Job Creation Potential of Clean Technologies

Study for the European Parliament

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Executive summary

The relation between environmental policies, clean technologies and their effects on the job market is subject to recurring discussion. For a long time these subjects have been perceived as conflicting and even contradictory, with business associations continuously quoting stricter environmental legislation as the reason for reduced revenues, job cuts or the move into countries with less strict environmental legislation. However, this perception has changed due to increasing evidence that the introduction of new environmental policies can actually contribute to job-creation. In the past years, discussions in the EU policy arena have increasingly addressed, highlighted and strengthened the relation between environmental protection and the generation of employment opportunities. Results of these discussions are expressed in several treaties, strategies and initiatives, including the Amsterdam Treaty, the Lisbon Strategy, the European Sustainable Development Strategy or the European Research Programs.

Commissioned by the European Parliament, Ecologic, Institute for International and European Environmental Policy conducted the following study on the job creation potential of clean technologies. Economic areas were identified which are characterised by a strong impact of environmental policies. In particular, the study analyses the following areas:

- Job creation in the energy economy;
- Employment effects of maximum pollution standards in the automotive industry;
- Employment in the field of transport infrastructure;
- Jobs generated in the field of the conservation and restoration of natural resources;
- Job-intensive farming;
- Environmental audits: consultation and planning; and
- Environmental Research and Development.

For each sector the study analyses the national backgrounds within the European Union and recent policy developments on the national and European level. Building on national experiences, relevant literature and studies, brief assessments are given about the job creation potential of each sector.

While it is difficult to quantify the exact implications of the use of clean technologies on employment, the analysis of all sectors shows a general trend towards positive effects. In many cases job creation was triggered by funding initiatives from national or European authorities, as is demonstrated in the case of natural resource conservation and restoration.

In addition, a conducive political framework, which includes the further development of certain environmental policies as well as the according advancement of employment policy are decisive for the job creation potential of clean technologies. Therefore, the study concludes that the integration of both policy fields is a key

requirement to exploit the job creation potential of clean technologies. Yet another issue are spill-over effects to other markets: Jobs created in the environmental sector frequently trigger the creation of jobs in other, related sectors up and downstream in the supply chain.

Furthermore it should be pointed out that a large number of jobs depend on an intact environment, as for example in eco-tourism and sustainable agriculture, as the success of these industries is heavily contingent on efforts to conserve and protect natural resources. Finally, the development and stronger promotion of clean technologies through environmental legislation contributes to innovation and thus to increased (eco-) efficiency and competitiveness throughout the European Union.

While the linkage between jobs and environmental policy undoubtedly exists, identifying evidence and assessing the impacts are major undertakings. Therefore, the study recommends to analyse the respective connections in more detail to enable sound decision-making at the interface of environmental and employment policies.

On the conceptual side, the link between environmental policies, the introduction and development of clean technologies and the ensuing effect on jobs should be discussed and investigated more systematically. Also of help would be the creation of a database of actual effects of environmental policies and clean technologies, including sound numerical data. To this end, in-depth studies need to diligently separate the effects of the introduction of clean technologies from other employment-effective developments. Moreover, it is crucial to develop methods for valuation and quantification taking into consideration ancillary as well as adverse effects. At best, this would be undertaken for a wide range of member states accounting for the different economic backgrounds, thus providing a sound analysis of necessary pre-conditions and circumstances for positive effects of the introduction of clean technologies and environmental policies on job creation and employment.

In conclusion, the effects of environmental policies and particularly of clean technologies on the creation of jobs and employment in the European Union are gaining more and more in importance. However, job creation through environmental measures alone cannot solve the current employment problems in the European Union. Moreover, progress in environmental policies and clean technologies should not alone depend on their immediate beneficiary effect on employment and job creation.

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1. Introduction

1.1 The Job Creation Potential of Clean Technologies

The relation between clean technologies, environmental policies and the creation of jobs is subject to recurring discussion on the national as well as the European level. For a long time these subjects have been perceived as conflicting and even contradictory, with business associations continuously quoting stricter environmental legislation as the reason for reduced revenues and job cuts. In the meantime, these perceptions have changed due to increasing evidence that the introduction of new environmental policies can actually contribute to job-creation.

For job creation through environmental policy, clean technologies play a vital role. This is due to the fact that the development and use of clean technologies offer opportunities to replace the consumption of (imported) natural resources with the expert knowledge and entrepreneurship of engineers and other high-skilled jobs, thereby contributing to (1) saving money, (2) protecting the environment, and (3) creating jobs at the same time. Furthermore promoting clean technologies stimulates innovation on a broad scale, which is likely to result in economic growth and job creation as well. The report will provide an overview of recent developments in this sector.

In a broader context, jobs are also created in sectors which are less based on technological developments, but highly influenced by environmental politics, legislation and funding schemes, such as agriculture, natural resource protection, environmental auditing and research. The job creation potential in these sector will also be discussed accordingly.

1.2 The European Policy Background for Job Creation through Clean Technologies

In the past years, discussions in the EU policy arena have increasingly addressed, highlighted and strengthened the relation between environmental protection and the generation of employment opportunities. In general, it can be said that this was triggered by problems with increasing unemployment on the one hand and the development of a strong policy agenda on the environment on the other. In particular the following EU policy developments can be considered as decisive for the past, current and future developments in both areas.

In 1997, the newly signed Amsterdam Treaty gave renewed impetus to employment and the environment likewise. The new Treaty included a new objective on employment (“a high level of employment") and a stronger commitment on the environment (“sustainable development”). In order to reflect this new development, not only various initiatives to take employment and environmental policy forward, but also a Commission communication combining the two, referred to as the ‘Commission communication on environment and employment’, were issued. This communication outlines how environmental protection can contribute to job creation

and how environmental policy and employment policy can mutually reinforce each other.[1]

With the launching of the Lisbon process in 2000, both topics attained renewed political attention. The Lisbon strategy aims to make Europe "the most competitive and dynamic knowledge-based economy in the world" by 2010 through sustainable economic growth with more and better jobs and greater social cohesion. In 2001 the Lisbon process – until then consisting of an economic and social pillar – was completed with adding the European Sustainable Development Strategy to the Lisbon process as its environmental pillar. With this strategy, the EU has underlined its aim to promote economic and social development while protecting the environment.

With the mid-term review of Lisbon scheduled for 2005, the 2004 spring report[2] emphasises the need for continued action. To this end, synergies between enterprise and the environment should be used to allow for economic growth that brings broader benefits while minimising environmental damage. One of the most prominent initiatives to create synergies between environmental protection and economic growth is the "Environmental Technologies Action Plan".[3] According to this European strategy, efforts are to be directed at "stimulating the development and marketing of innovations that contribute to an eco-efficient economy, which in the longer term could provide the European economy with a strategic lead and increased productivity".

This overall European policy approach is also re-emphasised in the declaration on the occasion of the Dutch EU presidency for the second term of 2004.

In addition, the Commission has announced to table a white paper on "Environment and Employment" this year, which is expected to outline the Commission's approach to strengthening activities in this area. Yet it remains unclear when the Communication will be issued.

1.3 Job Creation through Clean Technologies

As outlined above, the Lisbon strategy as well as recently issued policy documents advocate eco-efficiency as an important condition for creating a competitive and sustainable European economy. The promotion of clean technologies is considered a key component towards more eco-efficiency and therefore attracted renewed interest as a way of operationalising the concept of sustainable development so as to strengthen the environmental dimension in the Lisbon process. In the following paragraph the potential for job creation through cleaner technologies and eco-efficiency will be described.

[1] Communication from the Commission on Environment and Employment (Building a Sustainable Europe). COM(1997) 592 final.
[2] Report from the Commission to the Spring European Council, Delivering Lisbon – Reforms for the enlarged Union.
[3] Communication from the Commission to the Council and the European Parliament: Stimulating Technologies for Sustainable Development: An Environmental Technologies Action Plan for the European Union. COM(2004) 38 final.

1.3.1 What are Clean 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".*

In addition to this, it is also possible to identify cleaner technologies as a distinct approach that differs from more traditional end-of-pipe technologies, instead following a more integrated approach to reducing environmental pressures. This distinction is also made by the European Commission:

> *"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".*

This definition highlights the attraction of cleaner technologies: they reduce production costs by improving process efficiencies. This means that investment in cleaner technologies occurs mainly through replacing or optimising existing systems and equipment thus at the same time bringing about environmental benefits as well as efficiency gains, whereas end-of-pipe solutions represent additional investments in almost all cases. The use of cleaner technologies therefore triggers efficiency, thus presenting a means of implementing the concept of eco-efficiency.

As an example, cleaner technologies can help to achieve a sustainable development in the following ways:

- Using primary energy and raw materials more efficiently,
- Systematically recycling products and waste,
- Designing durable products,
- Giving preference to renewable energy resources and raw materials.

1.3.2 How do Clean Technologies Generate Jobs?

One main argument in favour of the eco-efficiency concept and thus clean technologies is the so-called "triple dividend". First, eco-efficiency helps to diminish resource consumption and thus reduces pressures on the environment. Secondly, it increases efficiency in the production process and therefore reduces costs. Thirdly, it enables a higher labour input in the production of goods and services, and thus creates employment. This idea is expressed in the concept of the win-win-win-situations that eco-efficiency aims to achieve to replace the consumption of (imported) natural resources with the expert knowledge and entrepreneurship of engineers and other high-skilled jobs, in order to protect the environment, save money and create jobs at the same time.

However, while this connection is largely a theoretical one, the empirical reality for the job creation effects are more uncertain. The interactions between environmental policy and employment have been the subject of research in the past. For the case of Germany, for example, current research suggests that up to one million people are employed in the environmental sector. However, these jobs are mainly associated with classical “additional” measures, such as the manufacture of end-of-pipe technologies, remediation of contaminated lands, or the recycling of waste.

However, the idea of eco-efficiency suggests a more integrated approach to environmental protection measures, whereby environmental pressures are reduced at all stages of the product life cycle – from design to production, from their use to the disposal or recycling. For such integrated measures, however, the impact on employment generation is much harder to identify.

Analytically, the employment-generating effects of cleaner technologies can be distinguished into first-order and second-order effects. First-order effects arise directly from the development, design, the production, implementation, use, and the disposal of the technology or the product that embodies the technology. In addition, second-order-effects may arise from the effect that the product or the technology has on other sectors.

Examples of first-order effects include:

Scientists and engineers involved in the development of new energy-efficient household technologies;

Labourers producing cars with a higher fuel-efficiency, or farmers producing organic foods;

Construction workers installing solar heating systems on private homes;

Engineers optimising the energy consumption of firms and plants;

Mechanics that check vehicle engines in order to minimise pollution;

Workers involved in the disassembly of old cars to be recycled into new products.

Examples of second-order effects would be:

While the direct employment arises from the development, the manufacturing or the application of clean technologies, indirect effects arise at the firms that manufacture intermediate inputs and components. Thus, for example, while steel manufacturing would not normally be considered as a prime case of an eco-efficient industry, the wind energy sector has now become one of the largest steel consumers in Germany. Thus, the generation of wind energy helps to support jobs in German steel mills. Such effects can be modelled e.g. through input-output models.

Sectoral shifts within the economy may arise as eco-efficient sectors receive more (economic or political) support. While political support mechanisms, such as the promotion of renewable energies, lead to additional employment in one sector (e.g., wind energy and photovoltaics), these gains will be offset by reductions in other sectors (conventional, fossil-based energy generation).

