The economic benefits of environmental policy

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Executive Summary

Introduction (Section 1)

The European Union aspires to become the most dynamic and competitive economy in the world. The Lisbon Strategy, launched by EU leaders in 2000 and subsequently revised and simplified in 2005, emphasises the need to modernise Europe's economy and focus attention on growth and employment, in order to address the challenges of globalisation and demographic change and to support our wider economic, social and environmental goals. To achieve this, the updated strategy emphasises the need for Europe to become a more attractive place to live and work, to develop knowledge and innovation for growth, and to create more and better jobs.

The current global economic crisis represents a significant setback in implementing Europe's economic agenda, with problems of loss of demand, unemployment and deteriorating public finances. In order to address these economic problems, restore growth and tackle unemployment, a European Economic Recovery Plan (European Commission, 2008) was launched, which sets out the actions the EU will implement to deal with the crisis.

The European Commission (DG Environment) commissioned GHK, IVM, SERI and TML to assess the role of environmental policy measures in the EU's economic development.

This report describes the areas in which environmental policies deliver Europe's current economic priorities, often more successfully than other forms of economic policy intervention. It provides evidence of the role of environmental policy both in providing a short term economic stimulus and in building a sustainable, efficient and resilient economy in the long term. It highlights many areas where environmental policy is essential for sustainable economic progress.

Economic Outcomes of Environmental Policy (Section 2)

The report explains and illustrates how environmental policy may benefit the economy by delivering eight key economic outcomes. These are that environmental policy:

1. Enhances **Productivity**
2. Stimulates **Innovation**
3. Increases **Employment** (and/or the quality of Employment)
4. Improves our **Balance of Trade**
5. Strengthens our **Capital Base**
6. Supports **Public Finances**
7. Promotes **Economic Cohesion**
8. Encourages the **Transition to a Resilient and Sustainable Economy.**

Delivery of these key economic outcomes is important both in stimulating economic recovery and in delivering the EU's longer term economic goals, as set out in the Lisbon Strategy. A broad overview of the linkages between environmental policy and the economy is provided in Section 2 of the report.

Environmental Policies and Productivity (Section 3)

There is widespread agreement that environmental policy can enhance productivity by increasing the efficiency with which we use resources and energy. This will benefit the economy and the environment alike, thus being a true winning strategy for the EU's economy. Resource efficiency

is becoming increasingly critical for economic success in a world where many resources (including oil, raw materials and food) are becoming increasingly scarce and expensive, while EU imports are increasing. There is much evidence that many resource efficiency gains can be achieved relatively easily and cost effectively. For example, studies show that there is widespread scope for reductions in material throughputs of around 20% among EU manufacturers. Evidence on the marginal abatement costs for greenhouse gases highlights the scope for cost reductions through investments in building insulation, fuel efficiency in vehicles, and improvements in the efficiency of water heating and air conditioning systems. A UK study found showed that, even with existing policies, savings of £6.4 billion in the cost of energy, water and waste disposal could be made with no-cost or low-cost investments with a payback period of less than one year. Studies of the EU eco-industries demonstrate that they have higher productivity and higher growth rates than the manufacturing sector as a whole.

An evaluation of ENWORKS, a waste minimisation and resource efficiency programme in North West England, estimated that programme expenditure of £3.4 million yielded annual net cost savings to businesses of £12.2 million. Modelling studies indicate that resource efficiency has scope to deliver substantial macro-economic benefits. For example, the RESA study found that a 20% improvement in resource efficiency in Austria could enhance GDP by 24% and employment by 2.4%. Modelling by the Aachen Foundation forecast that a 20% reduction in resource and energy use in Germany will create 1 million jobs, enhance GDP by 12% and improve the public finances by €100 billion.

Environmental Policies and Innovation (Section 4)

Environmental policies can stimulate innovation and investment in innovation. By internalising the external costs of pollution and natural resource use, policies change relative prices and stimulate research and development and uptake of alternative inputs, production methods and products. Similarly, restricting the use of certain processes and materials stimulates the commercialisation and diffusion of cleaner alternatives. Environmental policies have led to innovations in conservation of energy and resources, pollution prevention and environmental clean-up. These innovations have reduced costs and reinforced the competitiveness of EU industries, as 'clean' technologies developed in Europe have become successful export products on the world market. Policy-induced environmental innovation has directly and indirectly stimulated growth, competitiveness and jobs.

The European Commission has estimated that the total commercial value of eco-innovative products and technologies in sustainable construction, renewable energy, bio-based products and recycling in the EU can grow from €92 billion in 2006 to €259 billion in 2020, creating more than 2.4 million new jobs.

Environmental Policies and Employment (Section 5)

The net effects of environmental policies on employment are positive or neutral. While environmental policies can cause shifts in the composition of employment, evidence suggests that any negative effects on polluting products and processes are at least balanced by growth in less pollution-intensive ones. These positive effects result from:

- Growth in labour intensive environmental activities. It is now estimated that 36 million jobs – one in six jobs in the EU – are linked directly or indirectly to the environment. The EC has

estimated that cost effective investments in energy efficiency could create 1 million new jobs while reducing energy consumption by 20%;

- The potential to shift the burden of taxes away from employment and towards pollution and resource use. It has been estimated that the German eco-tax (an additional tax on fuel and electricity) has contributed to the creation of 250,000 jobs since 1999 by reducing labour costs.
- Promoting growth in eco-technology and eco-innovation. The EU eco-industry is growing at 8% per annum and now employs 3.4 million people. The European 20% renewables target is forecast to increase employment in the renewables sector to 2.8 million, providing 410,000 net additional jobs.

Environmental Policies and the Balance of Trade (Section 6)

Environmental policies can improve the balance of trade by enhancing competitiveness, supporting export-oriented eco-innovation, and reducing material use and hence imports. While critics have argued that environmental policies increase costs and adversely affect competitiveness, evidence indicates that any negative effects are offset by growth in new environmentally friendly products and processes with significant export potential. Furthermore, progressive environmental policies require industries to innovate and adapt quickly, giving them first mover advantages and positioning them well against foreign competitors when the latter catch up. High environmental product standards drive innovation and create export opportunities over time.

The EU has a strong position in global environmental markets, with estimated market shares of 10% for material efficiency and natural resources, 30% for sustainable water management, 35% for sustainable mobility, 35% for energy efficiency, 40% for green power generation and 50% for waste management and recycling. Exports grew by 8% in 2005, and there was a trade surplus of environmental goods and services of over €600 million. The world eco-industry is expected to more than double in size between 2005 and 2020, when it is forecast to be worth €2.2 trillion. In the UK, which is already a major exporter of environmental goods and services, estimates indicate that a successful implementation of a green manufacturing strategy could result in a doubling of export volumes of 'green' goods and services – from £25 billion currently to £45 billion in 2015. In Germany, recycling saves raw material imports worth €3.7 billion per year, with further benefits for reduced energy costs, with positive effects on the balance of trade.

Environmental Policies and the Public Finances (Section 7)

Environmental policies have positive effects on the public finances by:

- Raising revenue and expanding the tax base through environmental taxes. Environmental taxes can be used either to enhance public revenues or to reduce labour and other taxes; the use of revenues determines the extent to which they have net benefits for the public finances or are used to deliver other economic outcomes (e.g. enhancing employment by reducing taxes on labour). Environmental taxes accounted for 6.6% of public revenues in the EU and this proportion has declined in recent years. There is considerable scope for environmental tax increases to yield economic and environmental gains.
- Reducing environmentally harmful subsidies. Considerable progress has been made in recent years in reforming or reducing environmentally harmful subsidies in the agriculture, energy and transport sectors. However, substantial levels of subsidies remain - those due to reduced

VAT rates on EU household energy are estimated to amount to €7.3 billion annually, while transport subsidies in the EU were estimated to total €240 billion in 2005.

Environmental Policies and the Capital Base (Section 8)

Environmental policies can greatly add to and enhance the quality of our capital base, contributing to the stock of buildings and infrastructure, plant and machinery, human capital and natural capital. This capital stock determines the long term output and income streams of the economy. Environmental investments make a key contribution to economic development, providing the infrastructure necessary for growth, driving the transition to a resource efficient economy, maintaining the health and productivity of the workforce, and delivering the ecosystem services on which people and the economy depend. Environmental policies drive investments in energy efficiency, renewables infrastructure, pollution control and waste management plant, and natural capital, enhancing the productive capacity of the economy and the health and wellbeing of the workforce. For example, it is estimated that a failure to halt the decline in biodiversity and natural capital worldwide will impose losses equivalent to 7% of GDP by 2050.

Environmental Policies and Cohesion (Section 9)

The environment has a key role to play in achieving the goals of cohesion policy and vice versa. Since poor environmental quality is often a barrier to development, investing in the environment is essential in many cohesion areas to provide the right conditions for growth and the necessary infrastructure for sustainable development. Cohesion Policy is helping to create new market openings for local economies by enabling them to seize the opportunities created by the need to tackle climate change as new potential sources of growth. Environmental activity offers opportunities for all cohesion regions but has a special role to play in peripheral areas with few alternative development opportunities for which high environmental quality may be one of the greatest economic assets. A better environment can enhance opportunities for tourism and recreation and attract mobile investors, businesses and workers. In areas which have suffered industrial decline and dereliction, environmental improvement may be a prerequisite for regeneration. In many regions, poor environmental quality caused by inadequate infrastructure is a barrier to attracting visitors, workers and investments, so that environmental investments are necessary to provide the conditions for economic growth.

Section 9 of the report gives numerous examples of the economic benefits that environmental projects have brought to cohesion regions. As well as helping to deliver long term prosperity, environmental investments offer a substantial short term boost to economic output and job creation. It has been estimated that meeting the identified environmental investment needs of cohesion regions in the 2007-2013 programming period will enhance the GDP of most member states by between 1% and 2%, and create 388,000 jobs.

Environmental Policies and the Transition to a Sustainable and Resilient Economy (Section 10)

The EU's Growth and Jobs Strategy and certain aspects of the European Economic Recovery Plan (2009) aim at stimulating the transition towards a sustainable, low-carbon, low impact economy. This is needed, as by 2050, the global economy would need to grow to 15 times its current size for the global population to meet its aspirations of OECD levels of consumption. The much greater demand for resources that this would involve is certain to drive underlying upward price trends in finite oil and natural resources, with the probable recurrence of spikes. Meanwhile,

global action to limit the increase in average temperatures to 2°C is acknowledged to require a revolution in our economies' use of energy: with OECD countries to reduce CO_2 emissions by 80%. Future competitiveness in this changing world requires significant structural change. The Commission and most Member States are committed to the structural changes needed for future competitiveness. Environmental policy increasingly cuts across all policy areas and is a main driver for the structural changes needed. It contributes to managing the transition to a resilient and sustainable economy by encouraging economic restructuring, supporting growth sectors of low carbon and resource efficient process and products, improving energy efficiency, food and resource security and hence resilience to external shocks, whilst also reducing vulnerability of the economy to climate change and other environmental impacts.

One of the key findings of the 2006 Stern report was that the cost of inaction with respect to climate change might be up to twenty times greater than the costs of action. Various studies demonstrate that investments in energy and resource efficiency and greener transport infrastructure offer opportunities for short term economic stimulus, while helping to position the economy to respond to long term challenges.

The Need for Policy Action (Section 11)

The report demonstrates that there are numerous "win-win" opportunities for the EU simultaneously to strengthen its economy and enhance its environment. However, because of market failures (and especially the presence of public goods, positive and negative externalities and information failures, as well as failures of government intervention) these opportunities are not being fully realised by the free market. For example, studies of greenhouse gas abatement costs demonstrate that numerous opportunities for net cost reductions through energy efficiency measures remain unexploited, while case studies also demonstrate the role of publicly funded advisory schemes to unlock business cost savings in waste minimisation and energy efficiency. There is therefore a need for government intervention if the EU is to take full advantage of the opportunities identified.

A Package of Environmental Policies to Achieve Economic Goals (Section 12)

The report concludes by presenting a proposed package of environmental policy measures that will strengthen the EU's economy, and contribute to the Lisbon priorities of enhancing growth and employment.

The chosen package is designed both to:

- Provide a short term stimulus to the EU economy, creating jobs and boosting demand during the current economic crisis; and
- Support the development of a stronger, more resilient and sustainable economy in the long run, by promoting a more innovative and resource efficient economy that is less dependent on fossil fuels and imported raw materials and less prone to climate change and other environmental damage.

The package is designed to meet the following policy outcomes:

- Building a **Resource and Energy Efficient Economy**, including by enhancing:
    - ***Energy efficiency in buildings***, through an EU wide programme of low interest loans to help households to invest in domestic energy efficiency measures, involving an annual investment of €2 billion;

- ***Business resource efficiency***, through an EU wide programme of advice and training to SMEs on waste minimisation and energy efficiency, involving an annual investment of €2 billion.

- Developing an **Energy Supply Infrastructure for the Future**, through an integrated package of measures designed to encourage investment in renewable energy, achieving the target of achieving a 20% share of renewable energy in Europe's final energy consumption by 2020;

- Investing in our stock of **Natural Capital**, by ensuring that adequate resources are committed to the implementation and ongoing management of the Natura 2000 network of special nature sites across the EU;

- Increasing the returns from **Environmental Innovation**, through a strengthened and better co-ordinated programme of investment in environmental and energy R&D, designed to enhance the effectiveness of current investments through the Seventh Framework Programme for Research and Technological Development (FP7), the Competitiveness and Innovation Framework Programme (CIP), the Environmental Technologies Action Plan (ETAP) and the Lead Market Initiative (LMI) for Europe;

- Addressing the environmental barriers and opportunities for **Economic Cohesion**, by fully meeting the environmental investment needs of the cohesion regions, through a €100 billion programme of investment in water supply; waste water treatment; municipal solid waste; renewable energy and natural risk management in the 2007 to 2013 programming period; and

- Increasing **Green Taxes** to enhance the sustainability of our public finances, through:

    - ***Energy taxation*** – implementing an environmental tax reform, involving a new carbon tax and materials tax, designed to reduce greenhouse gas emissions by 20% by 2020, compared to 1990 levels. The revenues would be recycled through lower labour taxes;

    - ***Transport pricing*** – introduction of a new fuel tax and km tax for all vehicles, designed to address all of the environmental impacts of transport in the EU. A €564 billion taxation package has been proposed, the majority of which would be used to reduce other taxes.

The economic outcomes of the package are summarised as follows:

- **Employment** – the package is estimated to increase employment by 7.5 million jobs. The largest effect is due to the role of energy taxes in enabling reductions in labour and income taxes, providing incentives for greater use of labour and less use of natural resources in the economy. There are also significant increases as a result of growth in innovative environmental industries, labour intensive investments in buildings energy efficiency and the management of nature sites, and the supply chain effects of investments in renewables and environmental infrastructure in cohesion regions.
- **Productivity** – the package will increase EU productivity and GDP by reducing energy and resource costs, driving innovation and business growth, and allowing labour and income taxes to be reduced. Most of the measures have positive, quantifiable effects on GVA.

- **Innovation** – the package will stimulate innovation in environmental and energy saving technologies and processes.
- **Capital Base** – the measures will drive productive investment in renewables, buildings energy efficiency, clean technologies, skills and natural capital, which will further enhance the economy's future productivity.
- **Public Finances** – the package will have no net budgetary cost. Some elements involve improved delivery of existing commitments, while increases in net public expenditure on energy efficiency and business resource efficiency can be met by the proposed environmental taxes.
- **Balance of Trade** – the measures will strengthen the EU's position in the global market, increasing exports of key products and services including renewable energy and energy efficient technologies, bio-based products, waste recycling technologies and sustainable construction techniques. They will also reduce the EU's imports of energy and materials.
- **Economic Cohesion** – the package will provide the environmental infrastructure necessary to support economic development in the EU's lagging regions. It will help to address environmental barriers to growth, and to stimulate new opportunities in areas with limited economic opportunities.
- **Transition to a Sustainable and Resilient Economy** – the package will reduce the EU's reliance on oil and imported natural resources, thereby increasing its resilience to potential future supply shortages and price volatility. Enhancing resource productivity and investing in renewables will help to build a more resilient and sustainable economy for the future.

Table ES1: Employment and Economic Outcomes of the Environmental Policy Package

Policy Measure	**Jobs (000)**	**Other Economic Outcomes**
Building a Resource and Energy Efficient Economy	+320	Annual cost savings of up to €100 billion annually after 10 years. Reduced CO_2 emissions and reduced reliance on energy imports.
Developing an Energy Supply Infrastructure for the Future	+410	0.24% increase in GDP. Reduces oil imports by €157 billion and increases exports of renewable technologies by €10 billion p.a.
Investing in our Stock of Natural Capital	+207	Annual GVA of €5.2 billion in managing N2K network. Delivery of ecosystem services, improving human health and wellbeing, supporting tourism and providing protection against climate change effects.
Maximising the Returns from Environmental Innovation	+665	Increased GVA in lead markets of recycling, bio-based products and sustainable construction. Increases in exports, displacement of imports. Many new jobs are high quality, high skilled.
Addressing the Environmental Barriers and Opportunities for Economic Cohesion	+388	Gross impact on GVA of €18.4 billion, promoting convergence. Provision of long term development opportunities by addressing environmental constraints to development, encouraging diversification and increasing tourism.
Energy Tax Reform	+5,550	0.6% net increase in GDP. Reduced energy demand of 13%, reducing imports. Opportunities to enhance public finances if not all revenues recycled.
Transport Pricing	0	Overall gain of 1.2-2.7% of GDP, through tax reductions, reduced congestion, accidents and environmental costs. Opportunities to enhance public finances if not all revenues recycled.
Total	**+7,530**	

Table ES2: Summary of Economic Outcomes from Environmental Policy Package

Policy Measure	Productivity	Innovation	Employment (000 jobs)	Balance of Trade	Capital Base	Public Finances	Economic Cohesion	Transition to a Resilient and Sustainable Economy
Building a Resource and Energy Efficient Economy	Enhances total factor productivity by reducing energy and resource use. Annual cost savings of €18 billion to households and €78 billion to businesses, after 10 years.	Will boost product and process innovation, particularly in SMEs.	Creates jobs by encouraging substitution of labour for material and energy inputs. Potential to create 300,000 FTE jobs in housing renovation and 20,000 FTE in SMEs.	Resource efficiency reduces costs, cuts reliance on imported energy and raw materials, and enhances international competitiveness, thus improving the balance of trade.	Encourages investment in productive assets which yield cost savings to the economy. Reduces impacts of energy on natural and built capital.	Net cost of €4 billion annually to public sector, some of which will be recouped through reduced energy costs.	Provides environmental infrastructure for economic development in lagging regions, helps to address environmental barriers to growth and stimulate new economic opportunities.	Enhances self-sufficiency and resilience of the EU economy, reducing threat to economic security and the risk of future price shocks caused by global competition for limited resources.
Developing an Energy Supply Infrastructure for the Future	Evidence indicates that the shift to renewables will lead to a small net increase in EU GDP.	Innovation plays a key role in the renewables sector, which invests heavily in R&D designed to stimulate the development of new and cost effective technologies.	410,000 net FTE jobs, in development, installation, operation of renewable energy sector and industries supplying it. Labour intensive with strong local supply linkages compared to conventional power.	EU is a market leader and significant net exporter of renewables technology. Also displaces energy and fossil fuel imports. Policy increases exports by €5-7 billion and reduces imports by €45 billion by 2020.	Meeting the 20% renewables target will involve investments estimated at €600-670 billion by 2020.	Most investments are indirectly paid for by electricity consumers through higher prices, so the effect on government finances is limited.	Wind, wave, solar, geothermal and biomass energy offer new opportunities in regions not well endowed with mineral resources. Structural and Cohesion Funds have supported many successful renewables projects.	Renewables will enhance self-sufficiency and resilience of the EU economy, reducing the threat to economic security and the risk of future price shocks caused by global competition for limited resources.
Investing in our Stock of Natural Capital	Managing N2K network supports €5.2 billion GDP, skilled and knowledge based employment, and enhances physical and mental wellbeing of the workforce.	The impact of Natura 2000 on innovation is likely to be limited.	207,000 FTE jobs in management of Natura 2000 network and among suppliers and contractors, plus further tourism employment.	The impact on balance of trade is expected to be minimal.	N2K covers 20% of EU land area, plays key role in management of the EU's natural capital base, which supports key ecosystem services	Network will be funded from existing EU budgets, but depends on sufficient funding being allocated from these budgets.	Implementing the network will have disproportionate benefits for less developed regions of the EU, which tend to have the richest natural assets.	Natural areas play a key role in climate change mitigation and adaptation, important for our economic future.
Maximising the Returns from Environmental Innovation	The focus on growing, high value added sectors will enhance productivity and boost GDP per worker.	Better delivery of environmental innovation programmes will increase their contribution to overall levels of innovation in the EU.	Creation of 665,000 jobs in waste recycling, sustainable construction and bio-products, including many high skilled, high wage jobs.	Creates new export opportunities in growing global markets; helps EU to remain competitive against producers overseas.	Enhances the capital base by stimulating investment in cleaner technologies and growth sectors.	Substantial budgetary resources already committed - need for improved delivery of existing measures, rather than increased expenditure.	Can play an important role in growth of cohesion regions, with Structural and Cohesion funds supporting various environmental innovations.	Innovation in energy and resource efficient technologies and processes will reduce dependence on imported energy and materials.
Addressing the Environmental Barriers and Opportu-	Environmental investments will enhance an-	Structural Fund programmes have sup-	Environmental investments will create	Many regions have used the Structural	Investments in water, wastewater,	Environmental priorities can be met	Environmental investments promote cohe-	Help to deliver lasting economic improvements by enhancing envi-

nities for Economic Cohesion	nual GVA by €18.4 billion and provide conditions for lasting economic growth.	ported successful eco-innovation projects in various EU regions.	388,000 jobs and provide conditions for lasting job creation in future.	Funds to support the development of environmental industries with export potential, enhancing international trade.	solid waste, renewables, and other environmental infrastructure are prerequisite for economic development in many regions.	within current cohesion budgets but require sufficient resources to be focused on environmental investments.	sion through delivery of the range of economic outcomes listed here.	ronmental capital, improving energy and resource efficiency and reducing carbon emissions.
Energy Tax Reform	GDP is enhanced by 0.6% as effects of energy tax are offset by reductions in other taxes. Resource productivity increases.	Taxes provide incentive for innovation to stimulate continuous improvements in energy and resource efficiency.	Employment increases by 2.5% (5.55 million FTE) as tax burden shifts away from use of labour.	Effects on the balance of trade are broadly neutral, even if the EU introduces the ETR unilaterally.	Carbon taxes encourage investment in renewable energy, though this is offset by reduced investment in conventional power, causing slight decline in overall investment	ETR is budget neutral if tax revenues are recycled through lower labour and income taxes.	Effects on different Member States depend on their economic structure and their use of energy and materials; modelling results suggest that cohesion regions benefit most.	ETR reduces overall energy demand by 13% compared to baseline, reducing the EU's reliance on imported fossil fuels.
Transport Pricing	Positive effect of 1.5-2.7% of GDP, through reduced congestion/ pollution/damage to human health, recycling of tax revenues to reduce labour and general taxes.	Encourages innovation through incentives for fuel saving measures and lower impact transport modes.	Effects are broadly neutral, with the negative effects of tax offset by the positive effects of reductions in labour taxes.	Balance of trade enhanced by reduced demand for imported fuels.	Reduced damage to infrastructure from pollution and congestion; lower impacts of transport on natural capital.	Overall effect depends on use of tax revenues; recycling these through reduced labour or general taxes should enhance economic effects.	Cohesion regions will benefit from incentives for more efficient and sustainable transport systems.	Reduces reliance on imported fuels and sensitivity to oil price movements, enhances ability to address challenge of climate change.

1. Introduction

The European Union aspires to become the most dynamic and competitive economy in the world. The Lisbon Strategy, launched by EU leaders in 2000 and subsequently revised and simplified in 2005, emphasises the need to modernise Europe's economy and focus attention on growth and employment, in order to address the challenges of globalisation and demographic change and to support our wider economic, social and environmental goals.

To achieve this, the updated strategy emphasises the need for:

- **A more attractive place to live and work** (by extending and deepening the internal market, improving European and national regulation, ensuring open and competitive markets inside and outside Europe, and expanding and improving European infrastructure)
- **Knowledge and innovation for growth** (increasing and improving investment in Research and Development, facilitating innovation, the uptake of ICT and the sustainable use of resources, and contributing to a strong European industrial base); and
- **Creating more and better jobs** (attracting more people into employment and modernising social protection systems, improving the adaptability of workers and enterprises and the flexibility of labour markets, and investing more in human capital through better education and skills)(EC, 2005).

The current global economic crisis represents a significant setback in implementing Europe's economic agenda, leading to problems of loss of demand, unemployment and deteriorating public finances. In order to address these economic problems, restore growth and tackle unemployment, a European Economic Recovery Plan (European Commission, 2008) was launched, which sets out the actions the EU will implement to deal with the crisis.

At the same time, the EU faces significant environmental pressures and challenges such as climate change and biodiversity loss that threaten to undermine the quality of life around the world and the essential support systems on which economies and societies depend. These pressures highlight the need for new patterns of development if the EU is to achieve lasting prosperity.

The European Commission (DG Environment) commissioned GHK, IVM, SERI and TML to investigate the links between environmental policy and the economy, and to assess the role of environmental policy measures in the EU's economic development.

This report demonstrates that addressing environmental priorities is fully consistent with meeting Europe's current economic challenges and building a sustainable, efficient and resilient economy in the long term. Indeed, we highlight many areas where environmental policy is essential for sustainable economic progress.

The next section of the report presents an overview of the linkages between environmental policy and the economy and the potential role of environmental policy instruments in economic development. Sections 3-10 review evidence of the links between environmental policy and key economic outcomes, assessing its role in relation to:

- Productivity
- Innovation

- Employment
- The Balance of Trade
- The EU's Capital Base
- Public Finances
- Economic Cohesion
- The Transition to a Resilient and Sustainable Economy.

The report is designed to demonstrate the positive role that environmental policy plays in relation to each of the economic outcomes, thereby contributing to economic recovery and the longer term economic strategy of the EU, as set out in the Lisbon agenda.

Section 11 examines the need for public intervention to deliver solutions that benefit the environment and the economy, based on market failure arguments.

The final section draws on this evidence base to set out a package of environmental policy measures which have the potential to contribute to economic development in the EU, meeting both short term and long-term economic development priorities.

2. Environmental Policy and the Economy

Environmental policy is designed to tackle market failures, by controlling pollution, regulating resource use and protecting and managing the natural environment. It aims to achieve a more efficient use of resources in the economy, maintaining the environmental assets which people value and which support a healthy economy and society, while reducing the costs to people and businesses of environmentally damaging activities.

By influencing the use of resources, environmental policy affects the way in which economic activity develops. It encourages the more efficient use of energy and materials and the development of new, cleaner products and services, while discouraging activities that are environmentally damaging. In doing so it encourages product and process innovation and influences the allocation of labour, capital, land and raw materials, either through direct regulation or through the pricing mechanism. It encourages the development of new products and services designed primarily to enhance the environment, and the integration of environmental considerations into wider economic activity.

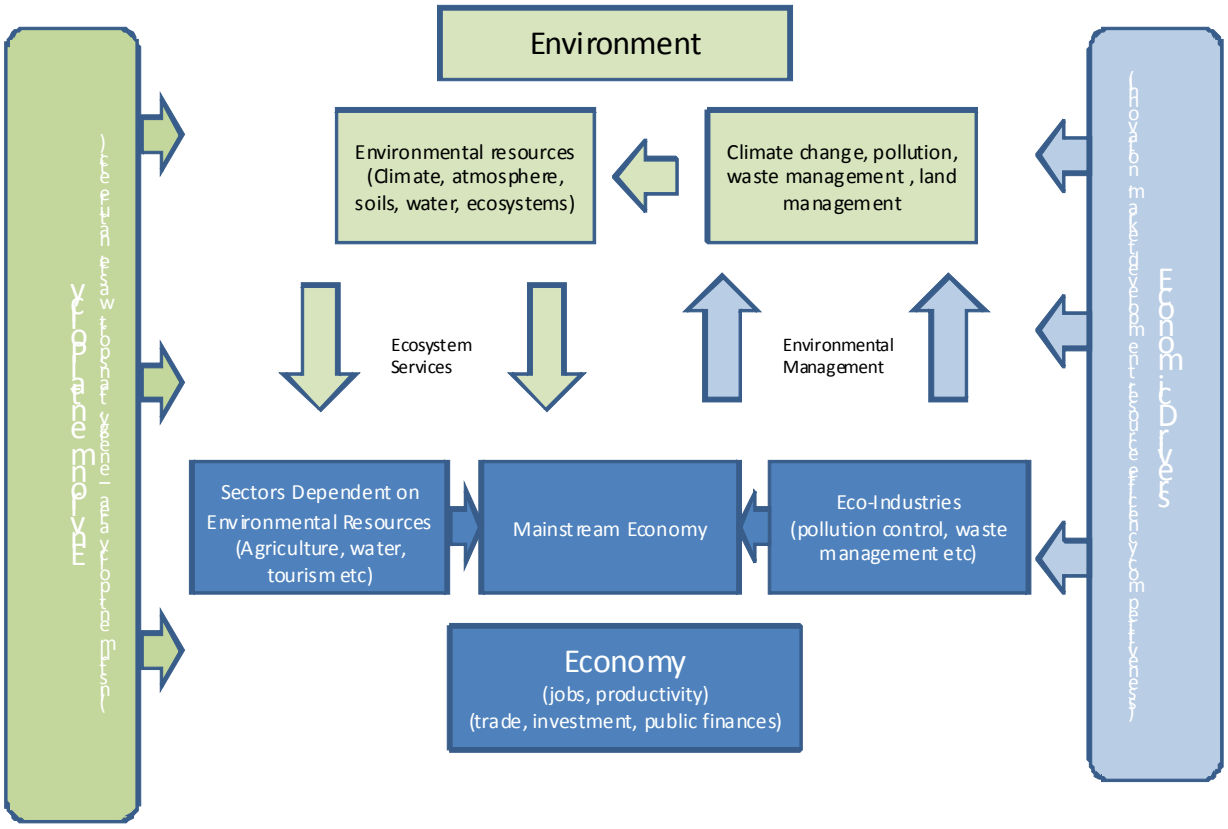
Environmental resources have important impacts on the economy, through the provision of ecosystem services such as the provision of clean air and water, the regulation of the climate and protection from floods and hazards. These ecosystem services are essential for supporting economic activity. Certain sectors such as tourism and agriculture are particularly dependent on the quality of the environment and on the ecosystem services it provides.

The economic significance of activities linked to the environment can be measured in terms of their contribution to employment and GDP. Economic assessments of environmental policies must take account not only of their direct effects, but also the indirect and often longer term impacts through economic multiplier effects, innovation, changes in trade, resource and product substitution and wage and price adjustments.

These linkages between the economy and the environment are influenced by environmental policy, which seeks to influence environmental management activity, as well as by key economic drivers such as innovation, competition, the efficiency of resource use, and the development of new markets.

Figure 2.1 provides an illustration of these environment-economy linkages.

Figure 2.1: Illustration of Environment-Economy Linkages



The various linkages between environmental policy and the economy can be categorised in different ways, according, for example, to:

- The **economic drivers** or **mechanisms** by which environmental policy benefits the economy (e.g. resource efficiency, innovation, new market creation etc)
- The **nature and direction of linkages** between the environment and economy (distinguishing, for example, between activities primarily concerned with environmental management (the "eco-industries"), the effects of environmental management in the wider economy, and activities in sectors highly dependent on environmental quality (such as tourism and land management activities);
- The **type of policy instrument** (e.g. decentralised instruments such as moral suasion, property rights and liability laws; command-and-control/direct regulation such as technology standards combined with enforcement; and market based instruments, such as emissions taxes, subsidies, and tradable permits)
- The **policy area** in question (e.g. science and innovation, energy, transport, agriculture and rural development, fisheries and marine environment, nature conservation)

- The **beneficiaries or agents of policy** (e.g. households, businesses, landowners, local authorities etc, including those affected directly and indirectly)
- **Economic development outcomes** – including employment, output, productivity, innovation, capital investment, income distribution, the balance of trade and the balance of public finances. These are, ultimately, likely to be of greatest interest to economic policy makers.
- The **type of economic impacts** (including direct, indirect and induced effects). Evidence demonstrates that supply linkages, for example, are important determinants of the economic impact of environmental policies.
- The **sectors of the economy** affected (including different primary, manufacturing and service industries).
- The **timescale** of effect (short, medium or long term), recognising that some effects (e.g. direct effect of green investment) will be noticeable in the short run while others (e.g. effects of policies on innovation and competitiveness) will only be observable over long time periods.

This report focuses on the **economic outcomes** delivered by environmental policies, on the grounds that these are likely to be of greatest interest to economic policy makers. The following sections provide evidence to demonstrate that well designed environmental policies are capable of:

1. Raising Productivity
2. Promoting Innovation
3. Increasing Employment
4. Improving the Balance of Trade
5. Improving the Public Finances
6. Strengthening our Capital Base
7. Promoting Economic Cohesion
8. Supporting the Transition to a Resilient and Sustainable Economy.

A variety of policy opportunities can be identified which have the potential to contribute to these economic outcomes. These include:

- Investments in environmental, energy and transport infrastructure;
- Economic instruments (including taxes, tradable permits and incentives);
- Product standards and labelling;
- Skills and training programmes;
- Innovation programmes;
- Business advice and demonstration; and
- Environmental regulations affecting a wide range of economic sectors and activities.

The following sections present evidence and examples to demonstrate these linkages, quantifying as far as possible the extent to which they have delivered the economic outcomes identi-

fied, and identifying opportunities for new policy initiatives to contribute to economic development in the EU.

Each section:

- Describes how environmental policy delivers the economic outcome identified;
- Identifies the types of policy measures capable of delivering this outcome;
- Provides evidence to support this from the literature;
- Identifies examples and case studies from around the EU and internationally;
- Presents available evidence of the current scale of these economic effects;
- Identifies the potential for further policy action in each area; and
- Identifies methods/metrics/models for assessing the benefits of potential policy developments.

3. Environmental Policies and Productivity

3.1 Description and background

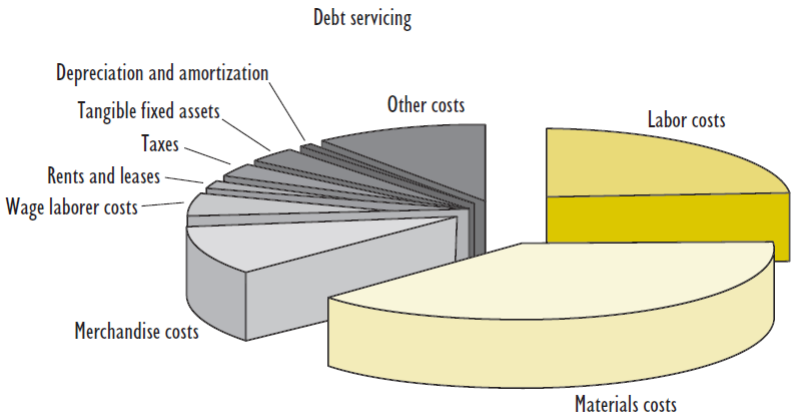
High productivity is key to any successful modern economic policy. Historically, productivity growth – which means increasing outputs per unit of input – has been a fundamental source of economic growth (European Commission, 2004).

Overall, two general trends in today's economies lead to the overuse of natural resources and the underuse of human resources. On one hand, labour productivity rises due to developments such as the application of new technologies, the increase of "slim" production, and globalisation. This has negative effects on employment as fewer workers are needed to achieve the same amount of GDP (Aachener Stiftung Cathy Beys, 2005).

On the other hand, resource productivity is often ignored compared to labour productivity. When companies think about "rationalisation", most think of reducing labour costs. Reducing the costs of materials, which are often considerable, is often neglected. Company controllers focus essentially on the labour factor, because in the past salaries rose continuously whereas prices for raw materials may have been subject to great fluctuations, but they followed no clear tendency. Because of this, there is often simply a lack of knowledge about resource-saving alternatives to conventional production processes. This means that resources are wasted and thus total factor productivity is smaller than it could be (Jäger, 2008). Enterprises and consumers have to pay three times for wasted resources: in purchasing goods and services, processing them, and in disposal of waste. If resource use is reduced to the minimum level necessary, procurement and processing costs can be reduced and total productivity increases.

The Hannover Chamber of Commerce, for instance, determined that materials currently account for 40% of the costs in manufacturing industries – as compared to labour, which accounts for 23% (see Figure 3.1 below). A main reason for the miscalculation of the true proportion of costs lies in accounting systems. Often they record labour costs as separate items on diverse accounts, whereas material costs are aggregated, usually in just a single account, without differentiating between individual groups of materials. It is thus impossible to calculate the real consumption of individual materials and their exact share of the cost of the product. The International Federation of Accountants, the umbrella organisation for company controllers and tax accountants, recently pointed this out in its new Guidance for Environmental Management Accounting, which explicitly recommends counting losses of materials in order to assess environment-related costs (Jasch and Savage, 2005).

Figure 3.1: Cost Structure of the Manufacturing sector



Source: Jäger (2008)

Especially in the light of increasing resource use, resource scarcity and availability this becomes a major issue. Absolute levels of resource and energy use are constantly rising due to the requirements of a growing world economy. Between 1980 and 2005, global extraction of abiotic (fossil fuels, minerals) and biotic (agriculture, forestry, fishing) resources increased from 40 to 58 billion tonnes. Scenarios anticipate the necessity to extract a total of around 80 billion tonnes of resources by 2020 (200% of the amount in 1980) in order to sustain worldwide economic growth (Giljum et al., 2008). Moreover, evidence is growing that pressure on the availability of natural resources is causing a strain on both the environment and the economy. The inefficient use of resources at a time of growing demand is leading to increasing environmental pressures and resource scarcity which will have a strong effect on European industries. Prices for global commodities like oil, raw materials and wheat have been increasing over the past five years. The current economic and financial crisis has led to lowering demand for natural resources, however, only temporarily (European Parliament, 2009). And, the EU's dependency on resource and energy imports is dramatically increasing. Without major changes over the next 20 to 30 years, approximately 70% of the EU's energy will have to be imported. This is 20% more than today (Rocholl et al, 2006).

Achieving resource and energy efficiency is thus a key challenge for the future of the EU economy. And the more efficient use of the technologies implemented today is relatively easy to achieve. More and more companies recognise the advantages of saving resources: enterprises, consumers, and the environment benefit from increased efficiency in the use of raw materials, supplies, and primary products. Reduced resource use cuts purchasing costs, which provokes four main effects:

- Production gets cheaper, so prices go down.
- This increases competitiveness and domestic demand, as well as export demand.
- Resource productivity increases.
- The effects of higher resource productivity are partly compensated by higher demand for the now cheaper products. The material use stays nearly constant (rebound effect).

Business consultants report that even providing nothing more than technical advice to companies in the processing sector could bring savings of around 20% of material costs (Fischer et al., 2004). The implementation of a dematerialisation strategy is not only ecologically but also economically good. Forward looking companies which increase the resource productivity of their products and services go in this direction because they want to be still in business in 10 or 20 years.

The idea to "make Europe the most energy and resource efficient economy in the world" is gaining momentum. Increasing the EU's resource and energy efficiency would benefit the EU in many ways. It would:

- push forward innovation;
- increase competitiveness;
- minimise the ecological footprint;
- help to maintain natural capital and eco-systems services
- create jobs;
- improve national self-sufficiency and security;
- improve global equity; and
- save money spent on expensive imports of resources and energy (Rocholl et al, 2006)

Without a dramatic rise in resource productivity, sustainable economic growth cannot be achieved. However, a massive improvement in resource efficiency cannot be achieved by relying on individual people and companies to reconsider and change their actions. It is necessary to provide the right economic signals and incentives for individuals and enterprises to invest in resource-saving technologies or innovative services. The main goal of environmental policy must be to ensure that the prices of natural resources send the right signals (Jäger, 2008). This is discussed further in the next section.

3.2 Policy instruments

Environmental policy has long limited itself mainly to so-called “end-of-pipe” solutions to clean up acute environmental problems. Precautionary measures have been widely neglected. Meanwhile, the view that environmental policy should focus on the underlying root causes of environmental burdens rather than fighting symptoms of impacts is gaining more and more support. The need is not to replace the traditional approach of environmental protection, but to add a new dimension to it and to enlarge its scope. Attention needs to be put on the input side of economic activities, so that precautionary actions can be taken before production and consumption processes start.

In principle, policy measures can be categorised according to how strongly they influence companies’ and consumers’ individual choices. There is a variety of policy opportunities to drive resource and energy efficiency. Typically, the options to be considered are eco-taxes, tradable permits and subsidies (European Parliament, 2009; Bleischwitz, 2002; EEA, 2006; Jäger, 2008).

Green Taxes on resource consumption. All European nations collect environmental taxes. They can be divided into four categories: energy, transport, pollution and resource taxes (European Parliament, 2009). An often mentioned instrument to set an incentive for increasing resource efficiency is a resource tax. It increases the price of natural resources in order to compensate for market failure (Aachener Stiftung Kathy Beys, 2005). A market that taxes resource

consumption steers the economic necessity of lowering costs in the right direction. At the same time, producers get the right signals to produce goods that impact less on the environment. Higher prices for energy and material inputs work their way along the production chain to the consumer, who is encouraged by the pricing system to adopt more efficiently produced goods and services. Experience shows that incremental increases of these taxes are advisable, in order to give business and consumers enough time to adapt (Jäger, 2008).

Ecological tax reform. Shifting taxes from labour to energy and natural resources, thus taxing environmental "bads" and subsidising environmental "goods" – is one of the most effective ways to boost eco-efficiency and innovation while creating jobs and economic benefits at the same time (see Case Study 3.3). A cost-neutral shift of overheads, charges and taxes from income to natural resources:

(1) internalises the costs of natural resource use;
(2) stimulates eco-innovation;
(3) gives incentives to producers for dematerialising goods and services;
(4) creates a price structure in the market that rewards purchasing and using eco-efficient goods and services; and
(5) makes labour less costly and thus creates new jobs (Schmidt-Bleek, 2008).

Tradable resource use permits. While green taxes set a tax rate and the quantity used or emitted adjusts to reflect the higher price, in emissions trading schemes the policy sets the quantity and the market sets the price. By allocating permits to companies they can trade amongst themselves the government intends to encourage companies to make use of existing opportunities to reduce resource use and, in particular, to develop innovative resource-saving technologies. At the European level, the EU Emissions Trading Scheme (EU ETS) was introduced in 2005 as the first EU-wide economic instrument and the first supra-national emissions trading system in the world. The scheme ran a 'pilot' phase until 2007 and continues in the second phase through the first commitment period for the Kyoto targets, 2008–2012 (EEA, 2006). Similar to the regulation of carbon dioxide emissions, so-called "material input permits" could be created with set ceilings of an agreed amount. The total amounts could be reduced incrementally in order to give companies enough time to adapt (Jäger, 2008).

Subsidies. Traditional economists are often sceptical about subsidies. However, financial support may be justified where it helps to encourage research and technological innovation. Efficient technologies generate external benefits that are internalised by subsidies. The point is to reduce environmentally harmful subsidies – so-called "perverse subsidies" (specifically for fossil fuels) - which also harm the economy in the long run, and increase environmentally-motivated subsidies. Perverse subsidies not only encourage resource consumption, they also delay conversion to renewable energy sources.

These instruments could be introduced in combination. The overall goal is to create framework conditions for competition in a manner that makes it attractive for companies to develop resource-saving products and process innovations. An overview of the most important instruments is provided in Box 3.1.

Box 3.1: Political measures to increase resource efficiency (Jäger, 2008: 149):

- Shifting the tax burden in the course of an ecological tax reform away from labour and towards resource consumption.
- Eliminating subsidies that encourage the overuse of natural resources in the sectors of agriculture, fishing, transportation, and energy.

- Supporting research and technology development to increase the resource efficiency of products and production methods.
- Introducing targets to improve resource efficiency in public procurement as well as company environmental reporting.
- Binding minimum standards for the average energy use of products (consumption ceilings for household appliances or cars).
- Value-added tax exemptions for products with recognised labels such as environmental labels, organic products, and fair trade products.
- New spatial planning measures that bring all spheres of life back together: housing, working, and shopping.

At the European level, a range of directives, regulations, policies and processes are currently under discussion or in the state of implementation. Resource-related EU policies include the renewed Lisbon Strategy and the related trade strategy Global Europe (2006), the Raw Materials Initiative (2008), the Action Plan on Sustainable Consumption and Consumption (2008), the thematic strategy for the sustainable use of natural resources (Resource Strategy), and others. However, a strategy that orchestrates policies to promote an eco-efficiency revolution in the EU is still missing.

Key policy areas that tackle the resource and energy issue at EU level are (Rocholl et al, 2006):

- **Energy policy**: Delivering a low-energy economy, whilst making the energy consumption more secure, competitive, efficient and sustainable (i.e. through a larger share of renewable energy).
- **Climate policy**: Efforts to reduce greenhouse gas emissions go hand in hand with energy and resource efficiency enhancements.
- **Transport**: Growth in resource use by the transport sector makes it a major target for resource efficiency. European-wide measures are so far almost completely lacking.

Examples of other policy areas where further action is possible are:

- Public procurement: framework legislation could use the purchasing power of the state to drive forward resource-efficient products.
- Environmental Technology Action Plan: development of the ETAP could encourage the development of technologies capable of achieving long term improvements in resource efficiency.
- Lending of the European Investment Bank and the European Bank for Reconstruction and Development could be geared away from fossil fuels and towards resource efficiency.
- The Integrated Product Policy (IPP) and the Eco-Design Directive could be improved with more concrete actions and instruments aiming for much more eco-efficient products.
- EU programmes can be used to direct the economy to more efficiency. The 7th research framework programme, for instance, could put a stronger emphasis on renewables, energy efficiency and energy savings.
- EU budget: The tens of billions spent via the Structural and Cohesion Funds every year represent an enormous potential to influence the development path of the EU – specifically in the new Member States where energy and resource efficiency is still poor (Rocholl et al, 2006).

3.3 Review of evidence from the wider literature

There is widespread agreement among academics that increasing resource and energy efficiency would benefit the economy and the environment alike and help reduce unemployment, thus being a true winning strategy for the EU's economy.

According to research conducted by the University of California[1] between 1970 and 2005, solar and wind show stronger marginal returns to labour investments than fossil fuel technologies. They also found that renewable technologies' patents show greater returns to R&D investment relative to fossil fuels. Furthermore, increasing the use of renewable energy improves an economy's technical efficiency, i.e. how much more output can be produced with the given levels of inputs using current technology (Taichen and Hua, 2007).

A study published by Allianz Dresdner Economic Research (2008) describes energy and resource efficiency as "a key driver for growth". A cross-sectional analysis of economic performance in EU-15 countries for 2004 shows a positive correlation between energy efficiency and prosperity levels: countries with high energy productivity in general also exhibit high levels of GDP growth. Moreover, ecologically driven structural change provides extremely good growth prospects for "environmental markets", such as energy technologies, sustainable mobility and transport technologies, efficiency technologies, and recycling technologies. Allianz Dresdner Economic Research Empirical research states that economies with a strong science and research environment can play a prominent role in these fields. The real winners will be the countries, regions and companies that take the lead in developing and deploying the new technologies.

