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ENV/EPOC/WPNEP(2003)11/FINAL



Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development

17-May-2004

English - Or. English

**ENVIRONMENT DIRECTORATE
ENVIRONMENT POLICY COMMITTEE**

**ENV/EPOC/WPNEP(2003)11/FINAL
Unclassified**

Working Party on National Environmental Policy

ENVIRONMENT AND EMPLOYMENT: AN ASSESSMENT

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JT00164300

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CHAPTER 1: INTRODUCTION

1.1 Background

The employment impacts of environmental policies was first raised as an issue at the beginning of the 1970's, when such policies were introduced. This led the OECD to review the literature and the available empirical data (OECD, 1978). The question of the relationship between environmental policies and unemployment came back at the surface in the 1990's, when many Member countries faced high levels of unemployment. Again the OECD undertook a comprehensive review of this issue, which gave rise to a second assessment (OECD, 1997).

This 1997 publication presented an analytical framework for discussing the possible employment effects of environmental policies including positive and negative effects, direct and indirect effects, short-term and long-term effects or gross and net effects. It also reviewed a number of methodologies for a quantitative appraisal of such impacts, and highlighted some of their strengths and weaknesses. In addition, the empirical evidence on environment-related employment available in OECD countries was assembled. The study examined as well possibilities to effectively integrate environmental and employment policies such as using environmental expenditures; promoting active labour-market policies by improving the quality of the labour supply in the fields of environmental protection and environmental technologies; integrating labour market and environmental policies at the regional and local level; and implementing tax reform to serve environmental and employment goals.

In a situation of persistently high unemployment (see OECD, 2003), the possibility to design a strategy in which environmental policy and policies aiming at reducing unemployment could be mutually reinforcing has received renewed attention. In this context, a new work programme on Environment and Employment was initiated as a key component of the activity on "Social and Environmental Policy Integration" which is a priority of the OECD's Environmental Strategy for the First Decade of the 21st Century (OECD, 2001).

Although the previous analysis of the various processes and mechanisms through which environmental policies can have an impact on employment (OECD, 1997) remains valid, there was a need to update most of the empirical information. Drawing on previous work (OECD, 1997), the new OECD programme on Environment and Employment expands the analysis with a particular emphasis on the economy-wide employment impacts of environmental policies in general, and of climate change policies in particular. Questions are often raised concerning the potential impact of climate change policies on the level and composition of employment. On the one hand, representatives of the energy-intensive industries claim that implementation of measures to fulfil obligations under the Kyoto Protocol will lead to job losses in these industries. Hence, they argue for exemptions, or other provisions that would limit impacts on the sectors in question – and consequently would increase the burden on other parts of the economy. Others point to the potential of increased employment in new, more energy efficient, sectors or technologies which can offset the job losses occurring in the conventional energy-intensive sectors or technologies.

1.2 Objectives

Taking into account these recent developments, the objectives of the 2001-2003 work programme on environment and employment were to:

1. Update information on employment in environmentally-related sectors in OECD Member countries;
2. Examine the contribution of environment-related *local* initiatives to sustainable development through their impact on employment;
3. Discuss *economy-wide* employment impacts of environmental policies in more depth; and,
4. Assess in particular the potential impact of climate change policies on employment.

A number of activities were undertaken to provide inputs for these four work components:

Concerning the information update on environment-related employment in OECD Member countries (component 1), a report was prepared based upon the replies to a questionnaire provided to the delegates and other data sources (OECD, 2002).

With respect to the contribution of *local* initiatives (component 2), a document focusing on the lessons from experience in the European Union was first elaborated (OECD, 2001a). This survey was complemented by a review of experiences in a few non-EU countries (OECD, 2002a).

Different reports provided inputs for components 3 (economy-wide employment effects) and 4 (effects of climate change policies) of the programme: a scoping paper on economy-wide employment impacts of environmental policy (OECD, 2001b); a survey of model-based literature assessing the economy wide employment effect of environmental policies (OECD, 2002b) and simulations of the employment effects of climate change policies using the Nemesis model (OECD, 2003a).

Drawing upon the information and the analysis carried out in the context of these four work components, this overall synthesis report on Environment and Employment was elaborated, as the final phase of the programme.

This synthesis report is based on contributions from Professor Rolf-Ulrich Sprenger - IFO, Munich (Chapters 2 and 3, Annex I and II); Nils-Axel Braathen and Philip Bagnoli - OECD Secretariat - and Professor Paul Zagamé with the assistance of Alexandra Niez - Université Paris I Panthéon-Sorbonne, Paris (Chapter 4); Professor Paul Zagamé, Arnaud Fougeyrollas and Pierre le Mouél - Ecole Centrale de Paris - with the assistance of the Secretariat (Annex III and IV). Ysé Serret - OECD Secretariat - coordinated the report.

1.3 Structure of the report

This Report is divided into six chapters structured as follows:

The context and objectives of the report are explained in the introduction (Chapter 1). Chapter 2 presents an update of the statistical information on environmental-related employment in OECD Member countries. The possible contribution of local/regional initiatives in integrating environment and employment objectives is then examined in Chapter 3, while the next chapter raise the issue at the macro-economic level. Chapter 4 reviews the literature on economy-wide employment effect of environmental policy and presents the results of simulations on the employment impacts of climate change policies. Finally, Chapter 5 draws general conclusions.

CHAPTER 2: ENVIRONMENT-RELATED EMPLOYMENT IN OECD COUNTRIES

Empirical evidence on environment-related employment is increasingly becoming available in OECD countries. Taking into account these developments, this chapter intends to improve the understanding of the employment effects of environment-related activities and to bring together available data in Member countries with a view to update the statistical information collected in 1997 (OECD, 1997). It is however impossible to summarise all the empirical studies done on this issue in this chapter.

The results presented here are subject to considerable variations due to various factors, such as the general economic conditions, the coverage of the analyses, the nature, timing and financing of environmental activities involved. Other difficulties stem from major differences with respect to definitions, data bases, and methodological approaches. *Therefore, the data are brought together here to provide order-of-magnitude estimates of the various employment effects of environmental protection.*

2.1 Measuring environment-related employment effects

The sustained policy interest in the impact of environmental policies on growth, competitiveness and employment raises a number of questions. These include how can environment-related activities be defined and identified, can we measure the employment effects of such activities? Answering these questions poses difficulties related to problems of definition, methodological concepts and data availability.

2.1.1 Definition of environment-related activities and actors

In identifying and measuring environment-related employment effects, one of the main obstacles is the definition of environment-related activities and the relevant actors. A number of studies and statistical surveys have tried to define, delimit and describe environment-related activities and the economic sectors where they are carried out, but there has been little agreement on them. There are a number of reasons for these divergences:

First, environment-related activities include a heterogeneous set of activities. At the core of these activities, there is a group of industrial and service activities which are carried out to clean-up existing processes and production ('end-of-pipe' equipment and/or technologies), treat water and effluent, and control air pollution. There is also a set of waste management and recycling technologies and services to deal with waste material and past environmental damage, and a growing range of environmental services such as research, design and engineering services. Most of these activities can be identified and measured, although they are heterogeneous.

Second, in the long run, 'cleaner technologies and products' will reduce the need for end-of-pipe and clean-up solutions, changing the relative importance of the present core activities. Clean technologies include activities which reduce or eliminate polluting emissions, but which are often carried out for other than environmental purposes. Therefore, their statistical assessment remains disputed because it is likely to produce imprecise, ambiguous and discretionary results.

