers of environment related economic activities (Chapter 8). Chapter 9 then explores the link between biodiversity/natural capital and the associated 'ecosystem services' with the economy – a link difficult to quantify fully and hence not included under Part B. There are a wide range of links between biodiversity and the economy. These links are not 'just' the generally perceived one of the economy's impact on biodiversity but about the positive impact on the economy of the existence of biodiversity and the provision of ecosystem services.

In the chapter 10 we look briefly at some of the other important links between the economy and the environment, which were not quantifiable under the I-O framework. These are green public procurement (GPP), the role of good quality environment in business and residential location choices, the environment voluntary sector and environment related insurance services, damage and rebuild costs.

[55] OECD/Eurostat (1998) Eco-industries definition

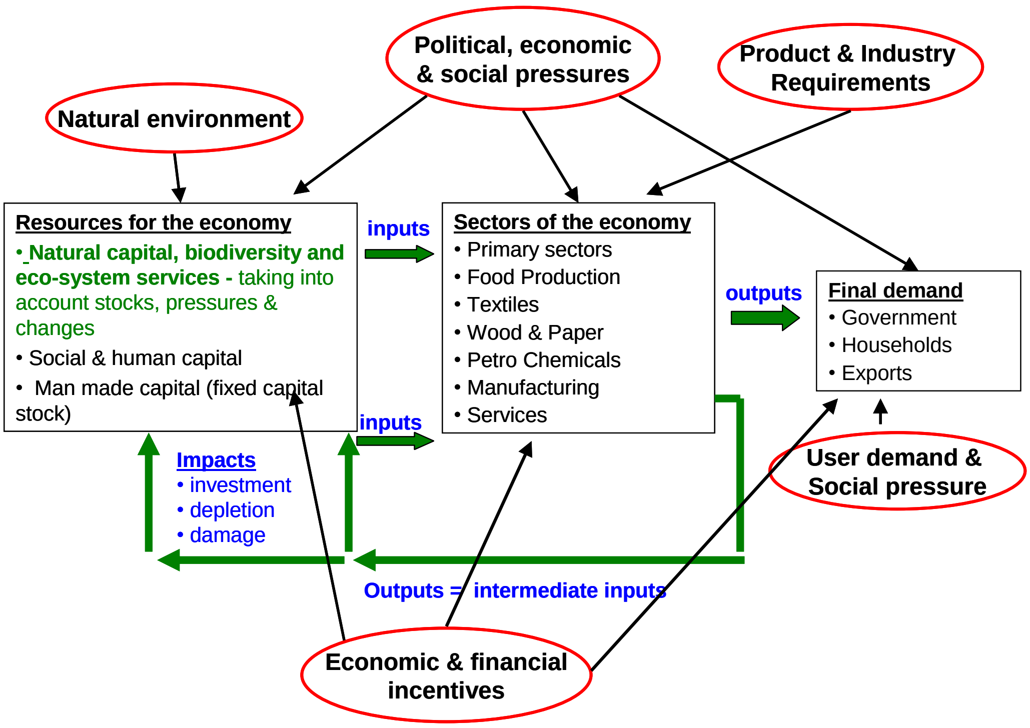
8 DRIVERS OF ENVIRONMENT RELATED ECONOMIC ACTIVITIES

The identification, description and indeed strength and dynamics of economy-environment linkages are influenced by a range of drivers. We have outlined five main drivers which shape environment related economic activity:

1. **The natural environment** – the stocks and quality of natural capital which is the input to, or focus of, different economic activities.
2. **Political, economic and social pressures** – the values, opinions, and economic wealth which influence the choices and actions of economic actors.
3. **User demand & social pressure**– the demand (by consumers, corporate or public buyers) for products (goods & services) that worsen / improve environmental performance directly or, through supply chains, indirectly
4. **Product and industry requirements** – legal or voluntary requirements of production or products (e.g. pollution control regulation, product standards, eco-labelling) to achieve set levels of environmental performance
5. **Economic/financial incentives** – any economic or financial incentive to produce or consume certain products and services with associated environment impacts e.g. CAP, structural funds, ethical investment, taxes and subsidies.

These five types of drivers are clearly interlinked and environment related economic activities are a result of interaction between different types of drivers. Figure 8.1 highlights the role of the drivers for a typical model of an economy.

Figure 8.1: Drivers of Environment Related Economic Activities



All relevant economic activities use and/or impact on environmental resources (natural capital). Some activities use the environment as an input, while others are concerned with managing resources or environmental risks. For activities to exist there must be final / user demand. In general terms user demand is affected by the other types of drivers: political, economic and social pressures (i.e. values, perceptions, and wealth), requirements (i.e. the types of products and services available), and economic and financial incentives (i.e. the price of products and services). The political, economic and social pressures also influence the way requirements are set and where economic and financial incentives are targeted, as well as the way the natural environment is valued and reflected in policy decisions.

Finally, the way we choose to use, regulate, and financially support environment related activities, products and services has effects on the natural environment. In the worst case it reduces stocks and quality of the environment (e.g. over fishing, use of fossil fuels), and in the better case it contributes to a minimising the negative impacts on the environment and the preservation of stocks and resources (e.g. organic farming, pollution control, energy efficiency products). In the latter case, it should however be noted that some activities which make a positive contribution to the environment, are actually driven by the existence of negative impacts on the environment, such as pollution.

These drivers indicate the complexity of the relationships between the environment and the economy. They also provide some appreciation of the influences that environmental policy can have on economic activity and hence on the use of environmental resources and associated environmental quality. These drivers therefore help in establishing policy scenarios and the assessment of their potential economic impacts.

Details on the drivers and how they interact with the 10 environmental activity domains is presented in Annex B.

9 BIO-DIVERSITY AND LINKS TO THE ECONOMY

9.1 A Classification of Bio-diversity and Eco-system Services

Biodiversity includes species diversity, genetic diversity and habitat diversity. Each of these are inter-linked and together form the wealth of ecosystems. They offer a range of different ecosystem services and the benefits that stem from ecosystems can be classified as:

1. **provisionary services**, such as food, fibre, fuel and water;
2. **regulating services**, ie benefits obtained from ecosystem processes that regulate the environment, such as the regulation of climate, floods, disease, wastes, and water quality;
3. **cultural services** such as recreation, aesthetic enjoyment and tourism; and
4. **supporting services**, ie services that are necessary for the production of all other ecosystem services, such as soil formation, photosynthesis, and nutrient cycling (see Table 9.1).

This typology follows the Millennium Ecosystem Assessment (MEA) classification[56]. Early references to the concept of ecosystem functions, services and their economic value date back to the mid-1960s and early 1970s. However, the concept of ecosystem services (also referred to as nature's services or ecosystem/nature goods and services) became widely used only in the 1990s (see for example Daily 1997, Costanza et al. 1997, Pimentel and Wilson 1997, Daily et al. 2000).

Table 9.1: Classification of Ecosystem Services [57]

TYPE OF ECOSYSTEM SERVICE[58]
Provisionary Services
Food and fibre
Fuel
Biochemicals, natural medicines, and pharmaceuticals
Ornamental resources
Fresh water
Other
Regulating services
Air quality maintenance

56 Millennium Ecosystem Assessment (MEA, 2005). Ecosystems and Human Well-being: Biodiversity Synthesis. World Resources Institute, Washington, DC. 100 pp.

57 See Kettunen, M. & ten Brink, P. 2006. Value of biodiversity- Documenting EU examples where biodiversity loss has led to the loss of ecosystem services. Final report for the European Commission. Institute for European Environmental Policy (IEEP), Brussels, Belgium. 131 pp.

58 Defined as according to the MEA

Climate regulation (eg temperature and precipitation, carbon storage)
Water regulation (e.g. flood prevention, timing and magnitude of runoff, aquifer recharge)
Erosion control
Water purification and waste management
Regulation of human diseases
Biological control (e.g. loss of natural predator of pests)
Pollination
Storm protection (damage by hurricanes or large waves)
Fire resistance (change of vegetation cover lead increased fire susceptibility)
Avalanche protection
Other
Cultural services
Cultural diversity, spiritual and religious values, educational values, inspiration, aesthetic values, social relations, sense of place and identity
Cultural heritage values
Recreation and ecotourism
Other
Supporting services
Primary production
Nutrient cycling
Soil formation
Other

9.2 The Main Linkages between Ecosystem Services and the Economy

Ecosystem services provide economic benefits which can be reflected in the national accounts. For example the provisionary and cultural services can be directly quantified in economic terms due to the existence of a market for these products and services. On the other hand vital environmental regulating services such as flood protection, carbon storage and water purification can only be valued indirectly by comparing the cost of man-made interventions performing the same service. Moreover, other services such as pollination, climate control and the supporting services are extremely precious and can only to a very limited extent be valued in economic terms. Thus ecosystem services are important to the economy and the links between ecosystem services and the economy can be classified in three main ways:

1. **Ecosystem services providing inputs into production activities** – this can range from the water, soil, fuel to the minerals, biochemicals, natural medicines and pharmaceuticals. We have captured this link as much as possible in the standardised version of the study.
2. **Ecosystem services and products of extreme importance to the economy but not fully valued in economic terms** – mainly regulating services such as pollination, climate regulation, water purification, etc. For example, Costa Rica

has recognized that its protected forests contribute water for power generation that is worth $104 million per year (in other words, that is how much it would cost to import enough fossil fuels to produce an equivalent amount of energy).

3. **The economic value due to costs or losses of declining or damaged ecosystem services** (corollary of the above) – this refers to costs of constructing flood barriers, eutrophication of water bodies and depleting fish stocks. In this context, interestingly, New York City recently discovered that it will be 10 times cheaper to buy key parts of its watershed and manage them appropriately than to build new water treatment plants.

All relevant economic activities use and/or impact on environmental resources (natural capital). Some activities use the environment as an input, while others are concerned with managing resources or environmental risks. For activities to exist there must be final / user demand. In general terms user demand is affected by the other types of drivers: political, economic and social pressures (i.e. values, perceptions, and wealth), requirements (i.e. the types of products and services available), and economic and financial incentives (i.e. the price of products and services). The political, economic and social pressures also influence the way requirements are set and where economic and financial incentives are targeted, as well as the way the natural environment is valued and reflected in policy decisions. Recall Figure 1.1 from section 2 - which shows the main interactions of the economy with the environmental resources.

Earlier in the report we presented a typology of all environmental-economy linkages (Table 1.2) in Section 1. Table 9.2 below shows where biodiversity related ecosystem services contribute to the 10 environment-economic interlinkages that this study used as a way of categorising the range of links.