Clean technologies and the mechanisms in place to support them may lead to a shift in relative prices, which has ambiguous effects on the environment. E.g., if the

support of renewable energies leads to an increase in energy prices, this will place an additional burden on energy-intensive businesses, and may put employment there at risk. At the same time, increasing energy prices create a market opportunity for intelligent energy-saving technologies, which may give rise to job creation in this field.

1.3.3 What Kinds of Jobs are Created through Clean Technologies?

In order to describe the job creation effects of clean technologies, it has to be recognised that not all types of jobs are equally desirable from an economic point of view. If the additional labour input that clean technologies require is financed through resulting economies in the production process, there is a triple-win situation: the firm increases its profitability; the consulting engineer gains or consolidates his job; and the environment benefits from reduced emissions.

This may not be the case for the traditional, end-of-pipe technologies, where the economic viability may be questionable. Analytically, the support of such jobs may result in a win-win-lose situation: the environment gains through reduced emissions, the engineer through employment, but the economy loses as the expenses on emission control are not balanced by economic gains in other parts of the production process.

A related distinction can be made in relation to the public support given to particular sectors, or to the employment generated in these sectors. Many examples of cleaner technologies may not be economically feasible from the beginning, as these technologies face higher initial learning costs than traditional technologies. Technological development is a path-dependent process, where new developments depend on the inventions of the past. To change this path therefore requires ongoing, active support, not least through funding and employment. This consideration can be an argument for initial and temporarily limited support mechanisms, which allow the technology to mature. However, eventually technologies – and the employment they generate – have to be economically self-supporting.

A further aspect to consider is the knowledge-intensity of the jobs that are being created through clean technologies. Ideally, the development of clean technologies should contribute to building up technical know-how and experience in the efficient use of natural resources, which will eventually give European manufacturers a competitive advantage over their competitors overseas.

By contrast, clean technologies may also give rise to employment opportunities in the form of manual labour, e.g. in the disassembly and recycling of used products. However, such jobs are much more exposed to job competition from low-wage countries.

1.4 Methodology

1.4.1 Selection of sectors

The methodology adopted for this report features evidence on job creation through the adoption of environmental policies or the introduction of clean technologies in a number of selected sectors.

These sectors include highly technology-based sectors, such as the automotive industry, the energy industry as well as the transport sector. The processes and limitations pertaining to job creation through clean technologies are outlined above.

Sectors which are less based on or influenced by technological developments but highly sensitive to environmental politics and legislation are agriculture as well as the conservation and restoration of natural resources. In these sectors, the introduction of legislation foreseeing a more sustainable management of natural resources has necessitated and created new employment opportunities. In this respect it should be highlighted that the sustainable management of natural resources constitutes an important pre-condition for organic farming. Therefore the creation of jobs in this sector might be highly contingent on activities in the other.

Additionally, ancillary sectors, such as environmental auditing and environmental R&D were investigated in view of the employment opportunities created through new requirements established by EU legislation or new funding opportunities provided through the EU research funding schemes.

1.4.2 Structure of sector reports

For each of the sectors, a brief description of its most important aspects and co-ordinates is provided. Where possible, the current employment situation is presented as well as the types of jobs available. In a second steps, the most important recent policy developments on the European level with implications for job creation in that sector are described. Current and future job creation potentials in the sectors are highlighted through evidence provided by selected case studies for each of the sectors or data obtained for all of Europe where available or individual member states in other instances.

Finally, for each of the sectors, a conclusion summarising predominant tendencies and current developments with respect to job creation is provided.

1.4.3 Limitations of the study

Due to the limited scope of this study, providing a comprehensive picture of the job creation potential through clean technologies was not possible. The selected sectors only allow for a limited picture of the economy and possible opportunities for the generation of jobs through cleaner technologies.

Also, the situation in each of the sectors could not be represented in its entirety, but was approximated using case studies from different member states or data, which was readily available.

While this limited scope of the study only allows for a snapshot of the current situation in Europe in regards to job creation through clean technologies, it still allows for the detection of a certain tendency in this respect, which is described in the conclusion chapter in greater detail.

2 Job creation in the Energy Economy

The energy sector is vital for western European economies and societies. However, it is also a large user of resources and the basic driving force behind climate change and air pollution problems. Despite the fact that Europe actually produced more energy, the 1990s saw some progress in reducing the environmental impact of the energy sector. At present the gradual opening up and reorganisation of energy markets might also contribute to an increased use of clean and efficient technologies and thus less pollution. In addition, spill-over effects on the employment market, namely in Research and Development, manufacture, operating and maintenance, are anticipated. This is due to the major changes in the energy sector. Here, trends bring about shifts towards more environmentally friendly energy sources, namely renewable energy systems. Also, conventional energy production systems are altered by the use of end of pipe technologies and efficiency improvements. In addition, a strong development in energy efficiency took place on the demand side. While all these developments have repercussions in the job market, focus will be laid mainly upon the job creation potential of renewable sources of energy (RES). This is due to the availability of statistical data and the political priority given to this sector.

2.1 Renewable Energies in Europe

Characterised by low emissions and resource use, RES have an important role in addressing the growing concerns about dependency on energy imports in Europe and in tackling climate change. In several countries, the renewable energy sector has experienced high growth rates in the last decades and it seems likely that the pace will continue. This growth was underlined by national targets for renewable energy production and a large number of supporting programmes and legislation in the Member States, including feed-in tariffs, green certificates, market based mechanisms and tax exemptions. However, the ambitions differ among member states. According to DG Energy and Transport, Denmark, Finland, Germany, and Spain have initiated energy policies that should allow them to achieve their national targets in producing green electricity. However, while some countries, including Austria, Belgium, France, Ireland, the Netherlands, Sweden and the United Kingdom, have started to implement appropriate policies that could allow them to reach their national renewable objectives, other member States, such as Greece and Portugal need to strengthen their efforts. [4] However, high growth rates in the renewable energy sector are generally expected to continue, as countries such as Austria and France still have significant yet unused resources for wind, biomass, geothermal

[4] European Commission, Directorate-General for Energy and Transport, *Renewable Energy to take off in Europe?*, Brussels, 2004. Online available at: http://europa.eu.int/comm/energy/res/documents/country_profiles/2004_05_memo_res_en.pdf.

energy etc.[5] In particular the new Member states, such as Hungary Estonia, Lithuania and Poland have not yet exploited their potential for RES.[6]

Yet another issue, renewable energies are frequently seen as a key export into other countries. Given the growing energy needs of emerging markets, such as China and India, and the existing need for access to energy in most developing countries, RES are regarded as having great potential for commercialisation and sale on the world market.[7] Generally, the potential for export can be seen as a major driving force in all efforts to green the energy sector, not only in regard to RES. For instance advances in low CO2 emitting combustion technologies and higher conversion efficiency in electricity production from hard coal and ignite aim at both reducing European carbon emissions and capturing a larger portion of the growing world electric power market.[8]

2.2 Core EU policies and recent developments

There are several important legislations regarding renewable energies that have been adopted in the last few years. All of them have to be viewed against the objective to liberalise the European gas and electricity markets[9], which aims also to support the participation of new market entrants, such as renewable energy power producers.

The promotion of electricity from renewable sources of energy is a high Community priority for several reasons, including the security and diversification of energy supply, environmental protection and social as well as economic cohesion. In 2001, the Directive 2001/77/EC on the promotion of electricity from RES was adopted, setting out a target of generating 22% of EU-electricity from renewable sources by 2010. While this directive concerns electricity produced from non-fossil renewable energy sources, there are other directives, such as Directive 2003/30/EC of May 2003, on the promotion of the use of renewable fuels for transport.

In addition to the legislative measures, the Commission also took other political and promotional measures to advance its energy policy. For instance, in May 2004, the Commission adopted a Communication on “The share of renewable energy in the EU” which evaluated the progress in the EU15 to achieve the 2010 targets. As the Commission considered the efforts made to be insufficient, it called for the wind energy success in three Member States to be applied to the rest of the EU, including feed-in tariffs, green certificates, market based mechanisms and tax exemptions. Furthermore, the Commission proposes that the promotion of renewable energy sources be fully integrated in the structural and cohesion funds as well as EU international co-operation programmes. In addition, the Commission promised to

[5] Commission of the European Communities, *The share of renewable energy in the EU [Com(2004)366final]*, Brussels, 2004, p. 5 and 34.
[6] Ebd., p. 50.
[7] See Environment California Research and Policy Center, *Renewable Energy and Jobs*, Sacramento, 2003. Online available at http://www.environmentcalifornia.org/reports/renewables_jobs_7_03.pdf; Runci, PJ, *Energy R&D in the European Union*, Washington D.C. 1999, p.6.
[8] Runci, PJ, *Energy R&D in Germany*, Washington D.C., 1999, p. 16.
[9] It is called for the liberalisation of the gas and electricity markets by 1 July 2004 for industry and by 1 July 2007 at the latest for domestic consumers.

bring forward further actions, in particular a co-ordinated biomass plan to enhance biomass energy development, a strengthened effort in favour of biofuels or an assessment for an off-shore wind policy.

2.3 Job creation in the Energy Economy

There are a larger number of studies that focus on job development linked to growth in the renewable energy sector. A report to the European Commission in 2000 looked at the employment impacts of energy efficiency investment programmes, focussing on effects on direct employment resulting from the manufacture, installation and operation of energy efficient products and processes. The report comes to the conclusion that the employment effects of energy efficiency programmes were almost always positive and that the jobs were often in sectors, locations and skill groups that are prioritised in employment policies, such as manual occupations in the residential sector, engineers, consultants and technicians. However, it also pointed to the fact that the number of jobs created is typically small for the size of investments. Therefore the report concludes that the creation of employment can be regarded as a desirable side effect of programmes, but should not be the primary objective.[10] In its communication "Energy for the future", the Commission cites several sources for the creation of jobs expected with the growth in the renewable energy sector: Detailed estimations of net employment have been made in the TERES II study.[11] For 2010 a net employment of 500.000 jobs directly created in the renewable energy sector and indirectly in the sectors that supply the sector are expected.

Sectoral estimations have been made by the respective industry associations: The European Photovoltaic Industry Association (EPIA) estimates that a 3 GWp installed power in 2010 will create approximately 100,000 jobs in the PV sector; The European Biomass Association (AEBIOM) believes that the Biomass employment will increase by up to 1,000,000 jobs by 2010 if the biomass potential is fully exploited[12]; and the European Solar Industry Federation (ESIF) estimates that 250,000 jobs will be created. The European Wind Energy Association (EWEA) estimated that the jobs created in 2010 by the wind sector will be between 190,000 and 320,000, if 40 GW of wind power is installed.[13] These would be mainly concentrated in a few countries, as Germany, Denmark and Spain account for more than 90% of the wind turbine manufacturing.