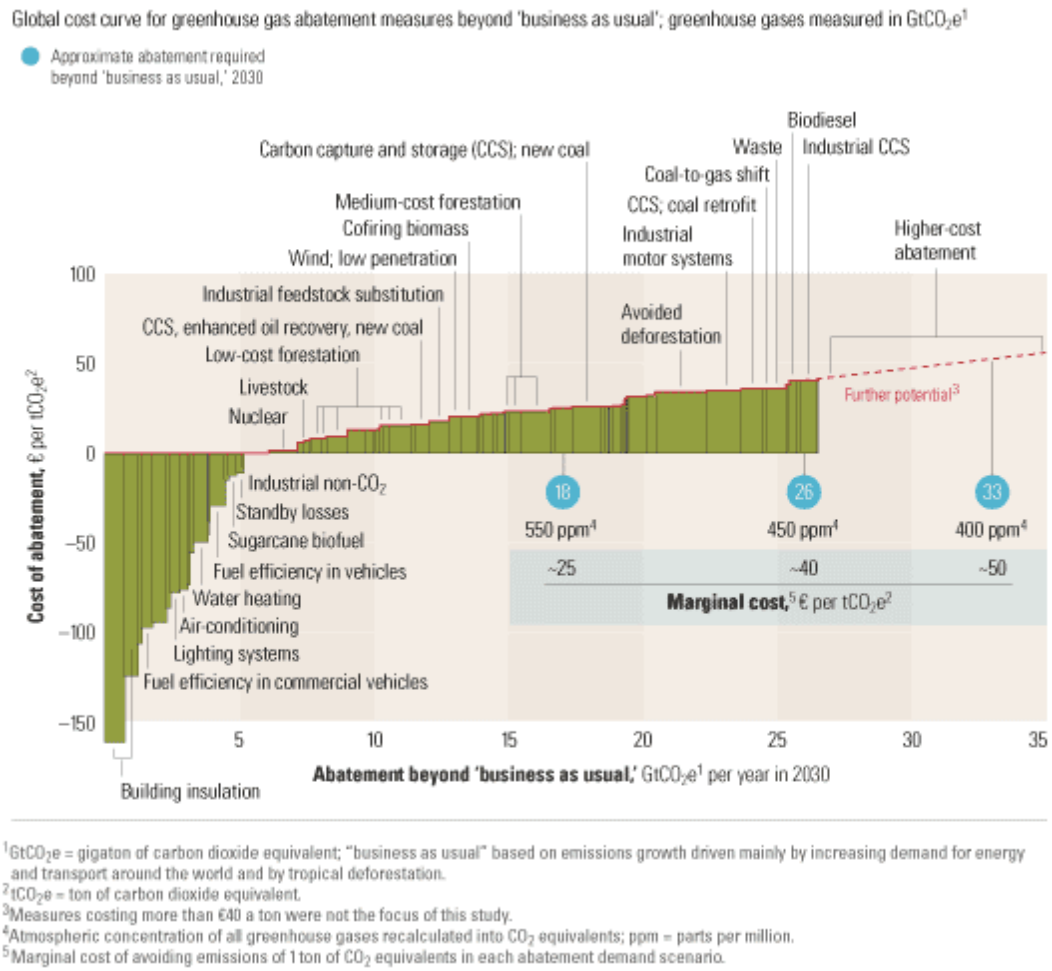
Artim et al. (2008) analyse how environmental projects contribute to achieving the goals of the Lisbon agenda. They conclude that projects within the energy efficiency and renewable energy sector lead to significant direct cost reductions and to indirect savings in the health and social sectors. At the same time, they stimulate employment and reduce fuel dependency. The study illustrates that the environmental pillar of the Lisbon strategy does not weaken but, on the contrary, strengthens its economic and social pillars and that investments in resource and energy efficient projects have the capacity to increase the competitiveness of the EU on the global market.

Besides positive economic effects on the macro-level, a number of studies show that companies often directly benefit from the cost-saving potential of production-integrated environmental protection techniques. There is a robust potential for decreasing material throughput costs of about 20% (Arthur D. Little et al, 2005; Aachen Stiftung Cathy Beys, 2005; Fischer et al., 2004). For SMEs the potential for improving resource productivity is estimated even higher.

Work by McKinsey (2009) on the marginal costs of greenhouse gas abatement demonstrates that a variety of measures have the potential to yield substantial cost savings to the economy, including building insulation, fuel efficiency in vehicles, and improvements in the efficiency of water heating and air conditioning systems (Figure 3.2).

[1] https://www.ipam.ucla.edu/publications/sews3/sews3_7467.pdf

Figure 3.2: Global Greenhouse Gas Abatement Costs



[1] $GtCO_2e$ = gigaton of carbon dioxide equivalent; "business as usual" based on emissions growth driven mainly by increasing demand for energy and transport around the world and by tropical deforestation.
[2] tCO_2e = ton of carbon dioxide equivalent.
[3] Measures costing more than €40 a ton were not the focus of this study.
[4] Atmospheric concentration of all greenhouse gases recalculated into CO_2 equivalents; ppm = parts per million.
[5] Marginal cost of avoiding emissions of 1 ton of CO_2 equivalents in each abatement demand scenario.

Source: McKinsey (2009)

A quickly growing body of literature assesses past developments in resource productivity, particularly in OECD countries but little work has so far been done to provide ex-ante assessments of environmental and economic effects of resource policies (see Giljum et al., 2008). The project MOSUS, funded by the European Commission, was designed to fill some of these research gaps. A comprehensive economic–energy– resource model simulated different development scenarios for Europe up to 2020 and evaluated the impacts of policy measures on economic indicators (such as growth, competitiveness, trade, national budgets, unemployment) as well as environmental indicators (material extraction, energy use, CO_2 emissions) (see Case Study 4.1).

Empirical research suggests that overall productivity in an economy grows more rapidly when conditions are conducive to innovation and the rapid dissemination of new knowledge. In spite of the empirical evidence of the economic benefits of resource and energy-efficient policies it is surprising that little concrete action has been taken so far. Studies repeatedly indicate that suitable framework conditions set by the state are a prerequisite for greater energy and re-

source productivity. Stronger policies are needed to reap maximum economic benefits. However, a strategy to systemically adjust policies to promote an eco-efficiency revolution in the EU is still missing (Giljum et al., 2008). This could result in Europe losing a major opportunity.

There is also evidence of strong productivity in the growing EU eco-industry. The recent Ecorys (2009) report found that both the productivity and growth rates of a representative sample of companies was higher than in the manufacturing sector as a whole in the period 2004-06. They concluded that in this respect eco-industries are an important contributor to the Lisbon Agenda for growth and jobs. There were significant variations between sub-sectors, with renewable energy, eco-construction and air pollution control having a relatively higher average productivity than manufacturing, while other sub-sectors such as recycling and waste treatment and collection have lower productivity values. However, productivity growth was found to be higher than in manufacturing for all sub-sectors except sanitation and remediation.

3.4 Evidence from examples and case studies

Examples of the economic outcomes generated by environmental projects focussing on resource and energy efficiency are given in Boxes 3.2-3.4, and in Case Studies 3.1-3.3.

Box 3.2. Modelling projects

RESA (Effects of resource savings on environment, employment and economy in Austria):

Project description:
This project estimated the environmental, economic and employment effects on Austrian society if companies reduce their resource use as a consequence of increased resource productivity due to technical improvements.

Four scenarios were simulated for the period 2005 – 2020, using a new integrated ecological-economic model for Austria. The scenarios specify what an increased dematerialisation may look like and aim at a reduction of resource use and an improved economic performance at the same time. Generally, the results of the scenarios show that material inputs have a strong positive impact on material productivity (for figures please see 'Scenario "Aachen I" – indirect effects' below) and that resource cost savings may lead to substantial economic improvements and employment increases.

Scenario "Aachen I" – outcome and assumptions:
One of the four scenarios ("Aachen I") calculates that a general reduction of material use by 20% by 2020 in the manufacturing sector, agriculture and forestry (with potential to yield 20% material cost savings, according to A.D. Little), would reduce material costs by 18% in 2020 (compared to the baseline scenario).

Inefficiencies in production can be identified and abolished by information and consulting[2]. Based on the experience of consulting firms, material costs in manufacturing, construction and public administration can be reduced by 20%, an average figure that may vary in the different sectors. These reductions of material inputs cannot be achieved without investments in consulting and machinery. The additional consulting and capital costs are of the magnitude of the material cost savings for one year. One third of the additional costs are consulting costs, and two thirds are capital costs. The additional consulting and capital costs are non-recurring, whereas savings of material and energy inputs are perpetual.

Scenario "Aachen I" - direct effects:
Dematerialisation has two direct effects on macroeconomic activity. First, it yields cost reductions in manufacturing, construction and public administration, and second, a reduction in material sales to these sectors. There are therefore winners and losers. However, as the winners are all domestic firms while the losers include both domestic and overseas suppliers of materials and intermediate products, the net effects on domestic GDP are positive.

Scenario "Aachen I" - indirect effects:
A number of indirect effects can also be observed: Cost reductions induce lower prices. If prices reduce less than costs—which is normally the case—profits increase. This raises tax revenues and household income. Both effects increase final demand and sales, production, and employment. In total, dematerialisation will strongly stimulate the economy. GDP in constant prices increases in 2020 by 24% from 312.6 billion EUR in the baseline scenario to 389.1 billion EUR in this scenario. Employment depends on both production and the real wage rate: production has a positive effect on employment, while the real wage rate has a negative effect. In this scenario employment rises, because the negative effect on employment from the real wage rate will be overcompensated by the positive production effect. Rising employment means a further positive effect on household income and in turn on final demand. Employment will rise continuously, so that in the year 2020 the employment level is 2.4% or about 81,000 persons higher than in the baseline scenario.

Scenario "Aachen I" – policy conclusions:
Although 18% less material would be used in 2020 than in the baseline scenario, in absolute terms resource use will not decline due to the rebound effect. Therefore an effective resource policy must take advantage of existing potential to increase efficiency while implementing appropriate measures to address the rebound effect. These are likely to apply equally to companies, households and political frameworks (e.g. taxes and certificates). Detailed examination of such a mix requires further investigation.

Resource productivity as a chance – a long-term economic stimulus package for Germany

In this modelling project, the Aachen Foundation commissioned a series of studies with the aim of improving Germany's resource and energy productivity. Based on the

[2] The government can support information campaigns which stress the importance of material management for the performance of the firms. Agencies could be founded to organise the dissemination of knowledge about saving potentials in material consumption. Consulting involves the concrete activities of engineers searching and installing known best practice technologies especially in smaller firms. The government could be the moderator of a process in which private firms organise the knowledge transfer necessary to dematerialise production processes.

INFORGE/PANTA RHEI model[3] the "Aachen scenario" was developed (for a twelve years' horizon). It shows that a linear decrease of material and energy use by 20% combined with innovations and investments leads to an increase in resource productivity of 2.9% per year and has positive effects on employment, corporate and state revenues, with a payback period of one year in the case of materials and six years for energy. These positive effects would be reinforced by applying a resource tax in the form of a material input tax or the transformation of the VAT system. Given that all 3481 input factors are reduced by 1%, the 20 most important input factors (e.g. coal, metals, stones and food) would account for 52% of reduced total material requirement. Most of them have a rather strong price-elasticity, thus making resource taxation very effective. These effects of the "Aachen scenario" are always identified in comparison with a baseline scenario, which basically assumes only slight economic growth, but continuing increases in resource use.

Economic benefits are as follows:
• More than one million jobs can be created.
• Resource use will decrease despite an improved growth rate.
• GDP will rise by 12% (compared to the baseline scenario).
• The fiscal balance will improve by €100 billion, so that a medium-term recovery of public finances is achievable.
• Two thirds of resource use in Germany is accounted for by a few key sectors, which are priorities for future innovations.

In order to tap the unused efficiency profits and to secure them permanently, accompanying measures are needed such as

- Business consultancy and information programmes: Some measures have already been introduced by the Ministry of Economy and Labour. Consultancy services (1/3 of the costs) and innovations and investment (2/3 of the costs) will enhance corporate profitability through significant reductions in material input costs. Such successful management strategies include, for example "Zero Loss Management" and "Design-to-Cost" (see Box 3.4.).
- Economic instruments: such as self-financing fiscal measures (energy taxes) or elimination of eco-unfriendly subsidies carried out by the state; and
- Best Practice support programmes funded by the state.

Resource productivity, environmental tax reform and sustainable growth in Europe (PETRE)

In the course of the project (for details, see Case Study 3.3), four selected cases of best practice of eco-efficient innovation in Germany were examined to illustrate the win-win potential and the role of policy intervention. The German eco tax has contributed to innovation and growth in the field of *(1) low-energy buildings* and **(***2) fuel-efficient diesel cars* (Jacob et al. 2005). In both cases additional supporting instruments came into effect: Energy minimum performance standards for buildings together with subsidies for energy-saving investments and a tax differentiation for new cars stimulating fuel-efficiency were additional instruments in the policy mix. *(3) Recycling* is dominated by regulation but in the case of industrial recycling the rapid increase of material prices has also stimulated more efficient solutions. The fourth case was

[3] INFORGE (INterindustry FORecasting Germany) is a sectorally deep structured model for economic predictions and simulations. It was developed from the Gesellschaft für Wirtschaftliche Strukturforschung mbH (GWS) in 1996, is updated annually and tested in numerous applications. More information available at: http://www.gws-os.de/Research/Modelle/inforge/inforge.htm. PANTA RHEI has augmented the model with environmental-economic analysis.

about *(4) renewable energies*, where monetary mechanisms – here subsidies as feed-in-tariffs – have stimulated rapid innovation. Again, a policy mix with additional instruments was relevant. The effects of the four case studies on growth, employment, innovation, export and environment are shown in the table below:

Table 3.1: Eco-Industry: Four German Success Stories

	Fuel-efficient Diesel Cars	*Low-Energy Buildings*	*Recycling*	*Renewable Energies*
Taxes / Price Mechanism	Car Tax, Eco Tax, Oil Price	Eco Tax Oil Price	Raw Material Prices	Oil Price
Other dominant instruments		**Standards, Subsidies**	**Regulation**	**Feed-in Tariffs, Subsidies**
Growth	++	+	++	++
Employment		+		++
Innovation	+	+	++	++
Export	++	+	++	++
Environmental Impacts	+	++	+	++

Source: Jänicke 2008. Judgement: + = above average, ++ = far above average

Important project outcomes were:

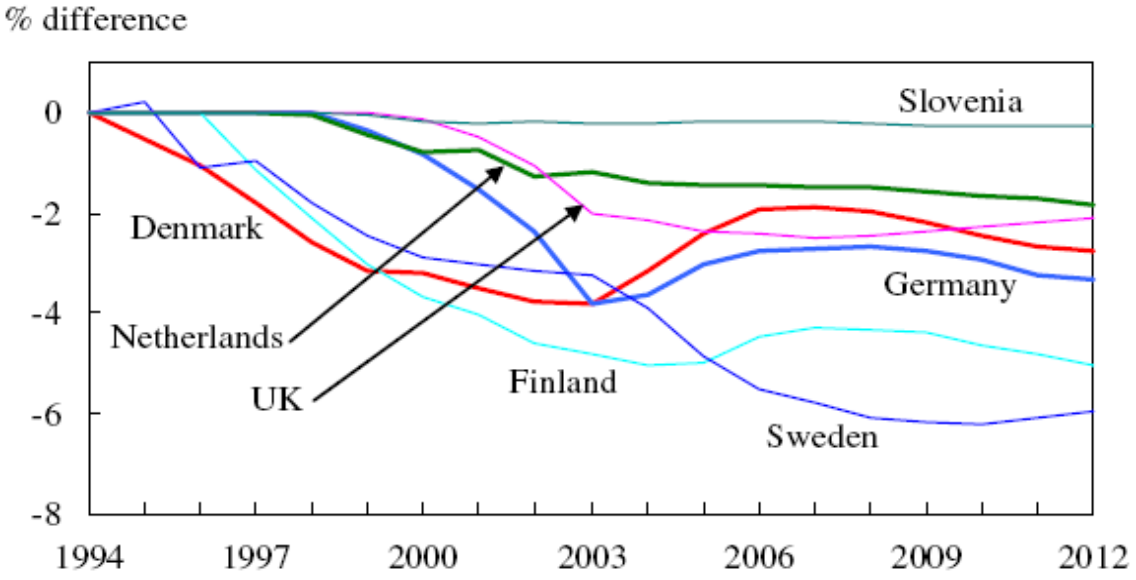
- There is a multiple win-win potential of strict technology-based environmental policy. The cases show the economic co-benefits of growth, successful export and employment.
- Strict and calculable environmental policy measures can also stimulate innovation, especially the feed-back of the innovation cycle from diffusion to invention.
- Government intervention was essential, generally through a policy mix of different instruments. The combination of the price mechanism and regulation was crucial.
- Sustainable growth was not only policy-driven but also depended on an innovative type of industry, the resource management sector of the environmental industry.

Box 3.3: COMETR (Competitiveness Effects of Environmental Tax Reforms)

The aim of the COMETR project has been to evaluate the economic impacts of environmental tax reforms (ETR). These effects have been analysed in seven EU member states: Sweden, Denmark, the Netherlands, Finland, Germany, Slovenia and the UK, where tax reforms have been implemented which to some extent shift the tax burden from taxation of labour to taxation of carbon-energy.

Different scenarios were generated using the E3ME4 model. The results are illustrated by comparing the Reference Case (a projection of what would have happened without ETR but taking into account current and expected developments in the EU economy) with the Baseline Case (an endogenous solution of E3ME including the different forms of ETR in each member state and consistent with historical data and forecasts). Both scenarios are projected to 2012 and assuming revenue neutrality.

Figure 3.3: Effect of Environmental Tax Reform on Fuel Demand



Note(s) : % difference is the difference between the base case and the counterfactual reference case.

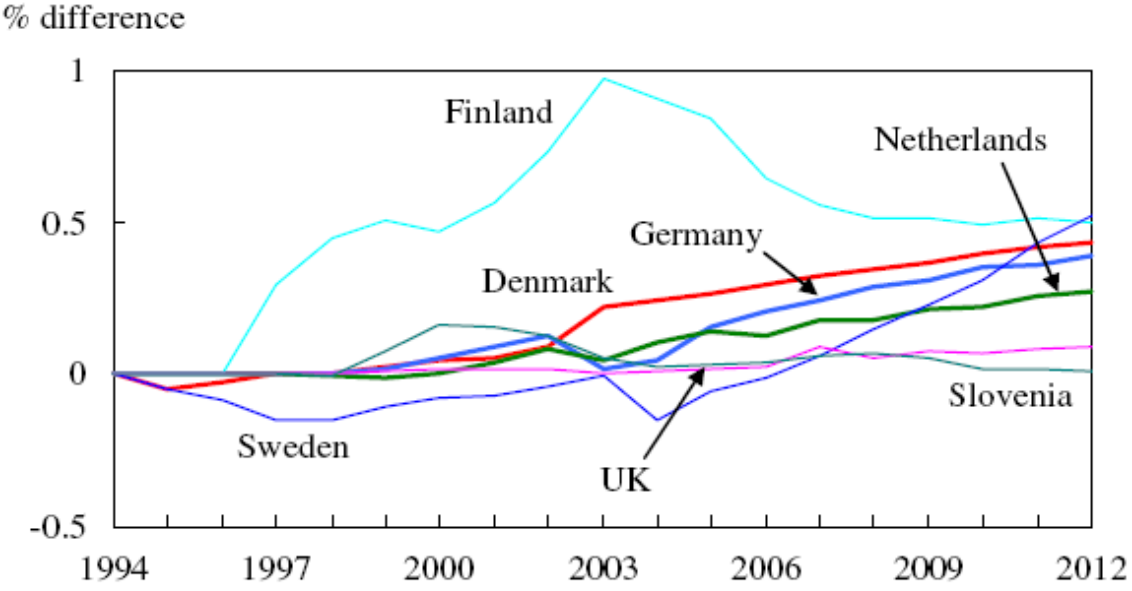
Source: Andersen et al. (2007)

The increasing fuel prices caused by ETR lead to a general decline in fuel demand (Figure 3.3), depending on the tax rates and the possibilities of substitution of fuel inputs. The recovery in fuel demand observed in some countries between 2003 and 2005 can be explained by increasing world energy prices which reduced the relative effect of ETR. A declining fuel de-

[4] E3ME (Energy-Environment-Economy Model of Europe) is a detailed model of 42 industrial sectors with the disaggregation of energy and environment industries, in which the energy-environment-economy interactions are central. The model was developed by Cambridge Econometrics and is designed to be estimated and solved for 29 regions of Europe (the EU-27 member states plus Norway and Switzerland). More information available at: http://www.camecon.com/suite_economic_models/e3me.htm

mand reduces the dependence of the EU on imported fossil fuels which positively affects the trade balance.

Figure 3.4: Effect of Environmental Tax Reform on GDP



Note(s) : % difference is the difference between the base case and the counterfactual reference case.

Source: Andersen et al. (2007)

The implementation of the ETR generally has positive effects on GDP, although transition costs can be observed in the short term (Figure 3.4). The magnitude of both positive effects and transition costs depends on how the revenues from the environmental taxes are recycled. In the case of Sweden, high taxes on household electricity put some pressure on real incomes in the short run, thus causing a longer transition period. Finland, on the other hand, has observed very positive short term effects on its trade balance due to a significant decrease in fuel demand caused by environmental taxes.

Other scenarios generated by the E3ME model show that ETR without revenue recycling will cause a net loss in economic output in most countries, while ETR with revenue recycling leads to an increase in GDP of up to 0.5% compared to the Reference Case.

Box 3.4. Increasing resource productivity through management techniques

Arthur D. Little – "Zero Loss Management" and "Design to Cost"

A concrete example for a possible material throughput cost reduction of 20% is given by the consultancy company Arthur D. Little GmbH. They regularly achieve this goal by using two approaches (Fischer et al., 2004):

- "Zero Loss Management": material and energy losses in the supply chain are reduced through improved cost transparency, task development by interdisciplinary teams and structured creativity techniques. For instance, material exploitation was improved at three European ice-cream factories by adjusting process parameters, strengthening pre-emptive mainte-

nance and selective machine investments. With Zero Loss Management, manufacturing costs are repeatedly reduced by 5%.

- "Design to Cost": the design of products, their functions and cost-benefit profiles are redrafted in collusion between product development, buying department, production, customers and suppliers. For instance, life cycle costs of equipment were reduced at a company producing chemical equipment by a more intelligent and material-saving construction of equipment components as well as increased energy efficiency during equipment operation. With Design to Cost, life cycle costs regularly reduce manufacturing costs by 15%. These annual savings are achieved with a one-time investment with an average payback of 12 months. A third of the one-time investment consists of internal and external personnel costs for task development and implementation, the other two-thirds consist of equipment expenditures.

Box 3.5: ENWORKS – Promoting Resource Efficiency in North West England

ENWORKS promotes waste minimisation and resource efficiency among SMEs in North West England, through provision of advice and training, in order to enhance their competitiveness and reduce their environmental impact.

An evaluation of the programme by SQW (2008) found that project expenditure of £3.4 million (of which £3.1 million was provided by the public sector) between 2003/04 and 2007/08 delivered the following outputs:

- 1200 businesses received resource efficiency support
- 700 people received skills training
- 19 jobs have been created or safeguarded
- Capital investment by businesses of £7.6 million stimulated, an average of £10,700 per business
- Annual savings of approximately 42 GWh of electricity and 52 GWh of natural gas usage, equivalent to 0.18% of regional electricity consumption and 0.14% of natural gas consumption
- Annual cost savings of £16.7 million gross and £12.2 million net, among 724 businesses, representing approximately 1.4% of business turnover, contributing to improved competitiveness, efficiency, productivity and GVA growth.
- Annual savings of 34,200 tonnes of CO2 emissions, with the potential to achieve a further 72,200 tonnes per annum.
- An annual saving of 27,200 tonnes of waste diverted from landfill.

3.5 Scale of economic benefits to date and assessment of the further potential

The scale of economic benefits from the promotion of resource and energy efficiency measures can be large. The case studies and examples presented in this section demonstrate significant economic impacts.

Case Study 3.1, for instance, concludes that environmental policies stimulating higher energy and resource efficiency can result in a win-win situation for both the economy and the environment. The HIGH sustainability scenario of the simulation model for the EU-25 shows that, by 2020, average GDP is around 4% higher than in the baseline scenario (business as usual).

Significant improvements in energy and resource efficiency of about 49 % in the European economy result in economic growth of 41 % and a reduction of unemployment by 14 %.

The Swiss energy efficiency programme "EnergySwitzerland" is a best practice example for driving innovations in the Swiss economy. An evaluation (INFRAS, 2007) aiming at analysing the effects of the programme on investments, employment and sectors shows that the allocation of CHF 39 billion by the Swiss Government and CHF 35 billion by the cantons triggered private investments of CHF 1065 billion in energy-related projects. Approximately CHF 315 billion were invested in energy-efficiency, mainly in the public authority and buildings sectors. The net employment effect is about 2,800 person years.

Lee et al. (2007) quantified resource efficiency potentials for the UK and showed that even with existing policies, £6.4 billion worth of energy, water and waste disposal could be saved with no-cost or low-cost investments with a payback period of less than one year (Table 3.2). This equals 0.6% of UK gross valued added and 1.9% of UK gross operating surplus. Table 3.3 shows that the highest energy saving potential exists in the transport sector.

Table 3.2: Estimated resource efficiency savings opportunity across the UK economy

Resource	Estimated Savings Opportunity (£M)	% of total estimated savings
Energy	3,349	52
Waste	2,659	41
Water	441	7
Total	**£6,449M**	**100%**

Source: Lee et al. (2007)

Table 3.3: Significant energy savings opportunities by subsectors

Energy		
Activity	**Estimated Savings Opportunity (£M)**	**% of overall energy savings**
Transport (road freight)	2,017	60.3
Chemicals, rubber & plastics	189	5.7
Retail	141	4.2
Hotels & Catering	109	3.3
Commercial offices	101	3.0
Basic metals / mechanical engineering	83	2.5
Food & Drink	77	2.3
Warehouses	77	2.3

Source: Lee et al. (2007)

3.6 Beneficiaries and timescale

The transformation towards a more resource efficient economy will produce clear winners and losers in terms of economic sectors. Dematerialisation yields cost savings for the public administration, manufacturing and construction sectors, but reduces the output of firms supplying and distributing raw materials. This means, sectors associated with domestic resource extraction or material- and energy-intensive production are losing ground. Manufacturing sectors, on the other hand, increase their overall share in total gross value added, due to rising productivity and competitiveness (Stocker et al, 2007; Fischer et al, 2004, Arthur D' Little, 2005, Giljum et al 2008).

Within the COMETR project (see Box 3.3), Andersen et al. (2007) identified seven sectors with low labour intensity which are potentially vulnerable to the effects of environmental tax reforms (ETR), since lower labour costs by revenue recycling do not compensate for higher prices for energy and material inputs caused by environmental taxes.

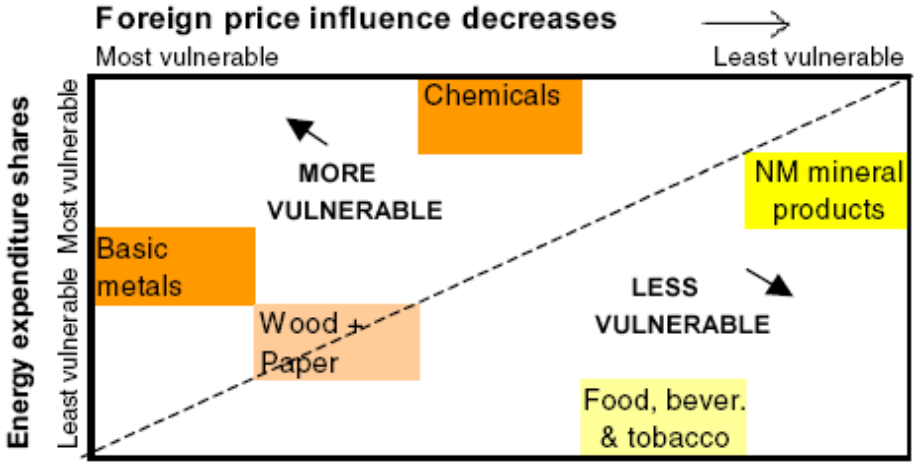
Table 3.4: Potentially vulnerable sectors under ETR

		Intensity			
	NACE code	**Energy**	**Labour**	**Export**	**Import**
Food and beverages	15	high	low	low	low
Pulp, paper and board	21	high	medium	low	low
Wood and wood products	20	medium	low	low	low
Basic chemicals excl. pharmaceuticals	24 less 24.4	high	low	high	high
Pharmaceuticals	24.4	low	low	high	high
Non-metallic mineral products	26	high	medium	low	low
Basic metals	27	high	high	medium	medium

Source: Andersen et al. (2007)

The proportion of those price increases which can be passed on by the producers depends on the competitive position in the respective markets. Figure 3.5 illustrates the vulnerability by combining unit energy costs and pricing power for these sectors in seven EU member states which implemented ETR (see Box 3.3). The most vulnerable sectors are Chemicals (with the highest energy expenditure share) and Basic Metals (which is the most exposed to the world price and therefore the least able to pass on cost increases).

Figure 3.5: Vulnerability with respect to pricing power, ETR countries



Source: Andersen et al. (2007)

Hence, revenue recycling in ETR needs to be well designed with respect to the market situation of vulnerable sectors in order to prevent the potential relocation of production according to the pollution haven hypothesis.

The government benefits from dematerialisation in two ways. On the one hand, it is a direct beneficiary because costs in public administration fall through a reduction in material costs. On the other hand, general economic development increases fiscal revenues for the state. Additionally, clear winners can be located in all service sectors. Trade and services close to companies, the health sector, education, culture, sports and entertainment benefit particularly. These branches profit from an increased demand from higher incomes induced by dematerialisation (Fischer et al, 2004).

CASE STUDY 3.1: MODELLING OPPORTUNITIES AND LIMITS FOR RESTRUCTURING EUROPE TOWARDS SUSTAINABILITY (MOSUS)

Background

The EU research project MOSUS developed and applied a global economy-energy simulation model to evaluate the economic, environmental and social impacts of key policy measures to increase energy and resource efficiency in Europe. The project formulated European development scenarios up to the year 2020 and assessed the effects of policy measures on economic and environmental trends.

Description of intervention

To identify a suitable mix of different environmental policies, the MOSUS project formulated three different EU development scenarios up to the year 2020. The "business-as-usual scenario" projected past trends into the future, without additional sustainability-oriented policy strategies and instruments. The "low sustainability scenario" reflected sustainability policy goals and measures derived from strategic documents of the EU, such as the 6th Environmental Action Plan. These measures included, amongst others, taxes on CO_2 emissions and transport, measures to increase metal recycling rates, and a consulting programme to increase material productivity of industrial production. The "high sustainability scenario" defined more ambitious policy goals and instruments compared to those included in current EU documents.

Description and quantification of economic benefits

The most important conclusion from the scenario simulations performed in the MOSUS project is that the implementation of a well-designed mix of (mostly) environmental policies stimulating higher energy and resource efficiency can result in a win-win situation for the economy and the environment. Environmental policy measures primarily geared towards decoupling economic activity from material and energy throughput can be conducive to economic growth, contrary to the popular assumption that such policies will mainly raise costs for enterprises, decrease competitiveness and thus have an opportunity cost in terms of reduced economic performance. The most effective policy measures to achieve this win-win situation were the implementation of a carbon tax on CO_2 emissions, the introduction of a consulting programme to increase resource productivity in manufacturing, the increasing share of biofuels and changes in fuel consumption structure.

The impacts of the LOW and HIGH sustainability scenarios are broadly positive for economic performance, with increasing real GDP per capita in the EU-25 (maximum increase in the HIGH scenario). By 2020, average GDP is around 4% higher in the HIGH scenario than in the baseline. With 2.8% (in HIGH), economic growth is strongest for the final simulation period between 2015 and 2020, with direct consequences for material extraction, in particular of construction minerals, which are directly linked to GDP. The figure below presents the main results of the HIGH scenario and describes the win-win situation. CO_2 emissions could be reduced by 12 % compared to 2005. This reduction is caused by significant improvements in energy and resource efficiency of about 49 % in the European economy. Those efficiency improvements result in economic growth of 41 % and a reduction of unemployment by 14 %.

Description of environmental benefits

As expected, domestic extraction decreases with rising levels of policy intervention. Hence, in comparison with the BASE scenario, extraction in 2020 is 4% lower in the LOW sustainability scenario and 7.3% lower in the HIGH sustainability scenario. Almost all policy measures introduced in the sustainability scenarios lead to decreases in material extraction, with reductions in the HIGH scenario of up to 18% (used extraction) and 22% (used plus unused extraction) depending on the implemented measure and the country under consideration. In general, the largest reductions were observed in response to the introduction of the carbon tax, with reductions of up to 10% of used extraction. However, MOSUS results showed that increased energy efficiency in enterprises and households is not enough to reduce overall material and energy consumption in Europe, as so-called "rebound effects" occur, which overcompensate efficiency gains. To limit rebound effects on the macro level, these instruments must be accompanied by other policies influencing the prices of energy and materials, such as higher energy or CO_2 taxes in order to achieve absolute reductions.

Effect on public finances

There is no information available on this issue.

Potential for wider application in EU, and possible means of measuring economic benefits

The extended GINFORS model developed and applied in the MOSUS project is one of the most comprehensive simulation tools for European and global integrated sustainability assessments currently available. It is also the first one to allow detailed forecasts on material extraction for all European countries and on the global level. The simulation model has the potential to be replicated also in other EU countries.

Further information

Project Website http://www.mosus.net/

CASE STUDY 3.2: JAPAN'S 3R-STRATEGY

Background

Japan can be considered as leading the way in setting quantitative targets for resource productivity increases (Giljum et al, 2008). After a long period of economic growth based on mass production, mass consumption, and mass disposal the country is facing environmental and resource constraints. These constraining factors could become a burden on economic growth. Thus, in 2003, the government of Japan adopted a strategy for establishing a material-cycle society. The powerful Japanese Ministry of Economy, Trade and Industry (METI) is promoting the "3Rs" – Reduce, Reuse, and Recycle – in order to create a sustainable society. Material consumption (in Japan's case, one third of it imported from overseas) is aimed to be as efficient as possible, waste generated as small as possible, and the waste recycling rate as high as possible.

Description of intervention

To make the Basic Law for Establishing the Recycling-base Society operational, the Fundamental Plan for Establishing a Sound Material-Cycle Society was formulated in 2003 for implementation over 10 years. The plan aims for an improvement of resource productivity (measured as GDP/direct material inputs) by 40% between 2000 and 2010, an increase of recycled materials by 40% to an absolute 14% of overall material use, and a decrease of the final disposal amount of 50%. Japan's legislation has become quite systematic in its coverage of these issues. Steady improvements have been made in the legislative structure dealing with waste and recycling. In addition, METI calls on industry to make voluntary efforts, and has released a set of guidelines on recycling for items and industries not subject to laws and regulations. METI also supports efforts through local governments to foster environmental industries as new industries.
In order to construct a Sound Material-cycle Society throughout the entire region of East Asia, Japan initiated the "3R Initiative" that was agreed at the G8 Sea Island Summit in 2004. Concrete 3R practices have advanced not only within each G8 member country, but also in countries in Asia through collaboration and cooperation. In mid-2008 Japan announced a new Action Plan for Global Zero Waste Societies, to demonstrate Japan's determination to support the establishment of sound material cycle societies internationally.

Description and quantification of economic benefits

3R policies have produced a new environmental business in recycling. The example of industrial waste management shows that there is growing realisation of a win-win relationship between the generators and the users of industrial waste. Both can reduce the management cost and the raw material procurement cost respectively while reducing the environmental load. Meanwhile, environmentally-sound technologies have made great progress, as the introduction of the EPR (extended producer responsibility) principle has stimulated the development of not only waste management and recycling technologies but also design and manufacturing technologies for environmentally-sound products. The mid-term review of the 3R policies of 2005 states that the number of businesses involved in industrial waste management has increased to comprise a market of ¥ 2-4 trillion (0.4-0.8% of Japan's GDP). The economic effects of the entire recycling sector are equivalent to 1.6 % of Japan's GDP. The market scale of the recycling industry was ¥ 8.2 trillion in 2000 and is projected to be ¥ 10.5 trillion in 2020. Employment figures amount to 212,000 in 2000 and are forecast to grow to 232,000 in 2020.

Description of environmental benefits

3R policies have been created so as to reduce input in the early phases of the material cycle and output in the final phases, while expanding reuse and recycling during the middle ones. Despite good progress so far, Japan's material consumption and waste generated are still too high. METI is facing the challenge by improving policies, for instance in areas such as promoting recycling of individual product categories, using standards for the 3Rs, creating local resource-recycling systems, and promoting programmes such as the Eco Town Program and the Local 3R Support Program.

Effect on public finances

On this issue, there is no information available in English.

Potential for wider application in EU, and possible means of measuring economic benefits

3R policies could easily be applied at EU level as well as on the level of Member States.

Further information

3R Initiative http://www.env.go.jp/recycle/3r/en/index.html

CASE STUDY 3.3: ENERGYSWITZERLAND

Background

The cooperative programme for energy efficiency and renewable energies EnergySwitzerland illustrates the economic effects of information measures and support programmes for improved energy efficiency. Launched in 2001 by the Swiss minister for energy on the basis of Swiss energy and CO2 legislation, EnergySwitzerland promotes energy efficiency measures by means of voluntary actions and support programmes in four sectors: buildings, public authority, mobility and economy. The close cooperation between the government, cantons, communities, business partners, as well as environmental and social NGOs and agencies is a major pillar and strength of the programme. EnergySwitzerland thus provides a platform for all relevant players in the energy sector that facilitates the development of intelligent energy policies and solutions.

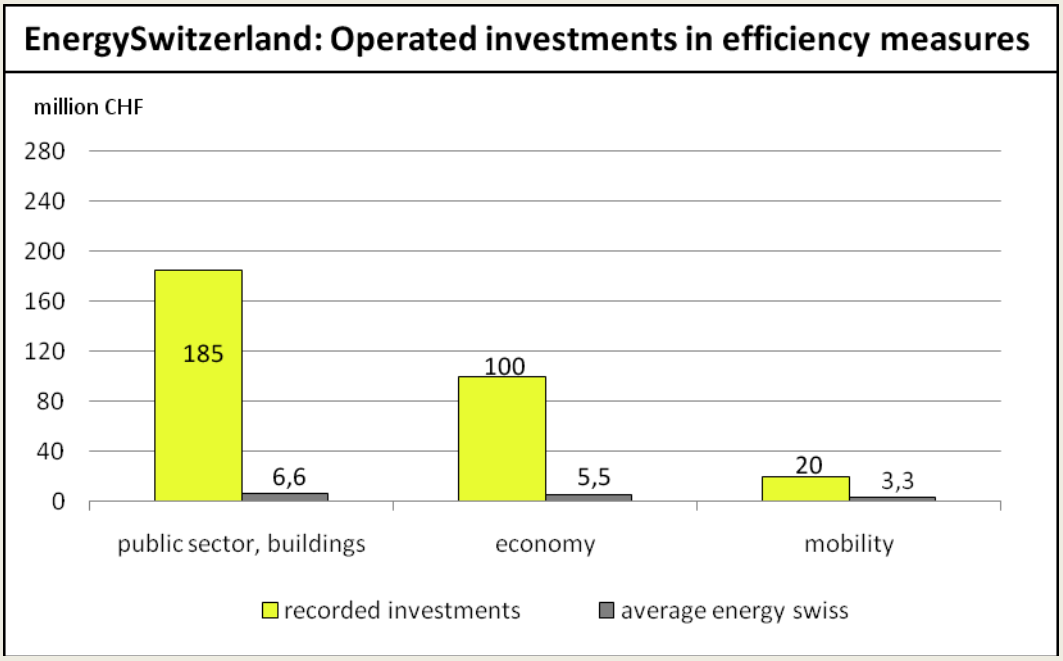
Description of intervention

The 10 year programme aims at reducing the use of fossil energies and emissions by 10% by 2010; limiting the use of electricity growth to 5% by 2010, sustaining and expanding the potential of hydropower for power generation, and increasing the share of renewable energy by 1% in electricity generation and 3% in heat generation. All measures are based on voluntariness. In this sense, the programme provides incentives for a concrete Swiss energy policy. Sharing know-how, new findings and experiences about energy technologies in the energy-network that consists of public and private actors is key for the success of the programme.

Description and quantification of economic benefits

EnergySwitzerland has been very successful during the last years. Five key areas of intervention (buildings, renewable energies, energy-efficient appliances, rational use of energy and waste heat, mobility) were chosen because 1) they bear the biggest potential for achieving the envisaged targets (including innovation potentials); 2) synergies can be exploited between the areas; 3) they can be easily communicated to the public. The programme has turned out to be a driving force for innovations in the Swiss economy. An evaluation of EnergySwitzerland carried out in 2007 (INFRAS, 2007) aimed at analysing the effects of the programme on investments, employment and sectors. The results are impressive. In 2006, the allocation of CHF 39 billion by the Swiss Government and CHF 35 billion by the cantons triggered private investments of CHF 1065 billion in energy-related projects. Approximately CHF 315 billion were invested in energy-efficiency, mainly in the public authority and buildings sectors (Figure 3.6).

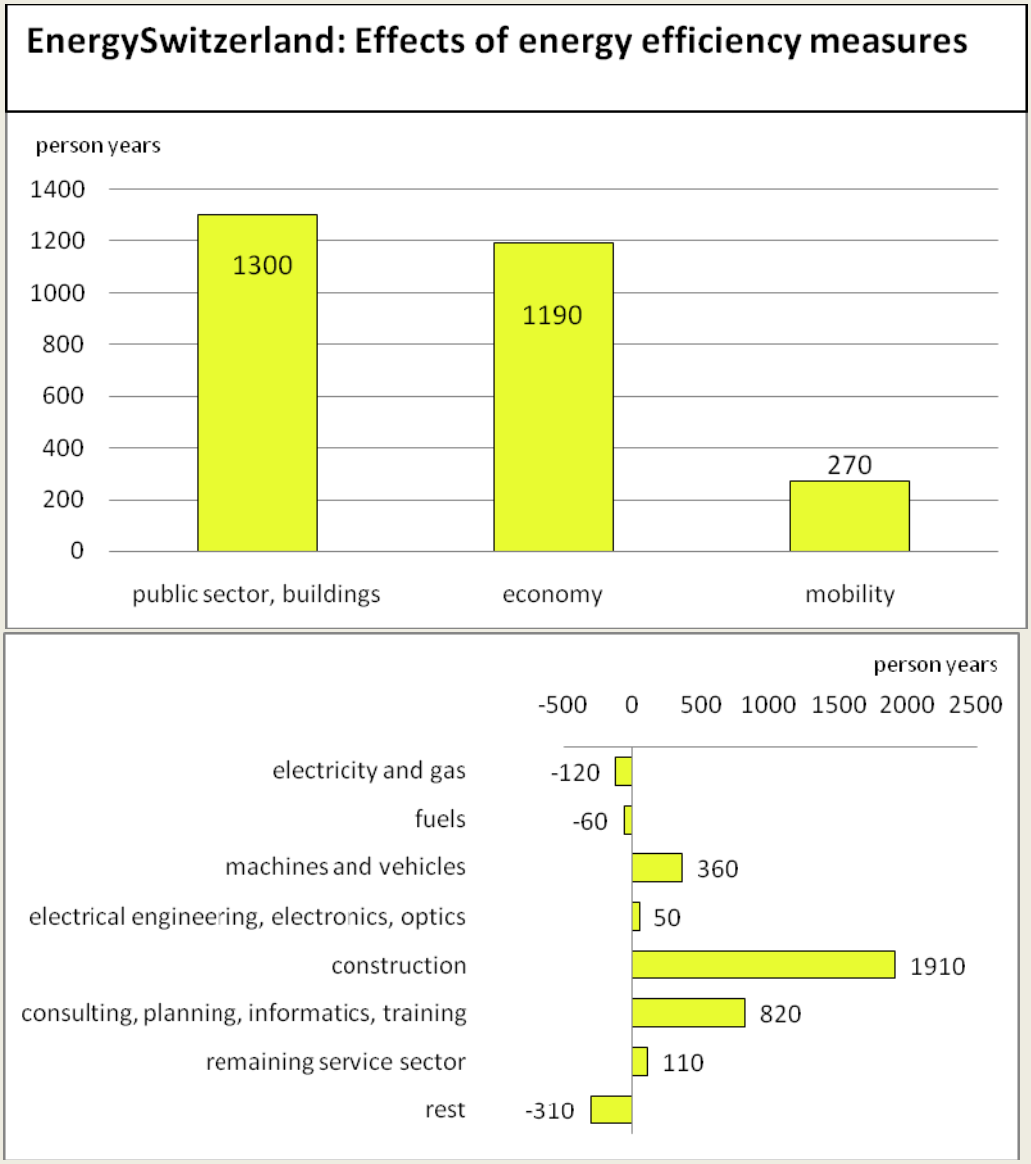
Figure 3.6



Source: INFRAS 2007

The net employment effect is about 2,800 person years. The public authority and buildings sector is the main beneficiary, receiving massive investments, followed by the business sector (Figure 3.7). A major beneficiary is the construction industry. There are also positive effects in the sectors machines and vehicles, consultancy, planning, IT, electronic industries and optics.

Figure 3.7



Source: INFRAS 2007

Description of environmental benefits

Since the launch of the programme, EnergySwitzerland has been very successful in its contribution to energy and climate policy. Without the programme, CO_2 emissions would be 2.8 billion tonnes higher, the use of fossil energy would be 7.9% above current levels and the use of electricity 4.7% higher. Due to the programme energy is used more efficiently and the share of renewable energies has been increased.

Effect on public finances

The allocation of CHF 74 billion by the Government and the Cantons resulted in private investments of CHF 1065 billion. This means CHF 1 public expenditures create CHF 13 private investments.

Potential for wider application in EU

Similar cooperative programmes for energy efficiency and renewable energies could be initiated by governments throughout the EU.

Further information

EnergySwitzerland website in German/French http://www.bfe.admin.ch/energie/index.html?lang=de

4. Environmental Policies and Innovation

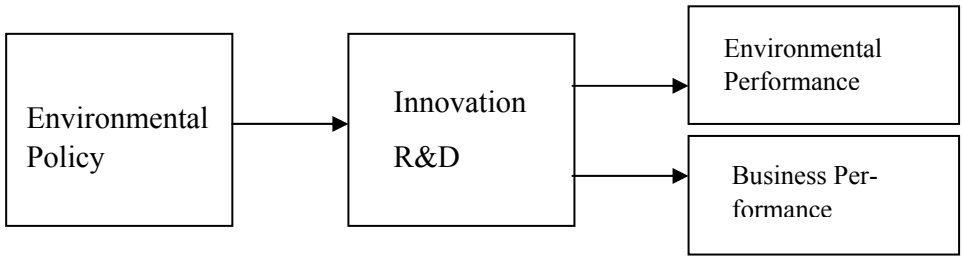
4.1 Description and background

Standard economic policy emphasises the role of innovation in driving the economy, pushing back the production frontier and opening new markets. It is the prime source of our future competitive advantage. Much economic policy, such as the Lisbon strategy, is based on trying to increase the levels of investment in innovation, and the spread of innovations across the economy.

Environmental policy is an important driver of innovation. Various environmental regulations have contributed to innovations in various industrial sectors such as energy supply (Johnstone et al., 2007), car manufacturing (Hascic et al., 2009), and pulp and paper (Popp and Hafner, 2008), to name a few. In renewable energy, environmental policy measures such as tax measures and quota obligations have been shown to have a measurable impact on innovation as measured by the number of patents in this area (Johnstone et al, 2007). Environmental regulations have contributed to more efficient motor technologies and innovations in post-combustion technologies (Hascic et al., 2009). In the pulp and paper industry, early policy interventions by the governments of Finland and Sweden resulted in strong "first-mover" advantages in the manufacture of chlorine-free (TCF) paper and paper products (Popp and Hafner, 2008).

Figure 4.1 depicts the causal chain from environmental policy, to research and development (R&D), and to environmental and business performance.