Table 9.2: Environment-Economy Linkages and the Economic Contribution of Bio-diversity Related Ecosystem Services

	Main heading	Linkages	Environment related (sector / subsector / products / activity)	Contribution of Biodiversity and Ecosystem services
1	**Econ based on Natural resources (Non renew.)**	Natural resource based activities – non-renewable natural resources	Energy (coal, oil, gas), mining & quarrying (minerals)	Historical (geological time periods): plants/animals sources of fossil fuels
2	**Econ based on Natural resources (Renew.)**	Natural resource based activities – renewable resources	**Agriculture, timber, fisheries, renewables, water supply, pharma (natural drugs)**	Yes - all, though with only part of water supply
3	**Econ based on Natural resources (EcoSP)**	Ecologically sustainable production	**Organic farming, Sustainable forestry, sustainable fisheries, biofuels; subset of '2'**	Yes: all
4	**Environmental Management (EM)**	Greening of the general economy - process and appliance and building efficiency	Energy efficiency in appliances, process efficiencies	generally not
5	**Environmental Management (PCM)**	Historically core Eco-industries – pollution control expenditure	SWM (inc direct recycling), WWT, APC, GPA, PEM, RCS, NVC, ERD & EMI	generally not

6	**Environmental Management (RM)**	History core- eco-industries – natural resource management	Recycled Materials, **Nature protection / conservation, natural risk mgmt.**	Yes for nature protection, conservation and natural risk management
7	**Environmental Management (GP)**	Green products - green procurement	Eco-labels, sustainable construction (e.g. passive houses inc. heat/energy saving and mgmt), Zero Emission Vehicles, ethical investment funds	generally not (some relatively minor potential via sustainable construction)
8	**Environmental Quality (EQ)**	Economic activities dependent on environmental quality	**Tourism; recreation; livelihood; culture value and identity, health**	Yes
9	**Environmental Quality (ERT)**	Economic activities dependent on environmental quality - subset	**Env. Related Tourism (ERT), inward investment, house prices;** subset of 8	Yes
10	**Environmental Quality (NRM)**	Natural risk management (NRM) - Avalanches, droughts, floods, fire, earthquakes, etc	**Natural risk management** (residual not captured in 6: Insurance, protection of assets, rebuilding)	Yes

Biodiversity and ecosystem services are directly important for linkages 1 to 5 of the 10 areas, partly for nature protection / conservation, natural risk mgmt areas, and within a geological timeframe for environmental management as fossil fuels come from biodiversity - plants and animals. Note that in the areas where biodiversity ecosystem services are not valuable inputs, the activities in these areas can help mitigate potential negative effects on biodiversity and associate ecosystem services. Hence in all areas there are direct or indirect connections.

To discuss the links further, biodiversity contributions to the industrial sectors of the economy were explored (Table 9.3). This is not an in-depth investigation but an exercise to highlight the biodiversity links for each sector.

The importance of the link between the sector and the environment is presented to show the level of significance. '>50%' underlines that most of the activity in the sector is related to the environment. Where the link is significant and substantial, but not determining the nature of the sector, the value of '<25%' is used. Where there is occasional, or local significance (for example for a discrete set of applications in the sector), but that this remains focused, the value of '<5%' is used. Where there is little importance at all, '<1%' is used. In some sectors there is a fast changing link – eg bioplastics within plastics – here a label 'F+' is used to indicate that future growth is expected. The numbers should be seen as indicators of significance rather than as empirical analysis based results; they relate more to expert judgment by the team, backed up by some analysis of the sectors by a short literature review. The Terms of Reference did not ask that such an analysis be done, but the team considered it useful to clarify the links and effectively clarify a possible future area for analysis.

Table 9.3: Potential Importance of Biodiversity Related Ecosystem Services Contribution to the Economy

	Sector	Importance	Examples of ecosystem service / contribution
1	Organic Agriculture	>50%	Genetic resources and stock availability (fish, seeds, resources for horticulture); Pollination; Seed dispersal
2	Other Agriculture		
3	Sustainable Forestry		
4	Other Forestry		
5	Fishing		
6	Coal	<1%	Water provision (for coal washing)
7	Oil & Gas etc	>50%	Purely speaking; (Historical) fibre
8	Other Mining	<1%	
9	Food, Drink & Tobacco	>50%	Food: crops, livestock, Fibre: tobacco + capture fisheries, aquaculture, wild plant and animal products + *dependent on the provisioning of fresh water (ie. water used by the industry)*
10	Textiles, Clothing & Leather	<25%	Fibre*:* cotton, hemp, silk, leather + Water purification and waste control (=> avoided costs of purification)
11	Wood & Paper*	>50%	Fibre*:* timber, pulp, wood fuel + Water purification and waste control (=> avoided costs of purification)
12	Printing & Publishing*	<1%	*difficult to identify Indirect: this sector is highly dependent on paper supply, hence wood, hence eco-system services*
13	Manufactured Fuels	<25% F: +	**Provisioning services:** Fibre*:* Biofuels, wood chips/shavings/charcoal, other organic material for manufactured fuels Future growth: bio-fuels
14	Pharmaceuticals	<25% F: +	Genetic resources; Natural medicines and pharmaceuticals; Fresh water; Pest and disease regulation; Alien species invasion resistance; Pollination ; Seed dispersal Future growth: bio-based pharmaceuticals
15	Chemicals nes	<25% F: +	Genetic resources; Biochemicals; Fresh water ETC Future growth: biochemicals
16	Rubber & Plastics	<5%	Fibre – latex for rubber production and organic material for plastic production; Genetic resources; soil formation**,** primary production – photosynthesis nutrient cycling**,** water

		F: +	cycling
17	Non-Metallic Mineral Products	<5%	Fossil-based sulphur deposits; Role of bacteria etc. in non-metal mineral products formation (e.g. sulphur).
18	Basic Metals	<1%	Water purification and waste control (=> avoided costs of purification)
19	Metal Goods		
20	Mechanical Engineering		
21	Electronics		
22	Electrical Engineering & Instruments		
23	Motor Vehicles		
24	Other Transport Equipment		
25	Manufacturing nes		
26	Renewable electricity	>50%	Fibre – biofuels (electricity from biofuels); wood chips, wind, solar
27	Non-renewable electricity	<5%	Fresh water used by the sector (e.g. water for cooling, hydropower);
28	Gas Supply	<1%	*Biodiversity related ecosystem services affect this sector through the (bio) gas production sector*
29	Water Supply	>50%	Fresh water supply, cycling, regulation and purification and Natural hazard regulation: flood protection / mitigation (=> effects on water supply)
30	Construction	<5%	Erosion regulation; Natural hazard regulation:
31	Distribution	<1%	Natural hazard regulation (e.g. flooding)
32	Retailing	<5%	Food: Ornamental resources; merchandise linked to ecotourism
33	Hotels & Catering	<25%	Food; Fresh water; Air quality control ; educational values, aesthetic values, cultural heritage values, recreation and ecotourism
34	Land Transport etc	<1%	Natural hazard regulation: flood and avalanche protection / mitigation,
35	Water Transport	<5%	Natural hazard regulation: flood protection / mitigation (=> stable conditions, minimising risks to water transport)
36	Air Transport	<1%	*difficult to identify*
37	Communications	<1%	Communication related to natural hazard monitoring and emergency response.
38	Banking & Finance	<1%	Liabilities associated with impacts on biodiversity and eco-system services

39	Insurance	**<25%**	Reduced (increased)insurance costs as the ecosystems and their services buffer/prevent (augment) environmental risks by: Erosion regulation; Pest and disease regulation; Natural hazard regulation:
40	Computing Services	**<1%**	*difficult to identify*
41	Professional Services	**<5%**	R&D, Natural hazard regulation; ecotourism Fresh water; Air quality control Water regulation/ water cycling
42	Other Business Services (inc. env. Services)	**<1%**	Natural hazard regulation: (e.g. flooding)
43	Public Administration & Defence	**<5%** F:+	Alien species invasion resistance and Natural hazard regulation: flood protection / mitigation, avalanche protection / mitigation, fire resistance, storm protection (protection for hurricanes and large waves etc) + *Growing importance of security of coastal areas, forests etc; heat waves and water scarcity also an increasing issue of public security and preventing environmental crises-based conflicts.*
44	Education	**<5%**	**Cultural services:** learning, spiritual and religious values**,** inspiration**,** aesthetic values**,** social relations**,** sense of place
45	Health & Social Work	**<5%**	**Regulating services** – as avoided costs for health / social work sector as a consequence of the existence of ecosystem services + **Cultural services:** spiritual and religious values**,** inspiration**,** aesthetic values**,** social relations**,** sense of place
46	Miscellaneous Services	**<25%**	**Regulating services** Water purification and waste treatment (=> avoided costs at waste / sewage treatment sector)l; nature reserve activities

Note: F+ indications positive growth in the future

More details on the environmental links for each of the 46 sectors in Table 9.3 is given in Annex H.

The sectors where biodiversity and ecosystem services play a **predominant role** include: agriculture (e.g. fisheries, aquaculture, and forestry), food, drink & tobacco, wood & paper, and water supply. Here the genetic resources and stock availability are clearly vital, as are biodiversity's role in pollination and seed dispersal and the ecosystem contributions to water and soil quality. Water purification is an important ecosystem service and can significantly help reduce costs of pre treatment of water. See Table 9.5 for economic benefits of water purification.

Biodiversity and ecosystem services also play a very **significant role** in the following sectors: textiles, clothing. & leather, manufactured fuels, pharmaceuticals, chemicals, hotels & catering, insurance and miscellaneous services (e.g. collection and treatment of waste/sewage, recreation, culture, nature reserve activities, sports, artistic / literature creation etc.).

It is also valuable to highlight that for some of these issues, the role is becoming increasingly important, notably for manufactured fuels, pharmaceuticals, chemicals, and rubber & plastics (as shown in Table 9.3). This is part of the growing move towards biological based goods, e.g. biofuels, biologically based pharmaceuticals, biochemists and bio-plastics. Those that speak of 'peak oil' foresee an important paradigm shift / transition from fossil fuel base in these sectors, to renewable biological base that is already starting now.

In the following sectors, ecosystem services can play an **occasionally important role**: non-metal mineral product, electricity, construction, retailing, water transport, professional services (e.g. R&D), public administration & defence (e.g. defence, public security, fire services), education, and health & social work.

This list of sectors where biodiversity plays a predominant and significant role is greater than half of the sectors of the economy, underlining that the link between biodiversity and the economy is critical sustainable economic growth.

Furthermore, economic activity can lead to losses in biodiversity and subsequently a loss of ecosystem services, which in turn would affect the economy. In short, economic activity can compromise other economic activities through negative knock on effects.

There are some important issues to consider with regards to biodiversity and ecosystem services with the economy:

- There is often an important non-payment for services and hence implicit subsidies to the economy. Resources can be under priced as can services (e.g. high value biodiversity). Table 9.4 shows to what extent the market values biodiversity goods and eco-system services. This table demonstrates that national accounts (and hence GDP values), and the associated input-output models do not take into account or represent the range of values from the different ecosystem services provided by biodiversity.
- There is often no liability for negative impacts on biodiversity.
- There are many economy-economy trade-offs that arise via the interlinkages to biodiversity and ecosystem services. This raises the question as to whether decision making needs upgrading[59].

[59] For more on the integration of these concerns into regional development assessments , see ten Brink et al (2007)

- The interlinkages are changing. There are, for example, growth areas – biofuels, bioplastics and biochemicals.

Table 9.4 Ecosystem services – are values picked up in the market?

Types of ecosystem services	Is the value integrated into market prices?
Provisioning Services	
Food, fibre, fuel	**Generally YES (in the EU)**
Biochemicals, natural medicines, and pharmaceuticals	**Resource value is NOT integrated**
Ornamental resources	**Generally YES (in the EU)**
Fresh water	**Resource cost are generally NOT integrated**
Regulating services	
Air quality maintenance	**Generally NOT**
Climate regulation - temperature and precipitation, carbon storage etc.	
Water regulation - flood prevention, timing and magnitude of runoff, aquifer recharge	
Erosion control	
Water purification and waste management	
Regulation of human diseases	
Biological control and pollination	
Natural hazards control / mitigation - storm and avalanche protection, fire resistance etc.	
Cultural services	
Cultural diversity, spiritual and religious values, educational values, inspiration, aesthetic values, social relations, sense of place and identity, cultural heritage values	**Only sometimes (through access fees)**
Recreation and ecotourism	
Supporting services	
Primary production, nutrient cycling, soil formation	**Almost never**

9.3 The Scale and Importance of Ecosystem Services

Studies analysing and quantifying ecosystem services are not widely available though this is an area of growing interest. More recently the need for evidence based policy making and the growing appreciation of monetary figures by decision makers is increasing the need for quantifying biodiversity related values.

Table 9.5 and 9.6 below presents some examples of values of ecosystem services and values of ecosystem service losses respectively.

