Analysis of the EU Eco-Industries, their Employment and Export Potential

A Final Report to DG Environment

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C1961

Ref: 11/04/02 F:\EG\Current Contracts\C1961 Eco-Industries\Reporting\Send\FINAL4.DOC

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EXECUTIVE SUMMARY

1.0 BACKGROUND

This study has collated available environmental expenditure data on the market for goods and services produced by eco-industries in both the EU-15 and the Candidate Countries, as the basis for describing the economic significance of the sector, including employment levels. Whilst there are gaps and inconsistencies in the available data sets, only limited estimation procedures are required to derive a detailed and rigorous basis for economic analysis. The study also provides insights into the export capabilities of EU Member States, particularly their relationship with the Candidate Countries.

For the purposes of this study, eco-industries have been defined according to the definition contained in "The Environmental Goods and Services Industry – Manual for Data Collection and Analysis" (OECD/Eurostat, 1999). This defines eco-industries as

"activities which 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 includes cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use".

The main eco-industry domains covered by this study are shown in Table 1:

Table 1: Environmental Domains comprising the EU Eco-industries Market

Eco-industry Group	**Environmental Domain (Sub-Sector)**
Pollution Management*	Air pollution Control (APC) Waste Water Treatment (WWT) Waste Management (WM) Remediation and Clean up of Soil & Groundwater Noise and Vibration Control Environmental Monitoring & Instrumentation Environmental Research & Development Public Environmental Administration Private Environmental Management
Resources Management	Water Supply Recycled Materials Nature Protection

Note (*) Pollution Management includes all investments in Cleaner Technologies and Processes. Such investments will be incorporated primarily into the values for APC, WWT and WM.

The approach used in this study is to focus on the final expenditure incurred by consumers when using environmental protection services. This is used as a proxy in determining the size (turnover) of the eco-industries. A template for data collection was used for each EU-15 Member State and the Candidate Countries. This enabled a clear audit trail to be established for expenditures on both "Pollution Management" (which includes "Cleaner Technologies") and "Resources Management". A detailed assessment of trade in environmental goods (including renewable energy plant), covering the period 1994 to 1999, was also undertaken for all EU Member States using Eurostat's COMEXT trade database.

2.0 KEY FINDINGS

Characteristics of the EU Eco-industries in 1999

- Total **EU eco-industries supply some 183 Bn euro of goods and services a year**, of which 54 Bn euro are investment goods and 129 Bn euro are services, including 'in-house' non-market services.
- Total **Pollution Management and Cleaner Technologies eco-industry supplies are around 127 Bn euro of goods and services a year**, of which 40 Bn euro are investment goods and 87 Bn euro are services, including 'in-house' non-market services.
- Total **Resources Management eco-industries (excluding renewable energy plant) supply around 56 Bn euro of goods and services a year**, of which 14 Bn euro are investment goods and 42 Bn euro are services, including 'in-house' non-market services.
- The **current size of the renewable energy plant market in the EU is around 5 Bn euro a year**. This ties in well with the anticipated spend of 20 Bn euro over the period 1999-2003 as outlined in the Commission's "Campaign for Take-Off, 1999-2003".
- The **waste management industry has seen a tremendous increase in operational expenditure since 1994**, and is the domain with the biggest annual expenditure.
- Spending on wastewater treatment continues to remain strong, whilst **air pollution control expenditure has dropped**.
- The estimated value added provided by eco-industries, based on direct labour costs, is 98 Bn euro, up from 35 Bn in 1994.
- **Investment in eco-industries in the EU each year totals 54 Bn euro** with consequent benefits for construction, capital goods industries and associated services.
- Average per capita expenditure in the EU in 1999 for 340 euro for pollution management and 150 euro for resources management, or close to **average per capita expenditure of 500 euro overall**.

Employment in EU Eco-industries

- **Direct employment in the EU in eco-industries amounts to over 2 million (FTE) jobs** – around 1.5 million jobs for pollution management and 650,000 for resources management.
- The **1.5 million jobs in Pollution Management eco-industries** are split into over 1 million operations-related jobs and 400,000 capital-related jobs.

- The **650,000 jobs in the Resources Management eco-industries** are split into 500,000 operations-related jobs and 150,000 capital-related. This demonstrates that employment levels for the wider environmental industry sector are significantly larger than the core eco-industry (i.e. pollution management) definitions used in the past. Areas such as nature protection and organic farming, which have not been covered by this study, also offer the potential for significant employment creation in rural economies in the future.
- Total employment generated by the demand for environmental goods and services is at least **2.6 million jobs taking into account the (first round) indirect effects** on the rest of the economy. These indirect jobs include, for example, jobs in supply of electricity to the eco-industry, as well as jobs in a range of other industries that supply (non-environmental) goods and services to ensure that environmental infrastructure remains fully operational (e.g. maintenance firms).
- A **high end estimate of environmental employment is around 4 million jobs**, using various procedures to give more realistic coverage and including the use of 'multipliers', which try to build in the indirect effects of environmental expenditure.
- Environmental sector employment accounts for on average **1.3% of total paid employment** in the EU-15, although it is higher in some countries (e.g. Austria, Denmark, France).
- The current study has produced robust employment data that compares well with a range of other Member State studies. This has been helped by significant developments in employment estimates since 1997.
- For every 1 Bn euro of investment in environmental goods and services there is another 1.6 Bn euro generated in operating expenditure and the generation of 30,000 direct jobs.
- **A significant level of investment-related jobs in the EU are generated by sales to Candidate Countries**.
- **Employment levels are expanding in the waste management sector**. Waste recovery and recycling offer particularly good prospects for future employment growth.
- Environmental employment has been a **source of job creation** at the Member State level, although it is impossible to identify accurately the impact on aggregate employment.
- There has been a **shift in employment from the public to private sectors**, particularly within the waste management sector (e.g. Netherlands, Sweden and UK).
- Parts of the environmental sector (e.g. environmental consultancy and research) comprise of highly educated and skilled workforces. There is, however, a **continual need for improvements in skills and training** across many sectors. For example, the rapid technological changes in the waste treatment and recovery/recycling sectors are creating a growing demand for new skills, with obvious implications for training providers.

Changes in EU Eco-industry Turnover and Employment Levels since 1994

Many of the results from this current study can be directly compared to the findings of a similar 1997 study, also commissioned by DG Environment. Comparisons show that:

- In real terms, **total pollution management expenditure has risen by 5% per annum** since 1994.
- The proportion of expenditure spent on **operating costs has increased in real terms by 8% per annum** to a level of 69% in 1999.
- The **73% increase in operating expenditure** (+12% per annum) is significant compared to the **4% rise in capital expenditure** (+0.7% per annum).
- The **share of capital investment has fallen across many EU Member States**, particularly in larger markets. This has major implications for the domestic eco-industries within these Member States and firms may well be looking elsewhere for capital equipment sales.
- The share of **capital investment in the former Cohesion Fund countries** – notably Ireland (48%), Portugal (55%) and Spain (46%) still remains high compared to other Member States. This reflects the on-going investment programmes to implement EU Directives.
- **Increased waste management activities during the period (of 11% per annum) could well explain the large increase in operating costs**. Increased waste management costs reflect rapidly increasing waste disposal costs as treatment routes become more sophisticated and landfill taxes are imposed.
- **Wastewater treatment expenditure has increased by 3% per annum in real terms**. This may well be due to the implementation of the 1994 Urban Waste Water Treatment Directive, which has imposed stringent environmental obligations on public/private water companies across the EU.
- **Air pollution control expenditure has fallen by 5% per annum**. This is likely to be a result of substantial investments having already been made during the past 10 years, for example, as a result of the Large Combustion Plant Directive of 1988.
- Contaminated land remediation and noise and vibration control expenditure have both risen.
- The **private sector is increasingly important** in driving pollution management expenditure rising from 45% of total expenditure in 1994 to 59% by 1999. Household expenditure remains around 5% of total expenditure.
- Total **direct employment resulting from Pollution Management activities has risen by around 500,000 jobs since 1994**.
- Direct employment due to **Resources Management increases this amount by a further 650,000 jobs** (although this employment was not determined in the 1997 Study). Including Resources Management means that the number of direct investment related jobs in the EU in 1999 has increased by around 75% to 550,000 jobs.

International Trade

- The **EU eco-industries is a strong and diverse export sector, and a major global player** alongside the USA and Japan.
- **North America remains the EU's biggest export market** and has shown significant growth, while the Candidate Countries **are becoming increasingly important export**

markets, in particular for EU Member States with close historical trading relationships to that region. The favoured method of EU company penetration into this market is through setting up a joint venture with domestic companies.

- **Northern European countries tend to be more active exporters** than Southern European countries.
- EU companies are amongst the **world leaders in developing new renewable energy technologies**, both for domestic markets and worldwide. The strong and expanding domestic markets provide the basis for many EU companies to be active in worldwide markets. For example, the EU is the largest market for wind energy developments, with 75% of the total world installed capacity of 18.5 GW.
- Although the EU operates a **trade surplus in environmental products** with the rest of the world (estimated, from a realistic scaling up of the trade code analysis, to around 5 Bn euro in 1999), the **amount of this positive trade balance overall is likely to have fallen** between 1997 and 1999, as a result of **increased imports and a levelling out in exports**.
- The **balance of trade with respect to environmental services is unknown** due to the difficulties of gathering accurate information.
- Estimates of total environmental exports from other countries show that these can be around 10% of revenues. Assuming the same level of exporting would mean that **total EU exports may be in the region of 18 Bn euro**.
- The **global eco-industry market is estimated at around 550 Bn euro**. This means the EU has approximately one third of the overall market (183 Bn euro), equal to the USA. The Japanese market is estimated to be worth about 84 Bn euro. The Canadian market is the next most significant at 36 Bn euro.
- Over the next 5 years, **real growth rates in developing markets are estimated to be between 5-8%, while those in western markets will fall to only 1-3%.**
- Variations are apparent in support schemes available in different EU countries but, in general, these are outweighed by the similarities.

Characteristics of the Candidate Country Eco-industries

- Total **Pollution Management eco-industries supply around 10.3 Bn euro of goods and services a year**, of which 5.5 Bn euro are investment goods and 4.8 Bn euro are services, including 'in-house' non-market services. Assuming Resources Management represents a further 20-30% of this figure, a low end estimate of the total eco-industry is approximately 13 Bn euro.
- The **most important environmental domain is the wastewater management industry**, which accounts for 35% of the market, followed closely by air pollution control at 30%. Solid waste management represents 20%. General environmental administration expenditure is significant at 13% of the market, reflecting the increasing role of staff in public administration.
- Overall, the Polish market, with total expenditure of around 3.8 Bn euro, constitutes almost a third of the Candidate Country Pollution Management market, followed by Turkey (2.6 Bn euro), Czech Republic (1.3 Bn euro) and Hungary (1 Bn euro).

- **Most Candidate Countries spend more on traditional end-of-pipe technology than on process integrated/cleaner technologies**. However, implementation of EU Directives such as IPPC will lead to increased investment in cleaner technologies.
- The **environmental *acquis* is the main driving force** behind each of the Candidate Country markets for environmental protection, particularly EU regulations such as the IPPC Directive.
- The **importance of international donor agencies**, programmes from the EU and elsewhere, as well as financial institutions is critical to the future funding of environmental projects in Candidate Countries.
- Candidate Country eco-industries currently **run a trade deficit with the rest of the world**, although this appears to have **declined since 1995**. Indeed, these countries are gradually reducing the market share of other global eco-industry suppliers into the EU, and have doubled exports to the EU since 1995.
- **Growth in exports to the EU is dominated by the Czech Republic**, followed by Poland, which together account for over 74% of exports.
- Poland, Czech Republic and Hungary are the countries where domestic environmental technology production capabilities appear to have improved the most since 1995.
- The **average share of GDP spent on pollution management expenditure in Candidate Countries was 1.9%.**
- **Average per capita spend in the Candidate Countries is 66 euro**. This is a substantial rise since 1995 (possibly doubling), with **average growth of around 10% per annum**.
- **Average compliance time with the environmental acquis is 8 years**, although several countries have very demanding requirements if they are to meet compliance within the next 20 years.

Employment in Candidate Country Eco-industries

- Direct employment in the Candidate Country pollution management eco-industries is **around 770,000 (FTE) jobs,** of which 460,000 (60%) are operational-related and 310,000 investment-related. Direct operating-derived employment on average accounts for 0.7% of national employment. Including investment-derived jobs means that **total direct employment is equivalent to around 1% of total national employment in Candidate Countries**. However, due to the significant level of capital-related imports (and hence leakage of jobs to other exporting countries) this figure should be treated with a degree of caution.
- **Exactly 50% of operational employment is in the waste management sector**, whilst wastewater treatment accounts for 25% and air pollution control 8%. Environmental administration accounts for 17% of operational employment.
- Turkey, Poland, Romania, Czech Republic and Hungary have the largest direct employment. Investment related employment is dominated by Poland, Turkey and the Czech Republic, which together account for 73% of this employment.
- **Employment in the environmental sectors is generally increasing at a significant rate**. Future employment growth is expected to be greatest in waste management, wastewater

treatment as well as in the formation of new (as well as the expansion of existing) public sector environmental institutions.

- **Overall, the trade deficit has led to jobs being displaced to developed exporting countries**, with the largest displacement of investment related jobs in those Candidate Country markets that are weak, both in domestic production (and export) of environmental technologies. However, this job displacement is reducing over time.

Relationship of EU eco-industries to those in Candidate Countries in the next 5-10 years

- The **continued demand for environmental technology investments in the Candidate Countries is unlikely to be fully met by domestic production capabilities**. This implies sustained employment for the EU overall, although individual Member States may well lose out.
- **EU firms will keep establishing joint ventures with domestic companies**, although fully-owned subsidiaries are likely to increase in the future. Also, consolidation within the sector and the purchase of promising Candidate Country firms by EU firms is highly likely.
- **Employment shifts from the EU-15 to the Candidate Countries** in the short term are most likely to occur in Poland, Czech Republic and Hungary since these are three of the largest markets; are rapidly expanding; have good domestic capabilities, especially in APC, WWT and WM; and are rapidly expanding their export capabilities.
- The **export performance of the Candidate Countries is likely to strengthen**, particularly from the most rapidly developing markets.
- **Export trade with the EU-15 is set to increase**, particularly in areas where the sales price is affected by labour costs. In particular, Candidate Country exports of end-of-pipe technologies are likely to increase, coinciding with a shift of EU exports towards cleaner technologies.

Contents

Annexes

Analysis of the EU Eco-Industries, their Employment and Export Potential

A Final Report to DG Environment

1.0 INTRODUCTION

1.1 Background

This Final Report presents the results of a study to analyse the EU and Candidate Country eco-industries. The study provides a detailed quantitative and qualitative analysis that gives important insights into the employment and export potential of the sector.

The study has been carried out by ECOTEC Research and Consulting Limited, in association with IFO in Germany. We have also used partners in most Candidate countries. The study has benefited from contributions from national statistical offices, Ministries and Trade Associations[1].

1.2 Objectives of the Study

The environmental industry comprises firms which provide goods and services for both environmental protection and resources management (e.g. waste recycling, renewable energy supply and water supply). The aim of the study is to collect economic data (level of turnover and investment, value added, employment, exports etc.) on this industry in a manner that is consistent with the OECD/Eurostat 1999 definitions of the sector. Secondary aims are to update the 1997 '*Estimate of Eco-industries in the European Union'* (Eurostat/DG Environment), as well as DG Environment's 1999 *'EU Eco-Industry's Export Potential'* study, which also examined the employment effects of EU exports.

Specific objectives of the study are to produce an analysis of the:

- Size of the eco-industry in the EU and within each EU15 member state, and its share of GDP;
- Level of eco-industry employment in the EU, and comparison with total employment;
- Size of the eco-industry within in each of the 12 Candidate countries (Candidate Countries) and its share of GDP;
- Level of eco-industry employment in the Candidate Countries, and comparison with total employment;
- EU's share of the eco-industry worldwide;
- EU eco-industry export trends, particularly building on the 1999 EU export study;

[1] Annex 7 contains details of environmental trade associations and trade bodies contacted during this study.

- Potential for the EU eco-industries and employment to grow;

- Examine the current relationships between the EU15 eco-industry and the Candidate Countries;

- Examine the potential impacts on the EU15 eco-industry – both markets and employment - of Candidate Countries joining the EU.

The Steering Group agreed the following research questions, mainly relating to a statistical and quantitative analysis of the EU (and Candidate countries) eco-industries:

1) size of the EU15 eco-industry per country, in terms of:

- turnover
- environmental domain
- value added
- employment
- export levels

2) size of the Candidate Country (CC) eco-industry per country, in terms of:

- turnover
- environmental domain, where possible
- value added
- employment
- export levels

3) Identify the industry structure for sub-sectors of the eco-industries and provide qualitative comments about the relative eco-industry strengths of the different countries;

4) Identify the main types of environmental technologies, products and services exported from both EU15 and the Candidate Countries;

5) Provide a review of analyses of clean production processes and their trade/employment effects;

6) Identify the major export markets for EU15 and the Candidate Countries;

7) Estimate the likely growth rate of different export markets;

8) Identify the generic export promotion activities (both at EU and Member State levels, and the different type of activities such as subsidies and information promotion), and identify which have been most successful in promoting exports;

9) Identify the likely impacts of Candidate Countries joining the EU on the eco-industry in the EU and in the Candidate Countries;

10) Analyse the data obtained from this study in conjunction with the data from the two studies previously commissioned by DG Environment, and identify trends in eco-industry and formulate predictions of future developments in the eco-industry;

11) Describe the methodology for monitoring the development of the eco-industry more regularly.

12) Impact of the candidate countries' transposition process of EU environmental directives (to give insights into the level of required environmental investments and thus a market for EU eco-industry).

13) Provide an overview of the world market of environmental technologies, products and services.

1.3 Definition of Eco-industries used in the Study

For the purposes of this study, eco-industries have been defined according to the definition contained in "The Environmental Goods and Services Industry – Manual for Data Collection and Analysis" (OECD/Eurostat, 1999). This defines eco-industries as

"activities which 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 includes cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use".

Previous estimates of the size of the EU eco-industry[2] (referred to subsequently as the 1997 Study) only looked at the so-called 'Core' element of the sector. This Core element is largely air pollution control, wastewater treatment and waste management. Since 1997, OECD/Eurostat has included this Core under a new "Pollution Management" label. The revised definition of eco-industries also includes "Cleaner Technologies, Products and Processes" and "Resources Management" activities (see Table 1). A full breakdown of the new eco-industry definitions is shown in Annex 1, while the issue of cleaner technologies (and the wider concept of cleaner production) is covered in more detail below.

Table 1: Classification of Eco-industries used in this study

(1) "Pollution Management" (which includes investments in "Cleaner Technologies and Processes")	**(2) "Resources Management"**
A. Environmental Goods B. Environmental Services C. Environmental Construction	e.g. water supply, recycled materials, renewable energy plant, sustainable forestry and agriculture, eco-tourism

Source: OECD Environmental Goods and Services Manual, 1999

[2] "An estimate of Eco-Industries in the EU - 1994", 1997, Eurostat Working Paper No.2/1997/B1, prepared for the European Commission (Eurostat & DG Env), by ECOTEC, BIPE and IFO.

Areas not covered by the statistical analysis in this study include:

- the production of cleaner products;
- the management, control and treatment of radioactive waste; and,
- expenditure on indoor air pollution, heat/energy saving and management, sustainable agriculture and fisheries, sustainable forestry, natural risk management and eco-tourism.

For the Resources Management analysis, most EU Member States are unable to provide reliable data on renewable energy plant. We have therefore presented limited expenditure data for a few countries. However, in a separate report[3], we have examined the nature of employment and EU exporting capabilities in this rapidly growing area of the eco-industries.

The main eco-industry environmental domains that are covered by this study are shown in Table 2.

Table 2 : Environmental Domains comprising the EU Eco-industries Market

Eco-industry Group	**Sub-Sector**
Pollution Management*	Air pollution Control (APC) Waste Water Treatment (WWT) Waste Management (WM) Remediation and Clean up of Soil & Groundwater Noise and Vibration Control Environmental Monitoring & Instrumentation Environmental Research & Development Public Environmental Administration Private Environmental Management
Resources Management	Water Supply Recycled Materials Nature Protection

Note (*) Pollution Management includes all investments in Cleaner Technologies and Processes. Such investments will be incorporated primarily into the values for APC, WWT and WM.

The lack of statistical economic data on eco-industries (environmental industry) results from the absence of a separate industry classification. Firms which produce environmental goods and services are located in all types of NACE defined industries, and hence their identification would require disaggregation and separation of existing data on industrial sectors. Since the NACE classification is based upon the direct nature of the goods/services produced (e.g. coal, cars, transport services) the eco-industry definition needs to be based upon an assessment of whether these specific outputs are used for environmental purposes.

[3] *'Renewable Energy Sector in the EU: its Employment and Export Potential'*, ECOTEC 2001 for DG Environment

Discrepancies between data quoted by various sources for the environment industry often results from differences in the comprehensiveness of definitions of environmental industries and markets. The definition above, for the eco-industries, covers the specification, design, manufacture, construction, installation, commissioning and operation of projects, together with the services and consumables associated with the operation of plant and other pollution control and waste management activities. Civil engineering work specifically associated with the above activities (for example in wastewater treatment) is included.

1.4 The Analysis of Cleaner Production (and Technologies) in the Study

This study is interested in the extra-market opportunities and jobs created through cleaner production. Cleaner production covers a range of activities (e.g. cleaner technology investments, good housekeeping measures, and changing inputs in a process), for most of which it is very difficult to obtain expenditure data. As a result, this study focused on additional investments in cleaner technology as a basis for establishing the additional costs to industry, and hence the market for cleaner technologies.

The OECD defines cleaner technology as:

"Technologies that extract and use natural resources as efficiently as possible in all stages of their lives; that generate products with reduced or no potentially harmful components; that minimise releases to air, water and soil during fabrication and use of the product; and that produce durable products which can be recovered or recycled as far as possible; output is achieved with as little energy input as is possible".

It is perhaps more useful to define cleaner technology in terms of how it differs from the traditional end-of-pipe approach to pollution control. The European Commission describes this difference thus:

"End-of-pipe solutions do not usually result in efficiency or productivity gains, therefore representing a pure cost to the firms. Cleaner technology on the other hand, improves process efficiency. Furthermore, cleaner technology usually reduces polluting emissions to all media instead of shunting them from one to the other".

One factor in defining cleaner technology is therefore the reduction in production costs that results from improved process efficiencies. In terms of investment the key difference with end-of-pipe investments is that these are nearly always additional investments, whereas investment in cleaner technologies is usually, at least partly, in replacing existing systems or equipment in order to bring about environmental benefits. This has obvious implications for employment.

Whilst this study attempted to collect recent investment data on cleaner technology investments, due to insufficient EU-wide coverage, all capital investment data in this report comprises of both end-of-pipe and cleaner technology investments.

Many EU Member States still do not breakdown the proportions of expenditure between end-of-pipe and cleaner technologies, primarily due to the difficulties of obtaining such data through

industry surveys. Countries such as Finland, Sweden and the UK have produced some key insights into investment patterns, principally through conducting year-on-year surveys (see Box 1).

Much more effort is needed by Member States, however, in order to more accurately produce a true breakdown of these two types of investment. Box 1 provides a summary of cleaner production, which is an abstract from a review by ECOTEC of recent studies on the subject (see Annex 2).

Box 1 : Key Issues relating to Cleaner Production

In seeking to produce a reliable estimate of the amount of investment in, and jobs created as a result of, the implementation of cleaner production in EU industry, there are a number of issues that need to be addressed:

- Definition of cleaner production is difficult - of the three aspects, technology, housekeeping and changing inputs, the last two are particularly problematic to analyse.
- Cleaner production is a dynamic concept and as its uptake in a particular industrial sector becomes the norm, its definition will have to evolve accordingly.
- Investments in cleaner production must be distinguished from investments in new processes where environmental considerations are not the prime motivation.
- Analysis of investment in clean production should only include the additional investment made over and above that which would have been made anyway (when a particular process component is due for replacement for example).
- Differences in the amount of investment in cleaner production between individual EU countries are the result of a complex series of factors including the sectoral composition of industry, regulatory measures, cultural attitudes, company structures and ethos and stage of development of a particular industrial activity.
- Certain industrial sectors lend themselves to the application of clean production - notably chemicals and food, although over a period of several years investment within sectors can vary significantly. In other sectors, the scope for applying such innovations may be less.
- In contrast to end-of-pipe technologies, which are by and large standard equipment, cleaner technologies tend to be process-specific, or indeed proprietary, so analysis of their uptake requires an in-depth knowledge of processes, something that only the investing companies themselves may possess.
- The timing of investments in cleaner technology presents a challenge to analysis of the size of the market and employment created. Factors here include the age of manufacturing plant and process equipment and hence timing of the need for replacements, and the concept of a theoretical maximum investment given that (apart from economic growth) there may come a point where all processes are as “clean” as technology allows.
- The extent to which technological development will continue to produce ever-cleaner technologies. It appears likely that the potential for this is considerable, although dependent to some extent on the effectiveness of European systems for innovation.

1.5 Overview of the Research Approach

The study produces a detailed statistical characterisation of eco-industries, in each EU Member State (Figure 1) and each Candidate country (Figure 2). The approach follows that adopted in the 1997 Study, which produced the first definitive statistical analysis of EU eco-industries.

The analysis was directed at three levels:

1) **Macro-economic analysis** of the overall EU economic impact of environmental expenditure (based upon environmental expenditure and engineering studies) highlighting the direct and indirect impacts on both markets and employment;

2) **Micro-economic analysis** of the industry (based upon environmental expenditure and some supply-side analysis, including environmental employment studies from individual Member States), characterising the sector in terms of the levels and growth rates in turnover, value added, investment, and employment;

3) **Market appraisal** of the competitive position of EU suppliers (based particularly upon recent export studies within respective EU Member States and the experience of ECOTEC), comparing the sector with non-EU suppliers.

1.6 Relationship of Environmental Expenditure to Gross Domestic Product (GDP)

At various places in this report, environmental expenditures (or eco-industry turnovers) are compared to GDP. This is done to give an indication of the order of magnitude involved, either for the EU as a whole or for particular Member States. It is not done to indicate the share of the environment in GDP. Indeed, the sum of operating and capital expenditure is not a complete measure of the environment industry's contribution to GDP. GDP includes the consumption of fixed capital (also known as 'depreciation') as well as the net operating surplus. Since both these items are not included in the expenditure estimate, the eco-industries' contribution to GDP is **underestimated**. The eco-industry is more capital intensive than the economy as a whole. Roughly speaking, therefore, these two missing items may be estimated to be in the order of 30% of the expenditure. **Hence, the true contribution of the eco-industry to GDP would be around 2.3% times 1.3 = approximately 3%.**

1.7 Structure of the Report

Section 2.0 develops the **framework for defining and collecting data** on eco-industries. Estimation procedures are also discussed, together with consideration of the extent and quality of available data.

Sections 3.0 and 4.0 present analysis of **environmental expenditure** and of **extra-EU trade** in environmental goods and services, respectively. The analysis aims to indicate the size of the EU market for goods and services produced by eco-industries, and the size of EU exports. A summary of export support measures and the role of EU eco-industries in the global market is also given.

Section 5.0 calculates **the employment** associated with EU eco-industries. There continues to be a strong policy interest in the possible "double dividend" of greater environmental protection and employment generation. The analysis contributes further to this debate.

Section 6.0 looks at **changes between 1994 and 1999** in expenditure and employment levels , thus helping to shed light on structural changes, including growth rates, within the EU eco-industries.

Section 7.0 provides insights into the nature of the **Candidate Country eco-industries**, presenting a statistical analysis of environmental expenditure and a more qualitative overview of the industry, based upon recent studies and the views of in-country experts. The section also provides a low end estimate of the level of employment in the Candidate Countries.

Section 8.0 summarises the study's **conclusions**

Section 9.0 provides **recommendations** to aid further statistical analysis of eco-industries in both the EU-15 and CC-13, including employment and trade impacts.

Three stand alone reports have also been submitted with this report. These cover:

- EU Eco-industries: Trade and International Markets;
- Renewable Energy Sector in the EU: its Employment and Export Potential;
- Analysis of the Size and Employment of the Eco-industries in the Candidate Countries.