Figure 4.1: Environmental policy, innovation and business performance (adapted from Lanoie et al. 2007)



Porter (1991, 1995) suggested that "properly designed environmental regulations can trigger innovation that may partially or more than fully offset the costs of complying with them". A recent study based on a large OECD survey among 4200 industrial facilities in seven countries (USA, Canada, Japan, Germany, France, Hungary and Norway) firmly established a positive statistical link between the stringency of environmental policy and expenditure on environment-related R&D (Lanoie, 2007). About 10% of the facilities in the sample had specific R&D budgets for environmental matters. In the facilities with environmental R&D budgets, these budgets were on average 16.6% of total R&D budgets.[5] The facilities that face more stringent environmental policies are more likely to have an environmental R&D budget (Aruimura et al.,

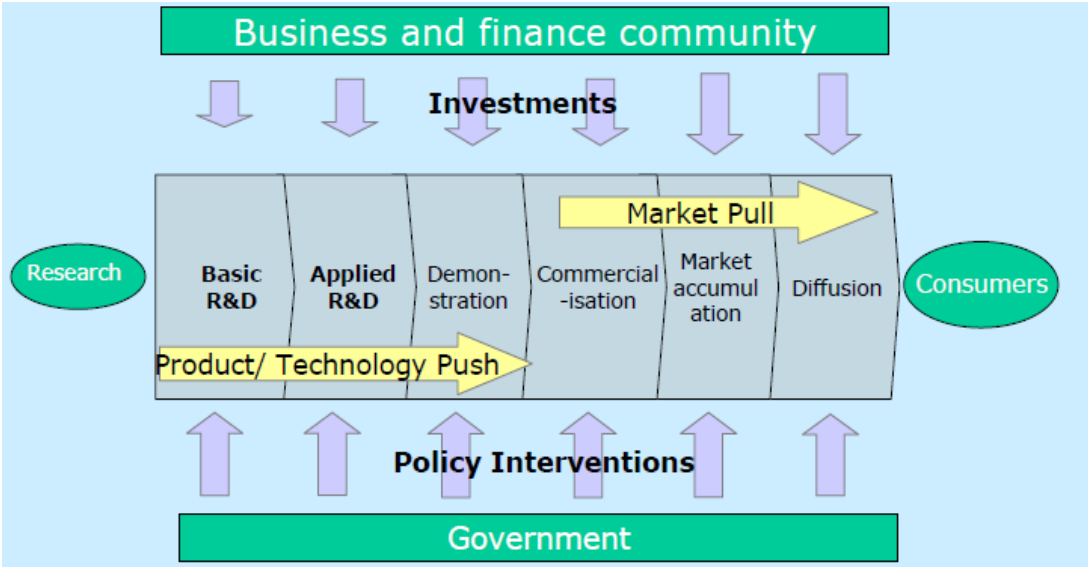
[5] The lowest shares are for Canada (13%) and USA (16%) and the highest share for Norway (35%). The shares of European countries are in-between: Germany 17%, Hungary 19% and France 20%.

2007). The study also established a positive statistical link between expenditures on environmental R&D and business performance (as measured in profits). Hence, the study found support for at least a weak version of the Porter Hypothesis, i.e. compliance costs are at least partially offset by innovation (Lanoie, 2007). This does not preclude, of course, that for some firms the benefits of innovation will more than offset compliance costs, resulting in win-win situations. This section will present some examples of potential win-win situations, where environmental pressures are reduced and business performance is improved.

Statistics on environmental or eco-innovation by firms are scarce (Kemp and Pearson, 2007). Eurostat's "Community Innovation Survey" measures the share of innovative firms that consider environmental aspects as highly important effects of innovation. Of these firms, 9.5% consider savings on materials and energy as a highly important effect of innovation, and 14% consider positive impacts on the environment and health as highly important. Total R&D expenditures of business enterprises in the EU27 in 2007 were €146 billion or 1.18% of GDP. If we assume from the above that 10% of these R&D expenditures are for environmental matters, this would constitute an annual expenditure of business enterprises in the EU27 of almost €15 billion for environmental innovations in both products and processes.

Many of these innovations have led to reductions in costs and/or reinforced the competitive strength of EU industry, as 'clean' technologies that were developed in Europe, such as wind turbines and waste and recycling technologies, became successful export products on the world market after some time. Hence, "innovation" is an important way in which environmental policy can indirectly stimulate growth, competitiveness and jobs (for a description and examples of the link between eco-innovation policies and employment, see Section 5).

Figure 4.2: The main steps in the innovation chain



Source: Stern (2006: 349)

Figure 4.2 presents a simple technology-push, market-pull representation of the innovation process. The early stages of innovation are characterised by technology drivers that "push" the technology towards the market. In the later stages of the innovation process, customer demand must "pull" the innovation onto the market. Environmental policies can play a role in all

phases of the innovation process. By "internalising" the external costs of polluting or natural resource consuming technologies and products they can stimulate the research and development of "cleaner" alternatives. By making the "dirty" technologies and products more expensive or by restricting their use, they stimulate the commercialisation and diffusion of successful "clean" alternatives (Tressel et al., 2007).

The European Commission has estimated that the total commercial value of eco-innovative products and technologies in sustainable construction, renewable energy, bio-based products and recycling in the EU can grow from €92 billion in 2006 to €259 billion in 2020.

4.2 Policy instruments

There is a continuing debate on how environmental policy instruments affect eco-innovation and which types of instruments are most effective. Based on an extensive review of the literature, Vollebergh (2007) concludes that all studies confirm a positive link between environmental policy and technical change, with only some exceptions. Some examples of environmental policies with a strong impact on innovation energy and climate change policies that increase the costs of CO_2-intensive energy sources and thus encourage innovation in CO_2-free energy technologies and energy efficiency; the Integrated Pollution Prevention and Control (IPPC) directive that promotes Best Available Technology (BAT); and the Packaging and Waste directive and the Landfill directive that both promote innovation in biodegradable packaging materials (European Commission, 2007).

EU policies, initiatives and instruments that, inter alia, promote eco-innovation include:

- The Eco-design Directive (2005/32/EU);
- The Competitiveness and Innovation Framework Programme (CIP), including the Eco-innovation field within the Entrepreneurship and Innovation Programme and the Intelligent Energy Europe Programme;
- The Seventh Framework Programme for Research and Technological Development (FP7);
- The Environmental Technologies Action Plan (ETAP);
- The Directive on the Energy Performance of Buildings (EPBD, 2002/91/EC);
- The European Union Action Plan on Sustainable Consumption and Production;
- The Directive on Waste from Electrical and Electronic Equipment;
- The European Union Energy Label; and
- Lead Market Initiative (LMI) for Europe (COM (2007)860 final).

The "Lead Market Initiative for Europe" distinguishes as potentially promising lead markets for eco-innovations: the construction market for buildings and infrastructure; bio-based products (bio-plastics, bio-lubricants, surfactants, enzymes and pharmaceuticals); recycling of wastes; and renewable energy (European Commission, 2007). Facilitating the growth of these lead markets, by closing the gap between emerging technologies and their market success, is expected to increase returns on investments in R&D, enhance productivity, and increase exports, ultimately leading to higher levels of growth and employment. Facilitating the growth of the selected lead markets will also generate substantial environmental and societal benefits (European Commission, 2007). Environmental policies can stimulate and harness such lead markets, by directly or indirectly promoting technologies (such as renewable energy technolo-

gies) with high knowledge intensities, high innovation dynamics, and high potential learning effects (such as wind and photovoltaics).

4.3 Review of evidence

Environmental policies have a positive effect on innovation (Vollebergh, 2007), but not all policies are equally successful. The conventional premise is that market-based policy instruments (such as taxes and charges) are more effective as they provide a continuous incentive for innovation, while command-and-control regulations provide no reward for *exceeding* their requirements. The empirical evidence on the benefits of market-based environmental policy instruments to foster innovation is limited. Much depends on the specific design of the policy instruments (Vollebergh, 2007). Important design factors are the stability and long-term character of the instrument; transaction costs and risk perception, especially for new entrants; the variety of technical solutions that is promoted by the environmental policy instruments; and the presence of specific innovation incentives. These design factors have a large impact on the "innovation-friendliness" of policy instruments (Tressel, 2007; Walz et al., 2007).

Walz et al. (2007) empirically assess the contribution of the innovation-friendliness of environmental policy instruments to the innovation dynamics of the wind energy sector in ten European countries over the period 1991 to 2004. In their analysis, innovation is measured by the number of international patents in renewable energy technologies, while "innovation-friendliness" is measured by an indicator whose value on a scale between 1 and 4 is determined by an expert panel, taking into account the above-mentioned dimensions of innovation-friendliness (long-term; low transaction cost, high variety, specific incentives). Applying linear regression they find that, next to other factors such as R&D expenditures and historical capacity, the innovation-friendliness of the dominant policy approach in countries is a highly significant factor in explaining innovation success.

4.4 Examples and case studies

Examples of the economic outcomes generated by eco-innovation projects are given in Box 4.1 and in case studies 4.1, 4.2, 4.3 and 4.4. The boxes contain illustrative examples and aim to give a flavour of the variety of innovative solutions environmental policies can encourage. The examples in the boxes are not related to specific environmental policies. The case studies give a more comprehensive picture of the potential economic benefits of environmental policies by way of their effect on innovation.

Box 4.1: The Economic benefits of Eco-innovation – some illustrative examples

Innovative solutions for wastes – Used cooking oil, Malta

In 2004, the Edible Oil Company, Malta's largest producer of cooking fats and oils, found an innovative solution for the increasing waste problem caused by used cooking oils. The solution was to use the waste as fuel (biodiesel) for diesel cars and lorries. A collection system was set up involving restaurants and 24,000 households. The project matched economic benefits with environmental improvement and won the BBC World Challenge Award (Runner Up in 2005). The availability of biodiesel is helping the economy by reducing Malta's dependence on imported fossil fuels. Because biodiesel burns cleanlier than diesel, air pollution is also reduced. To encourage more buyers to opt for the cleaner fuel, the government of Malta has made biodiesel tax-free. Key to the success was the cooperation of the Ministry of Rural Affairs and the government-owned waste management company.

Source: Artim et al. (2008)

Eco-innovation in batteries, Germany

In 1998 VARTA Gerätebatterie GmbH decided to investigate the large-scale production of rechargeable long-lasting lithium-ion button cells in Ellwangen. There was a market forecast for the application of these cells in the areas of 'communication devices' and 'personal computer' of approximately 120 million batteries in 1998, with an annual increase of up to 10 percent. In a direct comparison with competing technologies, taking into consideration the operating voltage, capacity, and life-cycle, one lithium-ion button cell replaces 3 nickel-cadmium button cells. Compared with lithium-primary button cells, the application of a lithium-ion button cell saves more than 150 percent of materials, which is a remarkable contribution to safeguarding resources. Lithium-ion button cells are free of cadmium and mercury and have a high service life, which in normal circumstances exceeds the utilisation time of the applications. The development and implementation of the project was completed successfully in just less than 1.5 years (from February 1998 to June 1999). At the end of this period the rechargeable long-lasting lithium-ion button cell went into production. The newly created production area works without any disturbance and delivers high quality button cells, which have been well received in the market. In the production plant in Ellwangen, harmful emissions and material wastage are almost completely avoided by using environmentally compatible materials, automated production flow with integrated reprocessing circuits, and the most modern exhaust and wastewater treatment processes.

Source: http://ec.europa.eu/environment/life/project/Projects/

Eco-innovation in potato processing, the Netherlands

The hot-water blanching of potatoes is a standard procedure in the production of chips (french-fries), and other potato-based products. The process is necessary to inactivate enzymes, gelatinise starch and reduce sugar content. The Dutch potato products company Aviko bv currently processes 1.4 million tonnes of potatoes, using 0.35 million m^3 of water for potato blanching, as well as 88 200 GJ (gigajoules) of energy to heat the water. The eco-innovation of closed loop blanching (CLB) is based on selective leaching out of sugars during the blanching, by keeping the concentration levels of all components in the blanching water (ions enzymes, amino acids, anti oxidants, vitamins and organic acids) at a constant level, and selectively removing sugars from the water. As a consequence, leaching out of valuable raw materials is prevented and the objective of the blanching sequence (reducing sugars) is still achieved. Test results over the period 2005-2007 show that the CLB system can yield considerable savings in energy, water and raw materials. CLB results in reductions of groundwater

retraction and wastewater treatment requirements of about 240 l/tonne potatoes; energy savings of 94 MJ/ tonne potatoes, resulting in reductions of 5.3 kg of CO_2 and 3.1g of NOx emissions per tonne of processed potatoes; and savings of 3.6% of raw materials. The production volume of potato products in Europe suitable for the CLB technology is 10 million tonnes.

Source: http://ec.europa.eu/environment/life/project/Projects/

Bio-based packaging materials, The Netherlands

In 1996, the Dutch company Vertis bv invented the Injection Moulding Technology for producing biopolymer based foam-packaging. The "PaperFoam" project was carried out to show the industrial packaging market that the patented injection moulding technology is a method that can be easily applied, is very competitive and is also an environmentally friendly alternative which can be used in the production of packaging for food (hamburgers, etc.) and non-food applications (electrical equipment, electronics etc.). The technology is based on the use of recyclable raw materials, such as potato starch, instead of the usual polystyrenes or cardboard.

At the end of the project, the financial figures exceeded expectations. The profit after 7 years was forecast to be between €1.4 and €4.5 million. An ex-post evaluation, carried out by the LIFE external monitoring team in July 2004, showed that PaperFoam has continued to flourish. It has sold 4 licences, in Malaysia (Penang) Denmark (Torring), China (Beijing) and the US (Dallas). There are approximately 45 machines worldwide of which 30 are licensees. Since the end of the LIFE project, PaperFoam has also obtained several new customers such as Motorala, Axis, Stabilo, Iomega and SONICblue/Rio. PaperFoam has won several new awards including the UK Starpack Award 2003 for Consumer Family (classification: Gold), the Ameristar 2003 and the reputed Worldstar 2003 award (in the category 'electronics').

Source: http://ec.europa.eu/environment/life/project/Projects/

4.5 Scale of economic benefits

The scale of economic benefits from the promotion of eco-innovations can be large. Case Study 4.1 discusses a recent study on the economic potential of renewable energy in the EU. This study estimates that the value added of renewable energy in the EU could grow from €58 billion in 2005 to €188 billion in 2030. Employment could increase to 3.4 million jobs. These growth figures are, however, dependent upon strong support policies on renewable energy in line with the EU's goal of reaching a 20% share of renewables in final energy consumption. Without the policies supporting this goal, the growth in renewable energy would be much slower, reaching €92 billion in 2030. The European Commission made a rough estimate of the potential growth of the selected lead markets of the Lead Market Initiative. Table 4.1 presents the estimates for the four selected eco-innovation lead markets.

Table 4.1: Expected market growth of selected eco-innovation lead markets in terms of turnover and jobs related to new markets, products and services

		2006	2020
Sustainable construction	Turnover (€million)	24,000	87,000
	Jobs (thousand)	500	870
Renewable energy	Turnover (€million)	25,000	79,000
	Jobs (thousand)	300	634
Bio-based products	Turnover (€million)	19,000	57,000
	Jobs (thousand)	120	380
Recycling	Turnover (€million)	24,000	36,000
	Jobs (thousand)	500	535

Source: European Commission, COM (2007) 860 final, Annex II

According to the estimates of Table 4.1, the total turnover in these four lead markets in the EU would grow from €92 billion in 2006 to €259 billion in 2020, an annual growth rate of 7.4%. The new products and services would generate more than 2.4 million 'new' jobs in 2020.

The projected growth of the lead markets depends on a number of policy instruments in the areas of regulations, standardisation, certification and labelling, public procurement, intellectual property protection, finances and communication (EC, 2007). The key drivers to their success are ambitious, long-term and "innovation-friendly" environmental policies. More details of these policies for the respective lead markets are given in the case studies.

4.6 Beneficiaries and timescale

Eco-innovation can take many forms and have the potential to benefit a wide variety of sectors, firms and individuals in both rural and urban areas. Case Study 4.1 discusses a recent study on the economic potential of renewable energy. This study assesses that in terms of gross employment creation, the new Member States do relatively well, with proportional increases in employment well above the EU-average in Lithuania, Latvia, Estonia, Poland, Hungary and Romania. The study also suggests that a quarter of the employment in renewable energy is in agriculture and forestry in the production and processing of fuel (biomass). In a country like Hungary, a major part of the additional economic activity due to renewable energy policies is in agriculture. In recycling (Case Study 4.4), the major beneficiaries are small to medium sized enterprises. The case studies show that the results of eco-innovation may already be significant by the year 2020. Case Study 4.1 suggests that in the renewable energy sector at least, significant additional economic benefits can be expected in the decade after 2020. The net positive effect of ambitious renewable energy policies on the GDP of the EU27 increases from 0.13% in 2020 to 0.23% in 2030.

CASE STUDY 4.1: RENEWABLE ENERGY

Background

The Climate and Energy Package that the EU agreed upon in December 2008 includes commitments to reduce greenhouse gas emissions by 20%, to raise energy efficiency by 20%, and to ensure that 20% of final energy consumption is met with renewable sources by 2020. Commission President José Manuel Barroso announced that this package "represents a green "new deal" which will enhance the competitiveness of EU industry in an increasingly carbon-constrained world. Moving to a low carbon economy will encourage innovation, provide new business opportunities and create new green jobs." A recent study for the European Commission, EmployRES, assessed the economic benefits of a strong support policy for renewable energy sources in Europe that is in line with EU's objectives (European Commission, 2009).

Description of intervention

The study assessed the impacts of a policy in line with the 20% renewables objective on competitiveness, growth and employment. A key environmental policy in this area is the EU's energy and climate change policy that makes CO_2-intensive energy technologies more expensive. Member States decide on the specific policy instruments to encourage renewable energy technologies. Presently the main policy instruments that are used are feed-in tariffs, production tax incentives, tendering systems and quota obligations based on tradable green certificates**.**

Description of economic benefits

At present, the EU is a world market leader in renewable energy technologies with a market share of 69%. Without further support policies, this global market share is expected to decrease substantially in the near future due to strong developments in upcoming countries such as China. Strong supportive policies can maintain Europe's leadership and are expected to lead to the development of an innovative, competitive industry with economic benefits in terms of (high-quality) employment and value added.

Description of environmental benefits

The renewable energy target is part of the climate and energy package that aims to reduce the emission of greenhouse gases by 20%. A switch from fossil-based to renewable energy sources also has environmental benefits in terms of, for example, a reduction of conventional air pollutants.

Quantification of contribution to economic outcomes

In contrast to the Lead Market Initiative estimates that focus on direct turnover and employment, the EmployRES study assessed both direct and indirect effects of renewable energy on value added and employment. Important indirect effects occur in the construction phase of installations and in the production and processing of biomass as fuel[6]. The EmployRES study assessed that with strong support, the renewable energy industry in Europe could generate value added of €129 billion in 2020 (1.1% GDP) and support 2.8 million jobs. By 2030, value added could increase to €188 billion and employment could

[6] In 2005, 52% of employment was in construction, 22% in operation and maintenance and 26% in the production of fuel (biomass) (European Commission, 2009, Table 11).

increase to 3.4 million jobs. Even if account is taken of substitution effects and macroeconomic feedbacks (due to higher energy prices), net effects on GDP and employment are still positive. In 2020, the positive net effect on GDP is expected to be 0.25% and the net effect on employment is 0.19% of the total labour force.

Effect on public finances

The support policy would create an export impulse of €5-7 billion in 2020 (21 to 31 billion in 2030) and save on the imports of fossil fuels to an amount of €45 billion (€85 billion in 2030). As the study assumes that most of the investments in renewable energy are indirectly paid by electricity consumers (in the form of higher prices through, for example, feed-in tariffs) the effect on government finances remains limited.

Potential for wider application in EU, and possible means of measuring economic benefits

In terms of gross employment creation, the new Member States do relatively well, with proportional increases in employment well above the EU-average in Lithuania, Latvia, Estonia, Poland, Hungary and Romania. The average gross increase in employment in the EU is 0.6% between 2007 and 2020; in Lithuania it is 1.7%, in Poland 1.4%, in Latvia 1.1%, in Romania 1.0%, in Estonia 0.8%, and in Hungary 0.7%.

Further information

European Commission (2009). *EmployRES. The Impact of Renewable Energy Policy on Economic Growth and Employment in the European Union*. Report for the Directorate-General for Energy and Transport prepared by Fraunhofer ISI (Germany), Ecofys (Netherlands), EEG (Austria), Research + Consulting (Switzerland), LEI (Lithuania), and SEURECO (France), Karlsruhe, 27 April 2009

CASE STUDY 4.2: BIO-BASED PRODUCTS

Background

In 2007, the Joint Research Centre (JRC) of the European Commission published an extensive and in-depth study into the opportunities and challenges of biotechnology in Europe, including prospects for industrial bio-based products such as polymers, enzymes, detergents, pharmaceuticals, etc. Key conclusions from the study are that industrial biotechnology has positive economic and environmental implications: it increases labour productivity by 10% to 20% compared to conventional processes, while at the same time reducing energy and water consumption and emissions, including greenhouse gases. The EU is the leading producer of enzymes, but in many industrial applications of biotechnology the EU is outperformed by the USA (bioethanol, bio-based polymers) and Asian countries, especially China (chemicals) (JRC, 2007).

Description of intervention

Reliable legislative and jurisdictional environments are essential for business to invest in innovation and for consumers to take up new products and services (European Commission, 2007). Environmental policies can be used as instruments to further facilitate the use of bio-based products and encourage innovation. Such policies include energy and climate change policies (stimulating the reduction of CO_2 emissions), the Integrated Pollution Prevention and Control (IPPC) directive (by promoting the innovative emerging techniques in the fields of bio-based production techniques in Best Available Technology (BAT)), the Packaging and Waste and Landfill directives (by promoting biodegradable packaging materials) (European Commission, 2007).

Description of economic benefits

There is a common understanding that bio-based products can make a substantial contribution towards a more sustainable and competitive industry, capable of generating growth (European Commission, 2007). Bio-based products can also contribute to rural development by providing additional outlets for farmers and decentralised production facilities (i.e. bio-refineries) (European Commission, 2007). It is, however, not easy to quantify this contribution. Most forecasts in this area refer to McKinsey reports from 2003 and 2004 that assess that by 2010 biotechnology could be applied to between 10% to 20% of all chemical sales worldwide (Riese and Bachmann, 2004).

Description of environmental benefits

Environmental benefits relate to a reduction of the use of scarce non-renewable natural resources (such as oil), and a reduction of emissions to air and water, including the emissions of greenhouse gases. According to a recent study by McKinsey, the increasing use of bioplastics could provide greenhouse gas savings in the EU in 2020 of 9-27 million tonnes of CO2 (Riese and Bachmann, 2004).

Quantification of contribution to economic outcomes

The same McKinsey study estimates that the volume of global markets for bio-based products could more than triple by 2020 to €250 billion. In 2005, bio-based products accounted for 7% of global sales of the chemical industry; in 2020 this could increase to 20%. Based on these projections and on the assumption that the EU maintains its current market position in bio-based products (30%), the European Commission estimates an in-

crease in the volume of bio-based production in the EU from €19 billion in 2006 to €57 billion in 2020; increasing employment from 120,000 to 380,000 jobs. JRC argues that modern biotechnology leads to “better jobs”, reflecting the higher knowledge-intensity of these jobs, and helps to safeguard jobs by supporting competitiveness (JRC, 2007).

Further information

EC (European Commission) (2007) *A Lead Market Initiative for Europe*. COM (2007) 860 final, Brussels.

JRC (2007). *Consequences, Opportunities and Challenges of Modern Biotechnology for Europe.* Joint Research Centre, Institute for Prospective Technological Studies, European Commission, Luxembourg: Office for Official Publication of the European Communities.

Riese, J. and Bachmann, R. (2004). *Industrial Biotechnology: Turning the Potential into Profits.* Chemical Market Reporter, available at http://www.mckinsey.com/clientservice/chemicals/potentialprofit.asp

CASE STUDY 4.3: SUSTAINABLE CONSTRUCTION

Background

The construction market in the EU accounts for 10% of GDP and 7% of its total workforce. Buildings account for 42% of the EU's final energy consumption and 35% of greenhouse gas emissions. Interventions in existing buildings such as insulation works and double glazing have immediate effects on climate change, indoor air quality, re-use/recycling and other sustainability issues. The environmental benefits of sustainable practices in new construction will materialise in the longer term (European Commission, 2007).

Description of intervention

Building regulations are contained in national, regional or local building codes. At Member State level there is increasing interest for sustainable construction, as can, for example be witnessed by the UK Code for Sustainable Homes of 2006. A potentially important policy instrument to speed up innovation in the construction sector is the Directive on the Energy Performance of Buildings (EPBD) which is currently in the process of being recast (see Case Study 6.1). A recent report of the European Parliament criticised the current implementation of the Directive. The report included a proposal to ramp up activities in this area by, for example, integrating aspects of material and resource efficiency in building codes and standards, and enhancing and supporting radical eco-innovation of existing buildings via decentralised energy production and new materials (European Parliament, 2009). The report also discusses the wider application of eco-taxes on aggregates (sand, gravel, crushed rock) that are currently in place in the UK, Sweden, Italy, Czech Republic (European Parliament, 2009). Other European regulations that affect the market for sustainable construction include the Energy Services Directive (2006/36), the Waste Framework Directive (2006/12), the Drinking Water Directive (98/83/EC), and the Construction Product Directive (86/106/EC). New or revised legislation can support innovation by raising sustainable performance standards in the industry and enlarging the market for innovative and sustainable products.

Description of economic benefits

Currently, the market for sustainable construction in the EU is estimated at 5% of total construction, equivalent to €24 billion in 2006. The construction sector is an important economic actor in Europe and a major employer. Investments in sustainable construction offer important employment benefits. It has been estimated that one job in construction gives rise to two further jobs in the economy as a whole (European Commission, 1997). The EU construction sector also has the potential to offer technical and managerial solutions at the international level, for example in countries like China and India where construction expenditures increase by more than 8% per year, and where environmental constraints (in terms of energy, raw material consumption and waste) are becoming apparent (European Commission, 2007).

Description of environmental benefits

The total potential for CO_2 mitigation in the building sector by 2020 has been estimated at 200 to 300 Mt CO_2 (European Parliament, 2009). Other environmental benefits relate to the reduction of use of non-renewable natural resources, the improvement of indoor air quality, and the reduction of noise and waste.

Quantification of contribution to economic outcomes

The European Commission estimates that promoting sustainable construction solutions in residential and non-residential buildings as well as in infrastructure could increase the uptake of new products and services by 5% in new construction and 3% in renovation annually, resulting in a sustainable construction market of €87 billion by 2020, generating approximately 870,000 jobs. For a description and examples of the link between policy support for sustainable construction and employment, please see section 5 of this report. Although there is no estimate on substitution effects with 'old' construction, the labour-intensity of sustainable construction (especially renovation) suggests that sustainable construction will have a strong net additional effect on employment.

Effect on public finances

Eco-taxes on aggregates could be a welcome source of public revenue. Subsidies for sustainable construction in the EU vary greatly across Member States. While some Member States have introduced indirect support to construction by reducing tax burdens associated with building, others work with fixed budgets. So far, however, no overall estimate is available of the net effect of the promotion of sustainable construction on public finances.

Further information

European Commission (1997) *The Competitiveness of the Construction Industry*, COM (97) 539, Brussels

European Commission (2007). A Lead Market Initiative for Europe. COM (2007) 860 final, Brussels.

European Parliament (2009). *Eco-innovation – putting the EU on the path to a resource and energy efficient economy*. Study and briefing notes, Policy Department Economic and Scientific Policy, IP/A/ITRE/ST/2008-06&14, Brussels.

CASE STUDY 4.4: RECYCLING POLICIES IN THE EU

Background

The EU has a range of regulatory measures dealing with waste, including ambitious targets for recycling and recovery. Nevertheless, there remains a potential to improve efficiency and capacity of recycling through innovation and the introduction of more effective processes and improved technologies. The EU holds a leading position in recycling and recovery technology. Other countries such as China, Korea and Australia are adopting waste regulations similar to those in the EU, so there appears to be a significant potential for export of recycling technologies, industrial processes and European know-how. EU companies could have first-mover advantages in this regard (European Commission, 2007).

Description of interventions

In 2005, the European Commission proposed a Thematic Strategy on Waste Prevention and Recycling with the aim of integrating a thus far fragmented regulatory framework, and to "modernise our approach to waste, […] prevent waste, and […] build a solid market for recycling." (Commissioner Dimas as quoted in EurActiv.com). The Lead Market Initiative (Section 4.2) builds on this strategy with a special emphasis on the recycling of waste streams that fall under directives such as Electrical and Electronic Waste (WEEE) and End-of-Life of Vehicles (ELV) that have ambitious recycling and recovery targets. For example, targets for vehicles are 85% recycling and 95% recovery in 2015. The review of the Thematic Strategy in 2010 offers opportunities to strengthen Europe's recycling market by giving emphasis to more material-based approaches to promoting recycling (European Commission, 2007).

Description of economic benefits

At present, the waste management and recycling sector has a turnover of €24 billion and provides over 500,000 jobs in over 60,000 companies in the EU, 69% of which are small and 28% are medium in size. As world demand and prices for raw materials are rising, recycling becomes more profitable and an area of increasing strategic importance as it reduces dependency on imported raw materials. A study estimated the value of raw-material and energy-savings from secondary raw materials produced from recycling in Germany to be €3.7 billion per year (BMU, 2006). International trade in recycled materials is rising and the EU is a world market leader in waste and recycling technologies (a 50% share of the world market in waste and recycling industries).

Description of environmental benefits

Recycling reduces the flow of waste that has to be disposed of, the consumption of natural resources (raw materials), and the use of energy. Recycling rates in Europe are 95% for aluminium, 74% for steel, up to 64% for paper and up to 80% for plastics (European Commission, 2007).

Quantification of contribution to economic outcomes

BMU (2006) asserts that the ambitious recycling and recovery targets from waste directives are a key driver for the European recycling industry. If the European recycling industry can maintain its competitive position through innovation and the introduction of more effective processes and improved technologies, waste and recycling industries are expected to grow from a turnover of €24 billion in 2006 to €36 billion in 2020 (a growth rate of almost 3% per year), providing 535,000 jobs in 2020 (BMU, 2006; European Commission, 2007).

Further information

BMU (2006) *Ecological Industrial Policy – Memorandum for a "new deal" for the economy, environment and employment*, German Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU), Berlin.

EurActiv.com – *Waste Prevention and Recycling*, available at http://www.euractiv.com/en/sustainability/waste-prevention-recycling/article-128551, assessed 16/6/2009.

European Commission (2007*) A Lead Market Initiative for Europe*. COM (2007) 860 final, Brussels.

5. Environmental Policies and Employment

5.1 Description and background

This chapter provides evidence that environmental policy has positive impacts on employment. The fundamental reason why environment policies deliver employment goals is because they aim to rectify the current tendency of economic overuse of natural resources and underuse of human resources. Any negative employment effects tend to be dispersed and not unduly concentrated on a particular sector or location and their disruption can often be offset by good policy design. Understanding employment impacts necessarily includes assessments of both direct and indirect effects.

At the macro level, environmental policies cause shifts in the composition of employment across sectors and prompt transfers of future income streams within sectors of the economy. Such shifts occur as environmental policy stimulates demand for certain sectors or products (such as renewable energy and recycling) to the disadvantage of others. Shifts can take place both within sectors and within firms. For example, firms can change their product range.

Such sectoral or firm shifts may incur transitional costs. The extent of the burden from those transition costs depends on the baseline level of innovation and flexibility in the economy. The net effect in any location will depend on the nature of the new jobs created, the jobs lost in that transition and the conditions of the employment market. For example, some jobs created may be low-skill and have lower productivity per head than the average for the economy. Yet, if the new job opportunities put back to work people that were previously unemployed then they will contribute positively to both the overall productivity of the economy and the average productivity per head of population.

Positive indirect employment effects from change are also likely where jobs are created either:

- Within the EU, with losses in countries importing into the EU (e.g. where energy efficiency investment in buildings reduces fossil fuel imports); or
- In sectors which are relatively more labour intensive than the more resource intensive sectors in which jobs are lost.

These conditions frequently hold for changes induced by environment policy (for example in sectors such as organic agriculture, repair and recycling). Similarly, the labour intensity of the environmental goods and services sector is relatively high, suggesting that environmental expenditure would create more jobs than expenditure in many other parts of the economy (EC, 2005).

A key consideration in employment policy is the longevity of jobs – whether jobs are being created in sectors that will flourish in the future globalised economy or are in “sunset industries”.

To assess the economy-wide impact of environmental policies on employment, however, it is also necessary to examine the indirect (upstream and downstream) impacts that are triggered elsewhere in the economy. Indirect effects include substitution and income effects that relate to the macro-economic impacts on relative prices of resources and wages, and changes in the crowding out of investment. A positive (negative) impact on a particular firm will usually be at least partially offset by a negative (positive) impact elsewhere in the economy. Indirect im-

pacts may take place in different economic sectors or in different locations and may also take some time to materialise.

The long-run level of employment is determined by the size of the labour force, participation rates and the long run equilibrium rate of unemployment. In this context, environmental policies are more likely to change the composition of employment than its overall size. Impacts on future unemployment levels are likely to arise from influence on whether environment policy stimulates greater innovation and growth in sectors which will become more important in international trade, or whether they affect resource productivity. Evidence in sections 3, 4 and 6 suggest positive impacts here, and so positive impacts on unemployment rates.

Environmental pressures such as air pollution have direct effects on employment through efficiency losses due to increased incidence of sick-leave and a reduced labour force. Therefore, environmental policy measures which are designed improve air pollution, such as caps on greenhouse gas emissions and mandatory catalysts, are also beneficial for employment.

5.2 Policy instruments

Nearly all environmental policy has an impact on the direction of future employment trends. Many environment policies also have short-term employment effects.

Policies raising environmental standards – for example air-quality standards - promote shifts in production processes, purchasing or use, either stimulating innovation or its diffusion. These can have both positive and negative effects on employment, depending on the forces of demand and supply as well as relative price changes (Section 5.3). Though there may be short-term adjustment costs, standards may increase employment over time by promoting technologies with long term growth prospects (EC, 2005).

Policies leading to significant public investment stimulate creation of employment. Environmental policies with a good track record of creating employment are often strongly linked to other EU policy objectives, notably regional development. For example, the promotion of renewable energies has helped to create thousands of jobs over the past decade and provided a fresh stimulus for the economic development of many less prosperous regions in the EU. At the local level, the case of Güssing in Austria provides strong evidence that structural policies, in this case grants from the Austrian government and the EU (Objective 1 funding) for building district heating and renewable energy plants, can help to revitalise regions with high unemployment (see Case Study 5.2). Germany's renewable energy sources act has shown that environmental policy can be highly effective in creating employment (see Case Study 5.1). Due to the increased demand for inputs in these sectors, indirect employment effects arise in the intermediate input sectors for these industries, such as the metal industries and mechanical engineering. Similar success stories can be found across the EU, for example the Piemonte Region in Italy (see Box 9.2), the hydrogen community Lolland in Denmark (http://www.hydrogen-community.dk) and the Navarra region in Spain.

Policies promoting greater efficiency and the uptake of innovative products can give rise to positive employment effects in various sectors. These effects are described in the chapters on productivity and innovation.

Taxation is a good example to illustrate the indirect employment effects of environmental policy measures. A shift of taxation from labour to energy would induce companies to substitute other factors of production for energy, and less energy-intensive products will constitute a lar-

ger share of final goods. This will provide an opportunity for firms elsewhere in the economy to meet the induced demand (in this case, for example, in labour and in less energy consuming equipment). Environmental Tax Reform is a programme to shift taxation away from labour (or profits) to pollution or resource use.

5.3 Review of evidence from the wider literature

5.3.1 Overall effects on employment

Empirical analyses confirm that well designed environmental policy measures play a positive role in employment creation, particularly by:

- Helping to shift production to more labour-intensive sectors and activities;
- Supporting the creation of new jobs in green industries;
- Helping to revitalise regions with high unemployment through structural policies (see Case Study 5.2);
- Shifting the tax burden from labour to environmentally harmful activities;
- Bringing about stronger economic multiplier effects associated with particular activities (e.g. organic food and renewable energy);
- Increasing demand for skills and training; and
- Offering opportunities to make use of currently idle labour.

While some have claimed that environmental policies may also cause job losses, it is the net impact of environment policy that is of importance. Determining the net impact theoretically requires complete national balance sheets of the positive and negative, direct and indirect, short and long-term employment effects.

The net effects strongly depend on policy design and international participation (Lutz and Lehr 2008). This may include measures to integrate environmental policies with a broader range of polices (for enterprise, trade, research and innovation and employment, both domestic and internationally), and to pursue active labour market policies, designed to maximise the employment and social benefits from the move to a greener, low carbon economy.

Overall evidence suggests that environmental policies will have greater impacts on the distribution of jobs rather than the overall level of employment, but that there is scope for net gains in employment through carefully designed policy measures. Subsections 5.3.2 to 5.3.6 describe and evidence different ways in which environmental policy can increase net employment.

As a result, many studies indicate that the net impact on employment for the economy as a whole has so far been either neutral or slightly positive (see for example Bach et al., 2002; Ecorys, 2008).

A study by the OECD/IEA (2008)[7] examines the likely effect of climate change action on employment and GDP. It concludes that the required expenditure to meet carbon reduction targets will result in a redirection, rather than a reduction, of economic activity and employment. It finds that 'environmental policy just contributes to a process of structural change'. The main (macro) economic impacts of climate change policy are:

[7] OECD/IEA, (2008). Energy Technology Perspectives

- A reallocation of resources from polluting sectors to more environmentally-friendly sectors;
- An increase in value added, as a result of a transfer of demand to higher-value 'green' industries, potentially expanding net employment;
- An increase in investment - from the Government and/or the private sector (e.g. 'clean tech' venture capital); and
- First mover or fast follower advantage – benefiting particular firms or sectors capable of meeting the new challenges presented.

In the long term, the biggest impact of environmental policy may be on the composition of the labour market, rather than its size, as employment is determined by the size of the labour force, participation rates and the long run equilibrium rate of unemployment (EC, 2005). Transitional costs in the form of job losses and sectoral shifts occur with any policies affecting the labour market. Some of the jobs created may be low-skill jobs and put back to work people who were previously unemployed. This will contribute positively to both the overall productivity of the economy and the average productivity per head of population.

5.3.2 Growth in labour-intensive sectors brings net employment gain

At least in the short term, environmental policies boost demand in labour-intensive industries and thus have positive effects on employment. A study by GHK et al (2007)[8] describes and quantifies a wide range of links between the economy and the environment, including:

- Eco-industries: Activities relating to the protection and management of the environment – e.g. waste recycling, pollution & sewage control and environmental management;
- Activities reliant on environmental quality – e.g. environment-related tourism;
- Activities where the environment is used as a primary natural resource or input – e.g. agriculture, forestry, mining, electricity generation and water supply.

Estimates of employment based on the different definitions are presented in Table 5.1. Based on the broad definition (which includes all activities), about 21 million people are directly employed in environment related jobs in the EU. When the multiplier effects are included, this total increases to 36 million (or 17% of total EU employment), meaning one in six jobs in the EU is in some way linked to the environment.

Table 5.1: Employment and Total Turnover in Environmental Activities in the EU27 – narrow to broad definitions

	Direct Employment	Total Employment	Share of Total EU Employment
Eco-industries (mainly pollution control or treatment)	2.4 million	4.6 million	2%
Eco-industries plus activities closely dependent on a good quality environment (environment-related tourism, organic agriculture, renewable energy etc) - CORE	4.4 million	8.7 million	4%
CORE definition plus all activities dependent on the environment (all agriculture, energy, mineral extraction, etc)	21 million	36 million	17%

Source: GHK et al. (2007). Links between the environment, economy and jobs

[8] GHK et al. (2007). Links between the environment, economy and jobs. http://ec.europa.eu/environment/enveco/industry_employment/pdf/ghk_study_wider_links_report.pdf

Subsequent estimates by Ecorys (2009) put direct employment in the EU eco-industries at 3.4 million in 2007, having grown by more than 70% since 2000.

The positive employment effects of environmental and climate change policies are best approximated by the 'Core' definition of environment industries comprising pollution control and management plus natural resource based activities (organic farming and sustainable forestry), environment related tourism, renewable energy and water supply.

The GHK study also looked at a number of hypothetical policies and modelled the impact of a policy that changed the nature and/or costs of inputs (such as higher fuel costs or changes in current technology) to a sector (or group of sectors) and the subsequent impacts on GDP and jobs. In other words, it estimated the net economic impact of substitution to greener alternatives or investment environmental infrastructure and technology.

The answer is broadly that environmental policy contributes to a process of productive structural change. It causes a marginal reallocation of resources from those sectors financing a policy (paying its costs) to sectors that benefit from the intervention.

Examples of the policy scenarios are:

- Increasing the energy efficiency of the manufacturing sector (modelled as a 10% reduction in purchases of inputs from the energy sector with substitution to more energy efficient technologies). This led to a net increase in output of €480m and gain of 140,000 jobs (energy sectors have a low labour intensity).
- A 10% substitution of bio-fuels for manufactured fuels leads to a €1.5 billion increase in net output and 140,000 new jobs due to the labour-intensity of the agriculture sector and the industries that supply it.

5.3.3 Shifting taxation away from labour to pollution and resources

Environmental tax reform can increase the number of people in work in the economy as a whole, by lowering the taxes on labour, and moving towards taxing pollution, while using the tax revenue to lower social security contributions. The net effect on employment ultimately depends on the level of initial taxes on labour, the size of the reduction in the labour costs and the value of cross-price elasticities. Increasing the share of revenue that comes from environmentally-related taxes in the EU – a figure equivalent to 2.8% of GDP in 2004 (Eurostat, 2006) – could increase overall employment, particularly by moving away from taxing labour towards taxing pollution and using the tax revenue to lower social security contributions.

The German eco-tax (an additional tax on fuel and electricity), for example, has contributed to the creation of 250,000 jobs since 1999 by reducing the costs of jobs. The revenue from the tax is used to reduce employers' welfare contributions (Kohlhaas, 2005).

A modelling project, commissioned by the Aachen Foundation "Kathy Beys" investigated different scenarios to increase Germany's resource and energy productivity to 2020 (see Box 3.2). It shows that the Aachen Scenario – a 20% reduction of material and energy costs of the manufacturing sectors, construction and public administration – can create more than one million jobs in Germany by 2016. This result is driven by the introduction of an information and consulting programme of EU member state governments to increase material efficiency in the manufacturing sector, exerting a strong positive effect on growth through productivity gains that drive prices down and increase profit margins. The positive employment effects would be

further extended by the introduction of additional policies, such as a resource tax (material input tax) or the transformation of the VAT system.

5.3.4 Promoting growth in Eco-technology and Eco-innovation

A recent Commission study finds that stronger policies on renewable energy sources (RES) to reach the European 20% renewables target can provide a significant boost o the economy, give jobs to 2.8 million people in the RES sector and 410,000 additional jobs, and lead to total gross value added in the RES sector of about 1.1% of GDP (EC, 2009).

The European eco industry has been one of the most dynamic sectors over the past two decades and continues to be a core driver for future growth and employment. According to a study by Ecorys (2009), the core of the European eco-industry directly employs about 3.4 million people. Between 2004 and 2008, it achieved annual growth rates of 8.3%, a well above average increase, generating a turnover of €319 billion in 2008. The growth of eco-industries can generally be supported with regulation that internalises the external environmental costs of production. Their competitiveness would benefit, among other things, from incentives and environmental standards set for other industries to improve their environmental performance.

Environmental policies which promote high-innovation sectors can be very beneficial for employment. Mastrostefano and Pianta (2005) examine the quantitative relationship between innovation and employment in 11 industrial sectors and ten European countries in the 1990s. On the basis of empirical tests they conclude that innovation tends to increase employment in the high-innovation sectors (where product innovation prevails), and that tends to depress employment in low-innovation sectors (where process innovation prevails). Especially in the longer term, (product) innovation is the most important indicator for employment growth and should be fostered through policies such as the Integrated Product Policy by the European Commission which supports the realisation of environmental product innovations in order to achieve a broad reduction of environmental impacts along the life cycle of products.

5.3.5 Using currently idle labour

Environmental policy can play an important role in short term employment creation programmes, by making use of idle labour in cyclical sectors such as construction. This is particularly the case for environmental infrastructure investments which provide a strong stimulus to the construction and capital goods sectors (GHK et al, 2006, Case Study 9.1). Examples of the role of the environment in economic recovery programmes are given in Section 10.

5.3.6 Modelling indirect effects

Predicting and assessing the numerous and often interrelated effects of environmental policies requires complex models. A variety of different models has been used in the literature, which may complicate the comparison of results. The petrE research project is an example of a European study which has used such models to show how and why environmental policies aimed at expanding environmental industries are likely to be a major source of economic growth and employment in the future (see Case Study 5.3).

Two environmental policies have been shown to have particularly strong positive impacts: environmental tax reform and the promotion of environmental technologies. GHK et al. (2007) modelled the impact of various hypothetical policies on the nature and/or costs of inputs to a sector as well as on GDP and employment. The scenarios in this study indicate that while di-

rect effects of policy options may be neutral or small (reflecting quite often the substitution from "less green" to "greener" options), the indirect effects are often much larger and generally show that the EU economy would gain, especially in employment terms, from the introduction of environmental policies that change current production and consumption patterns. This is particularly true for policies that would encourage the greening of buildings (see Box 5.1), the creation of efficient transport systems (see Box 5.2) and other resource efficient technologies, and the generation of renewable energy.

5.4 Evidence from examples and case studies

Box 5.1: Greening the building industry

The building sector consumes more electricity than any other sector worldwide. Increasing the efficiency of buildings may include a wide range of measures, including improvements in the efficiency of material use (construction materials, energy and water), surface water management, site waste management, household waste management. Direct employment effects are related to all thermal insulation and energy-efficiency works, i.e. installation works, activities of design production and maintenance of low-energy consumption, heating and ventilation equipment, thermal regulation and energy-saving services.

Greening Buildings and Communities: Costs and Benefits
The "Greening Buildings and Communities" study (Kats et al., forthcoming) is based on extensive financial and technical analysis of 150 green buildings across the US and 10 other countries. Regarding employment impacts, it finds that green buildings create jobs by shifting spending from fossil fuel-based energy to domestic energy efficiency, construction, renewable energy and other sectors with green jobs potential. A typical green office creates at least one-third of a permanent job per year compared to a similar non-green building.

Energy saving fund project, Germany
A study carried out by the Wuppertal Institute and its partners developed a detailed technical, financial, organisational and legal concept for an energy saving fund in Germany which is supposed to increase energy efficiency between 2006 and 2030. The 12 energy efficiency programmes of the fund involve several highly energy intensive sectors (e.g. housing) that are expected to be able to realise an energy saving of 10% of primary energy consumption of final users (75 billion KWh of electricity consumption and 102 billion KWh of heating), or a monetary saving of €9 billion by 2015. To this end, 41,700 full time employment jobs will be created in Germany on average per year (of which 12,500 jobs would be tradesmen working essentially in construction) with a maximum of 75,000 jobs in 2015 (Irrek and Thomas, 2006).

Potential of energy saving measures in buildings, Belgium
Exploring different pathways to increase energy efficiency in Belgium, McKinsey (2009) identified an energy savings potential of 48% of the primary energy consumption in buildings by 2030, which represents more than half of the energy savings potential of the whole country. Implementing the necessary measures (improving energy efficiency in existing building stock; raising energy efficiency standards for new buildings; improving the energy efficiency of lighting, appliances, and electronics; installing more efficient heating, ventilation, air conditioning, and water heating systems; instilling behavioural changes) would require investments worth €24 billion between 2010 and 2030 and could create up to 20,000 jobs.

Box 5.2: Creating energy efficient transport systems

Creating sustainable transport systems has great potential for reaping the double dividend of the creation of jobs and significantly improved environmental standards. A study by Öko-Institut (2003) estimated that even in the short-run, an expansion of local public transport could yield a net gain of 200,000 jobs by 2010 in Germany. In some countries, unemployment is partly caused by poorly planned transport systems which can constrain the mobility of workers even over comparatively short distances, for example within urban centres. Where inadequate transport constitutes a major obstacle to household expenditure and livelihoods, improved transport and housing patterns not only improve household income but may also have a huge impact in terms of people's access to jobs and economic opportunities (UNEP et al., 2008: 163). Apart from job creation, other economic benefits include reduced congestion, agglomeration benefits, cost savings, increased productivity and competitiveness. Transport investment can also have an important influence on productivity by increasing the effective density of people and jobs within a given distance (UNEP et al, 2008).

Road and rail transport

Environmental policies in favour of sustainable transportation offer opportunities to increase net employment by creating jobs in manufacturing of buses, light rail, subways, and railways; in the provision of the required infrastructure, and in planning, running, and maintaining transit systems, outweighing any reductions in employment in car and truck manufacturing and related fields. Compared to road transport, rail transport is more fuel-efficient and more labour-intensive (WWF, 2009: 22). Based on German studies, Renner (1991) suggests that this is true for track construction relative to road construction, which generates the fewest jobs of any public infrastructure investment. Policies aiming to rebalance transport modes in favour of rail in particular would lead to net growth in overall employment of around 2% on average per year over the period 2000/2030 for passenger transport and 1.25% for freight transport (Dupressoir et al. 2007: 103). If sustainable transport policies aim to create employment they need to address the inevitable transition and smooth the process for those whose jobs will be reoriented or lost.