Table 9.5: Examples of Monetary Benefits Arising from Biodiversity and Related Ecosystem Services[60]

TOURISM		
Example	**Estimated value and/or potential/occurred loss**	**Reference**
Reintroduction of sea eagles, UK	Revenue from sea eagles related tourism 2.13 -2.48 million EUR / year	Dickie I, Hughes, J., Esteban, A. 2006. Watched like never before – the local economic benefits of spectacular bird species
Tourism in Muritz National Park, DE	Revenue from the tourism 12 million EUR / year, supporting ~ 628 jobs	Job et al. 2005. Ökonomische Effekte von Großschutzgebieten
Whale watching, Scotland	Revenue from whale watching tourism ~ 11.7 million EUR / year; ~12% of total tourism income	Warburton et al. 2001. Whale watching in West Scotland
RIVER / FLOODPLAIN ECOSYSTEMS		
Example	**Estimated value and/or potential/occurred loss**	**Reference**
Elbe river, DE	Value of nitrates pollution reduction by restoring floodplains 585 EUR / hectare; Potential total value of restoration (water quality & species conservation) 162 – 278 million EUR / year	Meyerhoff, J., Dehnhardt, A. 2004. The restoration of floodplains along the river Elbe.
River Bassee floodplain, FR	Value of flood control services 91.47 – 304.9 million EUR / year	Agence de L'eau Seine Normandie, Ministry of Ecology and Sustainable Development.
Saltmarshes in Scotland	Input of saltmarsh to the shellfish industry a marginal value of 1087 EUR / hectare / year	Coclough et al. 2003. The potential for fisheries enhancement associated with management realignment.
Inland fisheries, UK	Total value of inland fisheries in England and Wales 4,854 million EUR	Murray, M. and Simcox, H. 2003. Use of wild living resources in the United Kingdom: a review.
FOREST ECOSYSTEMS		
Example	**Estimated value and/or potential/occurred loss**	**Reference**
Value of trees in NY city, US	NY City's street trees provide benefit ~ $122 million / year $ 5.60 benefits / $ 1 dollar spent on trees	NY city Park Department (2007) (http://www.env-econ.net/2007/04/measuring_the_v.html)
Natural forests in Bavaria, DE	Value of provisioning good quality water 500 million EUR / year	Natur ist Mehr-Wert, Ökonomische Argumente zum Schutz der Natur. BfN Skripten 154 (2005)
Woodlands, UK	Total value of environmental and social services 42,924 million EUR	Willis et al. 2003. The Social and Environmental Benefits of Forests in Great Britain

[60] Building on cases from Birdlife, 2007. *Wellbeing through wildlife in the EU* and other source

Forest ecosystems, FI	Value of forest ecosystem services 2,690 million EUR / year (period 1995 – 2000)	Matero & Saastamoinen. 2007. In search of marginal environmental valuations — ecosystem services in Finnish forest accounting. Ecological Economics.

Economic benefits through tourism based on biodiversity and ecosystem services have been estimated using I-O tables. The findings in Table 9.5 should be considered separately from the estimate of jobs and output from environmental related tourism, using the I-O framework in Part B.

Table 9.6: Examples of the Economic Losses Due to the Loss of Biodiversity Related Ecosystem Services

CASE STUDY	ESTIMATES OF LOST VALUE
Case 1. Decline of European crayfish populations	✓ 40 per cent decline in native crayfish populations in France during the last 6 years; ✓ 95 per cent decline in native crayfish populations in Sweden since ~1900
Case 2. Modification of Danube river ecosystems	✓ Value of restored river fisheries ~US$16 million in the Danube delta; ✓ Value provided by restored habitat in the Danube delta for nitrogen and phosphorous absorption and cycling ~US$112.5 million and ~US$18.2 million respectively per year; ✓ Value of tourism in the Danube delta resulting from restored wetland habitat ~US$16 million per year
Case 3. Modification of Lake Karla ecosystem (Greece)	✓ Loss of entire fish catch in Lake Karla (Greece) of 80kg per hectare; ✓ Restoration of the lake has started at a cost of around €150 million
Case 4. Depletion of the North Sea resources	✓ Cod spawning stock biomass in the North Sea declined from a peak of 250,000 tonnes in the early 1970s to less than 40,000 tons in 2001
Case 5. Destruction of peat bogs in Finland and the UK	✓ Restoration of peat bogs in the Northwest England is expected to help improve drinking water quality and provide benefits between €1.8 and 3.6 million/year
Case 6. Agricultural changes in Portugal	✓ During 1980-2004 fires burned around 2.7 million ha of forest in Portugal; ✓ Costs arising from the loss of primary production due to forest fires ~€300 million per year (2000-2004) ✓ Investments in fire fighting and prevention amounted to €479 million (€17,8/hectare per year) (2000-2004)
Case 7. Eutrophication of the Swedish coast	✓ Estimated overall benefits of increased water quality would amount to €6 – €54 million per year; ✓ Annual costs of removing dead algae are €8119 per km of beach; ✓ Costs of mechanical harvesting of algal mats ~€7145/year
Case 8. Recovery of ospreys in the UK	✓ Osprey tourism is estimated to bring additional expenditure of £3.5 million per year to local economies
Case 9. Reintroduction of beavers in Germany	✓ Increased revenues from tourism in the area of reintroduction can total up to ~€0.55 million per year; ✓ Estimated additional retention of 2800 kgN per annum in the river and of 1900 kgN per annum in the floodplains
Case 10. Unsustainable clam fishing in Italy	✓ ~40 per cent decline in the clam catch between 2000 and 2001 due to decline of stocks

Source: (Kettunen & ten Brink 2006)

9.4 Specific Examples of the Links between Biodiversity and Some Sectors of the Economy

This section presents a review of certain links between biodiversity and selected sectors of the economy. This is presented to give further insights on the importance and potential of biodiversity related inputs into different economic sectors and other issues of interest (e.g. whether the links are growing or not).

This includes:

- Biodiversity, agriculture and the dangers of lack of genetic diversity.
- Biomedicine; building on genetic wealth
- Organic sources of plastics

9.4.1 Agriculture and Genetic Diversity

Currently the agriculture sector of the economy is based on a tiny fraction of the available plant varieties. The world's food supply depends on about 150 plant species (FAO), while there are 250,000 plant varieties available for agriculture, but less than 3% in use today (FAO). Furthermore, more than half of the world's food energy comes from a limited number of varieties of three "mega-crops": rice, wheat, and maize. (FAO). Note also that 80% of tomatoes and 92% of lettuce varieties have been lost during the 20th century. (Worldwatch Institute)

The loss of varieties has for the moment not had a major influence on agricultural output at a global scale. However, there are dangers of a loss of genetic diversity to agriculture and also a danger of basing agriculture on only a minority of crop varieties. Examples of problems include:

- In Ireland, in 1845, a mildew epidemic destroyed the entire potato crop for two consecutive years. Because potatoes were the basis of the local diet and there was only one variety on the island, over one million Irish died and another one million emigrated to North America to escape starvation
- The only species of banana widely used and consumed is the Cavendish. The bananas are thus deprived of their genetic dynamism. When a bacteria, virus, or insect targets the Cavendish as a host, the results are explosive because normal genetic variation is not there. Hence ever increasing quantities of chemicals inputs (an average of 280 different pesticides are currently authorized in banana cultivation) and significant environmental damage in terms of soil erosion, water pollution and land contamination.

The existence of a range of regional or local varieties can be valuable for the global markets. For example Ethiopian barley is said to be worth $150million in the United States each year.

9.4.2 Biomedicine

Ten of the twenty-five most sold medicines are made from natural resources (Greenpeace). Furthermore, around 80% of the world's population is at least partly dependent upon traditional medicine and medicinal plants to treat their ills. This demonstrates the importance and the biodiversity based resource base in this sector and its market value. In 1990 the annual world market value of medicinal plants alone was estimated at $43 billion.

Specific noteworthy examples of valuable bio-medicines include:

- Pau D'Arco, a medicinal plant from Latin America, which has long been used to combat malaria and cancers, has a market value in the North of $200 million a year.
- The rosy periwinkle, for example, "a plant vital to childhood leukaemia treatment, originated in, and has long been used by healers in Madagascar".
- A Chinese herb, Artemisia annua, is a promising new weapon in the fight against malaria.

- The Pacific Yew was considered a trash tee until taxol, a compound found in its bark, was discovered to be a powerful drug against ovarian, lung and other cancers.
- The bacterium living in the Yellowstone hot springs might have seemed quite worthless before it was discovered to have an enzyme that drives the polymerase chain reaction, a biochemical process that won the Nobel Prize in 1993 and that is now responsible for billions of dollars worth of economic activity annually.

9.4.3 Plastics

Plastics, with their current global consumption of more than 200 million tonnes (EU approx. 40 million tonnes) and annual growth of approximately 5%, represent the largest field of application for crude oil outside the energy and transport sectors. With the oil price increase it is becoming increasingly important and pressing for this significant industry branch (worth 200 billion euros in all sectors of Europe) to utilise alternative raw materials, hence the renewed interest for bioplastics. Companies see in this new raw material a combination of new market opportunities. National or regional interests served by bioplastics can be manifold and differ substantially at present: in the US, resource security and resource utilisation are paramount; in Japan, a strong drive towards products with green credentials; in Europe, resource utilisation, reduction of GHGs, and compostability.

Today, bioplastics development is just beginning. The European bioplastics association estimates that their market share in Europe is currently less than 1% (approximately 50,000 tonnes in 2005)[61]. The European countries with the highest consumption are Germany, England, France, Italy and the Netherlands. Bioplastics are also increasingly being used in individual applications in Belgium, Norway, Austria, Spain and Switzerland.

The Institute for Prospective Technological Studies (IPTS) one of the seven scientific institutes of the European Commission's Joint Research Centre (JRC) estimated the total technical substitution potential of bioplastics is around 15.4 million tonnes for EU-15, or 33% of the total current polymer production. In absolute terms, biobased polymers are projected to reach a maximum of 1 million tonnes by 2010 in the scenario without any incentive policies and measures (P&M) and max 1.75-3.0 million tonnes by 2020 in the scenarios with P&M and without P&M respectively. These (physical) amounts are equivalent to an estimated maximum (monetary) production volume of roughly 1-2 billion EUR by 2010 and 3-6 billion EUR by 2020. It is however highlighted that these quantities are modest compared to the expected production increase of petrochemical polymers by 12.5 million tonnes by 2010 and 25 million tonnes by 2020. Thus, the market share of bio-based polymers will remain very small, in the order of 1-2% by 2010 and 1-4% by 2020.

9.5 Conclusions

There are manifold links between biodiversity and the related ecosystem services and the economy and these links are more pervasive and fundamental to the economy (and society) that generally previously thought.

Table 9.7 provides an overview of the linkages in terms of the standard listing of economic sectors. Annex H provides a more detailed analysis.