The main findings from these reports are summarised within this Final report. In addition, a separate Appendix to this report contains environmental expenditure worksheets (and employment analyses) for each EU Member State.

Figure 1 : Integration of Collected Data for EU-15 ***(key areas in bold)***

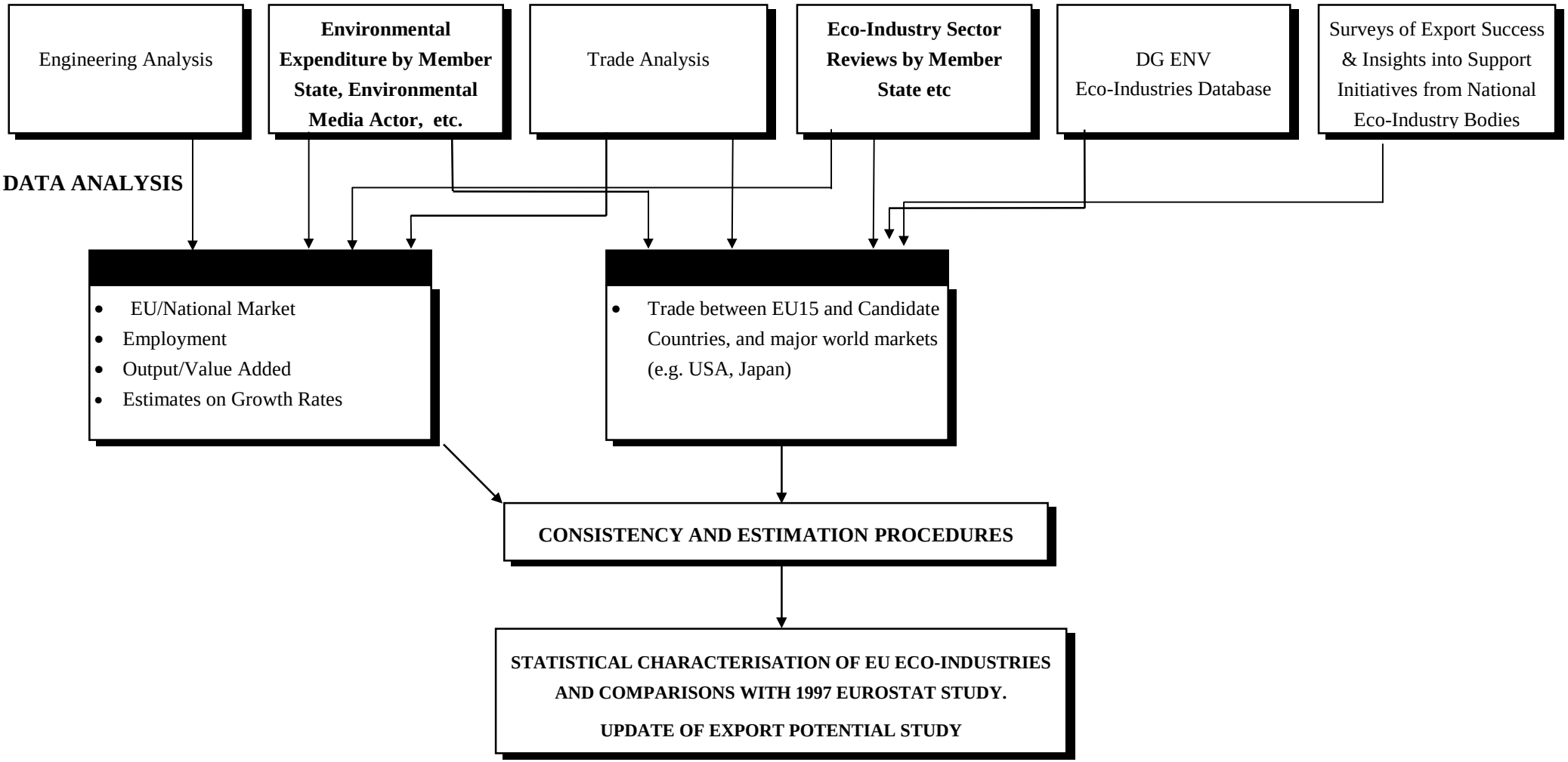
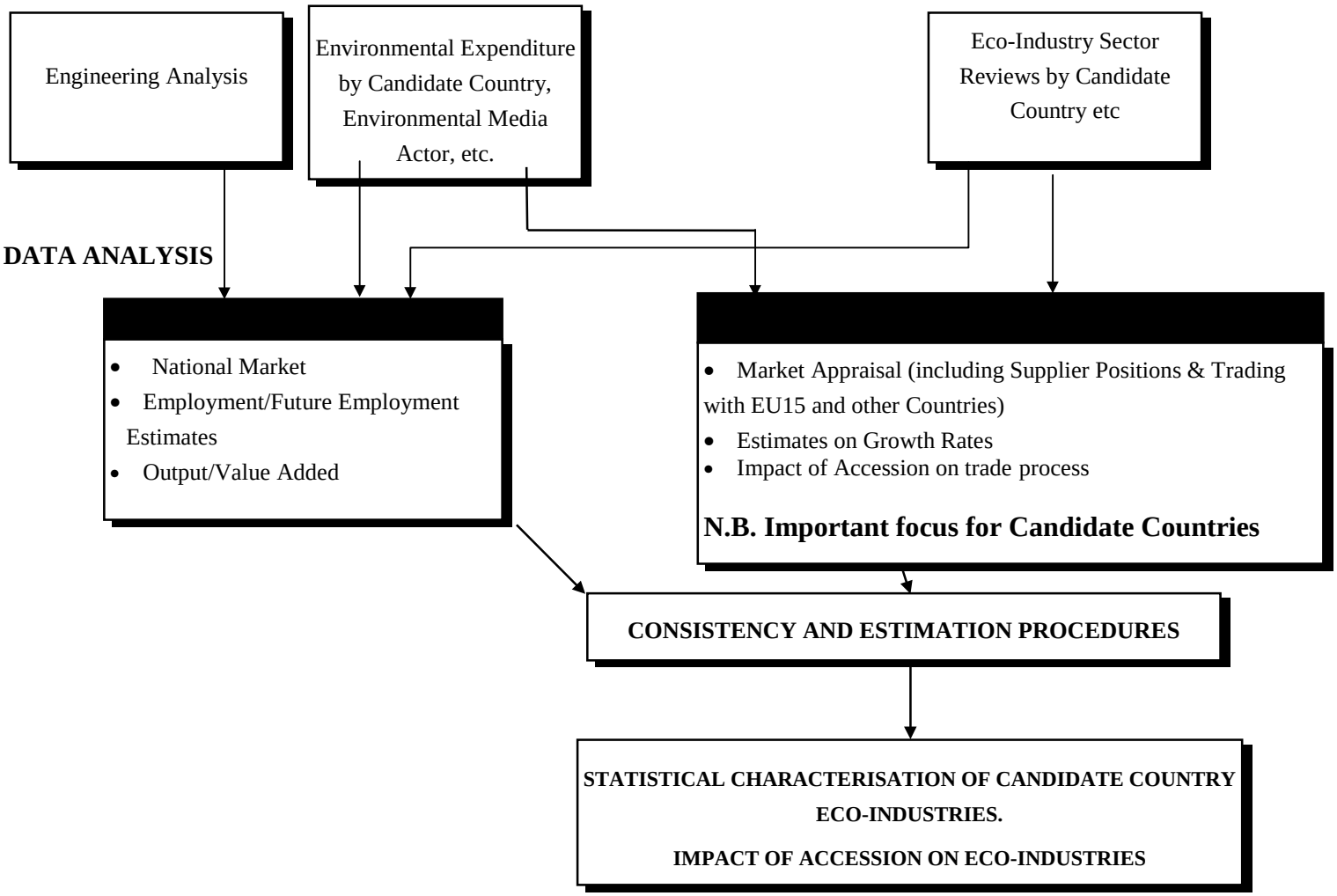


Figure 2 : Integration of Collected Data for Candidate Countries



2.0 STUDY METHODOLOGY

2.1 Demand and Supply of Eco-Industry Products

The study is directed to an analysis of EU and Candidate Country eco-industries in terms of their economic significance at a macro and micro level. The available statistical data however, generally relates to the expenditure made by purchasers of eco-industry goods and services rather than to the sales, investment, value added, etc of the producers. Environmental expenditure data (the demand side) therefore has to act as a proxy for the value added of the eco-industries. The emphasis in data collection has therefore been on environmental expenditure, with additional data (e.g. private sector waste management industry turnover) used to build up a more complete picture of particular eco-industry sub-sectors.

The original baseline data year agreed by the Steering Group was 1998, however it soon became apparent during data collection that a number of countries (including several Candidate Countries) had collected data for 1999. This therefore became the target year.

2.2 Method of Approach : Using Environmental Expenditure to Assess Eco-Industries

In order to define the economic significance of the eco-industries using expenditure data, it is important to understand the transactions between producers of environmental goods and services, intermediate goods producers, and the consumers of environmental goods and services.

Environmental protection services, can either be traded; carried out by in-house processes and staff (e.g. within industry); or provided free of charge by government on behalf of households, enterprises, i.e. collective consumption. Environmental protection goods in themselves cannot ‘execute'' environmental protection activity. Only when these goods are used is the characteristic activity executed and an environmental protection service provided. It is at this point that the environmental expenditure occurs. The approach used in this study is to focus on the **final expenditure incurred by consumers** when using environmental protection services. This is used as a proxy in determining the size (turnover) of the eco-industries.

2.3 National Template for Data Collection

The method of approach, described in the previous section, has to be applied in a practical fashion to structure and present data. The template for data collection separated out “Pollution Management” expenditure (i.e. end-of-pipe investments) from investments in “Cleaner Technologies”. A separate section covering “Resources Management” was also included. The worksheet in Annex 3 gives a full breakdown of environmental categories within these three groups.

In the event, there was insufficient data covering the proportion of investment dedicated to cleaner (or integrated process) technologies. EU-15 countries still do not gather such data, although some countries such as Sweden, Finland and the UK do make regular assessments.

Within industry, the proportion generally ranges between 20% (e.g. Portugal) and 55% (e.g. Finland). The industrial structure within a country is perhaps the single most important factor behind differences in this proportion. Annex 2 provides further insights into the level of expenditure set aside for cleaner technologies within the EU.

An Appendix to this report gives worksheets for each EU Member State (in both national and euro currencies and M euro).

2.4 Analyses of Trade in Environmental Goods

A detailed assessment of trade in environmental goods (including renewable energy plant) was undertaken for all EU Member States. The analysis focused on key goods for which trade data was available. Tables 3a and 3b show the trade codes used. The EU trade data used was derived from Eurostat's COMEXT database, using a time series from 1994 (the data year for the 1997 Study) to 1999[4]. Analysis was concentrated on extra-European trade, with particular emphasis on examining trade flows between the EU-15 and Candidate Countries, including the corresponding levels of imports from Candidate Countries. Trade balances for each EU Member State were also calculated. The analysis provides an unprecedented level of detail on growth rates for EU environmental technology exports.

It is unclear what percentage of total trade in environmental goods is captured by these trade codes. Due to data limitations, it is only possible for a few countries (usually strong exporters) to make a comparison between exports measured by trade code analysis with exports reported by environment industry suppliers.[5] This comparison suggests that only in the order of 20% of total trade is captured by trade codes in these countries. However, this ratio is highly variable across environmental categories. The limited evidence suggests that for air pollution control it is more like 50%, but for wastewater treatment and waste management less than 20%. The ratios are also likely to vary across countries. Transferring these ratios to Candidate Country trade is likely to generate inaccurate results, although it provides an indication of the possible orders of magnitude involved.

[4] COMEXT is the database for statistics on the European Union's external trade for Member States. External trade statistics only cover transactions in transportable goods, not services.

[5] See The 1997 Study (p.54, Section 4.6) for further details of country comparisons for Germany and Austria.

Table 3a : Trade Codes used for the Analysis of Environmental Technologies

Subsector	Product Category	Trade Code
Air Pollution Control	Machinery and apparatus for filtering and purifying air.	8421.39-30
	Machinery and apparatus for filtering and purifying gases (excluding air) by a liquid process.	8421.39-51
	Machinery and apparatus for filtering and purifying gases (excluding air) by an electrostatic process	8421.39-55
	Machinery and apparatus for filtering and purifying gases (excluding air) by a catalytic process	8421.39-71
	Machinery and apparatus for filtering and purifying gases (excluding air) (by other processes) (excluding 8421 39-51 to 75)	8421.39-99
Water Pollution Control	Machinery and apparatus for filtering and purifying other liquids	8421.29-90
	Activated carbon	3802.10-00
	Centrifugal Pumps - submersible, single stage	8413.70-21
Waste Disposal	Furnaces and ovens for the incineration of rubbish (non electric)	8417.80-10
	Parts of industrial laboratory furnaces and ovens	8417.90-00
Monitoring Equipment	Instrumentation for measuring and analysing liquids	9026.80-91 9026.80-99
	Gas or smoke analysis apparatus (electronic)	9027.10-10
	Gas or smoke analysis apparatus (non-electronic)	9027.10-90
Other Environmental Equipment	Parts of machinery for filtering and purifying gases and liquids	8421.99-00
	Other industrial and laboratory furnaces, (non-electric)	8417.80-90

Source: An Estimate of Eco-industries in the European Union 1994, DG Env/Eurostat

Table 3b : Trade Codes used for the Analysis of Renewable Energy Plant

Sub-sector	Product Category	Trade code (Notes)
Solar Thermal	Instantaneous gas water heaters (excluding boilers or water heaters for central heating)	841911 OECD *(1)*
	Instantaneous or storage water heaters, non-electric (excluding instantaneous gas water heaters and boilers or water heaters for central heating)	841919 OECD *(1)*
Photovoltaics	Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light emitting diodes (excluding photovoltaic generators)	854140 OECD *(1)*
	Photosensitive semiconductor devices, including photovoltaic cells	85414090 (*2*)
	Solar cells whether or not assembled in modules or made up into panels (excluding photovoltaic generators)	85414091 *(3)*
Hydropower	Parts of hydraulic turbines, water wheels including regulators (excluding those of cast iron or cast steel)	84109090
	Hydraulic turbines, water wheels and regulators therefor (excluding hydraulic power engines and motors of heading no 8412)	8410
	Hydraulic turbines and water wheels of a power =< 1 000 kW (excluding hydraulic power engines and motors of heading no 8412)	841011
	Hydraulic turbines and water wheels of a power > 1 000 kW but =< 10 000 kW (excluding hydraulic power engines and motors of heading no 8412)	841012
	Hydraulic turbines and water wheels of a power > 10 000 kW (excluding hydraulic power engines and motors of heading no 8412)	841013

(1) The Environmental goods and Services Industry, Manual for data collection and analysis. OECD / Eurostat 1999.

(2) Code started in 1999

(3) *Code ran from 1988 to 1998.*

2.5 Engineering Analysis

To estimate the level of employment associated with expenditure on environmental goods and services, it is important to know how the money is spent - not only how much is operating expenditure (OPEX) and how much capital investment (CAPEX), but also how much of OPEX and CAPEX is used to pay for salary costs, as well as the costs of construction, intermediate goods, capital goods, associated energy use and services.

The purpose of the engineering analysis is to indicate the inputs required from other sectors of the economy in order to carry out environmental protection activities, as the basis of economic modelling. The economic modelling was conducted using the HERMES[6] model. Nine input sectors are defined according to the HERMES nomenclature. These nine sectors are comprehensive, covering all forms of economic activity.

It has been assumed, that with the exception of the waste management sector, the cost structures of the eco-industries in each Member State are sufficiently similar as to allow a standard engineering breakdown to be applied. The cost structure of the waste management sector is heavily influenced by the importance of incineration or landfill as disposal routes, which can vary significantly between Member States, with the former requiring relatively higher expenditure on capital goods. This has been taken into account in preparing the engineering analysis. Further details of the engineering analyses by the three main domains are given in Annex 4. This Annex also includes the typical cost structure of the provision of environmental protection activities in terms of the HERMES input sectors, and the relationships between cost components and HERMES input sectors.

To determine the employment impact of expenditure on environmental goods and services requires specification of inputs to the environmental sector, including labour. In turn, the costs of labour for each sector (including those sectors providing intermediate inputs) by country, and the share of labour costs in each of the sectors providing intermediate inputs, needs to be identified.

Wage rates were obtained from Eurostat's Labour Costs Survey of 1996, which provides rates for a range of industrial sectors across all the EU-15. The share of labour costs for each of the sectors providing intermediate inputs has been estimated to be, on average, around 1/3 of turnover for these sectors. This is supported by reference to data in a number of countries from economic models, e.g. UK, Italy, Spain.

Unlike the 1997 Study, wage data was available for **all** EU-15 countries[7]. Wage rates per industry/commercial sector per country were inflated to 1999 levels using Consumer Price Index values[8].

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[6] HERMES : Harmonised Econometric Research for Modelling Economic Systems

[7] In the 1997 Study, wage data for Austria, Finland, Italy and Sweden was based on EU-wide averages, therefore introducing an element of error in the calculation of employment levels.

2.6 Available Data on Environmental Expenditure

The first requirement of the analysis was to collect available data from Member States on environmental expenditure. Detailed national enquiries have therefore been conducted in each Member State to obtain such expenditure data. Both National Statistics Offices and Ministries of Environment (or the appropriate Ministry) were contacted. This task was facilitated by close liaison with Eurostat. This included analysis of New Cronos Pollution Abatement Control (PAC) data, which is submitted by individual Member States to Eurostat on a regular basis.

The data collection exercise has examined the availability of published official statistics in each Member State. Expenditure by actor (public sector, private sector and households) and environmental domain was sought for each Member State. The range of available data, by Member State, and the extent of estimation by the Contractors is given in Table 4. Details of the individual data sources are given in the individual Member State worksheets[9] (see separate Appendix).

For the majority of countries, relatively recent data (ranging from 1999 to 1996), divided into capital expenditure (CAPEX) and operating expenditure (OPEX) and disaggregated by the different environmental domains and key actors was available (see Table 4 for details). However, for a few countries information was not complete or was relatively dated. Some information from Greece, Spain, Italy and the UK, for example, dated back to 1996. Other shortcomings of data include:

- In some countries little information is available by actor. In particular, for many Member States there is still little information available on household expenditure – an issue raised in the 1997 Study.

- Countries have different coverage of private sector expenditure. Most countries that have conducted environmental expenditure surveys of industry, for example, often sample NACE 10-36 and 40. This means that the reported private sector environmental expenditure is an underestimate of the true level of expenditure (and hence jobs) in the EU.

- Private environmental management expenditure was only reported by: Austria (1,017 M euro), Finland (81 M euro), Greece (4 M euro) Netherlands (323 M euro), Sweden (76 M euro) and the UK (900 M euro). This data was arbitrarily counted as 'public sector' administration expenditure data in order to conduct the employment analysis.).

[8] This is a conservative assumption (assuming low labour costs in 1999) which partly offsets the conservative assumptions elsewhere (e.g. expenditure data is also inflated using the CPI).

[9] Each EU Member State worksheet presents data in the national currency (various data years) and then in million euro for 1999. National currencies were converted using consistent exchange rates and price inflators.

- Estimates of public sector expenditure may include double counting when transfers to other public sector bodies are regarded as expenditure (i.e. over-estimation). Public sector estimates may also only relate simply to large public bodies (e.g. Ministries), and exclude expenditure by regions or provinces (under-estimation);

- Expenditure data sometimes represents an aggregate expenditure over a number of domains. However, the Contractors believe that advances in reporting PAC data amongst Member States has reduced the level of overlap in this current study.

Table 4a : Data Availability and Estimation EU-15 (Pollution Management)

		Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Lux	NL	Portugal	Spain	Sweden	UK
Pollution Management																
Air Pollution Control	Pub.	✔	✗	✔	✔	✔	✗	Est	✗	✔	✔	Est	✔	✔	✗	Est
	Pri.	✔	✔	Est	✔	✔	✔	✔	✔	Est	Est	✔	✔	✔	✔	✔
	HH	Est	✗	✗	✗	✔	✗	✗	✗	✗	✗	✗	✗	Est	✗	✗
Wastewater Treatment	Pub.	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	Est	✔	✔	Est	Est
	Pri.	✔	✔	Est	✔	✔	✔	Est	✔	Est	Est	Est	✔	✔	✔	✔
	HH	Est	✗	✗	✗	Est	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Solid Waste Management	Pub.	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	Est	✔	✔	Est	Est
	Pri.	✔	✔	Est	✔	✔	✔	✔	✔	Est	Est	✔	✔	✔	✔	Est
	HH	Est	✗	✗	✗	✔	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Remediation & Clean Up	Pub.	✔	✔	✔	✗	✗	✔	Est	✗	✔	Est	Est	✗	✔	✗	Est
	Pri.	✔	✗	Est	✗	✗	✔	✗	✔	Est	Est	Est	✗	✔	Est	✔
	HH	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✔	✗	✗	✗	✗
Noise & Vibration	Pub.	✔	✗	✔	✗	✔	✗	✗	✗	Est	Est	Est	✔	✔	✗	✗
	Pri.	✔	✔	✗	✗	✔	✔	✔	✔	Est	Est	Est	✔	✔	Est	✔
	HH	Est	✗	✗	✗	✔	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Monitoring analysis & assessment	Pub.	✗	✗	✗	✗	✗	✔	✗	✗	✗	✗	✗	✗	✗	✗	✗
	Pri.	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	Est	✗
	HH	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗

Research & Development	Pub.	✗	✗	✔✗	✗	✔	✔	✗	✗	✔	✗	✗	✗	✔	✗	Est
	Pri.	✗	✗	✗	✗	✔	✗	✗	✗	Est	Est	✗	✗	✔	Est	✗
	HH	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Environmental Administration (Public)	Pub.	✔	✔	✔	✗	✔	✗	✔	✔	✗	✗	Est	✗	✔	Est	Est
	Pri.	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
	HH	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Environmental Management (Private)	Pub.	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
	Pri.	✔	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	Est	✗
	HH	Est	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗

Key: ✔ Data source available; Est. estimates as thought important; ✗ no data available and no estimation

Note 1: Where there is no data available for the three main domains, values have been estimated using the generally available data. For the other domains no estimation has been carried out due to the possibilities for significant bias caused by extrapolating from limited data.

Note 2: In some cases expenditure data relating to domains such as remediation and clean-up and noise & vibration control is only recorded in aggregate and cannot be separated out. In this case expenditure values are placed in the 'Environmental Administration' category. The '✗'therefore does not imply that the final expenditure estimate is an under-estimate (for example Finland has around 20% of Pollution Management expenditure analysed in this manner).

Note 3: Identified household expenditure is mainly in Air Pollution Control, which covers catalytic converters for cars.

Table 4b: Data availability and estimation for the EU-15 (Resource Management)

		Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Lux	NL	Portugal	Spain	Sweden	UK
Resource Management																
Water Supply	Pub.	✔	✔	✔	✔	Est	Est	Est	✔	✔	✔	✔	✔	✔	✔	✔
	Pri.	✗	✗	✗	✗	Est	Est	✗	✗	✗	✗	✗	✗	✔	✗	✔
	HH	✗	✗	✗	✗	Est	Est	✗	✗	✗	✗	✗	✗	✗	✗	✗
Recycled Materials	Pub.	✗	✔	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
	Pri.	✔	✗	✔	✔	✔	✔	Est	✔	✔	✔	✔	✔	✔	✔	✔
	HH	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Renewable Energy (Total)	Pub.	✗	✗	Est	Est	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
	Pri.	✗	✗	Est	✗	✗	Est	✗	✗	✗	✗	✗	✗	✗	✗	✗
	HH	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Nature Protection	Pub.	✔	✗	✔	✗	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
	Pri.	✔	✗	✔	✗	✔	✔	✗	✗	✔	✗	✔	✗	✔	✗	✔
	HH	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗

Key: ✔ Data source available; Est. estimates as thought important; ✗ no data available and no estimation

Problems with "Pollution Management" data in specific Member States included:

- Belgium - CAPEX/OPEX ratios were missing for most fields and had to be estimated.
- Denmark - only public sector data was available; private sector expenditure (and CAPEX/OPEX ratios) had to be estimated from total expenditure data.[10]
- Finland - 338 M euro, representing 19% of total pollution management expenditure, was classified by Statistics Finland as 'Other' for both public and private sectors. Since the expenditure was not separated into, for example, remediation and clean up, noise and vibration etc., public expenditure was grouped under 'General administration' and private under 'Environmental management (private)' etc. This also occurred for the private (industry) sector in both the Netherlands (323 M euro) and UK (900 M euro -5% of total pollution management expenditure) – both were therefore grouped under 'Environmental management (private)'.
- Italy - information is quite old and not transparent. Estimates for the entire private sector had to be made since the expenditure data given was clearly unrepresentative of industry overall.
- Luxembourg - Little information was available, with all private expenditure data estimated.
- Netherlands, Sweden, UK - CAPEX/OPEX ratios were missing for all public sector data.

Reliance only on the actual reported "Pollution Management" expenditure estimates therefore raises some difficulties.

Conversely, with the exception of Renewable energy plant[11], there was excellent expenditure data for the "Resources Management" group. Data collection in this area was greatly helped by Eurostat's New Cronos database which contained much data from 1998 and 1999[12]. A decision was therefore taken to obtain complete data sets for the EU-15 covering water supply, recycled materials and nature protection. Only Greece had to have estimates for water supply and recycled materials, whilst Sweden was the only Member State not to report any nature protection expenditure. A separate report on Renewable Energy plant, mainly covering exports and employment, was written to highlight the significant contribution this makes to the EU eco-industries.

[10] In the 1997 Study, the issue of erroneous expenditure data was most clearly seen with Denmark, where comparatively low expenditure estimates were reported despite that country having a developed environment industry. This issue appears to have been rectified, as demonstrated by a massive increase in 1999 expenditure.

[11] Limited data available from Denmark, Finland, Germany and Spain.

[12] A large proportion of the Resources Management expenditure was 1999

2.6.1 Estimation methods

In order to have comparable expenditure estimates for the different Member States, estimation methods were used to account for all data gaps in the three main Pollution Management domains (i.e. air pollution control, wastewater treatment and waste management). These methods were kept deliberately simple and consistent to maintain the transparency in the data trail. . For other domains, an estimate of CAPEX and OPEX was made only where total expenditure was known. This prevented extrapolation from limited data. For household expenditure data, we ensured that the air pollution control domain was complete.

Data gaps were filled using the following methods, where applicable:

- Where only "Total Expenditure" was available for a specific actor, sector-specific EU average ratios for CAPEX/OPEX shares were applied for all sectors (see Table 5). Annex 5 shows those Member States reporting sufficiently robust data to enable these shares to be calculated.

- Where private sector expenditure was either unavailable (i.e. Luxembourg) or inadequate (i.e. Italy), reference was made to the 1997 Study to derive the percentage of GDP spent on environmental expenditure overall[13]. Private sector expenditure was then derived by subtracting known public sector expenditure from this total.

- Belgium, Germany, Ireland and Sweden had missing public sector APC expenditure - average values were applied based on returns from other EU Member States (adding around 300 M euro to total Pollution Management expenditure).

- Only Austria, France, Spain and UK provided figures for household APC expenditure, contributing a total of 1.4 billion euro. Despite the low sample size, average values were applied based on these returns. This added an extra 800 M euro (of which Germany accounted for 350 M euro).

- Where expenditure figures referred to data from before 1999, the data was inflated by the national consumer price index to 1999.

[13] e.g. Italy 1% of GDP, Luxembourg 0.99% of GDP

Table 5 : CAPEX/OPEX shares used to complete data gaps in EU Member States

	Domain	**CAPEX (%)**	**OPEX (%)**
Pollution Management	Air Pollution Control	52	48
	Wastewater treatment	44	56
	Waste Management	13	87
	Remediation & Clean up	19	81
	Noise & Vibration	35	65
	Monitoring, Analysis & Assessment	66	34
	Research & Development	12	88
	Environmental Management (Private)	11	89
	General Administration (Public)	16	84
Resources Management	Water Supply	29	71
	Recycled Materials	8	92
	Nature Protection	41	59

Note: only Germany responded for Monitoring, Analysis & Assessment. Household APC estimates were based on a ratio of 80% capex: 20% opex, reflecting the capital costs associated with catalytic converters for cars.