Electric and hybrid cars

Growth in use of electric cars and hybrids (cars with combustion engines but powered partly by batteries that recharge from energy released by the car) is likely to benefit manufacturers of cars, batteries and companies involved in creating an infrastructure for recharging and servicing electric cars. If batteries can be can be made sufficiently cheap, reliable, safe, and recyclable, this will lead to the creation of a substantial number of jobs (UNEP et al., 2008: 153). According to Wolfgang Bernhart, partner with Roland Berger Strategy Consultants, "There's a tremendous momentum and electric vehicles will be introduced very quickly in the next decade." If oil prices continue to rise and battery prices fall, he forecasts that electric vehicles could come to account for more than 25% of the European and 10% of the global market. The estimate does not include hybrids (Reed, 2008).

One of the most rapidly expanding companies in this field is "Better Place" which aims to build a global network of charging points and battery-exchange stations to bring electric cars to the mass-market. The company sells electric cars provided by its partner (Renault-Nissan), charging by the kilometre. So far, Better Place has signed deals with Japan, Israel, Denmark, Canada, Australia, Hawaii and California to build networks of recharging points. In a similar move, the Spanish Ministry of Industry has launched a huge electric car infrastructure plan in Madrid, Seville and Barcelona (Proyecto Movele) as part of a larger economic stimulus package which is forecast to generate 300,000 jobs within a year (Morsella, 2009).

5.5 Scale of economic benefits to date and assessment of the further potential

The activities most often identified as having very strong potential in the future are activities associated with the greening of buildings, transport, and environmental technologies, including waste and recycling (see boxes above and Murray, 1999).

According to Ernst and Young (2006), in 2004, the total direct and indirect employment supported by the eco-industries was approximately 3.4 million full-time job equivalents, of which 2.35 million jobs were in pollution management activities. Around 430,000 pollution management jobs were related to capital expenditure and 1.92 million jobs related to operating expenditure. Resource management activities supported approximately 1 million full-time job equivalents. The majority (77%) of the jobs in the pollution management activities were in the waste water treatment and solid waste management sectors. Ecorys (2009) estimated direct eco-industry employment at 3.4 million jobs in 2008.

Table 5.2 outlines past estimates of employment in the EU from environmentally related productive investment in the EU and two estimates of specific impacts from EU energy policy.

Table 5.2: Current and estimated future impacts of environment-related investment and capital expenditure (capex) on jobs

Investment/ Capital expenditure	Current impact on jobs	Future impact on jobs	Remarks
Renewables Infrastructure[a]	Around 1.4 million jobs in 2005, equal to 0.65% of the total EU workforce	2020 RES target would generate ~ 410,000 net additional jobs and 2.8 million jobs in total	~ 55% of value added and employment occurs directly in the RES sector and 45% in other sectors due to the purchase of goods and services
Buildings Infrastructure[b]		208,000 to 450,000 jobs by 2020	Based on range of scenarios under the European Energy Performance of Buildings Directive.
Transport Infrastructure (Rail manufacture)[c]	140,000 jobs in 2003, 0.5% of all industrial jobs		
Man-made capital (10 EC Directives)[d]	0.5 million jobs between 1990 - 2010, equivalent to 3% of Europe's unemployed		
Man-made capital (Pollution management)[e]	430,000 jobs in 2004	Na	Jobs related to capex only
Natural Capital (Resource management)[e]	1 million jobs in 2004	Na	Jobs related to capex and opex
Natural Capital (Environment related tourism)[f]	3.3 million in 2000	Na	

Sources: [a] EC (2009)
[b]WWF (2009)
[c] WWF (2009)
[d] EC (2001)
[e] EC (2006)
[f] GHK et al (2007) Links between the environment, economy and jobs

Environmental policies which promote energy efficiency and energy conservation still have an enormous potential to create jobs. The European Commission's 2005 *Green Paper on Energy Efficiency* states that Europe could cost-effectively reduce 20% of its current energy consumption by 2020, saving €60 billion per year, and creating as many as 1 million new jobs. In order to realise this potential a sound and consistent energy efficiency policy is needed. To this end, a study by Rocholl et al. (2006) for the Aachen Foundation suggests that a common, ambitious, mandatory target for energy demand reduction needs to be adopted. The authors suggest the introduction of a target of at least 20% reduction of today's energy consumption by 2020. Moreover, they propose that energy efficiency and energy conservation should be given a prominent role in the EU priorities and financing (in the place of carbon intensive technologies such as 'clean coal' or other fossil fuels, gas infrastructures or nuclear energy) through the FP7, structural and cohesion funds, European financial institution programmes and loans.

5.6 Beneficiaries and timescale

Environmental policies have the potential to increase employment across the economy as a whole, with particular positive effects in a wide range of activities such as energy efficiency, renewable energy, waste management and recycling, pollution control, clean technology, bio-products, nature conservation, sustainable construction, forestry, agriculture and tourism. There will be negative effects on some sectors and activities, such as fossil fuel energy, energy intensive manufacturing processes, road transport and the landfill of waste. Evidence suggests that the net effects on key sectors such as energy, transport and manufacturing will be positive. New jobs will be created across the EU, offering potential for short term job creation and long term gains in net employment in decades to come.

CASE STUDY 5.1: RENEWABLE ENERGY SOURCES ACT, GERMANY

Background

The first Renewable Energy Sources Act (EEG) was enacted by the government of Germany in 2000 (last amended in January 2009) and aims to increase the share of renewables in total electricity consumption to at least 30 percent by 2020, after which date a continuous increase is prescribed.

Description of intervention

The EEG obliges operators of power grids to give priority to purchasing electricity from renewable energies and to pay fixed prices (a government-specified feed-in tariff) to energy generators supplying energy to the grid from renewable sources. In order to encourage technological advancements and cost reductions for parts and installation, the feed-in tariff drops yearly by a fixed percentage. The grid operator must provide free access to the grid for all interested generators and pay the specified reimbursement for those suppliers qualifying under the terms of the EEG.

Description and quantification of economic benefits

The EEG has helped to position German companies well in terms of price and cost advantage and helped Germany achieve an early and dynamic market growth of renewable compared with other international markets. Renewable energies are becoming an ever more important economic factor in the country. The domestic turnover in 2008 was around €28.7 billion. The number of people working in the renewables sector in Germany increased from 100,000 in 2000 to around 278,000 in 2008 (BMU 2007, 2009). In 2007, 60% of the 250,000 jobs in renewables were directly attributable to the EEG. Jobs are mainly created in the production and installation of the facilities needed to generate electricity from renewable sources.

Description of environmental benefits

Using renewable energy is safe, resource-efficient and environmentally friendly. By fostering the use of renewables the EEG has thus helped protect the climate and environment. In 2008 the use of renewable energies in Germany prevented the release of about 112 million tonnes of CO_2.

Effect on public finances

There is no significant effect on public finances as the EEG is based on a private sector cost splitting mechanism. Additional costs only arise for the operators of power grids and utility companies who can pass on the costs to their clients. Public expenditure is limited to the costs of enforcement (control and evaluation). A net gain for public finances may be assumed given the the reduced costs for environmental damage caused by fossil-fuel related pollution. By the year 2020 it is expected that the external environmental costs saved per year will be twice as high as the additional costs.

Potential for wider application in EU, and possible means of measuring economic benefits

The law has been implemented in similar forms in many other member states of the EU.

Further Information

http://www.umweltministerium.de/english/renewable_energy/doc/6465.php

CASE STUDY 5.2: GÜSSING, AUSTRIA

Background

Güssing is a model for forward-looking renewable energy policy at a local level that is driving the economic development of the whole region. Thanks to the interventions which started in the 1980s, Güssing has prospered economically and has become the first town in Austria to be self-sufficient in energy supply.

Description of intervention

Since the purchase of fossil fuels was identified as a major drain on the local resources a sustainable energy model was designed to utilise local renewable resources to supply the town's energy needs, create regional development and jobs. Austrian renewable energy legislation has been very favourable for these developments. Güssing is also a prime example of successful European Cohesion Policy investment.

Description and quantification of economic benefits

Using wood from local forests in its biomass heating plant, the town produces more electricity than it consumes and is able to provide power for the entire region. Over 50 companies and 1 000 jobs have been created in the renewable energy sector alone since 1995. Calculations of the overall costs and benefits of the model are unknown because the energy system consists of a combination of different technologies and machines for energy generation which are managed by different companies.

Description of environmental benefits

Güssing reduced its carbon dioxide emissions by 93% between 1995 and 2008. The use of regional renewable resources for energy generation increases the use, management, and maintenance of forests. The use of agricultural resources contributes to landscape management, and the processing of old cooking oil reduces pollution of sewage.

Effect on public finances

EU funding was an essential lever for triggering this development: nearly €20 million was invested in projects such as Blue Chip Energy GmbH, the development of an enterprise producing solar cells, with additional national and regional funding needed to make this ambitious project happen. Two power plants which were built with the help of EU and Austrian government grants have made Güssing more than self-sufficient for electricity and heat. It is estimated that €18 million stays in the district each year that would otherwise have leaked out. This is understood to represent a substantial return on the EU and Austrian grants.

Potential for wider application in EU, and possible means of measuring economic benefits

The project continues to attract attention, and many similar models are planned or implemented around the world. The crucial barriers are often the lack of initial funding, knowledge of suitable technologies and design, as well as research and development.

More information

European Centre for Renewable Energy: http://www.eee-info.net

CASE STUDY 5.3: RESOURCE PRODUCTIVITY, ENVIRONMENTAL TAX REFORM AND SUSTAINABLE GROWTH IN EUROPE (PETRE)

Background

The three-year research project PETRE, funded by the Anglo-German Foundation (AGF), investigates major issues related to resource productivity and environmental tax reform (ETR), including both economic and environmental implications and impacts in the EU (especially in Germany and the UK) and within the global economy.

Description of intervention

PetrE models the single-country, European and global economic and environmental effects of different ETR regimes. Six different scenarios were devised to investigate the implications of using ETR to achieve large-scale reductions in CO_2 emissions and meet EU targets by 2020:

(i) a baseline scenario without policy interventions, assuming low energy prices,
(ii) a baseline sensitivity scenario, assuming high oil prices,
(iii) a unilateral EU ETR scenario with revenue recycling designed to meet the EU 2020 target to achieve a 20% reduction in GHG emissions by 2020 compared to 1990,
(iv) a unilateral EU ETR scenario with revenue recycling designed to meet the EU 2020 GHG target, assuming high oil prices,
(v) a unilateral EU ETR scenario with revenue recycling and 10% of revenues being spent on eco-innovation measures to meet the EU 2020 GHG target, assuming high oil prices, and
(vi) an ETR scenario with international cooperation and revenue recycling designed to meet the cooperation EU 2020 GHG target of 30% reduction, assuming high oil prices.

Description of economic benefits

With stimulation through public policy (but not without) the expanding environmental industries are likely to be a major source of economic growth and employment in the future. Employment impacts of a scenario in which the revenue of environmental taxes is used to reduce social security payments are positive for almost all EU countries as lower labour costs increase labour demand and labour intensity.

Description of environmental benefits

ETR at the EU level could achieve EU greenhouse gas reduction targets and reduce EU resource consumption, cutting pollution and resource use by making resources more expensive. Since the scenarios include taxes on both biomass and material inputs, direct material consumption will fall.

Quantification of contribution to economic outcomes

If the tax revenues are used to reduce social security payments and thus cut labour costs, or to invest in low-carbon technologies in a scenario with high oil prices, the simulation results suggest a net increase in employment in the EU-27 of up to 0.8% compared to the business as usual scenario in 2020.

Effect on public finances

The implementation of an ETR could raise additional revenue of up to 4.1% of the EU-27 GDP by 2020, which could be used to fund government expenditures or reduce other taxes. By comparison, the German ETR from 1999 to 2003 raised an additional €17 bn (0.75% of German GDP at the time).

Potential for wider application in EU, and possible means of measuring economic benefits

Environmental tax reforms have already been implemented on a relatively small scale in a number of North European countries in the 1990s and early 2000s, with broadly positive results. The petrE project has shown that the introduction of an EU-wide ETR would have positive economic, environmental and resource implications, depending on the size of the reduction in the labour costs effected by the ETR. This, in turn, depends on the size of the labour tax reduction that is enabled through the taxation of energy use. The net impact on employment also depends on the extent to which labour use increases as energy becomes more expensive.

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Further information

Project website: http://www.petre.org.uk

6. Environmental Policies and the Balance of Trade

6.1 Description and background

A positive balance of trade depends on various factors, including the state of technology, the perceived image of export products, production costs, exchange rates and the economic situation of the trading partners. Environmental policies may improve the balance of trade in two ways. On the one hand, they may boost exports (especially of eco industries). On the other hand, they may reduce material use and hence imports.

Critics have claimed that environmental policies add to costs and make industries less internationally competitive. Reconfiguring existing products to become more environmentally friendly incurs costs which consumers have to pay for – just like any other cost increases (in raw materials, wages, social security contributions, interest rates, research, etc.). Without compensatory factors, such as increases in productivity or product quality, these price increases will affect international competitiveness. However, given the worldwide growth of environmental problems, environmental protection techniques or new environmentally friendly products and processes will have significant export potential, with any increases in costs compensated by productivity improvements and the better image of environmental quality.

Some sceptics have also expressed concerns about national or regional environmental policies in globalised markets where energy and resource intensive production can easily be shifted to countries with less rigorous environmental standards. Studies have shown that these risks have been overestimated given the globalisation of environmental policies, the growing importance of international environmental institutions and NGOs as well as the increasing role of ecological concerns in non-environmental institutions (Jänicke et al., 1999).

Progressive environmental policies require industries to innovate and adapt quickly, giving them first mover advantages and positioning them well against foreign competitors when the latter catch up. High environmental product standards in the home market (e.g. for white goods) drive innovation, create export opportunities over time, and can improve international competitiveness generally.

Environmental policies are also important in reducing European expenditure on imported materials and energy. Again, the deployment of eco-innovations in the EU is crucial as it reduces energy and material import costs and dependencies and increases energy and material security. In addition, a range of effective environmental policy instruments can be used to increase the efficiency of energy and resource use in production and consumption activities, such as standards and regulations on dematerialisation (using smaller quantities of materials), substitution, recycling and waste mining (extracting useful materials from waste streams). Environmental policies which have encouraged enhanced resource efficiency have thus helped to lower production costs at the micro level and improve the competitiveness of European companies. At the macro level, environmental policies which succeed in reducing imports of fossil fuels and other materials through improved efficiency and the use of renewable energy sources not only reduce the burden on the environment but can, at the same time, make the EU more independent.

Environmental policies can support environmental technologies and their export potential by adopting long term policies that take account of the length of the innovation process for vari-

ous technologies and their successful market penetration (see Box 6.1). Long-term, stable regulation and market conditions are essential for technologies to access markets and to gain a solid position. The extent of changes in export market shares depend on the potential to create "first mover" or "fast follower" advantages for the technologies and sectors involved.

The impact of environmental policy on EU competitiveness and the composition of jobs and output across all sectors will depend on a number of factors, such as:

- the cost incurred relative to competitors outside the EU;
- the pattern of changes in total and intermediate demand;
- the ability to pass on these costs in prices of products and services;
- the share of that market taken by domestic producers as against imports;
- the prevailing budget constraints of households;
- the share of output sold to households compared to businesses;
- the extent to which compensating measures are taken; and
- the assumptions regarding non-EU country environmental policies.

The overall macroeconomic results can be calculated as the sum of its sectoral outcomes. Sectoral impacts will however vary because of the relative importance of these factors. For example, in the case of environment policies, the main sectors expected to be negatively impacted are the ones most affected by higher electricity and energy prices.

6.2 Policy instruments

Environmental policies have been a driving force behind the growth of eco innovation in products and services which now constitute a growing share of high value exports from the EU. Modern environmental laws, standards, regulations and investment incentives have had a significant role to play in supporting eco-industries which have strengthened the global trade position of many EU member states.

Encouraging firms to implement and invest in climate protection measures and associated research helps them to strengthen their position on the global market and increases demand for European climate protection technologies.

Increasing the use of renewable energies reduces the dependency on fossil fuels and thus improves both the trade balance as well as energy security. A wide range of support mechanisms are used across the EU to stimulate renewable energy uptake, including quota systems based on tradable green certificates (TGCs), feed-in tariffs, green certificates, investment grants, tender procedures and tax measures. According to Ernst and Young (EC, 2006), growth in renewable energy in Europe is mostly driven by EU policy.

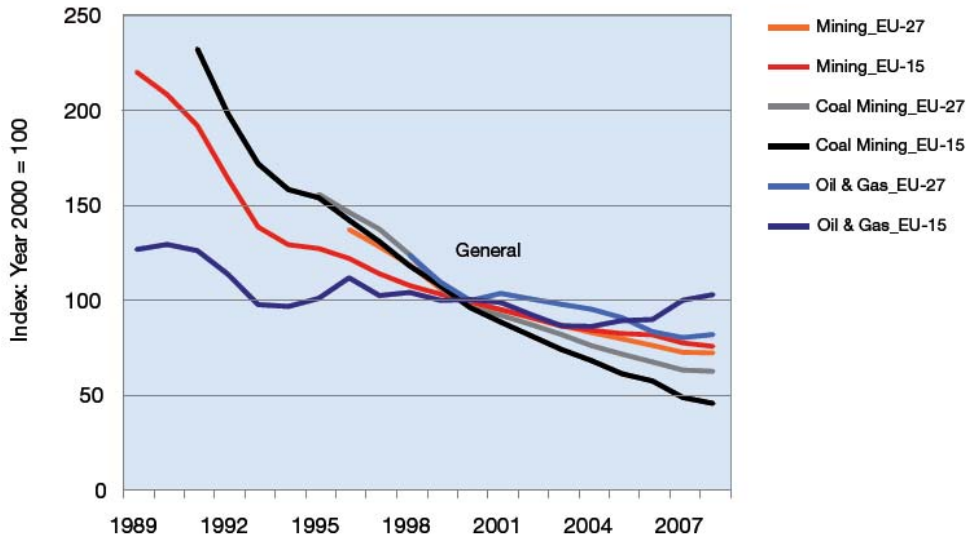
6.3 Review of evidence from the wider literature

A number of studies have assessed the influence of environmental policies on exports and imports – both theoretically (through scenario analyses and environmental-economic models) and empirically (through policy evaluation). One of the most widely used measures of the trade balance of European environmental products is trade code analysis. Despite certain drawbacks (primarily the limited number of products that can be included) the main advantage is that trade code analysis easily allows identifying trends (how export destinations are changing over

time and how the different sub-sectors are rising or falling in importance in different countries) (see Ecotec, 2002).

At the level of individual sectors, environmental and climate change policies are likely to have an impact on sectors sensitive to international competition. A number of EU industries are losing their market share over time due to the growth in global competition. The costs of stringent product and quality standards resulting from environmental regulation and/or from the EU ETS increase the challenge of competing in international markets. As a result job losses (and job shifts) will occur, especially in energy extraction and refining, the power sector, and in energy-intensive industries like chemicals, steel, aluminium, paper, and cement. It should be noted that extractive industry jobs have been on the decline for many years in the EU-15 and EU-27 (Figure 6.1). These job losses are largely due to growing automation, rising labour productivity, and trade dynamics (exchange rate fluctuations, growth in non-EU markets and trade policies), rather than an outcome of environmental policies.

Figure 6.1: European Union Employment Index, Extractive Industries



Source: Eurostat, "Industry, Trade and Services": accessed 27 February 2009.

On the other hand, the sectors positively impacted from environmental policies include the eco-industries (including renewables) and certain activities in transport (e.g. rail, hybrid cars), and business and financial services. Incentives and regulations such as product standards and labelling requirements have created demand for environmentally friendly products and techniques and fostered environmental innovations. As a result, the European market for environmental goods and services was worth €227 billion in 2004, representing 2.2% of the GDP in the EU-25 area. From a global perspective, the EU has large market shares in the eco-industry markets (Roland Berger, 2007). The EU's market share is 10% for material efficiency and natural resources, 30% for sustainable water management, 35% for sustainable mobility, 35% for energy efficiency, 40% for green power generation and 50% for waste management and recycling. Exports grew around 8% in 2005, and there was a trade surplus of environmental goods and services of over €600 million. The EU operates a trade surplus in environmental products with the rest of the world. The three major markets (Germany, France and the UK) are all net exporters of eco-industry goods and services and are responsible for 55% of eco-

industry trade. Germany has the largest trade surplus of all EU Member States, while Belgium, the UK and Sweden also have large positive balances. Spain, Portugal and Greece have trade deficits in eco-industry goods (Ecotec, 2002).

Ecorys (2009) estimated that exports between EU member states in the eco-industries increased by 75 percent between 1999 and 2007, while exports to countries outside the EU increased by 44 percent over the same period, outstripping export growth by the US and Japan.

A monitoring and evaluation report of policy instruments to support renewable electricity across the EU (Ragwitz et al. 2005) examines the effectiveness of the promotion of innovative technologies, following the adoption of the Directive 2001/77/EC on renewable energies in the electricity (RES-E) sector. The highest effectiveness is found in countries which use feed-in tariffs as their main support system. Two main criteria were used to evaluate the respective policies: minimising generation costs and lowering producer profits in order to minimise the transfer costs for consumers and societies at large.

The Employ-RES research project conducted on behalf of the European Commission DG Energy and Transport (EC, 2009) modelled three projections for the RES deployment in the EU: no-policy, business as usual (BAU) and accelerated deployment policy (ADP, using the Green-X model. The BAU scenario extrapolates on current policies in all Member States, which are inadequate to achieve the agreed target of 20% RES in the EU-27 by 2020. The ADP scenario includes strengthened national policies and is consistent with reaching the 2020 target. The results of the study suggest that the EU's renewable energy sources (RES) avoided fossil fuel imports worth €43 billion in 2006. By 2020, this saving could increase to €110 million in the business as usual scenario, or to 158 billion with accelerated deployment policies (ADP). The net exports of EU RES technologies to rest of the world were €3.6 billion in 2005 and are expected to increase to €6.6 billion (business as usual) to €9 billion (with ADP) by 2020.

Analysing the impacts of energy efficiency on employment, growth and trade, Schleich and Jochem (2000) conclude that technological progress in energy efficiency may foster economic growth and exports of energy efficient products, in particular, if policies are appropriately designed to realise untapped efficiency potentials and to encourage innovation in energy efficient technologies.

The project petrE (see Box 6.3) generated substantial new insights into the conditions for sustainable economic growth, and how this might be promoted through public policy, by linking the concepts of resource productivity and environmental tax reform (ETR). Using a global economic-environmental model, petrE illustrates the effects of an ETR on European exports as well as the implications of higher European resource productivity for European competitiveness, world-wide patterns of natural resource extraction, production, trade and consumption, and for other (especially developing) countries, and it suggests relevant policy implications.

6.4 Evidence from examples and case studies

Box 6.1: Export performance of environmental technology in selected countries

The export performance of environmental technologies depends crucially on their success in the domestic market and supporting policy measures. Many EU governments have shown that well-designed environmental policies that spur innovation and other measures that contribute

to creating and consolidating domestic markets for environmental technologies constitute a basis for success in global markets.

Green manufacturing and innovation strategy, United Kingdom
The British government has recently called for a "green manufacturing and innovation strategy" designed to re-direct economic activity from a contracting financial sector towards industries focused on sustainable development and to reverse the trend of steadily declining manufacturing shares in national production. While the UK is already a major exporter of environmental goods and services, estimates indicate that a successful implementation of the green manufacturing strategy could result in a doubling of export volumes of 'green' goods and services – from £25 billion currently to £45 billion in 2015. Moreover, this strategy aims at creating 1 million 'green-collar jobs' by 2030 by investing heavily in education and infrastructure, as well as R&D (Edenhofer and Stern, 2009).

Environmental technologies, Sweden
Sweden's environmental technology companies are at the forefront in the areas of renewable energy and water and waste water treatment. The sector's turnover increased by 11% between 2005 and 2006, reaching €10.4 billion. Exports increased by almost 20 % to €2.7 billion in 2006. Between 2003 and 2006, the exports of cleantech companies increased by 75 %, turnover by 36 % and employment by 13% (Swedish Environmental Technology Council, 2009).

Swedish environmental policy has had a key role to play in these achievements. In 1999, the Swedish parliament adopted 16 environmental quality objectives and 72 national interim targets which are continually being evaluated by a special government-appointed body. Since the Swedish government regards environmental technology as an important growth market, the Swedish Trade Council has been allocated SEK 30 million (€2.7 million) over three years and instructed to step up its efforts to promote Swedish environmental technology exports.

Box 6.2: Recycling

Recycling plays a strategic role for sustainable resource use and for the balance of trade. At present, resources make up about half of all production costs in modern industries, while labour costs often account for less than 20%. Since the reserves of many non-renewable resources are located outside of Europe, many European industries are critically dependant on other countries and regions. As a result, "waste" materials (especially metals) are becoming increasingly recognised as a valuable resource to substitute for new and raw materials. At the micro level, increased rates of recycling are an effective way for industries to reduce production costs. At the macro level, recycling improves the trade balance by contributing to increased independence from imports of non-renewable resources.

Lead market development thanks to a waste levy, the Netherlands

Following the introduction of a domestic levy on waste in the 1970s, the Netherlands developed into a lead market for innovative waste water treatment technologies. These technologies were initially developed by Dutch firms to avoid paying the levy. Later, these firms successfully exported their technologies to those countries which adopted similar policies and set the global standards (OECD, 2008).

Box 6.3: Environmental taxes

petrE - Resource Productivity, Environmental Tax Reform and Sustainable Growth in Europe
The modelling results from PETRE (Case Study 5.3) show that an environmental tax reform which meets the 20% GHG emissions reduction target by 2020 will lower resource consumption and annual import growth rates and raise employment.

Source: http://www.petre.org.uk/

6.5 Scale of economic benefits to date and assessment of the further potential

Given the high dependency of the European economy on increasingly scarce and expensive raw material imports (EP, 2009) and the high costs of research and development, there is growing political demand to increase resource efficiency and nurture eco innovation.

Eco-innovative goods developed within Europe are also important due to their significant export potential which stimulates sustainable growth and jobs in Europe ("first mover advantage"). The EU eco-industries have developed into a strong and diverse export sector, and a major global player alongside the USA and Japan. North America remains the EU's biggest export market and has shown significant growth (Ecotec, 2002).

Between 2004 and 2008, the core of the European eco-industry grew by 8.3% per annum and generated turnover of €319 billion in 2008 (Ecorys & Idea Consult, 2009). Leading European countries in terms of eco-industry turnover relative to GDP are Denmark, Austria, Poland, Slovenia, Germany and the Netherlands. Germany and France together account for 49% of the EU's turnover. The 10 new Member States account for only 6% of the sector's turnover. The EU plays a leading role in world markets, with market shares from 30% to 50% depending on the particular sub-sector. Sub-sectors where the EU is in a leading global position are recycling (50%), water supply (30%) and renewable energy (40%). In other areas such as bio-fuels BRIC countries are in the lead, while the EU also has a relatively weak market position in hybrid car technology, cradle to cradle and eco-design.

A study by the German Institute for Economic Research, the Fraunhofer Institute and Roland Berger (2007) forecasts that the worldwide growth rate of the eco-industry will be 5.4% per annum over 2005-2020 and reach a global market value of €2.2 trillion (compared to €1 trillion in 2005). The growth of the various subsectors and the drivers of that growth reveal a number of differences: whereas some of the process management sectors, such as the waste sector, are quite mature, other sectors such as air pollution control, recycled materials and renewable energy present substantial opportunities both now and in the future.

In addition, eco-innovations also create growth and employment due to reduced energy and material costs. The world market for eco-technologies is estimated to reach US$ 800 billion worldwide by 2015 and US$ 1 trillion afterwards (Bleischwitz et al. 2009: 68). An important policy challenge may arise from new mandatory product requirements via standards and sectoral agreements, which might hold off imports of less environmentally friendly products – and raise issues at the World Trade Organisation.

In Germany, recycling saves raw material imports worth €3.7 billion per year, thus increasing its trade balance surplus. The energy savings from recycling are equally remarkable. Recycling

aluminium takes 95% less energy than making it from raw materials and can generate substantial cost savings in production. The recycling industry itself is a profitable sector. In Germany, it generates a yearly turnover of about €50 billion (Roland Berger, 2009).

According to the EU's Energy Efficiency Action Plan (2006) the EU could realise energy savings of 20% by 2020. Apart from consequent reduction of imported fossil fuels and increased export opportunities for new, energy-efficient technology and positive employment effects, realising the 20% potential by 2020 will also 'result in large energy and environmental benefits. CO_2 emissions should be reduced by 780 Mt with respect to the baseline scenario, more than twice the EU reductions needed under the Kyoto Protocol by 2012 (EC, 2006)'.

Ernst and Young (2006) recommend expanding efforts to help European eco-industries access export markets. The strongest growth opportunities for most sectors are considered to be in new member states or in fast growing emerging economies. Initiatives to support eco-industries in understanding and accessing export markets could include:

- Expanding existing export promotion programs at EU and member state level (e.g. supporting specialised trade fairs, assistance and advice on overseas market opportunities and tendering procedures, financing feasibility studies and market surveys, sponsoring demonstration projects of innovative technologies, etc.);
- Improving networking between providers of environmental goods and services to build solid partnerships for large contracts, including with local suppliers, and helping eco-industries establish stronger links with financial institutions and investors for offering integrated financing solutions for large markets;
- Supporting the growth of demand for environmental goods and services in developing countries by using financial instruments dedicated to external aid to further support the development of the export potential of eco-industries;
- Supporting the development of financial solutions adapted to eco-industry needs; and
- Improving the development and access to markets of innovative environmental technologies.

Various studies recommend the elimination of barriers to trade in renewable forms of energy and the technologies used to exploit them, in order to reduce dependence on more polluting and less secure energy sources. The OECD (2006) suggests that manufacturers across the world would benefit from increased trade in renewable energy technologies and components. Further opportunities to create employment will arise from the export of renewable energy technology, especially to developing countries. An active renewable energy policy creates substantial potential for European manufacturers to export this technology, which would grow with domestic production.

As shown in other chapters of this report, there is still significant scope for action to exploit the large potential offered by renewable energies in the EU. Given the fact that countries all over the world are including renewable energies into their energy mix in order to reduce the emission of greenhouse gases, there are good chances to exploit the export advantage of these technologies.

Since many EU member states such as Austria and Germany already excel in efficient primary resource use, support could focus on the development of innovative processes in the primary industry as well as recycling and the use of alternative renewable primary products (see Box

6.2). Such measures not only benefit the balance of trade but also offer particularly good prospects for future employment growth in the EU (Ecotec, 2002).

6.6 Beneficiaries and timescale

Given the comparative disadvantage of high labour costs in Europe, innovation programmes to increase resource efficiency may compensate for high labour costs and ensure prosperity in an effective trading strategy.

The beneficiaries of most environmental policies aimed at promoting exports of eco-innovations are eco-industries. Since the mid-1990s, the main beneficiaries have been located in the renewable energies and waste management industries.

Bleischwitz et al. (2009) argue that the medium-term policy goal must be to minimise the use of carbon rich materials as a source of energy, particularly that of imported fossil energy carriers. ‘The political implication of the import dependence - from Russia for example - should give a powerful incentive to the EU to develop at the greatest speed possible an economy that does no longer depend on strategic imports into the EU. For that reason, smart grids and ecologically-sound buildings and a whole shift to a bio-based economy merge to become a strong pillar for the future of the European Union’.

CASE STUDY 6.1: DIRECTIVE ON THE ENERGY PERFORMANCE OF BUILDINGS (EPBD)

Background

The Directive on the Energy Performance of Buildings (EPBD; 2002/91/EC) was adopted in December 2002. It acknowledges the fact that the buildings sector is responsible for about 40% of the EU's final energy consumption and that buildings account for 38% of the EU's CO_2 emissions and 45% of energy costs. A large amount of energy (which is, to a large extent, generated from imported fossil fuels) could be saved simply by applying energy-efficient technologies. The EPBD is assigned a key role in realising the savings potential of the buildings sector, which is by far the most resource-intensive sector in the EU. The existing directive had to be fully applied by Member States by January 2009.

Description of intervention

The EPBD is the main legislative instrument affecting energy use and efficiency in the buildings sector in the EU. It aims at minimising the energy consumption of residential and tertiary buildings in the EU Member States through a number of requirements:

- Development of a general framework for a methodology of calculation of the integrated energy performance of buildings;
- Application of minimum requirements on the energy performance of new buildings;
- Application of minimum requirements on the energy performance of large existing buildings (>1000 m^2) that are subject to major renovation;
- Energy performance certification of buildings which have to be presented when the building is rented out, sold or constructed;
- Regular inspections of boilers and air-conditioning systems above minimum sizes in buildings, and in addition an assessment of the heating installation in which the boilers are more than 15 years old;
- Requirements for experts and inspectors for the certification of buildings, the drafting of the accompanying recommendations and the inspection of boilers and air-conditioning systems.

Description of economic benefits

Energy efficiency measures in buildings reduce energy imports and thus retain purchasing power and stimulate growth within the EU, while at the same time creating new jobs in the construction and production sector, and reducing energy output. Higher energy performance of residential buildings also leads to savings in household energy costs.

Description of environmental benefits

The ambitious implementation of the EPBD in some countries has resulted in eco-innovations such as nano-gel insulation, vacuum insulation, heat pumps with high coefficient of performance (COP), micro-CHP solutions, innovative passive house or energy-plus house concepts, and the revival of renewable building materials like wood, loam or straw.

Quantification of contribution to economic outcomes

The impact the EPBD has achieved so far on energy and material use is difficult to estimate, partly because of difficulties in comparing the different degrees of implementation and the different calculation methods of the energy performance of buildings in the differ-

ent Member States. The minimum total gross direct impact of the options identified by the Commission as being most beneficial, and which are therefore included in the Commission's draft of the recast proposal of the EPBD is 280,000 to 450,000 potential new jobs by 2020, not including secondary job effects (European Commission 2008).

Effect on public finances

No estimates have been found on the effects of the EPBD on public finances.

Potential for wider application in EU, and possible means of measuring economic benefits

The Directive is currently being amended. The revised directive may enlarge the scope of buildings, strengthen and specify some of these requirements and add, for instance, financing aspects.

Further information
http://www.buildingsplatform.org/cms

CASE STUDY 6.2: CLOSED SUBSTANCE CYCLE WASTE MANAGEMENT ACT, GERMANY

Background

As everywhere in the EU, waste volumes have continually grown in Germany over the past decades, with damaging human and environmental consequences. In response, Germany introduced the Closed Substance Cycle Waste Management Act (Kreislaufwirtschafts- und Abfallgesetz) – first enacted in 1994 and last amended in 2008 – which promotes closed substance cycle waste management in order to conserve natural resources and to ensure environmentally compatible disposal of waste.

Description of intervention

The provisions of the Act apply to the avoidance, recycling and disposal of waste. The Act introduced a waste management hierarchy, establishing that waste generation must firstly be prevented by means of reducing its amount and toxicity. Secondly, waste must be subjected to substance recycling or energy recovery (using waste as a substitute fuel). Only as a third priority, when minimisation or recovery is not possible, should waste be disposed of. A new feature of the Closed Substances and Recycling Act were the regulations on producer responsibility, committing producers and distributors to design their products in a way that prevents waste in the manufacture and usage of a product (Defra, 2007).

Description of economic benefits

Recycling alleviates future resource shortages and thus contributes to price stability. It reduces energy demand for the extraction and production of primary materials and decreases material and energy costs. The Closed Substance Cycle Waste Management Act has helped Germany to achieve a clear decoupling of GNP growth and waste generation since the year 2000. Among the wider macroeconomic benefits of the policy have been rapid growth and increased employment in the waste industry and in the recycling sector (BMU, 2007).

Description of environmental benefits

Recycling has many environmental benefits, including resource conservation, reduced levels of pollution, saving water, decreased solid waste disposal and incineration. Recycling aluminium, for example, is 95% more efficient than producing primary aluminium from raw ore and significantly reduces air and water pollution. It saves 95% of the energy necessary to mine bauxite ore and extract alumina. Recycling 1 tonne of aluminium saves the equivalent in energy of 8900 litres of gasoline (Chiras, 2006).

Quantification of contribution to economic outcomes

The policy helped to increase the German trade surplus, saving raw material imports worth €3.7 billion. Turnover and employment in the special recycling sector grew by 13% and 9% respectively between 2004 and 2006 and are expected to grow by 11% and 7% respectively between 2007 and 2009. The recycling act also managed to increase recycling rates and heat recovery from incineration and to reduce the rate of final disposal to landfill from 63.5 mt in 1998 to 45.7 mt in 2005 (Statistisches Bundesamt, 2007: 7).

Effect on public finances

Not known.

Potential for wider application in EU, and possible means of measuring economic benefits

As the EU Thematic Strategy on the prevention and recycling of waste points out, the potential for waste prevention and recycling is not yet fully tapped, and legislation is, in some cases, poorly implemented. Emerging knowledge about the environmental impact of resource use is not yet fully reflected in waste policy. Since there is no “one size fits all” solution to European waste management, strategies on waste must be customised to individual national conditions if they are to prove effective.

Further information

BMU (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety) (2007): GreenTech made in Germany 2.0. Environmental Technology Atlas for Germany.

European Environment Agency: http://www.eea.europa.eu/themes/waste/about-waste-and-material-resources

7. Environmental Policies and the Public Finances

7.1 Description and background

Public finances are important for the economy, influencing macro-economic conditions and the ability of Governments to meet their spending priorities. Environmental policy can contribute to the public finances by increasing net revenues, decreasing net expenditure and reducing future risks from revenue decreases or expenditure increases[9]. The main ways that this can happen are as follows:

- Raising revenue and expanding the tax base through environmental taxes
- Reducing environmentally harmful subsidies
- Reducing the net costs to public finances of environmental damage (e.g. healthcare) by improving the environment.

Taxes are used to achieve environmental objectives by increasing the cost of resource use and environmental damage, therefore providing an incentive to use resources more efficiently and to reduce adverse impacts on the environment. New taxes on resource use and environmentally damaging activities also expand the tax base. The level of revenue raised will depend on the elasticity of response to the tax as well as the tax rate. The higher the elasticity the greater will be the reduction in environmental impact but the larger will also be the reduction in revenue. So, for instance, the smaller the impact that an energy tax has on energy use, the greater the revenue from that tax. There can therefore be a potential tension between a revenue raising objective and the environmental objective. This also suggests that there may be uncertainties over the medium and long-term over the revenue stream. However, some tax bases will remain over time (e.g. energy use), and so environmental taxes have the potential to raise money over the long-term as well as reducing environmental degradation. Taxes will transfer funds from the private sector to the public sector, reducing private income and improving public finances. Any adverse impacts can be addressed by recycling revenues to reduce other taxes, which may, in turn, reduce or remove the benefit to the public finances.

Subsidies can harm the environment by encouraging environmentally harmful activities. They include both on-budget subsidies (i.e. direct payments) and off-budget measures (e.g. market and regulatory support and tax exemptions; EEA, 2004). From a viewpoint of public finances, the most relevant subsidies involve monetary transfers and hence public expenditure. Reductions in such subsidies will reduce environmental degradation and improve the public finances. Subsidies can also be reformed so that they are less damaging to the environment while the actual level is maintained, which may enhance value for taxpayers' money without actually improving the balance of public finances (e.g. reforming the Common Agricultural Policy (CAP) from a system of producer subsidies to subsidies relating to land holdings, or rural development payments). Most subsidies distort production and trade, encouraging relatively inefficient activities, stifling innovation, reducing incentives to develop least cost solutions, and therefore affecting international competitiveness. Environmentally harmful subsidies often promote over-use of energy and resources and therefore increase aggregate economic costs. Subsidy

[9] Environmental policy can also require public expenditure and hence reduce public finances although this should be justified by the overall benefits of the policy in question.

reform therefore has the potential to deliver economic benefits through greater efficiency, enhanced competition and increased trade.

Environmental damage can lead to direct costs to the public finances, such as health care related costs for the treatment of respiratory diseases caused by air pollution, or the increasing costs of providing flood defences as a result of climate change. Reducing environmental damage may therefore reduce costs to the public budget. In theory most environmental policy instruments will contribute to reducing environmental damage, and many of these will have public finance benefits as a result of reductions in pollution, its effects on property and public health, and the need for expenditures designed to prevent or restore resulting damage.

7.2 Policy instruments

The main environmental policy instruments that improve public finances are environmental taxes and the removal of environmentally damaging subsidies.

Environmental taxes are widespread across the EU, with taxes on particular forms of activity (such as energy use) being particularly prevalent. Specific taxes on waste, different forms of pollution, and particular products or resources (e.g. pesticides, fertilisers, plastic bags) have been introduced by some Member States. In addition, general taxes such as VAT may be levied at differential rates for different products, and can be varied to meet environmental objectives.

The scope to reduce environmentally harmful subsidies clearly depends on the extent of these subsidies at the EU and Member State level. Progress in cutting and reforming subsidies reduces the scope for further action, though there is still some potential for further progress in the energy, transport and agriculture sectors (Section 7.4).

7.3 Review of evidence from the wider literature

7.3.1 Environmental Taxes

Much of the focus in the literature has been on the potential of environmental tax reforms to shift the overall burden of taxation, rather than to generate net increases in revenues and contribute to the public finances. Environmental tax reform proposals are often designed to be neutral in budgetary terms, recycling revenues in order to demonstrate positive impacts on the economy. Much of the literature therefore concentrates on the achievement of environmental outcomes and/or on the potential employment benefits of a tax shift from employment based taxes to environmental taxes (with no overall change in revenue, see Section 5 on Employment). Bosier et al. (1998) report a 'slightly positive' effect on public finances even though they model fiscally neutral measures. Analyses on the potential of environmental taxes to raise revenues suggest that energy and transport are the main potential bases for significant revenue raising (EEA 2006, Ekins 2008, Fullerton et al. 2007). Both these tax bases are wide and have a relatively low elasticity of demand, so that increasing the tax will not change demand substantially.

Modelling revenues from environmental taxes can be fairly straightforward, based on the size of the tax base, the proposed tax rate and the elasticity of demand for the taxed item. It is the

last of these that is most challenging to estimate in advance (Fullerton et al 2007). Elasticities of demand may well change over the long-run as there are greater options for changing production and consumption patterns. The elasticity of demand for energy, for example, has been very low and income elasticity high. Demand for energy is likely to rise substantially with economic growth, providing a good revenue base unless there is significant potential to shift to renewable, untaxed energy supplies.

Environmentally Damaging Subsidies

The OECD (2005) concluded that subsidies were pervasive in the OECD and many of them were potentially environmentally harmful, especially for agriculture (estimated at US$318bn in 2002), road and rail (US$40bn in 1998) and energy (US$20-30bn). Subsidies are environmentally harmful if they increase activities that have negative environmental impacts. For instance, production based subsidies for agriculture have historically increased levels of production, increasing resultant environmental impacts such as eutrophication of water courses. The OECD review concluded that there was significant scope for reducing environmentally harmful subsidies in most of the sectors examined (agriculture, fisheries, transport, energy and water). EEA (2006) also discusses the potential for subsidy reform, noting the difficulties in estimating the scale of subsidies. Molte et al. (2004) point to the potential for reform of energy subsidies in the OECD to give an economic and environment gain albeit with potential social effects. Removing fossil fuel subsidies would boost trade and economic growth while also reducing CO_2 emissions, although there would be short-term impacts on employment and household spending on energy. The EEA (2004) estimated that non-renewable energy subsidies in the EU-15 totalled €24bn. All note that there may be justifications for some subsidies for environmentally beneficial technologies, although even these are best if time limited.

The immediate benefits to public finances can be relatively easily estimated in theory as they equate to the financial reductions in subsidies which directly benefit the public finances. However in practice there are substantial complications in their estimation (EEA 2006, OECD 2005).

Environmental Damage

Assessing the costs to the public finances of environmental damage is difficult. For instance, OECD (2001) estimated that environmentally related public health costs in the OECD totalled US$50-US$130bn per annum, but was not able to allocate them to specific environmental causes. In a later publication, OECD (2008) does not even refer to healthcare costs, but looks to the broader assessment of the benefits of reduced ill health from willingness to pay valuation studies, which are not directly relevant to public finances. We do not therefore consider it is possible to estimate the benefits to the public finances in this area.

Another positive contribution of environmental policies to public finances is the reduced costs of capital maintenance due to reduced environmental damage, which is considered in Chapter 9.

7.4 Scale of economic benefits to date and assessment of the further potential

According to the EC (2008) the share of environmental taxes in total tax revenue for the EU-27 is decreasing. In the period 2003-05 it decreased from 6.9% to 6.6%, and first data from 2006 suggests that this trend is continuing. By far the biggest source of this revenue is taxes on petrol and diesel. Compared to taxes on labour (>50%) they are low as a share of total revenue.

Potentially there is significant possibility for increasing their level, but the UK Case Study (Case Study 7.1) on the Fuel Duty Escalator shows how this can be met with significant resistance. In the UK, the Green Fiscal Commission (www.greenfiscalcommission.org.uk) suggests that the potential for an increase in revenues is between 15 and 20 per cent of total tax revenues. The Green Fiscal Commission is an independent body which includes experts from business, leading academics and senior MPs of all three main UK political parties.

The largest area of directly environmentally harmful subsidies in the EU has historically been the Common Agricultural Policy, which receives almost €50bn of funding (see Figure 7.1) although not all this subsidy is environmentally harmful. The environmental effects of the CAP have been substantially enhanced through a series of reforms since 1992, although progress has been much more gradual than in New Zealand (see Case Study 7.2).

Figure 7.1 CAP Expenditure

While the CAP was previously dominated by price supports which encouraged increased production of commodities, driving intensification of agriculture and excessive use of resources, reforms have to a large extent decoupled support from production while increasing the proportion of the budget devoted to agri-environment and rural development schemes, designed to re-couple support to the production of environmental and social goods. Furthermore, recognition of the contribution of agriculture to rural landscapes and biodiversity, and the vulnerability of many traditional EU farming systems to a competitive world market, mean that the environmental effects of subsidy reform are now more ambiguous, with the effect that pressure from environmentalists for budget cuts has substantially reduced.

The CAP budget is set to be stable in real terms over the period 2007-13, leading to real declines in subsidies for the EU-15 of 5% given the increasing size of the EU over that period. Hence there has been some public finance gains compared with business as usual although these have been balanced by new subsidies for new members of the EU.

Another area of subsidies is energy. The EEA (2004) estimated on-budget subsidies for energy for the EU 15 to total €8.2Bn in 2001. Of this amount, the most significant element is €6.4Bn for coal mining mainly in Germany and Spain. These coal subsidies are already to be phased out by 2010. Hence there are no significant further financial gains to be made from addressing direct, on-budget energy subsidies. However, IEEP et al (2007) estimated the subsidies due to reduced VAT rates for EU households to amount to €7.3 billion, including €5.0 billion for electricity, €2.1 billion for natural gas, €114 million for fuel oil and €66 million for solid fuels. This indicates that there is significant potential to enhance tax revenues by taxing these energy sources at standard rates, although concern about the social effects of fuel poverty means that there is significant political resistance to reform.

Another report by the EEA (2005) estimated that transport subsidies in the EU totalled €240 billion in 2005. These included subsidies of €128 million for road, €72 million for rail, €26 million for air and €14 million for water transport. Subsidies for road transport are dominated

by investments in road infrastructure (€113 million) and those for air transport by fuel tax and VAT exemptions (€26 million).

The above examples suggest that much progress has been made in reducing or reforming environmentally harmful subsidies, with some benefits for the public finances and wider economy. Given progress in agriculture and energy supply, the most promising areas for further reform would appear to be transport (particularly through road pricing) and elimination of VAT exemptions for domestic energy. Case Study 7.3 looks at proposals for reforming transport subsidies in Austria.

7.5 Beneficiaries and timescale

The immediate beneficiaries of the improvement of public finances are governments, which may then use this improvement to reduce debts or other taxes, or to increase expenditure, for the benefit of taxpayers. The distribution of benefits depends on how the revenues are used.