[61] See http://www.european-bioplastics.org

Table 9.7: An Overview of Bio-diversity and Eco-system Services Linkages with the Economy

	Economic sectors
Sectors with high biodiversity eco-system services linkages	1 Agriculture, (e.g. fisheries, aquaculture, forestry) 5 Food, Drink & Tob. 7 Wood & Paper 24 Water Supply Renewable electricity *Historically* 2 Coal; 3,Oil & Gas; 23 Gas Supply
Sectors with medium biodiversity eco-system services linkages	6 Text., Cloth. & Leath. 10 Pharmaceuticals 11 Chemicals 9 Manuf. Fuels 28 Hotels & Catering 34 Insurance 41 Misc. Services *collection and treatment of waste/sewage, recreation, culture, nature reserve activities, sports, artistic creation*
Sectors with low biodiversity eco-system services linkages	2 Coal; 3,Oil & Gas; 4, Other Mining 8 Printing & Publishing 12 Rubber & Plastics 13 Non-Metal Mineral Products 14 Basic Metals; Metal Goods; Mech. Engineering ; Electronics; Elec. Eng. & Instrumentation.; Motor vehicles; Other. Transport Equipment; Manuf.. nes 22 Electricity (most countries) 23 Gas Supply 25 Construction 26 Distribution 27 Retailing 29 Land Transport etc 30 Water Transport 31 Air Transport 32 Communications 33 Banking & Finance 35 Computing Services 36 Prof. Services Inc. R&D 37 Other Bus. Services 38 Public Admin. & Def. (e.g. defence, public security, fire services)
Sectors where the importance of biodiversity eco-system services are changing significantly (traded goods in 4 of the 5 sectors)	9 Manuf. Fuels 10 Pharmaceuticals 11 Chemicals 12 Rubber & Plastics 38 Public Admin. & Def. (e.g. defence, public security, fire services)

The understanding of these linkages is still in the early stages of development and more research is needed. That said, the links are already clear and it is not a case of waiting for new research for there to be action. There is a range of things already being done and to be done already. This includes:

- There is often an important non-payment for services and hence implicit subsidies to the economy. Resources can be under priced as can services (e.g. high value biodiversity). This demonstrates that national accounts (and hence GDP values), and input-output models do not take into account or represent all the range of values from the different ecosystem services provided by biodiversity.

- Full resource pricing. There is a need to move to greater use of resource pricing to help build the value of the resource into economic decision making and make the market work more efficiently.
- Payments for environmental services: In recent years, the recognition of environmental services and their value has led to efforts to internalise environmental services to the functioning of markets through direct payments for environmental services (PES). The idea of PES consists of beneficiaries of ecosystem services making direct, contractual and conditional payments to local landholders and users providing the services, e.g. farmers sustainably managing the landscapes or beekeepers / honey producers for pollination of crops etc. Existing examples on the use of PES suggest that such payments can be a promising tool for internalising the values of biodiversity and related ecosystem services into different economic sectors[62]. However, despite the benefits PES should not be considered as a “standard fix” to all situations.
- There is often no liability for negative impacts and hence the price signals in the market do not do full justify the cost implications of inappropriate resource allocations or loss of undervalued resources or services. There is clearly scope for better application of EIA and liability rules
- There are many economy-economy trade-offs that arise via the interlinkages to biodiversity and ecosystem services. This raises the question as to whether decision making needs upgrading[63] and opportunities for greater use of strategic environment assessments (SEAs) and impact assessment to take into account issues not picked up by market prices.
- The interlinkages between the economy and the environment are changing. There are, for example, growth areas – biofuels, bioplastics and biochemicals. There is also an ongoing loss or genetic materials and hence primary genetic materials for biochemicals, medicines, food crops that might reduce opportunities for development in the future.

[62] Wertz-Kanounnikoff, S. 2006. Payments for environmental services – A solution for biodiversity conservation? Institut du développement durable et des relations internationales (IDDRI) publications number 12, 16 pp.; Kettunen, M., Bassi, S. & ten Brink, P. 2007. Complementary Financing for Environment in the Context of Accession – Innovative Resources: A synthesis of the national level analyses from Bulgaria, Croatia, Macedonia, Turkey and Romania, IEEP, Brussels. 49 pp + Annexes; Kazakova, Y., Kettunen, M., Bassi, S., & ten Brink, P. 2007. Complementary Financing for Environment in the Context of Accession – Innovative Resources: Final Project Report. A project for the European Commission (ENV.E.3/SER/2006/0063). WWF Danube Carpathian Programme/Institute for European Environmental Policy, Brussels. 70 pp + Annexes.

[63] For more on the integration of these concerns into regional development assessments , see ten Brink et al (2007)

10 OTHER ECONOMY-ENVIRONMENT LINKAGES

10.1 Green Public procurement (GPP)

10.1.1 Introduction and definitions

Public authorities in Europe spend about 16% of the EU's gross domestic product to purchase goods and services per annum. If in their purchasing decisions they opt for more environmentally friendly choices, they can have a real influence on suppliers, stimulating the production of more sustainable goods and services – such as greener vehicles, environment friendly buildings and office equipments and biofuels.

Through 'green' public procurement (GPP) (see Box 10.1), public authorities can reduce the impact of their procurement on human health and the environment. They can develop niche markets and even ensure the widespread diffusion of technologies.

Box 10.1 Definitions of GPP

'Green public procurement means that contracting authorities take into account environmental elements when procuring goods, services or works at all stages of the project and within the entire life-cycle of procured goods'[64].

More specifically, a recent Commission report on GPP[65] refers to GPP as 'Green Public Procurement is the approach by which Public Authorities integrate environmental criteria into all stages of their procurement process, thus encouraging the spread of environmental technologies and the development of environmentally sound products, by seeking and choosing outcomes and solutions that have the least possible impact on the environment throughout their whole life-cycle'.

GPP is the focus of priority action 8 of the EU's environmental technology action plan (ETAP) to encourage procurement of environmental technologies. ETAP was adopted by the Commission on 28 January 2004, with the aim of harnessing the full potential of environmental technologies to reduce pressures on natural resources, improve the quality of life of European citizens and stimulate economic growth. The objectives of ETAP are to remove the obstacles for environmental technologies, to ensure the EU takes a leading role in developing and applying environmental technologies and to mobilise all stakeholders in supporting these objectives. ETAP is thereby also meant to contribute to the EU SDS and the Lisbon Strategy. The idea behind ETAP is that technology could improve the environment while contributing to competitiveness and growth, and could therefore truly embody the concept of sustainable development. ETAP sets out a series of separate, though interlinked, initiatives to encourage environmental technology.

If public procurement, which accounts for around 16 percent of the EU's GDP, becomes 'greener', this could in principle lead to a step change in the uptake of environmental technologies. It is mostly up to Member States to take action in the field of Green Public Procurement (GPP), within the framework of the EU Directives on

[64] http://ec.europa.eu/environment/gpp/green_vs_sustainable.htm

[65] Bouwer M, Jonk M, Berman T, Bersani R, Lusser H, Nappa V, Nissinen A, Parikka K, Szuppinger P and Viganò C, 2006. *Green Public Procurement in Europe 2006 – Conclusions and recommendations*

public procurement and other related initiatives such as a handbook[66] on GPP. Country initiatives in the area of GPP are already in place, notably in Austria, Denmark, Finland, the Netherlands, Sweden and the UK. The Commission has launched a project looking to develop an EU wide comparison of GPP and establish guidelines and a target to be able to progress the OMC (open method of coordination) type activities.

GPP at the EU level are mainly disciplined by two Directives:

- Directive 2004/18 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts
- Directive 2004/17 on the coordination of procurement procedures of entities operating in the water, energy, transport and postal services sector

The elements of these directives are clarified in a document proving guidelines for public authorities and contracting parties to support the introduction and use of GPP:

- European Communities, 2004: *Buying green! A handbook on environmental public procurement* http://ec.europa.eu/environment/gpp/pdf/buying_green_handbook_en.pdf

In the field of Green Public Procurement, the European Court of Justice has issued important rulings, two are:

- The 'Helsinki bus' case (Case C-513/99 of 17 September 2002) - see box below
- The 'Wienstrom case' (Case C-448/01 of 4 December 2003)

Box 10.2 The 'Helsinki bus' case

Concordia Bus Finland, a Finnish bus company, contested the procurement procedures taken by the Helsinki administration, with regard to a contract for renewing the city bus network.

The tender notice issued by the Finnish administration indicated that the contract would have been awarded to the most economically advantageous tender, and included some environmental criteria.

The tender was awarded to a rival company, HKL, which, despite not offering the lowest price, gained additional points by fulfilling environmental criteria on low nitrogen oxide and noise emission. Concordia argued that the award of additional points to HKL fleet was unfair and discriminatory. It submitted that additional points had been awarded for the use of a type of bus which only HKL was in fact able to offer.

The Case was brought to the European Court of Justice, which had to clarify the extent to which environmental requirements can be taken into consideration at the award stage of a public service contract, and therefore in which cases extra points should be awarded for them.

The Court confirmed that, while awarding a contract to the tenderer who submits the economically most advantageous offer, a contracting authority may take into consideration ecological criteria - such as, in the case of buses, the level of nitrogen oxide emissions or the noise level of the buses.

The Court though clarified that environmental criteria should fulfil four conditions:

[66] European Commission, 2004: Buying Green! A handbook on environmental public procurement (http://ec.europa.eu/environment/gpp/pdf/int.pdf)

- they should be linked to the subject matter of the contract;
- they should not give unrestricted freedom of choice on the contracting authority, i.e. environmental requirements must be specific and objectively quantifiable;
- they should be expressly mentioned in the contract documents or in the tender notice; and
- they have to comply with the general EC Treaty principles.

The EU Member State approach to GPP is developing quickly. It is seen as one area of ETAP where there is some potential for real progress. A report will be out shortly (financed by the European Commission) that should provide details of national approaches (see also the ETAP road maps) and size of GPP expenditures.

10.1.2 Assessing the size of GPP expenditures

According to Commission estimates[67], total public procurement amounted to 1,500 billion euros in 2002, accounting for 16.3% of EU's GDP.

Estimating the share of public procurements undertaken on the basis of environmental criteria can help understand the weight of GPP on the supply of green products, and the potential for public administration to affect the market by increasing their GPP.

A recent study on GPP[68] in the EU 25 provides useful data on the percentage of tenders including environmental criteria, although it does not allow defining the actual outcome of the procurement – i.e. the quantity of green products actually bought.

The study reveals that some product groups are more suitable for greening than others. For instance, professional services such as advertising, general management, research and auditing services seldom contain environmental criteria whereas furniture and construction often do. The study also shows that seven countries in particular are leading the way with regards to GPP. These are Austria, Denmark, Finland, Germany, Netherlands, Sweden and UK (therefore called the 'Green 7'), as they consistently have more tenders with green criteria than other member states. A summary table (Table 10.1) of the green tenders analysed, by product group, is provided below and in Figure 10.1.