Third, there is a group of activities which may be associated with environmental protection, although their primary purpose is not environmental protection, e.g. energy saving, organic farming, sustainable forestry, or eco-tourism. These activities are carried out for other economic reasons but are also beneficial to the environment.

Despite the complexity of definition and the difficulties to delimit, describe and assess the environmental content of a heterogeneous set of activities, there are now three groups of activities which are widely agreed on as being environment-related:

- Pollution management;
- Activities associated with cleaner technologies and products; and,
- Resource management.

Each broad category of activities is described in Table 2.1.

Based on this concept and in accordance with the OECD/Eurostat definition of the environmental goods and services industry (EGS), the following definition of environment-related activities seems to encompass the most pertinent considerations:

“Environmental protection consists of activities to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes activities, cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use (OECD/EUROSTAT, 1999).”

In analysing environment-related activities and their impacts on employment, another difficulty stems from the problem of identifying all actors involved in pollution management or resource management. A number of studies have focused on environment-related activities in the environmental goods and services industry or in utilities and manufacturing, others have also covered activities carried out in the public sector, producing divergent results. To achieve an analytical framework which will capture broader groups of environment-related activities, not only business activities but also public activities and activities of not-for-profit organisations should be included.

If data collection and analysis cover only business activities, then changes resulting from privatisation (or contracting out) of activities that were previously carried out in the public sector could lead to a misinterpretation of the measured employment effects and growth rates. Table 2.2 gives an overview of the main groups of actors carrying out environment-related activities.

To ensure correct interpretation of available information and international comparability it is most important to clearly label the groups of actors and the types of environment-related activities according to the matrix shown in Table 2.3. This matrix combines the major groups of actors (rows) and their environment-related activities (columns). The matrix is designed to reflect the structure of activities by sector and type of activity and to indicate where data are available. Not all cells in the matrix can be satisfactorily filled due to lack of information. In addition, not all the cells of the matrix can be considered to be important enough to justify time- and resource-efficient data collection.

Table 2.1: A typology of environment-related activities

A. Pollution Management:
<p>Production of equipment, technology and specific materials, provision of services, and construction and installation for:</p> <ul style="list-style-type: none"> Air pollution control Wastewater management Solid waste management Remediation and clean-up of soil, surface water and groundwater Noise and vibration abatement Environmental monitoring, analysis and assessment Environmental R&D Environmental contracting and engineering Analytical services, data collection, analysis and assessment Education, training, information Other
B. Cleaner Technologies and Products:
<p>Production of equipment, technology, specific materials or services for:</p> <ul style="list-style-type: none"> Cleaner/resource-efficient technologies and processes Cleaner/resource-efficient products
C. Resource Management:
<p>Production of equipment, technology and specific materials, provision of services, and construction and installation for:</p> <ul style="list-style-type: none"> Indoor air pollution control Water supply Recycled materials (manufacture of new materials or products from waste or scrap, separately identified as recycled) Renewable energy plant Heat/energy saving and management Sustainable agriculture and fisheries Sustainable forestry Natural risk management Eco-tourism Other

Source: OECD/Eurostat (1999).

Table 2.2: Major groups of actors carrying out environment-related activities

Groups of actors	Examples of activities
Business <ul style="list-style-type: none"> • Environmental goods and services industry • Construction • Recycling industry • Water industry • Manufacturing • Utilities • Services • Agriculture 	<ul style="list-style-type: none"> } Supply of goods and services } for environmental purposes Manufacturing materials from waste Water supply } In-house employment of } environmental staff; environment-related } ancillary activities not intended } for marketing
Public-private partnership	Energy and waste management, wastewater treatment and water supply
Not-for-profit organisations <ul style="list-style-type: none"> • NGOs • Research institutions • Third sector 	Social advocacy activities Environmental monitoring, analysis and assessment Environment-related training of unemployed
Public sector <ul style="list-style-type: none"> • Public administration • Public services • Public education 	Environmental legislation, permitting, enforcement Waste collection and management, wastewater treatment, water supply Environmental education
Private households	Waste separation and transport, energy saving

Table 2.3: Mapping employment-inducing environmental activities by groups of actors

Actors	Activities	Pollution Management	Cleaner Technologies and Products	Resource Management	Transversal Activities
Business					
Public-private partnerships					
Not-for-profit organisations					
Public sector					
Private households					

2.1.2 *Classification of environment-related employment effects*

Assertions made in the debate regarding the relationship between environmental policy and employment run the full range of outcomes. For the purpose of a comprehensive assessment of the environment-employment linkage, the full range of significant effects must be accounted for (OECD, 1997).

Positive and negative employment effects

Preserving and improving the environment can create new or preserve existing jobs. People are employed in the design, construction and operation of pollution abatement equipment and facilities. Employment may also be increased by specific job-creation programmes directed towards environmental projects.

On the other hand, environmental programmes can force plants to close down. They can cause price increases, and thus lower demand, production, and employment. And they might induce firms to shift new production capacity to foreign countries which have less stringent pollution control regulations.

Direct and indirect employment effects

Direct employment effects are the first-round changes in demand, output and employment induced by increased expenditures in environmental protection.

Environmental expenditure involve, along with other non-environmental expenditures, indirect (second- and third-round effects). These include employment effects due to:

- the demand for intermediate goods and services induced by environmental expenditures;
- multiplier effects through increased wage incomes generating further demand and employment;
- relative wage and price effects; and
- displacement effects due to the diversion of regular investments by pollution control investments.

Short-term and long-term employment effects

Many of the direct effects, such as impacts on demand, emerge relatively rapidly. Indirect effects, however, take much longer to work their way through the economy. Examples here are the long-term employment effects of an improved environment or a shift of mobile capital to 'pollution havens'.

Temporary and sustainable employment effects

When measuring employment effects it is important to specify those which are likely to be of a temporary nature and those which are sustainable (this term is used rather than "permanent" to underline the difficulty of predicting the actual duration of a job). Employment in the implementation of a specific policy measure or programme is usually transitory and experience shows that only a proportion of the employment effects can be expected to endure over even the medium-term.

Part-time and full-time employment

The employment effects of an environment-related activity may include both part-time and full-time jobs. Once again this distinction needs to be made in measurement and, consequently, two different types of figure are useful: first, full-time equivalents which reflect the aggregate amount of employment generated and, second, the simple number of jobs generated which better reflects the objective of combating unemployment.

Newly created and maintained jobs

A policy or activity may result in new employment being created or in existing employment being maintained. Created jobs refer to new posts while maintained jobs are posts which either would have been lost without the policy (protected jobs) or transformed by such assistance into viable employment. This distinction is particularly pertinent in the case of those interventions which are intended to protect existing levels of employment by assisting the adaptation of workers and the transformation of enterprises to more economically viable practices.

The scale of analysis

The employment effects of environmental policies can vary according to the scale of analysis: e.g. individual firms, industries, regions or countries.

Therefore, employment effects must be accounted for in terms of an adequate geographical and analytical scale.

Gross and net employment effects

Gross employment effects are only one side of the ledger. The net effects, can only be determined when a complete national balance sheet of the positive and negative, direct and indirect, short- and long-term employment effects has been drawn up.