According to the EWEA, both long-term commitment from EU and national R&D programmes have strongly contributed to Europe's dominant position in the wind

[10] Wade, Joanne, Wiltshire, Victoria and Scrase, Ivan, *National and Local Employment Impacts of Energy Efficiency Investment Programmes, Final Report to the Commission April 2000 Volume 1: Summary Report*, 2000, p. 6.
[11] See http://www.eurorex.com/teresii.
[12] EPIA, "Photovoltaics in 2010", European Commission, 1996; Statement of AEBIOM on the Green Paper of the European Commission, February 1997; here all from: Communication from the Commission Energy for the future: Renewable sources of energy – White paper for a community strategy and action plan [COM(97)599final(26/11/1997)]p. 12-13.
[13] EWEA Strategy Paper '97, ALTENER publication 1997; here from: Communication from the Commission Energy for the future, op. cit., p. 12.

power industry. As a result, 70% of global wind capacity is installed in Europe, and European companies make 90% of the turbines sold worldwide. Also, Europe is leading an entirely new technology frontier in offshore wind development and deployment.[14] Industry thus states that there is still much need to support R&D in wind energy development[15], which is mainly the message from all actors working in the renewable energy sector. If the existing growth rates and the leadership in the world market are to be maintained, further increase in efficiency and technological progress are needed. In other words, industry does not only emphasise the job creation potential of research and development in the energy sector itself. In contrast, industry associations usually point to the total employment related to the renewable energy sector, which is suggested to hinge upon Europe's technological lead in the world market.[16]

2.4 Conclusions

In conclusion, the transformation towards a more environmentally friendly energy sector is highly linked with employment. While it is not possible to reach any hard conclusion about the likely cumulative level of job creation which would derive from investments in energy policies and programmes, it is quite clear that a pro-active move towards such energy sources will lead to significant new employment opportunities. Given the number of countries that are characterised by a large potential but a low utilisation of renewable energy sources, one can expect the renewable energy sector to continue its recent growth in the near future.

Also there are additional economic benefits for the European renewable energy industry to be expected in international markets. In most technical areas, European Industry in this field is leader in providing equipment and technical, financial and planning services. This therefore offers significant business opportunities for exports and possibilities for expansion of the European renewable technologies industry.[17]

[14] EWEA, *The European Wind Industry Strategic Plan for Research and Development. First Report: Creating the Knowledge Foundation for a Clean Energy Area*, Brussels, 2004, online available at: http://www.ewea.org/documents/R&D_first_report_jan04.pdf, p. 5.

[15] This was also the message from the IEA R&D report: Long Term Research and Development Needs for Wind Energy for the Time Frame 2000 to 2020. The report states that, although costs have already fallen dramatically, if wind energy is going to supply 10% of the world's electricity needs by 2020, cost reductions in the technology of 30 to 50% is still necessary. Research and development work could contribute up to 40% of those cost reductions. Here from EWEA op. cit., p. 3.

[16] See for instance: Bundesverband Erneuerbare Energie e.V. (BEE), *Beschäftigungseffekte durch den Ausbau erneuerbarer Energien bis zum Jahr 2020*, Paderborn, 2004. Online available at: http://www.bee-ev.de/bee-homepage-neu/pdf/Beschaeftigungseffekte1.pdf.

[17] Communication from the European Commission, *Energy for the future: Renewable sources of energy – White paper for a community strategy and action plan [COM(97)599final(26/11/1997)]*, Brussels, 1997, p.13.

3 Employment effects of Maximum Pollution Standards in the Automotive Industry

The automotive industry is one of the core industries in the EU. In 2001, 38 % of the global car production took place in the EU, a total of 20,043,564 motor vehicles. The automotive industry plays an important economic role in almost all Member States. In six EU Member States, more than one million cars are produced each year: Germany (5,4 million mv), France (3,6 million mv), Spain (2,8 million mv), UK (1,7 million mv), Italy (1,6 million mv) and Belgium (1,1 million mv). In 2002 the net exports of cars to non-EU countries amounted to 3,4 million units, representing a value of € 36,4 billion.

For the EU-15 as a whole, the transport sector employs approximately seven million individuals[18]. Manufacturers of motor vehicles and of bodies for motor vehicles employ approximately 2 million people. Indirect employment linked to the motor vehicle sector reaches an estimated 10 million workers, including activities such as recycling, sale, repair and maintenance, land transport, construction of highways and roads[19].

At the same time, motor vehicles are responsible for a considerable part of environmental pressures in the European Union. In 2001, about a quarter of the transport-related CO_2 emissions of the EU-15 were caused by road transport.[20] Moreover, CO_2-emissions from road transport have been rising constantly for the last decades (24 % from 1990 – 2001), whereas the emissions from industry and households have remained stable or have even decreased over the last decade. In this sense, despite increases in the technical efficiency of engines or the use of clean fuels, the growth in road transport can be regarded as one of the main driving forces that complicate the fulfilment of European climate targets.

3.1 Recent clean Technology developments in the sector

There are several points where clean technologies come into play in the automotive industries. Efforts are undertaken to reduce emissions from cars either by increasing the efficiency of combustion processes, including hybrid vehicles, by moving towards cleaner fuels, e.g. natural gas or mineral fuels with a reduced sulphur content, or by introducing filter systems, such as particle filters for diesel-powered engines. At the same time, there are also research efforts to move away from the combustion of fossil fuels altogether, e.g. by replacing combustion engines with fuel cells on a hydrogen basis, or through an increased use of biofuels. Finally, aside from the question of fuels, there are efforts to improve the environmental performance of cars

[18] European Commission and Eurostat, Panorama of transport - Statistical overview of transport in the EU - Data 1970-2001, 2002.
[19] ACEA, *EU 15 – Economic Report*, 2004.
[20] European Commission and Eurostat, Panorama of transport - Statistical overview of transport in the EU - Data 1970-2001, 2002.

over their entire life cycle, e.g. by reducing the use of solvents in coating or by facilitating the recycling of parts from old cars.

Legislators in most regions of the world have been significantly tightening their motor vehicle regulations to address environment and health concerns. Policies include the program “Clean Air For Europe” (CAFE) and the Auto-Oil-Program I and II of the European Union, which imposes stricter limit values for light vehicles 2005 (Directive 98/69/EC) and for heavy duty vehicles 2005 and 2008 (Directive 1999/96/EC).

3.1.1 Sulphur in Liquid Fuels Directive

The Council Directive 93/12/EEC relating to the sulphur content of certain liquid fuels (in gas oils and diesel fuels) regulated permitted content of sulphur for diesel oils and gas oil with the exception of aviation kerosene.[21] This requirement has necessitated additional investments primarily in refineries, which had to change their configurations in order to meet the quality requirements for low-sulphur fuels. WRc (2000) estimates that this process has created 84,000 full time equivalent jobs.

3.1.2 Directive on end-of-life vehicles

For the proposed directive on end-of-life vehicles cost estimates are based on evaluations of the man-hours of work required for complying with the Directive. The evaluations are based on studies for the Netherlands, France, UK and Denmark. The best estimate is that the work required per end- of-life vehicle (ELV) for dismantling is 0.75 man-hours for complying with the target for 2005 and 2 man-hours per ELV for the 2015 target. Investments in transforming existing dismantling capacity into environmentally friendly plants are estimated to be 45 Euro per ELV (FAR/ARN BV (1996).

The qualified environmentally friendly treatment, dismantling and reprocessing of ELV is a labour-intensive process. Further labour requirements arise from the necessary investments. WRc (2000) estimates the direct and indirect job creation effect of the proposed ELV directive at 6,100 full time equivalent jobs in 2005 and 18,500 jobs in 2015.

3.1.3 Directive on air pollution from motor vehicles

The Directive on air pollution from motor vehicles (98/69/EC) introduced emission limits for passenger cars and light commercial vehicles in 1998. The emission standards have since been developed in regular intervals. Currently, a formal proposal by the Commission on a new stage of emission limits – Euro V – is anticipated for the end of 2004.

A related Directive has also been introduced to support measures against air pollution from heavy-duty-vehicles (1999/96/EC). This Directive follows a similar approach, also incorporating emission limit values that are developed in regular intervals. Currently, the Euro VI stage of limit values is being discussed, which would enter into force in 2008. A particular focus of the new stage would be the issue of particulate matter.

[21] The Directive was amended by two Directives, 98/70/EC and 99/32/EC.

In this context, the German government has decided to promote the usage of particle filters in diesel powered motor vehicles by the means of tax abatement (600 EUR). Together with the rising demand for diesel powered vehicles, this will substantially raise the demand for particle filters, with the consequence of falling costs. The market volume in 2008 is assessed at € 1.1 billion. The second big push for the particle filter market is expected for 2010 with the introduction of the EURO V norm, which the German government is seeking to link with the particle filters.

3.1.4 Other clean technologies in the motor industry

In addition, several technologies are under development that will lead to cleaner combustion of fuels in cars, exchange fossil fuels with cleaner biofuels, or that will reduce the overall fuel consumption of cars. These technologies include:

- fuel cell technologies (hydrogen-based or other);
- hybrid technologies;
- biofuels.

While these technologies can be qualified as clean technologies, they are currently not the subject of European legislation. Nonetheless, initiatives and projects are funded by the European Union to promote these technologies. Especially in the field of research and development for hydrogen technologies, the European Commission has taken a leading role, with the long term objective of transforming the EU to a hydrogen-based economy. To achieve this, an action plan is expected in the near future. Furthermore, a directive aimed at increasing the share of greener, alternative automotive fuels up to 2020 is currently under development. The directive would require member states to produce action plans, and could set alternative fuel use targets for 2010, 2015 and 2020. It would also contribute to achieving the target set by the 2000 Commission green paper on energy supply that one of five vehicles circulating in European cities in 2020 should run on biofuels or substitute fuels.

Some legal initiatives are expected for the future that may support the development and take-up of cleaner technologies in the automotive sector. These include the proposal for a directive on the public-sector purchasing of “green” vehicles, which would require public authorities to provide comprehensive information and services for purchasing clean vehicles and alternative fuels for public procurement offices.

3.2 Conclusions

There is some evidence that the European legislation on emission standards for motor vehicles has contributed to the creation of high-skilled research jobs at car manufacturers. Likewise, initiatives such as the directive on end-of-life vehicles can lead to the creation of some employment in the disassembly and recycling of old cars; such jobs would mainly involve low-skilled labour.

However, as with other manufacturing sectors, the greening of technologies in the automotive industries has largely become integrated into the production chain. Therefore, it is difficult to distinguish between that part of employment in the automotive R&D that is primarily due to the development of clean technologies, and

the remainder that stems from the “normal” technological development of combustion engines. An obvious example would be the work of engineers whose task it is to increase the efficiency of combustion engines – whether this work is done to increase the overall performance of an engine, or to meet stricter pollution standards, will often be impossible to tell.

Likewise, the impact of clean technologies in the car manufacturing industry is ambiguous, as the industry does not only stand to gain from the move towards cleaner industrial production. While the development of clean technologies, new fuels and more efficient engines may give the European automotive industry a competitive advantage in times of high and rising fuel prices, road transport as a whole is set to lose in importance if more sustainable modes of transport are to be developed (compare also chapter 4). Thus, a Greenpeace study commissioned to the Prognos institute,[22] which assessed the employment impact of moving towards a more ecological economy in Austria, Germany and Switzerland, sees the manufacture of vehicles as one of the biggest losers. Including indirect losses, the study estimated job losses of 1,300 in Austria, 41,000 in Germany and another 1,200 in Switzerland. These losses are only partly compensated by increases in the transport industry. However, it should be noted that the Prognos study did not assess the impact of an individual regulation mandating stricter pollution standards, but rather the impact of moving towards a more ecologically oriented mode of production altogether, leaving aside the choice of the policy instruments to achieve this state.