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[67] European Commission, 2004: A report on the functioning of public procurement markets in the EU: benefits from the application of EU directives and challenges for the future

[68] Bouwer M, Jonk M, Berman T, Bersani R, Lusser H, Nappa V, Nissinen A, Parikka K, Szuppinger P and Viganò C, 2006. *Green Public Procurement in Europe 2006 – Conclusions and recommendations*

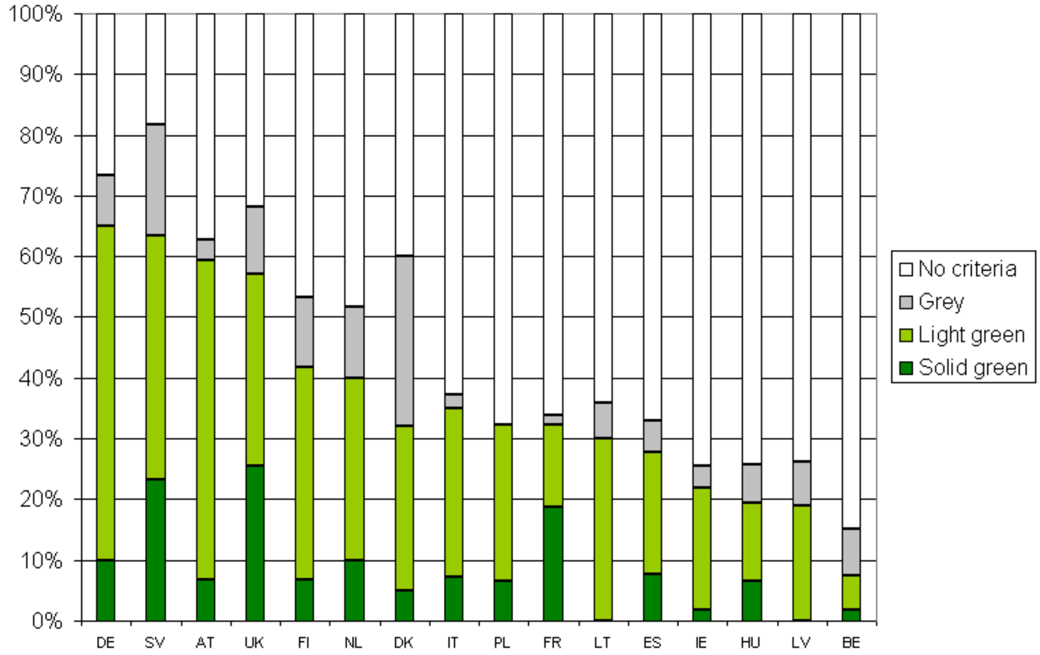
Table 10.1: Percentage of green tenders

Product group	# tenders analysed	% not green	% light green	% solid green	% solid 'Green-7'
Sewage- and refuse-disposal services, sanitation and environmental services	30	18%	52%	30%	18%
Transport equipment	80	42%	36%	11%	14%
Office machinery	100	50%	41%	9%	18%
Construction work	60	51%	36%	13%	23%
Furniture and other manufactured goods	40	56%	30%	15%	21%
Chemical products, rubber, plastic	30	56%	28%	16%	45%
Food products and beverages, Restaurant services	40	57%	38%	5%	0%
Architectural, engineering, construction, installation and related technical consultancy services	70	64%	27%	9%	14%
Cleaning services	30	65%	35%	0%	0%
Medical devices	80	68%	30%	3%	6%
Paper, printed matter, printing services	50	69%	13%	19%	50%
(Electrical) machinery and communication equipment	90	70%	21%	8%	7%
Transport and communication services	50	71%	18%	11%	18%
Education, health and recreational services	40	83%	17%	0%	0%
Professional services	40	86%	11%	3%	0%
Computer and related services	40	92%	9%	0%	0%

Source: Bouwer M, Jonk M, Berman T, Bersani R, Lusser H, Nappa V, Nissinen A, Parikka K, Szuppinger P and Viganò C, 2006. *Green Public Procurement in Europe 2006 – Conclusions and recommendations* [69]

[69] The study can be found at: http://ec.europa.eu/environment/gpp/pdf/take_5.pdf

Figure 10.1 Green Tenders Performance by country



Source: Bouwer M, Jonk M, Berman T, Bersani R, Lusser H, Nappa V, Nissinen A, Parikka K, Szuppinger P and Viganò C, 2006. *Green Public Procurement in Europe 2006 – Conclusions and recommendations*

Note: 'No criteria' means that no green specifications were found; 'grey' means that attempts for green specifications were found, but these would not lead to a green purchase; 'light green' means 1-3 clear specifications; 'solid green' means more than 3 specifications were found.

Linking GPP to the I-O structure of the Economy, it is possible to derive a broad sense of which sectors have the most potential to be affected by GPP. Again this is far from a full analysis, and shown as a constructive approach in Table 10.2 to explore the (potential) importance of GPP to the various sectors of the economy.

Table 10.2: Economic Sectors and Links to GPP

Sector	Type of link to GPP
Areas where there are clear linkages – actual or potential	
1 Agriculture etc	via the food and drink sector - organic food and drinks
5 Food, Drink & Tob.	organic food and drinks
6 Text., Cloth. & Leath.	Clothing
7 Wood & Paper	furniture, recycled photocopy paper
10 Pharmaceuticals	bio-pharmaceuticals
11 Chemicals	bio-chemicals
12 Rubber & Plastics	bio-rubbers
17 Electronics	office machinery (computers / monitors / printers / copiers)
18 Elec. Eng. & Instrum.	
19 Motor Vehicles	low emissions vehicles, electric vehicles, biofuel fleet etc
22 Electricity	energy saving light bulbs, renewable energy
24 Water Supply	water supply and sanitation (waste water/sewage)
25 Construction	construction work (to certain standards)

28 Hotels & Catering	restaurant and hotel services to certain standards – eco-label
29 Land Transport etc	low emissions buses, electric, biofuels, low emissions vehicles, electric vehicles, biofuel fleet etc
33 Banking & Finance	through structural development (SD) funds, ethical banking
41 Misc. Services	ecological cleaning products/services
Areas where there are few clear linkages – actual or potential	
2 Coal **3 Oil & Gas etc** **4 Other Mining** **8 Printing & Publishing** **9 Manuf. Fuels** **13 Non-Met. Min. Prods.** **14 Basic Metals** **15 Metal Goods** **16 Mech. Engineering** **20 Oth. Transp. Equip.** **21 Manuf. nes** **23 Gas Supply** **26 Distribution** **27 Retailing** **30 Water Transport** **31 Air Transport** **32 Communications** **34 Insurance** **35 Computing Services** **36 Prof. Services** **37 Other Bus. Services** **38 Public Admin. & Def.** **39 Education** **40 Health & Social Work** **42 Unallocated**	

10.1.3 Conclusion

Procurement decisions represent a very significant share of EU GDP – circa 16%. The current share of GPP is significant in a number of sectors (e.g. energy standards for office equipment, paper, furniture, renewable energies) and is growing both in product type within existing sectors responding to GPP, but also in new sector and growth overall. There are therefore a wide range of links between environment and the economy and these are growing.

As usual there are leaders and laggards with respect to GPP in Europe and it is very useful that there is EU benchmarking on activities to help encourage countries to build on good practice in other countries.

10.2 Inward Investment and Business Location Decisions

The environment is increasingly playing a role in influencing the choice of business location. This interest partly stems from changes in the structure of the economy, with improved communications and the growth of knowledge based businesses increasing the mobility of companies and their workers, and increasing the scope for quality of life considerations to influence the choice of business location.

Environmental organisations have highlighted the potential role of environmental factors in influencing business location and inward investment as a means of increasing the prominence of environmental issues in the regional development agenda, and have sought to gather and publicise evidence to support this proposition. However, while the arguments about the role of environmental and quality of life factors in driving business decisions are increasingly well rehearsed, the evidence base remains somewhat patchy.

10.2.1 Factors Influencing Business Location

There are a number of factors influencing business location. The main factors are primarily concerned with the actual business operation. Some of them are:

- Closeness to market
- Communications links including transportation
- Availability and price of raw materials
- Availability and price of appropriately skilled employees
- Availability and price of power supplies
- Availability and price of land
- Government incentives – tax incentives and benefits

In addition to core factors mentions above, environment factors such as air and noise pollution, proximity to parks and green spaces, water side location and other natural amenities are also important for businesses deciding location and remuneration packages. Surveys on quality of life based on environmental and other factors are often used by businesses for inward investment and remuneration packages.

The 2007 Worldwide Quality of Living Survey by Mercer Human Resource Consulting[70] has found that four of the world's five top-scoring cities for health and sanitation are in North America. Calgary ranks top with a score of 131.7, followed by Honolulu, which scores 130.3. Helsinki – the only European city in the top five – follows closely in the rankings with a score of 128.5. Ottawa and Minneapolis take fourth and fifth places with scores of 127.2 and 125.7 respectively. Almost half of the 30 top-scoring cities surveyed are in Western Europe. Helsinki has the highest score for the region, at position 3 with a rating of 128.5. Oslo, Stockholm and Zurich all rank 6th with a score of 125. London is ranked 63 with a score of 111.2.

Scores are based on the quality and availability of hospital and medical supplies and levels of air pollution and infectious diseases. The efficiency of waste removal and

[70] Mercer's study is based on detailed assessments and evaluations of 39 key quality of living determinants, grouped in the following categories: Political and social environment, Economic environment, Socio-cultural environment, Health and sanitation, Schools and education, Public services and transportation, Recreation, Consumer goods, Housing and Natural environment (climate, record of natural disasters).

sewage systems, water potability and the presence of harmful animals and insects are also taken into account. Cities are ranked against New York as the base city which has an index score of 100. The analysis is part of Mercer's Worldwide Quality of Living Survey, covering 215 cities.

These indices are increasingly used to decide personnel relocation, opening new offices and remuneration packages.

A report by Wong (1998) investigated the relative importance of traditional factors (such as location, infrastructure, workforce, knowledge etc) and softer, more tangible factors (quality of life, community identity and image, institutional capacity, business culture), on the grounds that the former are not capable of fully explaining variations in economic performance. A literature review revealed evidence that quality of life factors could be the major factor encouraging businesses to locate to certain high natural value areas such as the Greater Yellowstone region of the US, as well as other studies that suggested that quality of life and other intangible factors were important only if more traditional factors are satisfied.

Wong conducted a survey of economic development practitioners in North West and Eastern England, and found that they considered traditional factors to be more important than intangible factors in both regions. Quality of life factors were found to be relatively more important in the Eastern region than the North West. More in depth interviews concluded that, while the traditional factors were essential in providing the basic and necessary conditions for economic development, intangible factors such as quality of life could provide a competitive "cutting edge" if other conditions were satisfied.

The study also highlighted the distinction between the business environment and the living environment. While quality of life may be important among business executives and employees, commuting often makes it possible for individuals to enjoy a high quality living environment while working in a location chosen because of its more traditional business attributes.

Similar conclusions can be drawn from available business survey evidence. For example, a survey of major employers by OMIS Research (2003)[71], which examined which UK cities were best as a business location, concluded that workforce factors are now by far the most significant consideration, with the quality of the local environment among other factors playing an important supporting role. The survey highlighted increasing concern about traffic congestion and the quality of transport infrastructure, which is having an increasingly negative impact on business as well as the environment.

For retailers, a good-quality public environment can improve trading by attracting more people into an area. It has been shown, for example, that well-planned improvements to public spaces within town centres can boost commercial trading by up to 40 per cent and generate significant private sector investment[72].

[71] http://www.omis.co.uk/Downloads/BBC06.pdf

[72] DoE and The Association of Town Centre Management (1997) Managing Urban Spaces in Town Centres – Good Practice Guide. London, HMSO.

A report by CABE (2004) demonstrated how 11 cities[73] from Melbourne and Minneapolis, to Curitiba in Brazil and Malmo in Sweden are improving their residents' health, wealth and quality of life by investing in parks. The case studies show that policies and economic initiatives for better urban green space management and maintenance help in economic growth and development as well as improving quality of life. The view is that the visual image and recreational amenities offered by any city are attractive for living and will attract new enterprises and skilled employees, bringing with them clearly-defined social and economic benefits.

While effectively placing environmental factors at the core of every activity is a challenge for urban authorities, many are already making impressive steps. Two EU-funded projects have stimulated solutions for participating cities (see below). Both adopted the *Liveable Cities* strap-line, which indicates that the European Commission is now much more aware of the importance of attractive cities to the 27-member Union. This is driven by the Lisbon jobs and growth strategy and now by the focus on climate change.

1. **Liveable cities – INTERREG project[74]:** City enhancement through public realm-led regeneration was the theme of an INTERREG project, 'Liveable Cities' implemented by six North Sea Arc city partners led by Norwich in the UK. The final conference of the four-year programme was in Norwich on 16 and 17 May 2007. The draft final report of the North Sea Arc cities seeks to measure the benefits of public realm-led regeneration widely and cites examples of successful interventions, most of which are replicable, in the six partner cities. Broader conclusions are also drawn by the report, which says that public space is the city's living room. "Positive nurturing of urban space is not a mere peripheral townscape cosmetic - it is at the heart of what makes a city liveable and therefore successful."
2. The **Liveable Cities project[75],** funded by the European Commission - DG Environment within the framework of the 'Community framework for co-operation to promote sustainable urban development'. This was co-ordinated by the Euro Cities network and carried out in eight cities for two years. In February 2007, the conclusions and a comprehensive guidance brochure were produced and presented to stakeholders from the European Parliament, the Commission and the Committee of the Regions. Guidance documents include examples of effective policies and actions by cities and towns across Europe. The results show that improving the quality of public realm and reducing environmental problems like traffic pollution has significant benefits in attracting people to live closer to where they work. This satisfies an important sustainable principle as both commuting and traffic pollution are important quality of life and sustainable development indicators.