2.7 Confidence of the Data

The data collection and analysis conducted and summarised above, has meant that the resulting statistical conclusion represents a **robust, lower bound estimate of eco-industry activity in the EU**. The verification of the final data has also been carried out by national statistics offices.

Confidence in the data is also enhanced, because:

- data for the main EU markets in Germany, France, UK, France, Italy and the Netherlands is, with the exception of the Italian data, considered to provide a reliable basis for the subsequent analysis; and,

- data is generally available for either 1999 or 1998, allowing adjustments for price inflation to be kept to a minimum. Information on the extent of data estimation by Member State is summarised in Table 6, together with an overall qualitative assessment by ECOTEC of the confidence attached to the data.

We believe that the level of estimation in this current study, for the three main Pollution Management sectors of APC, WWT and WM at least, is lower than that conducted in the 1997 Study. This is primarily due to better provision of data from respective National Statistics Offices and/or Eurostat. The reported 1999 figures for the Resources Management group are also likely to be the best estimate of expenditure so far obtained for this aspect of the EU eco-industries.

Table 6 : Data Confidence in EU Expenditure Data

	% of EU expenditure	**% of data: non-estimated**	**Year of data or whether estimate**		**Confidence of total/total figures (high, medium, low)**
			Public	**Private**	
Austria	7.9%	100%	1998	1998	High
Belgium	1.9%	80%	1997	1996	Medium
Denmark	4.0%	90%	1999	1998	High
Finland	1.3%	95%	1998	1998	High
France	20.6%	90%	1998	1998	High
Germany	29.5%	90%	1998	1998	High
Greece	0.8%	85%	1999	1996	Low
Ireland	0.3%	95%	1998	1998	Medium
Italy	8.4%	50%	1996	Est	Low
Luxembourg	0.1%	50%	1997	Est	Medium
Netherlands	6.8%	80%	1998	1998	High
Portugal	0.5%	95%	1998	1999	Medium
Spain	3.7%	95%	1996	1996	High
Sweden	1.9%	80%	1997	1997	High
UK	12.4%	80%	1996	1999	High
EU-15	**100%**				**High***

*Notes: * 88% of Pollution Management data (by expenditure value) is based on data from countries rated 'High'.*

3.0 MARKET SIZE OF THE EU ECO-INDUSTRIES

3.1 Introduction, Approach and Data Sources

The size of the market for eco-industries in the 15 EU Member States, has been defined by reference to the capital and operating expenditure on environmental goods and services[14], and defined in relation to the environmental domains listed in Table 2. This section presents estimates for each of these environmental domains for all fifteen Member States. The reported (1999) level of expenditure and the type of expenditure (capital expenditure and operating expenditure) have all been examined. Where appropriate, comments on data availability and comparability have been added to assist the interpretation of results.

The presentation is based upon the information presented in country worksheets in an adjoining Appendix A. These worksheets provide a detailed country by country analysis of the expenditure data (as well as the employment analysis).

[14] The demand-side approach, of assessing market size using expenditure data, has been chosen because there are significantly more reliable and robust information sources available than if a supply side approach, assessing market sizes through survey questionnaires to suppliers of environmental goods and services, had been adopted.

3.2 Total EU Market for Environmental Goods and Services

The EU market (defined by the level of environmental expenditure) for environmental goods and services amounted to around **183 billion euro** (Bn euro) in 1999, or equivalent to **2.3% of the EU's GDP**. Pollution Management accounted for 127 Bn euro[15], or 69% of the total (1.6% of GDP), with Resources Management expenditure totalling 56 Bn euro. These figures are an underestimate as they exclude expenditure on "cleaner products", which statistically are too difficult to measure.

Figure 3 : EU Market for Environmental Goods and Services, 1999

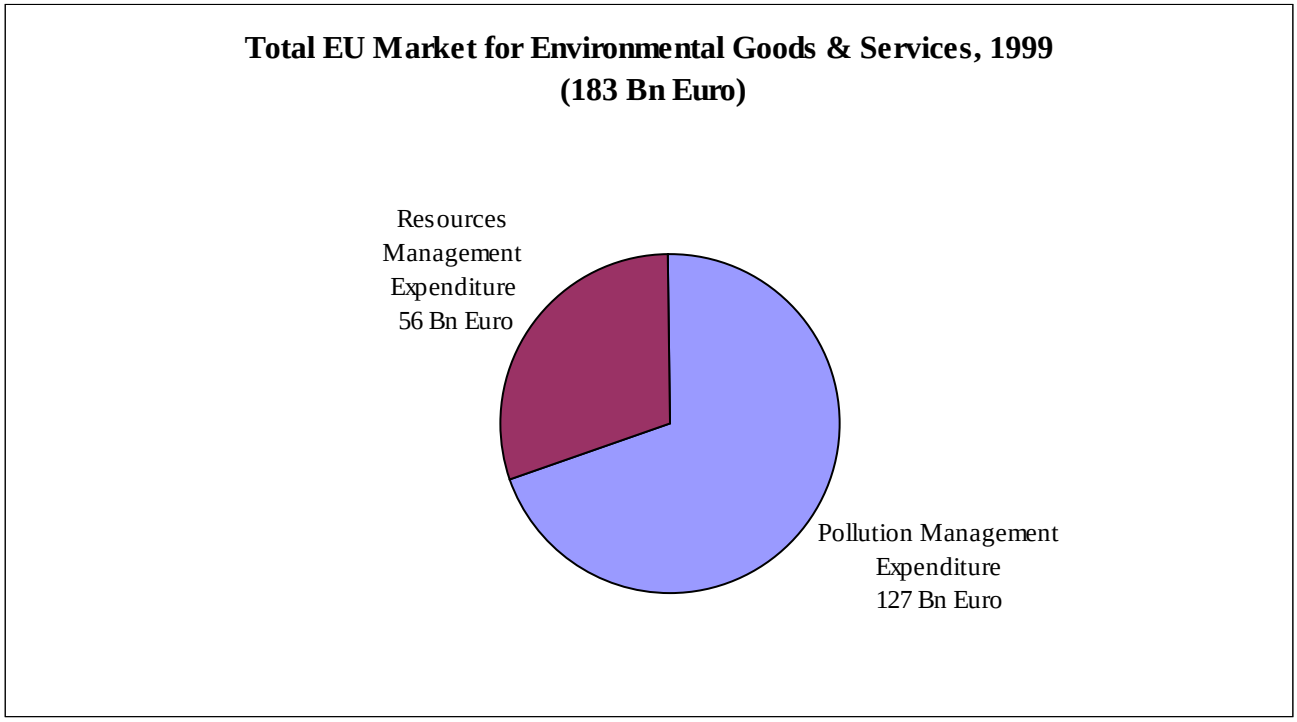


Table 7 below gives turnover details of the eco-industries across Member States, broken down into the two main eco-industries market groupings for which data could be collected. The level of Resources Management expenditure is generally proportional to the level of Pollution Management expenditure within any one Member State.

Overall, the German market, with total expenditure of around 57 Bn euro, constitutes almost a third of the EU market. The French market, with 21% of EU environmental expenditure, was the

[15] Eurostat recently estimated the value of EU-15 environmental expenditure for 1998 to be between 120 and 140 billion Euro, measured as actual outlays following the PAC concept (i.e. excluding consumption of fixed capital but including expenditure of other specialised producers, nature protection and adapted and connected products). *'A low end estimate for EU-15 1998 Environmental Protection Expenditure'*; Revised Version of 12 April 2001, Eurostat B1/GG/AS

next most significant, followed by the UK, Italian, Dutch and Austrian markets - with 13%, 9%, 5% and 5% respectively.

Figure 4 : Turnover of EU Eco-industries by Resources Management & Pollution Management

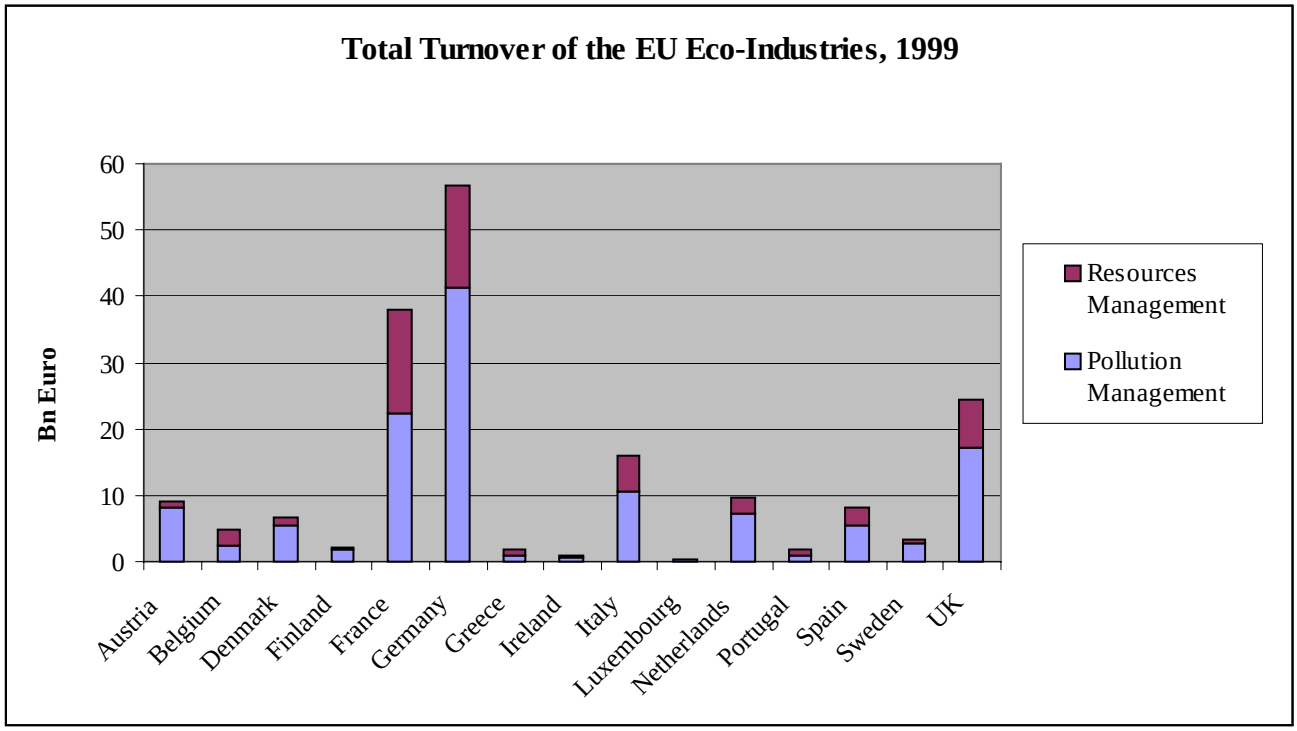


Table 7: Turnover (M euro) of the EU Eco-industries, 1999

Country	Pollution Management	%	Resources Management	%	Total Turnover	%
Austria	8,270	7	620	1	8,900	5
Belgium	2,400	2	2,380	4	4,770	3
Denmark	5,400	4	1,220	2	6,630	4
Finland	1,790	1	310	1	2,100	1
France	22,330	18	15,660	28	37,990	21
Germany	41,190	32	15,510	28	56,710	31
Greece	1,040	1	850	2	1,900	1
Ireland	530	0.4	250	0.5	790	0.4
Italy	10,700	8	5,280	9	15,980	9
Luxembourg	160	0.1	110	0.2	280	0.2
Netherlands	7,170	6	2,440	4	9,610	5
Portugal	920	1	830	1	1,750	1
Spain	5,530	4	2,510	4	8,030	4
Sweden	2,620	2	690	1	3,310	2
UK	17,090	13	7,390	13	24,470	13
EU-15	**127,140**	**100**	**56,070**	**100**	**183,220**	**100**

Note: Totals may not sum due to rounding. Turnover is defined as the sales of eco-industries, based upon the estimated level of environmental expenditure (demand) for eco-industry product. This overstates the actual level of market transaction because expenditure includes the value of in-house production and public services

Whilst Section 1.6 has already noted that the eco-industries' share of GDP is underestimated, Table 8 shows that the environmental sector is most significant - in terms of the share of GDP - in Austria (4.5%) and Denmark (3.9%). Total environmental expenditure accounted for between 2-3% of GDP in Belgium, France, Germany and the Netherlands. With the exception of Ireland, all remaining countries spent between 1.4% and 1.8% of GDP on both pollution and resources management. **The true contribution of the eco-industry to GDP would be around 2.3% times 1.3 = approximately 3%.**

Table 8 : Turnover (Bn euro) of the EU Eco-industries, 1999

	Pollution Management		**Resources Management**		**Total**	
Country	**Turnover**	**Turnover as % of GDP**	**Turnover**	**Turnover as % of GDP**	**Total Turnover**	**Turnover as % of GDP**
Austria	8	4.2	1	0.3	9	4.5
Belgium	2	1.0	2	1.0	5	2.0
Denmark	5	3.2	1	0.7	7	3.9
Finland	2	1.5	0.3	0.3	2.3	1.7
France	22	1.7	16	1.2	38	2.8
Germany	41	2.1	16	0.8	57	2.9
Greece	1	0.9	1	0.7	2	1.6
Ireland	1	0.6	0.3	0.3	1	0.9
Italy	11	1.0	5	0.5	16	1.4
Luxembourg	0.2	0.9	0.1	0.6	0.3	1.5
Netherlands	7	1.9	2	0.7	10	2.6
Portugal	1	0.9	1	0.8	2	1.6
Spain	6	1.0	3	0.4	8	1.4
Sweden	3	1.2	1	0.3	3	1.5
UK	17	1.3	7	0.5	24	1.8
EU-15	**127**	**1.6**	**56**	**0.7**	**183**	**2.3**

Note: Totals may not sum due to rounding.

3.2.1 Per capita expenditure for the EU-15

Perhaps more revealing than examining expenditure as a ratio of GDP, is the per capita expenditure levels. Table 9 shows that average per capita expenditure in the EU for pollution management was 339 euro and resources management 149 euro in 1999.

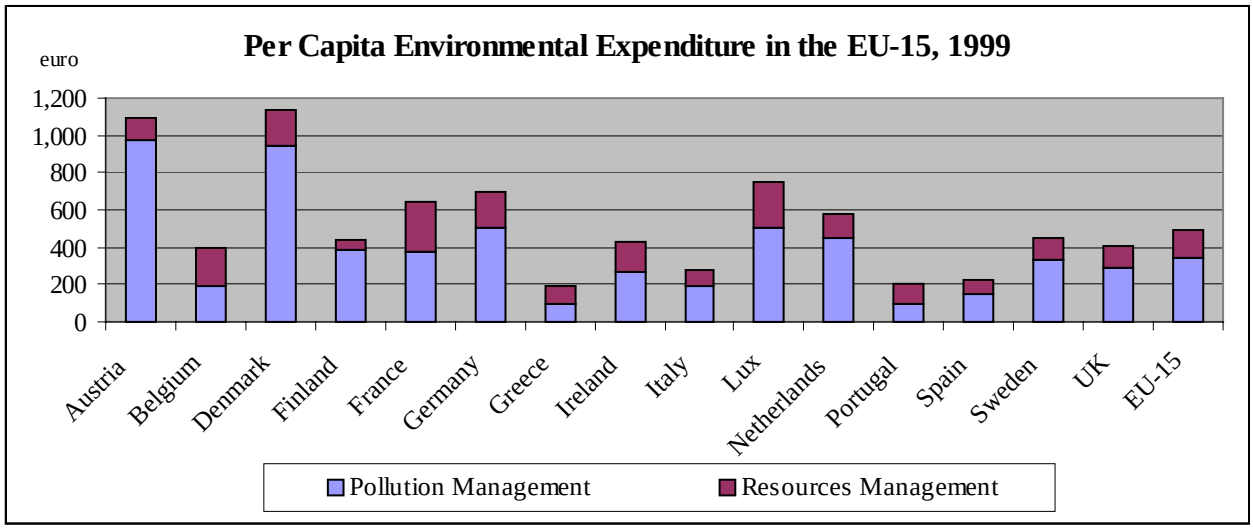
Member States with by far the largest per capita spend were Denmark (1,130 euro) and Austria (1,100 euro). The next largest per capita spend was Luxembourg at 750 euro, followed by France and Germany. The lowest per capita spend was in Greece, Portugal and Spain, all of which spend 230 euro or less.

Table 9 : Per capita expenditure for the EU Eco-industries, 1999

	Population	Pollution Management		Resources Management		Total
Country	**(Millions)**	**Turnover (Bn euro)**	**Per capita**	**Turnover (Bn euro)**	**Per capita**	**Per capita**
Austria	8.2	8	980	1	120	1,100
Belgium	10.1	2	200	2	200	400
Denmark	5.3	5	940	1	190	1,130
Finland	5.2	2	390	0.3	60	440
France	58.9	22	370	16	270	650
Germany	82.2	41	500	16	200	690
Greece	10.6	1	90	1	90	190
Ireland	3.7	1	270	0.6	160	430
Italy	57.3	11	190	5	90	280
Luxembourg	0.4	0.2	500	0.1	250	750
Netherlands	15.7	7	450	2	130	570
Portugal	9.9	1	100	1	100	200
Spain	39.6	6	150	3	80	230
Sweden	8.9	3	340	1	110	450
UK	58.7	17	290	7	120	410
EU-15	**374.8**	**127**	**340**	**56**	**150**	**490**

Note: Totals may not sum due to rounding.

Figure 5 : Per Capita Environmental Expenditure in the EU-15 in 1999



3.3 EU Environmental Expenditure by Domain

3.3.1 Pollution Management Expenditure

Pollution Management expenditure was greatest in two main sectors - waste water treatment and solid waste management. Each sector represented almost 40% of expenditure, both making up around 48 Bn euro of EU expenditure (Table 10). The next most important industry, with an expenditure of around 15 Bn euro was air pollution control, accounting for 12% of EU expenditure. These three domains account for 87% of total EU pollution management expenditure. Figure 6 shows how expenditure in these three most important domains differs across EU-15 Member States, whilst Table 11 breaks down total pollution management expenditure into both domain and Member State.

Table 10 : EU Pollution Management Expenditure by Environmental Domain, 1999

Domain	**M euro**	**%**
Air Pollution Control	14,640	12
Wastewater Treatment	48,180	38
Solid Waste Management	47,560	37
Remediation & Clean Up	3,430	3
Noise & Vibration	1,910	1
Monitoring Analysis & Assessment	3,250*	3
Environmental R&D	1,860	1
Environmental Administration (Public)	3,920	3
Environmental Management (Private)	2,400	2
EU-15	**127,150**	**100**

*Note: Totals may not sum due to rounding.. * Germany represents 100% of this total. The low response in this domain is mainly due to the fact that it is very difficult to separate out monitoring services from the main sectors.*

Although the expenditure on other domains is far less significant than that for APC, WWT and WM, the expenditure results may under-estimate these other domains. This is because national data may include this expenditure under the main domains. For example, land remediation is sometimes regarded as a sub-sector of waste management, partly due to the fact that waste management companies may carry out the remediation of contaminated land.

Figure 6 : Pollution Management Turnover by Member States & Environmental Domain

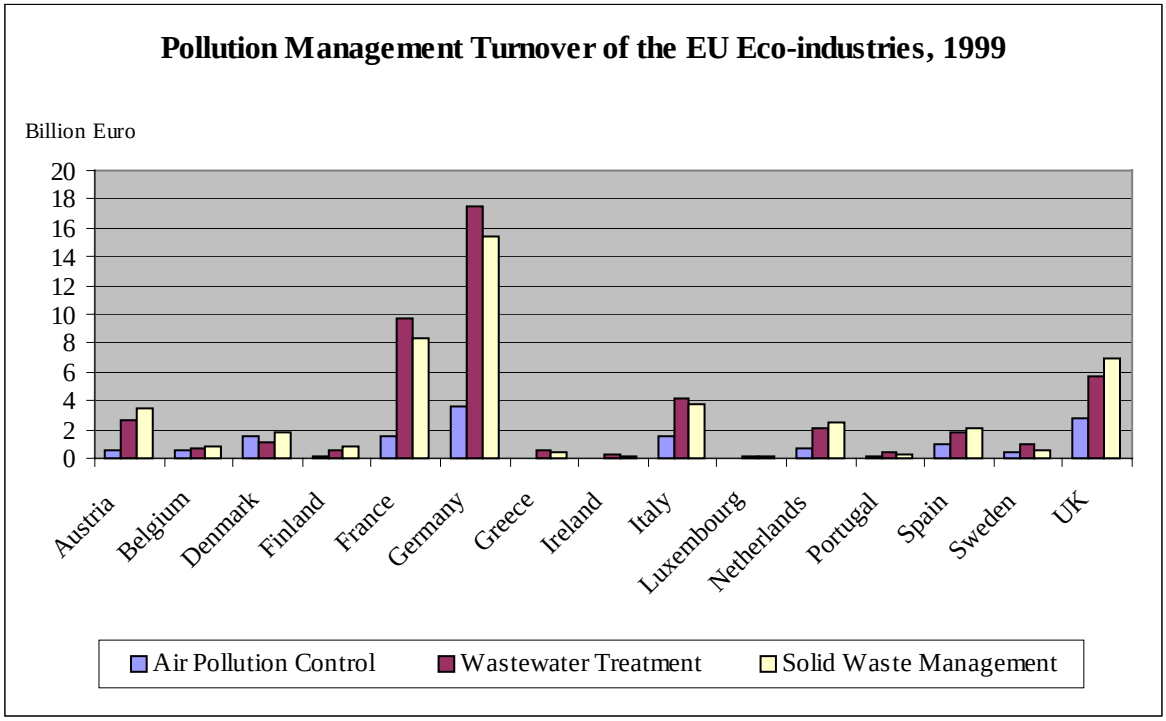


Table 11 : EU Pollution Management Expenditure by Member State and Environmental Domain (M euro), 1999

	Environmental Domain									
	Air Pollution Control	**Wastewater Treatment**	**Solid Waste Management**	**Remediation & Clean Up**	**Noise & Vibration**	**Monitoring Analysis & Assessment**	**R&D**	**Environmental Administration (Public)**	**Environmental Management (Private)**	**Total**
Austria	500	2,670	3,450	230	100	nr	nr	300	1,020	8,270
Belgium	530	700	900	60	30	nr	nr	160	nr	2,400
Denmark	1,470	1,090	1,800	710	0	nr	120	210	nr	5,400
Finland	190	490	770	nr	nr	nr	nr	260	80	1,790
France	1,570	9,710	8,340	nr	700	nr	880	1,120	nr	22,330
Germany	3,670	17,510	15,450	870	270	3,240	180	nr	nr	41,190
Greece	50	510	420	0	0	nr	nr	50	0	1,040
Ireland	60	240	170	20	0	nr	nr	50	nr	530
Italy	1,460	4,200	3,780	420	420	nr	420	nr	nr	10,700
Luxembourg	10	70	70	0	0	nr	0	nr	nr	160
Netherlands	710	2,060	2,550	470	100	nr	nr	960	320	7,170
Portugal	160	450	300	nr	10	nr	nr	nr	nr	920
Spain	1,010	1,830	2,130	190	70	nr	140	160	nr	5,530
Sweden	470	930	540	90	10	nr	50	440	80	2,620
UK	2,760	5,710	6,880	370	180	nr	60	210	900	17,090
Total EU-15	**14,640**	**48,190**	**47,560**	**3,430**	**1,910**	**3,250**	**1,850**	**3,920**	**2,400**	**127,150**
%	12	38	37	3	2	3	1	3	2	100

Note: nr = no record. Totals may not sum due to rounding. Zeros are due to rounding

3.3.2 Resources Management Expenditure

Figure 7 demonstrates that EU-15 Resources Management expenditure is dominated by water supply, representing 33 Bn euro[16] or 61% of total expenditure in this group. The recycled materials sector is the next most important domain at 14 Bn euro, followed by nature protection (7 Bn euro).

Figure 7 : EU-15 Resources Management Expenditure, 1999

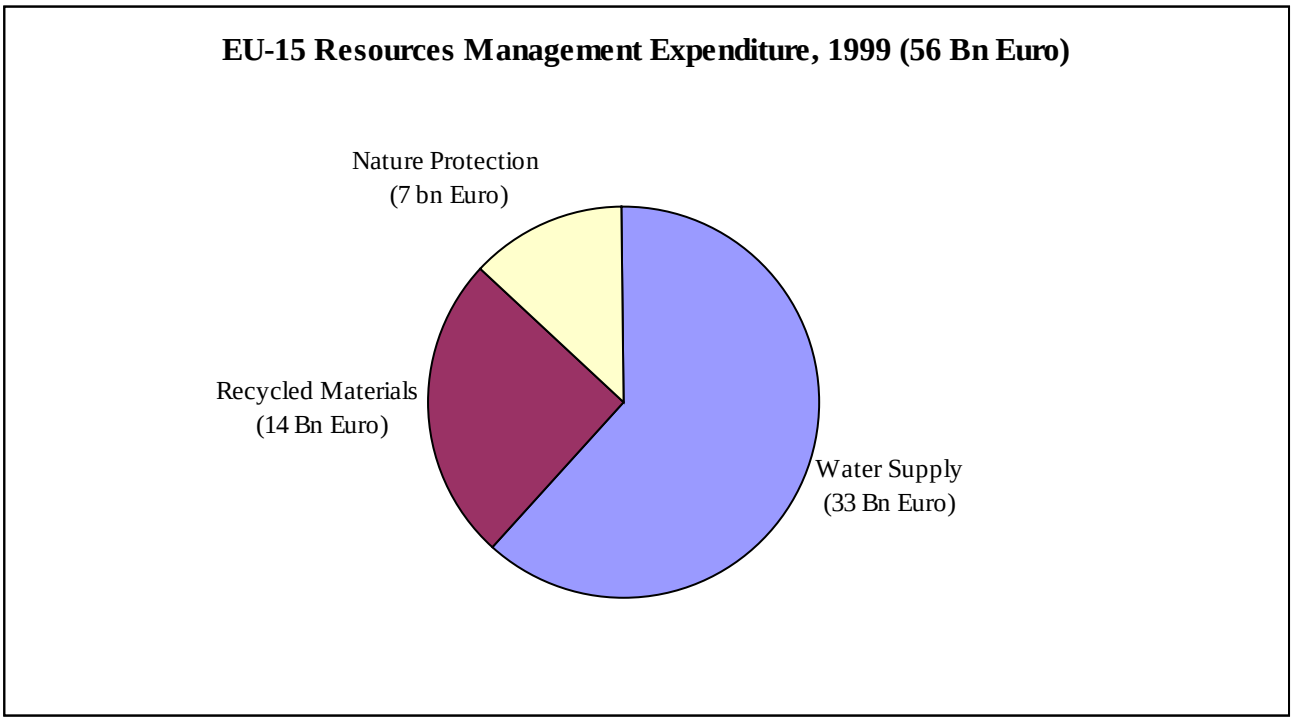
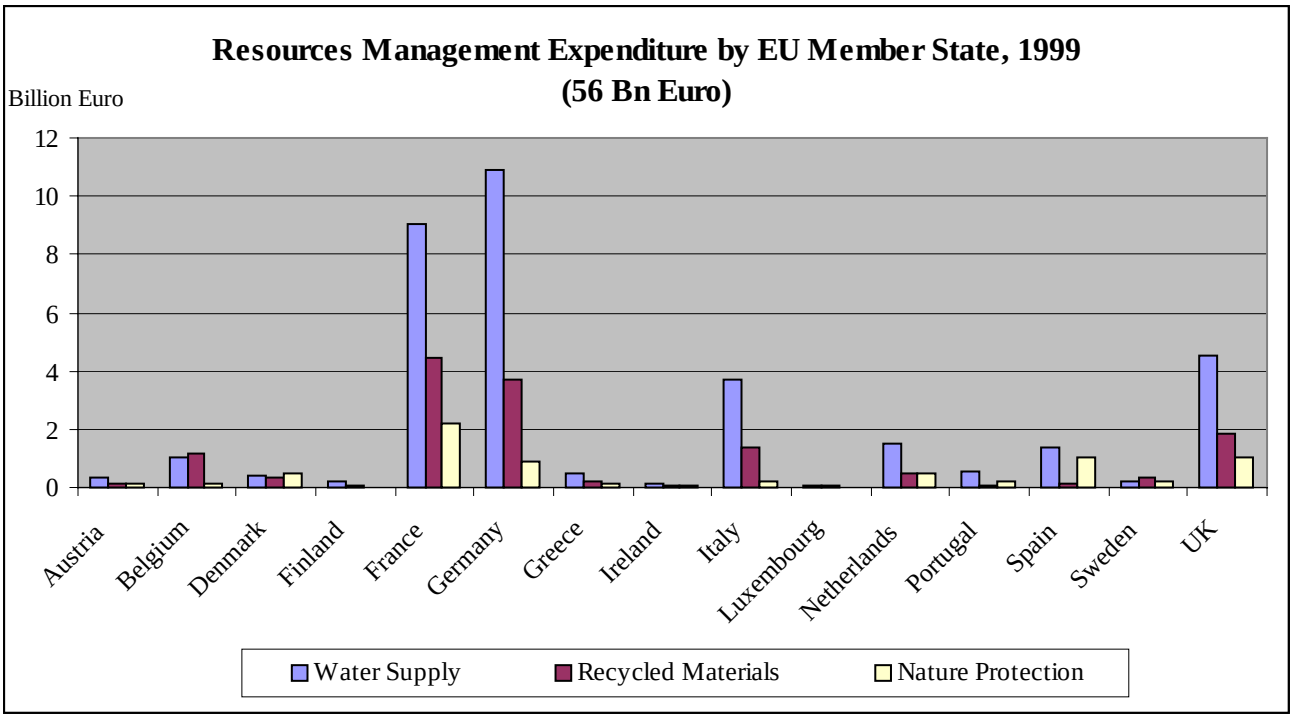


Figure *8* shows the distribution of the three domains across the EU-15. It is interesting to see that the French recycled materials market, at 4.5 Bn euro, is larger than that of Germany. France also spends the most of any EU country on nature protection (2.2 Bn euro), followed by Spain.