[22] Greenpeace (ed.): Mehr Arbeitsplätze durch ökologisches Wirtschaften? Eine Untersuchung für Deutschland, die Schweiz und Österreich. A Study by the Prognos-Institute, commissioned by Greenpeace. Greenpeace: Hamburg, 1999.

4 Transport Infrastructure

The transport sector is one of the largest and fastest-growing sectors in the European Union. For the year 2000, the EU-15 reported personal consumption of transport by households as nearly €700 billion – just over 14% of total household expenditure.[23] For those of the EU-15 countries that reported data on employment, the total employment in the transport sector equalled 5,66 million people. For most Member States, between a quarter and a third of the total employment is in the road freight transport, with another 10 to 20% in the rail transport sector.

At the same time, the environmental impacts of the transport sector are considerable. In 2001, 28.7 % of CO_2 emissions of the EU-15 were caused by the transport sector, of which the largest part (24 %) was due to road transport.[24] Moreover, emissions from the transport sector have been rising constantly for the last decades: while the total CO_2 emissions from households have remained stable for the period from 1990 – 2001, and while the emissions from industry have decreased by about 12 %, the emissions from transport have increased by about 24 % in the same period. Thus, the fact that total CO_2 emissions in the EU-15 have increased by about 3 percent can largely be attributed to the development of the transport sector.

Apart from CO_2 emissions, the environmental impacts of the transport sector include resource consumption, emissions of airborne pollutants such as NO_x, VOC, SO_2 etc., noise emissions, land-use and sealing through infrastructure, and accidents.

There are different strategies to reduce the environmental impact of transport, with the ultimate goal of decoupling growth in transport from the associated environmental impacts. In practice, most of these approaches tend to be pursued in parallel, possibly with the exception of the last approach.

One strategy is to increase the technical efficiency of cars and engines, with the aim of reducing fuel consumption and emissions (see also 3);

A related approach is to increase the systemic efficiency of the transport sector, e.g. by reducing congestion, or by avoiding deadhead transport through improved logistics

Another approach is to shift the “modal split”, i.e. the distribution of transport volumes between road transport, public transport, air transport and shipments, with the aim of transferring more transport volume to environmentally friendly modes of transport.

Finally, a further possibility is to reduce the volume of transport altogether by eliminating “unwanted” or “unnecessary” transport.

Transport infrastructure has a significant impact on the environmental performance of the transport sector, and plays a crucial role for any of the strategies listed above. This is most obvious for policies that aim at shifting the modal split: e.g., the

[23] European Commission Directorate-General for Energy and Transport in co-operation with Eurostat, ‘European Union Energy & Transport in Figures 2002’.
[24] Ibd.

construction of the high speed train link between Paris and Lyon eliminated the need for plane connections between the two cities. More recently, similar effects have been observed with the introduction of the AVE between Madrid and Seville, and with the Thalys connecting Paris and Brussels.

A link can also be made between infrastructure projects and strategies that improve the systemic efficiency. However, the environmental impact of such measures may be ambiguous, e.g. in the case of new roads, which help to reduce congestion and thereby benefit the environment, but which may also create more traffic in the medium to long term.

4.1 European Policies with an Impact on Employment and Environment in the field of Transport Infrastructure

The European Union disposes of several policy instruments that have an influence on transport policy, infrastructures and employment in the transport sector. The most important of these are the EU regional policy instruments – the structural funds and the cohesion fund.

4.1.1 The EU Structural Funds

The European Union operates four Structural Funds which are used to channel financial assistance in order to reduce inequalities between different regions and social groups and to alleviate structural economic and social problems. The four structural funds relate to Development, Agriculture, Fisheries, and the Social funds. Of these, the European Regional Development Fund (ERDF) is applicable to public transport investments. Its resources are allocated to disadvantaged regions according to the Structural Funds' objectives. The ultimate aim of assistance from the ERDF is to create jobs by fostering competitive and sustainable development.

Financial assistance from the ERDF is mainly targeted at:

- supporting small and medium-sized enterprises
- promoting productive investment
- improving infrastructure
- furthering local development.

For the period of 2000 – 2006, the four structural funds reached a total volume of € 195 billion, accounting for almost a third of the Community budget.

4.1.2 The EU Cohesion Fund

In addition to the four Structural Funds, the Cohesion Fund provides additional structural assistance to the least developed Member States by financing projects that improve the environment or the transport infrastructure, including the Trans European Networks (TEN).

Support from the cohesion fund is directed to those Member States whose Gross Domestic Product (GDP) per capita falls short of 90% of the Community average, and which prepared a programme of economic convergence. In the 2000 – 2006

period, the four beneficiary countries were, as in the previous period (1993-99), Spain, Portugal, Greece and Ireland. Their eligibility will, however, be reviewed in the light of the Eastern enlargement of the European Union, and in the light of the recent economic progress of the previous beneficiaries.

4.1.3 Research and Development

The European Union influences transport policy not only through regional policies, but also through research and development activities under the Research Framework Programmes. One example of this is the CIVITAS initiative, which is funded under the 5th framework programme with an earmarked budget of 50 million Euro. The initiative, which was launched in 2000, aims at promoting more sustainable forms of urban transport in 19 large European cities, ranging from Barcelona to Stockholm and from Cork to Bucharest. The activities that are carried out in the participating cities combine range of measures which are all aimed at changing the modal split towards more sustainable modes of transport.

4.2 Results

An ex-post evaluation by Ernst & Young provided a synthesis of the research undertaken in Objective 2 regions to evaluate the impact of the 1989-93 Structural Fund interventions.[25] The study found significant impacts both on short-term unemployment reduction and longer-term industrial restructuring. It was estimated that about 850,000 gross jobs were either created, saved or redistributed as a result of Objective 2 intervention during the 1989-1993 period. Adjusting these gross estimates for additionality, displacement and indirect effects, it was calculated that a total of 450,000-500,000 net additional jobs could be attributed to the Objective 2 programmes. The average cost per job, based on ERDF and ESF expenditure, was estimated at ECU 7,243 (gross) and ECU 13,696 (net).

However, the Ernest & Young assessment considered the effects of the Objective 2 expenditure in its entirety, rather than distinguishing between different sectors and activities. Of the total expenditure, the largest share (40.9%) went into support for the productive environment, including SME support and the promotion of innovation and technology diffusion. The second largest share (36.0%) was allocated to „physical regeneration and the environment“ and included measures to improve transport and communication links. Infrastructure measures alone accounted for between 12% of the total allocated funds in Belgium and 37% in France.

In terms of the spatial distribution of impacts on job creation, Ireland was the largest recipient of ESF funding in the respective period, and showed a remarkable increase in employment (24% in 4 years). At the same time, Greece also received substantial

[25] Ernst & Young (1997), Ex-post evaluation of the 1989-1993 objective 2 programmes: Synthesis report, September 1997. See also Jaap de Koning and Peter van Nes, SEOR: Employment effects of the structural funds: an assessment based on theoretical considerations and on empirical evidence, 2002.

ESF support, but showed relatively little employment generation. The other main recipients, Portugal and Spain, ranged in-between Ireland and Greece by showing moderate employment growth.

4.3 Case Studies[26]

4.3.1 South Yorkshire Supertram and the Midland Metro, UK

The Supertram connects Sheffield City Centre with Hillsborough, Mosborough and the Lower Don Valley. The metro, for its part, is the first of the light rapid transport links planned for the West Midlands conurbation. These two initiatives aim to help regenerate old industrial areas, to economically develop the served conurbations, and to reduce road traffic congestion and environmental consequences.

Funding sources and costs:

The capital cost of Supertram was € 300 million. 4% of the expenses were covered by the private sector. Metro Line One has an estimated cost of € 100 million. The private partner is running the system until it is operational and has contributed to development costs. The Metro's annual revenue costs are an estimated € 2.65 million.

Project impacts

Employment/Economy:

The Supertram project employs 260 people directly and has indirectly created an estimated 1000-2000 jobs along the track in the Lower Don Valley area. The construction of the route is about 170 people-years. The Metro outputs: 1300-1700 new jobs generated, property values enhanced by an estimated € 19 million.

Environment:

Reductions in noise and air pollution, a positive visual impact on the streetscape, physical environment benefits are estimated at 3.7-11 million euros.

4.3.2 Park & Ride Facility in Slinge, NL

The centre of Rotterdam has been faced with a growing parking and traffic problem in recent years. Park-and-ride facilities were developed on the outskirts of the city but were not used very much because of safety problems. The municipality of Rotterdam combined safer park-and-ride facilities with jobs for the long-term unemployed.

Funding sources and costs:

The total expenditure amounted to € 700,000. The initiative was financed by the municipality of Rotterdam and by the European Regional and Social Fund which specifically funded training programmes.

[26] The following examples were taken from: "Case Studies of links between Environmental Policy and Employment", Study carried out by the Association Européenne Pour L'Information Sur Le Développement Local (AEIDL) on behalf of the European Commission, DG Environment. Brussels: AEIDL

Employment/Economy:

The project employs 20 people from the job creation scheme (18 people on the security staff and 2 staff members to supervise the environmental park) and 1 co-ordinator responsible for the daily operations.

Environment:

The environmental park offers a facility for people to dispose of their waste, which contributes to a cleaner city. Also, the use of public transport has increased, with a positive influence on the environment. However, exact figures are not available.

4.3.3 The Manchester Metrolink Light Rail System, UK

The Manchester Metrolink system was built to improve mobility in the city and thus reduce car traffic, lower emissions and achieve a better environment. At the same time, this benefits the local economy.

Employment/Economy

The number of passengers using Metrolink reached 13.4 million in 1996. Metrolink has reduced car travel by 25%. The building and operating of Metrolink created a considerable number of jobs: around 1000 in the first phase and about 600 in the second phase (1998 to 1999). Building tasks within phase two will require more than 1500 jobs.

Environment

Between 1980 and 1999, 18 old stations have been renewed and eight new ones have been built. All of them are fully accessible for people with disabilities. Metrolink uses less energy per person compared to other forms of road transport and lowers emissions. Analyses have shown that Metrolink delivers a 60-70% energy saving compared to bus and car. Car trips in the two Metrolink corridors have been reduced by 2.5 million.

4.4 Conclusions

Strategies that succeed in shifting transport volume from road transport to rail or ship transport have the potential for win-win-win solutions. The benefit for the environment is obvious, as transport by ship or rail causes only a fraction of the environmental impacts associated with road transport. To judge the economic viability of such strategies, the outcome depends on the perspective taken: On the one hand, the steady increase of the share of road transport in total freight volume is due to the relatively low cost of road transport. On the other hand, the side effects in terms of congestion, pollution and noise have reached an extent where a stronger role for rail and ship transport would provide significant social benefits, certainly in the most affected regions. As the European Commission notes in its White Paper on

Transport,[27] the integration of different modes of transport may give rise to a new type of profession altogether, specialising in the integrated transport of full loads (exceeding 5 tonnes). Such 'freight integrators' would combine the specific strengths of each mode of transport in order to offer the best service in terms of efficiency, price and environmental impact.

Also, strategies aimed at shifting passenger transport from private vehicles to public means of transport have the potential to benefit the environment and create employment at the same time. As they stimulate the move from a product (car) to a service (public transport), they tend to increase the employment-intensity of the transport sector and thereby facilitate further employment.