Attempts to measure the net effects of programmes on aggregate employment and unemployment must not ignore what are called “dead-weight”, “substitution” and “displacement” effects. These effects are mostly relevant for employment programmes, i.e. programmes that attempt to stimulate job creation in the private sector (including self-employment), as well as direct job creation in the public sector. Since subsidised employment programmes have the explicit objective of increasing the number of jobs in the economy at large and/or raising the employment prospects of the target group, evaluations must determine whether the subsidised jobs would have been created anyway in the absence of the subsidy (so-called dead-weight effects). They must also seek to quantify whether improved employment prospects for the target group come at the expense of worsened employment prospects for other non-subsidised workers (so called substitution effects), or whether the subsidised jobs have displaced, or have been substituted for, unsubsidised jobs else-where in the economy (so-called displacement effects).

2.1.3 *Methods for data collection and analysis*

In general, data collection and analysis will depend on policy or research interest and statistical feasibility. The collection of information and the international comparability of data should be time- and resource-efficient and produce robust results which do not remain disputed.

As different methods of data collection pose different questions of data availability, data coverage and resource efficiency, those methods which best respond to policy interest and fulfil information needs should be used.

Since quantitative information is now increasingly available both on the level and the composition of environment-related employment effects, it might be helpful to present the various approaches used to investigate these employment effects.

In general, positive, direct and indirect employment effects can be and have been investigated using following approaches (see Table 2.4).

- Supply-side approaches;
- Demand-side approaches;
- Combined supply- and demand-side approaches; and
- Other approaches.

Supply-side approaches

They are characterised by the collection of data on the supply of goods and services for environmental protection, principally by means of targeted surveys of the EGS industry. Business associations, research institutes and more recently statistical offices have launched surveys of broader or narrower groups of environment-related activities. These surveys are often supplemented by labour market statistics for sectors with explicit environment-related activities.

Demand-side approaches

Demand-side approaches are characterised by the collection of information on the demand for goods and services for environmental protection and resource management in the form of the related expenditure.

Some demand-side studies try to estimate the direct employment effects by using figures for manpower requirements per unit of expenditure either by type of environmental measures and/or type of expenditure. This rather crude approach requires data on the labour component of various categories of environmental expenditure and entails dividing demand/output data by employment/output coefficients derived from data on productivity, labour requirements, etc. within the supplying industries. More sophisticated demand-side approaches try to estimate the direct and indirect employment effects using data on environmental expenditures and input-output calculations.

As a rule, statistics or estimates on public and private expenditures are used to derive final demand vectors for input-output calculations. Once the final demand vectors have been established the next step in the analysis entails multiplying the input-output ‘inverse’ matrix in turn by each of the vectors. The final step in the analysis requires the translation of output into employment by industry. This is accomplished by utilising data on manpower requirements, man-hours, and productivity within each sector. The use of an industry-occupation matrix and corresponding employment/output coefficients allows to estimate the number of jobs induced by environmental expenditures.

Combined supply- and demand-side approaches

Combining both supply- and demand-side data attempts to supplement available information on both sides and to benefit from the strengths and to reduce the weaknesses of the two approaches taken separately. Using an integrated approach may help to reconcile information on both sides in a consistent accounting work, it may also provide a more comprehensive picture by including indirect employment effects.

Other approaches

Some studies try to estimate the direct employment effects of environmental protection by defining and assessing ‘green’ jobs, i.e. jobs in the environmental sector and/or jobs requiring specific environment-related skills. Where ever possible these approaches try to use existing labour-market statistics for the relevant sectors or occupations.

Table 2.4: Approaches to identify and assess the positive employment effects of environmental and resource management

Types of approaches	Scope of analysis	Methodology and assumptions	Major data sources
1. Supply-side approaches	Direct positive employment effects in the environmental sector	Analysis of microeconomic data	Environmental business surveys
2. Demand-side approaches	Direct positive employment effects in the environmental sector	Calculation of manpower requirements per unit of environmental expenditure	Statistics or estimates on environmental expenditures and on jobs per unit of expenditures
	Direct and indirect positive employment effects	Input-output calculations using changes in final demand	Statistics or estimates on environmental expenditures; input-output tables; sectoral occupational data
3. Combined supply- and demand-side approaches	Direct and indirect positive employment effects	Supplementing available information on both sides	See above
4. Other approaches	“Green” jobs	Identification of jobs requiring environment-related qualifications	Labour market statistics by occupations; surveys

2.2 Available information on environment-related employment in OECD countries

Since the 1997 publication (OECD, 1997), information on environment-related employment in OECD countries is increasingly becoming available.

This section draws upon available statistical information and studies on employment in the environmental goods and services industry and other sectors of environment-related employment, and makes use of information gathered by an OECD survey of environment-related employment effects (see Annex I) and from sources such as individual OECD Member countries, Eurostat, the European Commission and individual consultancies or research institutes.

As underlined earlier, the available statistics and studies are subject to considerable variations, therefore, the data are brought together here to provide order-of-magnitude estimates of environment-related employment.

2.2.1 Level of environment-related employment effects

Direct employment effects

More information has become available on the direct employment effects of environmental and resource management in Member countries¹. Based on an OECD questionnaire (see Annex I) and a literature review, Table 2.5 provides up-to-date information on direct environment-related employment in OECD countries.

Environment-related activities in the business, public and third sector have become a significant source of employment in a number of OECD Member countries. Existing data indicate that the direct employment effects in the Environmental Goods and Services (EGS) sector alone vary between 0.4 and 3.0 per cent of total employment and between 1 and 1.5 per cent in the majority of countries². Since data on environment-related employment in the public and third sector is lacking for most countries, the estimates only represent the lower bound of environment-related employment.

However, these are not all new jobs, nor are they all attributable to (new) environmental legislation. Some of these jobs would most likely have existed even in the absence of new environmental legislation. On the one hand, activities regarding water supply and the collection and treatment of waste and wastewater entail employment in the relevant utilities and local services, and have done so in OECD countries for many decades. On the other hand, a significant number of environment-related new jobs results from a change of business attitudes as well as of consumer's preferences and demand for a cleaner environment.

Direct and indirect employment effects

The results presented in Table 2.5 only cover the direct employment effects in the sectors included, i.e. the first-round changes in demand, output and employment induced by expenditures for environmental and resource management. However, environmental expenditures also involve indirect (second- and third-round) effects due to the demand for intermediate goods and services induced by environmental expenditure. Various studies for (West) Germany provide estimates of both direct and indirect employment effects for the years 1990, 1994, and 1998. On the basis of surveys, labour-market statistics and input-output-analyses the number of jobs directly or indirectly related to environmental and resource management in Germany was estimated (see Table 2.6).

Table 2.6: Direct and indirect employment effects of environmental and resource management in Germany, 1990, 1994 and 1998

	1990	1994	1998
	Jobs ('000s)		
- Direct employment effects	458	764	1 122
- Indirect employment effects	137	192	165
Total	595	956	1 287

Note: Data are based on partly different definitions and methods of data collection; data for 1990 are for West Germany only. Sources: Sprenger et al. (1991), Sprenger et al. (2003).

¹ Some countries like Mexico where no official national data were available on environmentally related employment are also starting to compile statistics by sectors and by type of activities (OECD, 2003e).

² Preliminary assessments for Mexico where environmental jobs are estimated to account for about 1% of total employment are in line with most other OECD countries (OECD, 2003e).