In general, increasing taxes and reducing subsidies is likely to happen over a reasonably long timescale in order to allow the affected groups the ability to adjust (and to overcome the political forces and vested interests opposing reform). Having said that, the New Zealand reform of agricultural subsidies was very quick and the current economic downturn, which has led to significant increases in government debt, may provide a motivation to improve public finances quickly.

CASE STUDY 7.1: FUEL DUTY ESCALATOR (FDE) IN THE UK

Background

UK Governments in the 1990s increased revenue by taxing sales of road fuel. This policy also became linked with environmental objectives of reducing environmental impacts from road transport. However, as UK fuel prices became the most expensive in the EU, the Fuel Duty Escalator (FDE) became increasingly unpopular and was consequently abandoned.

Description of intervention

The FDE was introduced in 1993 and lasted until 1999. It entailed an annual increase in fuel duty above the rate of inflation, of 3% in 1993-94, 5% from 1994-95 to 1997-98, and 6% from 1998-99 to 1999-2000.

Description and quantification of economic benefits

The main economic benefit was to the public finances. Public revenue from fuel duty almost doubled from £12.5bn in 1993 to £23bn in 2000. After the FDE was abandoned in 2000, real annual revenues from fuel duty fell by £3bn by 2005.

Description of environmental benefits

Given the increased cost of road transport due to the fuel duty, road transport miles travelled were less than would have been the case without the tax growth (Glaister 2002). Hence, in comparison to the development without the fuel tax, greenhouse gas emissions were reduced, thus mitigating climate change impacts and local air quality impacts. Overall, however, road transport was increasing over the period of the FDE and the net effects of the FDE on the environment are not known.

Potential for wider application in EU, and possible means of measuring economic benefits

Taxes on energy and transport form a large proportion of environmental taxation in the EU and offer the main potential to increase tax revenues further. However, the strong opposition to the FDE in the UK suggests that any increase in energy prices needs to be coordinated across the EU to avoid competition distortion and must be clearly presented as an environmental measure. Revenue from environmental taxation is currently monitored and reported so this economic benefit can easily be measured.

Further information

Glaister, S. 2002 – 3521 - UK Transport Policy 1997-2001, Oxford Review of Economic Policy, vol. 18, no. 2, pp. 154-186.
www.greenfiscalcommission.org.uk

CASE STUDY 7.2: SUBSIDY REFORM IN THE NEW ZEALAND AGRICULTURAL SECTOR

Background

New Zealand had a track record over many decades of exporting primary and processed produce to other developed markets, especially to the UK. This changed somewhat when the UK joined the EU, but only in that they diversified their export markets rather than their products, which reflected their comparative advantage. In the early 1980s New Zealand was suffering high inflation, unemployment, and a large fiscal deficit, while its support for the agricultural sector had ballooned leading to significant over production including the use of highly marginal land, only brought into production due to subsidies. Although this overproduction caused environmental damage, the main driver for reform was economic.

Description of intervention

A wide range of support measures for farmers were removed over a short period between 1984 and 1987. The main changes were in 1984 and 1985 when:

- Minimum price schemes for wool, beef, sheep meat and dairy products were abolished;
- Tax concessions for farmers were withdrawn;
- Free government services for farmers were eliminated; and
- Access to concessionary Reserve Bank funding was withdrawn.

Description of economic benefits

The agricultural sector reduced in size dramatically, e.g.:

- The national sheep flock declined from 70 million in 1983/84 to 40 million in 2006; and
- The number of sheep and beef farms has reduced by 31%.

However, agricultural productivity grew dramatically, three times greater than in the economy as a whole and particularly in sheep breeding. So for instance revenue from the reduced sheep flock is now higher than it was in 1984. Meanwhile horticulture grew substantially, particularly through wine and fruit exports. Farm land prices dropped by 50% initially but are now almost back to original levels in real terms.

Description of environmental benefits

There are a wide range of potential environmental benefits although the causality is not always provable and the data is sometimes limited:

- Reduced fertiliser and pesticide use potentially benefiting water quality;
- Reduced sheep stocking rates reducing run-off and erosion;
- Reduced pressure on water use compared to business as usual; and
- Reduced felling of native forests.

Quantification of contribution to economic outcomes

The Producer Subsidy Equivalent (PSE), a standard measure of subsidy, had peaked in 1983 at 34% of output in New Zealand. It is now down to about 3%. This implies a substantial reduction in public finance expenditure.

Potential for wider application in EU, and possible means of measuring economic benefits

The EU's current PSE is at a similar level to New Zealand in 1983 so it could be argued that it could be reduced to current New Zealand levels. Public financial benefits could be measured in terms of PSE reduction as currently. However it would be important to note that such reduction should exclude pillar II subsidies that have environmental benefits.

Further information

V. Vitalis, 2006, Subsidy Reform in the New Zealand Agricultural Sector in OECD (2006), Subsidy Reform and Sustainable Development, OECD

CASE STUDY 7.3: REFORMING SUBSIDIES IN AUSTRIAN TRANSPORT

Background

Transport in Austria is provided with a range of subsidies based largely on the assumption that transport promotes economic growth. This case study explores how these subsidies can be reduced or reformed. Transport is supported by two types of measures:

- Institutional support measures: obligation to provide free car parking spaces provides an implicit subsidy for car travel while lack of planning for public transport can favour requirements for private transport.
- Financial and tax support measures: tax allowances for commuters; fixed rate tax deductions per kilometre for business use of private cars; public financing of transport infrastructure; and land tax exemptions for land used for transport.

The value of these subsidies has been estimated by Steininger and Prettenthaler (2006):

Measure	Effective Support [€Million per year]
Parking construction obligation	170 – 200 (lower bound)
Public funding schemes for housing construction and development	100 (lower bound)
Zoning regulations	85 – 170
Fixed tax allowances for commuters	36
Flat rate tax deductions per kilometre	100
Road infrastructure financing	11,300
Accident health cost coverage	84
Land tax exemption for transport land	100 – 130

Description of intervention

The following major proposals for reform have been made, but not implemented:

- A reduction in parking space obligations linked to the availability of public transport;
- Reduced funding for residential construction not within 500m of public transport;
- Flat rate tax deduction for commuters;
- Tax deductibility for business mileage only to reflect variable costs; and
- Full pricing of road infrastructure, based on distance and emissions.

Description & quantification of economic benefits

The main economic benefit would result from the pricing of roads, removing a subsidy of €11.3bn per annum and increasing the efficiency of the transport market by removing this distortion. It will also increase public finances by €11.3bn.

Description of environmental benefits

These are not enumerated but are likely to be reduced air emissions from transport as transport activity reduces, particularly providing climate change benefits as well as local air quality improvements.

Potential for wider application in EU

Transport subsidies for road and rail infrastructure are widespread in the EU, estimated at US$40bn in 1998 by the OECD. Introduction of cross-EU road pricing, though, would be a major practical challenge.

Further information

Steininger K.W. and F.E. Prettenthaler, 2006, Reforming Counterproductive Subsidies in Austrian Transport in OECD (2006), Subsidy Reform and Sustainable Development, OECD.

8. Environmental Policies and the Capital Base

8.1 Description and background

A strong capital base is essential for a healthy and successful economy. It determines the productive capacity of the economy and its ability to provide goods and services necessary to meet human needs.

While traditional thinking on economic development has emphasised the importance of investing in built and manufactured capital (buildings, infrastructure, plant and machinery), it is now recognised that our future welfare also depends on other assets and attributes such as skills, knowledge, culture, communities and the environment.

Different forms of capital include:

- Built capital – the buildings and infrastructure necessary for a healthy modern economy;
- Man-made capital – the plant and equipment necessary for the production of goods and services;
- Natural capital – the natural resources and ecosystems on which we rely for the production of food and fibre, the regulation of the living and working environment, and the provision of recreational and cultural resources;
- Human capital - the health, well-being, skills and productive potential of individual people.
- Social capital - the social networks that support an efficient, cohesive society, and facilitate social and intellectual interactions among its members.

Investing in these different forms of capital maintains and enhances the productive capacity of the economy, determining its size and growth potential.

Environmental policy can contribute to different forms of capital:

- Built capital – by improving standards and requirements for new buildings, retrofitting existing buildings, and investing in energy and transport infrastructure.
- Man-made capital – by investing in systems such as air quality monitoring, pollution abatement, energy efficiency, waste management and recycling, and water treatment and management, all of which provide productive services to the economy.
- Natural capital – by protecting and enhancing natural resources such as forests, fisheries and water resources.
- Human capital – by investing in environment related skills and enhancing the health and wellbeing of the workforce. Environmental policy helps to tackle health problems caused by poor environmental quality, and, by improving the quality of the natural environment, enhances opportunities for recreation and amenity, thereby contributing to physical and mental wellbeing.

These different forms of capital provide future income streams and economic services. Moreover, natural capital has existential value and provides vital economic and ecosystem services. This section focuses on the impact of environmental policy on the capital base and the services that this provides to the economy. Many of the benefits of enhancing our capital base are reflected in other economic outcomes, by enhancing productivity (see Section 3), competitive-

ness and external trade (see Section 6). Investing in the environmental capital base also creates jobs (see Section 5) and provides a focus for schemes designed to stimulate economic activity.

Maintaining the stock and quality of capital is important for increasing productivity, ensuring a high quality of life, increasing resource efficiency and reducing environmental damage. The impact of environmental policies on built, man-made and natural capital is discussed below.

8.2 Policy instruments

Environmental policies in recent years have added to and enhanced the quality of our capital stock and the economic services it provides. These productive investments also yield significant environmental benefits which in turn provide a number of indirect economic benefits. Some of the direct and indirect economic benefits of environment related investments are described below and further quantified in the next section.

- ***Investments in greener buildings reduce energy costs*** - policies such as the Directive on the Energy Performance of Buildings (EPBD) encourage investments in energy efficiency measures, such as insulation and heating efficiency (see Case Study 6.1). A study by the Centre for European Policy Studies (CEPS, 2006) found that insulation is highly cost-effective from the end-user point of view in reducing the emissions of greenhouse gases and has ancillary benefits for energy security and air quality.

- ***Investments in pollution control protect property and buildings*** - air quality policies, such as the Directive on ambient air quality and cleaner air for Europe (2008/50/EC), protect buildings from damage and decay and reduce the cost of building maintenance.

- ***Investments in renewable energy infrastructure diversify our energy supply base and enhance the resilience of the economy to oil price shocks*** - there is no shortage of renewable energy but a shortage of infrastructure to harness it. This is caused by a range of factors from material shortages (such as silicon for photovoltaics, PV), to incompatibility with the existing centralised energy grid system prevalent in most Member States. The centralised fossil fuel grid model itself remains highly inefficient, wasting a total of two-thirds of primary energy inputs (Wade, 2000). Environmental policy thus has a key role to play in making our energy infrastructure compatible with renewable energy at all scales. This would create a pathway for greater renewables penetration and further technological stimulus.

- ***Investing in renewable infrastructure can enhance competition and entrepreneurship,*** further strengthening the capital base - renewables can offer a very different pattern of system ownership as renewable systems can operate at a large and small scale. Higher penetration of renewable and decentralised energy systems could lower barriers to entry, opening up the system to the widest possible array of new actors to invest in solutions. Sectors particularly well placed to contribute are the construction, farming and waste industries, commerce, and concerned communities and individuals. This will further enhance the capital base and create new economic activities and opportunities.

- ***Environmental policy is helping to renew and modernise our stock of man-made capital and to make it cleaner and more efficient*** - As a direct influence of climate change policies, such as the EU Emission Trading Scheme and IPPC Directive, energy intensive industries are increasingly making their capital stock more energy efficient by either replacing old plant or retrofitting existing plant. Increasingly pollution abatement and energy efficiency systems are being integrated into production technologies rather than resorting to

end-of-pipe measures, helping to reduce waste and costs. More stringent air and water quality targets have led to an increase in investment in pollution abatement and water treatment systems. EU waste policies have also led to significant investments in waste management, disposal and recycling systems for businesses and households, helping to improve the efficiency of resource use and reduce the financial and environmental costs of landfill (EC, 2000).

- ***Natural capital provides ecosystem services which are vital in maintaining human life and the resources on which the economy depends*** - ecosystem services include the provision of food, timber and other raw materials; the regulation of our climate, atmosphere and water systems; protection against floods and natural hazards; and the provision of opportunities for tourism and recreation. Environmental policies help to maintain the natural capital base and the ecosystem services it provides. The economic value of these services has been estimated at US$33 trillion globally (Costanza et al, 1997). Key EU policies to maintain the natural capital base include specific policies for nature and biodiversity, such as the Birds and Habitats Directives, and a broader suite of policies that reduce pollution levels and hence reduce the risk of damage or decay to natural capital. A damaged or deteriorating natural capital base can have serious social, environmental and economic costs. A clean environment and access to green space for outdoor recreation enhances human capital, by improving physical and mental health and hence labour productivity.

8.3 Review of evidence from the wider literature

This section provides some empirical data and examples to show how environmental policy can add to or enhance built, man-made, natural and human capital.

8.3.1 Built Capital

Buildings infrastructure
A number environmental policies and instruments have been used for improving the quality and energy efficiency of the building stock. The main environmental instruments comprise:

- **Regulatory instruments** – such as energy standard performance measures, mandatory environmental performance evaluation, energy supplier obligations and energy or building upgrading requirements (when renovating a building);
- **Economic instruments** – such as preferential loans for significant (above-standard) energy performance improvements and tax credits for installing energy-saving products;
- **Communicative instruments** – such as building energy performance audits, demonstration projects and voluntary energy conservation agreements.

These environmental policy instruments are aimed at reducing costs (and hence improving competitiveness), meeting environmental protection goals including Kyoto obligations and reducing the EU's dependency on energy inputs. Initiatives targeting domestic buildings also aim to meet social objectives such as addressing fuel poverty. According to a European Commission study, *Doing More with Less: Green Paper on Energy Efficiency* (2005), energy end-use efficiency investments create three to four times the number of jobs of comparable energy supply investments, (i.e. coal-fired and nuclear power plants). An EC (2005) study estimated that 12–16 job-years of direct employment are created for every US$1 million invested in energy efficiency, compared with just 4.1 job-years for investing in coal-fired power plants or 4.5 job-

years in nuclear power plants. The study also states that the EU could save at least 20% of its present energy consumption (and related to CO_2 emissions) in a cost-effective manner, equivalent to €60 billion per year, or the present combined energy consumption of Germany and Finland. Some examples of economic outcomes from environmental policies for improving the building stock are given in Box 8.1 and Case Study 8.1.

Box 8.1: Household energy efficiency market UK

The quality of existing housing in the UK is poor compared to most European countries. The UK's household energy efficiency market is mainly driven by policies to achieve improvements in the housing stock over the period to 2020. Principal among these are the supplier obligation – a requirement for energy suppliers to support energy efficiency improvements in the existing housing stock, in order to deliver certain energy or carbon saving targets – and, in the new build sector, tightening of the building regulations (in line with the Code for Sustainable Homes). In addition there are a number of grant schemes targeted specifically at the fuel poor and low income households and a variety of financial incentives for various household energy efficiency technologies.

In 2001, the total market size market size of the household energy efficiency market was £8.25 billion (in retail prices). The energy efficiency industry is estimated currently to support around 75,000 UK manufacturing jobs. There were around 11,625 insulation jobs (based on the mean of employment figures in SIC 2614 and SIC4532) related to supply, installation and servicing in the domestic insulation market. The growth in the UK household energy efficiency market helped energy suppliers to exceed their energy saving target with savings of 187 TWh achieved compared to a target of 130 TWh between 2005 and 2008.

Source: Energy Efficiency Partnership for Homes, (2008) and EEC2 2005-2008 review, Of-GEM (2008)

Renewables infrastructure

The EU has had an ambitious renewable policy since the late 1990s. The 1997 White Paper for a Community Strategy and Action Plan set an EU target of increasing the share of renewable energy to 12% of total energy consumption by 2010. More recently, on 23 January 2008, the Commission put forward a proposal for a new Directive on renewable energies to replace the existing measures adopted in 2001. According to the text, each member state is required to invest in renewable technologies to increase the EU's share from 8.5% in 2008 to 20% by 2020. A 10% use of 'green fuels' in transport is also included within the overall EU objective. To achieve the targets, every nation in the EU-27 is required to increase its share of renewables by 5.5% from 2005 levels, with the remaining increase calculated on the basis of per capita gross domestic product (GDP) (Euractiv August 2007).

The EU continues to be the largest market for renewables worldwide with new investment totalling US$49.7 billion in 2008, an increase of 2% on US$48.6m in 2007 and representing 42% of total new global renewables investments (UNEP, SEFI, 2009). Globally, 2008 was actually the first year that investment in renewable energy power generation capacity (approximately US$140 billion including large hydro) was more than investment in fossil-fuel based generation capacity (approximately US$110 billion). By 2008, installed wind power capacity in the EU27 was 65GW (representing 54% of world capacity) and grid-connected photovoltaic capacity had reached 9.5GW (73% of total world capacity) (REN21, 2009). Increasing the RES

capital base will help Europe tackle climate change, reduce its dependence on oil and other fossil fuels, improve energy security, and insure against the social and economic vulnerabilities of rising energy costs. Further costs and benefits of improving the renewable energy capital base are discussed below.

The European Commission's Impact Assessment (SEC (2006) 1719) outlines the investment needed to meet the 20% renewable target by 2020. In the absence of a full internalisation of external costs and benefits, most forms of renewable energy cost more than the conventional alternatives. The cumulative investment needed to increase the share from 6.5% in 2005 to 20% in 2020 is in the range of €600–670 billion (2005). This would have a net positive impact of 0.5% on GDP in 2020 compared to business-as-usual conditions and would increase employment by around 0.3%, which amounts to about 650,000 additional jobs. The jobs are created across the entire supply chain of the renewable industry including environmental monitoring, development design, commissioning and procurement, manufacturing, installation, project management, transport and delivery and operations and maintenance.

Studies have shown that renewables investments can enhance the productive capacity of the economy. Kammen et al. (2004) reviewed 13 EU and US studies and found that the renewable energy sector generates more jobs per megawatt of power installed, per unit of energy produced, and per dollar of investment, than the fossil fuel-based energy sector. According to research conducted by the University of California between 1970 and 2005, solar and wind provided stronger marginal returns to labour investments than fossil fuel technologies. They also found that renewable technologies' patents show greater returns to R&D investment relative to fossil fuels. Furthermore, increasing the use of renewable energy improves an economy's technical efficiency, i.e. how much more output can be produced with the given levels of inputs using current technology (Taichen and Hua, 2007). Case Study 8.3 provides details on the economic impacts of renewable energy infrastructure investments in Europe.

With rising energy prices, renewables investments can provide a strong and positive return on investment even after taking into account maintenance costs and any lost interest from the investment. An 11kw wind turbine costing around £42,000 (€49,000), producing 30Mwh to 40Mwh electricity per year, could pay for itself in 4-5years[10]. This would equate to a 20% return on investment in the first year itself.

An increase in the share of renewables in total EU energy production from 6.5% in 2005 to 20% in 2020 would lead to an annual saving in the range of 700–900 Mt of CO_2 emissions in 2020. Replacing fossil-fired electricity generation with renewable energy has favourable air quality effects, especially where the fuel replaced is coal.

8.3.2 Man-made Capital

At the EU level, policy on air, water and waste has a significant impact on investments and employment. A study was carried out analysing ten directives with related investments be-

[10] Assuming current Electricity Price: 13.95 p/unit and Value of ROC (£) per MW: £70. Source: http://www.britisheco.com/files/ecopagedownloads-filename-164.pdf
Note: Renewable energy markets are highly complex, being dependent on diverse and often changing government support mechanisms. Different renewable energy technologies have achieved various degrees of maturity, and the economic attractiveness of a given technology will vary depending on the markets in which it is deployed and the support it is given. Ernst & Young, Renewable Energy Country Attractiveness Indices, Q3 2007, p. 12.

tween 1990 and 2010 (EC, 2000). The ten Directives together account for €40 billion (0.5% of EU-15 GDP or €110 per capita) worth of capital expenditure per annum. Total capital investments of €260 billion between 1990 and 2010 were estimated and resulted in associated operating costs of €15 billion per year at the height of implementation. The Urban Waste Water Treatment Directive was responsible for high capital expenditures in most Member States (EC, 2000), accounting for nearly 63% of total capital expenditure.

These capital expenditures are estimated to provide half a million job opportunities per annum – equivalent to 3% of Europe's unemployed.

According to Ernst and Young (2006), the capital expenditure of the EU eco-industry was around €58 billion in 2004, making up 0.6% GDP for the EU-25. In general, eco-industries require both capital intensive equipment and a skilled workforce to develop, manufacture and operate advanced technologies. The ratio of operating expenditures to capital expenditures differs considerably based on the labour or capital intensity of a sector.

Waste management imposes growing costs on the EU as economic growth continues to increase resource use, while standards of waste management increase. Investments in capacity for waste recycling and recovery deliver important economic benefits for the EU, which include:

- Avoiding the cost of extraction of primary raw materials by recovering valuable metals such as iron, steel, copper and aluminium;
- Avoiding the cost of landfill and incineration and reducing the need to invest in ever more landfill and incineration capacity;
- Saving energy by reducing the need to extract and process virgin raw materials to manufacture new products;
- Reducing production costs as a result of mechanical recycling;
- Increasing total factor productivity;
- Reducing dependency on imports of raw materials as world demand and prices for raw materials rise;
- Reducing exports of waste (hence saving costs and enhancing the balance of trade);
- Stimulating the development of and investment in greener technologies; and
- Creating direct and indirect jobs.

It is not possible easily to quantify all the benefits identified above. However, some estimates of employment and economic benefits for resource and energy saving are given in Box 8.1 and discussed below.

At present, the waste management and recycling sector has a turnover of €24 billion with over 60,000 companies in the EU, 69% of which are small and 28% are medium sized. Extrapolation of published figures (CECOP, 2000)[11] suggests that waste recycling provides half a million to 1 million jobs in EU-25. The ferrous and non-ferrous metals recovery and recycling sector in EU-25 (excluding steelworks, smelters, refiners and foundries) comprises over 60,000 enterprises, and half a million people are employed in this sector across the EU-25.

[11] CECOP gives some estimates of the number of jobs in the sector: 250 000 in Germany, 14 000 in Belgium and 6 000 in France. The extrapolation to EU-15 is consistent with information provided by the recycling sector.

Although clearly very large, it is difficult to quantify the potential of waste prevention to reduce resource use and the associated environmental impact because the benefits of waste prevention concern the whole life cycle of resources and would depend on the type of resource saved. A German study estimated the value of raw-material and energy-savings from secondary raw materials produced from recycling in Germany to be €3.7 billion per year (BMU, 2006). Another exploratory study estimates the potential environmental benefits of municipal waste prevention in the range of €258– €380 per tonne of municipal waste prevented (EC RIVM, 2000).

Recycling aluminium is 95% more efficient than producing primary aluminium from raw ore and significantly reduces air and water pollution. Recycling aluminium saves 95% of the energy necessary to mine bauxite ore and extract alumina. Recycling one tonne of aluminium saves the equivalent in energy of 8,900 litres of gasoline (Chiras, 2006). The amount of materials that the recycling industry provides to manufacturing industry is increasing. The statistics show that at least 50% of the paper and steel, 43% of the glass and 40% of the non-ferrous metal produced in the EU are currently derived from recycled materials. Almost 100 million tonnes of ferrous metal scrap with a value of between €15 billion and €20 billion is consumed in the EU25 each year. International trade in recycled materials is rising and the EU is a world market leader in waste and recycling technologies, with a 50% market share.

Box 8.2: The Economic benefits of increasing waste recycling capacity

Energy saving in manufacturing new products- Aluminium recycling- USA

Alcoa is a major company in the production and management of primary aluminium, fabricated aluminium and alumina. In 2007, the company invested US$22 million on a project at its Tennessee operation to help increase recycling capacity, using state-of-the-art environmental and fuel efficiency technologies. It is estimated that the implementation of this project will increase used beverage can molten output capacity by nearly 50%. As recycling aluminium requires only 5% of the energy and produces only 5% of the CO_2 emission, the project will save 95% of the energy and CO_2 emission in making new cans.

Source: http://www.businesswire.com/news/alcoa/20071206005168/en

Recovering materials - Morrison supermarket, UK

The WRAP Aggregates Programme, funded by the UK Department for Environment, Food and Rural Affairs, was involved in selecting recycled materials from a local supplier to provide materials for the construction site at the Morrison supermarket, Girlington, UK in 2000. The material was sourced from a local Tarmac Recycling Ltd facility, resulting in a significant reduction in haulage cost. The recovered material was priced at £5.15 per tonne, of which £1.20 per tonne was haulage cost. This was £2.60 per tonne below the price of equivalent primary product. Approximately 25,000 tonnes of recycled material were supplied leading to a total saving of £65,000 for the whole project.

Source: http://www.aggregain.org.uk/case_studies/2663_use_of_recy.html

Reduction in the cost of waste processing- Wongpanit Co. Ltd., Thailand

Wongpanit Co. Ltd, based in Phtsanulok province in Thailand, purchases used articles for recycling. The products are then separated into different categories to be sold to recycling plants. The recycling capacity was increased from 1 tonne of waste per day in 1974, to 100 tonnes per day in 2003. The increased recycling capacity reduced the cost of waste treatment in the Phtsanulok Province by about US$9 million per year.

Source: http://www.apfed.net/ki/database/doc/RISPO_GP023.pdf

Over time, investments in pollution control, resource and waste management (both end-of-pipe and integrated systems) have led to increased resource efficiency and other benefits. This has contributed to increased total factor productivity by minimising resource inputs, increasing production efficiency and recycling waste materials. For example, the EU15 water supply sector (*NACE 41*) recorded apparent labour productivity of €83,700 per person employed in 2001, well above the manufacturing average of €51,200.

8.3.3 Natural capital

Natural capital provides ecosystem services which are not fully 'captured' in commercial markets or adequately quantified in terms comparable with economic services and manufactured capital. Some ecosystem services, such as provisioning services (production of food, fibre and fuel) and tourism, have a direct market value and can be readily quantified in economic terms. On the other hand vital environmental regulating services such as flood protection, carbon storage and water purification can only be valued indirectly by comparing the cost of man-made interventions performing the same service. Other services – such as open access recreation and certain cultural and aesthetic benefits have no market, though economic tools such as Revealed Preference Methods (Replacement / Avoided Cost, Travel Cost, Hedonic Pricing), Stated Preference Methods (Contingent Valuation and Choice Modelling) and Benefits Transfer can be used to estimate their value. Table 8.1 gives estimates of the value of a range of ecosystem-related services.

The EU has been legislating on protecting and enhancing its natural capital base since the 1970s. More recently, the Commission is tackling biodiversity loss at home, by pressing ahead with the implementation of the Biodiversity Action Plan, extension of the Natura 2000 network of protected areas (Case Study 8.4), and internationally, by integrating sustainability concerns into its international agreements. In response to the request of G8+5 Environment Ministers in Potsdam, Germany, the Commission and Germany launched an international study of the economic value of biodiversity in 2007. The study 'The Economics of Ecosystems & Biodiversity (TEEB)' evaluates the costs of biodiversity loss and the associated decline in natural capital and its services worldwide, and compares them with the costs of effective conservation and sustainable use. It is intended that this will sharpen awareness of the value of biodiversity and ecosystem services and facilitate the development of cost-effective policy responses.

Studies from the first phase of TEEB estimated the cost of biodiversity loss and decline in land based natural capital at around €50 billion per year, a loss which increases cumulatively in every subsequent year. Taking 2000 as the baseline (or point for comparison), by 2010, the value of services lost annually grows to €545 billion compared to 2000, for land based ecosystems alone. This is just under 1% of world GDP in 2010. A failure to halt current rates of

global biodiversity loss will result in a global loss of GDP of 7% by 2050 (Braat and ten Brink, 2008). These losses are an underestimate as they only include losses from land based ecosystems and do not include significant ecosystem losses from coral reefs, fisheries, wetlands, and invasive aliens.

Compared to these losses, the cost of biodiversity conservation is relatively low. The cost of implementing the Natura 2000 network of protected sites, which account for 20% of the EU25 territory, has been estimated at €6.1 billion annually (European Commission 2004). These costs include management, restoration and infrastructure (including for recreation and education).

The TEEB report for policymakers (TEEB, 2009) provides numerous examples of the value of biodiversity conservation and its benefits to people and economies, indicating that, when the full benefits of ecosystem services to the economy and society are taken into account, these normally significantly outweigh the costs of conservation.

Some examples of the economic benefit of ecosystem services are summarised in Table 8.1 and Case Study 8.4.

Table 8.1: Examples of Economic Benefits Arising from Ecosystem Services

TOURISM		
Example	**Estimated value and/or potential/incurred loss**	**Reference**
Reintroduction of sea eagles, UK	Revenue from sea eagle related tourism €2.13 -2.48 million / year	Dickie I, Hughes, J., Esteban, A. (2006) *Watched like never before – the local economic benefits of spectacular bird species*
Tourism in Muritz National Park, DE	Revenue from the tourism €12 million/ year, supporting ~ 628 jobs	Job *et al*. (2005). *Ökonomische Effekte von Großschutzgebieten*
Whale watching, Scotland	Revenue from whale watching tourism ~ €11.7 million/ year; ~12% of total tourism income	Warburton *et al* (2001) *Whale watching in West Scotland*
RIVER / FLOODPLAIN ECOSYSTEMS		
Example	**Estimated value and/or potential/occurred loss**	**Reference**
Elbe river, DE	Value of nitrates pollution reduction by restoring floodplains €585/ hectare; Potential total value of restoration (water quality & species conservation) €162 – 278 million / year	Meyerhoff, J., Dehnhardt, A. (2004) *The restoration of floodplains along the river Elbe*.
River Bassee floodplain, FR	Value of flood control services €91.5 – 304.9 million/ year	Agence de L'eau Seine Normandie, Ministry of Ecology and Sustainable Development.
Saltmarshes in Scotland	Input of saltmarsh to the shellfish industry a marginal value of €1087/ hectare / year	Coclough et al. (2003) *The potential for fisheries enhancement associated with managed realignment*.

Inland fisheries, UK	Total value of inland fisheries in England and Wales €4,854 million	Murray, M. and Simcox, H. (2003) *Use of wild living resources in the United Kingdom: a review.*
FOREST ECOSYSTEMS		
Example	**Estimated value and/or potential/occurred loss**	**Reference**
Value of trees in NY city, US	NY City's street trees provide benefit ~ US$122 million / year US$5.60 benefits / US$1 dollar spent on trees	NY city Park Department (2007) (http://www.env-econ.net/2007/04/measuring_the_v.html)
Natural forests in Bavaria, DE	Value of provision of good quality water €500 million / year	Natur ist Mehr-Wert, Ökonomische Argumente zum Schutz der Natur. BfN Skripten 154 (2005)
Woodlands, UK	Total value of environmental and social services €42,924 million	Willis et al. (2003) *The Social and Environmental Benefits of Forests in Great Britain*
Forest ecosystems, FI	Value of forest ecosystem services €2,690 million/ year (period 1995 – 2000)	Matero & Saastamoinen (2007) *In search of marginal environmental valuations — ecosystem services in Finnish forest accounting.* Ecological Economics.

Source: Birdlife (2007) Wellbeing through wildlife in the EU, and other sources

As well as the values summarised in Table 8.1, a number of GDP-related benefits are derived from ecosystem services (see Table 8.2)

8.3.4 Human capital

Environmental policies such as the EU Air Quality Directive can enhance the human capital base by improving health and quality of life. The human health damage that air pollution causes is estimated to cost the European economy between €427 and €790 billion per year, through increased mortality, hospital admissions and medical costs (Amann et. al, 2005). In the most polluted areas, the average life expectancy may be reduced by as much as two years due to air pollution. An estimated 350,000 deaths and the loss of an estimated 2.47 million life years[12] each year can be linked to high levels of PM2.5[13]. The cost of this damage to human health is estimated at €189- €609 billion per annum in 2020. Europe's New Air Quality Directive objective is an annual PM 2.5 target value of 25 micrograms/m^3, to be attained where possible by 2010, and a limit value set at the same level, to be attained across the EU by 2015.

[12] Disability Adjusted Life Years (DALYs) The sum of years of potential life lost due to premature mortality and the years of productive life lost due to disability. World Health Organisation (2009) http://www.who.int/mental_health/management/depression/daly/en/

[13] Dust particles with a diameter of less than 2.5 micrometers (PM 2.5) are small enough to be inhaled deeply in the lungs, and are linked to lung-related illnesses including asthma, emphysema and bronchitis.

The Thematic Strategy on Air Pollution[14] under the sixth Environmental Action Programme (6th EAP)[15] set specific interim objectives for reducing air pollution impacts by 2020. Achievement of the strategy goals would save EU healthcare systems between €42 and €135 billion per year[16] or 0.3% to 1.0% of EU25 GDP in 2020. Additionally, estimated annual deaths linked to PM 2.5 emissions would be reduced by around 63,000 in 2020, compared with the business as usual scenario. Lower income groups are expected to benefit more as they are generally exposed to higher levels of air pollution than those in higher income groups.

Studies have shown that improvements in health are positively related to productivity. Studies by Rivera and Currais (1999*a*, 1999*b*) and Knowles and Owen (1995, 1997) suggest that between 21 and 47.5% of GDP growth per worker (working-age person) over the last 25 to 30 years can be explained by improvements in the health of populations (defined as health-care expenditures and life expectancy) for OECD countries. Bloom et al. (2001) also found a significant relationship between health and GDP growth. Each extra year of life expectancy is estimated to increase a country's GDP by 4%.

8.4 Scale of economic benefits to date and assessment of further potential

The case studies and examples above show that environmental policy, by enhancing or adding to the capital base, has a number of economic benefits. Some of the main benefits – in terms of the EU's output - are given in Table 8.2.

Table 8.2: Impact of environment related investment and capital expenditure (capex) on output

Investment/Capital expenditure	Current impacts on output	Future impacts on output	Remarks
Renewables Infrastructure[a]	GVA €58 billion in 2005	2020 RES target would lead to total gross value added in the RES sector of about 1.1% of GDP	About 55% of value added occurs directly in the RES sector and 45% in other sectors due to the purchase of goods and services.
Man-made capital (10 EC Directives)[d]	Total Capital Investments of €260 billion between 1990 and 2010		
Man-made capital (Pollution management)[e]	€36.5 billion capex in 2004	N/a	

[14] Rapid (2007) Questions and Answers on the new directive on ambient air quality and cleaner air for Europe http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/07/571&format=HTML&aged=1&language=EN&guiLanguage=en#fn4

[15] Adopted jointly with the proposal for the new ambient air quality Directive (IP/05/1170) by the Commission in September 2005.

[16] There are two distinct ways to calculate the damage to the economy caused by premature mortality. The lower figure is based on the median of the value of a life year lost (VOLY) while the higher figure is based on the mean value of a statistical life (VSL).

Investment/Capital expenditure	Current impacts on output	Future impacts on output	Remarks
Natural Capital (Resource management)[e]	€21.5 billion capex in 2004	N/a	
Natural Capital (Environment related tourism)[f]	€418 million in 2000	N/a	

Sources: [a] DG Energy and Transport, The impact of renewable energy policy on economic growth and employment in the EU, April 2009
[b] WWF (2009).
[c] WWF (2009).
[d] EC (2000)
[e] Ernst and Young (2006), Study on Eco-industry, its size, employment, perspectives and barriers to growth in an enlarged EU. Final report to EC, August 2006
[f] GHK (2007)

8.5 Beneficiaries and timescale

Creating new capital or enhancing the existing capital base will benefit society as a whole, with positive impacts on households, businesses and governments. There will be particular impacts on the sectors most affected, including energy, transport, water, agriculture and forestry. The direct impact on jobs and output of creating new capital or enhancing existing capital will take place during the implementation of policy measures. However, the capital base will also provide a continued flow of future incomes, benefits and services as shown in Tables 8.1 and 8.2 above.

CASE STUDY 8.1: KFW CO2 REDUCTION PROGRAMME AND LOANS, GERMANY

Background

In Germany, efforts to promote sustainable building through market-led measures and price signals had an effect on energy saving behaviour, but were not adequate to attract investments and improve the energy efficiency of the existing housing stock. Germany's National Climate Protection Programme (NCPP) in 2000 identified renovation of existing buildings as a priority task. Preliminary work for NCPP, based on the most recent energy projection, policies and measures implemented in 1998-2000, found that under business as usual conditions the national target of a reduction of CO_2-emissions by 25% until 2005 would be missed by about 5 to 7% (or 50 to 70 Mt of CO_2). Consequently, additional policies were identified in order to meet the target, among which private households and buildings should be responsible for additional emission reductions of 18 to 25 Mt of CO_2.

Description of intervention

The climate protection programme for existing buildings started in January 2001 offering loans at 3% points below market interest rates for initially four different combination packages of emission reduction measures with a minimum CO_2-reduction of 40 kg per m^2 per year. Applicants eligible for the loan received grants equal to 100% of the costs of improvement up to a maximum of €250 per m^2. Later the program was expanded to a fifth package allowing for the exchange of heating systems alone and a support for low energy renovations with improved conditions. Investments of €1 billion per year were required for the implementation of the programme for existing buildings and providing grants at a reduced rate of interest. For this purpose, €200 million per year was earmarked by the government to subsidise the reduced rate of interest.

Description of economic benefits

The programme delivered significant energy cost savings. There was also a suggestion that the programme in the future could be structured in a way that energy cost savings could be directly used to repay the loan. Building owners were required to prepare a fairly precise assessment of the energy performance of a building for a loan application. This has had a noticeable impact on the awareness of building owners regarding the energy performance and energy costs of their property. Programme investments led to the creation of new jobs and services. The economic impact of the programme was especially relevant for SMEs, as the majority of jobs created were in labour-intensive small and medium-sized construction firms. Improvements of the existing housing stock also had positive impacts on the value of properties in the local areas.

Description of environmental benefits

The CO_2 reduction programme of the German Kreditanstalt für Wiederaufbau (KfW), combined with the climate protection programme for existing buildings, contributed a 5-7 Mt CO_2 reduction per year to 2005. The subsidies alone led to a CO_2 reduction of 2-2.5 Mt by 2005, less than half the CO_2 reduction anticipated in the National Climate Protection Programme.

Quantification of contribution to economic outcomes

The programme has had a major impact on jobs in the construction sector, with 13,000 to 23,000 full-time jobs generated for energy efficiency improvements and a further 12,300 jobs for new building improvements each year, based on the budgets available for 2001.

Effect on public finances

An allocation of loans of around €3.2 billion enabled 166,600 dwellings to be renovated under the programme. The total budget was subsequently increased from €1 billion per year to €1.4 billion per year, of which €800 million was allocated for preferential loans.

Potential for wider application in EU, and possible means of measuring economic benefits

The European Insulation Manufacturers Association suggests that similar preferential loans could be combined with the energy certificates of the Directive on Energy Performance of Buildings (EPBD). For example, the certificate levels A/B/C/D/E/F (similar to energy efficiency labelling for household appliances) could be used as a prerequisite for the preferential loan. The energy cost savings could be directly used to repay the loan (Eurima, 2006). The buildings improvements could be specified as bands (e.g., from C to D). The label is suggested as an indicator instead of CO_2 reduction per floor surface area (m^2).

Further information

http://www.kfw-foerderbank.de/EN_Home/Programmes_for_residential_buildings/Energy-Efficient_Rehabilitation.jsp

Eurima (2006), Better Buildings through Energy Efficiency: A Roadmap for Europe, Fact Sheets.

CASE STUDY 8.2: ECONOMIC IMPACTS OF RENEWABLE ENERGY INFRASTRUCTURE INVESTMENTS

Background

The need to mitigate climate change and improve energy security in the EU, by reducing dependency on imported fossil fuels and diversifying traditional thermal energy mixes, are the two strongest market drivers for promoting investment in renewable energy sources (RES), now enshrined in an EU wide 20% renewable electricity target by 2020. The combination of public policy targets, economic instruments and financial support for the development of innovative renewable technologies have all helped to stimulate large-scale investment in RES across the EU, leading to large level of new jobs and a significant contribution to GDP – key elements of the Lisbon agenda.

Description of intervention

In December 2008 the EU Renewable Energy Directive was adopted, bringing in a binding target of 20% of renewable energy from final energy consumption by 2020. However, for a long time, public policy across the EU has focused on providing the right market conditions for RES investment. A mixture of long-term renewable policy targets combined with economic measures such as feed-in tariffs, mandatory renewable energy targets (e.g. renewables obligations on electricity generators forcing many either to make capital investments or else pay fines) and tax incentives have been used to stimulate investment and deployment. In addition, grant funding for basic and applied R&D as well as for pre-commercial demonstration has provided large levels of financial support to developers of innovative RES technologies.

Installed capacity in the EU27 to date has been impressive. By 2008, installed wind power capacity was 65GW (representing 54% of world capacity) and grid-connected photovoltaic capacity had reached 9.5GW (73% of total world capacity)[17]. The EU continues to be the largest market for renewables worldwide with new investment totalling US$49.7 billion in 2008[18], an increase of 2% on US$48.6m in 2007 and representing 42% of total new global renewables investments. The spectacular rise in renewable energy investments in the EU is illustrated by cumulative annual growth rates (CAGR) of 37% between 2006 and 2008. In 2002, investment totalled just US$3.2 billion.

Despite its well established and relatively mature markets for investments in wind, solar and bio energy, there remains massive future potential for the RES market growth in the EU. For example, achieving the EU's binding target of generating 20% of primary energy from RES by 2020 will require an accelerated pace of investment, forecast to be worth €443 billion in renewable energy over the period 2001-2020 including €156 billion for wind, €89 for biomass and €76 billion for photo-voltaics[19].

Description of economic benefits

The deployment of RES in the EU provides a wide range of benefits including:

[17] REN21 global status report, 2009 update, May 2009
[18] UNEP, SEFI, New Energy Finance, Global Trends in Sustainable Energy Investment, 2009
[19] Renewable Energy in Europe – Building markets and capacity, European Renewable Energy Council, 2004

- Jobs (both direct and direct) and new employment opportunities as new technologies reach market.
- Comparative and first-mover advantage in trade and markets – for example, the rapidly growing number of wave and tidal power firms locating in the UK to take advantage of generous incentives may help that member state to capitalise on worldwide markets; the Danish wind industry is now the world leader following over €300m in subsidies from the Danish government in the 1980s and 1990s.
- Supply chain impacts - growth in new products and services helps to create new business and provide opportunities for more established industries (e.g. construction) to diversify.
- Reduced vulnerability to imported hydrocarbons, particularly as fossil fuel prices are likely to rise in the long-term, therefore enhancing spend into other parts of the economy.
- Indirect economic benefits such as health benefits from reduced SO_2 and NO_x pollution.

Description of environmental benefits

RES investments will continue to play a significant role in mitigating climate change by helping to decarbonise energy production and supply, particularly with an EU target under the Second Strategic Energy Review to achieve a 60% renewable share of power generation by 2050. As innovations arise and improvements are made in the design and use of new materials, they should reduce the overall carbon impact of RES technologies – for example, less concrete used for offshore wind foundations; a switch from metals to organic composite materials; greater robustness of equipment to enhance equipment lifetime in harsh operational conditions such as wave/tidal power etc.

Quantification of contribution to economic outcomes

The total gross value added generated by the RES industry was €58 billion in 2005, equal to 0.58% of EU GDP. The RES sector employed roughly 1.4 million people in 2005, equal to 0.65% of the total EU workforce. About 55% of value added and employment occurs directly in the RES sector and 45% in other sectors due to the purchase of goods and services. Installed capacity has led to the avoidance of fuel imports and the ability to increase exports of key components to other global markets and supply chains.

The Commission has estimated, under its cost efficient reference option, that achieving simultaneously the EU's 20% renewable energy target and its 20% GHG reduction target will have a direct economic cost of 0.58% of EU GDP or €91bn in 2020. However, Fraunhofer et al. (2009) estimate that meeting the EU's 20% RES targets alone could deliver:

- Up to 2.8m jobs in the RES sector in 2020, including around 410,000 net additional jobs (using 2006 as a baseline year);
- 0.24% in additional GDP (generated mostly by capital investment and improved trade balance; less so by energy price increases);
- An increase in overall employment to 3.4m people in work by 2030, assuming deployment policies are accelerated and forecasts for exports remain optimistic.

The Fraunhofer Institute (2009) suggests "comparably low cost" biomass and onshore wind projects should continue to be promoted as these will help the EU to meet its near-term future RES production as well as employment and economic growth. However, the

market potential across Europe for new, higher cost pre-commercial renewable technologies like wave and tidal power and new deployment opportunities such as offshore wind and solar thermal electricity generation give the EU a considerable opportunity to lead the world in investment and deployment of leading-edge RES technologies. Over time this will enable a decline in capital costs from technology learning, which in turn will bolster the EU's export base, maintaining competitive advantage, increasing employment and GDP in the medium term.

Effect on public finances

Cumulative investments in RES infrastructure between 2006 and 2030 are estimated by Fraunhofer (2009) at between €900bn and €1,530bn, of which around two thirds of investments are made in the electricity sector. Whilst it is assumed that the bulk of this money will be met through the capital markets, European governments have spent billions of Euros in subsidies to date encouraging utilities and householders to adopt and deploy renewable technologies. Recently, the EU European Economic Recovery Plan, endorsed by Heads of State in December 2008, allocated €500m to offshore wind generation and grid connection[20] out of a total of €5 billion towards meetings it 2020 renewables and energy efficiency targets. The subsidies allocated by Germany and France are substantially higher.

Potential for wider application in EU, and possible means of measuring economic benefits

The European Commission acknowledges that achieving the EU 20% target by 2020 will be challenging, requiring significant initial economic investment[21] – after all, RES only accounted for 8.5% of final energy consumption in 2005. More radical public policy interventions such as increased subsidies and spending on R&D for RES will enable more rapid scale-up and deployment across Europe. This in turn will incentivise R&D institutes and firms (including those who wish to diversify into renewables) in the EU to further develop renewable technologies to capitalise on market opportunities. Furthermore, success at home will provide valuable routes into international RES supply chains. The wide geographic distribution of renewable resources and RES projects also provides opportunities for economically deprived rural areas to benefit from initial construction and local servicing contracts at remote renewable power sites. Such benefits could be quantified through analysis of: levels of new company formation by region; trade data; R&D spending; supply chain formation and regional support initiatives.

[20] HSBC, A Climate for Recovery: the colour of stimulus goes green, February 2009

[21] Impact Assessment, Package of Implementation measures for the EU's objectives on climate change and renewable energy for 2020, SEC(2008) 85

CASE STUDY 8.3: THE NATURA 2000 NETWORK

Background

Natura 2000 is a network of special nature sites across the EU, designated by Member States in accordance with the requirements of the Birds and Habitats Directives (implemented in 1979 and 1992 respectively). The network covers an area of 850,000 km^2, more than 20% of the EU land area, and comprises a variety of terrestrial, aquatic and marine habitats.

Description of intervention

Natura 2000 sites require not only protection but also active management in order to maximise their benefits to wildlife and people. A variety of actions are required including management planning, restoration of degraded sites, ongoing land management activities, visitor management and education work. This creates a demand for a variety of nature conservation related skills. The Commission has estimated that the annual cost of managing the network is around €6.1 billion annually, with the EU contributing to the costs of this through existing funding instruments such as the Structural Funds and Rural Development programme, to add to existing measures funded by MS and regions.

Description of economic benefits

Natura 2000 sites have been shown to support a variety of economic and social benefits:

- Site restoration and management activities support employment among land managers and contractors;
- Management payments help to diversify the incomes of farmers and landowners;
- Sites attract visitors, helping to support the rural tourism industry, often extending the tourism season;
- Many sites have exploited opportunities to market locally distinctive and environmentally beneficial produce, including food and timber products. Natura 2000 has helped to promote the marketing of “bear-friendly cheese” in France, Spain and Italy; heathland beer in Belgium, pasture-grown beef in Finland and mushroom-focused ecotourism in Navarra, Spain;
- Well managed sites deliver important ecosystem services, among other things helping to improve air quality and water management, enhance landscape and promote opportunities for healthy outdoor recreation. These ecosystem services are essential for human life and provide the conditions on which many economic activities depend.