The regional policy instruments, i.e. the structural funds and the cohesion fund, are the main tool whereby the European Union influences the infrastructure for transport policy. Some evidence exists on the impact that these instruments have had on the generation of new employment. However, the incorporation of environmental objectives into these funds is more difficult to quantify. In theory, environment and sustainable development have been agreed as one of three horizontal themes in the 1999 Structural Funds rules, which should be 'mainstreamed' across all other funding areas, including investment in transport.

However, it remains debatable to which extent the investments in transport infrastructure that are mobilised through the regional instruments have indeed integrated these environmental requirements successfully, and whether the created employment can therefore be regarded as green jobs.

[27] European Commision, Directorate-General for Energy and Transport: White Paper "European transport policy for 2010: time to decide". COM(2001) 370 final. Brussels, 2001.

5 Jobs in the conservation and restoration of natural resources sector

Natural resources conservation comprises all activities related to the maintenance of natural habitats and landscape features, the preservation of biodiversity as well as land management. Natural resources management mostly pertains to the re-instatement of natural conditions, where they have been altered through human activities and the reversal of habitat degradation. Prominent examples of restoration are management of lignite open mining pits, the clean-up of old military sites as well as the renaturation of rivers.

Employment in the natural resources sector is generated at several levels. Jobs are created directly through the implementation of conservation and restoration measures. In many cases these are undertaken in reaction to concrete natural resource legislation in the individual member countries. Employment is created for maintenance and conservation workers, clean-up technicians, planners, information, monitoring and enforcement officers.

On a second level, jobs are created due to the added value of a restored and intact natural environment. Here the most prominent sector is eco-tourism followed by the production and marketing of environmentally sound products[28].

Ecotourism is a small but growing sector in tourism. It is tailored to customers who travel for the observation and appreciation of nature as well as traditional cultures, and usually contains educational features, is organised for smaller groups and offered by locally owned businesses. Its overarching goal is to limit the impact of travelling on the natural and socio-economic environment, while at the same time generating economic benefits for the host communities though providing alternative employment and income opportunities. Ecotourism generates jobs in traditional touristic fields, such as the provision of accommodation, tour guides and restaurants, as well as additional posts in education and monitoring.

5.1 Sector description

Natural resource conservation and restoration is usually undertaken in reaction to the respective regulation either on national or European level.

The key EU policies in the area of natural resource conservation and protection include one of the earliest EU directives, the 1979 Birds Directive[29] and the more recent 1992 Habitats Directive[30], which integrates protection concepts laid out in the Birds Directive. A key aspect of the Habitats Directive is the creation of the so-called Natura 2000 ecological network, a coherent stretch of natural habitats throughout Europe with the goal of preserving habitats and species designated in the Habitat

[28] Aspects of organic farming are discussed in the chapter on Agriculture.
[29] Council Directive 79/409 conservation of wild birds.
[30] Council Directive 92/43 on the conservation of natural habitats and of wild fauna and flora.

Directive. The directive further stipulates that these habitats must be protected against further deterioration and the disturbance of species and that measures need to be established to maintain or restore a 'favourable conservation status' for all habitats and species present. For a large number of areas it creates a plethora of jobs in research, planning, monitoring, education and implementation.

In support of the Habitats Directive as well as other environmental legislation, the EU has devised several funding tools, the most prominent being LIFE-NATURE and LEADER.

LIFE-Nature is a funding instrument to contribute to the implementation of the Birds and the Habitats Directive and in particular the establishment of the Natura 2000 network. Funding is disembursed on a project basis to areas designated as Special Protection Areas or Sites of Community Importance under the Directive. The current budget of the Fund amounts to approximately 300 million Euros for the period 2000-2004. The rate of Community co-financing may be up to 50% of the costs and in exceptional cases up to 75%.

LEADER+ is one of four initiatives financed by EU structural funds and is designed to help rural actors consider the long-term potential of their local region. Encouraging the implementation of integrated, high-quality and original strategies for sustainable development, it has a strong focus on partnership and networks of exchange of experience. A total of € 5 046.5 million for the period 2000-2006 will be spent, of which € 2 105.1 million is funded by the EAGGF[31] Guidance section and the remainder by public and private contributions.

In addition to these funding opportunities, other budget from the EU's structural and cohesion fund can be used to promote and finance habitat conservation and restoration.

5.2 Evidence of job creation in the natural resources sector

Job creation in the natural resource sector is taking place at the local level in the member states and reporting about industry size in the member states is therefore usually fragmented. General observations with respect to their economic relevance show that[32]

- the nature conservation sector is a significant and growing employer,
- conservation activities can generate substantial opportunities for ecotourism and support four to six more (indirect) jobs by attracting visitors to rural areas than those provided directly,
- these impacts are particularly significant at the local level, especially in promoting the diversification of more remote rural economies suffering from loss of employment in agriculture,

[31] Agricultural Guidance and Guarantee Fund (EAGGF), set up by Regulation No 25 of 1962 on the financing of the common agricultural policy (as last amended by Regulation (EEC) No 728/70)

[32] Cuff, Rayment (1997) Working with Nature, Economies, Employment and Conservation in Europe, BirdLife International.

- conservation schemes in the wider countryside have brought new opportunities for generation of employment and income.

The following examples will address the specific circumstances and dimension of job creation in the area of natural resources conservation and restoration.

5.2.1 Example 1 : Natural Area of Riaza River Gorges, Spain[33]

The following case study exemplifies the generation of employment through nature conservation measures at the micro-level at a nature site in rural Spain. It also emphasises the key aspects of job creation in this sector as outlined above.

The Riaza River Gorges Region is located in the north of Spain and covers an area of 6,470 hectares. Featuring a distinct climatic situation, the region provides habitat for a number of rare species. Since 1974, the area has been managed as a refuge for birds of prey by WWF Spain. In 1989, the Region was declared Special Protection Area for Birds of Prey and in 1999, the site was included as a Site of Community Importance in the Spanish Proposal for the Natura 2000 network. Currently, it is also in the process of being declared as a Natural Park.

The region faces severe social problems due to its very sparse and predominantly elderly population. Young people are increasingly leaving the region due to lacking job opportunities. Employment is mainly provided in the primary sector, other sectors are marginal.

In 1998, the European Commission approved a LIFE-Nature Project run by WWF Spain. This project supported several types of activities in the areas of infrastructure improvement, staff training, support for information and monitoring work, research activities and actions for habitat improvement.

Besides benefits in terms of ecological restoration and improved rural and regional development, funding through the LIFE programme has led to considerable economic benefits with ensuing employment effects:

- Progressive increase in the number of tourist in the refuge, which led to a steady rise in the quality of accommodation.
- Further support though EU funding, such as the LEADER II initiative,

While direct employment effects have been limited to a few full-time positions generated in the management of the LIFE project, indirect employment benefits have been more significant. The increasing number of visitors and the creation of new tourist infrastructures have converted tourism into an economic activity, which has generated a considerable number of jobs in the past years. This trend is likely to continue with tourism revenues creating new opportunities in the limited job market. In the short term, the opening of an educational centre in the region will permit the creation of 2-3 new positions and several temporary ones. In the entire region EU funding has contributed to the consolidation and creation of 140 posts. It is expected that the implementation of Natura 2000 requirements will continue this positive development and provide new momentum to job creation and sustainable development in this region.

[33] IEEP, WWF, Promoting the benefits of Natura 2000, The Natural Area of the Riaza River Gorges.

5.2.2 Example 2: Coed Cymru: Managing small woodlands in Wales[34]

Small broad-leaved woods are characteristic for large parts of Wales. Due to their fragmentation, lack of awareness about their potential value and skill shortages in woodland management, woodland owners had no real incentive to manage those woods, which lead to a further deterioration.

The Coed Cymru scheme was established in 1985 by a consortium of Welsh local authorities and national conservation, forestry and farming organisations to enhance woodland management in Wales and prevent further deterioration. While the initiative first concentrated on advising farmers on proper land management, it soon turned to actively promoting the marketing of locally grown timber through encouraging the production of high-quality wood products at a small scale. These products would sell on markets which had previously been supplied by imported timber. At the same time the initiative sought to improve the sustainable management of Welsh woodlands. It was expected that bringing neglected woodlands back into management would gradually improve the quality of timber while at the same time preserving an important feature of the Welsh landscape with a high ecological value.[35]

It is estimated that Coed Cymru initiative supports 290 full-time jobs in management harvesting and manufacturing activities. This includes new jobs (100-150) which were created by the scheme as well as job which already existed before the inception of the initiative and were further secured. It is further estimated that 4,000 m³ of hardwood timber is harvested for high-value uses and that the sale generates revenues of GBP 2.2 million for local economies. There are additional benefits for the local economy resulting from multiplier effects as the revenues from the sale of timber and wood products are spent locally.

Generally, small scale processing using simple machinery is more labour intensive than the softwood processing industry which relies on large scale machinery. Additionally, management of farm woodlands is more labour intensive than new planting and provides opportunities for pluriactivity.

There is a potential for further job creation by increasing the area of woodland managed and continuing to add value to timber extract from Welsh woodland, much of which goes into low value uses.

In terms of future prospects, it needs to be pointed out that while Coed Cymru continues to provide employment to local communities and encourage the sustainable management of natural resources, there is still is an ongoing need for external funding.

5.3 Conclusions

A key observation in this sector is that jobs generated in the natural resources sectors are likely to have the greatest impact on local and specifically rural communities, which is particularly interesting in countries where there is still a

[34] Rayment, Stankey: Working with Nature in Britain, Case studies on Nature Conservation, Employment and Local Economies, RSPB.
[35] http://www.coedcymru.org.uk/objectives.htm.

dominance of the primary sector and high unemployment rates in rural areas due to the down-scaling of agricultural activities.

Job creation in this sector is highly dependent on funding from national or European authorities, such as the funding tools provided through the structural and cohesion funds. In some cases, these funds might provide the necessary initiation for other job creation processes. In other instances however, there is an ongoing dependency on external funding.

In many cases, work generated in nature conservation and restoration is voluntary in the first place, encouraged by nature conservation groups. This situation might help to generate paid positions but could also significantly impede their creation.

As a general rule, paid jobs directly created in the field of natural resources conservation and restoration seem to be rare. However, there is a considerable potential for the creation of job though indirect effects, either in ecotourism or other related field, which depend on intact natural resources.

Another tendency which can be observed related to the phenomenon of pluriactivity is that while jobs in natural resources protection might not provide full employment, they might help to provide a small income next to other sources thus providing rural economies with additional stability.

6 Job intensive farming

Despite the continuing decrease in the number of persons employed in the agricultural sector, agriculture remains an important economic sector in the European Union. This is mainly due to the role of agriculture in regard to food security, healthy and safe production of food, rural development issues, as well as interlinkages with the environment. Moreover, the agricultural sector gained a new impetus with the accession of the new member states and the share of their labour force employed in the agricultural sector.

In regard to employment effects within the agricultural sector, job intensive organic farming has been growing rapidly in the last years. This is not only of interest as organic farming is often seen as achieving higher prices for its products, involving less intensive land use and better protection of the environment, but also because organic farming can contribute to rural employment and support a more sustainable agricultural production.