Table 2.5: Direct environment-related employment in OECD countries, 1997 – 1999

Countries	Years	Private sector						Public Sector			Other Sectors	Total environment-related employment (sectors included)	Share of total employment in p.c.	Sources	
		Environmental goods and services Industry			Business			Total	Environmental services	Environ-mental administration					NGOs, Third Sector
		Total	Pollution management	Cleaner technologies and products	Resource management	Business									
Australia	1997	127,266	b)	b)	b)	c)	c)				c)	127,266	1.5	NIER (1998)	
Austria	1998	85,348	55,534	18,319	11,495	c)	c)				c)	85,348	2.3	Petrovic (2000)	
Belgium	1999	49,400		b)		c)	c)				c)	49,400	1.3	ECOTEC (2002)	
Canada	1998	95,042	b)	b/d)	b/d)	a)	a)	19,286	b)		b)	167,333	1.2	Statistics Canada (1999)	
Denmark	2000	61,000	b)		b)	c)	c)				c)	61,000	2.3	OECD (2002)	
Finland	1998	14,800	6,180	1,660	6,960	c)	c)	8,980			170	23,950	1.1	Saarnilehto (2000)	
France	1998	178,500	102,900	c)	75,600	d)	d)	25,200	77,700	20,000	9,000	310,400	1.4	IFEN/MATE (2002)	
Germany	1998	922,095	b)	b)	b)	b)	b)	84,125	38,450	71,430	18,000	1,134,100	3.2	Sprenger (2003)	
Greece	1999	42,400		b)		c)	c)				c)	42,400	1.1	ECOTEC (2002)	
Ireland	1999	11,200		b)		c)	c)				c)	11,200	0.7	ECOTEC (2002)	
Italy	1999	168,900		b)		c)	c)				c)	168,900	0.8	ECOTEC (2002)	
Japan	1997	695,145	b)	b)	b)	c)	c)				c)	695,145	1.1	OECD (2002)	
Luxembourg	1999	3,100		c)		c)	c)				c)	3,100	1.2	ECOTEC (2002)	
Netherlands	1997	46,633	43,533	c)	3,100	c)	c)	6,815	21,000	14,315	3,430	92,193	1.3	Dietz/Kuipers/Salomon (2000)	
Portugal	1997/1998	5,328	5,328	b)	b)	b)	b)	1,763	10,447	10,447	326	17,864	0.4	Romao (2000); OECD Survey (2002)	
Spain	1998	165,627	88,594	c)	77,033	c)	c)	10,447	b)	b)	c)	219,382	1.7	Price Waterhouse Coopers (2000)	
Sweden	1998	61,130	24,285	5,451	31,394	a)	a)	c)	c)	c)	160	61,290	1.5	Tängden/Svensson (2000)	
Switzerland	1998	52,388	38,558	1,320	12,510	d)	d)	7,030			2,670	62,088	1.6	Pillet (2000)	
United Kingdom	1999	279,700		b)		c)	c)	c)	c)	c)	c)	279,700	1.0	ECOTEC (2002)	
United States	1999	1,389,638	1,067,952	28,890	292,796	c)	c)	c)	c)	c)	c)	1,389,638	1.0	U.S. Dept. of Commerce (2001)	

a) Estimates based on official statistics, b) Not specified, c) Not covered, d) Only partly covered, e) Total including cross-sectoral activities, f) The number of people employed in the eco-industry sector in 1994 was estimated at 101 600 and about 30 000 new jobs were created in 1999 (OECD, 2002f).

Note: Data relate to different years (1997, 1998, 1999), and are based on widely different national definitions, methods of data collection and coverage of the universe. In cases where data were missing from the OECD survey, estimates were calculated based on existing national statistics and available imputation rates.

Even though this study represents the most comprehensive approach to assess environment-related employment³, the estimates do not include the indirect employment involved in providing goods and services for the personal consumption of these persons employed as a result of environmental expenditures (“multiplier effects”).

Environment-related jobs and full-time equivalents

The estimates noted above represent the number of environment-related jobs as usually measured in labour-market statistics. However, these are not all full-time jobs⁴. A study prepared for Germany (Sprenger and Rave, 2001) assessing the number of jobs in environment-oriented services indicates a significant difference between the estimated number of jobs and the person-years assuming full-time equivalents (see Table 2.7). This is accounted for by two factors: The first is that in some sub-sectors such as cleaning services and facility management more than 70% of the jobs offered are part-time, favoured by special provisions regarding taxation and/or social security contributions. The second reason is that higher shares of part-time employment can be observed in sub-sectors with a high share of female employees.

Table 2.7: Jobs and work volume in environment-related services in Germany -1998, by major sectors

Sectors	Jobs	Person yrs (i)
Agriculture, fishing and forestry	55,700	48,500
Manufacturing industry and utilities	253,900	244,900
Retail and wholesale trade and transport	166,500	149,000
Housing services, financial services, business-related services	168,500	139,600
Government services and other services	261,600	238,500
Total	906,500	820,500

Sources: Sprenger and Rave (2001).
(i) full-time equivalent

Environment-related employment growth

Various studies in the past have underlined the growing importance of jobs in the EGS sector (OECD, 1994; OECD, 1997). Available estimates suggested that growth for EGS employment was expected to be strong over the 90ies, ranging from 3 to 10 per cent. Some of these optimistic expectations appear to have materialised (see Table 2.8). Projections in Japan for 2010, for instance, see private environment-related employment increasing by about 25%. Assuming a more moderate 10% increase in the public sector, about 1 million jobs would be directly related to environmental activities by 2010 (OECD, 2002g).

For some market segments an even faster growth rate can be observed, e.g. for the private sewage and refuse disposal sub-sector. However, the growth rates in this sub-sector can be explained by and large by a privatisation or contracting out of services that were carried out previously by the public sector.

³ Estimates on the employment effects of pollution control and resource management are also available for the UK and conclude that some 465 000 jobs are directly or indirectly related to eco-industries, equivalent to 1.7% of total employment (OECD, 2002h).

⁴ Estimates on direct environmentally related employment in the Netherlands indicate that about 30% of these jobs are part-time (OECD, 2003d).

Table 2.8: Average annual growth in environment-related activities

Countries	Period	Category	Average annual growth rate in p.c.	Sources
Austria	1997-1998	Employment in the EGS sector	5.1	Petrovic (2000)
Canada	1997-1998	Revenues from sale of EGS	25 ^{a)}	Statistics Canada (1999)
Czech Republic	1995-2000	Employment in private sewage and refuse disposal	11.4	OECD (2001c)
Denmark	1996-1999	Employment in the EGS and energy sector	5.3	OECD (2002)
Finland	1995-2000	Employment in private sewage and refuse disposal	2.5	OECD (2001c)
France	1996-2000	Environment-related jobs	2.2	IFEN/PLANISTAT (2002)
Germany	1998-1999	Revenues from sale of EGS	4.6	Federal Statistical Office (2001)
Netherlands	1996-1998	Employment in the EGS sector	13.4	VLM (1998)
New Zealand	1995-2000	Employment in private sewage and refuse disposal	17.3	OECD (2001c)
Poland	1995-2000	Employment in private sewage and refuse disposal	4.2	OECD (2001c)
Switzerland	1995-2000	Employment in private sewage and refuse disposal	1.7	OECD (2001c)
United Kingdom	1995-2000	Employment in private sewage and refuse disposal	2.0	OECD (2001c)

a) 6% of this growth was due to improved coverage in the 1998 survey.