No overall attempt has been made to date to value the benefits of implementing the network, and the available evidence is patchy. However, a study in Scotland (Jacobs, 2004) estimated that the benefits of maintaining the network to residents and visitors was £210 million (€235 million) per year, and outweighed the costs of management by 7 times.

Description of environmental benefits

Improved management of Natura 2000 sites is important for the conservation of wildlife in the EU, including a variety of scarce and threatened species and habitats. Well functioning natural systems also provide a range of important ecosystem services for people and the economy.

Quantification of contribution to economic outcomes

No estimate is available of the total economic impact of the network. However, BirdLife International estimates that 125,000 people are directly employed in nature conservation in the EU-15 alone, and asserts that ensuring that sites are adequately protected and managed offers the potential to increase this number. There are also numerous case study examples from particular sites. For example:

- The pond complex of Central-Limburg (Belgium) supports employment of between 65 and 85 full time jobs directly and indirectly;
- The Natura 2000 site of Lille Vildmose (Denmark) was estimated to support 68 direct jobs in 2002 with 167 expected in the following 5-10 years;
- The Salaca river, Latvia, supports 21 jobs directly, 11 indirectly, and generates further employment through tourism;
- Successful development of wildlife tourism in the Prespa wetlands, Greece, has created 50-60 new jobs and extended the season year-round.

Effect on public finances

The Commission has estimated that effective management of the Natura 2000 network requires overall annual expenditures of €6.1 billion across the EU, most of which needs to be met by the public sector (and co-financed through the EU budget). This cost estimate is currently being revised. No estimate is available of current expenditure; however a significant net increase is likely to be required to ensure that sites receive adequate levels of protection and management and deliver the full benefits intended for species and habitats.

Potential for wider application in EU, and possible means of measuring economic benefits

Natura 2000 is an EU-wide network, and has the potential to deliver significant economic benefits across the EU-27, including in some of the most remote rural areas with limited alternative economic opportunities.

Further information

http://ec.europa.eu/environment/nature/index_en.htm
BirdLife International (undated) Socio-economic benefits of protected sites
The EU Natura 2000 network. http://www.birdlife.org/eu/pdfs/natura_socio.pdf
IEEP (2009) Assessing Socio-Economic Benefits of Natura 2000. A methodological toolkit for practitioners. Draft report for European Commission. Unpublished

9. Environmental Policies and Economic Cohesion

9.1 Description and Background

There are substantial disparities in economic prosperity and performance between different regions of the EU, significantly weakening Europe's economic dynamism. These disparities are much greater as a result of Eastern enlargement, with two thirds of the population of the newer Member States living in regions with a GDP per head of less than half the EU average. European regional policy allocates more than a third of the EU budget to the reduction of these gaps in development, aiming to help regions lagging behind to catch up, to restructure declining industrial regions, diversify the economies of rural areas and revitalise declining neighbourhoods in the cities (ENEA, 2006b).

Environmental improvements play an important role in promoting economic and social cohesion, by delivering the types of economic outcomes identified in this report. In particular, environmental investments contribute to:

- Improved quality of life and regional image – enhancing the health of the workforce and hence improving productivity; making regions more attractive places to live, work, visit and invest; and offering opportunities for regional branding and marketing;
- Enhanced resource efficiency and risk prevention – reducing production costs and enhancing competitiveness, as well as reducing the damage costs and disruption caused by pollution;
- Innovation and the development of eco-industries – enhancing regional productivity by stimulating the growth of knowledge intensive, high value added and growth businesses, providing new opportunities for employment and skills development.

Conversely, a failure to invest in environmental improvements can reduce quality of life, exacerbate regional disadvantage, impose damage costs and expend resources in unproductive activities, thereby raising barriers to convergence. The rising cost of resources and energy will hit hardest on regions that do not integrate environmental issues in their development programmes (GHK et al, 2007; GRDP Partnership, 2007).

These arguments led the Regional Environmental Centre for Central and Eastern Europe (REC, 2008) to conclude that environmental projects, supported through cohesion policy, have a strong contribution to make to the Lisbon agenda to boost competiveness and employment. Similarly Nordregio (2009) concluded that focusing on environment-economy synergies offers opportunities for cohesion policy to strengthen links between the Lisbon and Gothenburg agendas, the challenge being to embed this 'win-win' approach across as many elements of Cohesion Policy as possible.

DG Regio (2008) recognises that, with EU support, sustainable development can be a major opportunity for European regions. The total support from the European budget under Structural and Cohesion Funds allocated to environmental programmes in 2007-13 has doubled since the 2000-2006 programming period, to around €100 billion.

> *Environmental investment is a source of economic growth, for example, in developing innovative clean technologies, fostering the efficient use of energy, promoting ecotourism, or simply by enhancing the attractiveness of the natural environment. New technologies using wind, solar and biomass for sustainable energy production, can give regions a new competitive edge. Even the fight against climate change can present new opportunities: by exploiting their natural assets and specific know-how, regions can improve their energy balance and strengthen their competitiveness.*
>
> Danuta Hübner, Commissioner for Regional Policy

The EU has embraced ambitious objectives in the fight against climate change – a 20% reduction in EU greenhouse gas emissions with a 20% share of renewable energies in EU energy consumption by 2020. With €48 billion targeted at measures aimed at achieving EU climate objectives and creating a low carbon economy, Cohesion Policy is making a considerable contribution to these goals. This includes €23 billion for railways, €6 billion for clean urban transport, €4.8 billion for renewable energies and €4.2 billion for energy efficiency[22].

High levels of environmental quality are often one of the greatest assets of peripheral regions with few alternative development opportunities. Structural and Cohesion Fund programmes in these areas often recognise this and seek to take advantage of the opportunities that the environment offers. These opportunities may relate to the protection and management of the environment and natural resources, and to their role in attracting tourism, inward investment and in-migration. Examples of more peripheral regions which have recognised the opportunities that the environment offers through cohesion policy are the EU's Northern Peripherary (Mijnhijmer, 2008), Cornwall, UK (Convergence Programme for Cornwall and the Isles of Scilly, 2007) and South Transdanubia, Hungary (DG Regio, 2007).

On the other hand, environmental activity can also play an important role in the regeneration of regions suffering from industrial decline. For example, a recent WWF report (WWF, 2009) found that wind energy development has helped revitalise regions such as north-western Denmark, Schleswig-Holstein in northern Germany, and Navarra in Spain.

The role of environmental enhancements in regional development is therefore clear and wide-ranging. Nevertheless, the explicit and intentional achievement of regional economic development benefits from environmental investment is often poorly articulated, with many plans focusing on legal compliance rather than wider development rationales (GHK et al., 2007).

9.2 Policy Instruments

The role of the environment in cohesion policy is complex and has evolved over the last 20 years.

In 1995 the Commission wrote a Communication *Cohesion policy and the environment*, stressing that "regional development and the environment are of complementary character". The Communication noted that:

> *Natural resources (water, air, soils, etc.) are of major environmental and socio-economic importance in that they are the basic support elements for man and ecosystems. The quality of the environment determines regional attractiveness and as such is a location factor for investment. Over-exploitation as well as degradation of the natural resource base can*

[22] http://europa.eu/rapid/pressReleasesAction.do?reference=IP/09/369&format=HTML

> *have severe consequences not just for the environment but for economic activity [...]. The environment is an important area of new employment. Besides the jobs generated by the construction and maintenance of environmentally-friendly infrastructures mentioned above, more and more attention is given to the employment potential offered by the so-called eco-business, where SMEs play an important role.*
>
> *Moreover environmental services including development and maintenance of the necessary infrastructure [...] are very labour intensive and thus contribute significantly to employment. The Commission's Communication on a "European Strategy for encouraging Local Development and Employment Initiatives" of June 1995, gives many examples of job creation potentialities in the environment sector [...]. The increased demand for "natural" agricultural products or "green" tourism opens new regional perspectives in rural areas. Furthermore, other economic activities relying on a "clean" environment (e.g. technological research) can contribute considerably to the diversification of revenues and thus to the maintenance of the rural population.*

The Communication then went on to specify different areas of environmental activity through which cohesion policy could stimulate regional economic development.

These links have subsequently been strengthened through successive programmes of the Structural and Cohesion Funds. Environmental sustainability was one of two “horizontal” themes in the 2000 to 2006 Structural Funds programmes, in order to ensure integration of environmental concerns and to promote sustainable development. At the same time, the ability of environmental investments to meet economic and social objectives has provided opportunities for “vertical” integration of the environment into Cohesion Policy, allowing aspects of programmes to focus on environmental activity. Indeed, environmental investments have a key role in the accession process and are important in meeting the environmental acquis of the new Member States.

In 2007-13, the focus of cohesion policy is on the Lisbon goals of growth, competitiveness, innovation and employment, with the majority of funds earmarked to these priorities. Sustainable development continues to be one of the two horizontal principles. Cohesion policy has been simplified and decentralised, with the number of funding instruments reduced to three (the European Regional Development Fund (ERDF), the Cohesion Fund (CF), and the European Social Fund (ESF)). These funds support the three principal objectives of Convergence, Competitiveness and Employment, and Territorial Co-operation.

The Community Strategic Guidelines 2007-2013 (European Commission, 2005) set out the framework for Cohesion Policy for the 2007-2013 programme cycle. The Guidelines are entitled *Cohesion Policy in Support of Growth and Jobs*, and emphasise these elements of the Lisbon Strategy. The Guidelines specify three overall priorities for programmes financed through Cohesion Policy:

a. Improving the attractiveness of Member States, regions and cities by improving accessibility, ensuring adequate quality and level of services, and preserving their environmental potential

b. Encouraging innovation, entrepreneurship and the growth of the knowledge economy by research and innovation capacities, including new information and communication technologies.

c. Creating more and better jobs by attracting more people into employment or entrepreneurial activity, improving adaptability of workers and enterprises and increasing investment in human capital.

Under the first priority, the Guidelines refer to the expansion and improvement of transport infrastructures, for which "promoting environmentally sustainable transport networks" is a guideline for action, with public transport, mobility plans, and the promotion of "soft" traffic (cycle, pedestrian) emphasised. Developing short-sea shipping as an alternative to long-distance road and rail transport is also noted as being of importance.

Guidelines also call for strengthening the synergies between environmental protection and growth, through actions to:

- Address the significant needs for investment in infrastructure (particularly in convergence regions) to comply with environmental legislation in water, waste, air, nature and species protection.
- Promote land-use planning to ensure attractive conditions exist for businesses and skilled staff, such as through reducing urban sprawl and the rehabilitation of the natural environment.
- Promote investments which contribute to the EU Kyoto commitments.
- Undertake risk prevention measures through improved management of natural resources.

These guidelines recognise that environmental investments have economic benefits. Three key areas are noted: decreased external environmental costs; stimulation of innovation, and job creation. The provision of environmental services (e.g. waste and wastewater treatment), natural resource management, land decontamination and protection against environmental risks, are all identified as being of priority, and emphasis is put on tackling environmental pollution at its sources. The guidelines further state that development strategies should be based on a prior evaluation of needs and specific issues faced by regions, where possible using appropriate indicators, and include efforts to promote the internalisation of external environmental costs, supporting the setting up and development of market based instruments. They also call for improvements in energy efficiency and renewable energies.

The guidelines explicitly refer to the Lisbon objective of ensuring that by 2010, 12% of energy is generated from renewable sources. Under their second priority, the Guidelines call for greater eco-innovation, which includes promotion of the use of environmental management systems.

Each of the three funds is capable of supporting environmental investments. According to DG Regio (2008), total support from the European budget under Structural and Cohesion Funds allocated to environmental programmes in 2007-13 has doubled since the previous period, to around €100 billion. Half of this amount will be devoted to infrastructure investments related to water and waste treatment, renewal of contaminated sites, pollution reduction, and support for nature protection and risk prevention. The other half will go to investments with an environmental impact on areas such as transport and energy systems, eco-innovation, urban and rural regeneration, environmental management for businesses and ecotourism.

9.3 Review of Evidence

A number of studies examine the links between cohesion policy, the environment and economic development. Many of these focus on the integration of environmental sustainability concerns to ensure that regional policy does not damage the environment. Other studies (e.g. Milieu Consortium, 2008) examine the role of cohesion policy in meeting environmental investment needs. Evidence of the economic outcomes delivered by environment-related activity through cohesion policy is more limited, but nevertheless growing.

The available evidence takes different forms:

- Case studies of the economic impacts of environmental investments in different regions. For example, the Greening Regional Development Policy (GRDP) Partnership (2006, 2007, Box 9.2) has provided case studies of the impact of environmental investments in different EU regions, while Inforegio – the EU Regional Policy website – provides case studies of cohesion projects under different themes, including environment (Box 9.1).
- Evaluations of the effects of environment-related activity in particular cohesion programmes. For example, the impact of environmental business support through the South West England Objective 1 and 2 programmes has been assessed (Ekos, 2007)
- Studies of the overall economic impact of meeting environmental priorities in cohesion areas. This type of evidence is more limited than that for individual case studies. However, GHK et al (2007) provided a Strategic Evaluation on Environment and Risk Prevention under Structural and Cohesion Funds for the period 2007-2013, which included modelling the economic impacts of the package of environmental investments required (Case Study 9.1). The case study demonstrates that, collectively, such investments are capable of having a substantial impact on regional economic development, enhancing GDP by between 1-2% in most of the member states concerned.

Because of the wide variety of linkages between the economy and the environment, evidence demonstrates that environment related activity provides opportunities in a wide range of regions and sub-regions. Evidence and examples suggest that environmental activity has a particularly strong role to play in cohesion policy through:

- Tackling the effects of industrial decline and dereliction;
- Provision of new opportunities in peripheral regions and under-developed rural areas;
- Promoting economic diversification;
- Tackling poor environmental quality and unsustainable practices that are a barrier to development;
- Provision of infrastructure for economic modernisation and competitiveness;
- Stimulating skills and innovation to provide new high value growth opportunities in the knowledge economy.

Table 9.1 illustrates the particular role that the environment plays in addressing the needs of cohesion regions, with reference to the examples in the case studies and boxes.

Table 9.1: The role of the environment in Cohesion – examples from the case studies and boxes

	Tackling industrial decline and dereliction	Providing opportunities in peripheral and underdeveloped areas	Economic Diversification	Providing infrastructure for economic modernisation	Tackling poor environmental quality	Providing new high value growth opportunities
CENER, Spain (Box 9.1)			√	√		√
Contaminated land in Basque Country (Box 9.1)	√				√	
Waste management in Ramnic Valcaea (Box 9.1)				√	√	
BioFix, Estonia (Box 9.1)						√
Ribeira Grande Geothermal Power Plant, Azores (Box 9.1)		√	√	√		√
ReMaDe Kernow (Box 9.2)		√	√			√
Envision, UK (Box 9.2)		√				√
Environment Park, Piemonte (Box 9.2)	√				√	√
Water Management in Poland (Box 9.3)				√	√	
Working Woodlands, UK (Box 9.3)		√	√			√
2007/13 Cohesion Programme (Case Study 9.1)	√	√	√	√	√	√
SW England Objective 2 Programme (Case Study 9.2)		√	√			√

9.4 Examples and Case Studies

Examples of the economic outcomes generated by environmental projects financed by the Structural and Cohesion Funds are given in Boxes 9.1 - 9.3, and in Case Studies 9.1 and 9.2.

Box 9.1: EU Regional Funding and the Environment – Examples from InfoRegio

CENER – National Renewable Energies Centre, Spain

CENER, the National Renewable Energies Centre, was built with the support of ERDF funding, in the Navarre Innovation Park in the new "ecocity" of Sarriguren, a few miles from Pamplona. The building employs bioclimatic architecture designed to minimise energy consumption and employs ultra-modern equipment including laboratories for the characterisation of thermal and photovoltaic solar panels, biomass analysis and testing, wind generator certification and an energy accumulation laboratory, enabling it to conduct R&D related to renewable energies in five specific fields: wind power; solar energy (thermal and photovoltaic); biomass energy; bioclimatic architecture; electronics and power electronics and the use of hydrogen for energy storage. Employment at the Centre increased to 120 by April 2006, most of whom are researchers, with a significant impact on the local economy. CENER has already acquired a solid reputation both nationally and internationally, with contracts in five continents. In February 2006 the government of Navarre and the department of Education and Science signed an agreement to invest €48.35 million on major CENER projects, including the creation of a unique wind technologies development unit at Sangüesa, research into crystalline materials which could provide lower-cost alternatives to silicon in photovoltaic equipment and the development of thermal solar panels for solar refrigeration. The project cost a total of €15.6 million and received €2.8m in ERDF funding.

Treatment of Contaminated Land in the Basque Country
The Cohesion Fund has played a key role in the treatment of numerous sites in the Basque Country contaminated by the pesticide Lindane. Production of the pesticide in the region had left 33 sites with 560,000 m3 of contaminated soil, causing damage to air and water, threatening public health and presenting a major barrier to economic development. The clean-up operation, begun in 1995, involved the removal and isolation of contaminated soil and the chemical treatment and recycling of waste. The project had a significant economic impact, employing around 200 people in construction of the isolation zone and creating 20 jobs directly and more than 100 indirectly in the chemical treatment plant; these jobs were temporary in nature but greater economic benefits are expected in the longer term through the regeneration of the area. The €45.6m project received €35.5m of EU funding.

Integrated Waste Management in Ramnicu Valcea, Romania
The Instrument for Structural Policies for Pre-Accession (ISPA) co-financed the installation of a new waste treatment system at Ramnicu Valcea. The town of 120,000 is situated in an area important for both industry and tourism, but its environmental quality was threatened by inadequate and unsustainable systems of waste management. The €20.0 million project, receiving €11.0 million in EU funding, provided an integrated waste management system including collection, segregation, recycling, composting and public education. The project created 68 full time jobs and reduced the risks of water, air and soil pollution, and their consequent risks to public health. It helped the town to win various international awards for environmental management.

BioFix – Wastewater Treatment in Estonia
An ERDF funded R&D programme in Estonia helped, Fixtec, a small environmental technology company, to develop BioFix, a small scale organic wastewater purifier for homes and hotels, aimed primarily at the Finnish market. BioFix has been sold to several hundred Finnish companies and is expected to reach sales of €1 million in 2006. The EU met one third of the total project cost of €43,000.

Ribeira Grande Geothermal Power Plant, Azores, Portugal
Two geothermal power plants, built with ERDF assistance, have demonstrated that volcanoes are a source of endogenous energy for the Azores, capable of providing renewable energy in a

remote and economically disadvantaged location and reducing reliance on high cost imported energy. By 2007, geothermics was expected to deliver 161 GHw, 38% of the archipelago's electricity supplies. As a zero emission source of energy, this contributes to maintaining the high environmental quality of the island. The project created 200 temporary construction jobs and 25 ongoing operational jobs, and there are plans for a regional skills centre. The project received ERDF funding of €19.6 million, 50% of the total project cost.

Source: European Commission (2006) Regional Policy – InfoRegio factsheets

Box 9.2: Greening Regional Development Policy - Examples from the GRDP Partnership

ReMaDe Kernow, United Kingdom

ReMaDe Kernow is a not for profit organisation working with businesses to find new uses and markets for waste materials. The project has received £251,000 of European Regional Development Fund (ERDF) funding under the Cornwall Objective 1 programme, helping it to reduce business costs, enhance competitiveness, develop new niche markets, improve management of waste and create jobs and wealth. Since 2001 the project has diverted 20,000 tonnes of waste from landfill, created over 30 full time jobs, helped 15 small businesses within the recycling sector, and generated £1.4 million of business turnover within Cornwall.

Envision, United Kingdom

Envision is a business support mechanism in the South West region of the United Kingdom which provides businesses with dedicated tailored support and an expert "one-stop" shop at a subsidised rate through European funding. Envision offers business the opportunity to save costs and improve competitiveness through real increased environmental performance and credibility, saving 255 businesses more than £2 million over three years, with these cost savings projected to increase further in future. Businesses have typically saved 10% of costs on energy, water and reduced waste. Businesses benefiting include:

- Colour Works, which reduced waste by 90% and expanded its customer base
- James Townsend & Son, which saved £85,320 through waste minimisation.
- Kitley House Hotel, which saved £13,000 annually through energy, waste and water savings, helping it to grow occupancy to 80%.
- Tideford Organics, which has become more energy and resource efficient, making it more competitive and enhancing its environmental credentials.

Environment Park, Piemonte Region, Italy

The Environment Park is a Science and Technology Park (STP) that combines environment and business and is part of a project involving four other STPs in the Piemonte Region. The project is a cluster in which small and medium-sized enterprises, research bodies and start-up companies can share services, join in new initiatives and develop new projects. Its facilities were planned according to the principles of 'green architecture' and made intensive use of innovative technologies, particularly in energy and water management. It combines technological innovation and eco-efficiency, hosting several companies and research institutes operating in both environmental protection and information and communication technology. Economic benefits of the Environment Park include: large-scale remediation of an industrial area in the centre of Turin; 20 new businesses started since 1999; eight foreign companies located in the

Park; about 500 people working in the Park, of whom 80% are graduates; about 150 new jobs created since 1999.

Source: GRDP Partnership (2007)

Box 9.3: Cohesion and Structural Funds Environmental Projects and the Lisbon Agenda

Water Management in Poland
In Poland, €3.3 billion is planned to be invested in the wastewater sector in 2007–2013 from OPs. Based on macro-economic modelling by the Wroclaw Agency for Regional Development, these investments will have the following economic impacts by 2013:

- An increase in employment of 50,000;
- A fall in the unemployment rate of 0.3%;
- An increase in labour productivity of 0.28%;
- An increase in private consumption of 0.66%
- An increase in investments in tangible assets of 1.42%

Woodland Management in the UK
In the UK, Working Woodlands is a public-private partnership project promoting the sustainable management of the woodland resources of Cornwall and the Isles of Scilly. The project is co-financed by the EU Structural Funds and has provided £2 million in capital investments and business development support services to businesses involved in the management, use, extraction or distribution of timber and wood products from local forests. Activities benefit from the use of wood waste for heating; local networking and purchasing; and the marketing advantage of certifiably sustainable wood products. By the end of 2006, it had supported or advised more than 600 local businesses; contributed grant aid towards more than US$ 4 million of capital investments; brought 1,250 hectares of woodland back under sustainable management; and helped the industry increase its annual sustainable turnover by more than £8.5 million.

Source: REC (2008)

9.5 Scale of Economic Benefits

The case studies and examples demonstrate that individual environmental projects funded by the Structural and Cohesion Funds are capable of generating significant economic impacts at the local and regional level. These include:

- The direct, temporary economic impacts of capital expenditures on GDP and employment;
- The effects on employment and output through the operation of environmental infrastructure;
- The role of environmental improvements in regeneration of regions suffering from industrial decline and dereliction;
- The role of environmental enhancement in stimulating tourism;
- The role of cohesion funded projects in stimulating innovation and market development;
- The impacts of skills and training programmes on employment and productivity;

- The role of business advice programmes in enhancing resource efficiency;
- Economic multiplier effects associated with the above.

The diversity of these impacts makes their overall effects difficult to quantify, although the positive impacts of individual projects has been demonstrated (Boxes 9.1-9.3, Case Study 9.2). Case Study 9.1 estimates that the impact of capital investments funded by the Structural and Cohesion Funds could be to create 290,000 jobs in 15 MS in the period 2007 to 2013. There would be additional economic impacts through the effects of environmental enhancement, resource efficiency and innovation on regional development over time.

9.6 Beneficiaries and Timescales

Environmental investments can take many forms and have the potential to benefit a wide variety of sectors, firms and individuals in both rural and urban areas. Direct effects can be expected to occur during the programming period, with further benefits over time as a result of the effects of policy on the regional business base and environment.

CASE STUDY 9.1 – MEETING ENVIRONMENTAL PRIORITIES IN THE 2007/13 COHESION PROGRAMME

Background

Lagging regions of the EU have a substantial need for investment in environmental infrastructure, in order to address environmental barriers to economic growth and to avoid environmental damage costs with adverse impacts on economic development. A study by GHK et al. (2006) assessed environmental investment needs in 15 member states (the 12 new member states plus Greece, Portugal and Spain) in the fields of water supply, waste water treatment, municipal solid waste, renewable energy sources and natural risk management and modelled the economic impact of the required investments in these areas.

Description of intervention

The study assessed the needs for environmental investments for each state, taking account of current levels of investment, and the overall levels of infrastructure needed for regulatory compliance, achieving CO_2 reduction targets, and acceptable levels of risk management, in order to establish priorities for investment that are consistent with the objectives laid down by the regulations governing the Structural and Cohesion Funds. The study identified an overall need for some €100.8 billion of investment across the 15 member states over the period 2007 to 2013. This is equivalent to between 1-2% of national GDP, except in Bulgaria and Romania where investment needs are 4.5-4.7% of GDP. Investment in water, waste water and waste account for the large majority of the share of investment needs, except in Spain, Portugal and Greece where previous programmes have provided the basic infrastructure required and where a greater share of investment is required in renewable energy and risk management.

Description of economic benefits

Substantial economic benefits were identified in the national evaluations. For example:

- Improvements in water quality reduce industrial water treatment costs and promote the growth of water intensive industries. In Slovakia, for example, water-intensive industries such as chemicals and metals as well as the power sector are expected to experience yearly growth rates of between 4-11% per year.
- Enhanced water and waste infrastructure is needed to facilitate growth in tourism, particularly in hotspots such as Cyprus and Greece. As well as providing basic infrastructure for the sector it will maintain and enhance the coastal environment on which much tourism depends.
- Investments in resource efficiency will reduce costs, enhance regional competitiveness and create employment opportunities associated with collecting, recovering and recycling secondary materials;
- Investment in wastewater treatment is seen as a prerequisite for economic development in many areas, necessary to support economic growth and industrial development and provide a reasonable quality of life for workers and investors. It is highlighted as a key issue in Poland, Czech Republic and Estonia. In Bulgaria, differences in sewerage infrastructure have been identified as a key factor explaining differential rates of regional development.

- The need to address health problems caused by inadequate waste and wastewater infrastructure, and associated effects on productivity, has been identified in Slovenia and Hungary. It is a key requirement for the development of tourism in Bulgaria.
- Natural risk management programmes are identified as being important to reduce the economic costs of floods in Bulgaria, fires and coastal erosion in Portugal, and drought in Spain and Slovenia.

The environmental investments identified will have direct macro-economic benefits by boosting the national construction and capital goods industries in the states, adding to GDP and employment. The study found that the programmes have the capacity to accelerate regional convergence by increasing GDP/capita in regions below the national average by more than in wealthier regions. This is especially the case in new states, which have a very strong capital city region (in which a substantial environmental investment has already been made) and much weaker provincial regions.

Description of environmental benefits

The need for environmental investment was assessed through national evaluations. Investment in water supply, waste water treatment and municipal solid waste management is required to ensure compliance with the environmental acquis, through investment in new or replacement infrastructure. As well as meeting legal standards this will help to prevent adverse effects of poor environmental quality on regional disadvantage and the problems of convergence. Investment in renewable energy and risk management requires additional activity to supplement and accelerate the benefits of national programmes, to avert the damage caused by climate change and other environmental problems.

Quantification of Economic Benefits

The contribution of the programmes to the economic performance of the MS was assessed using a macro-economic model. This indicates a positive impact on GDP because of the boost to national construction and capital goods industries. Because of the relative capital intensity of the investment the employment effects are smaller than the impacts on GDP. In gross terms the investment would generate in the order of 388,000 jobs over the 2007-13 period, equal to increasing employment in the 15 member states by some 0.7% by the end of the programme period. With an intervention rate of 75% from the cohesion policy funds the net impact would be some 290,000 jobs. As well as these direct economic impacts, the programmes will address environmental barriers to development and convergence, and stimulate a wide range of economic growth opportunities. The report therefore concluded that they would provide a good return for the resources invested.

Effect on public finances

The total investment required is estimated at €100.8 billion over 7 years, 2007 to 2013. Though there is some scope for private investment and user charges, the majority of this would be financed by the public sector, with up to 75% met by the Structural and Cohesion Funds. It is assumed that this would be met through existing budgets.

Potential for wider application in EU

The study covers the main lagging regions of the EU.

Further Information

GHK, Ecolas, IEEP and Cambridge Econometrics (2006) *Strategic Evaluation on Environment and Risk Prevention under Structural and Cohesion Funds for the Period 2007-2013.* Report for DG Regio. http://ec.europa.eu/regional_policy/sources/docgener/evaluation/pdf/strategic_environ.pdf

CASE STUDY 9.2 – SW ENGLAND OBJECTIVE 2 PROGRAMME

Background

The Objective 2 programme for South West England, 2000 to 2006, recognised the environment as one of the region's greatest assets and as an important driver of the economy, attracting inward investment, supporting a healthy tourism industry and providing an inspiration for good environmental management in the workplace. Efforts were made to integrate environmental and economic development measures in the programme.

Description of intervention

Between 2000 and 2006 the South West England Objective 2 Programme provided support worth £120 million to over 160 projects to deliver new jobs, help businesses start and grow, and raise skill levels in the region. One of its objectives was to protect and enhance the environmental assets of the region, in recognition of the importance of the environment as a key economic driver.

Description of economic benefits

Examples of the economic outcomes delivered by environmental projects in the region are documented in four booklets produced by Devon County Council (undated). These demonstrate that projects that improve energy and resource efficiency have yielded cost savings, enhanced community relations and strengthened customer loyalty. Other projects to enhance the built, historic and natural environment have created jobs and increased tourism revenues. The programme has also enhanced productivity and employment through training and the development of environmental skills.

Description of environmental benefits

It is estimated that more than 70% of expenditure through the Objective 2 programme yielded environmental benefits. These have included reductions in greenhouse gas emissions, reductions in waste, conservation of wildlife, restoration of landscape and the historic environment, promotion of local and environmentally beneficial food, and development of environmental skills.

Quantification of Economic Benefits

Examples of the outcomes of different projects include:

- Envision – an environmental business advisory scheme created 95 jobs and £3m of new sales, as well as achieving significant reductions in waste and energy use;
- The South Hams Green Tourism Business Scheme created or safeguarded 54 jobs and £8 million in business turnover;
- Groundwork SW trained 149 people in environmental skills;
- The Tamar Mining Heritage project created 7 new jobs and supported £6 million of additional or safeguarded sales through restoration of the natural and historic environment of the Tamar Valley;
- The Exmoor Food Links project promoting locally distinctive produce assisted 42 businesses and supported £2 million in new and safeguarded sales.
- The Life into Landscape project, enhancing the landscape of Devon's South Hams Area of Outstanding Natural Beauty, created or safeguarded 18 jobs and £1.8 million of sales.

- A project to restore Tiverton's Grade II listed Pannier Market created or safeguarded 37 jobs and £2 million in sales.
- The Ocean Discovery Zone at the National Marine Aquarium, Plymouth created 20 jobs and generated £2.8 million in new and safeguarded sales.

Effect on public finances

The eight projects listed above together received Objective 2 funding of £6.4 million out of a total project cost of £18.7 million.

Potential for wider application in EU

The programme supported a wide variety of projects in both urban and rural areas, many of which have the potential to be replicated in other parts of the EU.

Further Information

http://www.devon.gov.uk/index/economyenterprise/european/enveufunds.htm

10. Environmental Policies and the Transition to a Resilient and Sustainable Economy

10.1 Description and background

Although the EU economy is increasingly service-oriented, it still depends vastly on different raw materials. For various commodities, the peak of extraction has already been reached or is about to be reached. Although the financial crisis and the recession brought a significant correction for the oil price to below US$ 40 per barrel, the fuel crisis remains real. Peak oil is certainly approaching. In July 2007, IEA predicted an oil crunch by 2012 and projects the oil price to reach US$200 per barrel by 2030 due to rapidly increasing demand in contrast to increasingly constrained supply. The implications of peak oil are a dramatic drop in demand and a rapid rise in unemployment (nef, 2008).

Scarcity of 'critical metals' will affect the European economy in ways more subtle, but further reaching. A large number of goods of daily use and application contain small, but critical amounts of certain metals (e.g. gallium, indium, or platinum), the non-availability of which would endanger the production of a whole sector (such as mobile phones). High-tech industries, particularly the electronic industry, will be affected by declining availability of precious metals. Also the development of new eco-technologies could be slowed down by resource scarcity (European Parliament, 2009). The rapidly increasing demand for commodities like oil, raw materials and wheat has led to a boost in resource prices, especially during the last five years. The current financial crisis has temporarily led to lowering demand for natural resources.

Furthermore, the EU economy is increasingly dependent on resource imports from other world regions. Studies show that domestic raw materials (such as metals) are increasingly substituted by imports (e.g. EUROSTAT, 2007). This development leads to a substantial dependency of Europe on imports from other countries, in particular fossil fuels and metal ores (according to the European Commission (2006), import dependency is 83% for iron ores, 80% for bauxite, and 74% for copper). From a geological viewpoint, apart from oil and gas, there is no imminent physical shortage of the majority of raw materials in the world. However, the challenge lies in ensuring access to and supply of these raw materials for European companies. Since it is expected that worldwide competition for resources will significantly increase in the near future the challenges are multiple, complex, and interrelated (European Parliament, 2009).

Another severe constraint for future economic activity is caused by climate change. By now, an inviolable consensus exists among climate scientists that even a rise of 2°C could be catastrophic in both economic and environmental terms. The UK Government's Stern Review predicted in late 2006 that the global economy could face a climate-change bill of £4 trillion if greenhouse gas emissions are not cut deeply within the next ten years. But Stern also highlighted the opportunities of the necessary changes, which are worth over £1 trillion (nef, 2008). Referring to his 2006 report, Sir Nicholas Stern said in April 2008: *"We underestimated the risks… we underestimated the damage associated with the temperature increases… and we underestimated the probabilities of temperature increases."* The fourth and most recent assessment report of the Intergovernmental Panel on Climate Change (IPCC) confirmed that the warming of the climate system is clear and headlines with 'worse than we thought'.

Collectively, these global challenges are severely impacting the EU's ability to sustain prosperity in the long term. Achieving a resource efficient and a low carbon society is thus key for the future of EU's economy, its industrial and service sector, and its citizens. A significant reduction of worldwide resource use will be necessary as well as radical progress on resource productivity. This enhances competitiveness, offers opportunities to innovate, and strengthens Europe's strategic position on future world markets.

Environmental policies play a crucial role in tackling the global risks described above. In particular, environmental policies contribute to managing a transition to a resilient and sustainable economy by:

- Encouraging economic restructuring and modernisation, supporting new, clean and sustainable economic activity (low carbon and resource efficient);
- Improving energy, food and resource security and hence resilience to external shocks;
- Reducing vulnerability of the economy to climate change and other environmental impacts (and hence costs of inaction).

Although the causes of the challenges vary, at a basic level, they share a common characteristic: the misallocation of capital. In the last two decades, much capital has been invested into property, fossil fuels, and structured financial assets with embedded derivatives, but comparably little has been placed in energy efficiency, renewable energy, public transport or sustainable agriculture (UNEP, 2009). A failure to change this investment track could lead to social problems of job losses, socio-economic insecurity and poverty which threaten overall economic and social stability.

10.2 Policy instruments

The European Commission triggered a wide-ranging debate on the future European energy policy with the publication of a Green Paper in March 2006. As a follow-up to the Green Paper, a package of energy and climate change proposals was revealed in January 2007 in order to increase EU resilience to future oil-price shocks (EurActiv, 2009). Coming up to the Lisbon Agenda's commitment to "sustainable economic growth," the European Council endorsed the integrated package of energy and climate change proposals in March 2007. The key commitments are:

- a 20% increase in energy efficiency by 2020,
- a 20% reduction in greenhouse gas emissions by 2020,
- a 20% share of renewables in overall EU energy consumption,
- a 10% biofuel component in vehicle fuel by 2020.

The package was created to reduce the EU's dependency on imported fuels and set the pace of "a new global industrial revolution". It is a first step towards a low-carbon and resource-efficient economy.

A complex challenge such as the transition towards a resilient and sustainable economy also demands an elaborate and far-reaching mix of policies and policy instruments. The current economic and financial crisis will require important structural changes to enable a sound recovery. There seems to be extensive consensus that much investment and spending is needed to restore economic growth and employment.

According to Bowen et al (2009) fiscal policy is not always the right tool to use for counter-cyclical purposes. However, the comparative advantage of monetary policy is less evident in the current situation. Past experience gives guidance as to when active fiscal policy is likely to be more effective. Given the size of the adverse demand shock, there is a strong case for a timely and temporary fiscal stimulus in industrial countries now. Generally speaking, increases in spending are likely to be more effective than tax cuts, because part of the tax cuts is likely to be saved. An IMF report based on OECD experience illustrates that short-run fiscal multipliers tend to be in the range 0.6 to 1.4 for spending increases, while for tax cuts, they tend to be notably lower, lying in the range 0.3 to 0.8.(Hemming et al, 2002).

Wade et al (2000) illustrated in a review of 44 energy efficiency programmes in nine EU countries that small increases in public spending can unleash disproportionate increases in private sector investment. They highlight that education and information campaigns and innovative programmes led to a combination of high employment gains, low government expenditure and cost-effective investments (Bowen et al, 2009).

The argument is that a "green" fiscal stimulus could be a more effective fiscal stimulus; one that is not about solely mending the financial system, risking to reproduce the imbalances and vulnerability which caused the current crisis, but building the foundations for long-lasting growth in the future, rather than unsustainable bubbles. In this sense, the objectives of economic recovery and action on environmental challenges complement each other.

Drawing on inspiration from Franklin D. Roosevelt's programme after the Great Crash of 1929, such a green stimulus package is in the current debate often called "Green New Deal" (GND). By a UNEP definition (2009) it is "*a set of globally coordinated large-scale stimulus packages and policy measures that have the potential to bring about global economic recovery in the short term while laying the foundation for sustained economic growth in the medium and long term*". Thus, it is not just about greening the economy, but about ensuring that an appropriate policy mix reduces resource dependency and protect ecosystems while fostering economic recovery, creating employment and restoring stability to financial, political and ecosystems (UNEP, 2009). Its outlook is international, but it requires action at local, national, regional and global levels (nef, 2008).

Elements of a Green New Deal that are rather a "menu" of options which can be customized and adapted for consideration by different countries might include:

- **Setting a price for carbon.** A legislative framework backed up by price signals may include rising carbon taxes and a price for traded carbon that is high enough to cause a drastic drop in carbon emissions.
- **Allocating public investments in R&D, education and innovation**. The shift towards low carbon economies will require extensive expertise, e.g. energy analysis, design and production of hi-tech renewable alternatives, large-scale engineering projects etc.
- **Reducing and eliminating perverse subsidies.** There is a risk that perverse subsidies will jeopardise many elements of the GND, e.g. agricultural subsidies that block sustainable forms of agriculture, or subsidies on fossil fuels which inhibit the take-off of renewables.
- **Providing the right incentives and taxes.** An incentive system of subsidies, taxes, and regulations may help to internalise external effects and encourage responsible behaviour.

- **Targeting sectoral fiscal stimulus.** Studies such as UNEP (2009) and nef (2008) suggest that spending should be focused on establishing infrastructure, such as sustainable transport, renewable energy, low-carbon technologies and energy efficient buildings.
- **Improving national legislation.** Domestic legislation in areas such as the environment, transport, energy, construction, and others, can create enormous market incentives and stimulate green investment.
- **Reforming the international policy architecture.** This is crucial in order to enable and support national initiatives.

Environmental policy increasingly cuts across all policy areas and serves as a main driver for structural change. Many resource efficient measures would be especially effective as they could be implemented quickly and would be relatively labour-intensive. The massive scale of the required energy transition will create millions of jobs. Plenty of new and existing businesses and services will benefit and the government will generate a large increase in tax revenue (nef, 2008).

10.3 Review of evidence from the wider literature

The case for a stimulus focused on energy and carbon is very strong. A number of studies focus on the creation of low-carbon economies. They all agree that major investments are needed over the next decades.

In a study published at the end of 2008, Deutsche Bank identified a 'green sweet spot' for stimulus spending, consisting of investment in energy efficient buildings, the electricity grid, renewable energy and public transportation. The bank claimed that the "green sweet spot" is an attractive focus for an economic stimulus because of its labour intensity (Deutsche Bank, 2008).

A report by the University of Massachusetts Political Economy Research Institute supports that view. Six priority areas for investment were identified: buildings, mass transit/freight rail, smart grid, wind power, solar power and next generation biofuels. The study indicates that spending US$100 billion on these sectors over two years would create 2 million new jobs. The same amount of money directed at household spending would produce 1.7 million jobs and directed at the oil industry less than 600,000 (SDC, 2009).

UNEP's Global Green New Deal (GGND) also includes investment in natural infrastructure, including sustainable agriculture and ecosystem protection. As ecosystems provide tens of trillions of dollars worth of services to the world economy, protecting and enhancing them is vital to economic productivity in the future (UNEP, 2009).

The London based think-and-do tank nef (new economics foundation) installed a Green New Deal Group that calls for substantial market-enablement support from the government to foster the installation of new technologies – as it has been the case in all big new technological transitions. The group indicates that markets for renewable energy are growing rapidly overseas because of the generous subsidy approach of some governments (e.g. Japan, California) or policy innovations such as feed-in tariff laws (e.g. Germany, Spain). The German approach combines feed-in tariffs and low-interest loans for older properties to reach new-build energy standards. This has created 250,000 jobs and demand is such that Bavarian farmers, with large barn roofs and fields, are the biggest customer group for PV in the world (nef, 2008).

Considering the costs for a low-carbon society, the Stern Report famously argued that investments totalling around 1% of global GDP are necessary to reach the stabilisation target of 550 ppm. GHK (2009) and UNEP (2009) came up with costs consistent to Stern but highlighted that costs are rising with delays in implementing policies and making inefficient policy responses. On the grounds that climate change is proceeding faster than expected, Lord Stern himself revised his cost estimate to 2% of GDP later on. The UK Climate Change Committee's first report published in the end of 2008 calculated similar results. PriceWaterhouseCoopers estimated the costs of achieving a 50% reduction in global carbon emissions at 3% of global GDP (SDC, 2009).

Besides this theoretical evidence for the case for green stimulus packages, quite a few politicians have highlighted positive employment effects caused by green stimulus in practice. South Korea aims to protect more than 700,000 workers from unemployment with green spending of US$30.7 billion. The Center for American Progress (Pollin et al., 2008) estimated that a green stimulus of US$100 billion could safe roughly 2 million jobs in the USA (Edenhofer et al, 2009).

Many studies examine the economics of climate change and their link to economic development and recovery (e.g. OECD 2008 and 2009; Climate Group 2008a and 2008b; Barrera et al, 2008; CBI, 2009; McKinsey 2009; Edenhofer et al, 2009) leaving out other resource issues. Hence, availability of figures that illustrate the economic impact is broadly limited to climate policies. According to GHK (2009) the economic impact of climate change polices in the EU has been the subject of a range of studies. However, there are only a few estimates of the macroeconomic impact of meeting carbon reduction targets in terms of the net effect on GDP levels (global, European or national level) and the potential level of investment required to reach the reduction levels. Much greater focus has been on where the potential benefits and market opportunities of low-carbon business and resource-efficiency might be (GHK, 2009). The following summary of the overall economic impact of climate change policies carried out by GHK (2009) shows that the overall level of impact is modest and that costs will be associated with the opportunity to take competitive advantage from the structural changes triggered by climate change policies:

- Globally, market growth in the environmental sectors is driven primarily by legislation, whether at the international or national level, particularly in the more mature markets of the US, EU and Japan.
- Costs will increase if the most efficient carbon reduction technologies are not used. Delays in implementing climate change polices will increase costs to achieve given reductions or fail to achieve target reductions.
- Overall climate change policy will have a modest aggregate economic impact on job growth in the US and in the EU. Climate change policies are more likely to lead to a redistribution of jobs within and across sectors than to changes in absolute employment levels.
- Markets for low-carbon energy products are likely to be worth at least US$500bn per year by 2050, and perhaps much more.
- US and EU support for the renewable energy industry will benefit sectors of the economy and states that currently suffer from high unemployment.
- All models estimate that overall, the renewable energy industry generates more jobs per MW than the fossil fuel based industries (mining, refining and utilities).

10.4 Evidence from examples and case studies

Examples of the economic outcomes generated by environmental projects are given in Boxes 10.1-10.3.

Box 10.1: Economic and employment implications of greening the energy sector

- Green energy initiatives have the potential to save the US economy an average of US$450 million per year for every US$1 billion invested. In addition, every US$1 billion in government spending would lead to approximately 30,000 job-years and reduce annual US greenhouse gas (GHG) emissions by 592,600 tons between 2012 and 2020 – a 20% increase in job creation over more traditional fiscal stimulus measures.
- The renewable energy sector of China has a value of nearly US$17 billion and already employs close to 1 million workers. Further investments the renewable energy sector and other "clean technologies" could have a major impact on developing new economic growth, expanding exports, and creating employment.
- An immediate and large-scale programme to expand energy conservation and renewable energy supply in the European Union (EU) could create 1 to 2 million new, full-time jobs.
- The energy conservation and green building investments that form part of South Korea's Green New Deal amount to 0.5 per cent of GDP, and the full low carbon strategy accounts for 1.2 per cent of GDP. These strategies are expected to create 181,000 and 334,000 jobs, respectively.

Source: UNEP (2009b)

Box 10.2: Low-carbon transport strategies can stimulate growth and create jobs

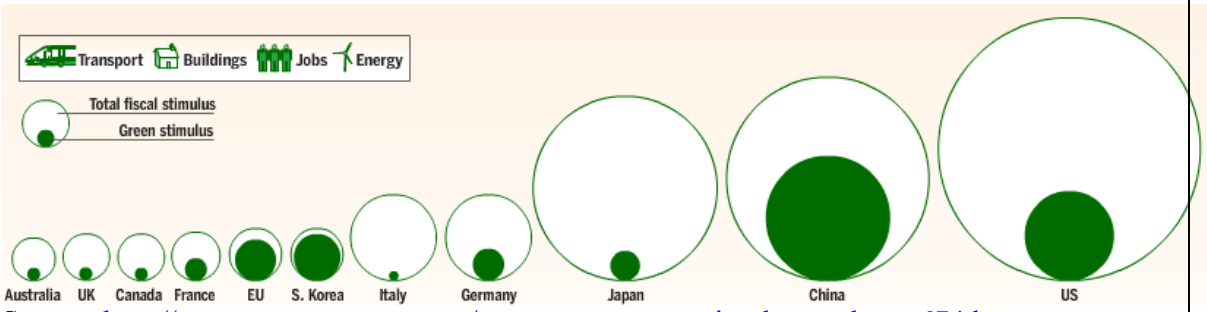
- More than 3.8 million jobs could be created globally through the production of vehicles with high fuel efficiency, hybrid and alternative fuel use and low emission technologies, and up to 19 million additional ancillary jobs worldwide in fuel refining and distribution, sales, repairs and services.
- At least 1.2 million jobs are involved worldwide in biofuel production, but global expansion of next generation feedstocks could easily yield 10 million jobs or more.
- Mass transit systems have significant direct employment impacts globally, accounting for 367,000 workers in the United States and 900,000 in the European Union alone. Investment in public urban transit has also has major secondary employment effects, with a multiplier of 2.5 to 4.1 per direct job created.
- In the United States, a 10-year federal investment programme in new high-speed rail systems has the employment potential of 250,000 new jobs.
- In South Korea, US$7 billion invested in mass transit and railways over the next three years is expected to create 138,000 jobs.

Source: UNEP (2009b)

Box 10.3. Green Stimulus packages

Many countries are looking to renewable energy as a way to boost their economy by providing opportunities for increased investment, building low carbon efficiency into the infrastructure and creating millions of jobs. Most of the countries are using similar strategies to address the crisis. The white bubbles in the graph below show the total size of each county's fiscal stimu-

lus package, while the green bubbles are equivalent to the country's allocation towards environmental initiatives.



Source: http://greeneconomypost.com/country-greenest-stimulus-package-674.htm

While most countries remain well below the 20% suggested by Bowen et al., South Korea and China will spend as much as 80.5% and 34.3% respectively of their stimulus packages on broadly green measures – 3.2% and 4.8% of total GDP respectively.

Overview of how countries plan to spend their green stimulus funds:

United States – US$19.2 billion are allocated for credit and tax cuts for renewable energy, with an additional US$ 9.45 in tax credits applied specifically for solar and wind power. Public transportation will receive US$10 billion, US$2 billion has been approved for carbon capture and storage, US$ 52 billion will be invested in the smart grid and energy efficiency, and an additional US$ 22.5 billion will be invested in wind, biomass and geothermal energy.