6.1 Sector description Organic Farming

Organic food[36] is a part of the food industry subject to specific legal requirements that cover cultivation and labelling. It differs from other farming systems in a number of ways: Thus, it favours renewable resources and recycling; meat and poultry production is regulated with particular concern for animal welfare and by using natural foodstuffs. Generally, organic farming aims at using the environment's own systems for controlling pests and disease in raising crops and livestock, and avoids the use of synthetic pesticides, herbicides, chemical fertilisers, growth hormones, antibiotics or gene manipulation. As the emphasis of organic farming is on production and processing methods that have proved to be sustainable over many decades, modern technologies are generally only used on the condition that there is no potential risk associated with these techniques and production methods.

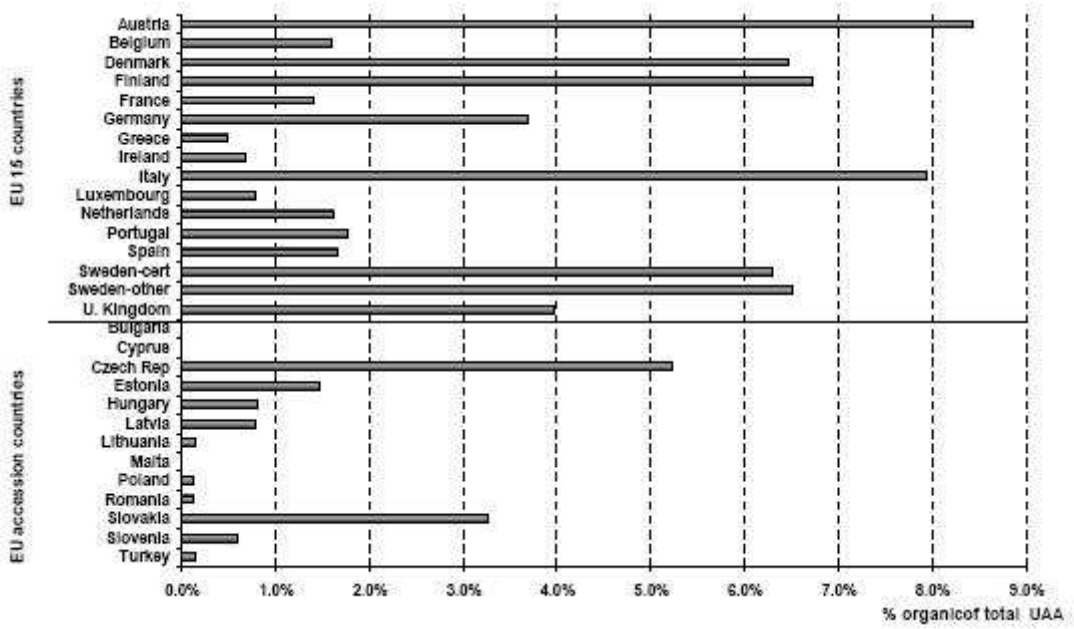
6.2 Organic Farming in the EU

Since the 1992 reform of the CAP (Common Agricultural Policy) increased consumer awareness of food safety issues and other environmental concerns have contributed to the very rapid growth of organic farming in the EU. Although Organic Farming only represented around 2 % of the total EU utilised agricultural area (UAA) in 2000, organic farming has in fact developed into one of the most dynamic agricultural sectors in the European Union, growing about 25 % to 30% per year.

[36] 'Organic' is the description used only in English-speaking countries; in other markets 'Bio', 'Oko' or 'Eco' are the more usual descriptions.

Although a 2% share of the total utilised agricultural area may still seem marginal, it should be emphasised that organic farming is very unevenly distributed within the EU. In some countries, such as Austria and Sweden, organic farming now covers significant parts of the total agricultural area (in 1998 8.43 and 7.26 respectively). In other countries, such as Portugal and Greece, organic farming in 1998 still only covered about 0.5 per cent of the total agricultural area.[37]

Organic utilised area (including conversion areas) in 100.000 ha in 2001[38]



6.3 EU Policies for Organic Farming

With the reforms in the CAP that began in the late 1980s came the recognition of the key role that organic farming could play in meeting revised objectives, such as reducing surpluses, promoting quality goods and integrating environmental conservation practices into agriculture. For organic farming to enjoy the confidence of consumers, however, it was evident that stringent regulation covering production and quality would be necessary, as well as measures to prevent fraudulent claims to organic status. Regulations have therefore been introduced to ensure the authenticity of organic farming methods, which have evolved into a comprehensive framework for the organic production of crops and livestock and for the labelling, processing and marketing of organic products. They also govern imports of organic products into the EU.

The first regulation on organic farming [Regulation EEC N° 2092/91] was drawn up in 1991 laying down in detail how food must be produced, processed and packaged to qualify for the description 'organic'. The regulation also specifies detailed criteria for

[37] Michelsen, Johannes et. al., *Organic Farming Development and Agricultural Institutions in Europe: A Study of Six Countries*, University of Hohenheim, 2001 p. 1. Here from www.organic-consultancy.com/articles/MISC/ifst.shtml. For information on organic farming in EU member states consult also: www.ewindows.eu.org/Agriculture/organic/Europe/of_research_table/#authors

[38] Source Lampkin (2003); here from Dabbert Stephan (2003) Herausforderung an Gesellschaft und Politik: Der Ökologische Landbau in Europa, Universität Hohenheim, p. 1.

the inspection and subsequent certification of food producers and processors. Since its implementation in 1992, many farms across the EU have converted to organic production methods. In August 1999 rules on production, labelling and inspection of the most relevant animal species (i.e. cattle, sheep, goats, horses and poultry) were also agreed [Regulation EC N° 1804/1999]. This agreement covers such issues as foodstuffs, disease prevention and veterinary treatments, animal welfare, husbandry practices and the management of manure. Genetically modified organisms (GMOs) and products derived from GMOs were explicitly excluded from organic production methods. The regulations also include imports of organic agricultural products from third countries whose organic production criteria and control systems have been recognised by the EU as equivalent.

In addition to the legislation, the Commission adopted a "European Action Plan for Organic Food and Farming"[39] in June 2004. The new initiative is setting out the Community policy for organic farming to develop the market for organic food and improve standards by increasing their efficacy, transparency and consumer confidence.

In sum, the EU Regulation has established a level playing-field for manufacturers by harmonising organic legislation throughout Europe. This in turn has led to easier transfer of organic ingredients and finished organic foods within the EU. Moreover, the close regulation of organic food production within the EU has resulted in an increase in consumer confidence and a clear set of standards that can be adhered to by new companies entering the organic food industry.

6.4 Potential Employment Effects of Organic Farming

In general, studies report that at least in the Northern European Context, labour use on organic farms is generally higher than on their equivalent conventional.[40] There are several reasons for this assumption:

- The absence of chemical plant protection increases the demand for manual labour;
- Organic farms frequently cultivate more labour intensive products, such as potatoes or vegetables;
- In particular during the conversion period from conventional to organic farming there are higher information requirements and experimentation with new crops;
- Next to the farming process, there are frequently additional activities, such as processing, marketing and selling of organic products by the producers; and

[39] Online available at: http://europa.eu.int/comm/agriculture/qual/organic/plan/comm_en.pdf.
[40] See: Padel S. and Lampkin N., *Farm-level performance of Organic Farming Systems*, in Lampkin N., Padel S. (eds.), *The economics of organic farming. An international perspective*, CAB International Wallingford, 1994; see also Nieberg, Hiltrud “Umstellung auf ökologischen Landbau: Wer profitiert?“; online available at: http://orgprints.org/00000860/01/860-nieberg-2001-umstellung-profitabel.pdf.

- Organic farms are frequently not specialised in one single product. In general, the more diverse the enterprise mix, the greater the labour requirements, since the benefits of specialisation and economies of size are diminished.

Figures on how much more labour is needed on organic farms vary widely: Some studies state that on average between 7 and 11% more labour is needed for organic farming.[41] Other point to an increase of 10%-20% on average.[42] According to the German Minister for Consumer Protection and Agriculture the additional demand for labour ranges between 11 and 36% depending on the type of enterprise and the enterprise mix.[43]

Along this line, Gegenbach looks into the employment effects distinguishing among different types of enterprises. He points out that conversion to organic livestock breeding or to organic cultivation increase labour demand by 10% each. Processing and direct marketing, however, can increase the labour demand by another 20%.[44] An evaluation of the organic farming scheme in the UK differentiates between the creation of different types of employment. It comes to the conclusion that conversion has led to significant increases in casual labour and employed part-time labour compared with full-time labour.[45] Also, it is emphasised by others that in particular in the beginning of the conversion the increase in labour demand is not always linked to greater employment, as the additional work is frequently compensated by longer working times and not by hiring new workers.[46]

In addition to the increased employment effects on the farms, it should be kept in mind that organic farming nowadays represents an industry from the production to the processing and marketing to the retailers. Therefore, downstream industry has also experienced strong growth in recent years.

Share of retail sellers of organic food products at the entire market (estimation)[47]

	Turnover in Billion Euro	% of the Market
Germany	2.8 – 3.1	1.7 – 2.2
United kingdom	1.6 – 1.8	1.5 – 2.0
Italy	1.3 – 1.4	1.0 – 1.5
France	1.2 – 1.3	1.0 – 1.5
Switzerland	0.7 – 0.8	3.2 – 3.7
Denmark	0.3 – 0.4	2.2 – 2.7

[41] Prognos study (1999) cited by Hildebrandt, Eckhard during the Ökoforum Berlin, which took place 22 October 2003 in Berlin. Online available at: http://www.stiftung-naturschutz.de/aktuelles/oekoforum/oekof1_Protokoll031126.pdf

[42] Offermann, Frank & Nieberg, Hiltrud, *Economic Performance of Organic Farms in Europe*, in Organic Farming in Europe: Economics and Policy, Volume 5, 2000, p. 13.

[43] Renate Künast at a speech during the Ökoforum Berlin, which took place 22 October 2003 in Berlin. Online available at: http://www.stiftung-naturschutz.de/aktuelles/oekoforum/oekof1_Protokoll031126.pdf.

[44] Gengenbach, Heinz, *Kritischer Agrarbericht* 1998; Bonn, 1998; here from www.karstwanderweg.de/sympo/3/hentschel.

[45] Defra *Economic Evaluation of the Organic Farming Scheme - May 2002*, London, (2002) Online available at: http://statistics.defra.gov.uk/esg/evaluation/organic/

[46] Schulze Pals, L. *Ökonomische Analyse der Umstellung auf ökologischen Landbau*, Schriftenreihe des Bundesministeriums für Ernährung Landwirtschaft und Forsten, Angewandte Wissenschaft, Heft 436, 1994, pp.124ff.

[47] International Trade Centre (2003); here from: Dabbert, Stephan op. cit., p. 2.

Austria	0.3 – 0.4	2.0 – 2.5
Sweden	0.4 – 0.6	1.5 – 2.0
Europe total	10.0 – 11.0	2.0 – 2.5

6.5 Conclusions

In conclusion, organic farming represents real opportunities to contribute to vibrant rural economies. Indeed, new employment opportunities in farming, processing and related services are already evident in the growth of the organic sector. As well as the environmental advantages, these farming systems can bring significant benefits both to the economy and the social cohesion of rural areas. The availability of financial support and other incentives for farmers to convert to organic production is designed to help the sector grow still further and to support associated businesses throughout the value chain. The success of organic farming practices in the long run is however heavily contingent on efforts to conserve and protect natural resources. Reconciling the needs and potentials of organic agriculture and measures for habitat protection as well as achieving a sound balance of these two aspects constitutes a major challenge for the future and might also suggest the limits to the growth of organic farming.