2.2.2 *Composition of environment-related employment effects*

Employment shares of the private, public and third sector

The public and private share of local environmental services and/or the ownership structures in the environmental services sector differ widely across OECD countries. Furthermore, significant changes are expected since there is evidence of a trend towards privatisation, either through full ownership privatisation of previously public services or through increased subcontracting to private suppliers. Changes in employment that result from such privatisation or contracting out of activities that were previously carried out in the public sector could lead to an overestimation and misinterpretation of the environment-related employment changes in the private sector and render national aggregates less comparable.

Table 2.9 provides an overview of the shares of the private, public and third sectors in total environment-related employment. Public shares range from some 11 per in Switzerland to 59 per cent in Portugal, with the majority in the range of one third of total environment-related employment.

Even though the share of the public sector appears to be less important than that of the private sector, environment-related employment is by and large a result of various governmental activities.

Table 2.9: Environment-related employment by sectors

Countries	Years	Total employment	Share of total employment (per cent)			Sources
			Private Sector	Public sector	Third sector	
Canada	1998	167,333	68.8	25.5	6.2	OECD (2002)
Finland	1998	23,950	61.8	37.5	0.7	Saarnilehto (2000)
France	1998	310,400	65.6	31.1	2.9	IFEN/MATE (2002)
Germany	1998	1,134,100	88.7	9.7	1.6	IFO (2002)
Netherlands	1997	92,193	58.0	38.3	3.7	Dietz/Kuipers/ Salomons (2000)
Portugal	1997/1998	17,864	39.7	58.5	1.8	Romao (2000); OECD Survey (2002)
Spain	1998	219,382	80.3	19.7	•	Price Waterhouse Coopers (2000)
Switzerland	1998	62,088	84.4	11.3	4.3	Pillet (2000)

Employment in the EGS sector by type of activity

Most of the national studies are limited to sales by and employment in firms providing goods and services for environmental and resource management. Even though these studies may use different definitions of the EGS sector, include different sub-sectors of the EGS universe and/or represent a different coverage of the sub-sectors included, some of these produce a breakdown of employment in the EGS sector by type of activity (see Table 2.10).

Table 2.10: Employment in the environmental goods and services industry by type of activity

Countries	Years	Total Employment	Share of total employment (per cent)			Sources
			Pollution Management	Cleaner technologies and products	Resource management	
Austria	1998	85,348	65.1	21.4	13.5	Petrovic (2000)
Finland	1998	14,800	41.8	11.2	47.0	Saarnihleto (2000)
France	1998	178,500	57.6	a)	42.4	IFEN/MATE (2002)
Netherlands	1997	46,633	93.4	a)	6.6	Dietz/Kuipers/ Salomon (2000)
Spain	1998	165,627	53.5	a)	46.5	Price Water-house Coopers (2000)
Sweden	1998	61,130	39.7	8.9	51.4	Tängden/ Svensson (2000)
Switzerland	1998	52,388	73.6	2.5	23.9	Pillet (2000)
United States	1999	1,389,638	76.8	2.1	21.1	U.S. Dept of Commerce (2001)

a) Not covered.

Available information indicates that the traditional “core” element of the EGS sector, the so-called “pollution management” sub-sector, still accounts for more than half of all jobs in the EGS industries⁵. However, where data were also gathered for suppliers of “cleaner technologies, products and processes, and firms involved in “resource management”, the latter’s share of total EGS employment can vary between 23% (United States) to 61% (Sweden). This demonstrates that employment levels for the wider EGS sector are significantly larger than for the core “eco-industry” as measured in the past (OECD, 1997). The broader definition and coverage of the EGS sector do not only explain the higher levels of employment compared to previous estimates, but also contribute to the observed change in the breakdown of employment by manufacturing industries and services (see also Table 2.11).

Table 2.11: Direct and indirect employment effects of environmental and resource management in Germany by major economic sector

	1984	1990	1994	1998
Total jobs (thousands)	433	546	956	1,287
Of which (in p.c.):				
Agriculture, fishing and forestry	0.4	0.3	0.3	4.3
Manufacturing, mining and utilities	48.6	49.1	44.1	40.2
Services and government services	51.0	50.7	55.6	55.5

Notes: Estimates are not fully comparable due to definition changes and sectoral or regional coverage; 1984 and 1990 West Germany only.

Sources: OECD (1997); Sprenger et al. (2003).

The data for the EGS industry should be complemented by the relevant information for the public and the third sector. Based on available studies, it can be assumed that most of the environment-related jobs in these sectors are still related to pollution management services, such as waste management and wastewater treatment.

Environment-related employment by major economic sector

Some of the studies focusing on the EGS sector also provide an industrial breakdown of the national aggregates. Apart from these EGS-specific data some studies for Germany also provide a breakdown of the more comprehensive national estimates of direct and indirect employment effects by major economic sector (see Table 2.11).

As can be expected from previous studies an increasing proportion of total environment-related jobs can be observed in the environmental services such as environmental administration, operation of pollution abatement equipment, local environmental services, consulting services, environmental research, education and training, etc. Correspondingly less and less jobs can be identified in the manufacturing industries producing pollution abatement equipment, instruments for monitoring, chemicals for controlling pollution etc.

⁵ A recent study on environment-related employment in the UK suggests similar results with 58% of the jobs directly linked to pollution control (OECD, 2002h).

The trend reflected by the available data can be explained by:

- a change in the definition of the EGS sector;
- the increasing availability of disaggregated data for environment-related activities; and/or
- the increasing importance of services in the knowledge-based economies on their way to pursue sustainable development strategies.

Environment-related employment by size of establishment

Taking a look at the EGS sector which is the major source of environment-related employment, available information for Canada indicates that the medium-sized and large establishments appear to be the major source of employment in the EGS sector. In 1998, there were 6,294 business establishments in Canada engaged, in whole or in part, in environment-related activities. Small establishments with fewer than 100 employees appear to dominate the EGS industry in Canada: they made up 96 per cent of all establishments in the Canadian environment industry (see Table 2.12) On the other hand, the share of the medium-sized and large establishments with 100 and more employees accounted for less than 4 per cent of all establishments, but generated more than 50 per cent of total environment-related revenues and employment.

Table 2.12: Distribution of environment industry establishments in Canada by number of employees, 1998

Number of employees	Share in p.c. of		
	Establishments	Revenues	Employment
0 - 4	52.0	5.7	4.6
5 - 9	14.3	4.7	5.2
10 - 24	16.8	13.0	12.8
25 - 49	7.8	11.8	11.2
50 - 99	5.1	12.8	14.7
100 - 499	3.5	31.4	29.0
500 - 999	0.4	13.1	13.2
1 000 +	0.01	7.6	9.2
Total	100.0	100.0	100.0

Notes: Figures may not add up to totals due to rounding.
Source: Statistics Canada (1999).

Export-driven employment in EGS sector

Contrary to what is often thought or said, exports appear not to be the major driving force of activities and employment in the EGS. In most countries, the exports of the national EGS industries represent less than 17% of all revenues, whereas only in Austria and Finland more than 50% of total EGS revenues are export-driven (see Table 2.13). However, even though small countries such as Austria and Finland appear to have a very high export rate, which is what would be expected for small countries, these countries do not have a large share of the global market. Reflecting this, the environment-related export rates are not markedly different from the overall profile of exports in both countries.