[16] This level of turnover compares with the 48 Bn euro on wastewater. The similar levels of expenditure provides some confidence that the overall magnitudes of expenditure are correct, given that the two water sub-sectors are essentially similar, dealing with the two halves of the water cycle, collecting and treating broadly equal volumes of water.

Figure 8 : Resources Management Expenditure across the EU



3.4 Capital and Operating Expenditure, Investment and Value Added

3.4.1 Capital and Operating Expenditure : Pollution Management

Estimates of expenditure have been calculated for annual capital expenditure (CAPEX or gross fixed capital formation) and operating expenditure (OPEX) by environmental domain (Table 12) and Member States (Table 13) respectively. The lack of available data on the depreciation of the environmental capital stock[17] has meant that this is not covered by this analysis.

Sixty nine percent of total EU pollution management expenditure is accounted for by operating costs, and 31% by capital expenditure. OPEX is the largest share of total annual expenditure in the waste management and contaminated land remediation domains, both of which involve more labour intensive activities. The division of expenditure between CAPEX and OPEX is more equal for wastewater and air pollution control. The type of expenditure described is consistent with the engineering analysis (Section 2.0) which identified the relative importance of the capital costs of new facilities and the annual operating costs. Only in Portugal does capital expenditure exceed 50%, reflecting on-going capital investment programmes. Capital expenditure accounts for less than 30% in Austria (18%), Denmark (28%), France (23%) and the Netherlands (15%).

[17] Member States which have carried out analyses include France, Denmark and the UK (water industry only)

Table 12 : Capital and Operating Expenditure by Environmental Sector, in the EU, 1999

	Expenditure (M euro)			%	
Domain	**Capital**	**Operating**	**Total**	**Capital**	**Operating**
Air Pollution Control	7,260	7,370	14,640	50	50
Waste Water Treatment	21,410	26,770	48,180	44	56
Waste Management	6,400	41,160	47,560	13	87
Remediation and Clean Up	750	2,690	3,430	22	78
Noise & Vibration Control	670	1,240	1,910	35	65
R&D	230	1,630	1,860	12	88
Monitoring Analysis & Assessment	2,130	1,120	3,250	66	34
General administration (public)	580	3,340	3,920	15	85
Environmental Management (private)	320	2,090	2,400	13	87
EU-15	**39,760**	**87,390**	**127,150**	**31**	**69**

Note: Totals may not sum due to rounding. Source – Country worksheets. In general, in some Member States the OPEX share may exaggerate the true level of operating expenditure, at the expense of CAPEX. This is due to the limitations of data availability and the form in which expenditure data is noted. For example where a company pays for waste water treatment or waste management through annual charges, this is noted as OPEX. Often there is no information available on the related CAPEX.

Table 13 : Pollution Management - Capital & Operating Expenditure by Member State

	Expenditure (M euro)			%	
	Capital	**Operating**	**Total**	**Capital**	**Operating**
Austria	1,470	6,810	8,270	18	82
Belgium	730	1,660	2,400	30	70
Denmark	1,480	3,920	5,410	27	73
Finland	670	1,120	1,790	38	62
France	5,210	17,120	22,330	23	77
Germany	14,110	27,080	41,190	34	66
Greece	380	660	1,040	37	63
Ireland	260	280	530	48	52
Italy	3,610	7,090	10,700	34	66
Luxembourg	60	100	160	36	63
Netherlands	1,080	6,100	7,170	15	85
Portugal	510	410	920	55	45
Spain	2,550	2,980	5,530	46	54
Sweden	930	1,680	2,620	36	64
UK	6,710	10,380	17,090	39	61
EU-15	**39,760**	**87,390**	**127,150**	**31**	**69**

Note: Totals may not sum due to rounding. Source – Country worksheets

3.4.2 Capital and Operating Expenditure : Resources Management

Figure 9 demonstrates the larger proportion of capital investment within the water supply sector, compared to the recycled materials sector – a reflection of the labour intensive nature of the latter in collection, sorting and recovery operations.

Figure 9 : EU Resources Management Expenditure, by Capital and Operating Costs

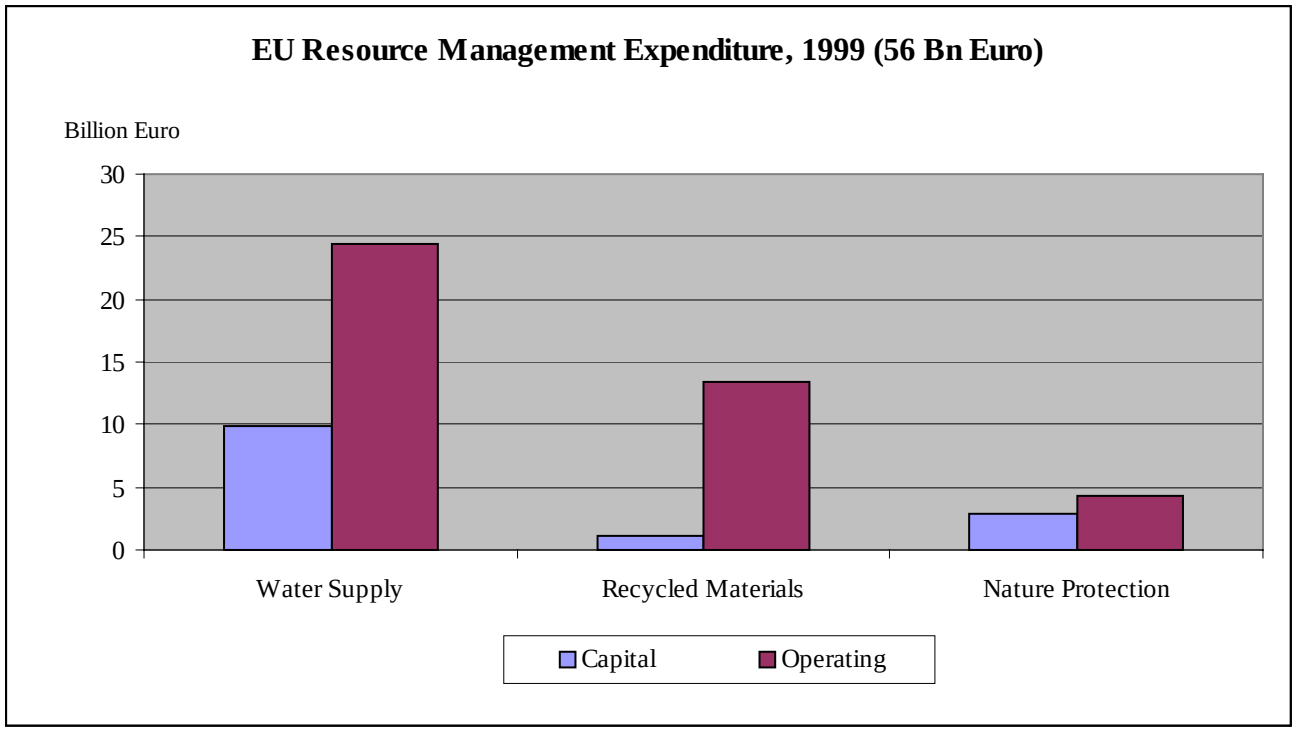


Table 14 shows that 75% of total annual EU resources management expenditure is operational expenditure and 25% capital expenditure. However, generally, the proportion of capital to operating expenditure lies between 15-25%. Member States with proportionately larger expenditure on capital investments include Finland (51%), Italy (41%) and Spain (59%). All three countries have high capital spend on nature protection. In addition, Finland has large capital spend on recycling, whilst Italy and Spain have high spend on water infrastructure.

Table 14 : Resources Management - Capital & Operating Expenditure by Member State

	Expenditure (M euro)			%	
	Capital	**Operating**	**Total**	**Capital**	**Operating**
Austria	100	530	620	16	84
Belgium	340	2,040	2,380	14	86
Denmark	210	1,010	1,220	17	83
Finland	160	150	310	51*	49
France	1,810	13,850	15,660	12	88
Germany	3,230	12,290	15,520	21	79
Greece	190	660	850	22	78
Ireland	40	210	250	16	84
Italy	2,190	3,090	5,280	41*	59
Luxembourg	20	100	120	13	87
Netherlands	890	1,550	2,440	36*	64
Portugal	190	640	830	23	77
Spain	1,470	1,040	2,510	59*	41
Sweden	140	550	690	20	79
UK	2,960	4,420	7,390	40*	60
Total	**13,920**	**42,140**	**56,070**	**25**	**75**

Note: Totals may not sum due to rounding. (*) Denotes countries which may be purchasing land under this environmental domain, thus explaining the high level of capex to opex expenditure. Source – Country worksheets

3.4.3 Value Added

The **value-added by the eco-industries is estimated to total 98 Bn euro**, based upon the salary costs of labour employed directly as a result of operating and investment expenditures. This estimate is conservative, given the exclusion of taxes and profits paid by the industry, but consistent with the employment analysis (Section 5.0 below).

The value-added by the pollution management group of eco-industries is around 66 Bn euro (see Table 15), whilst that of the resources management group is around 32 Bn euro (see Table 16).

Table 15 : Value Added (M euro) of EU Pollution Management Eco-industries, 1999

	Environmental Domain								
	Air Pollution Control	**Waste Water Treatment**	**Waste Management**	**Remediation & Clean-up**	**Noise & Vibration**	**R & D**	**Environmental Administration (Public & Private)**	**Total**	**% of EU**
Austria	120	1,450	2,270	80	70	nr	760	4,750	4
Belgium	150	350	600	20	20	nr	90	1,230	2
Denmark	420	580	1,190	240	nr	90	120	2,640	2
Finland	60	250	430	nr	nr	nr	190	920	1
France	370	5,010	5,600	nr	480	630	570	12,660	20
Germany	910	8,560	9,830	300	180	130	nr	19,900	33
Greece	20	240	270	nr	nr	nr	30	560	0
Ireland	20	100	110	10	nr	nr	30	260	1
Italy	420	2,060	2,440	150	280	290	nr	5,650	9
Lux.	0	40	40	nr	nr	nr	nr	90	0
Neths	200	1,130	1,730	160	70	nr	770	4,060	8
Portugal	50	190	180	nr	10	nr	nr	430	1
Spain	350	810	1,350	70	30	90	90	2,790	3
Sweden	160	460	350	30	10	30	310	1,350	4
UK	840	2,510	4,470	130	100	40	610	8,720	12
EU-15	**4,090**	**23,730**	**30,870**	**1,180**	**1,250**	**1,300**	**3,560**	**66,000**	100
% Total	6	36	47	2	2	2	5	100	

Note: Does not include Monitoring & Analysis (only Germany). Totals may not sum due to rounding. Zeros are due to rounding. Note: nr = data not recorded. Value added in SERIEE is defined as labour costs plus taxes and profit, less subsidies. Value added in this table is estimated on the basis of salary costs. These salary costs relate to the labour employed directly as a consequence of operating and investment expenditure. No allowance has been made for taxes and profits.

Table 16 : Value Added (M euro) of EU Resources Management Eco-industries, 1999

	Water Supply	Recycled Materials	Nature Protection	Total	% of EU
Austria	190	100	80	370	4
Belgium	600	780	80	1,460	2
Denmark	230	240	270	740	2
Finland	110	30	10	150	1
France	5,400	3,060	1,140	9,610	20
Germany	5,990	2,530	490	9,010	33
Greece	270	140	90	500	0
Ireland	80	20	50	150	1
Italy	1,150	910	110	2,180	9
Luxembourg	40	30	10	70	0
Netherlands	810	180	300	1,290	8
Portugal	310	60	100	480	1
Spain	1,580	110	470	2,160	3
Sweden	100	210	110	420	4
UK	2,080	1,260	540	3,890	12
EU-15	**18,960**	**9,670**	**3,840**	**32,470**	**100**
% Total	58	30	12	100	

Note: Totals may not sum due to rounding. Zeros are due to rounding.

3.5 Environmental Expenditure related to Renewable Energy Plant

As previously discussed, only limited data is available on investments and operational costs associated with renewable energy plant. This is presented below in Section 3.5.1. Given the increasing importance of renewable energy and the supply side industry to the EU eco-industries, a separate report was produced for DG Environment. This examines the current contribution of renewable energy plant to the EU eco-industries, as well as their employment and export potential. Appropriate sections within this report contain summary details from that study.

EU energy policy places a high priority on the increasing use of renewable energy, because of the important contribution that renewable energy can make towards improving security and diversification of energy supply, environmental protection and social and economic cohesion.

In 1997 the EU agreed a strategy and target to double the share of renewable energies in gross domestic energy consumption, from 6% to 12% by 2010. In 2001, member states agreed national (non-binding) targets for electricity production from renewable sources, to expand the aggregate proportion of electricity from renewable sources in the EU from 13.9% in 1997 (3.2% excluding large hydro) to 22.1% by 2010 (12.5% excluding large hydro).

Individual member states have widely different current levels of renewable energy use, and therefore have different national targets to 2010. There is a wide range of different support

mechanisms being used to stimulate renewable energy uptake, including quota systems, feed-in tariffs, green certificates or a combination.

Most member states now recognise that political support is necessary to overcome the barriers that prevent a more rapid uptake of renewable technologies. To achieve these targets by 2010 requires considerable investment from both public and private sector sources. The European Commission is currently promoting a short term stimulus for renewables, the "Campaign for Take-Off, 1999-2003". This estimates that investment required to meet the 2003 targets for new capacity amounts to about 20 Bn euro, of which 20% or 4 Bn euro is public funding. Total investment needed to achieve the 2010 target amounts to some 165 Bn euro, between 1997 and 2010.

These investments are seen across all of the renewable technologies, including wind, hydro, photovoltaics, geothermal, solar collectors, and biomass. More than half (84 Bn euro) of the total investment is predicted to be targeted towards biomass projects, with a target to increase biomass capacity in the EU by 90 Mtoe by 2010. Other important technologies include wind, with a target of 36 GW additional capacity (29 Bn euro investment) and photovoltaics (3 GWp target, 9 Bn euro investment). Already however, these predictions are being modified with new developments: wind energy in particular is expanding more rapidly that the EU predictions, with the wind industry's latest target for wind capacity in the EU by 2010 now revised upwards to 60 GW. Offshore wind will also make an increasing contribution to this target.

3.5.1 Available Expenditure Data from EU Member States

Table 17 gives details of the available expenditure data for renewable energy plant (covering data for wind, solar, hydro and biomass). Whilst this provides only limited coverage, it does provide some good data for some of largest renewables markets in the EU. The wind energy markets in Germany (818m euro) and Denmark (332m euro), for example, are two of the largest in the EU-15. It is quite likely that the vast majority of the 818m euro of German expenditure is on Danish wind technologies.

Table 17 : Available Member State Expenditure Data for Renewable Energy Plant, 1999

	Expenditure (M euro)	**Population (Million)**	**Per capita spend (euro)**	**Comment s**
Denmark	366	5	70	Wind (332m euro), biomass (34m euro)
Finland	603	5	117	Includes 597m euro on wood biomass (accounts for ~70% of energy used in pulp & paper plants in Finland)
Germany	818	82	818	Only wind energy contribution
Spain	16	40	16	Wind (3m euro), Solar (7 m euro), Hydro (2m euro) and biomass (4m euro)
Total	**1,804**	**132**	**14***	

Note (*) Average per capita expenditure for Member States shown

Based on the average per capita expenditure of 14 euro for those four countries reporting expenditure, Table 18 shows a possible breakdown of renewable energy plant expenditure across all Member States. This produces a rough estimate of **5.1 Bn euro** of expenditure for the EU-15.

Given the small sample size and large variation in expenditure between Member States, this figure should be treated with caution, as should the geographical distribution of the expenditure. It is very likely, for example, that Austria represents a far larger proportion of the EU total due its extremely large hydro capacity. Nonetheless, the estimate overall does appear to tie in well with the anticipated spend of 20 Bn euro in the Commission's "Campaign for Take-Off, 1999-2003", as discussed in the section above.

Table 18 : Estimated renewable energy plant expenditure by Member State, 1999

Country	Population (Millions)	Per capita expenditure (euro)	Total Expenditure (M euro)	%
Austria	8.2	14	111	2
Belgium	10.1	14	138	3
Denmark	5.3	70	366	7
Finland	5.2	117	603	12
France	58.9	14	801	16
Germany	82.2	10	818	16
Greece	10.6	14	145	3
Ireland	3.7	14	50	1
Italy	57.3	14	780	15
Luxembourg	0.4	14	6	0
Netherlands	15.7	14	214	4
Portugal	9.9	14	134	3
Spain	39.6	0.4	16	0.3
Sweden	8.9	14	121	2
UK	58.7	14	799	16
EU-15	**374.8**	**14**	**5,100**	**100**

Note: zero due to rounding

4.0 EU ECO-INDUSTRIES TRADE AND INTERNATIONAL MARKETS

4.1 Availability of data

This study draws on several sources of data and information in an attempt to build as robust a picture as possible of the trade in environmental products and services within the European Union (EU) and between the EU and the rest of the world. The sources used are:

1. Information from national sources (reports, studies and national statistical offices).
2. Official trade statistics ("trade code" data) provided by EUROSTAT for the period 1994 to 1997.
3. Information on global environmental markets.

Gaps in the availability of data and information, combined with the lack of compatibility, and sometimes reliability, of that which is available, means that it is difficult to produce an accurate analysis of the trade in environmental goods and services. Where useful data is available, it is presented in this section.

To provide a more in-depth picture, we have analysed standard export data for a limited number of relevant trade codes. The advantages of such an approach are that the resulting analysis is based on a comprehensive and consistent set of data for all EU Member States, both export and import data is available and it offers a complete and up-datable time series, rather than a "snap-shot". The disadvantages are that it captures products only and not services, is based on a limited number of products and does not reveal anything about factors that drive markets.

Indeed, it should be noted that goods covered by the trade codes used include only a small proportion of the total trade in environmental goods and services. Therefore, while the analysis is more rigorous for the trade covered, it is estimated to represent only around 20% of total trade in environmental goods and services.

4.2 Current export activities

4.2.1 Overview

Overall, the picture that emerges is of a **strong and diverse EU Eco-industrial export sector, which is a major global player**. The Northern European countries tend to be more active exporters than Southern European countries. The Candidate Countries are becoming increasingly important export markets, in particular for EU Member States with close historical trading relationships to that region.

Although the EU **operates a trade surplus** in environmental products and services with the rest of the world (1,061 M euro in 1999, based on trade code analysis, and hence **around 5 Bn euro** if we assume this is around 20% of the overall trade), the amount of this positive trade balance fell between 1997 and 1999, as a result of increased imports and a levelling out in exports. Table 19 below presents a summary of information on the exporting profiles of EU Member States.

Table 19: Summary information on EU Member States

Country	Regional strengths	Sectoral strengths
Austria	Germany, CEE	
Belgium		
Denmark	W. Europe, CEE, Asia (waste)	Water, thermal waste treatment technologies
Finland		Process technology, water and wastewater treatment
France	N. America, EU, Latin America, CEE	Water and wastewater treatment, APC
Germany	Western Europe, Japan	APC, water and wastewater treatment, instrumentation
Greece		
Ireland		
Italy	N. America, Latin America, SE Asia, CEE	Waste management, APC
Luxembourg		
Netherlands	N. America, CEE, EU	Wastewater treatment, waste management, APC
Portugal	EU	water resource protection, metals recycling, trade in waste
Spain	Mexico, Brazil, N. America, Europe	Water purification and wastewater treatment
Sweden	Nordic countries and W. Europe	Wastewater treatment, waste management, clean technology, APC
United Kingdom	EU, N. America, Middle East, Japan	Water and wastewater treatment, monitoring, APC

4.2.2 Individual EU Member States

The overall status of exports from the EU hides many variations between the 15 Member States. Some of the most pertinent of these features are described below.

Austria has a very export-oriented eco-industry sector. The main export markets are other EU countries and its main EU customer is Germany. Exports to Central and Eastern European Countries (CEEs) are also significant, at 9% of total exports - reflecting traditionally close trading relationships. Exports to Asia are relatively small.

Denmark is a strong exporter particularly in the water and waste sectors, although a small number of companies account for the majority of exports. Two-thirds of exports of water-related products stayed within Europe, most going to the Nordic countries, Germany and the UK. The

rest of Europe and the CEEs are also important customers. In the waste sector the largest exports are of thermal waste treatment technologies, exported mainly to the Asian market and to the Nordic countries, the UK and Germany.

Finland exports some 52% of its Eco-industry products and these represent 20% of all Finnish exports. However, these figures include pulp and paper-making technologies. Finnish expertise is particularly strong in process technology, waste and wastewater processing, solid waste treatment, energy-from-waste, biotechnology and measurement equipment.

France is the world's foremost exporter of water and waste management services, mainly as a result of the success of two companies, Suez-Lyonnaise-des-Eaux and Vivendi. The biggest growth area for French Eco-industry exports is now the APC sector, boosted by the demand for household waste incineration units and industrial dust-abatement equipment. French investment abroad is increasing and overall, about 25% of French foreign financial guarantees are designed for environmental projects.

Germany is the largest provider of environmental products and services in the EU and while it is a significant exporter (with a 17% share of world trade in the sector - second only to the USA), exports account for a relatively low proportion (14%) of its total production. SMEs in particular have not been able to take full advantage of international opportunities. German exporters are heavily dependent on exports to the rest of Western Europe, with relatively small sales volumes to CEE and in particular to North America, although exporting to Japan has been very successful.

Ireland exports between 5% and 10% of its total turnover in environmental goods and services, with activity in markets in Central and Eastern Europe, North America, the Middle East and SE Asia. However, export activity is generally confined to niche markets (i.e. not major infrastructure projects) and the overall performance of the Irish Eco-industries sector is limited compared with the larger EU countries. The Irish Government's trade department does not believe that the sector offers good prospects for growth, compared to other industry sectors.

Italy (according to information provided by the Italian Eco-industries trade association AIMA) exports mostly to South America, SE Asia and North America, with only 5% of exports going to the rest of Western Europe. Central and Eastern Europe is a significant destination with 15% of total exports in the sector. Very little official information is available from the Italian Government on exports of environmental goods and services.

The Netherlands Eco-industries are very export-focussed, with 45% of products and 10% of services exported. Compared with other EU countries, a high proportion of Dutch Eco-industry exports (49%) go to destinations outside the EU. North America and the CEE countries are the biggest extra-EU markets, but Dutch exporters also have a presence in all the other major global environmental markets. Intra-EU exports are evenly spread between wastewater treatment, APC and waste management. Exports to Eastern Europe are particularly strong in the APC sub-sector, and waste management dominates exports to North America.

Portugal has a relatively small Eco-industries sector and exports represent 15% of its total turnover. The majority of exports are in just two areas - recycling of metals and wholesale trade in waste. The most important market is within the EU.

Spain has strong export markets in Latin America (particularly Mexico and Brazil) for products and services in the fields of water purification and wastewater treatment. Exports to this region represent almost a third of exports of environmental goods and services. The volume of exports to other EU countries appears to be very small, although exports to non-EU European countries and the CEE are about 20% of the total.

Sweden exports about 14% of total turnover in the Eco-industries sector, mainly in the fields of wastewater treatment, indoor air pollution control and cleaner technologies. About 60% of Swedish environmental exports went to other EU countries - Germany, UK, Finland, Denmark and France in particular. Outside the EU, the largest markets are Norway and the USA. Exports to Canada, Australia and Japan are limited. The data does not show much activity in the Candidate Countries, but it is known that Swedish firms are making significant local investments in the Baltic States in particular.

The United Kingdom is strongest in the export of water and wastewater treatment, environmental monitoring and air pollution control products and services. The water and wastewater treatment sub-sector in particular has seen significant growth in exports. Although similar in volume to those of France, UK exports are only a third the size of German exports. In terms of export destinations the EU is the biggest market (just under half of all exports), with North America in second place. UK companies recorded increases in exports to all the major non-EU markets between 1995 and 1997.

4.2.3 Export support programmes

While variations are apparent in support schemes available in different EU countries, in general, these are outweighed by the similarities. Support measures comprise:

1. Export guarantee schemes;
2. Export financing schemes;
3. Credits for investments in developing countries;
4. EU investment programmes for pre-accession;
5. Provision of export promotion materials- publications etc.;
6. Promotion at international events;
7. Financial support to companies for trade missions;
8. Advisory and information services (including market intelligence) for exporters;
9. Support for domestic R&D;
10. Provision of training in industrialising countries;
11. Support via embassies (facilitation of local contacts for example);
12. Advice on legal aspects of foreign trade and project implementation;
13. Tax incentives for exporters;
14. Financing of feasibility and market studies.

15. Promotion of technology transfer to rapidly developing and industrialising countries.

It is likely that the emphasis may be different in different countries but the information provided by national trade associations for this study is not of sufficient quality to examine this issue in any detail. Similarly, insufficient information is available to allow an analysis of the relative impacts of these different measures.

4.3 Results of trade code analysis

As discussed already, analysis of trade based on trade codes has a number of drawbacks, including the limited number of products that can be included, which means that they do not necessarily give an accurate indication of the size of EU exports. However, their main advantage is that they allow the identification of trends - how export destinations are changing over time and how the different sub-sectors are rising or falling in importance. Taking into account the caveats discussed previously, analysis of trade codes for 15 selected products indicates the following:

Balance of trade

- The EU operates a trade surplus in environmental products with the rest of the world (see ***Figure 10***).
- Germany has the largest trade surplus of all EU Member States, while Belgium, the UK and Sweden also have large positive balances. Spain, Portugal and Greece all have trade deficits in eco-industry goods.