7 Environmental Audits: consultation and planning

Environmental auditing is a means for organisations to observe their environmental actions and performance. Most prominently, it is used in the context of environmental management systems. This voluntary instrument is aimed to help organisations to systematically manage their environmental activities. In the past the design of environmental management system has varied strongly, since each company has designed its system to meet its particular needs. Therefore, the need to harmonise the elements that an environmental management system should contain grew. Harmonisation would contribute to ensure transparency and offer organisations a chance to better communicate their efforts on environmental protection by using a certificate. In response, two main management systems emerged: The European Eco-Management and Audit Scheme (EMAS) and ISO 14001, which has been formulated by the International Organisation for Standardisation. In order to register an organisation with EMAS, achieve ISO certification as well as for the administration of the environment management system, additional human resources are needed, which can either be provided internally or recruited from consultancies.

7.1 Sector description

In the EU, EMAS was introduced in the mid-nineties as a voluntary instrument for companies and other organisations to evaluate, report and improve their environmental performance.[48] Originally it was restricted to industrial companies, but has been opened to all economic sectors in 2001, including public services.[49] In parallel to EMAS, internationally, the International Standards Organisations (ISO) has developed a series of voluntary standards and guidelines in the field of environmental management. These are known as the ISO 14000 series. Within this series only “EN ISO 14001:1996 environmental management systems – specifications with guidance for use” is a certifiable standard. In 2001 EMAS was not only opened to all economic sectors but also expanded: EN ISO 14001:1996 was integrated into EMAS as the required environmental management system.

In the EU, currently 3041 organisations are registered (15 July 2004). Geographically, the biggest number of EMAS registered organisations are located in Germany with 1697 organisations, Spain (383) and Austria (257). Denmark, Sweden and Italy follow with between 115 and 200 registered organisations. In Belgium, Finland and the UK between 30 and 60 organisations are registered, while most new Member States lag behind, some of them even having no organisations registered.[50]

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[48] Council Regulation (EEC) No 1836/93 of 29 June 1993 allowing voluntary participation by companies in the industrial sector in a Community eco-management and audit scheme.

[49] Regulation (EC) No 761/2001 of the European Parliament and of the Council of 19 March 2001 allowing voluntary participation by organisations in a Community eco-management and audit scheme (EMAS).

[50] EU register of EMAS organisations (http://europa.eu.int/comm/environment/emas).

In order to apply for an EMAS registration, various requirements must be met. This includes conducting an environmental review, establishing an environmental management system, carrying out an environmental audit and providing a statement of environmental performance. The audit is to ensure that the environmental management system is effective in operation, is meeting its goals, and continues to perform in accordance with relevant regulations and standards. They are designed to provide information on management and practices in order to show where these differ from the rules of the management system and to offer an opportunity for improvement. The outcome of an environmental audit is a report in which possible corrective actions are suggested. Under EMAS the minimum frequency for an audit is at least once every three years, and the whole environmental management system including the audit cycles are reviewed and validated by an external accredited EMAS verifier. Additional human resources can either be financed by the savings resulting from the environmental management system, or organisations can apply for state funding.

In general, the audits can be carried out by an external auditor or by competent company staff. If a company does not have qualified staff it can either employ an external auditor or have its staff trained in the necessary auditing skills. This is where environmental auditing becomes relevant for job creation. In both cases, i.e. if the audit is managed internally or externally, additional human resources are necessary. Therefore, if it is known how much human resources are needed in order to carry out an environmental audit, it is possible to roughly estimate how many jobs the introduction of environmental management systems and their auditing has created and on this basis also to project future developments.

7.2 Selected, exemplary data from EU / Member State level

The human resources intensity and thus the personnel costs for auditing vary strongly, depending on the size and nature of the business. Two examples might help to develop an idea of the costs implied by an environmental audit / EMAS certification:

- Costs for external auditing in GB with regard to ISO 14001 varied between GBP 15.000 and GBP 80.000 per site. Typical fee rates for a consultant are about GBP 550.[51] This would mean 27 to 145 days of work. Assuming that a full time job covers about 200 days a year, it can be concluded that the audit of a big organisation would create a three-quarter job for one person.
- In Germany, the *Bundesland* Bremen offers funding for EMAS certification. They offer to cover between 50 and 60% of the staff costs up to Euro 18.000 (including external consultants, staff, training, etc.).[52] Thus, they assume that EMAS certification will cost an organisation about Euro 36.000 staff costs. With an average rate of Euro 40 per hour for internal staff this would mean approximately 112 days for one person working eight hours a day. An external consultant could

[51] Smiddy, Niall (2004): “Effective Use of Your Consultant”, ENDS Environmental Data Services.
[52] Amtsblatt der Freien Hansestadt Bremen, Nr. 37 vom 26. März 2002.

work ca. 47 days (Euro 770 per day). Assuming that a full time job covers about 200 days a year, it can be concluded that this would create a half-time job for one person.

Although these two examples result in concrete numbers on how much work an environmental audit / certification can create, conclusions cannot be generalised. A more in depth analysis of different sectors, countries and size of business would be necessary. The extent to which EMAS will contribute to job creation in the future depends on the expected development of EMAS registration activities.

The Statistics currently show a decrease of registered organisations throughout the EU. In 2002 about 3800 organisations were registered in the EU,[53] while in 2004 there were about 3040 organisations.[54] Also, one can observe different trends across the Member States. Registrations have stagnated in countries with the highest EMAS density, e.g. Germany.[55] In other countries with a lower density of registered organisations, , such as Italy, registration numbers have increased.[56] From a sectoral perspective, new registrations are primarily recorded in the "new" non-industrial sectors, such as the public sector and tourism whilst the number of manufacturing industries is decreasing. ISO certifications in contrast seem to enjoy increasing popularity, with growing numbers of new registrations.[57]

During 2005 a general revision of EMAS is to be expected, which is according to Article 15.1 of the EMAS Regulation due five years after the entry into force of the Regulation. The revision will be based on an evaluation of the current EMAS practice undertaken by the Commission. Depending on its outcome, the EMAS regulation will be amended.

7.3 Conclusion

Implications of environmental auditing under EMAS and ISO for job creation strongly depend on the future development of EMAS / ISO certifications. Rising registration numbers will certainly create jobs: External consultants, internal staff, trainers. In the above analysis, the following opportunities for job creation can be assumed:

The opening of EMAS to other sectors has contributed to an increase of registrations in these areas, which can be expected to continue.

The last two years have shown an increase of EMAS registrations in certain Member States, which can be expected to continue, especially in the new Member States.

ISO certification number have increased in the past few years and this trend is expected to continue.

[53] Clausen, Jens, Keil, Michael and Martin Jungwirth (2002): The State of EMAS in the EU. Eco-Management as a Tool for Sustainable Development. IÖW and Ecologic.
[54] Ibid.
[55] Kring, Friedhelm: EMAS auf dem absteigenden Ast. WEKA-Praxislösungen – Umweltschutz vom 11. März 2003.
[56] Concerns grow over health of EMAS scheme (http://www.edie.net/news/news_story.asp?id=6772&channel=0).
[57] Ebd.

- The introduction of EMAS / ISO has certainly led to job creation, but both the actual number of jobs created as well as its potential for further job creation is difficult to quantify and strongly depends on the future political framework, which is to be revised in 2005.

8 Environmental R&D

Although Europe is acknowledged for its scientific excellence, it is said to launch fewer products, services and processes resulting from its research and development efforts than its main competitors in the global economy. This is partly due to the fact that until relatively recently the European policies in this area were managed mainly at Member State level. EU research efforts therefore often were in danger of duplicating Member State activities. As a result, R&D activities at the European level have been intensified in the last couple of years with the aim to better co-ordinate national European policies and facilitate co-operation and networking. Also, R&D is a crucial element of the so-called Lisbon agenda, which is aimed to boost European economic growth. In the context of Lisbon, R&D first of all is a goal in itself. Among others the strategy aims at “preparing the transition to a knowledge-based economy and society by better policies for the information society and R&D”.[58] Secondly, R&D decisively contributes to economic growth – the overall goal of the Lisbon strategy. Therefore, Heads of State and Government agreed at the Barcelona European Council, where progress towards the Lisbon goal was reviewed, to increase R&D investment with the aim of approaching 3% of GDP by 2010.[59] Given the labour intensity of R&D, this certainly has strong ramifications in the job market.

8.1 Sector description

In order to implement its efforts towards a more coherent research and development policy and with the view to realise the goal of Lisbon, the European Commission, Member States and the European Parliament, the scientific community, and industry committed to work together towards the creation of a European Research Area (ERA). The ERA aims to pool and streamline European research efforts and to build a research and innovation equivalent of the "common market" for goods and services. It is regrouping all Community supports for the better co-ordination of research activities and the convergence of research and innovation policies, at national and EU levels. The main instrument for supporting the creation of the ERA are the subsequent Research Framework Programmes of the EU.

Currently Research and Development activities in the EU make up 1,9% of GDP. The total budget for the period of the current Sixth Research Framework Programme 2002-2006 is about 17,5 billion Euro, a 17% increase compared with the previous programme. This increase in R&D resources cannot be expected to directly create a significant number of jobs, although it will certainly contribute to job creation. This is because already established scientists will make use of the opportunities, and scientists needed additionally in response to the demand created will need to be educated.

[58] Presidency Conclusions of the Lisbon European Council, 23 and 24 March 2000 [100/1/00].
[59] Presidency Conclusions of the Barcelona European Council, 15 and 16 March 2002 [100/02].

However, innovation as a result of R&D activities is a driving force in economic competitiveness. Since European Research and Development policies have been referred to in the past as serious handicap to European business and society, which had severe implications for job creation and employment, a significant increase of the R&D budget is designed to contribute to job creation in the long run. Of course this development will need time, because the impacts of the Sixth Research Framework Programme on economic growth and thus the employment market will have to take effect first.

On the national level the EU-15 spent 0,79% of their total government budget for research and development in 2001.[60] In the same year, 34,35% of GDP was spent for R&D activities.[61] For the EU-25 or the period 2002-2004 no data are available.

Patent application, which is a measure of innovation, is increasing in parallel to the European R&D budget. The OECD members experienced an increase of patent applications of 32% in the period from 1991 to 2003, with a total of 60.698 patent applications in 2002[62] and a distribution by Member States as follows: A group of three, Germany, France and the UK with between 7.000 and 24.000 patent applications lead the list of patent applications. This group is followed by Spain, Italy, the Netherlands, Belgium, Denmark, Austria, Finland and Sweden with between 2.000 and 4.000 applications, while the new Member States including Portugal and Greece complete the list with a significantly lower number of patent applications.[63]

R&D intensity gives a similar picture, starting with around 1% of GDP or less in the Southern Member States to 3,4% in Finland and 3,8% in Sweden.

This gives room for two assumptions: First, the EU announcements to increase research efforts are implemented and second, Member States' research policies in Europe vary strongly and show certain cores of innovation and laggards.