Table 2.13: Environment industry employment and revenues and share of export-related revenues or employment

Countries	Years	EGS Industry Revenues		Environment-related jobs	Share of export-related revenues/employment
		Currency	Millions		
Austria	1997	ATS	9,300	•	63,0
Canada	1998	Can. Dollars	14,278	•	8.3
Finland	1998	FIM	- 21,000	•	~ 50.0
France	1997	•	•	174,955	> 6.3
Germany	1998	DM	21,094	•	13.9
	1999	DM	22,066	•	16.9
Portugal	1997	PTE	63,612	•	15.1
Sweden	1998	SEK	163,041	•	17.1
United States	1989	US \$	196,465	•	10.8

Sources: OECD (2002); Statistics Canada (1999); IFEN (2000); Köppel (2000); Romao (2000); Saarnilehto (2000); Tängden and Svensson (2000); Federal Statistical Office of Germany (2001); US Dept. of Commerce (2001).

2.2.3 *Qualitative features of environment-related jobs*

Apart from the quantitative aspects of environment-related employment, qualitative features of the jobs under review are also an issue, both with respect to labour market policy and with respect to the strategy of sustainable development.

Occupational patterns

Taking a look at the EGS sector which is the one most favoured by environmental expenditures, available information indicates that it is a labour-intensive sector principally hiring people in the following occupations: Scientists and technicians, craft and service occupations, machine operators as well as helpers and labourers.

The EGS sector is rather oddly polarised into high-skill and low-skill areas. Such areas as waste management with a variety of waste collection, handling and recycling pick-up tasks often provide rather low-skill and low-pay jobs (see Table 2.14). The breakdown of employment given below for the traditional eco-industry that is providing equipment for pollution abatement is not markedly different from the overall profile of employment in any major “traditional” industrial sector. Inevitably such sectors rely heavily on relatively unskilled labour for much of their day-to-day operations, but they would not exist (and, more importantly, develop) without the skilled management executives, technicians and service experts who typically comprise one third of their workforce. However, there are many roles in the EGS Sector in which skills of the highest order are required – such as in environmental consulting

Against this background of general occupational patterns in the sub-sectors specialisation may vary in the countries under review.

Level of education

Data about the level of education is of interest when looking at the EGS sector as a source of new jobs. It has been suggested that both new low skilled and highly skilled jobs can be found in the various sub-sectors of the EGS industry.

Table 2.14: Environment-related employment by occupational groups and sectors

Occupational Category	Managerial Occupations	Scientists	Technicians	Sales and Admin. Support Occupations	Service Occupations	Craft Occupations	Machine Operators Assemblers	Helpers and Labourers
Countries and sectors in %								
Austria								
Total labour force	7	10	14	14	13	17	9	9
Eco-consulting	4	17	29	5	1	21	20	2
Eco-industry	2	0	9	9	3	12	17	49
Waste management	3	0	4	7	0	16	38	31
Germany								
Total labour force	6	13	20	13	11	18	7	8
Eco-consulting	12	50	21	7	1	7	0	3
Eco-industry	6	3	17	23	0	11	18	21
Waste management	6	2	6	18	0	14	35	20
Netherlands								
Total labour force	12	17	17	12	13	10	7	9
Eco-consulting	5	5	19	6	10	42	2	7
Eco-industry	11	7	5	7	24	6	6	32
Waste management	7	0	6	9	2	53	21	2
Portugal								
Eco-industry	10		14	17		5		54
Spain								
Total labour force	9	11	9	10	14	17	10	14
Eco-consulting	6	2	30	19	6	22	11	4
Eco-industry	2	1	41	15	2	24	14	1
Waste management	3	2	2	9	0	30	52	2
Sweden								
Total labour force	5	15	20	11	18	12	11	5
Eco-consulting	5	0	88	6	0	0	0	1
Eco-industry	6	7	16	14	18	30	8	1
Waste management	9	0	3	9	3	65	7	3
Total (excl. Portugal)								
Total labour force	7	13	17	12	13	17	8	9
Eco-consulting	5	9	29	7	6	30	6	5
Eco-industry	6	3	12	11	11	12	12	32
Waste management	6	1	5	11	1	36	29	12

Sources: Institut für Wirtschaft und Umwelt (2000); OECD Survey (2002).

According to a comparative study done by the Austrian Institut für Wirtschaft und Umwelt, employment, the EGS industry does not necessarily require skills beyond the general qualification requirements of the sector of employment (see Table 2.15). However, in the sub-sector of eco-consulting, employment appears to be highly sophisticated: these firms employ relatively high levels of university and college graduates compared to the average qualifications in the national labour forces under review.

While a completed education and training is not relevant for most of the jobs offered in waste management, in the eco-industries the share of employees that completed their educational and vocational training is above average. In the eco-industries secondary education or completed apprenticeships dominate, while higher education is prevailing in eco-consulting. Correspondingly, in eco-consulting the share of employees with technical training is above average.

Share of foreign employees

The share of foreign workers of the labour force can be considered as an indicator for problems of specific labour market segments where migration policy may contribute to overcome bottlenecks.

According to existing information, the sub-sectors of the EGS industry employ relatively more foreign workers compared to the average of the national economies (see Table 2.16).

Only in Sweden the share of foreign employees in the EGS sectors is significantly below the national average, whereas in the Netherlands a surprisingly high share of foreign employees can be observed in the eco-consulting sector.

It doesn't come as surprise that the highest share of foreign workers is found in waste management and waste sorting in particular. Apparently these activities do not require highly qualified labour. This sub-sector relies heavily on relatively unskilled labour in the following occupations: machine operators, helpers and labourers. Furthermore, advanced knowledge of the nationally spoken language is not a precondition for being hired.

Table 2.15: Environment-related employment by educational background and sectors

Levels of education	University	Advanced technical College	Grammar school, secondary school, apprenticeship	Compulsory school, no learning certificate
Countries and sectors	Shares in per cent			
Austria				
Total labour force	7	2	69	22
Eco-consulting	25	15	60	0
Eco-industry	3	4	69	24
Waste management	1	0	42	57
Germany				
Total labour force	15	9	59	14
Eco-consulting	54	22	21	2
Eco-industry	6	9	57	28
Waste management	5	6	61	28
Netherlands				
Total labour force	26		43	31
Eco-consulting	13	26	54	2
Eco-industry	11	21	52	15
Waste management	2	7	55	35
Spain				
Total labour force	17	8	17	58
Eco-consulting	41	20	40	0
Eco-industry	33	29	27	11
Waste management	3	3	28	66
Sweden				
Total labour force	13	16	50	21
Eco-consulting	15	23	62	0
Eco-industry	13	16	59	13
Waste management	4	4	47	45

Total (countries included)				
Total labour force	16	8	48	26
Eco-consulting	17	23	55	1
Eco-industry	9	12	58	21
Waste management	3	5	50	42

Source: Institut für Wirtschaft und Umwelt (2000).

Table 2.16: Environment-related employment and share of foreign workers (per cent)

Countries	Total labour force	Eco-consulting	Eco-industries	Waste management
Austria	10	2	12	11
Germany	9	7	6	10
Netherlands	4	23	10	8
Spain	1	3	0	2
Sweden	5	1	1	1
Total	6	14	9	7

Source: Institut für Wirtschaft und Umwelt (2000).