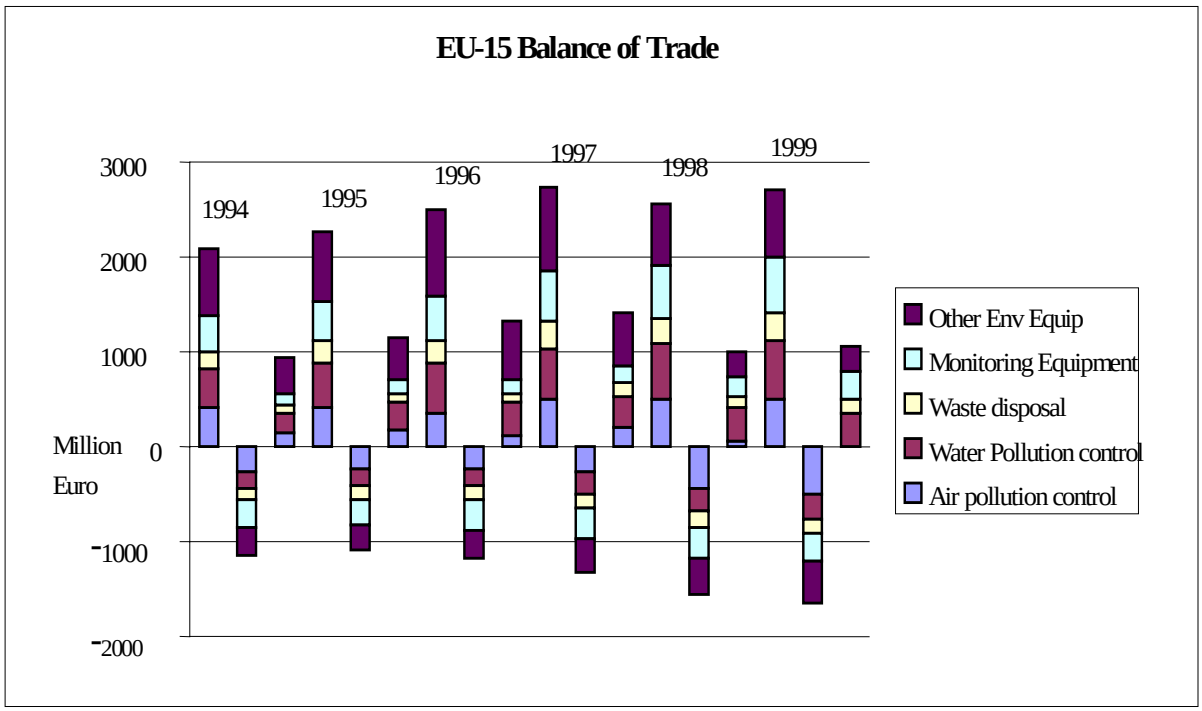
Growth trends

- Between 1994 and 1999 exports of environmental products from the EU increased by 63% in real terms. Intra-EU exports have doubled over this period and now represent nearly 60% of all exports.
- Growth was strongest between 1994 and 1997, stagnated between 1997 and 1998 and picked up again between 1998 and 1999.
- Growth has been strong across all sub-sectors, so the relative importance of the different sub-sectors has remained unchanged.
- Although extra-EU trade has grown more slowly than intra-EU exports, growth was still significant at 31%.

Sectoral strengths

- Almost three-quarters of EU exports trade is in the three sub-sectors air pollution control, water pollution control and “other environmental equipment”.
- The waste sub-sector experienced the strongest growth between 1994 and 1999, closely followed by water and air pollution control equipment.

Figure 10 : EU Balance of Trade, based on selected trade codes, 1994 –1999



Export destinations

- North America remains the biggest export market and has shown significant growth, while the Candidate Countries have replaced SE Asia as the second biggest export market. Exports to Candidate Countries are expected to continue to grow strongly after a short period of stagnation in 1998-99.
- North America is the leading buyer of EU exports in all sub-sectors except APC, where the Candidate Countries predominate. Latin America is also an important market for APC products.

Imports

- North America is by far the biggest source of imports of environmental products, with Japan in second place.
- Africa is the third biggest source of imports.

Candidate Countries

- Exports to Candidate Countries grew steadily between 1995 and 1997, but appear to have "levelled out" by 1999.
- Export volumes to the Candidate Countries were largest in the APC sub-sector.

- Germany is the leading exporter, accounting for 54% of total EU exports to the Candidate Countries, while other countries show strengths in particular sub-sectors (Sweden in water processing, Denmark in waste and the UK in monitoring equipment for example).
- Italy, Spain and the UK have particularly low levels of exports to the Candidate Countries in relation to the size of their Eco-industries, while Greece, Ireland and Portugal have insignificant trade with the Candidate Countries.
- Poland is the largest Candidate Country market for environmental products, followed by the Czech Republic, Turkey and Hungary.
- Imports from Candidate Countries to the EU are increasing, dominated by Poland and the Czech Republic.
- Companies from most EU countries have a presence in Candidate Countries, with the strongest players being Germany, Austria and France. The presence of UK, Dutch and Italian firms is relatively weak and Greek companies are entirely absent.

The results of the trade code analysis were also used to examine the relative importance of the trade in environmental products to the economies of individual Member States, by comparing exports as a percentage of GDP. Three main groupings emerged:

- Austria, Belgium, Germany, Ireland and Sweden show a particularly strong export performance based on this indicator. It is surprising that Ireland features so highly given its relatively low levels of domestic expenditure. However, such performance may be the result of particularly strong exports for the selected trade codes analysed.
- Italy, Greece, Spain and Portugal show a particularly low proportion of exports of environmental goods relative to their respective GDP.
- Netherlands, UK, Finland, Denmark and France perform at a level near to the EU average.

4.4 Estimations of total exports

Deficiencies in the availability and quality of data and information about exports from individual Member States makes it difficult to prepare a reliable estimates of the extent of trade in environmental goods and services for individual EU countries. Comparisons of the results of trade code analysis with national data can give an indication of the total size of markets for particular products defined by the codes. It may be expected, for example, that the value of trade calculated using trade codes might represent around 20% of the real value of total exports. Comparisons of trade code data with national analyses for Germany and Austria have indicated that the real value of trade is some five times that derived from trade data. Further investigation of the relationship between trade code analyses and real trade values may eventually lead to the determination of a suitable formula that might be applied.

Estimates of exports from other countries show that exports can reach up to 11% of the total revenues (e.g. in the USA) and in Canada 8%. Assuming the same level of exporting, would mean that **total exports for the EU-15 may be in the region of 18 Bn euro**.

4.5 Global environmental markets

4.5.1 Market sizes

Estimates of the total global market vary, but it is probably about 550 Bn euro[18], **giving the EU approximately one third of the overall worldwide eco-industry market** . The US Department of Commerce estimated the Western European market to be worth 140 Bn euro in 1999, whilst estimates prepared for this study indicate a market size of 183 Bn euro. This includes both pollution management and resources management, as well as an unknown amount of cleaner technology investments.

The USA, Western Europe and Japan, which together account for 85% of the total market, dominate global environmental markets. The US Department of Commerce predicts a gradual decline to 2008 in the share of markets held by the USA and Japan, with Central and Eastern Europe are not expected to expand their share overall. Asia (excluding Japan) is seen as the main expanding market. Analysis of US Department of Commerce data shows that between 1998-99 real growth rates of 7-9% occurred in "western" markets, whereas growth in developing markets over the same period was higher, at 10-17%. Africa and Latin America showed the strongest growth. By 2004-2008 it is expected that growth rates in the developing markets will be 5-8%, while those in western markets will have fallen to only 1-3%.

4.5.2 Overview of the USA, Canada, Japan, Brazil and China

USA

The US Department of Commerce estimates that the US environmental goods and services market was worth around **180 Bn euro** in 1999. This covers both pollution management and resources management industries. The Environmental Business Journal (EBJ) estimates a market-size of 225 Bn euro in 2000[19].

The US market is dominated by waste management and water and wastewater treatment (48% of the total value). Like the EU, the USA operates a substantial trade surplus in this sector, with total exports approaching 20 Bn euro. US exports are dominated by water equipment and chemicals, air pollution control and resource recovery technologies. Employment is estimated by EBJ to be around 1.4 million jobs.

[18] Based on estimates contained in Environmental Business Journal (EBJ) Volume XIII, Number 3/4, 2001, *"The Environmental Goods and Services Industry in the EU to 2010*', IPTS Seville (European Commission), 1999, and those produced for this study.

[19] Environmental Business Journal (EBJ) Volume XIII, Number 3/4, 2001

Canada

In Canada in 1999, the supply of environmental goods and services was estimated by Statistics Canada to be worth about **36 Bn euro**. Export markets represent 8% of environmental revenues in 1998, i.e. 1.7 Bn euro, with the USA being the largest export market for Canada's environmental industries followed by Asia then Europe.

Japan

The Japanese environmental market was estimated to be worth about **84 Bn euro** in 1999, the third largest behind Europe and the USA. Japan has a successful indigenous industry producing "end-of-pipe" pollution control equipment. In other sub-sectors, however, opportunities for foreign companies are excellent. Indeed the Japanese Government is positively encouraging the participation of foreign companies in the Japanese market. The US leads activity, with Germany and the UK in second and third places respectively. Other countries have not managed significant market penetration. The biggest demand for imports in air pollution control technologies, followed by water pollution control technologies and waste treatment technologies (mostly large facilities). Imports of environmental measurement and analysis equipment grew during the 1990s and this sub-sector offers continuing opportunities as stricter testing requirements are introduced.

Brazil

Brazil is the largest environmental market in Latin America and was worth an estimated **1.9 Bn euro** in 1995. Brazil has a strong domestic capability in pollution control equipment and operates a trade surplus in this field. Industrial wastewater treatment technologies and services represent the most important demand for imports (worth about 55 MEuro), and US, French and Japanese firms dominate this sub-sector.

China

In 1997, about **5.5 Bn euro** was invested in environmental treatment in China. A Government programme identifies some 1,600 projects requiring investment of 20 Bn euro. Implementation of half of these projects was underway in March 2000.

4.6 Renewable Energy Exports

4.6.1 Introduction

Today, EU companies are amongst the **world leaders in developing new renewable energy technologies**, both for domestic markets and worldwide. The strong and expanding domestic markets provide the basis for many EU companies to be active in worldwide markets.

The main drivers for encouraging renewable energy in developed countries (including the EU) lie in environmental protection, particularly the role that renewable energy can play towards meeting greenhouse gas reduction targets. However, in developing countries it is the shortage of energy that it the main driver. Renewable energy can provide off-grid power in rural regions currently without access to power. Its use can also reduce the need for importing costly fossil fuels.

4.6.2 Wind

The EU is the largest market for wind energy developments, with 75% of the total world installed capacity of 18.5 GW. The EU's wind energy capacity is predicted to grow from 12 GW in 2000 to 60 GW by 2010. International wind markets are predicted to continue to grow at an average of 25% per year to at least 2006. Outside of the EU, the US is expanding its wind energy developments, while emerging world markets include India, China and South America.

Market leaders in the EU are Danish companies, which have a world market share f 40-50%. Other countries, particularly Germany and Spain, have expanding domestic markets which are helping to underpin their export activities. Offshore wind developments in the EU are increasing in importance, particularly for Denmark, which is establishing itself as a leader in this new technology, building on its indigenous onshore capabilities.

4.6.3 Photovoltaics

The main market applications for photovoltaics are for off-grid systems and increasingly for grid-connected systems, particularly in developed countries. World annual shipments of photovoltaic modules have expanded by more than 30% annually since 1998, reaching 278 MWp in 2000. Japanese and US companies dominate photovoltaic manufacturing capacity, although the EU's capacity is expanding, reaching 85 MWp by 2000.

More than 75% of the total PV installed in the EU in the 1990s occurred in Germany, mainly because of its active market support programmes. Other EU countries are now initiating similar initiatives, including Italy and the UK. Principal manufacturing capacity in the EU occurs in Germany, Spain, the Netherlands and France, totalling 85 MWp in 2000. As well as the inter-EU market, EU PV companies achieve exports worldwide.

Despite these indigenous manufacturing capabilities, trade code analysis indicates that the EU has a negative trade balance in the import/export of photovoltaic products, including semiconductor devices and related products of relevance to the renewable photovoltaic industry. In 1999, this trade deficit was approximately 200 MEURO (imports totalling approximately 600 M euro against exports of about 400 M euro).

4.6.4 Biomass

Biomass is a diverse resource which includes in addition to biomass and the residues of the wood working industry, energy crops, agricultural residues and agrofood effluents, manure as well as the organic fraction of municipal solid waste, source, separated household waste and sewage sludge.

Biomass resources make up by far the most important contribution towards total renewable energy production in the EU. Biomass use covers a wide spectrum from producing heat and generating electricity to producing fuels for the transport sector. Biomass resources are proposed to produce more than 80% (90.2 out of 107.6 Mtoe, according to the Commission White Paper) of the total additional contribution of renewables by 2010 in EU countries. These resources are predicted to add a further 230 TWh electricity production and 75 Mtoe heat production by 2010.

The EU biomass sector has increased by 13.5% between 1995-98, although some countries have shown a much greater increase - particularly Germany (57%) and Italy (94%). Germany, Finland and Sweden in particular have strong indigenous biomass industries, with thriving export market activities based around combustion technologies for heat and power production. France is the leading EU country producing biofuels (particularly biodiesel and bioethanol), a resource that is likely to expand as taxation policies are changed in favour of biofuels as a transport fuel.

5.0 EMPLOYMENT IN EU ECO-INDUSTRIES

5.1 Introduction

The eco-industries are a significant sector of the EU labour market. The 1997 Study devised a method of calculating the contribution of the EU eco-industries in creating employment directly and indirectly. This section looks at the current contribution, derived from 1999 expenditure, using transparent estimates of employment for all fifteen Member States and across the key environmental domains. The direct employment associated with operating expenditure and capital investment is explored. This is complemented by insights into the level of indirect employment - that associated with the sectors of the economy providing intermediate inputs for the environmental sectors' production of environmental goods and services.

Direct employment can be split into:

- employment on the operation of characteristic activities or the provision of environmental services. This is calculated from the operating expenditure, and called *direct operating employment*; and,
- employment on the production of environmental goods, or infrastructure to provide environmental services. This is calculated from the investment expenditure and called *direct investment employment*. Analysis of the employment effects of investment also offers insights into the level of employment in those sectors of the economy supplying inputs to the environmental sector – e.g. capital goods, construction etc.

These two elements above constitute the large part of the first round expenditure. The remaining element is the first round indirect employment due to operating expenditure - i.e. the cost and provision of electricity needed to run the air emissions scrubbers, or the cost and provision of specialist chemicals. While the latter example (speciality chemicals is clearly environmental, the former (electricity) cannot be regarded as an environmental activity. Consequently, when talking of direct employment this third category is excluded. This means that the estimate for direct employment represents a lower bound. In addition the environmental sector's contribution to national employment (both direct and indirect) and the prospects for job creation over the next five years have been considered.

The employment estimate is based upon the use of an engineering analysis to indicate those economic sectors which benefit from expenditure on environmental goods and services. This analysis necessarily depends upon a high level of generalisation relating to the specification of purchases made when investing in, and operating, environmental activities. The study has made best use of available engineering descriptions and data but clearly results are sensitive to the engineering analysis. The assumptions made in the 1997 Study have been carried forward to this study because the engineering analysis is still felt to be robust.

The wage data used to calculate employment levels are full time wages, therefore the resulting calculation for the EU-15 are Full Time Equivalents (FTE), referred to subsequently as 'jobs'.

For the EU as a whole the actual number of jobs are likely to be in the order of 15-20% higher than the FTE, however this is variable across countries. Overall, the difference between FTE and jobs is probably of no great importance for the eco-industries, since many jobs will tend to be full-time.

5.2 Direct Employment

The analysis of direct employment in this section is based on the estimated levels of capital and operating environmental expenditures. The analysis does not take into account trade flows. This is because the quality of the available statistical analysis does not allow adjustment. However, since the trade code analysis has revealed a positive trade balance (of at least 1 Bn euro), and that most operational costs and construction are domestic in origin, we believe that the employment estimate is a reasonable guide to overall environmental employment in the EU.[20]

The following sections deal firstly with the employment associated with Pollution Management, followed by Resources Management.

5.2.1 Direct Employment Supported by Operating Expenditure : Pollution Management

The direct employment resulting from the operating expenditure on environmental goods and services is estimated to support around **1,065,000 jobs** in the EU (see Table 20, Table 21, Table 22, Figure 11 and Figure 12). Around 65% of the environmental jobs in the EU were in the waste management (WM) sector, which had 47% of the operational expenditure. This high employment ratio reflects the high labour intensity of the WM sector, notably due to the labour required for waste collection and transport, as well as the relatively low wage rates. Wastewater treatment (WWT) accounted for around 20% of direct operating environmental employment, and air pollution control (APC) accounted for around 3% of employment (see Table 20).

Around 24% of all the direct jobs supported by environmental operating expenditure in the EU were in Germany (261,000 jobs). France accounted for 196,000 jobs or around 18% of the EU total, closely followed by the UK with 188,000 (18%). These three largest environmental markets between them therefore account for 60% of EU operating related employment in pollution management. Italy, The Netherlands, Austria, Spain and Denmark account for 8%, 7%, 6%, 5% and 4% respectively of employment. All other Member States account for 2% or less.

[20] If there is a negative trade balance then expenditure is 'leaking out' of the EU in the form of imports, taking with it a certain amount of (mostly capital-derived) employment. In such circumstances, the employment levels are likely to be an over-estimate.

Table 20 : Total Employment in the Pollution Management Eco-industries, 1999

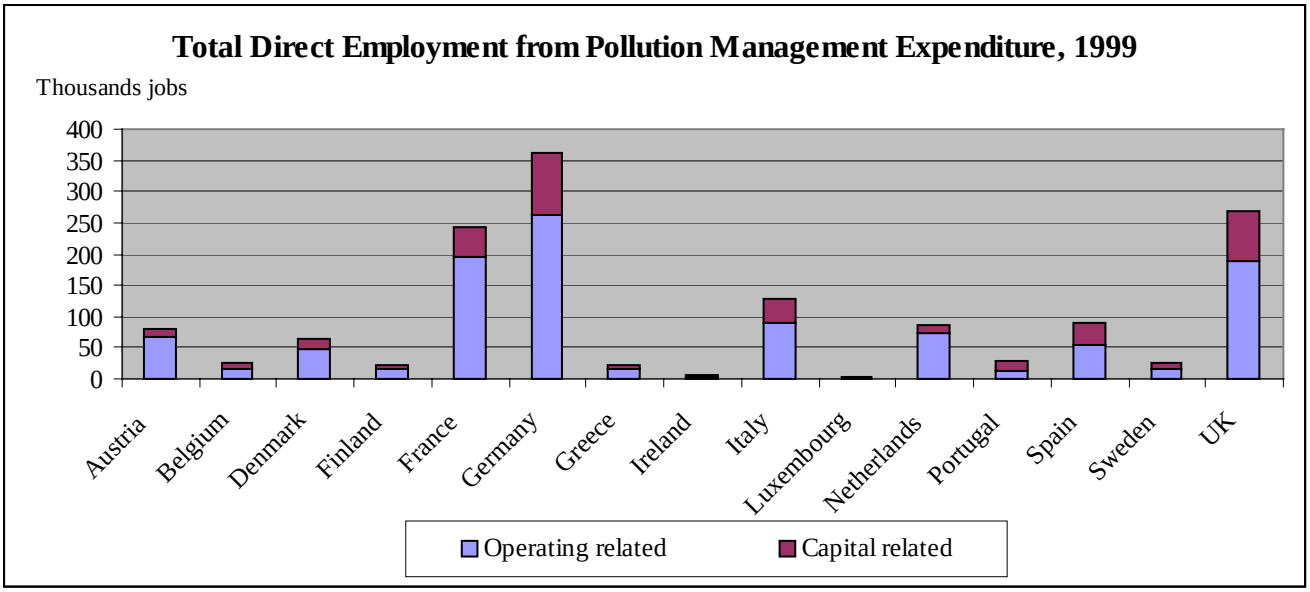
	Direct Employment					
	Operating Related	**%**	**Investment Related**	**%**	**Total Direct (Jobs)**	**%**
Air Pollution Control	30,300	3	80,700	21	111,000	8
Waste Water Treatment	209,100	20	218,500	56	427,500	29
Solid Waste Management	696,300	65	64,000	16	760,300	52
Remediation & Clean Up	15,100	1	8,000	2	23,100	2
Noise & Vibration	21,800	2	7,000	2	28,800	2
R&D	25,900	2	2,400	1	28,200	2
Environmental Administration*	66,500	6	9,100	2	75,600	5
Total (Jobs)	**1,064,900**	**100**	**389,600**	**100**	**1,454,500**	**100**
(%)	**73**		**27**			

Note: Totals may not sum due to rounding. This analysis does not take account of German monitoring & analysis expenditure. (*) Environmental administration includes both public and private sector employment

5.2.2 Direct Employment Supported by Investment Expenditure: Pollution Management

Investment in EU environmental goods and services supported a further **390,000 jobs** in 1999. Around 199,000 of these are related to construction activities and much of the remainder, 164,000, from investment in capital goods. Investment expenditure on waste water treatment is the most important contributor to employment in the construction and capital goods sectors. Indeed, 78% of the construction jobs correspond to capital investment in waste water treatment plants and infrastructure (see Table 22). Around 42% of capital goods related jobs are due to expenditure in the air pollution control sector; 26% are due to expenditure for wastewater treatment; and 23% to the waste management sector. This underlines the fact that the air pollution control and wastewater treatment sectors are more capital intensive than the waste management domain, although this is gradually changing as new innovative waste treatment technologies are being brought into operation – a result of the pressures of EU Waste Directives.

Figure 11 : Direct Employment through Pollution Management Expenditure, 1999



Around 26% of all the direct jobs supported by capital expenditure in the EU were in Germany (101,000 jobs). This was closely followed by the UK with 81,000 jobs, or around 21% of the EU total. The remaining large markets for capital expenditure derived employment are in France with 48,000 (12%), followed by Italy (10%) and Spain (9%). These five markets therefore account for 78% of all investment derived jobs in pollution management. All other Member States account for 4% or less.

Table 21 : Direct Employment in EU Pollution Management Eco-industries, 1999

Country	Direct Operating Related					Direct Investment Related				
	Air Pollution Control	Waste Water Treatment	Waste Management	Other[1]	Total	Air Pollution Control	Waste Water Treatment	Waste Management	Other[1]	Total
Austria	1,300	11,900	40,100	14,100	67,400	1,200	6,900	3,400	1,700	13,300
Belgium	900	2,300	12,100	2,100	17,300	2,700	2,900	800	500	6,800
Denmark	3,100	7,500	29,200	8,100	47,900	8,600	3,600	2,000	1,800	15,900
Finland	400	3,000	8,200	3,500	15,000	1,100	2,000	3,100	700	6,900
France	4,600	43,000	119,700	29,000	196,400	3,600	32,600	5,500	6,400	48,000
Germany	8,400	66,900	177,100	8,500	260,900	8,900	68,600	21,700	1,800	101,100
Greece	100	3,500	11,500	1,300	16,500	700	5,300	1,300	100	7,400
Ireland	100	700	3,100	600	4,600	600	2,000	300	300	3,100
Italy	3,000	18,300	55,800	12,600	89,600	8,700	19,400	5,600	4,000	37,600
Luxembourg	0	200	900	100	1,200	100	400	100	0	600
Netherlands	1,400	13,100	41,500	18,600	74,600	3,400	5,100	1,100	800	10,400
Portugal	600	2,500	10,700	200	14,100	3,300	9,400	2,200	200	15,100
Spain	600	6,800	40,500	5,400	53,400	12,000	15,600	5,300	2,100	34,900
Sweden	300	4,400	6,600	6,300	17,600	3,300	3,300	600	400	7,500
UK	5,400	24,800	139,000	19,200	188,400	22,500	41,500	11,100	5,600	80,800
Total (Jobs)	**30,300**	**209,100**	**696,300**	**129,300**	**1,064,900**	**80,700**	**218,500**	**64,000**	**26,400**	**389,600**
(%)	**3**	**20**	**65**	**12**	**100**	**21**	**56**	**16**	**7**	**100**

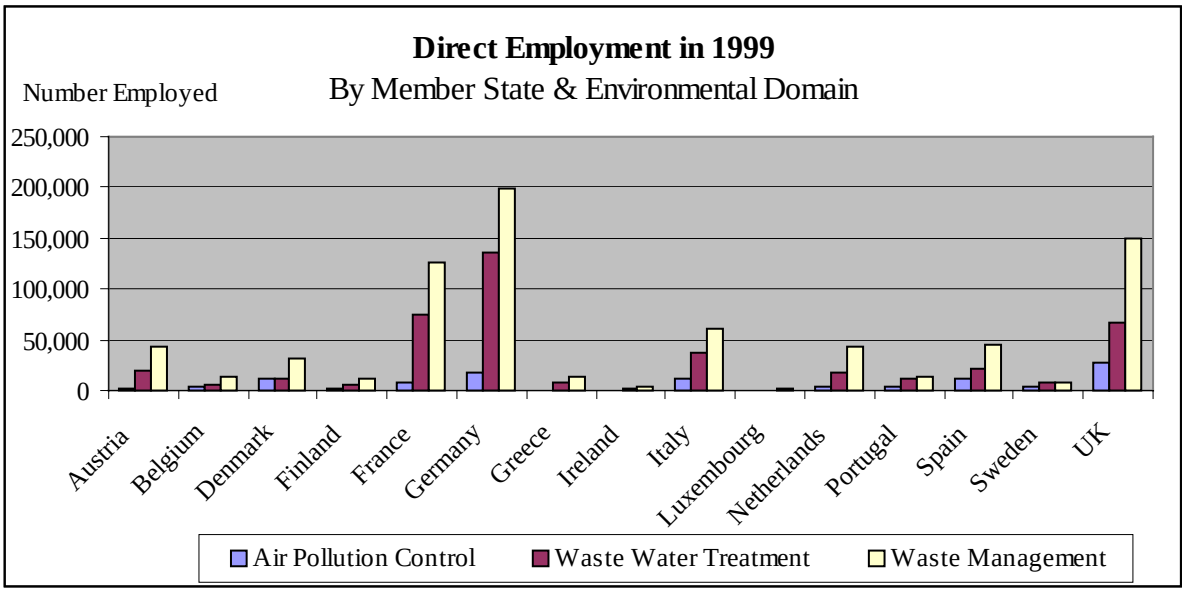
Totals may not sum due to rounding. Zeros are due to rounding. 1= 'Other' includes all employment in other domains, including private environmental management. This analysis does not take account of German monitoring & analysis expenditure.

Table 22 : Direct Employment from Pollution Management & Resources Management Capital Expenditure in EU Eco-industries, 1999

	Total Expenditure (M euro)	Capital Expenditure (M euro)	Expenditure in Supporting Sectors			Employment in Supporting Sectors				
			Capital goods M euro	Construction M euro	Services M euro	Capital goods	Construction	Services	Total	%
Air Pollution Control	14,640	7,260	6,170	1,090	0	68,700	12,000	0	80,700	21
Waste Water Treatment	48,180	21,410	4,280	14,990	2,140	43,400	155,000	20,000	218,500	56
Waste Management	47,560	6,400	3,840	1,920	640	38,200	19,800	6,000	64,000	16
Remediation & Clean Up	3,430	750	410	340	0	4,400	3,600	0	8,000	2
Noise & Vibration	1,910	670	300	370	0	3,200	3,900	0	7,000	2
R&D	1,860	230	230	0	0	2,400	0	0	2,400	1
General Administration	6,320	900	390	450	60	4,000	4,500	500	9,100	2
Pollution Management	**127,150**	**39,760**	**15,620**	**19,150**	**2,840**	**164,300**	**198,800**	**26,500**	**389,600**	**100**
Water Supply	34,250	8,160	1,630	5,710	820	17,700	62,200	8,300	88,100	67
Recycled Materials	14,440	1,090	660	330	110	6,600	3,300	1,000	10,900	8
Nature Protection	7,250	2,940	1,270	1,470	210	14,200	16,800	2,100	33,100	25
Resources Management	**55,950**	**12,200**	**3,550**	**7,510**	**1,130**	**38,500**	**82,200**	**11,300**	**132,000**	**100**
Total	**183,100**	**51,960**	**19,170**	**26,660**	**3,970**	**202,800**	**281,000**	**37,800**	**521,600**	**100**

Note: Totals may not sum due to rounding. This analysis does not take account of German monitoring & analysis expenditure.

Figure 12 : Direct Employment by Member State and Domain, 1999



5.2.3 Direct Employment Supported by Resources Management

Table 23 and Table 24 show that **Resources Management accounts for around 650,000 jobs in the EU**, of which 500,000 are operating related. The water supply sector accounts for around 50% of total jobs. Reference to Table 22 above shows that the construction sector dominates the jobs within water supply capital investment related employment.