China – China's carbon emissions have grown by 250% over the last decade. After years of ignorance, China has dramatically changed its attitude towards climate change. The country's leadership is now showing the political will and backing it up with a significant financial investment, following the realisation that long-term growth is dependent on reduce power using and energy efficiency. In 2009 and 2010 China will spend more than six times the US green stimulus. Part of the stimulus involves investments in nuclear, solar and hydroelectricity, and the electricity grid to enable renewable sources to be connected. Exact figures for how much of their stimulus is allocated for environmental and renewable energy projects are unknown.

Japan – Japan's green stimulus is focused on energy efficiency in buildings. Tax cuts have been put in place to encourage investment and US$92 million are set aside to install solar panels in housing this year. The plan is to double that amount next year. Japan plans to announce a green economy plan.

Germany – Wind and solar powered energy are already a huge part of Germany's economy so their green stimulus funds are focused on energy efficiency (US$101 billion). Incentives are provided which encourage people to buy fuel efficient cars. US$2.5 billion will be spent on public transportation infrastructure and US$ 633 million in loans to promote the development of low carbon engines.

Italy – Italy created a car incentive programme with US$1.6 billion to encourage people to replace older vehicles with fuel efficient vehicles. US$79 million have been allocated to finance projects.

South Korea – South Korea has committed US$36 billion to a green job creation plan and is allocating US$6 billion to energy conservation. To promote clean modes of transportation, rail will be a major focus with a budget of US$7 billion.

European Union – The EU has allocated over 59% of its stimulus funding to green programmes. The EU recovery plan allows for an increase of funding over the next two years for green infrastructure initiatives in the EU by US$ 15 billion. In addition US$22 billion will be allocated for wind power grids and carbon sequestration. The plan also proposes that individual member states lower the value added tax for green products and foresees that funds not spent by September 2010 will be invested in energy efficiency and "smart city" projects.

Source: The Green Economy Post, 1 June 2009, http://greeneconomypost.com/country-greenest-stimulus-package-674.htm

10.5 Scale of economic benefits to date and assessment of the further potential

It is difficult to be precise about the scale of economic benefits as the transition towards a resilient and sustainable economy covers a wide spectrum of different sectors and policy angles. However, a large-scale investment in an immediate green recovery programme would not only be an important step in the transition to a low-carbon economy but also create new economic sectors and jobs and hence boost economic recovery and growth. According to UNEP (2009), a US$100 billion programme implemented over the next two years in both the United States and the EU (about 0.7 % of GDP in both economies) would be crucial.

The scale of economic outcomes certainly depends on the scale of investments. Also, the required transition will be a bigger challenge for some countries than for others, so the scale of will vary according to local circumstances.

Whilst there are barely estimates of overall economic benefits, there is much evidence about the costs of inaction. The economic costs of not supporting environmental projects are increasing and becoming more evident at the global level over time. The economics of climate change have clearly established that the costs of inaction are very likely to outweigh heavily the costs of action against climate change. One of the key findings of the 2006 Stern report is that the cost of inaction might be up to twenty times greater than the costs of action. Estimates show that 1% of global GDP spent would be sufficient to tackle the problem. The long-term benefits of shifting the world onto a low-carbon path could be in the order of US$2.5 trillion each year (Artim et al., 2008). The main conclusion therefore is that the costs of inaction in dealing with persistent environmental problems are far higher than waiting for better solutions to emerge.

10.6 Beneficiaries and timescale

Scientific evidence is increasing around the idea that we have less than a decade to start drastically reducing CO_2 emissions to mitigate climate change, to do something against peak oil and "peak everything" (Heinberg, 2006). Hence, the quicker policies set binding targets and focus on implementing them, the bigger is the chance of making a soft landing. The timescale for measures varies. Some measures are a one-off adjustment; others range from the short to the medium-term whilst others will need to continue into the long term and hence will require funding arrangements.

In comparison, the timescale for a "Green New Deal" is rather clear. Because of the unavoidable need for Governments to deal with unemployment and deflation, there is a tight deadline to decide about the scale and composition of fiscal expansions. The opportunity for investigating a Green New Deal is now. According to UNEP (2009), the next two years are critical for a Global Green New Deal and for starting the transition to a low-carbon economy.

"Transition policies" will affect sectors differently. Each business and sector will face particular opportunities and challenges. Some sectors (e.g. coal mining) are likely to be adversely affected, other sectors will see an increase in demand (e.g. renewables industry), while others have to transform products to remain competitive (e.g. vehicles). The impact of different sectors largely depends on international competition, the scope to transform and the exposure to higher energy costs (nef, 2008). Overall, the necessary expenditure to change processes and products to meet carbon reduction targets reflects a re-direction of economic activity and employment and not necessarily a reduction of GDP (nef, 2008 referring to a study by OECD/IEA 2008).

CASE STUDY 10.1: "SMART2020" STUDY

Background

The information and communications technology (ICT) industry is a crucial player in creating a low carbon economy and could help to push other sectors in this direction. The sector's share of GDP growth worldwide is predicted to jump up to 8.7% from 2007 to 2020. This shows the sector's vital role in the growth of the global economy and international development. The study "SMART 2020 – Enabling the low carbon economy in the information age" carried out by The Climate Group with support from McKinsey & Company on behalf of the Global eSustainability Initiative (GeSI) in 2008, presents the case for a future-oriented ICT industry that responds quickly to global warming. The report illustrates the scale of the opportunity for ICT to drive efficiency across the economy and deliver emission savings of 15% – 7.8 $GtCO_2e$ – of global business as usual (BAU) emissions in 2020. ICT appears to offer the best way to accelerate the shift from a high to a low carbon economy.

Description of intervention

The study aims to understand the role of the ICT sector in the transition to a low carbon economy, firstly by reducing its own footprint and secondly by enabling CO_2 reductions across the economy. The analysis was designed to answer three main questions:

1. What is the impact of the products and services of the ICT sector?
2. What is the potential impact if ICT were applied to reduce emissions in other sectors such as transport or power?
3. What are the market opportunities for the ICT industry and other high-tech sectors in enabling the low carbon economy?

Based on historic trends, ICT impacts, opportunities and hurdles in the context of carbon emission savings and potential economic value were identified and quantified.

Description and quantification of economic benefits

ICT is a key sector for change because of its high pervasiveness. However, its function in enabling infrastructure in the global economy is often unrecognised. The sector can enable smart development of future technologies that could stimulate greater efficiency and behaviour change for CO_2e reductions and additionally participate in the new sources of value of low or zero carbon solutions markets. In economic terms, the 15% reduction of BAU emissions in 2020 (7.8 $GtCO_2e$) represents a value of € 553 billion in energy and fuel saved and € 91 billion in carbon saved, assuming a cost of carbon of € 20/tonne, totalling to € 644 billion savings. Companies that implement the solutions will capture part of the potential global savings. The study identifies some of the biggest ICT opportunities to achieve these savings:

- **Smart motor systems:** optimisation of motors and industrial automation by 10% would globally reduce 0.97 $GtCO_2e$ in 2020, worth € 68 billion.
- **Smart logistics:** Through efficiencies in storage and transport, smart logistics in Europe could deliver fuel, electricity and heating savings of 225 $MtCO_2e$. Globally applied, this means savings of 1.52 $GtCO_2e$ in 2020, with energy savings worth € 280 billion.
- **Smart buildings:** Better building design, management and automation could save 15% of North America's buildings emissions. Globally, smart buildings technologies would allow for 1.68 $GtCO_2e$ of emissions savings, worth € 216 billion.

- **Smart grids:** Smart grid technologies were the largest opportunity found in the study and could globally reduce 2.03 $GtCO_2e$, worth € 79 billion.

Description of environmental benefits

While increasing energy efficiency of its products and services, ICT's largest influence can be by fostering energy efficiencies in other sectors. There is an opportunity to deliver carbon savings five times larger than the total emissions from the entire ICT sector in 2020. In total, ICTs could deliver approximately 7.8 $GtCO_2e$ of emissions savings in 2020. The scale of carbon reductions which could be achieved by the smart integration of ICT into new ways of operating, living, working, learning and travelling makes the sector a key player in climate change mitigation. However, in order to prevent rebound effects, an emissions-containing framework is required (such as emission caps linked to a global price for carbon) to encourage the transition to a low carbon economy. Without such policies there is no guarantee that efficiency gains will not lead to increased emissions.

Effect on public finances

The study does not provide information on this question. However, it states that governments can reap substantial additional state revenues by providing an optimum regulatory context for smart implementation of ICTs, including standards and higher energy and resource taxes.

Potential for wider application in EU, and possible means of measuring economic benefits

Given the right policy framework, the potential of profiting from carbon efficient technologies could be immense for the entire European economy.

Further information

http://www.smart2020.org

11. The Need for Policy Intervention

The previous sections demonstrate that there are numerous examples where environmental policies and activities contribute positively to economic development, in different sectors and different regions of the EU. They also demonstrate that there are many currently unexploited opportunities offering potential both to improve environmental management and to deliver positive economic outcomes.

The presence of these "win-win" opportunities for the environment and the economy may raise questions about why they are not currently being exploited. Experience suggests, however, that even where win-wins can be identified, they are not necessarily delivered by markets. A classic example is that of energy efficiency, where there is much evidence that households and businesses often fail to implement energy saving measures, even when it is demonstrated that they offer cost savings as well as environmental benefits (see Figure 3.2 above).

The case for new environmental policy interventions needs to be justified on the grounds of market failure. To justify government intervention, it is necessary to demonstrate not only that an unexploited opportunity exists, but also to understand why the market is not delivering the required solution, using this evidence to design an appropriate course of action.

Barriers to the efficient functioning of markets mean that they often fail to deliver economically efficient solutions. The causes of market failure are well understood and include:

- **Public goods.** The atmosphere, global climate and biodiversity are examples of public goods which benefit everyone and require collective action to protect them effectively.
- **Externalities.** The negative externalities of pollution are a classic justification for environmental policy. Interventions may also be justified on the grounds of positive externalities, such as R&D spill-overs or the tourism benefits of land management measures.
- **Information failure.** Some opportunities, such as energy saving and waste minimisation measures, may offer opportunities for win-wins but are not taken up because of imperfect information among businesses and households.
- **Monopoly power.** Markets do not function efficiently where there is abuse of market power by monopoly buyers or sellers, and this may lead to loss of opportunities for both economic and environmental gains. An example might be the failure of a monopoly water supplier to improve the efficiency of water supply and use.

Policy can also be justified on the grounds of **government intervention failure**, where existing policies are failing to deliver an optimal solution and would benefit from reform. A good example would be the reform of environmentally damaging subsidies, where subsidy reform may deliver environmental and economic gains while reducing distortion of the market mechanism.

In addition, there may be cause for intervention on the grounds of **equity**. Even where they deliver solutions that are economically efficient, markets may lead to variable rates of economic development, with some regions performing better than others and some groups in society benefiting more from economic activity than others. This provides a further rationale for re-

gional development policies and programmes designed to benefit disadvantaged groups in society.

The case for government intervention with regard to the environmental policy opportunities identified in previous sections can be made as follows:

- Energy Efficiency Programmes – Investment in energy efficiency is often cost effective for firms and households but may not take place as a result of information failures or general inertia. There are also externality effects, since energy efficiency helps to reduce the social costs of climate change, and, in the case of domestic households, equity considerations, helping to address problems of fuel poverty.
- Environmental Infrastructure Investments – Investments in transport systems and natural capital have strong public good characteristics, benefiting society as a whole, and therefore often justify public sector investment.
- Renewable Energy Investments – Support for renewable energy may be justified on the grounds of externalities – renewables play a key role in reducing the costs of climate change and therefore provide wider benefits to society. Renewables is a rapidly developing sector and there is also a case for intervention to promote innovation, enhancing the EU's collective knowledge base and enhancing our competitive position internationally. There may also be a case for intervention in order to enhance competition and address disparities in market power between large energy utilities and smaller producers.
- Cohesion Policy – The overall rationale of cohesion policy is based on a combination of equity and economic efficiency arguments, i.e. the need to achieve a more even distribution of income across the EU, while addressing a variety of market failures that lead to certain regions performing below their true potential. Within cohesion policy a variety of different types of environmental activities are supported, and these need to be justified according to market failure arguments (e.g. infrastructure investments may be justified according to the need to provide public goods and address environmental externalities which hinder economic development; innovation and skills programmes may be justified in terms of positive external effects).
- Innovation Programmes. Government support for innovation can be justified on the basis of the positive externalities associated with "technology spill-over" effects. In other words, innovation benefits not just the direct target of intervention but also other firms and society as a whole over time, justifying public sector support.
- Skills and Training. There are positive externality effects associated with skills development, which yields greater benefits to society at large than to individual employers, especially in areas and sectors where labour is mobile. Labour market interventions are often justified on equity grounds, in order to enhance the skills and earning potential of disadvantaged groups in society.
- Business Advice. Information failures may mean that businesses are not fully aware of environmental market opportunities – business advice and support schemes may help to address these.
- Environmental Labelling – Labelling schemes help to overcome asymmetries in information between producers and consumers, helping the latter to make informed choices and potentially to save money by adopting more energy and resource efficient products.

- Environmental Taxes – The case for environmental taxes is based on the external costs of environmental damage, which are not included in market prices. Environmental taxes are designed to "internalise" these externalities, leading to a more efficient working of markets. If used to reduce taxes on labour, they can also reduce distortions in labour markets.
- Reform of Subsidies – Subsidies in energy and agriculture can be environmentally damaging, as well as distorting trade and the allocation of resources. Subsidy reform can help to address these intervention failures and lead to a more efficient functioning of markets, as well as benefiting the environment.

A broad summary of the grounds for intervention in different aspects of environmental policy is given in Table 11.1.

The final section presents a proposed package of environmental policy measures which will benefit the EU's economy.

Table 11.1: Environmental Policy Opportunities - Rationale for Intervention

		Rationale for Intervention:				
Policy Opportunities:	**Public Goods**	**Externalities**	**Information Failure**	**Monopoly Power**	**Government Intervention Failure**	**Equity Considerations**
Environmental taxes		√√				
Reform of subsidies	√				√√	
Structural Funds	√√	√√				√√
Investment in Transport	√√	√√				
Investment in Renewable Energy		√√		√		
Investment in Energy Efficiency		√√	√√			√√
Investment in Nature Sites	√√	√√				
Skills and Training Programmes		√√	√√			√√
Innovation Programmes		√√	√√			
Agri-environment schemes	√√	√√			√	
Business advice and demonstration		√√	√√			
Product standards and labelling			√√			
Environmental regulations	√	√√				

12. An Environmental Policy Package for Economic Policy

12.1 Overview

In this section we outline a package of environmental policies which, if implemented, will strengthen the EU's economy, and contribute to the Lisbon priorities of enhancing growth and employment.

The choice of policy measures has been based on the review of economic outcomes from environmental policy in the previous sections, and also draws on the key elements of 'green new deal' packages (see Section 10).

The chosen package is designed both to:

- Provide a short term stimulus to the EU economy, creating jobs and boosting demand during the current economic crisis; and
- Support the development of a stronger, more resilient and sustainable economy in the long run, by promoting a more innovative and resource efficient economy that is less dependent on fossil fuels and imported raw materials and less prone to climate change and other environmental damage.

The package will meet the following policy outcomes:

- Building a **Resource and Energy Efficient Economy**, including by enhancing:
    - Energy efficiency in buildings;
    - Business resource efficiency.
- Developing an **Energy Supply Infrastructure** for the future;
- Investing in our stock of **Natural Capital;**
- Increasing the returns from **Environmental Innovation;**
- Addressing the environmental barriers and opportunities for **Economic Cohesion;** and
- Increasing **Green Taxes** to enhance the sustainability of our public finances, through
    - Energy taxation
    - Transport pricing.

The package will have significant benefits to the EU economy, increasing employment by an estimated 7.5 million jobs. The effects of different components of the package on employment and their other economic outcomes are summarised in Tables 12.1 and 12.2.

The economic outcomes of the package are summarised as follows:

- **Employment** – the package is estimated to increase employment by 7.5 million jobs. The largest effect is due to the role of energy taxes in enabling reductions in labour and income taxes, providing incentives for greater use of labour and less use of natural resources in the economy. There are also significant increases as a result of growth in innovative environmental industries, labour intensive investments in buildings energy efficiency and the management of nature sites, and the supply chain effects of invest-

ments in renewables and environmental infrastructure in cohesion regions. The environmental package will also lead to 'green upskilling' of existing jobs, by demanding new skills, for example in environmental monitoring, accounting, emissions trading and use of new technologies;

- **Productivity** – the package will increase EU productivity and GDP by reducing energy and resource costs, driving innovation and business growth, and allowing labour and income taxes to be reduced. Most of the measures have positive, quantifiable effects on GVA.
- **Innovation** – the package will stimulate innovation in environmental and energy saving technologies and processes.
- **Capital Base** – the measures will drive productive investment in renewables, buildings energy efficiency, clean technologies, skills and natural capital, which will further enhance the economy's future productivity. New systems and technologies will help to modernise the capital stock and increase its productive potential.
- **Public Finances** – the package will have no net budgetary cost. Some elements involve improved delivery of existing commitments, while increases in net public expenditure on energy efficiency and business resource efficiency can be met by the proposed environmental taxes.
- **Balance of Trade** – the measures will strengthen the EU's position in the global market, increasing exports of key products and services including renewable energy and energy efficient technologies, bio-based products, waste recycling technologies and sustainable construction techniques. They will also reduce the EU's imports of energy and materials.
- **Economic Cohesion** – the package will provide the environmental infrastructure necessary to support economic development in the EU's lagging regions. It will help to address environmental barriers to growth, and to stimulate new opportunities in areas with limited economic opportunities.
- **Transition to a Sustainable and Resilient Economy** – the package will reduce the EU's reliance on oil and imported natural resources, thereby increasing its resilience to potential future supply shortages and price volatility. Enhancing resource productivity and investing in renewables will help to build a more resilient and sustainable economy for the future.

Table 12.1: Employment and Economic Outcomes of the Environmental Policy Package[23]

Policy Measure	Jobs (000)	Other Economic Outcomes
Building a Resource and Energy Efficient Economy	+320	Annual cost savings of up to €100 billion annually after 10 years. Reduced CO_2 emissions and reduced reliance on energy imports.
Developing an Energy Supply Infrastructure for the Future	+410	0.24% increase in GDP. Avoided oil imports of €157 billion and increased exports of renewable technologies of €10 billion annually.
Investing in our Stock of Natural Capital	+207	Annual GVA of €5.2 billion in managing N2K network. Delivery of ecosystem services, improving human health and wellbeing, supporting tourism and providing protection against climate change effects.
Maximising the Returns from Environmental Innovation	+665	Increased GVA in lead markets of recycling, bio-based products and sustainable construction. Increases in exports and displacement of imports. Many new jobs are high quality, high skilled.
Addressing the Environmental Barriers and Opportunities for Economic Cohesion	+388	Gross impact on GVA of €18.4 billion, promoting convergence. Provision of long term development opportunities by addressing environmental constraints to development, encouraging diversification and increasing tourism.
Energy Tax Reform	+5,550	0.6% net increase in GDP. Reduced energy demand of 13%, reducing imports. Opportunities to enhance public finances if not all revenues recycled.
Transport Pricing	0	Overall gain of 1.2-2.7% of GDP, through tax reductions, reduced congestion, accidents and environmental costs. Opportunities to enhance public finances if not all revenues recycled.
Total	**+7,530**	

[23] Please note: these estimates have different timelines using different models so can only be seen as indicative. They contain a combination of gross and net estimates of impact. A comprehensive and integrated assessment of the overall net macro-economic effects of the package would require original macro-economic modelling work, which was beyond the scope of the current study.

Table 12.2: Summary of Economic Outcomes from Environmental Policy Package

Policy Measure	Productivity	Innovation	Employment (000 jobs)	Balance of Trade	Capital Base	Public Finances	Economic Cohesion	Transition to a Resilient and Sustainable Economy
Building a Resource and Energy Efficient Economy	Enhances total factor productivity by reducing energy and resource use. Annual cost savings of €18 billion to households and €78 billion to businesses, after 10 years.	Will boost product and process innovation, particularly in SMEs.	Creates jobs by encouraging substitution of labour for material and energy inputs. Potential to create 300,000 FTE jobs in housing renovation and 20,000 FTE in SMEs.	Resource efficiency reduces costs, cuts reliance on imported energy and raw materials, and enhances international competitiveness, thus improving the balance of trade.	Encourages investment in productive assets which yield cost savings to the economy. Reduces impacts of energy on natural and built capital.	Net cost of €4 billion annually to public sector, some of which will be recouped through reduced energy costs.	Provides environmental infrastructure for economic development in lagging regions, helps to address environmental barriers to growth and stimulate new economic opportunities.	Enhances self-sufficiency and resilience of the EU economy, reducing threat to economic security and the risk of future price shocks caused by global competition for limited resources.
Developing an Energy Supply Infrastructure for the Future	Evidence indicates that the shift to renewables will lead to a small net increase in EU GDP.	Innovation plays a key role in the renewables sector, which invests heavily in R&D designed to stimulate the development of new and cost effective technologies.	410,000 net FTE jobs, in development, installation, operation of renewable energy sector and industries supplying it. Labour intensive with strong local supply linkages compared to conventional power.	EU is a market leader and significant net exporter of renewables technology. Also displaces energy and fossil fuel imports. Policy increases exports by €5-7 billion and reduces imports by €45 billion by 2020.	Meeting the 20% renewables target will involve investments estimated at €600-670 billion by 2020.	Most investments are indirectly paid for by electricity consumers through higher prices, so the effect on government finances is limited.	Wind, wave, solar, geothermal and biomass energy offer new opportunities in regions not well endowed with mineral resources. Structural and Cohesion Funds have supported many successful renewables projects.	Renewables will enhance self-sufficiency and resilience of the EU economy, reducing the threat to economic security and the risk of future price shocks caused by global competition for limited resources.
Investing in our Stock of Natural Capital	Managing N2K network supports €5.2 billion GDP, skilled and knowledge based employment, and enhances physical and mental wellbeing of the workforce.	The impact of Natura 2000 on innovation is likely to be limited.	207,000 FTE jobs in management of Natura 2000 network and among suppliers and contractors, plus further tourism employment.	The impact on balance of trade is expected to be minimal.	N2K covers 20% of EU land area, plays key role in management of the EU's natural capital base, which supports key ecosystem services	Network will be funded from existing EU budgets, but depends on sufficient funding being allocated from these budgets.	Implementing the network will have disproportionate benefits for less developed regions of the EU, which tend to have the richest natural assets.	Natural areas play a key role in climate change mitigation and adaptation, important for our economic future.
Maximising the Returns from Environmental Innova-	The focus on growing, high value added sectors will	Better delivery of environmental innovation pro-	Creation of 665,000 jobs in waste recycling, sustainable	Creates new export opportunities in growing global	Enhances the capital base by stimulating investment in	Substantial budgetary resources already committed -	Can play an important role in growth of cohesion regions,	Innovation in energy and resource efficient technolo-

tion	enhance productivity and boost GDP per worker.	grammes will increase their contribution to overall levels of innovation in the EU.	construction and bio-products, including many high skilled, high wage jobs.	markets; helps EU to remain competitive against producers overseas.	cleaner technologies and growth sectors.	need for improved delivery of existing measures, rather than increased expenditure.	with Structural and Cohesion funds supporting various environmental innovations.	gies and processes will reduce dependence on imported energy and materials.
Addressing the Environmental Barriers and Opportunities for Economic Cohesion	Environmental investments will enhance annual GVA by €18.4 billion and provide conditions for lasting economic growth.	Structural Fund programmes have supported successful eco-innovation projects in various EU regions.	Environmental investments will create 388,000 jobs and provide conditions for lasting job creation in future.	Many regions have used the Structural Funds to support the development of environmental industries with export potential, enhancing international trade.	Investments in water, wastewater, solid waste, renewables, and other environmental infrastructure are prerequisite for economic development in many regions.	Environmental priorities can be met within current cohesion budgets but require sufficient resources to be focused on environmental investments.	Environmental investments promote cohesion through delivery of the range of economic outcomes listed here.	Help to deliver lasting economic improvements by enhancing environmental capital, improving energy and resource efficiency and reducing carbon emissions.
Energy Tax Reform	GDP is enhanced by 0.6% as effects of energy tax are offset by reductions in other taxes. Resource productivity increases.	Taxes provide incentive for innovation to stimulate continuous improvements in energy and resource efficiency.	Employment increases by 2.5% (5.55 million FTE) as tax burden shifts away from use of labour.	Effects on the balance of trade are broadly neutral, even if the EU introduces the ETR unilaterally.	Carbon taxes encourage investment in renewable energy, though this is offset by reduced investment in conventional power, causing slight decline in overall investment	ETR is budget neutral if tax revenues are recycled through lower labour and income taxes.	Effects on different Member States depend on their economic structure and their use of energy and materials; modelling results suggest that cohesion regions benefit most.	ETR reduces overall energy demand by 13% compared to baseline, reducing the EU's reliance on imported fossil fuels.
Transport Pricing	Positive effect of 1.5-2.7% of GDP, through reduced congestion/ pollution/damage to human health, recycling of tax revenues to reduce labour and general taxes.	Encourages innovation through incentives for fuel saving measures and lower impact transport modes.	Effects are broadly neutral, with the negative effects of tax offset by the positive effects of reductions in labour taxes.	Balance of trade enhanced by reduced demand for imported fuels.	Reduced damage to infrastructure from pollution and congestion; lower impacts of transport on natural capital.	Overall effect depends on use of tax revenues; recycling these through reduced labour or general taxes should enhance economic effects.	Cohesion regions will benefit from incentives for more efficient and sustainable transport systems.	Reduces reliance on imported fuels and sensitivity to oil price movements, enhances ability to address challenge of climate change.

The policy proposals complement the findings of a number of studies. For example, a recent report by WWF and E3G (2009) looked at the effectiveness of key environmental investment areas and policy instruments in promoting a green stimulus and in reducing greenhouse gas emissions. It concluded that the most effective investments are those to promote renewables and energy efficiency, while low interest loans and government guarantees are the most effective instruments. Similarly, Deutsche Bank (2008) identified energy efficient buildings, public transport and renewable energy as forming a 'green sweet spot' for stimulus spending, attractive for investment largely due to its labour-intensive nature. A US study (WRI, 2009) found relatively high employment intensity of investment in green programmes in their model, as compared to traditional infrastructure investments, due to the strong ability of public funding to catalyse private spending, and the net employment effect of reducing energy costs to the economy as a whole. Since the oil, natural gas, and power generation sectors are less labour-intensive and more import-dependent industries than other sectors, redirecting expenditures from energy to other types of goods and services creates jobs.

The following sections describe the proposed policy package in more detail and the economic outcomes it will deliver.

12.2 Building a Resource and Energy Efficient Economy

12.2.1 Description of problem being addressed

Growing demand for oil, gas and other raw materials in times of shrinking supply has led to rising prices, increased resource scarcity, resource dependency and conflicts. Worldwide competition for natural resources will continue to rise in the near future. Without major changes over the next 20 to 30 years, about 70% of the EU's energy will have to be imported, i.e. 20% more than today (Rocholl et al., 2006). At the same time, climate change and its economic, social and environmental consequences are increasingly affecting every facet of people's lives and will have severe effects on the European economy. Addressing these challenges requires a transformation of European industries, which can partly be met by radically raising Europe's energy and resource efficiency.

12.2.2 Rationale for intervention

The case for policy intervention with regard to resource and energy efficiency may be justified on the grounds of externalities, information failures, competitiveness and equity considerations. Resource and energy efficiency measures will help to reduce overall resource and energy use and the related social and environmental costs. Although investments in resource efficiency are often cost effective for firms and households, they are not necessarily made, as a result of information failures or general inertia. Intervention may further enhance the EU's competitive position internationally. In the case of domestic households, equity considerations also play a role as they help to address problems of fuel poverty.

The EU has already expressed a commitment to promote energy and resource efficiency, through the **EU Sustainable Development Strategy** (suggesting that increasing energy and resource efficiency will benefit both the economy and the environment and help reduce unemployment), the **Lisbon strategy** (with eco-efficiency as an important EU policy objective), the **6th Community Environment Action Programme** and the **Thematic Strategies** (esp. on the Prevention and Recycling of Waste and on the Sustainable Use of Natural Resources), and the

Cardiff Process of Environmental Integration (aiming at increasing resource productivity). Key EU policies include the thematic orientation of the **EU Structural Funds and Cohesion Funds** and **EU research policies** (e.g. the 7th Framework Programme), **EU energy and climate policies,** such as the European Emission Trading System (EU ETS), the EU Action Plan on Energy Efficiency, the EU Action Plan on Sustainable Consumption and Production, and the Biomass Action Plan, **transport policies** (e.g. CO_2 taxation of cars or the potential inclusion of aviation in the ETS), as well as policies to promote **green public procurements** or the support for environmental technologies (such as **ETAP**) (Giljum et al., 2009).

However, these policies are not coherent and coordinated and do not form a consistent strategy to systematically address and promote resource and energy efficiency. With a lack of concrete targets and timelines, and a comprehensive and integrated programme of interventions, the potential to build a resource and energy efficient economy – and the economic benefits that this offers – will not be fully realised.

12.2.3 Description of proposed policy measure

Since a strategy to systematically adjust policies to promote an eco-efficiency revolution is still missing (Rocholl et al, 2006), there is potential to devise a coherent approach towards resource and energy efficiency building on the policies described above. Implementation of this strategy can be achieved by improving existing policies, including stronger guidance and coordination to ensure a strong strategic direction and effective monitoring of progress. One possible governance feature of this strategy could be the introduction of the open method of coordination (OMC) at all levels, which has proved to be effective in the Lisbon process.

Improving resource efficiency requires investments to be made in buildings, equipment and processes that will reduce energy use and waste. Evidence demonstrates that such investments are cost effective but that unlocking their potential requires public action to catalyse change. The programme should include measures to promote:

- **Business resource efficiency** – Evidence demonstrates that there are substantial opportunities for businesses to reduce costs through waste minimisation and improvements in energy efficiency. These opportunities are not being fully exploited at present as a result of information failures and general inertia. The Energy Switzerland programme (Case Study 3.3), UK ENWORKS programme (Box 3.5) and Arthur D Little Case Study (Box 3.4) all demonstrate the significant economic benefits of improvements in resource efficiency. Unlocking these benefits often requires public sector action to invest in business advice and skills training. An EU wide business resource efficiency programme could play a key role in stimulating investment, and reducing waste and energy costs, stimulating growth in employment and GVA.
- **Energy efficiency in buildings** - Energy use in residential and commercial buildings is responsible for about 40% of the EU's total final energy consumption and CO_2 emissions. McKinsey (2007, 2009) has demonstrated that insulation is the most cost effective energy efficiency measure with huge potential to yield net cost savings and reduce carbon emissions (see Figure 3.2 above). Eurima estimates that simple measures such as roof and wall insulation have the potential to: reduce CO_2 emissions by 460 million tonnes a year (more than Europe's total Kyoto commitment); reduce energy use by 3.3 million barrels of oil a day; and save Europe €270 billion Euro in annual energy costs, while creating up to 530,000 jobs. This requires higher standards for the energy effi-

ciency of new buildings, new standards for existing buildings, and financial incentives to encourage energy efficient investments. An example of the latter is the German National Climate Protection Programme (Case Study 8.1), which, through the provision of low cost loans, stimulated domestic energy efficiency investments of €3.2 billion between 2001 and 2005, creating 25-35,000 direct FTE jobs and reducing CO2 emissions by 2.0-2.5 million tonnes annually. Such a programme at the EU scale offers substantial opportunities to stimulate investment, reduce costs and create employment.

12.2.4 Scope of intervention

Based on a critical review of current EU policies, Giljum et al. (2009) formulate the following key demands in order to fully reap the potential of existing policies that prioritise energy and resource efficiency:

- Quantitative and binding targets plus concrete timetables for implementation are needed to provide the right incentives. Additional to overall targets, more specific targets should address specific categories of resources or specific economic sectors, and binding time frames including review dates should be defined to create a concrete road map.
- An effective policy mix is required to achieve the targets. A well designed strategy needs to include policy instruments on different governance levels and must address all key economic sectors. Market-based instruments play a key role, as they provide price incentives and allow economic actors to achieve environmental objectives in a cost-effective way.
- Coherence between the different instruments is a key criterion for effective implementation. Implementation should also be accompanied by regular monitoring and review mechanisms, including appropriate indicators.
- Aspects of resource efficiency should be fully integrated in a number of EU policies in order to achieve substantial improvement.
- An absolute reduction of natural resource use in Europe is required as a basis for qualitative changes to reduce environmental impacts. A Factor 10 improvement in resource productivity has been suggested as an overall target for Western countries (Schmidt-Bleek, 2009). So far, there is no empirical evidence that technological improvements could avoid overusing the limited capacities of global ecosystems. Therefore, qualitative strategies can only be implemented as part of a quantitative reduction scenario.

12.2.5 Businesses/households/other stakeholders benefiting/affected

Increasing resource and energy efficiency will boost innovation, competitiveness and job-creation within the EU. Thus, environmental investments linked to promoting resource efficiency have wider benefits for the economy and society as a whole.

12.2.6 Effects on public finances

A Programme for Resource and Energy Efficiency will comprise a variety of measures, some of which will require public expenditures (including the process of action planning, target setting and monitoring; investments in infrastructure; advice and demonstration etc.) and others which will generate revenues or cost savings (such as environmental taxes, subsidy reforms

and reduced energy and resource costs for the public sector). The net effect on the public finances depends on the exact mix of policies to be implemented.

12.2.7 Expected environmental benefits

A well-designed mix of environmental and environment-related policies can result in a win-win situation for the economy and the environment. However, resource efficiency improvements on the micro level do not *per se* assure a reduction of resource and energy use on the macro level. Due to rebound effects, savings in resource productivity are often overcompensated by growth in production volumes. Achieving both economic and environmental benefits thus requires an additional correction of resource prices, for example through resource and energy taxes (Giljum et al., 2006).

12.2.8 Links with other proposed policy measures

Resource efficiency policies are linked with many other policies identified in this report, especially innovation and research policy, EU structural and cohesion funds, and employment policies.

12.2.9 Expected economic outcomes

Contribution to Key Economic Outcomes

The suggested policy will have several positive effects on the economy (Rocholl et al, 2006):

- Employment – improvements in resource efficiency will create jobs, by encouraging substitution of labour for material and energy inputs. Evidence suggests that waste minimisation, recycling and energy efficiency all increase labour inputs per unit of output.
- Productivity – evidence indicates that improvements in resource efficiency deliver significant reductions in costs, enhancing total factor productivity and value added.
- Innovation – product and process innovation is an integral part of enhancing resource efficiency, and efforts to stimulate innovation are therefore central to any resource efficiency programme.
- Balance of trade – resource efficiency reduces costs, cuts reliance on imported energy and raw materials, and enhances international competitiveness, thus improving the balance of trade.
- Public finances – waste minimisation and energy efficiency offer opportunities for cost savings for the public sector, as well as the private sector, and many opportunities for cost reductions are still to be exploited. Government action to promote resource efficiency more widely will result in net costs to the taxpayer.
- Capital base – infrastructure for energy efficiency and waste recycling forms an important part of our capital base, providing productive assets which yield cost savings to the economy. Resource efficiency also reduces demand for material and energy inputs, an associated environmental damage costs, thus reducing impacts on natural and built capital.

- Economic cohesion – the Structural and Cohesion Funds have funded successful resource efficiency projects which have enhanced economic performance in different cohesion regions.
- Transition to a Resilient and Sustainable Economy - An efficiency strategy will help to enhance the self-sufficiency and resilience of the EU economy, reducing the threat to economic security and the risk of future price shocks caused by global competition for limited resources.

Quantification of Economic Outcomes

Estimates of the economic outcomes of potential elements of an energy and resource efficiency programme are set out as follows.

Incentives for domestic energy efficiency

Based on evidence from Germany, provision of incentives for domestic energy efficiency through low interest loans, involving public sector investment of €2 billion per year, could:

- Stimulate annual investment of €10 billion in energy efficiency annually;
- Reduce annual CO_2 emissions by 70 million tonnes after 10 years, yielding annual cost savings of €18 billion;
- Create 300,000 direct FTE jobs in renovation and construction activities.

SME Business Resource Efficiency Programme

Based on evidence from the ENWORKS (Box 3.5) and BREW (Business Resource Efficiency and Waste, GHK, 2008) programmes in the UK, a €2 billion annual investment in provision of advice and training to SMEs on waste minimisation and energy efficiency could:

- Stimulate annual business investment in resource efficiency of €5 billion annually;
- Yield annual cost savings of €78 billion after 10 years;
- Create 20,000 direct FTE jobs;
- Provide further opportunities for employment and GVA growth over time.

Macro-Economic Effects of Resource Efficiency

The above estimates quantify the direct economic effects of investment programmes only. On a macro-economic level, the possible scale of economic outcomes is illustrated by modelling completed in the MOSUS project (see Case Study 3.1). This found that a well-designed mix of (mostly) environmental policies stimulating higher energy and resource efficiency can result in a win-win situation for the economy and the environment. The most effective policy measures to achieve this win-win situation were the implementation of a carbon tax on CO2 emissions, the introduction of a consulting programme to increase resource productivity in manufacturing, the increasing share of biofuels and changes in fuel consumption structure.

Under the HIGH sustainability scenario specified in MOSUS, real GDP per capita in the EU-25 was forecast to increase by 4% by 2020, with CO2-emissions reduced by 12 % compared to 2005. This reduction is caused by significant improvements in energy and resource efficiency of about 49 % in the European economy. A reduction of unemployment of 14 % is forecast by 2020 (from 22.9 million in 2005 to 19.7 million in 2020), a net change of 3.2 million.

12.3 Developing an Energy Supply Infrastructure for the Future

12.3.1 Description of problem being addressed

The EU recognises that its economy and society is becoming increasingly vulnerable to climate change, its increasing dependence on oil and other fossil fuels, growing imports, rising energy costs and concerns about security of energy supply.

Renewable energy has an important role in tackling these problems. The European Council of March 2006 called for EU leadership on renewable energies and asked the Commission to produce an analysis on how to promote renewable energies further over the long term to overcome these problems.

The Commission Communication "An energy policy for Europe" (SEC (2007) 12) clearly states the points of departure for a European energy policy as: "combating climate change, limiting the EU's external vulnerability to imported hydrocarbons, and promoting growth and jobs".

In December 2008 the Renewable Energy Directive was agreed by the European Parliament and the European Council. This Directive sets ambitious targets for each Member State with the aim of achieving a 20% share of renewable energy in Europe's final energy consumption by 2020.

12.3.2 Rationale for intervention

Renewable energy sources (RES) have the potential to tackle environmental, economic and energy supply problems. However, renewable energy is not developing as fast as hoped. Although progress has been made, current projections indicate that the EU looks unlikely to reach a contribution from renewable energy sources exceeding 10% by 2010, compared to a target of 12% (SEC(2006) 1719). There are several reasons for this:

- The high cost of most renewable energy sources, even though these have been declining.
- The failure to systematically include the external costs of fossil fuels into pricing structures, in spite of EU ETS and RES support frameworks.
- The failure of the market to balance the demand and supply of products required for energy security, sustainability and technological leadership.

RES investments can have additional benefits in enhancing competition and entrepreneurship, especially in sectors where jobs are currently in decline such as agriculture, forestry and construction. Significant opportunities also exist for increasing trade in renewable technology and fuels among EU countries and with the rest of the world – the extent of changes in export and market share depends on the 'first-mover' or 'fast-follower' advantage' potential of the technologies and sectors involved. Wind energy development has helped revitalise regions that had suffered from economic decline, such as north-western Denmark and Schleswig-Holstein in northern Germany.

12.3.3 Description of proposed policy measure

A number of studies, including the Commission's own Impact Assessment (SEC (2006) 1719) have looked at the economic and environmental impact of achieving the 20% target by 2020. Most of them recognise that more ambitious or accelerated RES policies than are currently in

place are required to achieve the 20% target. Business as usual policies will only achieve a 13-14% share of renewable energy.

The EC Impact Assessment, SEC (2006) 1719, and a recent DG TREN (2009) report outline the policies needed to achieve the 2020 RES targets. The 'strong renewable energy policy' scenario in the EC Impact Assessment and 'accelerated deployment policy' scenario (ADP) in the DG TREN (2009) report outline the following requirements:

- The RES electricity sector will contribute substantially to the achievement of the 20% RES target. Novel technology options like offshore wind, concentrating solar power and photovoltaics require increased RES policy support and improved framework conditions in order to provide significant contributions to Europe's energy supply in the years ahead. Main policy support measures are:
    - Fine-tuning of national support schemes involving feed-in tariff and quota systems to be based on a technology-specification of RES support.
    - Intensified cooperation between member states, including an intensively coordinated RES support all over Europe and an enhanced sharing of corresponding costs and benefits.
    - Implementation of renewable rights trading, amongst all the member states, (most likely through an EU-wide tradable green certificate scheme).
- A significant contribution to achieving EU renewables targets is also expected to come from the heat sector (21.7% of gross heat demand by 2020 in the ADP scenario), which requires strongly accelerated growth compared to current trends (14.2% of gross heat demand by 2020 under business as usual conditions).
- According to the ADP scenario, the share of biofuels in transport fuel demand is expected to rise continuously, reaching 8% in 2020 and 12.3% by 2030. In the business as usual scenario the biofuel share will reach saturation point at 6.4% after 2020.

Other policy measures that need to be implemented to meet the 20% RES target are:

- Higher internalisation of the external costs of fossil fuel energy (possibly through the introduction of a carbon or energy tax, applied, on average at €30/tonne of CO_2);
- Phased removal of excise duties on transport biofuels;
- A gradual decrease in renewable technology costs over the period to 2020 (mainly through current and planned Research and Technological Development (RTD) expenditures and lead market initiatives); and
- Continuous growth in greenhouse gas emission trading and an EU allowance price of €20-30/tonne of CO_2.

According to the European Commission's Impact Assessment (SEC(2006) 1719) the cumulative investment needed to increase the share from 6.5% in 2005 to 20% in 2020 is in the range of €600–670 billion (€2005). This would result in an increase in GDP by 0.5% compared to business-as-usual conditions.

The average yearly additional production costs are in the range of €13–18bn in the 20% policy case in the period 2005–2020. The additional costs are associated with development in innovative technologies with considerable long term potential.

12.3.4 Scope of intervention

Intervention is required across all member states. The scope for RES deployment depends on the type of technology and varies across member states and regions. Some countries posses significant RES potentials – e.g. in countries like Denmark, Estonia, Finland, Latvia, Lithuania, Portugal or Sweden the long-term potential is above 60% of current energy needs (TREN, 2009).

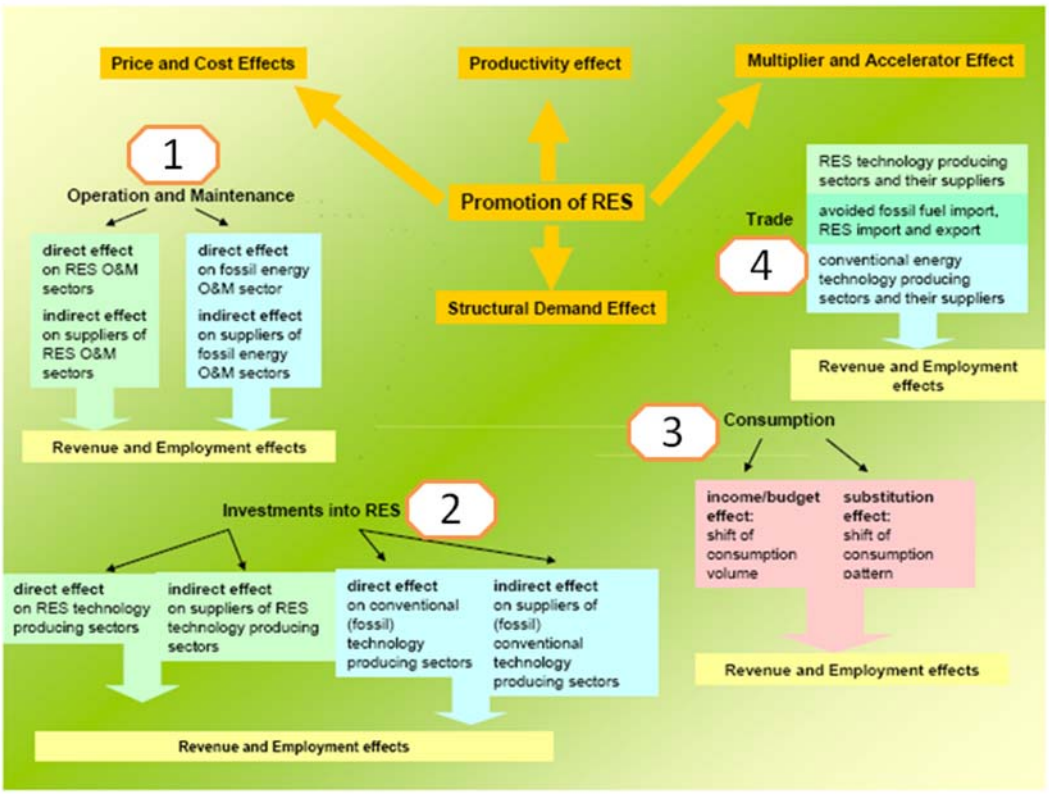
12.3.5 Businesses/households/other stakeholders benefiting/affected

RES deployment will affect the economy directly and indirectly through installation and operational activities. Figure 12.1 shows the impulses deriving from the promotion of RES and illustrates where shifts in demand have various effects in the manufacturing and service sectors and at the household level (impulses via prices). Active promotion of RES policies will affect businesses and households through a number of economic outcomes. The various economic outcomes are function of direct RES policies as well as adjustment reactions and effects induced by climate policies. The main economic outcomes are:

- Price and cost effects: the impact of prices (energy costs) on industry and households.
- Structural demand effects: the impact of demand on industry, households and trade.
- Multiplier and accelerator effects: the impact of household and industry behaviour on other economic sectors.
- Innovation/productivity effects: the impact of innovation or productivity on industry and households.

Direct economic outcomes occur in those industries which are directly involved in RES or fossil energy activities, while indirect economic outcomes occur in industries which are only linked to RES and fossil energy activities through other industries.

Figure 12.1: Economic effects and adjustment mechanisms



Source: DG TREN (2009)

According to one of the modelling scenarios in the GHK, CE & IEEP (2007) report, a 10% substitution of non-renewable electricity by renewable electricity leads to a net increase of EU27 output and jobs of €8.6 billion and 58,212 respectively. The economic impacts are positive because renewable energy has much more diversified supply chain especially for the design and installation stage.

The ten sectors (by NACE categories) whose output increases most from increased share of renewable generation are: Mechanical Engineering, Metal Goods, Electrical Engineering & Instruments, Construction, Professional Services, Basic Metals, Rubber and Plastics, Distribution and Electronics (GHK, CE & IEEP, 2007).

12.3.6 Effects on public finances

Reaching the 20% renewables target will impose additional costs on the public finances. The size of these depends on:

- The finance mix – public versus private monies;
- Technology choices – share of wind, solar and biomass;
- The degree of competition in the sector; and
- International prices for conventional energy sources, notably oil.

The average yearly additional production costs are in the range of €13–18bn in the 20% policy case in the period 2005–2020. The cumulative investments costs for a 20% and 22% renewable target by 2020 are estimated at €600-670 billion and €756-€844 billion respectively.

A large proportion of these costs will be met by the private sector, and ultimately by consumers, through higher energy bills. It is important to note, that the main factor influencing the cost of the renewable portfolio is the oil price. Under a scenario with oil prices at US$78/barrel by 2020, the additional average annual cost would fall to €10.6 billion. This will correspond to approximately €20 annually per European citizen. By comparison, the EU's total energy bill is expected to be about €350 billion that year. Bearing in mind the significant greenhouse gas savings that will occur as a direct consequence of an accelerated fuel switch from fossil fuels to renewable energies, carbon prices of €25 per tonne combined with high oil prices (US$78) would almost entirely cover the additional cost associated with reaching the proposed share of renewable energy (EC COM (2006) 848 final).