Share of female employees

Another labour market indicator is the share of female employees in the sectors under consideration. Available information indicates that the share of female employees in the EGS sub-sectors is significantly below the national averages (see Table 2.17).

Table 2.17: Environment-related employment and share of female employees (per cent)

Countries	Total labour force	Eco-consulting	Eco-industries	Waste management
Austria	44	17	30	8
Germany	43	20	12	15
Netherlands	42	18	7	7
Spain	35	37	24	8
Sweden	48	23	24	10
Total	42	19	19	10

Source: Institut für Wirtschaft und Umwelt (2000).

The lowest share of female employees can be found in waste management, a sector dominated by men. Only in the internal administration of the firms women are more likely to be employed. Although compared to waste management significantly more women are working in the eco-industries and in eco-consulting, their share of female employees is far below the national averages as well.

Part-time employment

The estimates for aggregate environment-related employment have already shown that employment measured in full-time equivalents is significantly lower than the simple number of environment-related jobs (see also Table 2.18).

Taking a closer look at the phenomenon of part-time employment in the EGS sub-sectors, survey results for seven countries indicate that part-time jobs can be found particularly in the EGS sectors of those countries that appear to have introduced more favourable framework conditions for part-time

employment such as child care services, social security provisions etc.: Denmark, France, and the Netherlands (see Table 2.18). As regards the various sub-sectors of the EGS industry part-time employment is scarcely represented in waste management, where male employees and full-time contracts are prevalent. Higher shares of part-time employees can be found in eco-consulting and the eco-industries in activities showing a high share of female employees as well.

Table 2.18: Full-time and part-time jobs in environment-related activities

Sectors	Share of part-time jobs in per cent			
	Total labour force ^{a)}	Eco-consulting	Eco-industry	Waste management
Countries				
Austria	12	6 ^{b)}	4 ^{b)}	3 ^{b)}
Denmark	10		26 - 27	
France	24,5		10	
Germany	17	7 ^{b)}	3 ^{b)}	5 ^{b)}
Netherlands	30	14 ^{b)}	29 ^{b)}	3 ^{b)}
Spain	8	3 ^{b)}	1 ^{b)}	2 ^{b)}
Sweden	14	7 ^{b)}	4 ^{b)}	1 ^{b)}

Notes: a) Share of those usually working less than 30 hours per week.

b) Share of those usually working less than 35 hours per week.

Sources: Institut für Wirtschaft und Umwelt (2000), OECD Survey (2002), IFEN/MATE (2002), ILO (2001).

2.3 Conclusions

Environment-related activities in the business, public and third sector have become a significant source of employment in a number of OECD member countries. Existing data indicate that the direct employment effects in the EGS sector alone vary between 0.4 and 3.0 per cent of total employment (between 1 and 1.5 per cent in the majority of countries).

These figures are meant to be a lower-bound estimate. In particular, areas such as environment-related jobs in the regulated industries, in the public sector and in the third sector were not taken into account in most countries under review. Moreover, the figures presented do not include indirect and multiplier effects resulting from the first-round effects of direct environment-related employment.

The estimates presented above are not comparable with the previous analysis of environment-related employment in OECD Member countries (OECD, 1997). This is mainly due to:

- a wider definition of the Environmental Goods and Services Industry;
- a better statistical coverage of all sub-sectors; and
- improved methods of gathering information.

Despite the improved coverage of OECD countries, a more consistent definition of sectors and activities to be included and an improved statistical coverage, there is, however, a continual need for improvements in the coverage and availability of environment-related employment data on an OECD-wide basis.

CHAPTER 3: INTEGRATING ENVIRONMENTAL AND EMPLOYMENT OBJECTIVES AT THE 'LOCAL' LEVEL

3.1 Introduction

Territorial initiatives, partnerships, networks and other forms of collaboration represent an increasingly important response to problems of unemployment, social exclusion and environmental disruption. In many OECD countries, in particular the European Union, these “bottom-up⁶” approaches have gained increasing importance in recent years. The aim of such initiatives is to harness the skills and resources of the key local actors -such as public authorities, employers, intermediary organisations, voluntary organisations and local community groups- in developing and implementing local strategies for integration of employment and environmental concerns.

While the principles of bottom-up initiatives are now quite widely accepted, relatively little evidence is available about the advantages and disadvantage of different approaches, and about the outcomes for different players and stakeholders, including both those directly involved in local/regional initiatives and those who have a wider interest in the success of such territorial initiatives. Moreover, while the establishment of local partnerships for a better integration of employment and environmental issues has become increasingly widespread in recent years there has been only limited *ex-post* evaluation and *ex-ante* assessment of specific initiatives, particularly on a cross-national basis.

Policy-makers and institutions seeking to create, stabilise or reinforce territorial initiatives attempting to combating unemployment, social exclusion and environmental degradation are faced with a number of issues that this paper seeks to explore. The methodology for the research was thus developed with the following objectives in mind:

- the need to develop an analytical framework to guide identification and understanding of the different forms of territorial bottom-up initiatives, but also to gain an overview of the major drivers of these initiatives; and
- the need to survey and document a significant number of territorial initiatives, in order to gain a grasp of the various types and experiences which exist, but also to analyse how bottom-up approaches actually work.

To meet these objectives, this chapter includes an:

- overview of the concept of bottom-up approaches exploring the different forms and the rationale for bottom-up initiatives;

⁶ The terminology “bottom-up” approaches as used in this report refers to “local/regional” or territorial approaches. It is distinct from “bottom-up” models which adopt a micro-economic point of view as opposed to “top-down” models.

- overview of the main features of all the territorial initiatives researched, the effects of territorial initiatives on employment and environmental improvements and their policy impacts; and
- analysis of success factors and obstacles of territorial initiatives.⁷

3.2 Bottom-up approaches for integration of employment and environmental Objectives: An Overview

3.2.1 Definition of Bottom-up Approaches

In general, two different approaches can be identified to integrate environmental and employment policies: the “top down” and the “bottom-up” approach. The first one is directly established at the “top” level due to the general character of a macro-economic policy. The second is confined to the “bottom” level, envisaging initiatives and specific commitments of local actors in taking simultaneously into account local or regional peculiarities. “Bottom-up” has quickly become a keyword both in relation to policy responses to integration of employment and environmental concerns, but also more widely in searching for new ways of coping with profound economic, social and political changes in the process of globalisation. The bottom-up concept is however used in many different ways, and is rarely defined very precisely. It is employed generally, alongside words like local initiative, local partnership, collaboration and networking. To an important degree, bottom-up initiatives are associated with the notions of self-help, participation mobilisation, co-operation and trust, reflecting the social capital of a given territory.

In order to distinguish bottom-up approaches from more limited and/or informal processes of collaboration, and to guide identification of suitable examples of bottom-up approaches for the analysis, a specific working definition of bottom-up approaches must be adopted. The definition adopted includes:

- A process through which a certain number of local stakeholders mobilise themselves in a given territory in order to initiate activities using, if possible, the resources of the territory.
- An attempt to involve and empower those people affected by the problems in the development and implementation of the solutions.
- The initiatives must spring from the local level and not be imposed by a higher authority.
- The mobilisation of a coalition of interest and the commitment of a range of key actors of a territory.
- A greater participation in the decision-making and actions of local stakeholders which often have been ignored by past policies.
- A formal organisational structure for project development and implementation.
- A common agenda and action plan.
- An approach to cover a broad range of employment, social and environmental issues (see for example Geddes, 1998).