[73] Tokyo, Japan; Aarhus, Denmark; Malmo, Sweden; Curitiba, Brazil; Minneapolis, USA; Hanover, Germany; Zurich, Switzerland; Wellington, New Zealand; Melbourne, Australia; Paris, France; Groningen, Netherlands

[74] http://www.interreg3c.net/sixcms/detail.php?id=312

[75] http://www.liveablecities.org/

10.3 Environment and Choice of Residential Location

The environment plays a more prominent and direct role in influencing decisions about residential location than business location. While environmental criteria are only one influence on choice of business location, and may be outweighed by other business critical factors, they play a central role in determining quality of life, which is clearly critical to choices people make about where they live.

Parks and green spaces define our communities. They enhance our quality of life and give local neighbourhoods the identity that helps engender a sense of belonging. In addition, high quality parks and green spaces can create economic benefits for a wide range of communities.

Good quality green spaces add value to the surrounding property, both commercial and residential, consequently increasing tax yield to maintain public services. However, there have been few studies of these wider economic benefits and this is an area where additional research would be valuable in informing understanding of the role that green spaces plays in sustaining vibrant urban communities. Most findings are based on academic research using economic tools such as hedonic pricing or willingness to pay (WTP) for quantifying environmental amenities.

The hedonic pricing method is based on the proposition that the value of a good or service is based on its attributes. The price of amenities for which markets do not exist – such as green spaces – can be inferred from observing and analysing the price of goods for which markets do exist – such as houses. For example, the purchase price of a house is determined by local socio-economic characteristics such as housing densities, accessibility to transport and health services, and local features such as green spaces and river views.

Findings from some of the studies are given below:

- Study from the University of East Anglia[76], UK indicates that being close to green space increased house prices from 1 to 30% depending on proximity, type of park and visibility
- In the towns of Emmen, Appledoorn and Leiden in the Netherlands, it has been shown that a garden bordering water can increase the price of a house by 11 per cent, while a view of water or having a lake nearby can boost the price by 10 per cent and 7 per cent respectively. A view of a park was shown to raise house prices by 8 per cent, and having a park nearby by 6 per cent[77].
- In Berlin in 2000, proximity to playgrounds in residential areas was found to increase land values by up to 16 per cent. In the same study, a high number of street trees resulted in an increase of 17 per cent in land values.[78]
- Study by Peiser and Schwann (1993)[79] in Dallas, survey residents and found that the public green spaces running behind their back gardens as a major factor in

[76] Equal access for all? Ethnicity and public park availability. Brainard, J.S et al in Birmingham School of Environmental Sciences, University of East Anglia and CSERGE, 2003

[77] Luttik, J. (2000) 'The value of trees, water and open spaces as reflected by house prices in the Netherlands'. Landscape and Urban Planning, Vol. 48, pp161-167.

[78] The Trust for Public Land (2001), Economic Benefits of Open Space Index (online). New York, The Trust for Public Land

their decision to move to the area. Sixty per cent of these residents believed that the value of their homes was at least 15 per cent higher because of the presence of the green spaces.

- An Ernst and Young report[80], 'How smart parks investment pays its way', examined six parks in New York and concluded that commercial asking rents, residential sale prices and assessed values for properties near a well-improved park generally exceeded those values in surrounding areas. Properties in immediate proximity to Bryant Park were shown to have enjoyed up to a 220% increase in commercial rental values as compared to a maximum 75% increase in the surrounding area.
- The Trust for Public Land (2001)[81] in the US compiled a casebook of evidence on the relationship between good quality public space and its social and/or economic benefits from earlier studies. In summarising these findings it was clear that a positive relationship exists but the extent of the impact does vary significantly across the different reports.
- According to a study by Tyrväinen and Miettinen (2000)[82] using hedonic models, in Finland, a one kilometer increase in the distance to the nearest forested area led to an average 6% fall in the market price of the dwelling. Dwellings with forest views on average were 5% more expensive than dwellings with otherwise similar characteristics.
- Study by Hui. et. Al (2007) looking at environmental effects on residential property values in Hong Kong, using hedonic model with spatial adjustments (GIS techniques), found that the availability of green belt area in proximity to homes did not significantly change the sale price. However, availability of sea views could increase the sale price by 4.6%. Apartments located in better air quality areas also attracted higher sale prices. Specifically, the sale price of an apartment was found to be approximately 1.3% higher than that of an identical one located in a neighbourhood whose annual average air pollution index was one percent less than the one under examination.
- Bolitzera and Netusil (2000)[83] looked at the influence of open spaces such as public parks, natural areas and golf courses on the sale price of homes in close proximity to these spaces. They found that that a home located within 1500 feet of any open space sells for 1.4% to 3% more than a home located more than 1500 feet from an open space. Open space size is also an important factor with each additional acre of open space estimated to increase a home's sale by 0.04%.

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[81] http://www.tpl.org/tier3_cdl.cfm?content_item_id=1145&folder_id=727

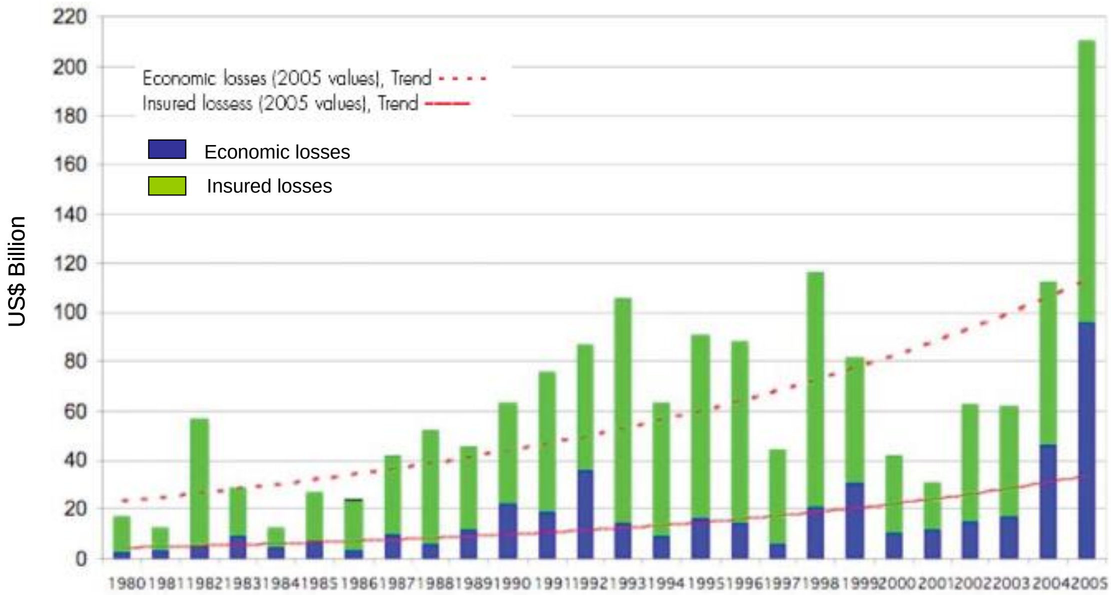
[82] Liisa Tyrväinen and Antti Miettinen (2000), Property Prices and Urban Forest Amenities, Journal of Environmental Economics and Management, Volume 39, Issue 2, March 2000, Pages 205-223

[83] B. Bolitzera and N. R. Netusil (2000), The impact of open spaces on property values in Portland, Oregon, Journal of Environmental Management Volume 59, Issue 3, July 2000, Pages 185-193

10.4 Environment Related Insurance Services, Damage and Rebuild Costs

Hurricane Katrina clearly showed how severe weather events can affect both local and global business. In recent times worldwide floods, severe windstorms, earthquakes and the hot summers, such as the one in Europe in 2003 have caused a significant number of deaths and damage to property. Figure 10.2a and 10.2b shows the increasing trend in losses to the insurance industry over time and extreme weather events. There is little doubt in the insurance industry that these trends are related to greenhouse gases[84].

Figure 10.2a: Global Weather-Related Losses from weather related natural disasters, 1980-2005



Note: Events are considered “great” if the affected region’s resilience is clearly overstretched and supraregional or international assistance is required. As a rule, this is the case when there are thousands of fatalilities, when hundreds of thousands of people are made homeless, or when economic losses — depending on the economic circumstances of the country concerned — and/or insured losses reach exceptional levels.
Source: Munich Re, NatCatSERVICE.

Global economic[85] and insured losses were around $100 billion each in 2005. The insured portion of losses from weather-related catastrophes is on the rise, increasing from a small fraction of the global total economic losses in the 1950s to 19% in the 1990s and 35% in 2004. The ratio has been rising twice as quickly in the US, with over 40% of the total disaster losses being insured in the 1990s (American Re 2005).

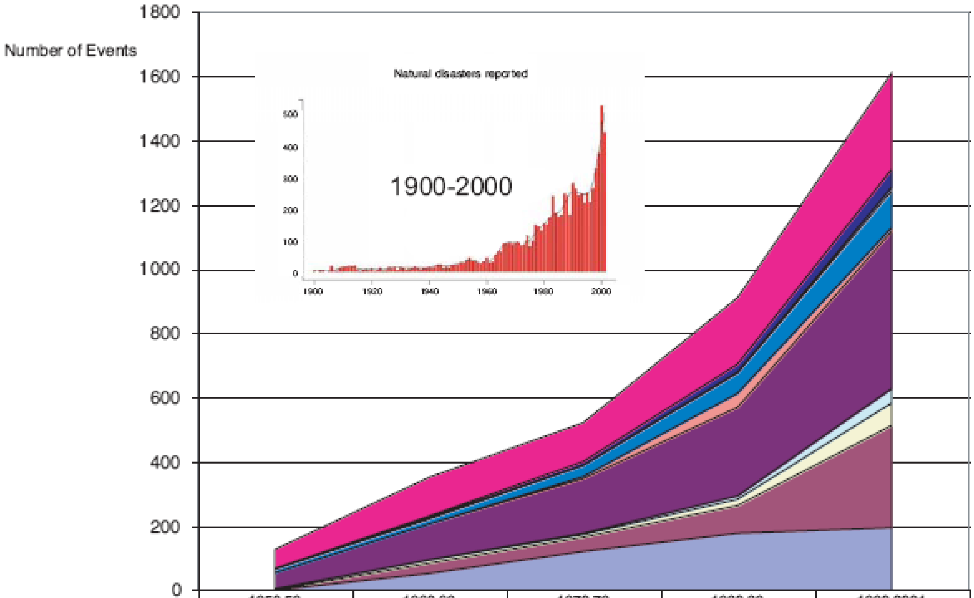
Where the burden of losses falls depends on geography, the type of risk and the political clout of those in harm’s way. The developed world has sophisticated ways of

[84] Association of British Insurers (2005), The financial risks of climate change

[85] Per Munich Re's definition, total economic losses are dominated by direct damages, defined as damage to fixed assets (including property or crops), capital, and inventories of finished and semifinished goods or raw materials that occur simultaneously or as a direct consequence of the natural phenomenon causing a disaster. The economic loss data can also include indirect or other secondary damages such as business interruptions or temporary relocation expenses for displaced households. More loosely related damages such as impacts on national GDP are not included.

spreading risk. While insurance covers 4% of total costs in low-income countries, the figure rises to 40% in high-income countries. A disproportionate amount of insurance payouts in high-income countries arise from storm events, largely because governments, rather than the private sector, tend to insure flood rather than storm risk. In both rich and poor nations, economic costs (especially insured costs) fall predominantly on wealthier populations, whereas the loss of life falls predominantly on the poor.