8.2 Selected exemplary data on EU level / from the Member States

Currently, no data on environmental research and employment are available, neither at EU nor Member State level. The following analysis, therefore, first gives an overview on employment in research and secondly analyses priorities of the European Research Policy, namely, the aforementioned Sixth Research Framework Programme. A comparison of the findings will allow to draw cautious conclusions on the job creation of environmental R&D.

[60] EUROSTAT: Share of government budget appropriations or outlays for research and development.
[61] EUROSTAT: R&D expenditure by source of funds: government.
[62] EUROSTAT: Total European patent applications.
[63] Ibid.

8.3 R&D Employment

In 2000 a total of about 1.6 million researchers were employed in the EU-25[64]. In order to attain the goal of a 3% increase of investment in research by 2010, more and adequately skilled researchers will be needed in Europe. The lack of human resources is even assessed as a major constraint on the EU's capacity to deliver on the 3% objective.[65] It is expected, that about 1.2 million additional research personnel will be needed, including 700 000 additional researchers, on top of the expected replacement of the ageing workforce in research.[66] The annual growth of researchers per 1000 workforce accounted for 5.23 or 2,89%.

8.4 The Priorities of the Sixth Research Framework Programme

The Sixth Research Framework Programme is structured according to research priorities, which bind 11.285 million Euro of the total research budget of the EU. These priorities include:

- Life sciences, genomics and biotechnology for health;
- Information society technologies;
- Nanotechnologies, multifunctional materials and new production processes;
- Aeronautics and space;
- Food quality and safety;
- Sustainable development, global change and ecosystems; and
- Citizens and governance in a knowledge-based society.

Community action in the area of "Sustainable development, global change and ecosystems", concentrates on three major fields: sustainable energy systems, sustainable surface transport, global change and ecosystems.

Research activities within the priority of "sustainable development" aggregate 2.120 million Euro, which is ca. 19% of the total money allocated for the priorities. For "human resources and mobility" a total of 1.580 million Euro is assigned. However, no data are available showing how much of the money for the priority of "sustainable development" is allocated to clean technologies and how much of the money of "human resources and mobility" is spent for environmental activities.

[64] European Commission (2003): Communication from the Commission – Investing in Research: An Action Plan for Europe. COM(2003) 226 final, p.11, footnote 17.
[65] European Commission (2002): Communication from the Commission – More Research for Europe. Towards 3% of GDP. COM(2002)499 final.
[66] European Commission (2003): Communication from the Commission – Investing in Research, a.a.O., p. 11.

8.5 Conclusions

On the basis of the numbers available, an exact calculation of the job creation potential in this area is not possible. Nevertheless, they allow to draw some cautious conclusions of a rather general character:

- Implications of R&D measures for the employment market are of an indirect character and expected to take a long time to take effect.
- The increase of the EU budget directed to research will contribute to job creation also in the area of environmental research.
- The potential for growth seems exceptionally high in the new Member States and southern Europe, because their research landscape is much weaker than in the other Member States. In order to change this situation not only investment is needed but also the human resources to take their efforts further.

9 Conclusions

9.1 Trends in environment and employment

In the past, most environmental jobs have been created through classical, additional environmental protection measures, such as the use of end-of-pipe technologies or waste treatment. Recent developments, however, indicate a shift towards a more integrated approach of environmental protection. Environmental impacts are to be prevented throughout the entire life-cycle of a product, starting with its production and ending with its disposal or re-use. Thus environmentally sound production methods play an increasingly important role. In addition, research, auditing and planning aim at contributing to better decision-making in the environmental field, thus pre-empting end-of-pipe solutions.

This increasingly integrated approach furthermore serves to achieve environmental protection as cost efficiently as possible. An important factor in this respect is also the increased use of clean technologies. These shifts in production methods, augmented by changing approaches towards environmental management, are expected to have a considerable impact in terms of the creation of employment opportunities. This is also reflected by the latest political developments in the EU context, which aim at utilising potential synergies between environmental protection and employment, such as

- the Commission's white paper on "Environment and Employment";
- the expected revival of the Lisbon process; and
- the Environmental Technologies Action Plan.

While the linkage between jobs and environment undoubtedly exists, identifying evidence is a major undertaking. This report shows the relation between environmental policies, clean technologies and job creation through highlighting examples from several European countries.

9.2 Job creation potential of clean technologies in selected areas

In particular, this study highlights the potentials of clean technologies for job creation with regard to the following sectors.

The growth of the **renewable energy** sector within the European Union was largely based on environmental policies and supporting programmes and legislation. While an entire economic sector benefited from this policy frameworks, employment in traditional, not-sustainable energy production decreased. However, most studies demonstrate that there was a net gain in employment, and that these newly created jobs are long-term jobs for skilled workers. Also, spill-over effects in upstream sectors took place, ensuring existing jobs in these industries. There are still a large amount of not exploited opportunities for renewable energy systems within the European Union and outside. However, according to renewable energy industry associations, these

jobs might be endangered if Europe's technological lead in the world market is not sustained. Thus, it is frequently argued for maintaining or even expanding the supporting policy framework in particular in regard to Research and Development.

The **motor-vehicles sector** has been the subject of several European directives, initiatives, action programmes and targeted projects in the field of research and development and dissemination of innovations. While there is considerable dynamism and innovation in clean technologies in the automotive sector, this process is mainly policy-driven. Some of the most influential European regulations in this field are the Directives establishing maximum pollution standards for cars and for heavy duty vehicles, the Directive on sulphur in liquid fuels and the Directive on end-of-life vehicles. Only for some of these has the employment impact been calculated. Thus, the net job creation impact of the sulphur in liquid fuels Directive amounts to 84.000 jobs, whereas the Directive on end-of-life vehicles has created an estimated 6.100 jobs. For the Directive on air pollution from motor vehicles, the employment effect is more difficult to discern, as the reduction of emissions is largely integrated into the development of new motor technologies. The overall job creation effects of clean technology development on the automotive sector are ambivalent: On the one hand, technology development is research-intensive and has the potential to create significant high-skilled employment. With high and rising fuel prices, fuel efficiency is becoming an increasingly important factor in the global competition with Asian and American manufacturers; clean automotive technologies could therefore become crucial in order to gain a competitive advantage. On the other hand, motor vehicles will also belong to the sectors that are adversely affected by a move towards more sustainable modes of transport. Thus, a shift of the modal split towards public transport may lead to substantial job losses at car manufacturers and related industries.

Environmental audits – as used in EMAS or ISO – create new jobs either internally, if the audit is conducted by employees or externally, if a consultant is assigned with this task. In both cases, the persons responsible for the audit need to be qualified and trained accordingly. The jobs created by auditing do not substitute other activities of registered organisations and therefore do not kill other jobs. Although it is impossible to quantify the number of jobs having been created by environmental auditing through EMAS or ISO, the jobs created thereby will be secure as long as the organisation remains EMAS registered. The potential for the creation of jobs in this area depends on the upcoming review of EMAS.

Increased efforts in the area of **natural resource protection** directly lead to the creation of jobs in the conservation and restoration of natural habitats. However, these jobs are highly dependent on funding from national or European Union authorities. Also, the number of direct jobs is quite limited and there is a tendency towards temporary rather than permanent jobs. More interesting is the indirect effect of protection measures on jobs. Thus, there a direct linkages between natural habitat conservation and restoration, the improved attractiveness of rural areas for tourists and the creation of jobs in the tourism sector. Similar developments occur in relation to sustainable farming practices.

In the field of **transport infrastructure**, one of the main areas of European policy that impact job creation and the environment are the regional policy instruments, i.e.

the cohesion funds and structural funds. Studies on the effectiveness of these instruments have found that they are successful in creating new jobs. However, the existing assessments do not identify which share of the newly created jobs is primarily related to environmentally friendly modes of transport, or to activities that aim at shifting the modal split away from individual road transport and towards public transport.

Albeit currently small in size, **job-intensive organic farming** represents real opportunities to contribute to vibrant rural economies by creating jobs in the agricultural sector. Thereby most jobs are created in the processing, marketing and selling processes, not in the production itself. The involvement of family work and seasonal low skilled workers make it particularly difficult to estimate the real additional employment effects, although numbers point to approximately 10% to 20%. While the organic farming sector experienced high growth rates in the recent past, and is still not fully developed in most EU Member States, it has yet to be seen how many consumers will be willing to pay extra premiums for organically produced agricultural products.

The implications of **research and development** measures in the environmental sector for the employment market are of an indirect character and will take a long time to commence. Although it is impossible to assess the number of jobs, R&D will help to secure existing and to create new jobs. The durability of these jobs as well as the number of new jobs created strongly relates to the EU budget directed to research. The character of jobs in R&D requires highly skilled and well educated people.

9.3 General conclusions on job creation of clean technologies

Taking into consideration the individual sectors and their specific potential for job creation in particular, still overarching conclusions pertaining to the overall situation can be drawn. While the implications of the use of clean technologies is difficult to calculate in most cases, the examples described for the individual sectors show a general trend towards positive effects. It needs to be highlighted that job creation through environmental measures alone cannot solve the current problems with employment in the European Union. On the other hand safeguards need to be established so as to prevent progress in environmental policies and clean technologies from depending on their immediate beneficiary effect on employment and job creation.

Upon careful analysis it can be stated that job creation in sectors heavily influenced by environmental policy and/or the development of clean technologies might be highly contingent on the following factors:

Funding initiatives from national or European authorities establishing the foundation for the creation of jobs, as demonstrated in the case of natural resource conservation and restoration;

A conducive political framework, which includes the further development of certain environmental policies (CAP reform, EMAS revision, modal shift in transport, next

RFP, etc.) as well as the according advancement of employment policy (taxes etc.). The integration of both policy fields under close consideration of the other is a key requirement;

Jobs created in the environmental sector might trigger the creation of jobs in other, related sectors, which depend on an intact environment, such as eco-tourism as well as sustainable agriculture, as the success of these industries in the long run is heavily contingent on efforts to conserve and protect natural resources;

The development and stronger promotion of clean technologies through environmental legislation is contributing to innovation and thus to competitiveness and increased (eco-) efficiency throughout the European Union. In some cases this leads to clearly discernible impacts on job creation, in other instances results are only obtained as secondary effects.

9.4 Recommendations

The effects of environmental policies and particularly of clean technologies on the creation of jobs and employment in the European Union is gaining more and more in importance. This trend is enhanced by the increasing relevance of economic and efficiency considerations in EU policy-making in times of economic slowdown.

In order to enable sound decision-making at the interface of these decisive policy fields, following key challenges should be tackled next:

- The database of actual effects of environmental policies and clean technologies should be extended by sound numerical data. To this end, in-depth studies on the effects of the introduction of clean technologies need to diligently separate these from other employment-effective developments and develop methods for valuation and quantification taking into consideration ancillary as well as adverse effects.
- At best, this would be undertaken for a wide range of member states accounting for the different economic backgrounds, thus providing a sound analysis of necessary pre-conditions and circumstances for positive effects of the introduction of clean technologies and environmental policies on job creation and employment.
- On the conceptual side, the link between environmental policies, the introduction and development of clean technologies and the ensuing effect on jobs should be discussed more systematically, in order to better understand and gauge the underlying effects for job creation in this context. In this respect, it should be ensured that environmental policies and strategies are not reduced to their potential contribution to job creation, but rather seen as an innovative and efficient way for achieving new momentum in the process towards more jobs and employment throughout the European Union.

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