Table 23 : Total Employment in the Resources Management Eco-industries, 1999

	Operating Related	Investment Related	Total Direct (Jobs)	%
Water Supply	208,800	88,100	296,900	47
Recycled Materials	223,600	10,900	234,500	37
Nature Protection	66,700	33,100*	99,800	16
Total	**499,200**	**132,000**	**631,200**	**100**

Note: Some of the underlying capital expenditure may be land purchase therefore employment could be overstated.

Table 24 : Direct Employment in EU Resources Management Eco-industries, 1999

	Direct Operating Related				**Direct Investment Related**			
Country	**Water Supply**	**Recycled Materials**	**Nature Protection**	**Total**	**Water Supply**	**Recycled Materials**	**Nature Protection**	**Total**
Austria	1,700	1,800	1,300	4,800	600	100	100	900
Belgium	5,000	15,900	1,200	22,100	1,900	700	600	3,200
Denmark	3,400	6,200	5,100	14,600	700	200	1,400	2,200
Finland	1,300	100	200	1,700	800	700	100	1,600
France	57,800	66,900	16,200	140,900	6,900	1,100	8,600	16,700
Germany	57,600	49,200	6,200	112,900	23,300	1,200	3,100	27,600
Greece	5,300	6,200	3,200	14,800	2,800	300	600	3,700
Ireland	1,200	700	1,100	3,000	300	0	100	500
Italy	13,600	21,700	1,600	36,900	2,400	1,100	1,300	4,800
Luxembourg	300	700	100	1,100	100	0	0	200
Netherlands	9,300	1,100	5,300	15,700	3,700	3,900	900	8,500
Portugal	8,200	4,300	5,000	17,400	3,200	0	2,500	5,800
Spain	19,500	3,600	7,700	30,800	12,300	100	8,100	20,500
Sweden	1,200	4,200	1,400	6,700	400	100	700	1,200
UK	23,500	41,000	11,100	75,700	28,700	1,300	4,900	34,800
Total (Jobs)	**208,800**	**223,600**	**66,700**	**499,200**	**88,100**	**10,900**	**33,100**	**132,000**
(%)	**42**	**45**	**13**	**100**	**67**	**8**	**25**	**100**

Totals may not sum due to rounding. Zeros are due to rounding.

5.3 Total Direct Employment Supported by Environmental Expenditure

Table 25 shows that **direct environmental employment, due to operating expenditure and the employment due to investment from both pollution management and resources management**, **totals over 2 million jobs in the EU**. Around 1.3 million jobs are related to the provision of wastewater treatment, waste management and air pollution control.

Table 25 shows the contribution of the total direct environmental employment to the labour markets in the Member States. In Austria and Denmark, 2.3% and 3% of the labour force is supported directly through environmental expenditure. France, Netherlands, Germany and the UK also demonstrate significant effects of environmental expenditure on the labour force, with 1.8%, 1.5%, 1.4% and 1.4% respectively, while in most other EU Member States the figure is around 1% or below.

Table 25 : Total Direct Employment in EU Eco-industries, 1999

	Opex			Opex + Capex		Environmental Employment as % of national employment	
Country	**Pollution Management**	**Resources Management**	**Total Direct Operating**	**Total Direct Employment**	**National Employment 1999 (millions)**	**Direct Operating**	**Total Direct Opex + Capex**
Austria	67,400	4,800	72,200	86,400	3.8	1.9	2.3
Belgium	17,300	22,100	39,400	49,400	4.0	1.0	1.2
Denmark	47,900	14,600	62,500	80,600	2.7	2.3	3.0
Finland	15,000	1,700	16,700	25,200	2.3	0.7	1.1
France	196,400	140,900	337,300	402,000	22.7	1.5	1.8
Germany	260,900	112,900	373,800	502,500	36.4	1.0	1.4
Greece	16,500	14,800	31,300	42,400	3.9	0.8	1.1
Ireland	4,600	3,000	7,600	11,200	1.6	0.5	0.7
Italy	89,600	36,900	126,500	168,900	20.9	0.6	0.8
Luxembourg	1,200	1,100	2,300	3,100	0.2	1.2	1.6
Netherlands	74,600	15,700	90,300	109,200	7.4	1.2	1.5
Portugal	14,100	17,400	31,500	52,400	4.8	0.7	1.1
Spain	53,400	30,800	84,200	139,600	13.8	0.6	1.0
Sweden	17,600	6,700	24,300	33,000	4.1	0.6	0.8
UK	188,400	75,700	264,100	379,700	27.4	1.0	1.4
EU-15 (Jobs)	**1,064,900**	**499,200**	**1,564,100**	**2,085,700**	**156.0**	**1.0**	**1.3**
(%)	**51**	**24**	**75**				

Note: Totals may not sum due to rounding. Zeros are due to rounding.

5.3.1 Employment from renewables

Renewable energy production is more labour intensive than conventional energy production, in delivering the same amount of energy output. Renewable energy can also be a significant local employer. However, jobs from renewables are not necessarily additional jobs, due to shifts from other parts of the economy. Job gains are greatest in the manufacturing industrial and agriculture sectors due to the need for a high degree of technology and the labour intensive requirements of, for example, biomass cropping. Biomass technologies in particular stimulate employment both in the biomass energy industry and in fuel supply, including planting, harvesting, transport etc.

Opportunities for employment are provided in a range of sectors, including manufacturing, project development, construction and installation, operation and maintenance. Strong indigenous manufacturing capabilities can be further strengthened by exporting goods and services worldwide.

An EU-wide study carried out in 1999 estimated that renewable energy has the potential to create over 900,000 new jobs by 2020, including 515,000 jobs in agriculture and biomass fuel supply. Industry estimates endorse these levels of job creation. Already a number of countries are achieving high employment levels from renewable energy activities, particularly in the wind energy industry. Germany, for example, estimates that the turnover of the Germany wind energy industry reached 1.7 Bn euro, providing 25,000 direct and indirect jobs.

5.4 Indirect Employment Impact due to Environmental Expenditure

Jobs related to the provision of intermediate inputs for operating expenditure are not included in direct employment. The expenditure in the environmental sector also leads to investment in other sectors, e.g. construction, services, intermediate goods, through the environmental industries' purchases from these other sectors of the economy. Employment is also supported by the spending of wages earned by those in direct employment. Environmental expenditure therefore leads not only to jobs created explicitly within the environmental sector, but also indirectly in other economic sectors. In addition, these other sectors of the economy will also purchase goods and services, which in turn leads to a further flow of money and creation of jobs. The sum of these steps gives the total GDP contribution and employment contribution of the sector to the economy and labour market respectively.

Jobs related to the provision of intermediate inputs for operating expenditure are not included, as discussed above, which leads to a lower bound estimate of the number of people employed in the environmental sector. This represents only the employment associated with direct expenditure, for the environmental domains selected for this study.

Table 26 shows that some 377,000 jobs are supported by indirect operating (but first round) expenditure from pollution management, and 204,000 from resources management. An upper-bound estimate could include these remaining 581,000 jobs and give a total of nearly **2.7 million jobs**. This does not take account of renewable energy technologies (see section above) and of

indirect (i.e. second and subsequent rounds, e.g. steel making). The section below gives more details on the implications of further indirect impacts on employment.

Table 26 : Total Employment in the EU Eco-industries, 1999

	Direct Jobs		Indirect Jobs[1]	
	Operating Related	**Investment Related**	**Operating Related**	**Total Jobs**
Pollution Management				
Air Pollution Control	30,300	80,700	50,400	161,400
Waste Water Treatment	209,100	218,500	132,200	559,800
Solid Waste Management	696,300	64,000	144,300	904,600
Remediation & Clean Up	15,100	8,000	17,700	40,800
Noise & Vibration	21,800	7,000	3,500	32,300
R&D	25,900	2,400	3,300	31,600
Environmental Administration*	66,500	9,100	26,100	101,700
Resources Management				
Water Supply	208,800	88,100	135,300	432,200
Recycled Materials	223,600	10,900	46,200	280,700
Nature Protection	66,700	33,100	22,600	122,400
Total (Jobs)	**1,564,100**	**521,800**	**581,600**	**2,667,500**
(%)	**59**	**20**	**22**	

Note: Totals may not sum due to rounding. (1) Indirect employment calculated using the HERMES macro-economic model. (*) Includes both public and private environmental administration. This analysis does not take account of German monitoring & analysis.

5.4.1 High end estimate of environmental employment

The analysis above gives a low end estimate of environmental employment in the EU of 2.08 million direct jobs (and 0.58 million indirect jobs) for 1999. There are various possible steps to extend these results to provide a more realistic high end estimate of environmental employment. These include:

a) The expenditure data obtained from Member States does not cover all items of the OECD/Eurostat definition and therefore a 'comprehensive' expenditure figure may be estimated. Employment is estimated as around 25-30% higher.

b) Jobs subsidised by Labour Ministries as part of labour market policy are not well captured by expenditure based estimates of employment and need to be assessed separately.

c) Estimate of the effect of including amenities (urban parks and gardens) and renewable energy activities.

d) Re-assessing the employment multipliers used in the EU study, which are likely to be too low. This is based on work done by the US Environmental Protection Agency which uses a multiplier of 2.24, not 1.47.

Table 27 : High End Estimate of EU Environmental Employment, 1999

Environmental employment	**Direct jobs**	**Indirect jobs***	**Total jobs**
Low end results (This study)	**2,085,700**	**581,600**	**2,667,300**
a) 'Comprehensive' expenditure estimate	~300,000	~150,000	~450,000
b) Subsidised jobs	~300,000	-	~300,000
c) Extended definition	~175,000	~88,000	~263,000
Subtotal (extensions a)-c))	**2,860,700**	819,600	3,680,300
d) Adjusted employment multiplier** (Rounded)	**2,900,000**	**1,650,000**	**4,500,000**

**.....Using Hermes-based employment multiplier of 1.47.*

***...Using a multiplier of 2 for the EU instead of 1.47, with no indirect effects attached to subsidised jobs.*

In conclusion an estimate of **4 million jobs** may be regarded as a 'central' high end estimate of environmental employment. This figure covers the:

- the producers of capital goods;
- the operators of capital goods; and
- other providers of goods and services (e.g. intermediate goods, consultancies etc.)

However, this figure should be used with caution since there are large uncertainties attached to the employment multiplier, questionable extensions of the definition, and imprecise estimates. The range of the estimates in the above table illustrates the magnitude of uncertainties in this kind of calculation.

Table 28 : Total Employment in EU Eco-industries (Pollution Management & Resources Management), 1999

	Direct Employment				Indirect Employment		Total Employment	
	Operating Related		Investment Related		Operating Related		Direct & Indirect	
Country	**Jobs**	**%**	**Jobs**	**%**	**Jobs**	**%**	**Jobs**	**%**
Austria	72,200	5	14,200	3	26,100	4	112,500	4
Belgium	39,400	3	10,000	2	13,500	2	63,000	2
Denmark	62,500	4	18,100	3	26,300	5	106,900	4
Finland	16,700	1	8,500	2	6,300	1	31,500	1
France	337,300	22	64,700	12	122,800	21	524,800	20
Germany	373,800	24	128,700	25	148,900	26	651,500	24
Greece	31,300	2	11,100	2	10,500	2	52,900	2
Ireland	7,600	0	3,600	1	2,900	0	14,100	1
Italy	126,500	8	42,400	8	46,600	8	215,600	8
Luxembourg	2,300	0	800	0	800	0	3,900	0
Netherlands	90,300	6	18,900	4	35,600	6	144,900	5
Portugal	31,500	2	20,900	4	11,900	2	64,300	2
Spain	84,200	5	55,400	11	34,200	6	173,900	7
Sweden	24,300	2	8,700	2	9,000	2	42,000	2
UK	264,100	17	115,600	22	85,800	15	465,500	17
EU-15 (Jobs)	**1,564,100**	**100**	**521,600**	**100**	**581,300**	**100**	**2,667,300**	**100**

Note: Totals may not sum due to rounding. Zeros are due to rounding.

5.5 Other Estimates of Employment

5.5.1 Introduction

To date, the only comprehensive analysis of EU-wide environmental employment has been the 1997 Study. Since then, many independent estimates of environmental employment have been conducted by individual EU member states. The majority of estimates have been derived from supply side data. The results of member state analyses by Austria, Finland, France, Germany, Ireland, Netherlands, Portugal, Spain, Sweden and the UK are summarised in Table 30, together with data from the 1997 Study for those countries where no recent information was available. Annex 8 contains summaries from a range of Member States that have carried out environmental employment analyses. Key conclusions from these summaries are given below.

5.5.2 Methodological issues affecting employment estimates

There is no common approach used by Member States in analysing the environmental sector and therefore comparison is difficult. For example, France uses macro-economic analysis, Finland derives employment based on levels of turnover, whilst Sweden uses a combination of official data sources and environmental industry databases.

Furthermore, discrepancies arise due to the different classification systems that exist within individual member states. Much of these revolve around individual country definitions of their respective environmental sector. For example, WIFO (2000) estimated that 15,000 people were employed in the environment industry in Austria in 1997[21]. However, the number is low since public sector organisations were not included. Such studies may also only include pollution management/protection activities in their estimates, thus ignoring wider "resource management" sectors such as renewable energy. In comparison, Germany's estimate uses a very broad definition, including indirect employment, so that the gross figure is based on the number of people supported by environmental policy overall. This approach, however, has little breakdown of employment by sub-sector and therefore it is difficult to identify significant sub-sectors.

France has conducted the most comprehensive environmental employment survey in the EU-15, with a data set broken down by sub-sector and split between public and private employment. Indeed, the French study is an excellent example of how employment estimates are based on the new OECD/Eurostat classification of the eco-industry sector. Statistics Sweden has also started using this classification for conducting its own analysis of the Swedish eco-industry.

It is interesting to compare the significant difference in employment estimates from the two broad approaches used by France (308,700)[22] and Germany (1,370,000)[23]. Given that

[21] A. Köppl, Österreichische Umwelttechnikindustrie, WIFO, Wien, 2000

[22] Ministry of Finance (1999) The French Eco-industry – Exports and Employment of 1997.

Germany's market is around 80% larger than France, it does seem unusual that environmental employment in the latter is so much greater. Indeed, inter-country comparisons can be just as complex as intra-country analysis – two studies in Spain, for example, show a discrepancy of 50,000 jobs[24]. Again this is mainly due to the inclusion of some categories in one study that are not present in the other.

Discrepancies such as these raise questions about the reliability of data sets and the respective methodologies still applied by member states. The sheer diversity in data collection, classification and presentation provides a barrier for a reliable comparative analysis to take place at present, although recent studies tend to be based more on OECD/Eurostat definitions.

5.5.3 Conclusions

Common features of environmental employment evident in many EU member states include:

- Employment levels are expanding in the waste management sector. Recovery and recycling offer particularly good prospects for the future (see the UK summary for more details).

- There have been some declines in the water/wastewater treatment service (supply side) sectors (e.g. UK – around 10,000 job losses between 1993 and 1999; France - 800 jobs losses in the water distribution sector between 1998 and 1999).

- Annual growth rates in environmental employment appear to be above typical employment growth rates at the Member State level.

- There is a shift in employment from the public to private sectors, particularly within the waste management sector (e.g. Netherlands, Sweden and UK).

- Employment levels for the wider environmental industry sector are significantly larger than the core eco-industry (i.e. pollution management) definitions used in the past. Areas such as nature protection and organic farming, for example, offer the potential for significant employment creation in rural economies (see last section of report).

- Environmental sector employment accounts for **around 1.3% of total paid employment** in any respective EU Member State, although it is significantly higher in some countries (e.g. Austria 2.3%, Denmark 3%, France 1.8%).

- Parts of the environmental sector (e.g. environmental consultancy and research) comprise of highly educated and skilled workforces. There is, however, a continual need for improvements in skills and training in certain sectors. For example, the rapid

[23] Federal Office for the Environment, Yearly Report 2000, Berlin 2000

[24] Price Waterhouse Coopers Report, for the Ministry of Environment (2000) "Estimates on Environmental Employment in Spain" Vs Fundacion Entorno, Empresa y Medio Ambiente (2000) *Employment and Training in the Environmental Sector in Spain.*

technological changes in the waste treatment and recovery/recycling sectors are creating a growing demand for new skills, with obvious implications for training providers.

Overall, since 1997 significant developments in employment estimates have occurred in Member States. This will enable better comparisons with expenditure derived employment to be made in the future.

5.6 Comparisons with other Country Studies

Table 29 shows that the current study has produced robust employment data which, in general, compares well with a number of Member State studies. ECOTEC's values are in many cases larger than those obtained from other types of analysis. This shows that the inclusion of resources management employment significantly enlarges environmental employment. It also highlights the difficulties in obtaining representative employment data from standard sources (i.e. NACE codes, industry VAT returns, industry databases etc.), which are used by many other studies.

Table 29 : Eco-industries Employment across the EU

Countries	**ECOTEC (2001)**	**Other Studies**
Austria	86,400	15,000*
Belgium	49,400	-
Denmark	80,600	-
Finland	25,200	11,600
France	402,000	308,700
Germany	502,500	635,000**
Greece	42,400	-
Ireland	11,200	4,400
Italy	168,900	-
Netherlands	109,200	92,200
Portugal	52,400	3,400***
Spain	139,600	185,500
Sweden	33,000	42,500
United Kingdom	379,700	196,000
EU-15	**2,085,700**	

Note : (*) Did not include Public sector (**) More details of this study are shown in Annex 8 since the wider figure in Germany, including indirect employment, equals 1,370,000 (***) Eco-industry supply side only.

Table 30 : Eco-industries Employment across the EU

				Pollution Management				Resources Management					
	Sector	**Note**	**Data Year**	**APC**	**WWT**	**WM *****	**Others***	**Water Supply**	**Nature protection**	**Renewable energy**	**Others****	**Sector Sub-Totals**	**Total (All Sectors)**
Austria	Public & Private	A	2000	4,395	1,920	3,135	855					10,305	**15,000**
Belgium	Public & Private	J	1994	2,002	2,705	4,603	329					9,639	**9,640**
Denmark	Public & Private	J	1994	2,899	6,304	4,083	431				1,504	15,221	**15,220**
Finland	Public	G	1999									2,446	**14,000**
	Private					4,546	522	6,486				11,554	
France	Public	B	1999		52,900	26,500	6,400	15,600	27,600		20,800	149,800	**308,700**
	Private			9,200	36,500	45,000	3,800	27,400	6,100		3,900	131,900	
Germany	Public & Private	C	2001										**1,370,000**
Greece	Public & Private	J	1994	796	1,131	440	70				1,362	3,799	**3,800**
Ireland	Public & Private	J	1994	786	2,917	1,555					610	5,868	**5,870**
Italy	Public & Private	J	1989	9,658	15,134	31,390					6,707	62,889	**62,890**
Luxembourg	Public & Private	J	1994		282	156					15	453	**450**
Netherlands	Public	H	1997		4,500	3,000	12,815					20,315	**89,550**
	Private				15,978	23,865	17,100		2,120		10,175	69,238	
Portugal	Public	D	1997										
	Private				384	2,517	326			19	182	3,428	**3,430**

				Pollution Management				Resources Management					
	Sector	**Note**	**Data Year**	**APC**	**WWT**	**WM *****	**Others***	**Water Supply**	**Nature protection**	**Renewable energy**	**Others****	**Sector Sub-Totals**	**Total (All Sectors)**
Spain	Public	E	1998									43,308	**185,450**
	Private			2,311		37,000		40,363	27,028	3,522	31,913	142,137	
Sweden	Public	F	1999		1,918		1,478	2,158		3,277		8,831	**15,220**
	Private				2,915		2,720	259		492		6,386	
UK	Public & Private	J	1994	9,915	31,224	24,374	5,309				3,211	74,033	**174,000**
	Private	K	2001									(166,000)	
Total EU Environmental Employment				**41,962**	**176,712**	**212,164**	**52,155**	**92,266**	**62,848**	**7,310**	**57,399**	**771,550**	**2,273,200**

NOTES

Private Sector values include internal services (& Institutions).

All values in different sub-sectors include environmental goods and services. Figures in Total column have been rounded.

* Others includes noise and vibration, monitoring and measurement, remediation of ground & water, other Environmental Management; ** Others includes Consultancy and transverse activities; *** Waste Management includes recycling and the wholesale of waste and scrap metal; **** Nature protection includes Eco-tourism & (ecological agriculture, Spain only)

6.0 CHANGES IN ENVIRONMENTAL EXPENDITURE & EMPLOYMENT SINCE 1994

6.1 Changes by Environmental Domain

Figure 13 shows the changes in the main Pollution Management[25] expenditure domains between 1994 and 1999. Key observations include:

- Despite wastewater treatment expenditure increasing by 3% per annum in real terms, the proportion of wastewater treatment expenditure has remained fairly constant at around 40% of total expenditure. However, the relationship to water supply costs has changed, with wastewater treatment now representing a greater share of the overall costs of water supply/treatment: 59% in 1999 compared to 52% in 1994. This may well be due to the implementation of the 1994 Urban Waste Water Treatment (UWWT) Directive, which has imposed stringent environmental obligations on public/private water companies across the EU.

- The waste management sector has seen a considerable increase of 11% per annum[26], reflecting the increased priorities attached to this from the EU Commission through to Member States. Waste disposal costs are rapidly increasing as treatment routes become more sophisticated and landfill taxes are imposed.

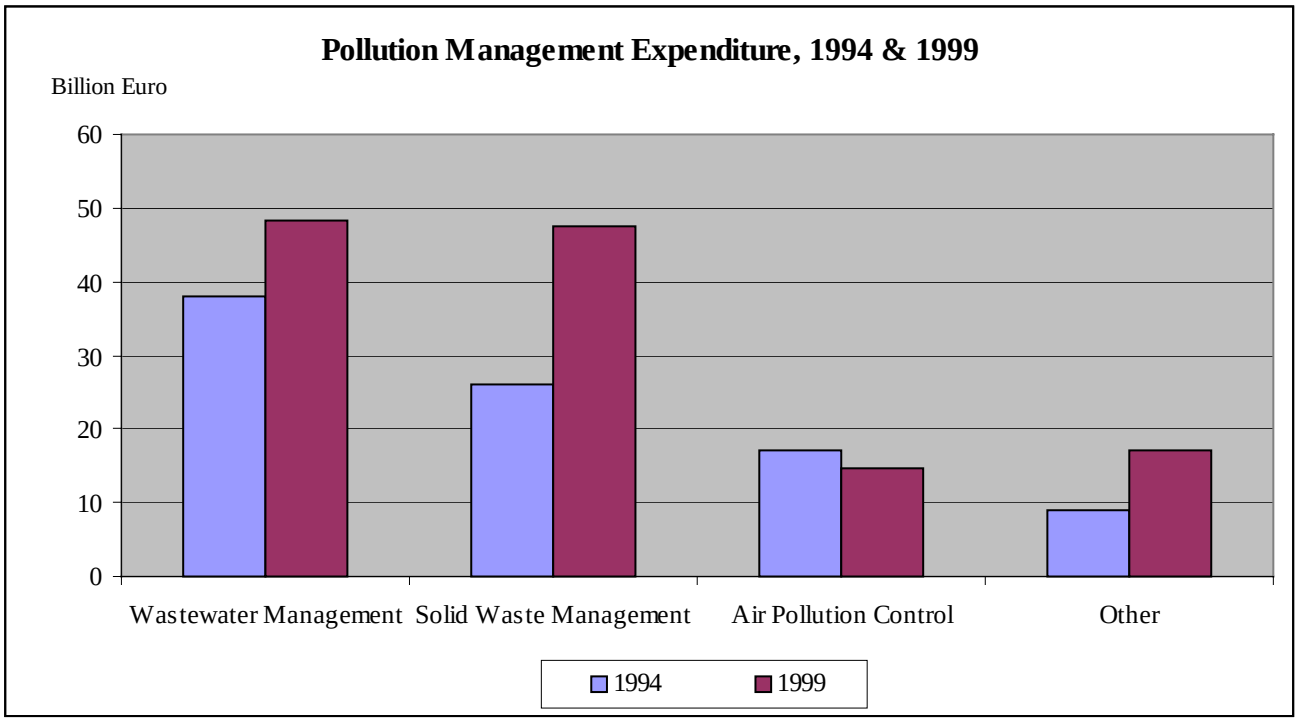
- Air pollution control expenditure has fallen by 5% per annum. This is likely to be a result of substantial investments having already been made during the past 10 years, for example, as a result of the Large Combustion Plant Directive of 1988.

- The proportion of 'Other' expenditure has risen by 10% per annum. Notable domains within this include a rise for contaminated land remediation from 0.55 Bn euro in 1994 (1999 prices) to 3.5 Bn euro in 1999. This is a reflection of the increased priority attached to regenerating brown field sites, as well as due diligence issues in the private sector. Noise and vibration control expenditure has almost doubled since 1994, to around 2 Bn euro. A large element of this is France's contribution of 700 M euro, which is almost twice that of 1994, and possibly caused in part by the building of the new TGV line between Lyons and Marseille.

[25] It is not possible to compare Resources Management expenditure due to a lack of data.

[26] Waste management expenditure for 1994 also included some waste recycling expenditure, which has been separated out in this current study. Therefore the real increase in spending is higher.

Figure 13 : Pollution Management Expenditure Changes, 1994 to 1999



6.2 Changes in Total, Capital and Operating Expenditure

In real terms, total pollution management expenditure has risen by 5% per annum since 1994, with the proportion of expenditure spent on operating costs increasing by 8% to a level of 69% in 1999 (see Table 31). The 73% increase in operating expenditure (+12% per annum) is significant compared to the 4% rise in capital expenditure (+0.7% per annum).

Increased waste management activities during the period could well explain the large increase in operating costs. The waste management sector is characterised by high operating costs (see Table 12 for comparison with other environmental domains). Other factors may be due to the 1990's being an 'investment heavy' period, producing substantially greater levels of pollution treatment plant (e.g. in the water sector) which consequently increase overall operating costs, or else rises in more complex integrated applications, with corresponding increases in opex (e.g. increased staffing levels etc.). Increases in capital spend can be partially explained by on-going capital refurbishments to the growing stock of existing treatment plants.

Table 31 :Change in EU-15 Pollution Management Expenditure, 1994 to 1999

	Expenditure (M euro) constant prices			%	
	Capital	**Operating**	**Total**	**Capital**	**Operating**
1994 (1999 Prices)*	38,280	50,530	98,810	39	61
1999	39,760	87,390	127,150	31	69
Total % Change	+4	+73	+29		
% Change per year	+0.7	+12	+5		

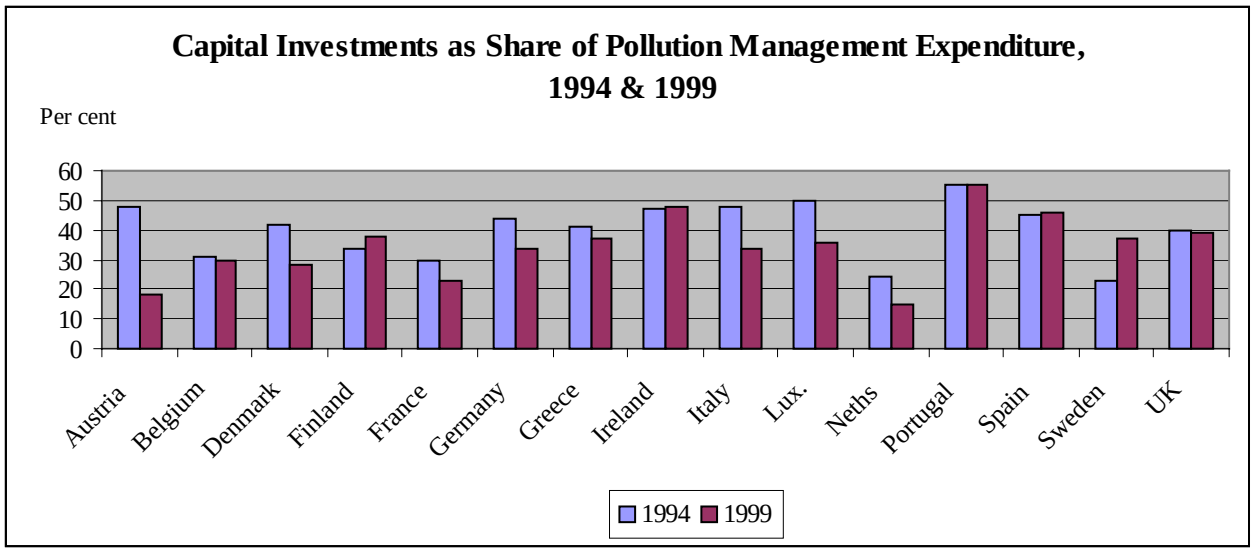
Note: (*) assumes price increase of 10% between 1994 and 1999

Figure 14 shows that the share of capital investment has fallen across many EU Member States, notably in Austria (14%), France (23%) and the Netherlands (15%). Germany has also seen a considerable reduction, from 44% to 34% in 1999. These are important findings since these Member States constitute major EU eco-industry markets. It also has major implications for the domestic eco-industries within these Member States – are firms looking elsewhere for capital equipment sales? The export review section earlier in this report shows that EU environmental exports have grown since 1994, although there will need to be additional growth in exports to compensate for declining investments in domestic markets.