Figure 10.2b Frequency of Weather-Related Disasters



	1950-59	1960-69	1970-79	1980-89	1990-2001
Wind storm	59	121	121	207	300
Wild fire	0	4	11	25	54
Wave/surge	2	5	2	3	12
Slide	11	15	34	63	114
Insect infestation	0	1	6	43	13
Flood	50	110	170	276	489
Famine	0	2	4	11	45
Extreme temp	4	10	9	19	70
Epidemic	0	31	44	86	317
Drought	0	52	120	177	195

Sources: OFDA / Center for Research in the Epidemiology of Disasters (CRED) "Natural.xls" Intl database of Disasters http://www.em-dat.net and US Census Bureau's International Database (http://www.census.gov/ipc/www/idbagg.html). From analysis completed by Padco's Climate Change Solutions Group for USAID's Global Climate Change Team.

It is important to understand that there are factors other than climate change responsible for this increase in economic and insured losses. The consequences are due to the combination of inflation, rising real estate values, the growth in coastal settlements and the increasing frequency and intensity of weather extremes

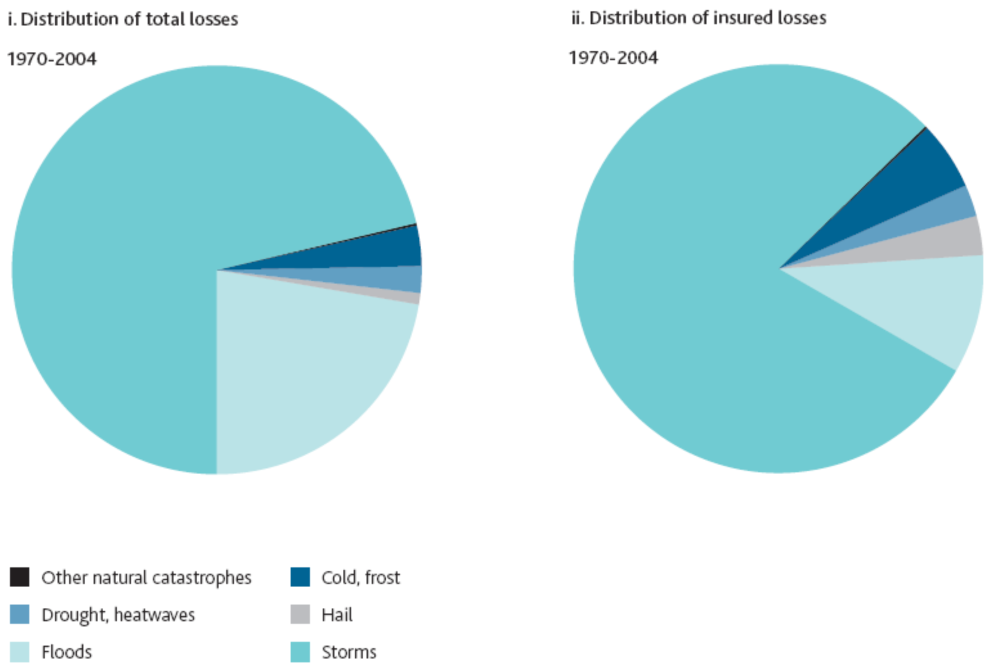
10.4.1 Global trends in extreme weather

Extreme weather results in extreme losses. For example,

- In 2004 the US and neighbouring countries were hit by four hurricanes in the space of a few weeks, making it the costliest hurricane season on record, with around $56 billion in total losses, of which around $30 bn was insured.[86]
- In the same year Japan was hit by ten tropical cyclones – more than any other year in the last century– leading to total losses of more than $14 bn, of which $7 bn was insured.
- In 1999, within the space of a month, three windstorms raged across Europe, causing losses around $23 bn, of which $11 bn was insured.
- Heavy rains and flooding across Europe during July and August in 2002 caused nearly $16 bn in losses, of which $4 bn was insured.

Storms and floods typically contribute over 90% of the costs of extreme weather each year (Figure 10.3). The number and cost of such events have been rising over the past few decades. There have been noticeable increases in the number of severe storms, which also tend to be the most costly insured events, and a more sporadic increase in the number of floods.

Figure 10.3: Distribution of Total and Insured Losses by Weather-related Catastrophe



Note: Since 1970 weather-related catastrophes resulted in about $345 bn in total damage, of which $300 bn was insured.
Source: Sigma Database, Swiss Re.

86 Annual review: natural catastrophes 2004, Munich Re, 2005, http://www.munichre.com/publications/302-04321_en.pdf?rdm=71622

10.4.2 *Impacts of climate change on costs of extreme weather around the world*

While individual extreme weather events cannot be attributed directly to climate change, the trends to date are consistent with what we might expect as climate change intensifies. Sea surface temperatures have been rising in line with global temperatures, increasing moisture evaporation and atmospheric humidity, and providing more energy to fuel tropical and temperate storms (Table 10.3).

Table 10.3: Potential Impacts of Climate Change on Storm Characteristics Towards the End of the Century

Weather Feature	Region	Stress-test[a]	Key References
Hurricane	US	Increased average wind-speed by 6%, with sensitivity tests for +4 to +9%	Third Assessment Report, Intergovernmental Panel on Climate Change, 2001, http://www.ipcc.ch Knutson and Tuleya (2004) Journal of Climate, 17(18): 3477–3495.
Typhoon	Japan	Increased average wind-speed by 6%, with sensitivity tests for +4 to +9%	
Windstorm	Europe	Increased frequency of storms that occur once every 20 years (or less) by 20%	Leckebusch and Ulbrich (2004) submitted to Global and Planetary Change. Kuzmina and others (2005) submitted to Geophysical Research Letters.

a. The stress-tests on tropical cyclones were applied to the entire distribution of all possible hurricanes and typhoons, whereas the stress-test on European windstorms was restricted to the extreme upper tail of the distribution of all possible storms. There may be an impact on less intense storms, but these are not considered here, because quantitative information about the changes is still limited. The stress-tests therefore severely underestimate the full potential impact of climate change on European windstorms – particularly, given that a considerable proportion of current insured losses result from more frequent but less intense storms.

Source: ABI, 2005

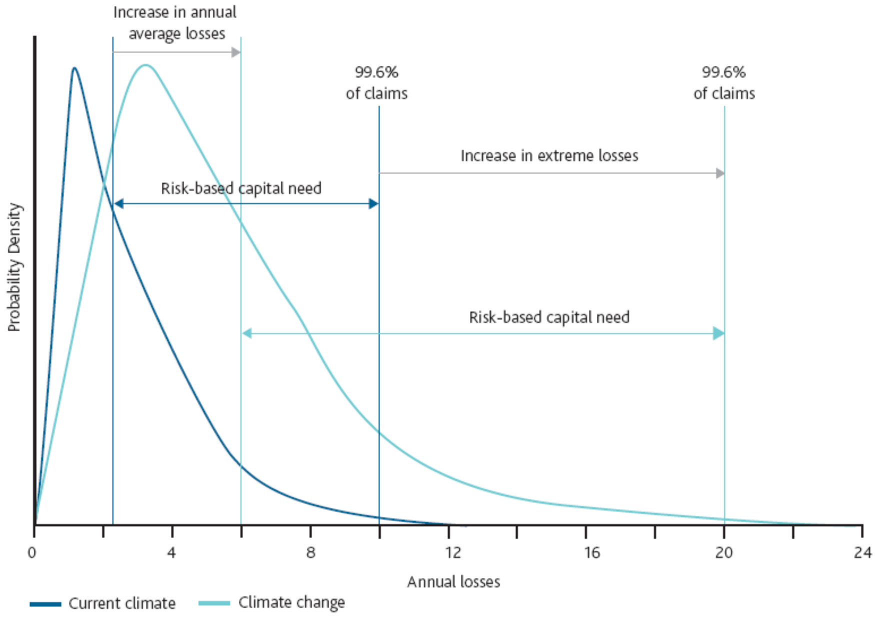
Very extreme storm losses, occurring once in every 100 or 250 years, could become even more severe.

- Insured losses from extreme US hurricanes could increase by $41 – 62 bn above present-day losses of $60 – 85 bn, representing a 70 – 75% increase, which is equivalent to an additional two to three Hurricane Andrews in a single season.
- Insured losses from extreme Japanese typhoons could increase by $10 – 14 bn (¥1100 – 1500 bn) above present-day losses of $15 – 20 bn (¥1600 – 2200 bn), representing a 67 – 70% increase, which is more than twice the cost of the 2004 typhoon season, the costliest in the last 100 years.
- Insured wind-related losses from extreme European windstorms could increase by $2 – 2.5 bn (€1.6 – 2 bn) on top of present-day losses of $30 – 35 bn (€24 – 28 bn), representing a 5% increase. This increase in cost excludes any flood costs and increases in losses from less intense storms. The additional wind-related costs are equivalent to the 1999 windstorm Martin, one of the most costly windstorms on record.

10.4.3 *How climate change could impact insurance*

Sufficient capital is needed to bridge the gap between expected and extreme losses (Figure 10.4). This risk capital ensures that the insurer can pay its liabilities, even following a major catastrophe[87].

Figure 10.4: Impact of Climate Change on Probability Loss Distribution and Implications for Risk Capital Requirements



For insurers to cover the vast majority of US hurricane, Japanese typhoon and European windstorm claims, except those occurring less than once in 250 years on average, they will need risk capital totalling approximately $67 bn, $18 bn and $33 bn, respectively (Table 10.4). Under a high emissions scenario where carbon dioxide emissions double by the end of the century, modelling from this study suggests that the risk capital requirement could increase by over 90% for US hurricanes, and around 80% for Japanese typhoons. In total, an additional $76 bn would be needed to cover the gap between extreme and expected losses resulting from tropical cyclones.

[87] In this example distribution the annual expected loss is $3 bn. If an insurer wants to be sure that it can pay claims in 99.6% of all cases (i.e. including those arising from a 1-in-250 year event should it occur), they need access to sufficient resources to pay $10 bn, as opposed to $3 bn. The 1-in-250 year event represents an “unexpected” loss, in that the corresponding claim far exceeds the expected or average loss. Unexpected losses are a financial risk to the insurer. In this case, the difference between the unexpected loss and expected loss is $7 bn, and the insurer will need to provide sufficient capital to cover unexpected losses up to chosen threshold (i.e. the 1-in-250 year event). In the example the insurer will need to allocate $7 bn of capital to this line of business.

Table 10.4: Potential Changes in Insurance Risk Capital to cover Hurricanes, Typhoons and Windstorms under Low and High Emissions Scenarios by the 2080s

Storm type	Approximate current risk-capital requirement	Additional capital required with low emissions[b]	Additional capital required with high emissions[b]
US hurricane[a]	$67 bn	+20%	+90%
Japanese typhoon[a]	$18bn	+10%	+80%
European windstorm[a]	$33bn	No change	+5%

Source: ABI, 2005
a. Capital requirements to cover a 1-in-250 year loss.
b. Percent changes from baseline (2004 prices).

In Europe, only the impact of climate change on the most severe storms was considered, so the increase in capital requirement is marginal (5%). However, flooding impacts of climate change could have a more significant effect on capital requirements within European markets, adding to that of windstorms: (1) present-day average annual losses for flooding in Europe may be higher than for windstorms ($8 – 10 bn compared to $3 bn), and (2) the projected influence of climate change on flooding could be considerable (potential 10 – 20 fold increase in flood losses under high emissions).[88]

While the price of insurance will vary according to market location and conditions, premiums will, in general, comprise the cost of annual average losses, the cost of financing the risk capital requirement, and administrative/operational expenses plus relevant taxes. The first two components can be thought of as the “risk premium”. An insurer may also opt to transfer the risk of larger losses to reinsurers, in exchange for paying a premium.