According to an HSBC Global Research[24] analysis, the EU has already committed €42 billion to meet climate and energy objectives as part of its green stimulus package.

12.3.7 Expected environmental benefits

An increase in the renewables share from 6.5% in 2005 to 20% in 2020 would lead to an annual saving in the range of 700–900 Mt of CO_2 emissions in 2020. Replacing fossil-fired electricity generation with renewable energy will also improve air quality, especially where the fuel replaced is coal. There will be indirect benefits for the natural environment and biodiversity.

12.3.8 Links with other proposed policy measures

Implementation of the RES targets will require a strong and ambitious innovation policy. The importance of biomass for meeting the 20% target means that renewable policy will have to be closely linked with agriculture, forestry and waste policies. Transport and buildings energy efficiency will also have key links with renewables policy.

Most EU Member States have already announced green fiscal stimulus packages including RES investments. RES capital investments will also have an important role to play for EU cohesion policy.

The Commission has outlined a template for National Renewable Energy Action Plans (NREAPs) as required by the recent Renewable Energy Directive. The template will guide Member States in the elaboration of their Renewable Energy Action Plan and detail their strategies including links with other policy areas for reaching their 2020 renewable energy targets. Each Member State must submit a NREAP to the Commission by 30 June 2010 at the latest.

12.3.9 Expected economic outcomes

Contribution to Key Economic Outcomes

Expansion of renewable energy capacity will have several positive effects on the economy:

- Employment – jobs will be created in the development, installation and operation of renewable energy technologies and in industries supplying to the renewables sector. Evidence demonstrates that increasing the share of renewables in power generation yields net employment gains as a result of its relative labour intensity, as well as its stronger local supply linkages compared to conventional power sources.

[24] http://globaldashboard.org/wp-content/uploads/2009/HSBC_Green_New_Deal.pdf

- Productivity – evidence indicates that the shift to renewables will lead to a small net increase in EU GDP;
- Innovation – innovation plays a key role in the renewables sector, which invests heavily in R&D designed to stimulate the development of new and cost effective technologies.
- Balance of trade – renewables make a strong contribution to the EU's balance of trade. Europe is a market leader and significant net exporter of renewables technology. Renewables also displace energy and fossil fuel imports. The policy would create an export impulse of €5-7 billion in 2020 (potentially increasing to €21-31 billion in 2030) and save on imports of fossil fuels of €45 billion (€85 billion in 2030).
- Public finances – Most of the investments in renewable energy are indirectly paid by electricity consumers (in the form of higher prices through, for example, feed-in tariffs), so the effect on government finances is limited.
- Capital base – meeting the 20% renewables target will involve investments estimated at €600-670 billion by 2020;
- Economic cohesion – renewables investments play a key role in the economic development of cohesion regions. The opportunity to exploit wind, wave, solar, geothermal and biomass energy offers new opportunities for development in regions which are not well endowed with mineral resources. The Structural and Cohesion Funds have supported a variety of successful renewables projects.
- Transition to a Resilient and Sustainable Economy – Renewables development will help to enhance the self-sufficiency and resilience of the EU economy, reducing the threat to economic security and the risk of future price shocks caused by global competition for limited resources.

Quantification of Economic Outcomes

Fraunhofer et al. (2009) estimate that meeting the EU's 20% RES targets alone could deliver:

- Up to 2.8m jobs in the RES sector in 2020, including around 410,000 net additional jobs compared to 2006;
- 0.24% in additional GDP (generated mostly by capital investment and improved trade balance; less so by energy price increases);
- An increase in overall employment to 3.4m people in work by 2030, assuming deployment policies are accelerated and forecasts for exports remain optimistic.

Employment effects depend on the labour intensities and productivities of different technologies. For example, they are relatively high for biomass fuel, given the relative labour intensity and relatively low labour productivity of the agricultural and forestry sectors. Jobs are created across the entire supply chain of the renewable industry including environmental monitoring, development design, commissioning and procurement, manufacturing, installation, project management, transport and delivery and operations and maintenance.The European Wind Energy Association (2008) has determined that on average 15.1 jobs are created in the EU per new MW (manufacturing) and 0.4 jobs per cumulative MW (operations and maintenance), declining gradually (with rising labour productivity) to 11 and 0.29 jobs, respectively, by 2030.

A Centre for American Progress (2008) report states that a US$100 billion investment in clean energy and efficiency would result in 2 million new jobs, whereas similar investment in old energy would only create around 540,000 jobs.

Meeting the 20% renewable target will lead to avoided fossil fuel imports of €157 billion per year (DG TREN, 2009). Furthermore, net exports of EU RES technologies to the rest of the world were €3.6 billion in 2005 and are expected to increase to €9-11 billion by 2020, if the 20% renewables target is met (TREN, 2009). European demand for biomass, and especially biofuels, can contribute to improving trade relations with the European Union's trading partners, in particular with developing countries, which have potential for producing and exporting biomass and biofuels at competitive prices.

These economic benefits do not take into consideration the economic value of RES benefits in terms of their contribution to the environment and security of supply and the CO_2 price in the EU Emission Trading scheme. These external costs and benefits further increase the economic benefits of RES deployment.

12.4 Investing in our Stock of Natural Capital

12.4.1 Description of problem being addressed

A healthy natural environment is necessary to provide essential services to the EU's economy and society. These include the provision of food and fibre; environmental regulation services, including the maintenance of air, soil, water and climate; pollination of crops and protection against floods and storms; and cultural services including recreation, tourism, education and maintaining local distinctiveness and sense of place. The economic value of ecosystem services has been estimated at $33 trillion globally, but is being eroded by the decline of ecosystems and biodiversity across the world. A recent EU study estimated that a failure to halt current rates of global biodiversity loss will result in a global loss of GDP of 7% by 2050 (Braat and ten Brink, 2008).

Ecosystem services depend on the maintenance of green infrastructure in urban and rural areas, and the protection of sites of special value for nature and landscape conservation. The latter is addressed by the Natura 2000 network - an EU wide network of special sites for nature, designated as Special Areas of Conservation under the Habitats Directive and Special Protection Areas under the Birds Directive. The network is designed to protect and favourably manage habitats and species that are of conservation importance and concern. The network currently covers some 850,000 km^2, equivalent to more than 20% of the surface area of the European Union. To be effective and to achieve the full benefits intended, the Natura 2000 network needs to be properly managed and resourced.

12.4.2 Rationale for intervention

Natura 2000 sites provide important benefits for society as a whole. As well as safeguarding species and habitats, they help to provide essential environmental services for people and the economy and are an important resource for recreation and tourism. Public funding for these sites can be justified on the basis of public goods – only a small proportion of the benefits that sites provide can be captured by land owners and managers through the market place.

12.4.3 Description of proposed policy measure

Actions required for the network include the designation of sites, conducting site surveys, preparing management plans, providing infrastructure such as visitor centres, restoring and managing habitats, and conducting ongoing ecological monitoring work. The costs of these measures have been estimated to amount to €6.1 billion annually in the EU25, to be met jointly by the EU, MS and regions (European Commission, 2004). A study is currently underway to update these cost estimates. No estimate is available of the economic benefits of the network at the EU level; however, evidence at the regional level suggests that the benefits can exceed the costs by a ratio of as much as 7:1 (Jacobs, 2004).

EU funding is provided through a variety of sources including the Structural Funds and Rural Development programme. However, as there are many competing priorities for funding, the network is in danger of being under-resourced, with a risk that the full benefits of the policy will not be realised. Unless the required resources are made available, there is a danger that sites will not be adequately protected, that inadequate restoration and management activity will prevent them from achieving favourable conservation status, and that the public access, appreciation and enjoyment will not be fully promoted. Adequate resourcing of the network will have direct economic impacts (creating jobs in environmental management) and offer lasting economic benefits through the delivery of ecosystem services and increased opportunities for tourism.

12.4.4 Scope of intervention

The network is EU wide and comprises a total of some 26,000 sites spanning 850,000 km^2, much of which is made up of forests, agricultural land, wetlands, coastal sites and marine areas.

12.4.5 Businesses and stakeholders affected

The direct beneficiaries of Natura 2000 related spending include land managers such as farmers, foresters and nature conservation organisations and their employees and contractors. There are indirect benefits to the tourism sector and to society as a whole.

12.4.6 Effects on public finances

The total cost of implementing the network has been estimated at €6.1 billion annually, to be met predominantly by the public sector, and co-funded by the EU, Member States and regions.

The EU's policy is to fund the network through existing programmes rather than to allocate additional, dedicated funds to it; therefore implementation of the network should not result in additional costs to the EU budget. However, it requires adequate resources to be allocated to Natura 2000 sites from existing funding programmes.

12.4.7 Expected environmental benefits

Improved management of Natura 2000 sites is important for the conservation of wildlife in the EU, including a variety of scarce and threatened species and habitats. Well functioning natural systems also provide a range of important ecosystem services for people and the economy.

12.4.8 Links with other proposed policy measures

Implementation of the Natura 2000 network will be partly funded through the Structural Funds and through agricultural policy reform, which is increasing the resources available for environmental management measures.

12.4.9 Expected economic outcomes

Contribution to Key Economic Outcomes

The implementation and effective protection and management of the Natura 2000 network plays an essential role in maintaining the EU's stock of natural capital and the services it provides to the EU's economy and population. Maintaining the network itself will generate direct employment and support the tourism sector.

The contribution to key outcomes is as follows:

- Employment – jobs will be created in the management of the Natura 2000 network, among supplier businesses (particularly rural land management contractors) and in sectors that benefit from it, especially tourism.
- Productivity – as well as offering opportunities for skilled and knowledge based employment, natural areas play a key role in promoting the physical and mental wellbeing of the population and workforce, both directly through recreation and indirectly by maintaining air and water quality;
- Innovation – the impact of Natura 2000 on innovation is likely to be limited;
- Capital Base – Covering 20% of the land area, Natura 2000 plays a key role in maintenance and management of the EU's natural capital base, which itself supports key ecosystem services;
- Balance of Trade – the impact on balance of trade is expected to be minimal;
- Public Finances – the network will be funded from existing EU budgets so there will be no net budgetary cost. However, there is a strong risk that it will be under-resourced and fail to meet its objectives unless sufficient funding is allocated from these budgets;
- Economic Cohesion – implementing the network will have disproportionate benefits for less developed regions of the EU, which tend to have the richest natural assets. Economic benefits will therefore occur disproportionately in these areas;
- Transition to a Resilient and Sustainable Economy – the EU's natural areas play a key role in climate change mitigation and adaptation, and will therefore play an increasingly important role in the economy in future.

Quantification of Economic Outcomes

Management of the Natura 2000 network can be expected to directly support 122,000 FTE jobs[25] and Gross Value Added of €3.05 billion in the regions in which sites are located, helping

[25] GHK estimates, based on estimate that wages comprise 50% of the costs of the network and an average wage rate of 25,000 euro per FTE job (from MS responses to EU questionnaire survey on costs of managing N2K sites)

to provide a new source of income for land owners and managers and to diversify the rural economy. Taking account of indirect and induced effects, the total impact at the EU level is estimated to be to support 207,400 FTE jobs and GVA of €5.2 billion at the EU level[26].

The above are gross estimates and do not take account of the economic effects of financing this expenditure, or of alternative uses of the funds expended. However, the economic impacts are likely to be strong compared to alternative uses of these funds, given the relative labour intensity of much of the work required as well as the economic multiplier effects.

There are additional benefits to the tourism sector, through opportunities to market locally distinctive and environmentally beneficial produce, and through the delivery of ecosystem services. Examples of the economic benefits of the network to date are given in Case Study 8.4.

12.5 Addressing the Environmental Barriers and Opportunities for Economic Cohesion

12.5.1 Description of problem being addressed

Environmental investments are needed to stimulate the development of the EU's lagging regions. Poor environmental quality and inadequate environmental infrastructure are barriers to economic development in many cohesion areas, particularly those that have suffered from industrial decline. The environment can be one of the greatest economic assets in other less developed regions with few alternative economic opportunities.

The Structural and Cohesion Funds have a key role to play in financing investments in environmental infrastructure across the EU, and especially in regions in greatest need of economic and social development. Positive linkages between the environment and the economy mean that these investments have the potential to contribute to economic development in cohesion regions. They are also necessary to enable compliance with environmental directives, to position cohesion regions to address the challenges caused by climate change, and to manage and respond to environmental risks. Failure to invest in environmental improvements will have an adverse impact on the regions concerned and their prospects for economic development; poor environmental quality exacerbates regional disadvantage and the problems of convergence.

12.5.2 Rationale for intervention

The overall rationale of cohesion policy is based on a combination of equity and economic efficiency arguments. There is a need to achieve a more even distribution of income across the EU, while addressing a variety of market failures that lead to certain regions performing below their true potential. Within cohesion policy, different environmental investments can be justified according to market failure arguments. For example, environmental infrastructure investments may be justified according to the need to provide public goods and address environmental externalities. Environmental investments provide particular opportunities for many lagging regions which may have high levels of natural resources and environmental quality but few alternative economic opportunities.

[26]Based on a multiplier of 1.7 (direct + indirect + induced to direct effects) for natural resource based activities from modelling work in the GHK et al (2007) study on the links between the environment, economy and jobs

12.5.3 Description of proposed policy measure

Environmental activities funded by cohesion policy span the breadth of different spending programmes covered by this report, including investments in infrastructure (e.g. buildings, renewable energy, energy efficiency, transport, water, waste management and the natural environment), eco-innovation, business support and skills development programmes.

12.5.4 Scope of intervention

A report by GHK et al (2006) for DG Regio identified investment needs of €100.8 billion over the 2007-13 programming period in the fields of water supply; waste water treatment; municipal solid waste; renewable energy and natural risk management (fire, flood, drought) in 15 Member States, comprising the 12 newest Member States plus Greece, Portugal and Spain. The majority of the identified investments were in water and wastewater treatment and waste management infrastructure, except in Greece, Portugal and Spain where such infrastructure is more developed and where there is a greater need for renewable energy investments. Further details are presented in Case Study 9.1.

12.5.5 Businesses/households/other stakeholders benefiting/affected

The main direct beneficiaries of the investment programmes identified by the GHK *et al* report are the water, waste and energy sectors, and associated construction and capital goods industries, and their employees. Environmental investments have wider benefits for the economy and society as a whole in the target regions.

12.5.6 Effects on public finances

The EU has allocated €347 billion to cohesion policy over the period 2007 to 2013, with additional public funding allocated by MS and regions as co-funding. It is important to ensure that sufficient funding is allocated to environmental priorities within the current programmes; this can be achieved within existing budgets. However, there is a strong risk that insufficient resources will be allocated to address environmental needs and opportunities, with negative effects on economic development and cohesion.

12.5.7 Expected environmental benefits

Investment in water supply, waste water treatment and waste treatment will ensure compliance with the environmental acquis, through investment in new or replacement infrastructure, helping to meet legal standards and prevent adverse effects of poor environmental quality on regional development. Investment in renewable energy and risk management will avert the damage caused by climate change and other environmental problems.

12.5.8 Links with other proposed policy measures

Cohesion policy provides essential funding for many of the other environmental investment programmes identified in this report, especially in lagging regions where needs are greatest and financial resources are otherwise scarce.

12.5.9 Expected economic outcomes

Contribution to Key Economic Outcomes

The national evaluations of environmental investment needs by GHK et al (2006) indicate that the suggested investment programmes will contribute to regional development through:

- Direct economic benefits from investment including net additional improvements in Gross Value Added (GVA) and accelerated regional convergence;
- Improved environmental quality delivering direct economic benefits, cost savings and new technological and market opportunities;
- Accelerated mitigation and adaptation to climate change, with a direct contribution to savings in CO_2 emissions;
- Enhanced EU scale management and strategic planning for risk management, especially linked to the cross-border management of water resources, avoiding major impacts from natural risks.

Environmental investments through cohesion policy contribute to key economic outcomes as follows:

- Employment – Environmental investments offer a wide range of opportunities for job creation;
- Productivity – Evidence demonstrates the positive effects of environmental investments in enhancing productivity and stimulating growth in GDP;
- Innovation – Structural Fund programmes have supported successful eco-innovation projects in various EU regions.
- Balance of Trade – Many regions have used the Structural Funds to support the development of environmental industries with export potential, enhancing international trade;
- Capital Base - environmental investments make an essential contribution to the capital base required to support economic development of cohesion regions. Inadequate water, wastewater, solid waste management, renewable energy and other key aspects of environmental infrastructure is frequently a barrier to economic development in cohesion regions;
- Public Finances – environmental priorities can be met within the current budgets allocated to cohesion policy, but require sufficient resources to be focused on environmental investments;
- Economic Cohesion – Environmental investments promote cohesion through the delivery of the range of benefits listed here;
- Transition to a Resilient and Sustainable Economy – By enhancing environmental capital, improving energy and resource efficiency and reducing carbon emissions, environmental investments help to enhance the economic resilience of cohesion regions and deliver lasting economic improvements.

Quantification of Economic Outcomes

GHK *et al* assessed the contribution of the programmes to the economic performance of 13 MS (all except Bulgaria and Romania) using a macro-economic model. They found that there will be a positive impact on GDP because of the boost to national construction and capital goods industries – this effect is so strong that it would enhance GDP even if the investment were fully funded by the MS.

Because of the relative capital intensity of the investment the employment effects are smaller than the impacts on GDP. However, in gross terms the identified investments will generate around 388,000 jobs among the 13 MS, increasing employment by some 0.7% by the end of the programme period (2013). The aggregate gross impact on the annual GVA of these 13 MS was estimated at €18.4 billion, or 1.4%. These are estimates of the gross impacts of the funded investments on GVA and employment; they do not take account of the effect on the EU's economy of funding these investments or the economic impacts of alternative uses of the money spent.

The programmes will accelerate regional convergence by increasing GDP/capita in regions below the national average by more than in wealthier regions. This is especially the case in new MS, which have a very strong capital city region (in which a substantial environmental investment has already been made) and much weaker provincial regions. As well as these macro-economic impacts, substantial economic benefits were identified in the national evaluations, through cost savings to business (especially to water intensive industries), greater resource efficiency, improved opportunities for tourism and economic benefits from health improvements. Further details are given in Case Study 9.1 above.

12.6 Increasing the Returns from Environmental Innovation

12.6.1 Description of problem being addressed

The Commission's Green Paper *"The European Research Area: New Perspectives"*[27] highlighted the fact that globalisation of research and technological development (RTD) is accelerating and that China, India and other emerging economies are developing scientific and technological power that is enabling them to attract considerable levels of R&D investments.

Consequently, there is an ongoing need for the EU to develop and adopt its own 'home grown' environmental technologies and eco-innovations both to achieve EU environmental policy targets and regulatory requirements (covering energy, climate change and sustainability) and to remain globally competitive. Indeed, the objective of ETAP is to improve European competitiveness and enable the EU to become a recognised world leader in the supply of environmental technologies.[28]

Achieving this high level aim requires the EU to undertake a critical scale of investment in environmental and energy research RTD. As outlined in ETAP, it is also necessary to create the right market conditions for new products to be adopted easily and in large volume, for example through the use of public sector procurement.

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[27] COM(2007)161 - http://ec.europa.eu/research/era/pdf/era_gp_final_en.pdf

[28] http://ec.europa.eu/environment/etap/etap/about_en.html

Such efforts will allow EU member states to compete effectively with both developed nations (e.g. USA and Japan) and rapidly developing economies (e.g. China and India) that might otherwise find it easy to sell their environmental goods and services into the EU.

12.6.2 Rationale for intervention

Investment in innovation can be justified on the grounds of technology spill-overs – the benefits to the EU as a whole of R&D investments can be expected to exceed the returns to individual firms.

The scientific and technological base of European research centres and industry (especially SMEs) needs to be strengthened to reduce the fragmentation of research activities and to boost innovation[29]. This may be achieved through investment into research, education and innovation (the "knowledge triangle") – a cornerstone of the Lisbon strategy.

Such investment will not only help the EU to boost its eco-innovation capability and maintain its competitive advantage relative to other leading nations; it will also allow the EU to continue to attract and retain highly qualified employees and inward investment to undertake leading edge environmental R&D.

Other benefits from this investment include increased employment, improved quality of life and environmental quality, and sustainable economic development, fulfilling key objectives of the Lisbon strategy.

12.6.3 Description of Proposed Policy Measure

A wide range of EU policies, initiatives and instruments aim to promote investment in energy and environment related R&D and knowledge creation, and facilitate the adoption of environmental technologies and eco-innovation by improving market conditions. Key initiatives include:

- The Seventh Framework Programme for Research and Technological Development (FP7);
- The Competitiveness and Innovation Framework Programme (CIP);
- Environmental Technologies Action Plan (ETAP); and,
- The Lead Market Initiative (LMI) for Europe.

This section examines the current status of these programmes and some of the anticipated outcomes. It then explores how new policy measures might be adopted to enhance the impact of such measures.

Overview of current RTD related measures

FP7 comprises a number of interventions which aim to achieve key energy and environmental research outcomes that support major EU environmental policy objectives whilst strengthening the skills capacity of the environmental research base. Joint Technology Initiatives (JTIs) are a flagship initiative under FP7 involving public private partnerships at the European level to achieve scale in research and world-leading outcomes. Of the six JTIs launched to date, two relate to environment and energy related issues: hydrogen and fuel cells (FCH) and aeronautics and air transport (Clean Sky).

[29] SEC(2008)2380

The ten research Themes of the FP7 "Cooperation Specific Programme" cover amongst others Energy, Environment including climate change, and Food, Agriculture and Biotechnology. This funding mechanism is the main funding conduit for transnational industry research with an objective of achieving world-class research outputs. 'Sustainability' figures highly in these Themes - 59% of the topics in the three first waves of work programmes (2007, 2008 and 2009) aim to contribute to one or more sustainability objectives. This translated into 44% of the "Cooperation" budget between 2007 and 2008 being allocated to interdisciplinary research supporting the renewed sustainable development strategy.[30]

The energy Theme has €2.4 billion allocated to projects that it is hoped will lead to the development of a more sustainable, secure and competitive energy system. Research into renewable electricity generation technologies and technologies for cheaper, more efficient heating and cooling from renewable energy are being funded.

The €2.2 billion **Entrepreneurship and Innovation Programme of CIP** places a high importance on the promotion and adoption of eco-innovation through the funding of demonstrators and market replication studies as well as skills and training capacity building measures.

The €730 million **Intelligent Energy-Europe (IEE) programme of CIP** aims to remove non-technical barriers to adoption of renewable energy, energy efficient technologies and alternative fuelled transport.

In addition to funding mechanisms, **ETAP** aims to overcome many of the barriers to adoption that are holding back the market diffusion of environmental technologies. For example, ETAP will create a network of technological centres to validate the performance of environmental technologies to ensure purchaser confidence. It will also promote green public procurement as a mechanism to drive demand for, and increase market penetration of, eco-innovation.

Also through ETAP, the EU has created **European Technology Platforms** (ETPs) to facilitate world-leading environmental and energy research and provide the strategic direction for coordinated environmental and energy research programmes such as JTIs. A range of low carbon energy-related ETPs have been established (e.g. photovoltaics, biofuels, solar thermal technologies, wind energy, and hydrogen and fuel cells) as well as environment related ETPs (e.g. water supply and sanitation, sustainable chemistry), to allow the research community, industry and other stakeholders to develop specific research roadmaps.

The "**Lead Market Initiative**" aims to stimulate selected highly innovative markets in the EU with a high growth potential. Facilitating the growth of these so-called lead markets is expected to increase returns on investments in R&D, enhance productivity, and increase exports, ultimately leading to higher levels of growth and employment. It will also generate substantial environmental and social benefits. Environmental Lead Markets include: sustainable construction, recycling, renewable energy and bio-based products.

Ensuring current measures achieve their objectives

The Commission already has mechanisms for monitoring and evaluating its research programmes, including FP7, CIP and LIFE+. For example, the interim evaluation of FP7, covering the period 2007 to 2013, is due in 2010. It will be important for the lessons learnt from

[30] http://ec.europa.eu/research/reports/2009/pdf/fp7-progress-report-communication-270409_en.pdf

these evaluations to be fed back into the remaining funding schedules so that such programmes can be refined within their lifetime and produce potentially greater research, innovation and education outcomes.

Improved integration of EU policies, initiatives and instruments

There are strong cross-cutting themes between FP7, CIP, LIFE+ and the Structural Funds. These include:

- Energy (both rational use of energy/energy efficiency and new/renewable forms);
- Eco-innovation;
- Competitiveness;
- Innovation;
- Technology transfer and adoption;
- Capacity building of employees in the private and public sector; and,
- Convergence across the EU.

The extent to which these themes have been explored and exploited in the strategic objectives of the various programmes needs to be further examined, particularly if there opportunities for greater coherence and alignment of policy objectives between the programmes. Within CIP, for example, the IEE programme clearly dovetails with the technology driven objectives of the Energy and Transport "Cooperation" funding Themes under FP7. It will be important to examine how effectively these linkages have already been identified and how, going forward, the potential synergies will be exploited. The ability to provide simultaneous feedback into other programmes areas such as LIFE+ and FP7 will also improve the market readiness of funded RTD.

Anticipated benefits from this co-ordinated effort include an increase in the levels of commercialised environmental technologies, the adoption of eco-innovation across the EU economy, and a more highly educated workforce. Such research will also help the EU to refine its environmental policy objectives over time.

Accelerating market adoption of environmental technologies and eco-innovation through improved education, awareness raising and coordination

Each EU funding instrument is generally targeted at a different stage of the innovation 'pathway'. In principle this helps to provide a coordinated and coherent support framework for enabling new technologies, services and innovative business models to be adopted by the market (see Table 12.3). In practice, however, there are often disconnects between one programme and another. There is also potentially a lack of awareness amongst stakeholders as to how these different mechanisms work together. By examining how the initiatives target different stages of the innovation chain, it may be possible to achieve greater coherence and faster adoption of innovative technologies.

Table 12.3: Provision of European support for energy and eco-innovation

Basic R&D	Applied R&D	Demonstration	Commercialisation	Market accumulation	Diffusion
FP7					
		EIP			
		IEE			
			ICT		
			LIFE +		
		ERDF			
					ESF
					Cohesion

Outcome based indicators

Current indicators used in research programmes tend to look at process-oriented factors such as participation rates of respective EU member states, activities of respective projects and types of dissemination activities.

It would be useful to examine how the use of outcome based (market-oriented) performance indicators could help to give better insight as to how effectively eco-innovation is being commercialised and taken up by the market. They could also examine the number of jobs arising from RTD as well as skill levels.

There are undoubtedly certain limitations to this, including the obvious 'lag' effects between RTD funding and diffusion, and the extent to which participating organisations such as SMEs might be willing to report back on a quarterly basis. However, it would be extremely valuable to gauge, for example, the scale of venture capital and private equity investment in RTD outcomes funded by EU programmes vis-a-vis RTD conducted outside the EU.

Use of public sector 'forward commitment' procurement to encourage radical innovations within the research community

'Forward Commitment' procurement, as currently being practised by the UK National Health Service[31], is a 'win win' process for both the public sector and business and research organisations. It involves the public sector articulating its future unmet needs to the market in a way that is credible and focuses on outcomes and performance standards.

By incentivising firms through a Forward Commitment and the promise of future business, investment is promoted in innovative RTD. Crucially, some of the most innovative and potentially highest growth firms that might otherwise struggle to bring a product to market are given

[31] http://www.dius.gov.uk/~/media/publications/C/CS03_RFT

an incentive and opportunity to offer something that is better and cheaper to the purchaser than incumbent technologies.

There are large opportunities for Forward Commitment procurement to be widely adopted across the public sector in the EU to drive investment and innovation in environmental technologies. This in turn could lead to a step change in the structure of RTD and related calls for proposals through, for example FP7 and CIP, since it would require far more involvement from the public sector.

It will be important for this measure to link closely with the Lead Market for public sector procurement networks which aims to improve public procurers' knowledge of innovative solutions, either available or being developed, by suppliers.[32]

New JTIs in the environmental and energy space

There is clearly potential for new JTIs to be developed to provide the scale of investment into novel environmental and energy technologies that would help the EU to match initiatives such as Futuregen in the USA[33] which is addressing Carbon Capture and Storage (CCS)[34].

There should also be alignment between EU research strengths and short to medium term environmental and energy challenges such as the greater use of bioenergy. JTIs could cover concentrating solar technology, off-grid water treatment, biomass to energy, biodiesel from algae, etc.

New Lead Markets

New lead markets could be developed to help provide a catalyst for environment related RTD, for example around bioenergy, water treatment and remanufacturing.

12.6.4 Scope of intervention

All member states could benefit from enhanced policy measures that will ultimately improve the quality and scale of environmental RTD and its diffusion into the market place, together with raised environmental education levels across the EU.

12.6.5 Businesses/households/other stakeholders benefiting/affected

Enhancing the policy packages that impact on FP7, CIP and other programmes will directly benefit staff in public and privately funded EU organisations that work on environmental and energy related R&D. There will be further benefits to the suppliers of energy and environmental technologies, through the commercialisation of this R&D, and to end users. Investment also benefits stakeholder organisations in third countries which often bring significant added value into transnationally funded research.

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[32] http://ec.europa.eu/enterprise/policies/innovation/policy/lead-market-initiative/public-procurement-networks/index_en.htm

[33] http://www.fossil.energy.gov/programs/powersystems/futuregen/index.html

[34] It is recognised that the EU is already working to develop an enabling framework and economic incentives for CCS as well as encouraging a network of demonstration plants. See http://ec.europa.eu/environment/climat/ccs/work_en.htm

12.6.6 Effects on public finances

The FP7 budget allocation of €50.5 billion, covering the period 2007 to 2013, represents a substantial increase on the FP6 budget (63% at 2007 prices). Of this, €2.4 billion for example, is focused on energy related RTD. The CIP budget, in contrast, is a mere €3.6 billion. The proposed policy measures would not increase this expenditure; they would in fact improve the efficiency with which existing budgets are utilised.

The Forward Commitment procurement concept would also enable the public sector to spend less over time through adoption of technologies with reduced life cycle impacts such as energy and resource usage.

12.6.7 Expected environmental benefits

The current range of environmental focused funding measures within the EU, combined with the policy measures discussed, could lead to a range of beneficial environmental outcomes which can help the EU to:

- Achieve more resource efficient and cleaner industrial production;
- Produce products that are more energy and resource efficient and able to be reused and recycled more easily;
- Create a thriving and competitive decarbonised power generation system that fulfils climate change mitigation targets;
- Understand better the challenges of climate change and be able to provide appropriate technological responses to aid mitigation and adaptation;
- Enhance environmental quality through better understanding of environmental systems and improved usage of data;
- Help other countries to fulfil the highest environmental policy objectives.

12.6.8 Links with other proposed policy measures

A progress report on FP7[35] has shown that the research to date has already made a large contribution to many EU policies, including to ETAP, the Climate Action and Renewable Energy Package, the Floods Directive, and the Sustainable Consumption and Production and Sustainable Industrial Policy Action Plans.

The funding and generation of more market-oriented RTD, combined with demand side mechanisms such as Forward Commitment that help to speed the transition of EU funded RTD, could greatly help to meet other environmental policy targets, for example the RES targets for 2020, as well as fulfilling key requirements under the Water Framework Directive and the Waste Framework Directive.

[35] Annual report on research and technological development activities of the EU in 2007, SEC(2008)2380, August 2008

12.6.9 Expected economic outcomes

Contribution to Key Economic Outcomes

Enhanced delivery of environmental innovation through FP7 and other environment and energy related support programmes is expected to strengthen the scientific and technological base of European industry, especially SMEs, and enhance the EU's international competitiveness. The expected effects on key economic outcomes are:

- Employment – Innovation will boost output and employment in target sectors, including waste recycling, renewable energy, sustainable construction and bio-products, and, by enhancing competitiveness, help to safeguard current employment which would otherwise be at risk from increased global competition. Many of the new jobs will involve high levels of skills and wages;
- Productivity – The focus on growing, high value added sectors will enhance productivity and boost GDP per worker;
- Innovation – Better delivery of environmental innovation programmes will increase their contribution to overall levels of innovation in the EU;
- Balance of Trade – Environmental innovation will create new export opportunities in growing global markets, as well as helping the EU to remain competitive against producers overseas;
- Capital Base - Environmental innovation will enhance the capital base by stimulating investment in cleaner technologies and growth sectors;
- Public Finances – The EU already commits substantial budgetary resources to environmental innovation. There is a need for improved delivery of existing measures, rather than increase expenditure;
- Economic Cohesion – Environmental innovation programmes can play an important role in the growth of cohesion regions. The Structural and Cohesion funds have supported various environmental innovations in different regions of the EU;
- Transition to a Resilient and Sustainable Economy – Enhanced innovation in energy and resource efficient technologies and processes will contribute to the economic resilience of the EU economy, reducing its dependence on imported energy and materials.

Quantification of Economic Outcomes

The lack of specific outcome-based indicators, combined with the fact that many of the innovation-related initiatives highlighted above are in the early stages of funding, make it difficult to quantify economic outcomes. However, the more effective delivery of environmental innovation programmes is necessary if the EU is to meet its potential in identified Lead Markets, which are the eventual adopters of much of the RTD funded by the EU.

Thus the economic outcomes of environmental innovations can be quantified as follows:

- **Recycling** - If the European recycling industry can maintain its competitive position through innovation and the introduction of more effective processes and improved technologies, waste and recycling industries are expected to grow from a turnover of €24 billion in 2006 to €36 billion in 2020 (a growth rate of almost 3% per year), providing 535,000 jobs in 2020 (European Commission, 2007; BMU, 2006; EurActiv.com, 2009).

- **Sustainable construction** – Promotion of sustainable construction solutions across residential and non-residential buildings and infrastructure constructions could increase the uptake of new products and services in construction by 5% in new construction and 3% in renovation. This would create a market by 2020 worth €87 billion, generating around 870,000 jobs. Sustainable construction (especially renovation) will lead to most sustainable construction projects generating net additional turnover and employment (European Parliament, 2009; European Commission, 1997, 2007).
- **Bio-based products** - McKinsey has estimated that the volume of global markets for bio-based products could more than triple to €250 billion by 2020 (Riese and Bachmann, 2004). In 2005, bio-based products accounted for 7% of global sales of the chemical industry; by 2020 this could increase to 20%. Based on these projections and on the assumption that the EU maintains its current market position in bio-based products (30%), the European Commission estimates an increase of the volume of bio-based production in the EU from €19 billion in 2006 to €57 billion in 2020; increasing employment from 120,000 to 380,000 jobs. JRC (2007) argues that modern biotechnology leads to "better jobs", reflecting the higher knowledge-intensity of these jobs, and helps to safeguard jobs by supporting competitiveness.
- **Renewable energy** – Effective delivery of innovation policy will play a key role in meeting targets for renewable energy, the economic outcomes of which are quantified in section 12.3 above.

A stronger and more integrated environmental research and innovation programme is required if these economic benefits are to be realised.

12.7 Increasing Energy Taxation

12.7.1 Description of problem being addressed

The use of energy in the EU gives rise to CO_2 emissions, which need to be reduced in order to mitigate climate change. It also has wider impacts on air quality and the natural environment. There are also strong economic arguments for reducing the EU's reliance on fossil fuel energy, which would reduce our reliance on imported fuels and make the economy less susceptible to potential energy shortages and fluctuations in oil prices.

12.7.2 Rationale for intervention

Energy taxation can be justified on the grounds of environmental externalities. Taxation can help to ensure that the price of energy reflects the full costs of its use, including the environmental costs. Increasing the cost of energy to consumers reduces demand and helps to promote efficiency of use, reducing CO_2 emissions and other environmental problems. It should also help to stimulate innovation and encourage the use of lower impact alternatives to fossil fuels.

12.7.3 Description of proposed policy measure

An illustration of the impacts of energy taxation has been made by the PetrE project, using the E3ME model (Case Study 5.2). E3ME is a large-scale model of Europe's economies, energy systems and environment, developed through EU research funding. PetrE modelled the single-country, European and global economic and environmental effects of different ETR regimes.

Six different scenarios were devised to investigate the implications of using ETR to achieve large-scale reductions in CO_2 emissions and meet EU targets by 2020. These involved the introduction of a carbon tax and materials tax, designed to reduce greenhouse gas emissions by at least 20% compared to 1990 levels. This would involve an increase in the carbon price to €147/tonne in 2020. It was assumed that the ETR would be budget neutral, with revenues recycled through reductions in other taxes.

12.7.4 Scope of intervention

Under the petrE project, the ETR was assumed to apply to all activities and users generating carbon emissions or using material inputs. It modelled the effects for 29 countries (the EU27 plus Norway and Switzerland), 19 energy-using groups, 12 fuels, 42 economic sectors and 41 categories of household spending.

12.7.5 Businesses/households/other stakeholders benefiting/affected

All end users of the above energy services and products would be affected by the tax which would cover all businesses and households in the EU. Energy suppliers and industries which are the heaviest users of energy would experience the greatest increase in costs. There would be benefits to the renewables sector and businesses supplying goods and services promoting energy efficiency. Society and the economy as a whole would benefit from reduced climate change impacts and other environmental effects. By using energy more efficiently, the economy will be more resilient to potential future energy supply shortages and price shocks.

12.7.6 Effects on public finances

The effects on the public finances would depend on the use of revenues from the increases in tax. Currently there is no requirement under the Directive on Taxation of Energy Products and Electricity for revenues from tax to be used in any particular way, such as to reduce employment related taxes. Also there are many countries, most of the EU15, with substantially higher taxes than the minimum levels so an escalator would take some time to affect those tax levels and hence revenue. In the current budgetary climate, governments might want to use any increased energy taxes to improve public finances by repaying debt and would certainly have that option. However, the PetrE modelling work employs the assumption that revenues are recycled to reduce other taxes, which produces the most favourable outcomes for the economy as a whole.

12.7.7 Expected environmental benefits

The ETR reduces the EU's Greenhouse Gas emissions by 20% by 2020, compared to 1990 levels. This alone is sufficient to meet the EU's emission reduction target, and will make an important contribution to addressing the challenge of mitigating climate change and its environmental impacts.

12.7.8 Links with other proposed policy measures

This policy proposal will help to reinforce proposals to deliver the 20% renewables target and the Resource and Energy Efficiency Programme.

12.7.9 Expected economic outcomes

Contribution to Key Economic Outcomes

Contributions to key economic outcomes are as follows:

- Employment – environmental tax reform will boost employment by shifting the burden of taxation away from labour and towards energy and resource use. This leads to a net increase in the use of labour;
- Productivity – there is an increase in resource productivity, measured in terms of output per unit of resource inputs. The effects on labour productivity are negative, as the ETR encourages greater use of labour inputs per unit of output. However, the PetrE results indicate that these are offset by the fiscal boost through reduced taxes, so there is an overall increase in GDP;
- Innovation – environmental taxes provide an incentive for innovation designed to stimulate continuous improvements in energy and resource efficiency;
- Capital Base – carbon taxes encourage investment in renewable energy, although this is offset by reduced investment in conventional power sources, leading to a slight decline in overall investment;
- Balance of Trade – the PetrE results indicate that the effects on the balance of trade are broadly neutral, even though the basic scenario assumes that the EU introduces the ETR unilaterally;
- Public Finances – the overall effects on public finances depend on the use of the tax revenues, which are assumed to be recycled through lower labour and income taxes in the modelling scenarios;
- Economic Cohesion – the effects on different Member States depend on their economic structure and their use of energy and materials. The PetrE results indicate that employment is expected to increase in all Member States, growing most strongly in Romania, followed by Estonia, Czech Republic, Italy and Slovakia. This suggests that the greatest benefits occur in cohesion countries;
- Transition to a Resilient and Sustainable Economy – the ETR reduces overall energy demand by 13% compared to the baseline, reducing the reliance of the EU on imported fossil fuels.

Quantification of Economic Outcomes

Table 12.4 sets out the results of the PetrE modelling work.

Table 12.4: Modelled Macro-Economic Outcomes of PetrE Environmental Tax Reform, 2020, Compared to Baseline

GDP	+ 0.6%	Exports	-0.1%
Employment	+ 2.5%	Imports	+0.0%
Household spending	+1.4%	Prices	+1.6%
Investment	-0.4%		

12.8 Increasing Transport Pricing

12.8.1 Description of problem being addressed

Transport plays a key role in the modern economy, being vital for the movement of goods, services and people. However, the EU's transport system operates less efficiently than it could. Congestion, pollution and accidents impose substantial costs on the economy, while over-reliance on oil, which is increasingly scarce, expensive and environmentally damaging, is increasing reliance on imports and raising doubts about the long term sustainability and security of our transport system. It has been estimated that road transport alone receives subsidies of €180 billion in the EU annually (EEA, 2005). Unless the full costs of road transport are incorporated into prices, transport is under-priced and therefore likely to be overused. The objective of better transport pricing is to improve the allocation of resources in the economy, ensuring that users pay the full cost of each trip.

12.8.2 Rationale for intervention

Transport taxation is justified on the basis of external costs. One of the principles of an optimal transportation tax system is to align the taxes with marginal social external costs. If taxes are set at appropriate levels, the users' price should cover the full marginal social cost (= resource cost + marginal external cost) of transport, which in turn should provide incentives for users to adopt the most efficient levels and modes of transport use.

12.8.3 Description of proposed policy measure

What is ultimately needed is to align the charges and taxes that every user pays with the external costs he/she causes, which differ by place, time, type of vehicle, user profile etc. This is marginal social cost pricing.

It is important to take into account two caveats when applying the "tax= marginal external cost" principle. First the level of the marginal external cost varies with the volume of transport use (which in turn depends on the tax level). In the case of external congestion costs this implies that the optimal tax is less than the marginal external cost measured before the introduction of the tax. Second, when we are dealing with close substitutes like alternative transport modes for passenger transport or freight transport, taxes equal to the marginal external cost for only one mode may be counterproductive when the other modes are not priced at marginal cost. It is therefore important to apply this principle as broadly as possible.

12.8.4 Scope of intervention

We here investigate a scenario[36] that comes as close as possible towards marginal social cost pricing by using a combination of a fuel tax and a km tax. The fuel tax covers the climate damage of the road modes (excluding public transport). All cars, vans, mopeds, motorcycles and trucks are subject to a km tax which covers air pollution, congestion, accidents, noise and in-

[36] Scenario 3 from Proost et al (2008). This scenario has been used by DG TREN to prepare the new proposal for a Eurovignette Directive.

frastructure wear and tear. The km tax is differentiated in function of vehicle type, zone, road type, country and peak/off peak. For non-road modes, similar assumptions have been made.

Tax scenarios have been modelled for the EU27, in 2020 (Table 12.5).

Table 12.5: Scenario for 2020, EU27

Mode	Price (inc. VAT, exc. taxes)	Total tax Reference scenario	Total Tax Marginal social cost pricing scenario
Slow mode*	0.0001	0.0000	0.0000
Moped*	0.0446	0.0080	1.4055
Motorcycle*	0.2476	0.0311	0.7825
Car*	0.2032	0.0335	0.0670
Van*	0.1733	0.0403	0.1345
Bus*	0.1077	-0.0478	0.0101
light duty truck**	0.2605	0.0615	0.3397
heavy duty truck 3.5-7.5t**	0.9349	0.0962	0.2910
heavy duty truck 7.5-16t**	0.2788	0.0384	0.1142
heavy duty truck 16-32t**	0.1586	0.0264	0.0775
heavy duty truck >32t**	0.0619	0.0162	0.0497
metro and tram*	0.2712	-0.1229	0.0026
passenger train*	0.2200	-0.1085	0.0121
Plane*	0.0948	0.0000	0.0140
freight train**	0.0783	0.0000	0.0088
inland ship**	0.0689	0.0000	0.0248

* €/passenger km

**€/tonne km

12.8.5 Businesses/households/other stakeholders benefiting/affected

All motorised transport (road and non-road) is affected – both freight transport, which relates directly to businesses, and passenger transport, which relates to households.

12.8.6 Effects on public finances

The effects on public finances depend on the use of revenues from transport taxes. The scenarios modelled by Proost et al (2008) raise additional tax revenues of €564 billion relative to the reference scenario. This could be used to enhance the public fiscal balance; however, it is as-

sumed that the revenue is recycled through lower general or labour taxation, in order to enhance the overall impact on the economy (see below).

12.8.7 Expected environmental benefits

Environmental benefits include reductions in CO_2, air pollution and noise, and resultant improvements in human health (see below).

12.8.8 Links with other proposed policy measures

Transport taxation links with a broader programme of measures to promote a resource and energy efficient economy.

12.8.9 Expected economic outcomes

Contribution to Priority Economic Outcomes

Road pricing has a clear and positive benefit for society. The mechanism is as follows: pricing generates at first higher transport taxes and thus costs to the user, which is a negative effect to society.

However, all secondary effects are positive:

- An environmental benefit to society (social security, health care) caused by the decrease in transport volumes.
- Benefits to society (social security, health care) for safety caused by the decrease in transport volumes.
- Less congestion, and therefore a lower production cost.
- Through the recycling of the higher taxes: benefits in other sectors, depending on the tax redistribution scheme.

The overall welfare gain is positive, when using a good tax recycling scheme. The effects in relation to key economic outcomes are as follows:

- **Employment** effects are broadly neutral if tax revenues are redistributed through reduced labour taxes.
- **Productivity** in the economy is enhanced, as a result of reduced congestion, pollution and damage to human health and the recycling of tax revenues to reduce labour and general taxes, thus boosting economically productive activities;
- The **capital stock** will benefit from reduced damage from pollution and congestion, and lower impacts of transport on natural capital;
- **Innovation** will be encouraged through provision of incentives for fuel saving measures and lower impact transport modes;
- The **balance of trade** should be enhanced, as a result of reduced demand for imported fuels;
- **Cohesion** regions will benefit from incentives to encourage more efficient and sustainable transport systems;

- The effect on **public finances** depends on the use of tax revenues, though recycling these through reduced labour or general taxes should enhance the economic effect of the measure;
- Transport pricing should contribute to a more **resilient and sustainable economy**, less reliant on imported fuels and sensitive to oil price movements, and better able to address the challenge of climate change.

Quantification of Economic Benefits

In detail, the effects modelled by Proost *et al* are that:

- The costs to households increase, caused by the higher transport cost (and partly countered by less congestion and thus time costs). This leads to a decrease of 2.5% of GDP (€452 billion).
- Production costs increase, caused by the higher transport cost (and partly countered by less congestion and thus time costs). This leads to a decrease of 1.5% of GDP (€272 billion).
- Tax revenue doubles due to the policy scenarios compared to the reference case. Tax revenues in the reference scenario are 2.3% of GDP (€416 billion), in the case scenario they are 5.4% of GDP (€980 billion) for the EU27 in 2020. This tax revenue is a only transfer, and thus not a benefit. However, through revenue recycling (redistributing the tax revenues via lowering general taxes or labour taxes), a benefit to GDP of 2.9% to 4.1% can be reached (€523 billion for lowering general taxes to €802 billion for lowering labour taxes).
- Gains due to accident savings sum to 2.1% of GDP (€376 billion).
- Environmental gains (noise, ozone, PM, CO_2) are 0.2% of GDP (€18 billion).

The overall welfare gain (sum of the above) is positive and is as high as 1.2 to 2.7% of GDP (for EU27, 2020): gains from a reduction of external accident costs (2.1%), a reduction of environmental costs (0.2%) and from a good use of the extra tax revenues (2.9-4.1%) minus the effect of higher transport costs (2.5%+1.5%). The use of the tax revenues is important in determining the overall effect.

The effects on employment are broadly neutral, with the negative effects of the tax offset by the positive effects of reductions in labour taxes.

The above benefits have been calculated with the TREMOVE model in the GRACE project (Proost *et al*, 2008). TREMOVE represents the transport activities in a country as an aggregate of the activities in three types of zones: metropolitan, urban and non urban. For each zone, one represents all modes of passenger transport and freight transport. Passenger and freight users have the choice between some 240 different types of modes and vehicles (mode, vehicle, timing etc.). Road freight and passenger transport interact via congestion and a distinction is made between peak and off peak traffic.

The package could be adapted so that only some of the net increase in tax revenues of €564 billion is used to reduce labour taxes, with the remainder used to finance other elements of our proposed environmental policy package. A marginal net increase in taxation of €4 billion would be sufficient to fund other aspects of the environmental policy package.

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