Conversely, there have been rises in capital expenditure in Finland and Sweden. This may be explained by 'one-off' industrial investments, for example, in the energy sector.

The share of capital investment in the former Cohesion Fund countries – notably Ireland (48%), Portugal (55%) and Spain (46%) still remains high compared to other Member States. This reflects the on-going investment programmes to implement EU Directives.

Figure 14 : Changes in Share of Capital Investment, 1994 -1999



6.3 Change by Actor

The importance of the private sector in driving pollution management expenditure is demonstrated by the large percentage increase since 1994, rising from 45% of the total to 59% in 1999. Household expenditure remains around 5% of total expenditure.

The shift towards private sector expenditure is more a reflection of the increased level of privatisation within the environmental protection field. Both water treatment and waste management services are increasingly being carried out by the private sector, either as a result of large-scale privatisation (e.g. Germany and UK) or through the use of public-private partnerships, which are driven by private investments.

6.4 Changes in Expenditure Levels and Growth Rates across Member State

Reference to both Figure 15 and Figure 16 (which are expressed in real prices) show that there has been considerable variation in expenditure levels and growth rates since 1994. Notable points include:

- All Member States, with the exception of Ireland, Netherlands and Sweden, have seen pollution management expenditure levels rise;
- Austria, Belgium, Denmark, Greece and Spain have seen expenditure levels rise by more than 10% per annum in real terms;
- Finland, Portugal and the UK have seen annual expenditure levels rise by between 5-10%;
- France and Germany – the largest EU eco-industry markets - have both risen annually by less than 5%.

Figure 15 : Change in Pollution Management Expenditure, 1994-1999

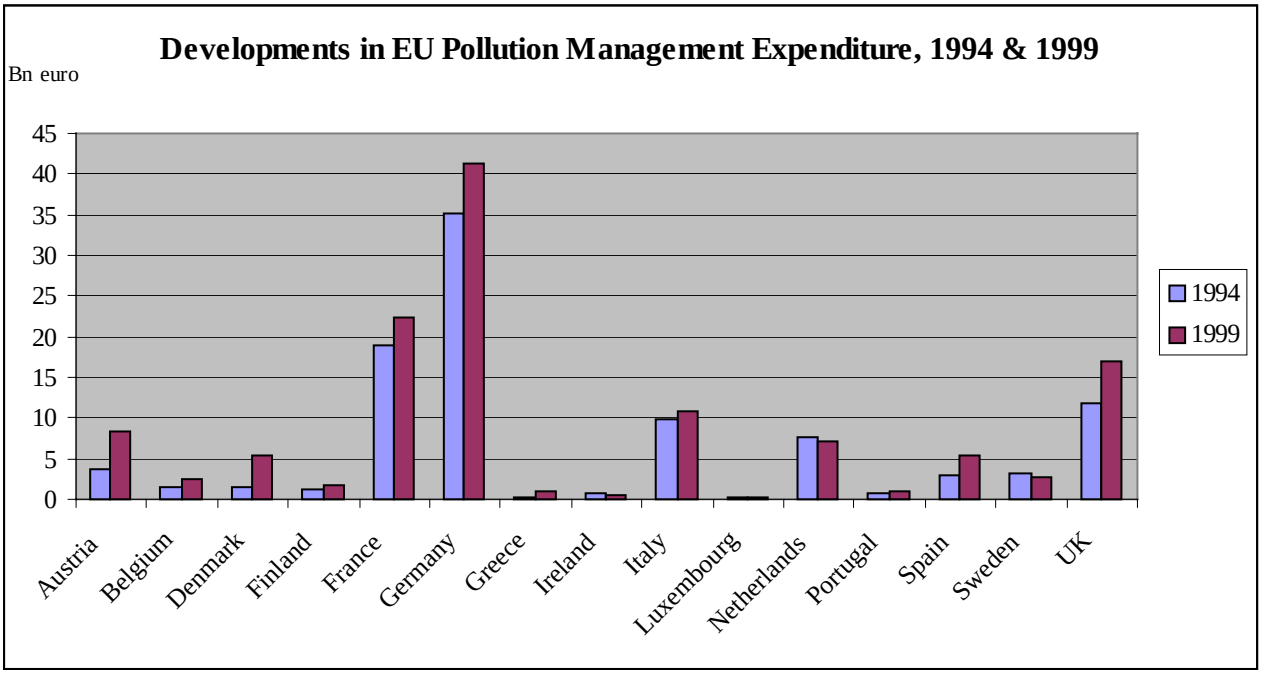
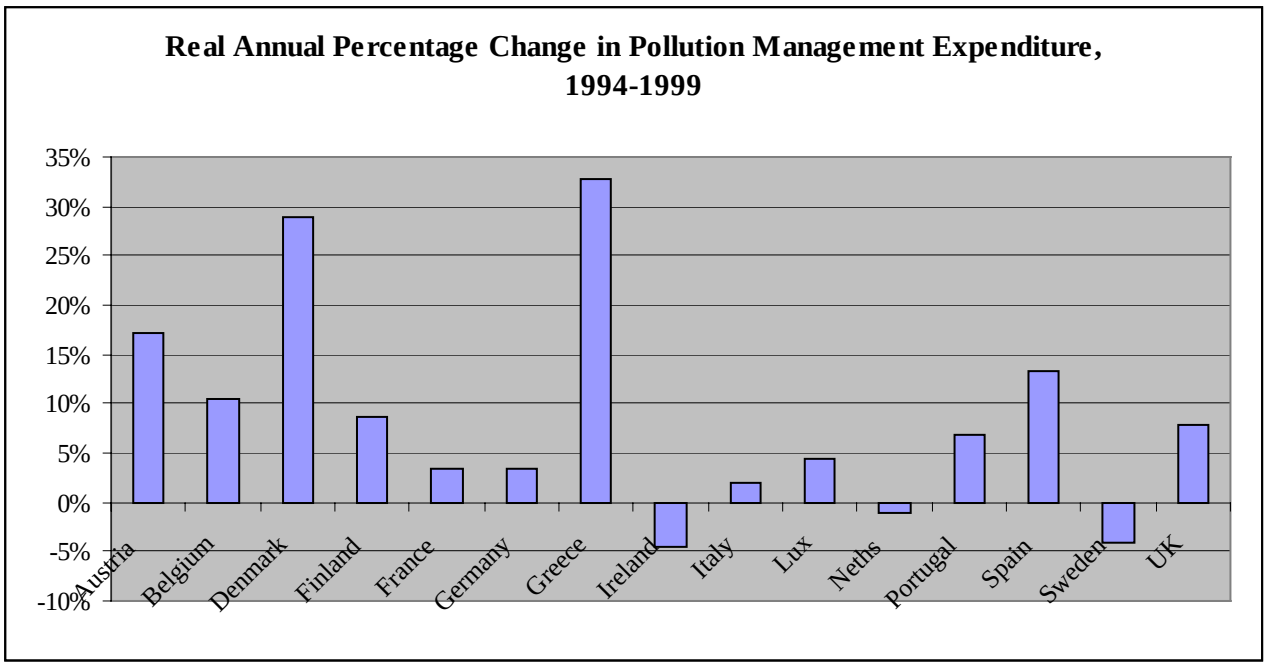


Figure 16 : Change in Pollution Management Expenditure, 1994-1999



6.5 Explanations for changes in expenditure

Changes in Member State expenditure between 1994 and 1999 may be due to several factors:

- **Actual changes in expenditure** (e.g. a general reduction in air pollution control spend in the EU, generally large increases in waste management expenditure across each member state).

- **Variable growth rates** in environmental expenditure across different Member States. isn't this the same as the bullet above

- **More accurate reporting of expenditure data** – Data collection methods and the results of Member State environmental protection expenditure surveys appear to have been fine-tuned since the 1997 Study, helped greatly by the efforts of Eurostat in developing common reporting procedures. PAC time series data, breaking down expenditure into CAPEX and OPEX, is now available for most EU Member States, generally covering both the public and private sectors. This allows reliable estimates to be made of CAPEX/OPEX levels where Member States have only reported total expenditure for the latest data year.

- **More representative reporting** – for example, the inclusion of the entire waste management sector in the UK private sector compared to only including industrial waste management expenditure. Denmark's expenditure data is now more representative of that country's eco-industry.

Table 32 below gives some indication of either insights within each Member State which have given rise to 1999 levels of expenditure, or else issues concerning data collection and analysis.

Table 32 : Some explanations for changes in Pollution Management expenditure between 1994 and 1999

Austria	Household expenditure is also covered comprehensively.
Belgium	Belgium was completely estimated in 1997 study. Whilst CAPEX/OPEX estimates have been made for the majority of values, domain totals are now more reliable.
Denmark	Huge increase in private sector spend, including around 700m euro on remediation and clean up. Ministry of Finance 1998 data was expressed in 2000 prices. This is not regarded as significant to the analysis.
Finland	Larger public sector spend.
France	Large increase in public sector spend. Reported 1998 data was expressed in 2000 prices, introducing a 0.5% increase or 112 M euro difference compared to 1999. This is not regarded as significant to the analysis.
Germany	Privatisation of the water industry and waste management sector has occurred since 1994.
Greece	New Cronos data used for much data, backed by estimation which may inflate data in some domains.
Ireland	Reduction in total spend reflected by decline in water investments
Italy	Estimates for total spend based on 1% of GDP, as in the 1997 Study. True level of spend still not known, although the Italian Statistics Office is trying to refine its methodology for collecting private sector expenditure.
Luxembourg	No industry represented therefore estimated.
Netherlands	Increase explained by rising operating costs, coupled with a slow down in investments.
Portugal	Increase in private sector spend
Spain	Large scale water infrastructural developments – 650 M euro in 1994 rising to 1,830 M euro in 1999.
Sweden	Not all industry represented in expenditure data.
UK	UWWT & Bathing Water Directives implemented. Improved industry expenditure coverage through improved methodologies. Waste management industry now fully represented. Household APC expenditure also covered.

6.6 Changes in Employment

Key findings include:

- **Total direct employment resulting from Pollution Management activities has risen by around 500,000 (FTE) jobs** since 1994.

- Total direct employment due to Resources Management increases this amount by a further **650,000 jobs** (although this was not determined in the 1997 Study).

- The largest changes in employment are related to the waste management sector.

- Including Resources Management means that the number of direct investment related jobs in the EU in 1999 has increased by around 75% to **550,000 jobs**.

Changes in employment between 1994 and 1999 can be explained by:

- A large increase in operating costs;

- More accurate wage rates for each EU member state.

There has been strong growth in employment in the environmental sectors across Europe over the last five years, and further environmental job creation is expected over the next five years. Further growth in expenditure is expected, providing the demand-side pull for new job creation - either through growth of employment within already existing firms, or through new entrants to the environmental market. Work by ECOTEC for regional UK development agencies shows that many environmental supply companies remain optimistic about future opportunities and growth, with most firms expecting to recruit more employees. Replicated across the major EU eco-industries, this perception of the market – whether it is in the EU or abroad - bodes well for the future of the EU eco-industries.

7.0 CANDIDATE COUNTRY ECO-INDUSTRIES

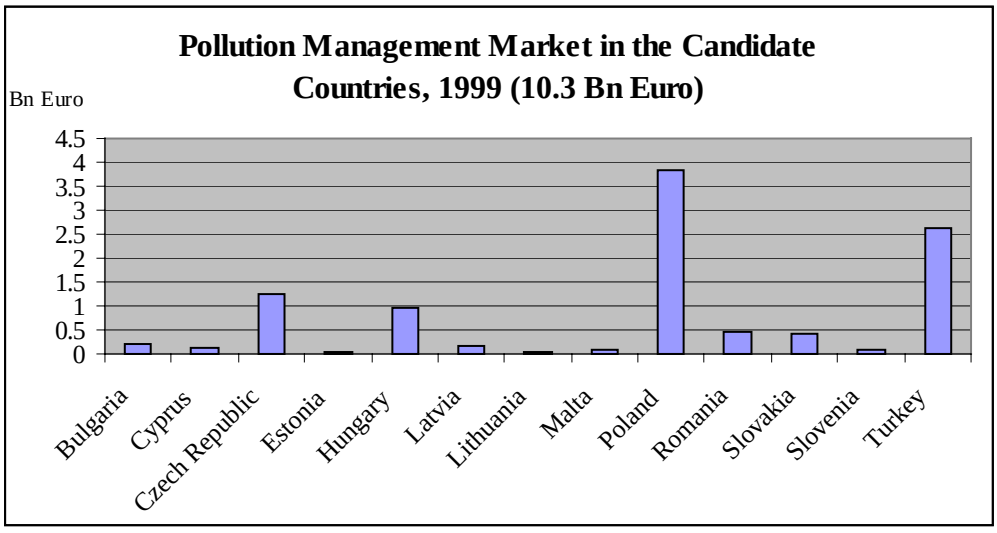
This study has collated available data on the market for goods and services produced by eco-industries in the Candidate Countries, as the basis for describing the economic significance of the sector, including employment levels. Whilst there are gaps and inconsistencies in the available data sets, only limited estimation procedures were required to derive a reasonably detailed and rigorous basis for economic analysis. The following section provides the conclusions from a separate report, entitled *'Analysis of the size and employment of the eco-industries in the Candidate Countries'*, which was produced as a specific input into this study.

7.1 Main Findings

7.1.1 Characteristics of the Candidate Country Eco-industries

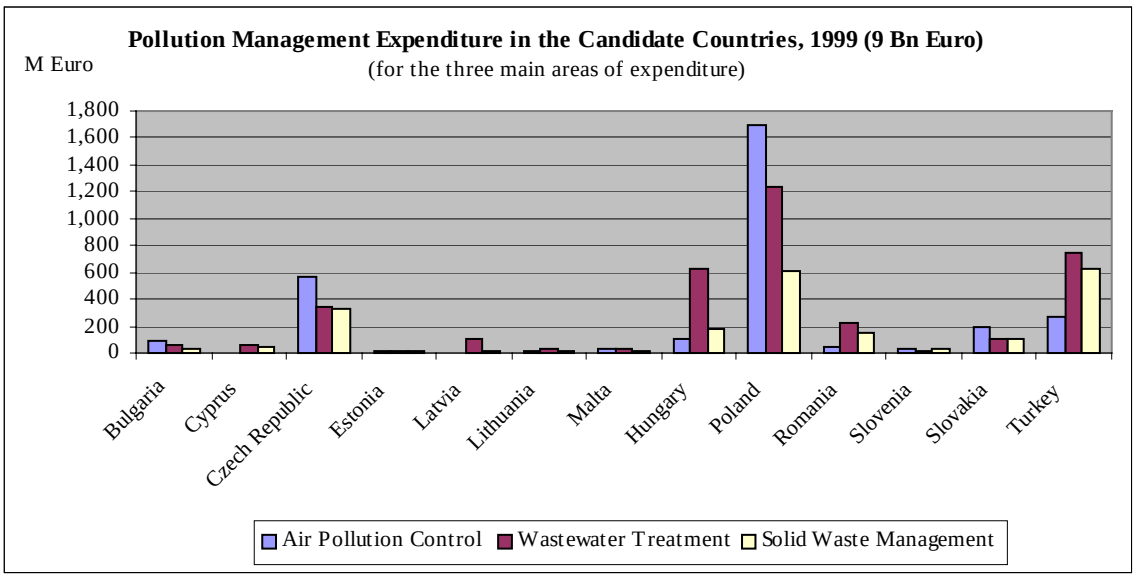
- Total Pollution Management eco-industries supply around 10.3 Bn euro of goods and services a year, of which 5.5 Bn euro are investment goods and 4.8 Bn euro are services, including 'in-house' non-market services. Figure 17 shows the distribution of total expenditure across the Candidate Countries.

Figure 17 : Turnover of Candidate Country Eco-industries (Pollution Management)



- The most important environmental domain is the wastewater management industry, which accounts for 35% (3.6 Bn euro) of the market. However, air pollution control is also a very important sector at 30% (3 Bn euro), followed by solid waste management at 20% (2.1 Bn euro). Figure 18 shows how expenditure in these three most important domains differs across Candidate Countries.

Figure 18 : Pollution Management Turnover by Candidate Country & Environmental Domain



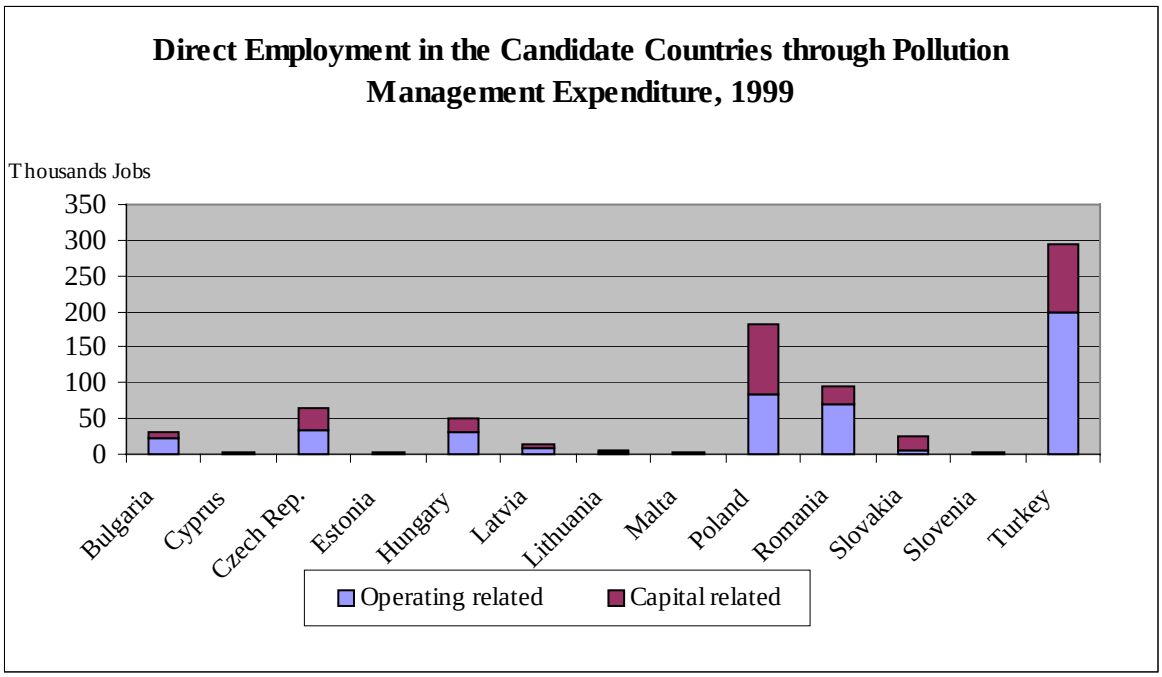
- Although separation of expenditure is difficult outside of the three main domains, the proportion of expenditure on General Administration is significant, at 13% (1.3 Bn euro). This reflects the increasing role of staff in public administration.
- Overall, the Polish market, with total expenditure of around 3.8 Bn euro, constitutes almost a third of the Candidate Country Pollution Management market. The Turkish market, with 25% (2.6 Bn euro) of Candidate Country environmental expenditure, is the next most significant, followed by the Czech Republic (1.3 Bn euro) and Hungary (1 Bn euro), with 12% and 9% respectively.
- Slovakia has the highest proportion of CAPEX:OPEX at 69%, followed by Estonia at 60%. Countries falling within the 50-60% range include: Cyprus, Czech Republic, Poland and Slovenia. Bulgaria and Romania appear to have very low proportions at investment relative to operational costs, at 25% and 30% respectively.
- Most Candidate Countries spend more on traditional end-of-pipe technology than on process integrated/cleaner technologies, although the exact breakdown between the two types of technology is hard to determine. On average, it is likely to be less than 20%. However, implementation of EU Directives such as IPPC will lead to increased investment in cleaner technologies.
- The Candidate Country eco-industries run a trade deficit with the rest of the world, although this appears to have declined since 1995.
- The average share of GDP spent on pollution management expenditure in Candidate Countries was 1.9%. The environmental sector is most significant – with respect to a comparison with GDP – in Poland (2.6%) and Czech Republic (2.5%), followed by Slovakia and Latvia (both 2.3%) and Hungary (2.2%).
- Average per capita spend in the Candidate Countries was 66 euro. The highest per capita spend was in Czech Republic (122 euro), Poland (99 euro) and Hungary (97 euro).
- Average growth rates in market size are around 10% per annum.

- A low end estimate of the total eco-industry is approximately 13 Bn euro, on the basis that 10.3 Bn euro is Pollution Management and that Resources Management accounts for approximately 20-30% of this.

7.1.2 Employment in Candidate Country Eco-industries

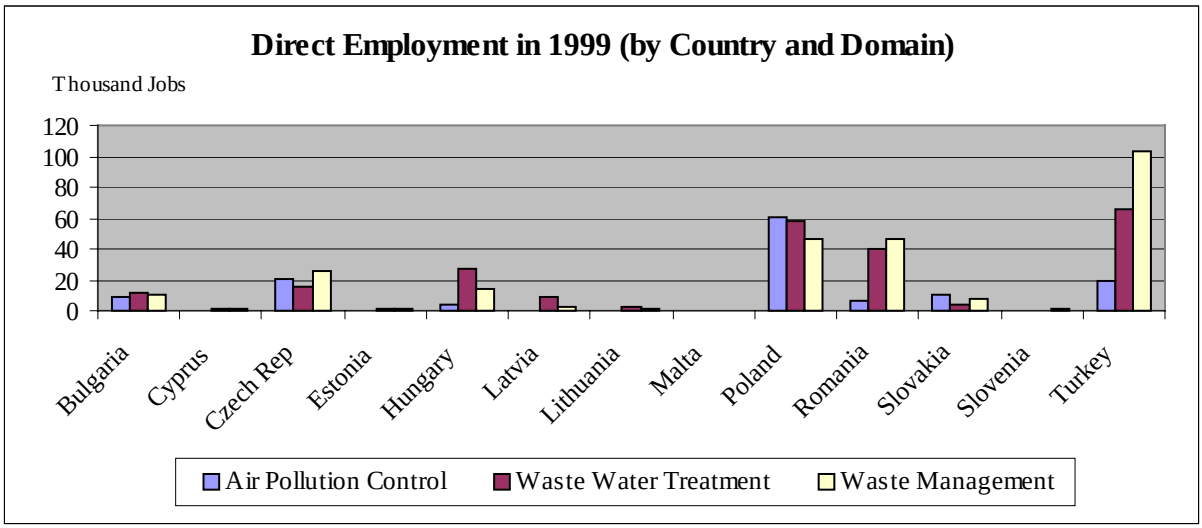
- Direct employment in the Candidate Country pollution management eco-industries is around 770,000 (FTE) jobs, of which 460,000 (60%) are operational related and 310,000 are investment related. The wage data used to calculate employment levels for the CC-13 are full time equivalent (FTE) wages. Since part-time work in general is still very rare in the Candidate Countries, the estimates give the most likely number of total jobs**.**
- Exactly 50% of operational employment was in the waste management sector, whilst wastewater treatment accounted for 25% and air pollution control 8%. Environmental administration accounts for 17% of operational employment, reflecting a significant increase in environmental priorities across government departments and public sector agencies.
- Turkey, Poland, Romania, Czech Republic and Hungary have the largest direct employment (see Figure 19).

Figure 19 : Direct Employment in the Candidate Countries, 1999



- Turkey accounts for 38% of all direct employment in the Candidate Countries, whilst Poland comprises of 24%.
- Direct operating-derived employment on average accounts for 0.7% of national employment.
- APC investments in Poland and Czech Republic alone account for 20% of all investment derived jobs in the Candidate Countries.

Figure 20 : Direct Employment by Candidate Country and Domain, 1999



- Investment related employment is dominated by Poland, Turkey and the Czech Republic, which together account for 73% of this employment.
- Total pollution management employment generated by the demand for environmental goods and services, taking into account the indirect effects on the rest of the economy, equals around 1m (FTE) jobs. The indirect effect is uncertain and likely to be an underestimate.
- The estimated value added provided by eco-industries, based on direct labour costs, is 4.6 Bn euro.
- Job displacement to more developed exporting countries (e.g. EU15, USA) is likely to have occurred across all Candidate Countries where these countries are purchasing the most advanced technologies, for example, in the APC and WWT sectors.
- The largest displacement of investment related jobs will be in those markets that are weak, both in domestic production (and export) of environmental technologies.
- The massive investment related employment on APC capital goods either implies that Candidate Country eco-industries have a significant domestic APC capability (which is only really true for the Czech Republic and Poland), or that a large proportion of this investment related employment resides elsewhere.
- The engineering analysis and subsequent employment analysis both appear to be fairly robust for many Candidate Countries, including the largest markets such as Poland. The Turkish Statistical Office is expecting to produce an estimate of environmental employment in the near future. In the meantime, ECOTEC's estimate is realistic since direct operational employment accounts for 0.9% of national employment.
- Although every effort has been made to establish the most accurate breakdown wage rates across Candidate Countries, employment estimates are very sensitive to wage rates. In future surveys this area needs to be more carefully investigated. Hopefully, Eurostat labour cost surveys will be extended to all the Candidate Countries to aid this analysis.

7.1.3 Candidate Country Market Drivers & the Future

- The main driving force behind each of the Candidate Country markets for environmental protection is the necessity to implement the requirements of the environmental *acquis*, particularly EU regulations such as the IPPC Directive. Other market drivers include national government policies and private sector interests (e.g. concessions, Build-Own-Operate contracts, and foreign investment into industry sectors).
- The importance of international donor agencies (e.g. World Bank), programmes from the EU (e.g. the ISPA pre-accession funds) and elsewhere (e.g. US Aid), as well as financial institutions (e.g. EBRD) is also critical to the future funding of environmental projects.
- Many Candidate Countries have state environmental plans that foresee the use of user charges and taxes on industry and households as additional revenue sources for the funding of environmental investments.
- The average compliance time with the environmental acquis is 8 years. Countries such as Poland, Czech Republic and Hungary all appear to be on course to comply in 9 years or less, whereas some countries (e.g. Romania and Bulgaria) will need to substantially increase their level of investments if they are comply within the next 10-20 years (see Table 33). It is worth noting that compliance times are derived from the original environmental expenditure data collected during this study. To the extent that this expenditure data may not fully reflect (and may underestimate) the true level of expenditure in any particular country, these compliance times should be treated with caution. Overall, the average compliance time of 8 years is a good indication that all Candidate Countries still need to make considerable investments in environmental infrastructure to meet compliance with the environmental *acquis*.

Table 33 : Compliance Costs Forecasts for Candidate Countries

Country	Turnover (M euro, 1999)	Compliance Cost (M euro)	1999 as % of total	Compliance time, based on 1999 expenditure (Years)
Bulgaria	200	8,610	2	43
Cyprus	120	1,086	11	9
Czech Rep	1,250	8,000	16	7
Estonia	50	4,406	1	88
Hungary	970	7,059	14	7
Latvia	150	1,920	8	13
Lithuania	50	1,600	3	32
Malta	90	130	69	2
Poland	3,840	32,450	12	9
Romania	440	22,000	2	50
Slovakia	420	4,809	9	12
Slovenia	90	2,430	4	27
Turkey	2,610	n/a	n/a	n/a
CC-13	**10,300**	**94,500**	**12***	**8***

Note: Compliance cost estimates include the cost of meeting the requirements for drinking water supply, whereas turnover estimates do not. For compliance cost a mid-point has been taken where a range was presented. (*) Figure derived from total Turnover and Compliance Costs excluding Turkey.