Based on the simulated climate-stress tests, under a high emissions scenario the aggregate risk premium could increase by nearly 80% for both US hurricane and Japanese typhoon insurance markets by the 2080s (Table 10.5). The increase in the aggregate risk premium for European windstorm insurance markets is considerably smaller by the 2080s, increasing by only 15% under the high emissions scenario. This might be expected as the impact of climate change only on the most severe storms was modelled. Increases in the aggregate risk premium are significantly lower for all windstorm markets under the low-emission scenario.

88 Based on work of Foresight http://www.foresight.gov.uk/previous_projects/flood_and_coastal_defence and Prudence http://prudence.dmi.dk

Table 10.5: Potential Changes in Aggregate Risk Premiums for Hurricanes, Typhoons and Windstorms under Low and High Emissions Scenarios by the 2080s

Storm type	Current indicative aggregate risk premium[a]	Increase in risk-premium under low emissions[b]	Increase in risk-premium under high emission[b]
US hurricane	$17 bn	+20%	+80%
Japanese typhoon	$5 bn	+20%	+80%
European windstorm	$7 bn	No change	+15%

Source: ABI, 2005
a. Based on an assumed cost of capital of 15%.
b. Results are shown as proportional increases in loss totals from baseline (2004 prices). Percentage changes were calculated by comparing industry baseline losses with incremental increases from climate stress-tests.

10.5 Economic Value of the Voluntary Environmental Sector

The voluntary environmental sector plays an important role in promoting environmental awareness, protection and conversation. Though a formal definition of such a sector does not exist the activities would mainly include ownership and management of conserved sites, unpaid reclamation and conservation work, through to lobbying and support services. Economic significance of the voluntary sector arises from employment in the various organisations together with their trading activities and the impact of their expenditure on the maintenance of properties, administration and member activities. Moreover, most sites managed also attract visitors that generate additional expenditure on-site and support further jobs in the local community.

As there are no formal classification for the voluntary sector, jobs and output will normally be reflected in broad sector categories such as Health & Social Work, Miscellaneous Services and Other Business services. These sectors are included in the 46 sectors in the I-O model for the quantitative analysis. Thus, in order to avoid double counting the numbers estimated in the voluntary sector from EU umbrella organisations should only be used as indicative figure; and not in addition to the economic estimates from the quantitative analysis earlier in the report.

Direct employment in the voluntary environmental sector has been estimated at being 6,233 (FTE), which results from information gathered from a limited list of EU-level umbrella organisations given in Table 10.6. This can be roughly broken down into:

- Environmental Activism: 500 (FTE)
- Conservation: 533 (FTE)
- General Environmental: 5,200 (FTE)

Table 10.6: Employment Estimates in the Voluntary Environment Sector

	Employment FTE
Volunteurope - Environmental Sector Estimate[89]	500
WWF Europe	226
EU Civil Society Contact Group - Environmental Sector Estimate[90]	1,200
European Council for Non-Profit Organisations (CEDAG)- Environmental Sector Estimate[91]	4,000
Friends of the Earth Europe[92]	308
Total	**6234**

10.5.1 Brief description of the main organisations

1. **Volunteurope -** Volunteurope is a European network of 1,500 agencies working in the field of social action. It is hosted by the CSV (Community Service Volunteers), which is the UK's largest volunteering and training organisation. Its main aim is to build links with voluntary organisations throughout Europe and promote the exchange of best practices in the voluntary sector. Primarily an organisation focused on social action, social exclusion and active citizenship, Volunteurope's Environmental Section is engaged in environmental activism and lobbying, as well in promoting projects which involve disadvantaged people in sustainable social enterprise, environment and education programmes, community clean-ups and greenspace maintenance.
2. **EU Civil Society Contact Group** - The EU Civil Society Contact Group is a network of NGOs in the following sectors: environment, culture, development, human rights, public health, social, and education. Its mission is to: "encourage and promote a transparent and structured civil dialogue that is accessible, properly facilitated, inclusive, fair and respectful of the autonomy of NGOs"[93]. In the environmental sector, its members include BirdLife, Greenpeace, Friends of the Earth Europe, and WWF Europe.
3. **European Council for Non-Profit Organisations (CEDAG)** - CEDAG is a network of non-profit organisations from across the EU member states. It represents over 50,000 non-profit organisations. It includes both regional and national umbrella bodies in the non-profit sector. Its objectives are to provide a

[89] http://www.csv.org.uk/about+us/csv+international/european+network/

[90] http://www.act4europe.org/code/en/default.asp

[91] http://www.cedag-eu.org/home/index.php

[92] http://www.foeeurope.org/

[93] http://www.act4europe.org/code/en/default.asp

forum for EU non-profit organisations, promote the non-profit sector and inform members of best practices.

4. **Friends of the Earth Europe** - Friends of the Earth Europe is a grassroots organisation which campaigns for the protection of the environment. It unites 30 national Friends of the Earth organisations throughout Europe.
5. **WWF Europe** - WWF Europe is the European Union office for WWF International. Its mission statement is: "to contribute to the achievement of WWF's global mission by leading the WWF network to shape EU policies impacting on the European and global environment".[94]

10.5.2 Main Problems and issues

As mentioned earlier employment in the voluntary sector is not collected through a central database such as Eurostat. Moreover, this information is also not systematically collected by umbrella organisations.

Calculation full-time equivalents (FTE) employment - In the voluntary sector it is difficult to calculate full-time equivalents. Due to the nature of the sector, many workers are unpaid, paid with lump-sum stipends or partially paid for the hours worked. This makes it difficult to calculate the actual number of paid hours worked.

Definitional Problems - Many volunteer organisations engage in several types of voluntary activity, including social, environmental, education, community involvement, etc. When reporting FTEs, they do not distinguish between specific voluntary sectors.

Difficulty Locating Organisations - Umbrella organisations do not always supply the contact information of the organisations they represent. In addition, a list of the specific non-profit or voluntary organisations they represent is not always publicly available, making it difficult to collect information from individual organisations.

[94] http://www.panda.org/about_wwf/where_we_work/europe/what_we_do/epo/about_us/index.cfm

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12 LITERATURE REVIEW

Environment-Economy linkages

	Main heading	Linkages	Environment related (sector / subsector / products / activity)
1	**Econ based on Natural resources (Non renew.)**	Natural resource based activities – non-renewable natural resources	Energy (coal, oil, gas), mining & quarrying (minerals)
	Azar, C. and Dowlatabadi, H. (1999), "A Review of the Treatment of Technical Change in Energy Economic Models", Annual Review of Energy and the Environment, 24, pp. 513-544		
2	**Econ based on Natural resources (Renew.)**	Natural resource based activities – renewable resources	Agriculture, timber, fisheries, renewables, water supply, pharma (natural drugs)
	▪ EUREC Agency (2005) FP7 Research Priorities for the Renewable Energy Sector ▪ European Commission (1999) The Impact of Renewables on Employment and Economic Growth. Project for the ALTENER programme, co-ordinated by a consortium led by ECOTEC Consulting ▪ Greenpeace (1999) Offshore Wind, Onshore Jobs. A New World Class British Energy Industry for the Millennium. A report by Energy for Sustainable Development Ltd for Greenpeace UK ▪ Barrett, J.P. and Hoerner, J.A., with Bernow, S. and Dougherty, B. (2002), Clean Energy and Jobs: A Comprehensive Approach to Climate Change and Energy Policy, Economic Policy Institute Study, Washington D.C. Available at http://www.epinet.org/studies/cleanenergyandjobs.pdf ▪ Sinha, A (1999) UK Electricity: A Brighter Future. A Strategy to Bring Solar Photovoltaics to Market. Forum for the Future, London. ▪ Kammen, D, Kapadia, K, and Fripp, M (2004) Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate? RAEL Report, University of California, Berkeley		
3	**Econ based on Natural resources (EcoSP)**	Ecologically sustainable production	Organic farming, Sustainable forestry, sustainable fisheries, biofuels; subset of '2'
	▪ Sustainable Agriculture, Food and Environment (1997) Double Yields: Jobs and Sustainable Food Production. London		
4	**Environmental Management (EM)**	Greening of the general economy - process and appliance and building efficiency	Energy efficiency in appliances, process efficiencies

	▪ Barry, R, Jenkins, T, Jones, E, King, C and Wiltshire, V (1998) Green Job Creation in the UK. National report submitted as part of the 'Awareness Campaign for Green Job Creation in the European Union. Supported by the European Commission DGX1 Unit A2 Project no: 306/68/24.4.96. Compiled by the Association for Energy Conservation, Friends of the Earth, GMB, UNISON.		
5	**Environmental Management (PCM)**	Historically core Eco-industries – pollution control expenditure	SWM (inc direct recycling), WWT, APC, GPA, PEM, RCS, NVC, ERD & EMI
	▪ CRIQUI, P., KOUVARITAKIS, N., SORIA, A. and ISOARD F. (1999), Technical Change and CO2 Emission Reduction Strategies: from Exogenous to Endogenous Technology in the POLES Model, pp. 473-488. ▪ GOULDER, L.H. and MATHAI, K. (2000), "Optimal CO2 Abatement in the Presence of Induced Technological Change", Journal of Environmental Economics and Management, 39, pp. 1-38. ▪ GOULDER, L.H. and SCHNEIDER, S.H. (1999), "Induced Technological Change and the Attractiveness of CO2 Emissions Abatement Policies", Resource and Energy Economics, 21, pp. 211-253. ▪ Pfeiffer, F and Rennings, K (2001) Employment Impacts Of Cleaner Production – Evidence From A German Study Using Case Studies and Surveys, Business Strategy and the Environment 10, 161–175 ▪ Rennings, K and Zwick, T (2002) 'The Employment Impact of Cleaner Production on the Firm Level – Empirical evidence from a Survey in Five European Countries', International Journal of Innovation Management (IJIM), Special Issue on 'The Management of Innovation for Environmental Sustainability', vol. 6, no. 3, pp. 319 – 342 ▪ Rennings, K and Zwick, T (Eds.), (2003) 'Employment Impacts of Cleaner Production', ZEW Economic Studies 21, Physica-Verlag, Heidelberg ▪ Rennings, K, Bartolomeo, M, Kemp, R, Miles, I and Arundel, A, (2004) 'The Impact of Clean Production on Employment in Europe – An Analysis using Surveys and Case Studies (IMPRESS)'. Office for Official Publications of the European Communities, EUR 21035, Luxembourg ▪ Rennings, K, Ziegler, A and Zwick, T (2004) 'Employment Changes in Environmentally Innovative Firms', Business Strategy and the Environment, vol. 13, pp. 374 – 387		
6	**Environmental Management (RM)**	History core- eco-industries – natural resource management	Recycled Materials, Nature protection / conservation, natural risk mgmt., Eco-tourism
	▪ Rayment, M (1997) Working with Nature in Britain. Case Studies of Nature Conservation, Employment and Local Economies ▪ Murray, R (1999) Creating Wealth from Waste. Demos, London ▪ Goodstein, E. (1997) A New Look at Environmental Protection and Competitiveness. Economic Policy Institute. Washington DC ▪ Institute of European Environmental Policy and WWF, *Promoting the Socio-Economic Benefits of Natura 2000 - Background Report for the European Conference on*		

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<tr><td>10</td><td>Environmental Quality (NRM)</td><td>Natural risk management (NRM) - Avalanches, droughts, floods, fire, coastal erosion, earthquakes, tsunamis</td><td>Residual not captured in 6 - Insurance, protection of assets, rebuilding</td></tr>
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