- Employment in the environmental sectors is generally increasing at a significant rate. Future employment growth is expected to be greatest in waste management, WWT as well as in the formation of new (as well as the expansion of existing) public sector environmental institutions.

7.2 The Current Role of EU Eco-industries in Candidate Country Markets

- Poland is the largest Candidate Country market for EU environmental products, followed by the Czech Republic, Turkey and Hungary.
- EU export volumes to the Candidate Countries were largest in the APC sub-sector.
- EU technology exports appear to have "levelled out" by 1999, at around 450 M euro, caused by a contraction in the exports of APC and "Other environmental equipment", despite a continued expansion in the other three sectors: Waste, monitoring equipment and water treatment technologies.
- Environmental technology exports for 1999 represent around 9% of total capital investment in the Candidate Countries. However, since the total volume of environmental technology trade identified by trade code analysis represents a low-end estimate, the total EU eco-industry contribution to environmental investments in the Candidate Countries may well be much higher.

- Germany is the leading exporter to the Candidate Countries, with 54% of the market, while other countries show strengths in particular sub-sectors (e.g. Sweden in water processing, Denmark in waste and the UK in monitoring equipment).
- Italy, Spain and the UK have particularly low levels of exports to the Candidate Countries in relation to the size of their eco-industries, while Greece, Ireland and Portugal have insignificant trade with the Candidate Countries.
- EU Member States situated next to their respective Candidate Country markets have larger trade in environmental technologies than other Member States.
- The current method of EU company penetration into the Candidate Country market is through setting up a joint venture with domestic companies.
- A significant level of investment-related jobs in the EU-15 are generated by sales to the Candidate Countries.
- Non-EU countries like Norway, Switzerland and the USA also have a significant presence in the Candidate Countries which may improve over time with the right incentives, such as financing and loans.

7.3 Impact of Candidate Country Eco-Industries on the EU Eco-Industries

- Total exports from Candidate Countries to the EU were 112 M euro in 1999, and have more than doubled since 1995.
- Candidate Countries are gradually reducing the market share of other global eco-industry suppliers into the EU, as demonstrated by the percentage contribution that Candidate Country imports into the EU represent – 5% in 1995, rising to 7% in 1999.
- Growth in exports to the EU is dominated by the Czech Republic, followed by Poland, which together account for over 74% of exports. Hungary is the third most significant Candidate Country exporter.
- Exports from the Czech Republic have increased dramatically over the period, most noticeably in the APC and other categories, although there has also been growth in WPC. Growth in other exporters has been fairly constant.
- The countries where domestic environmental technology production capabilities are most likely to have improved are: Poland, Czech Republic and Hungary. These countries are also now exporting more in 1999 to the EU (and possibly elsewhere) than in 1995.
- Given that environmental expenditure in the Candidate Countries has risen substantially since 1995 (possibly doubling), this implies that the domestic capabilities of Candidate Country companies (certainly in the field of APC) have improved significantly over the period.

7.4 The future of Candidate Countries Eco-industries in the next 5-10 years

- There will continue to be a large demand for environmental goods and services over the next 10-20 years in the Candidate Countries.

- The continued demand for environmental technology investments in the Candidate Countries is unlikely to be fully met by domestic production capabilities. This implies sustained employment for the EU overall, although individual Member States may well lose out.
- EU firms will continue to develop their presence in the Candidate Countries, especially on the back of EU funding programmes or single country schemes (e.g. Scandinavia).
- EU firms will keep establishing joint ventures with domestic companies, however the setting up of fully-owned subsidiaries (see example in the Czech Republic under Section 5) is likely to increase in the future.
- Consolidation within the sector and the purchase of promising Candidate Country firms by EU firms is highly likely.
- Employment shifts from the EU-15 in the short term are most likely to occur in Poland, Czech Republic and Hungary since these are three of the largest markets; are rapidly expanding; have good domestic capabilities, especially in APC, WWT and WM; and are rapidly expanding their export capabilities.
- Trade within the Candidate Countries is likely to strengthen, particularly from the most rapidly developing markets.
- Export trade with the EU-15 is set to increase, particularly in areas where the sales price is affected by labour costs.
- Candidate Country exports of end-of-pipe technologies are likely to increase, coinciding with a shift of EU exports towards cleaner technologies.

7.5 Comparison of Expenditure and Employment with EU-15

- The share of GDP attributable to pollution management expenditure in the Candidate Countries is 1.9%, compared to 1.6% in the EU-15.
- The total CAPEX:OPEX ratio of 47:53 for the CC-13 in 1999 compares to 31:69 for the EU-15 in the same year. This reflects the significant capital investments that are currently being made. Over time, the expenditure ratio should start to shift towards higher operational expenditure.
- The proportion of expenditure on capital investments across the three main domains is higher than in the EU-15 (see Figure 21). This reflects the importance of 'new build' facilities across the Candidate Countries, providing a greater market for environmental technologies (as opposed to consumable goods) than in more mature environmental markets (such as the EU and North America). Figure 21 also implies that over the next decade, markets in the Candidate Countries are likely to move closer to the EU profile, e.g. shifting away from APC and into WM. This may strengthen domestic markets and employment and reduce trade deficits.
- Expenditure by Domain – Table 34 demonstrates how the relative proportions of pollution management expenditure in the Candidate Countries compare to the EU-15 in both 1999 and 1994. The heavy level of expenditure in APC is evident, far higher than even that reported for the EU-15 in 1994. This reflects the immediate priority of controlling noxious gases in very young environmental markets. It is encouraging to see the higher percentage of expenditure on WWT, which is approaching that of the EU. Waste management stills lags well behind the EU for 1994,

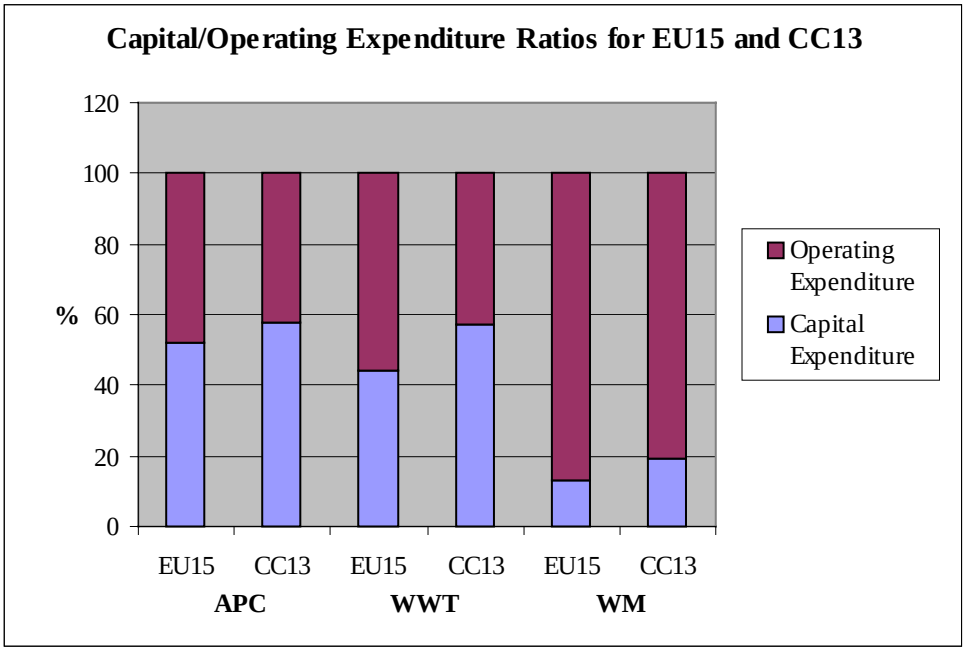
however there are signs that this area could develop more rapidly in the next 5 years in the Candidate Countries.

Table 34 : Proportion of Expenditure across Main Environmental Domains

	APC	WWT	WM	Total
CC-13, 1999	30%	35%	21%	86%
EU-15, 1999	12%	38%	37%	87%
EU-15, 1994	19%	42%	29%	90%

- Average per capita expenditure of 66 euro is 28% of that reported for EU-15 eco-industries in 1994. This gives an indication of the significant expenditure required to bring Candidate Countries up to a comparable standard to the EU. However, Czech Republic (122 euro), Poland (99 euro) and Hungary (97 euro) all represent between 40-50% of EU expenditure for 1994, indicating the progress at which these countries are making with implementing the *acquis communautaire*.

Figure 21 : Capex : Opex Ratios in CC-13 and EU-15



- The percentage of national employment derived from direct operating related Pollution Management expenditure averages 0.7% across the CC-13 - exactly the same as the EU-15.

8.0 CONCLUSIONS

This study has collated available data on the market for goods and services produced by eco-industries in both the EU-15 and the Candidate Countries, as the basis for describing the economic significance of the sector, including employment levels. Whilst there are gaps and inconsistencies in the available data sets, only limited estimation procedures are required to derive a detailed and rigorous basis for economic analysis. In conclusion, the analysis in this study indicates that in 1999:

8.1 Characteristics of the EU Eco-industries

- Total **EU eco-industries supply some 183 Bn euro of goods and services a year**, of which 54 Bn euro are investment goods and 129 Bn euro are services, including 'in-house' non-market services.
- Total **Pollution Management and Cleaner Technologies eco-industry supplies are around 127 Bn euro of goods and services a year**, of which 40 Bn euro are investment goods and 87 Bn euro are services, including 'in-house' non-market services.
- Total **Resources Management eco-industries (excluding renewable energy plant) supply around 56 Bn euro of goods and services a year**, of which 14 Bn euro are investment goods and 42 Bn euro are services, including 'in-house' non-market services.
- The **current size of the renewable energy plant market in the EU is around 5 Bn euro a year**. This ties in well with the anticipated spend of 20 Bn euro over the period 1999-2003 as outlined in the Commission's "Campaign for Take-Off, 1999-2003".
- The **waste management industry has seen a tremendous increase in operational expenditure since 1994**, and is the domain with the biggest annual expenditure.
- Spending on wastewater treatment continues to remain strong, whilst **air pollution control expenditure has dropped**.
- The estimated value added provided by eco-industries, based on direct labour costs, is 98 Bn euro, up from 35 Bn in 1994.
- **Investment in eco-industries in the EU each year totals 54 Bn euro** with consequent benefits for construction, capital goods industries and associated services.
- Average per capita expenditure in the EU in 1999 for 340 euro for pollution management and 150 euro for resources management , or close to **average per capita expenditure of 500 euro overall**.

8.2 Employment in EU Eco-industries

- **Direct employment in the EU in eco-industries amounts to over 2 million (FTE) jobs** – around 1.5 million jobs for pollution management and 650,000 for resources management.
- The **1.5 million jobs in Pollution Management eco-industries** are split into over 1 million operations-related jobs and 400,000 capital-related jobs.

- The **650,000 jobs in the Resources Management eco-industries** are split into 500,000 operations-related jobs and 150,000 capital-related. This demonstrates that employment levels for the wider environmental industry sector are significantly larger than the core eco-industry (i.e. pollution management) definitions used in the past. Areas such as nature protection and organic farming, which have not been covered by this study, also offer the potential for significant employment creation in rural economies in the future.
- Total employment generated by the demand for environmental goods and services is at least **2.6 million jobs taking into account the (first round) indirect effects** on the rest of the economy. These indirect jobs include, for example, jobs in supply of electricity to the eco-industry, as well as jobs in a range of other industries that supply (non-environmental) goods and services to ensure that environmental infrastructure remains fully operational (e.g. maintenance firms).
- A **high end estimate of environmental employment is around 4 million jobs**, using various procedures to give more realistic coverage and including the use of 'multipliers', which try to build in the indirect effects of environmental expenditure.
- Environmental sector employment accounts for on average **1.3% of total paid employment** in the EU-15, although it is higher in some countries (e.g. Austria, Denmark, France).
- The current study has produced robust employment data that compares well with a range of other Member State studies. This has been helped by significant developments in employment estimates since 1997.
- For every 1 Bn euro of investment in environmental goods and services there is another 1.6 Bn euro generated in operating expenditure and the generation of 30,000 direct jobs.
- **A significant level of investment-related jobs in the EU are generated by sales to Candidate Countries**.
- **Employment levels are expanding in the waste management sector**. Waste recovery and recycling offer particularly good prospects for future employment growth.
- Environmental employment has been a **source of job creation** at the Member State level, although it is impossible to identify accurately the impact on aggregate employment.
- There has been a **shift in employment from the public to private sectors**, particularly within the waste management sector (e.g. Netherlands, Sweden and UK).
- Parts of the environmental sector (e.g. environmental consultancy and research) comprise of highly educated and skilled workforces. There is, however, a **continual need for improvements in skills and training** across many sectors. For example, the rapid technological changes in the waste treatment and recovery/recycling sectors are creating a growing demand for new skills, with obvious implications for training providers.

8.3 Changes in EU Eco-industry Turnover and Employment Levels since 1994

Many of the results from this current study can be directly compared to the findings of a similar 1997 study, also commissioned by DG Environment. Comparisons show that:

- In real terms, **total pollution management expenditure has risen by 5% per annum** since 1994.
- The proportion of expenditure spent on **operating costs has increased in real terms by 8% per annum** to a level of 69% in 1999.
- The **73% increase in operating expenditure** (+12% per annum) is significant compared to the **4% rise in capital expenditure** (+0.7% per annum).
- The **share of capital investment has fallen across many EU Member States**, particularly in larger markets. This has major implications for the domestic eco-industries within these Member States and firms may well be looking elsewhere for capital equipment sales.
- The share of **capital investment in the former Cohesion Fund countries** – notably Ireland (48%), Portugal (55%) and Spain (46%) still remains high compared to other Member States. This reflects the on-going investment programmes to implement EU Directives.
- **Increased waste management activities during the period (of 11% per annum) could well explain the large increase in operating costs**. Increased waste management costs reflect rapidly increasing waste disposal costs as treatment routes become more sophisticated and landfill taxes are imposed.
- **Wastewater treatment expenditure has increased by 3% per annum in real terms**. This may well be due to the implementation of the 1994 Urban Waste Water Treatment Directive, which has imposed stringent environmental obligations on public/private water companies across the EU.
- **Air pollution control expenditure has fallen by 5% per annum**. This is likely to be a result of substantial investments having already been made during the past 10 years, for example, as a result of the Large Combustion Plant Directive of 1988.
- Contaminated land remediation and noise and vibration control expenditure have both risen.
- The **private sector is increasingly important** in driving pollution management expenditure rising from 45% of total expenditure in 1994 to 59% by 1999. Household expenditure remains around 5% of total expenditure.
- Total **direct employment resulting from Pollution Management activities has risen by around 500,000 jobs since 1994**.
- The largest changes in employment are due to the **waste management sector**.
- Direct employment due to **Resources Management increases this amount by a further 650,000 jobs** (although this employment was not determined in the 1997 Study). Including Resources Management means that the number of direct investment related jobs in the EU in 1999 has increased by around 75% to 550,000 jobs.

8.4 International Trade

- The **EU eco-industries is a strong and diverse export sector, and a major global player** alongside the USA and Japan.

- **North America remains the EU's biggest export market** and has shown significant growth, while the Candidate Countries **are becoming increasingly important export markets**, in particular for EU Member States with close historical trading relationships to that region. The favoured method of EU company penetration into this market is through setting up a joint venture with domestic companies.
- **Northern European countries tend to be more active exporters** than Southern European countries.
- EU companies are amongst the **world leaders in developing new renewable energy technologies**, both for domestic markets and worldwide. The strong and expanding domestic markets provide the basis for many EU companies to be active in worldwide markets. For example, the EU is the largest market for wind energy developments, with 75% of the total world installed capacity of 18.5 GW.
- Although the EU operates a **trade surplus in environmental products** with the rest of the world (estimated, from a realistic scaling up of the trade code analysis, to around 5 Bn euro in 1999), the **amount of this positive trade balance overall is likely to have fallen** between 1997 and 1999, as a result of **increased imports and a levelling out in exports**.
- The **balance of trade with respect to environmental services is unknown** due to the difficulties of gathering accurate information.
- Estimates of total environmental exports from other countries show that these can be around 10% of revenues. Assuming the same level of exporting would mean that **total EU exports may be in the region of 18 Bn euro**.
- The **global eco-industry market is estimated at around 550 Bn euro**. This means the EU has approximately one third of the overall market (183 Bn euro), equal to the USA. The Japanese market is estimated to be worth about 84 Bn euro, whilst the Canadian market is the next most significant at 36 Bn euro.
- Over the next 5 years, **real growth rates in developing markets are estimated to be between 5-8%, while those in western markets will fall to only 1-3%.**
- Variations are apparent in support schemes available in different EU countries but, in general, these are outweighed by the similarities. Support measures comprise:

1. Export guarantee schemes;
2. Export financing schemes;
3. Credits for investments in developing countries;
4. EU investment programmes for pre-accession;
5. Provision of export promotion materials- publications etc.;
6. Promotion at international events;
7. Financial support to companies for trade missions;
8. Advisory and information services (including market intelligence) for exporters;
9. Support for domestic R&D;
10. Provision of training in industrialising countries;
11. Support via embassies (facilitation of local contacts for example);
12. Advice on legal aspects of foreign trade and project implementation;

13. Tax incentives for exporters;
14. Financing of feasibility and market studies.
15. Promotion of technology transfer to rapidly developing and industrialising countries.

8.5 Characteristics of the Candidate Country Eco-industries

- Total **Pollution Management eco-industries supply around 10.3 Bn euro of goods and services a year**, of which 5.5 Bn euro are investment goods and 4.8 Bn euro are services, including 'in-house' non-market services. Assuming Resources Management represents a further 20-30% of this figure, a low end estimate of the total eco-industry is approximately 13 Bn euro.
- The **most important environmental domain is the wastewater management industry**, which accounts for 35% of the market, followed closely by air pollution control at 30%. Solid waste management represents 20%. General environmental administration expenditure is significant at 13% of the market, reflecting the increasing role of staff in public administration.
- Overall, the Polish market, with total expenditure of around 3.8 Bn euro, constitutes almost a third of the Candidate Country Pollution Management market, followed by Turkey (2.6 Bn euro), Czech Republic (1.3 Bn euro) and Hungary (1 Bn euro).
- **Most Candidate Countries spend more on traditional end-of-pipe technology than on process integrated/cleaner technologies**. However, implementation of EU Directives such as IPPC will lead to increased investment in cleaner technologies.
- The **environmental *acquis* is the main driving force** behind each of the Candidate Country markets for environmental protection, particularly EU regulations such as the IPPC Directive.
- The **importance of international donor agencies**, programmes from the EU and elsewhere, as well as financial institutions, is critical to the future funding of environmental projects in Candidate Countries.
- Candidate Country eco-industries currently **run a trade deficit with the rest of the world**, although this appears to have **declined since 1995**. Indeed, these countries are gradually reducing the market share of other global eco-industry suppliers into the EU, and have doubled exports to the EU since 1995.
- **Growth in exports to the EU is dominated by the Czech Republic**, followed by Poland, which together account for over 74% of exports.
- Poland, Czech Republic and Hungary are the countries where domestic environmental technology production capabilities appear to have improved the most since 1995.
- The **average share of GDP spent on pollution management expenditure in Candidate Countries was 1.9%.**
- **Average per capita spend in the Candidate Countries is 66 euro**. This is a substantial rise since 1995 (possibly doubling), with **average growth of around 10% per annum**.
- **Average compliance time with the environmental acquis is 8 years**, although several countries have very demanding requirements if they are to meet compliance within the next 20 years.
- Average per capita spend in the Candidate Countries for pollution management is 66 euro.

- Environmental expenditure in the Candidate Countries has risen substantially since 1995 (possibly doubling).
- Average growth rates in market size are around 10% per annum.

8.6 Employment in Candidate Country Eco-industries

- Direct employment in the Candidate Country pollution management eco-industries is **around 770,000 (FTE) jobs,** of which 460,000 (60%) are operational-related and 310,000 investment-related. Direct operating-derived employment on average accounts for 0.7% of national employment. Including investment-derived jobs means that **total direct employment is equivalent to around 1% of total national employment in Candidate Countries**. However, due to the significant level of capital-related imports (and hence leakage of jobs to other exporting countries) this figure should be treated with a degree of caution.
- **Exactly 50% of operational employment is in the waste management sector**, whilst wastewater treatment accounts for 25% and air pollution control 8%. Environmental administration accounts for 17% of operational employment.
- Turkey, Poland, Romania, Czech Republic and Hungary have the largest direct employment. Investment related employment is dominated by Poland, Turkey and the Czech Republic, which together account for 73% of this employment.
- **Employment in the environmental sectors is generally increasing at a significant rate**. Future employment growth is expected to be greatest in waste management, wastewater treatment as well as in the formation of new (as well as the expansion of existing) public sector environmental institutions.
- **Overall, the trade deficit has led to jobs being displaced to developed exporting countries**, with the largest displacement of investment related jobs in those Candidate Country markets that are weak, both in domestic production (and export) of environmental technologies. However, this job displacement is reducing over time.

8.7 Relationship of EU eco-industries to those in Candidate Countries in the next 5-10 years

- The **continued demand for environmental technology investments in the Candidate Countries is unlikely to be fully met by domestic production capabilities**. This implies sustained employment for the EU overall, although individual Member States may well lose out.
- **EU firms will keep establishing joint ventures with domestic companies**, although fully-owned subsidiaries are likely to increase in the future. Also, consolidation within the sector and the purchase of promising Candidate Country firms by EU firms is highly likely.
- **Employment shifts from the EU-15 to the Candidate Countries** in the short term are most likely to occur in Poland, Czech Republic and Hungary since these are three of the largest markets; are rapidly expanding; have good domestic capabilities, especially in APC, WWT and WM; and are rapidly expanding their export capabilities.

- The **export performance of the Candidate Countries is likely to strengthen**, particularly from the most rapidly developing markets.
- **Export trade with the EU-15 is set to increase**, particularly in areas where the sales price is affected by labour costs. In particular, Candidate Country exports of end-of-pipe technologies are likely to increase, coinciding with a shift of EU exports towards cleaner technologies.

9.0 RECOMMENDATIONS FOR FURTHER WORK

Whilst this study continues to demonstrate the strengths in producing meaningful economic analyses of eco-industries through the use of environmental expenditure data, there are important considerations that need to be examined to further refine the approach. This study has also highlighted new areas of research that could help provide more insights into environmental employment, cleaner production, export support strategies and the future of eco-industries in the Candidate Countries. Recommendations for further work in these areas are set out below:

9.1 Data Availability & Collection

- There is a clear need to **obtain more expenditure data for private environmental management,** both in the EU-15 and CC-13 data. There is clear evidence of such practices (e.g. in establishing Environmental Management Systems, Environmental Reporting, Waste/Environmental Auditing etc.) across a wide range of industrial sectors, which are not likely to be picked up in the other environmental domains. Environmental expenditure surveys of companies will need to look more closely at how this data can be captured.

- Since only four EU Member States in this current study were able to provide any meaningful data on **renewable energy plant**, more expenditure data is required to complete the data collection framework. Many Member States report expenditure at the regional/municipal level, so there is a need for channelling this information through to the national level, perhaps to National Statistical Offices.

- **Discrepancies between Eurostat and National Statistics Office data** mean that a clear data recording framework should be devised. This will help eliminate double counting of expenditure. The PAC questionnaire for example could be elaborated to ensure full coverage of resources management expenditure.

9.2 Employment

- Further analysis needs to be done on the **impact of the eco-industries on aggregate employment**, for example, in the use of multipliers which take account of indirect employment impacts. Research into new techniques used in other countries outside the EU (e.g. USA) should also be carried out.

- To help **refine the Resources Management employment levels** for the EU, it is necessary to develop an engineering (employment) analysis for the sectors of recycled materials, renewable energy plant and nature protection.

- **The difficulty in producing accurate comparisons of environmental employment across Member States suggests that further research is required to design an easily transferable methodology**. Common standards could be adopted across National Statistical offices or other organisations investigating environmental employment, perhaps following the lead of France and

Sweden. A key issue is to clearly present items (e.g. public, private, pollution management, resources management etc.) so that differences in coverage become clear.

- **Investigate the actual proportion of expenditure relating to employment in Candidate Countries**. The use of an EU-based engineering analysis for the current study means that the actual contribution of labour for some types of capital projects may not be fully taken into account. Whilst ECOTEC have made every attempt to use accurate wage data (which directly affects the number of jobs in any one country), differences in the breakdown of costs for other expenditure items (e.g. for materials) have not been investigated. This means that less confidence should be attached to the Candidate Country employment data than the corresponding data for the EU-15. Better wage data needs to be obtained in future, and Eurostat may be able to facilitate in this area.

- **Examine the impact on EU and** Candidate Country **employment from growth in environmental expenditure in the Candidate Countries.** Trade code analysis between 1999 and 2001 could be examined in the near future, when the data is finalised by Eurostat. This would help clarify whether the apparent stabilisation of EU exports has really occurred and whether, as a result, jobs in the EU-15 are being affected. Additional investigations of prominent EU eco-industry firms, either working in or exporting to the Candidate Countries, could help clarify whether EU firms are setting up manufacturing facilities in large numbers across key Candidate Country markets (e.g. Poland, Czech Republic, Hungary) or possibly manufacturing EU technologies under licence. The potential long term effects of such action could therefore be better understood. Similar analysis of other large global environmental markets (e.g. USA, Japan, Brazil) could help confirm any trends.

9.3 Clean technology

- Whilst recent studies have helped take forward this area of eco-industries, there is a **need for more work into cleaner technology and cleaner production and their effects on eco-industry (supply side) jobs**.

- A further study needs to be carried out on the **size of the cleaner technology sector, its composition and drivers**. This could include a survey of companies to examine the marginal costs of installing cleaner technologies as well as resulting cost savings in operation. Close liaison with Member States (e.g. Statistics Offices in Finland, Sweden, UK etc.) is required since there are already annual surveys examining such issues. The large variation in the proportion of capex spent on cleaner technologies does suggest, however, that further pan-European studies are required. These could also shed light on the supply of clean technologies, and whether the EU is as competitive as other countries such as USA and Japan.

9.4 International Trade

- **Further investigation of the relationship between trade code analyses and real trade values is required**. This may eventually lead to the determination of a suitable "grossing up" formula that might be applied to the select number of environmental trade codes in Eurostat's COMEXT

database. Member state trade bodies will benefit greatly from having a better understanding of the true nature of exports, so that their resources can be more efficiently targeted at key exporting sectors (or to highlight underperforming sectors).

- **New research into the export potential of environmental services** is required to build up the knowledge of the total environmental export market for both EU Member States and the EU overall.

9.5 Monitoring the Eco-industries

- There is a **need to conduct a more regular review of both the domestic and export capabilities of eco-industries across all Member States**. This will help shed light on the structural changes occurring within respective industries. For example: the degree to which SMEs are improving their currently weak capability in export markets; the extent to which the sector is improving its knowledge base and transferring this to new product innovations; the impact of large integrated companies in the eco-industries; the impact of global supply chains; the take up of new skills and training etc.

- **Domestic-oriented environmental technology support schemes (e.g. accelerated depreciation on environmental capital investment) should be monitored** to see how effective they are in both improving the domestic eco-industry in Member States where they are in operation, and in acting as a catalyst to the take up of cleaner technologies (as opposed to having an end-of-pipe bias).

- **Export promotion strategies should be closely monitored and reviewed** to allow an analysis of the relative impacts of these different measures; to see if they are complementary; and whether they are effective, especially with respect to assisting the Candidate Countries.

9.6 Growth and Developments in the Candidate Country eco-industries

- Better information should be collected on the **potential for the Candidate Country eco-industries to efficiently provide the environmental goods and services necessary to meet the *acquis communautaire***. Currently the relationship between domestic and foreign supply is complex for some countries and unknown in others.

- **Establish better growth rates of environmental expenditure**. A significant amount of expenditure information covering a range of data years has been collected by ECOTEC. Whilst outside the scope of this current study, with substantial work and analysis, including data standardisation, this information could be further examined to provide a better understanding of developments in expenditure (and hence eco-industries) in the Candidate Countries. This in turn could help confirm the real impact of EU environmental legislation on the Candidate Countries.