The territory provides the focus for the bottom-up initiative. Therefore, initiatives must have a clear territorial content, responding to territorial problems, objectives and preferences, to be initiated and carried out by institutions and people of a given territory. The territory is not necessarily defined by political or administrative delimitations; the size of the territory concerned rather depends on the

⁷ This chapter is largely based on Sprenger (forthcoming).

functional context, i.e. where institutions and people can most easily collaborate to tackle commonly perceived concerns (OECD/LEED, 1999).

3.2.2 *Types of Bottom-up Approaches*

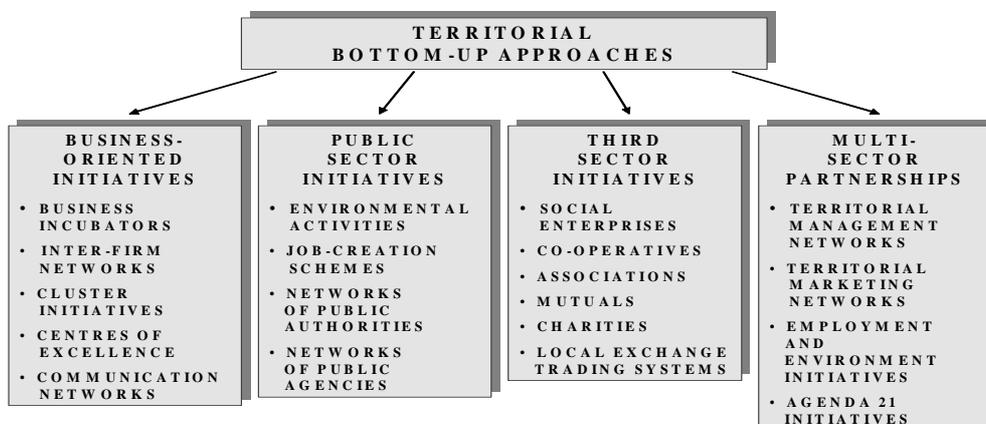
Bottom-up approaches can take different forms and their work tends to cover a broad range of employment, social and environmental issues. They range from small, local, voluntary organisations and associations or networks of SMEs in the eco-industry to large multi-sector partnerships engaged in Local Agenda 21 or regional sustainable development.

Therefore it appears to be useful at the beginning of the research to establish a common framework for the identification and differentiation of the wide range of territorial initiatives likely to be involved in combating unemployment, social exclusion and environmental disruption.

The bottom-up approaches included in the research fall into four main categories, classified according to their orientation and the type of stakeholder (see Figure 3.1):

- Territorial initiatives of - or aiming at the private sector;
- Territorial initiatives of the public sector;
- Territorial initiatives of the so-called third sector; and,
- Territorial initiatives of - or aiming at multi-sector partnerships.

Figure 3.1: Types of bottom-up approaches



Source: Sprenger (forthcoming).

This distinction is customary, though somewhat artificial, and not always clear-cut. Public sector bodies, for example, may act as catalysts for the establishment of local inter-firm networks or may be involved in funding organisations of the third sector. Social enterprises, although based in the third sector, intend to be economically viable businesses and have to live, to a significant extent, on market revenues. Some multi-sector public-private-partnerships may turn into businesses subjected to the imperative of profit making. Furthermore, regional inter-firm networks or cluster initiatives are not completely independent from their respective political-institutional environment. This chapter uses, as far as possible, the above-mentioned categories of initiatives.

Territorial Initiatives of - or Aiming at the Business Sector

If the partners of a territorial initiative are exclusively companies or if the initiative aims at strengthening the competitiveness of existing firms in the territory concerned or at searching for activities that can exploit new and growing markets, then this initiative is referred to as a business-oriented initiative. Within this group several types can be differentiated:

- Territorial business incubators, which primarily aim to assist entrepreneurs with enterprise start-ups by providing a combination of workspace, business services and utilities.
- Territorial inter-firm networks, where companies contribute information, know-how, services or funds in a joint capacity or competence management.
- Territorial cluster initiatives, a regional accumulation of companies of various fields whose services complement each other in a way so that meaningful co-operation and networking is possible.
- Territorial centres of excellence, representing a form of network in which co-operation between companies, state agencies, universities and research institutes occurs.
- Territorial communication networks which, similar to regional marketing networks, are concerned with pre-competitive image-building for a certain product, service or system resolution.

Territorial Initiatives of the Public Sector

The public sector with its local authorities and agencies is represented in many territorial initiatives by:

- providing job opportunities through direct job creation in the public sector; and
- partnerships wholly or very largely among public sector authorities and agencies.

The corresponding institutions to inter-firm networks in the public sector are regional and local authority networks (e.g. municipal networks), universities or independent research institutes as well as educational institutions. Environmental activities in the public sector are usually in the areas of waste collection and management, wastewater treatment and fresh water supply.

Research and educational institutional networks play an important role in regional development. Close co-operation between universities and other knowledge transfer institutions that allows for the swift exchange of information and expertise is of great importance to regional economic structure and the job market.

Territorial Initiatives of the Third Sector

Another group of bottom-up initiatives are taking place between the public and private sectors. Whilst there is not a full consensus, initiatives in this field are sometimes called the "third sector", the "third system", or the "social economy".

The term third sector generally includes a whole range of local initiatives dedicated to provide goods and services which belong to neither the public sphere nor to the world of private enterprises. They tend to differ from classical enterprises by having no profit-making aims. Examples are associations, co-operatives, mutual organisations, foundations, charities and social enterprises.

Social enterprises are one of the main pillars of the Third Sector. Although based in the non-profit sector, social enterprises intend to be economically viable businesses which balance their budgets by successfully combining market revenues, public grants, non-monetary resources (voluntary work) and private grants. They are particularly active in reintegrating disadvantaged groups in the labour market, in revitalising distressed areas and in providing local environmental services of community benefit, such as street cleansing, waste management, recycling and repair services (Heschl and Stüger, 1997).

Territorial Initiatives of - or Aiming at Multi-sector Partnerships

Finally, there are broad multi-sector partnerships, including representation of business, public, voluntary and community interest, adapting a multidimensional approach to problems of unemployment, social exclusion and environmental degradation.

The term multi-sector partnership or regional network can be defined as co-operation between (small and medium-sized) businesses, government agencies, educational and research institutions, intermediary institutions and other groups. Within territorial networks supporting employment and environmental protection co-operation usually occurs between companies, intermediary organisations (e.g. chambers of commerce, trades associations and guilds), government offices, educational and research institutions and other various groups of society. Some typical examples of regional networks in the area of 'employment and environmental protection' are:

- territorial management and marketing networks; increasing the region's ability to function and compete through initiation and continuation of integrative territorial development processes;
- watershed partnerships, which aim at decision making consensus in cases of regional, often cross national conflicts, through a process of mediation;
- territorial employment and environmental protection initiatives, which aim to secure or create jobs and stabilise the regional and local economy through effective employment campaigns and co-operation; and
- Agenda 21 initiatives, going back to the 1992 UNCED conference in Rio de Janeiro giving an important impetus for co-operation and networking to local participants.

3.2.3 *The Rationale for Bottom-up Approaches*

While the types of bottom-up approaches and the content of territorial efforts may vary, they share a fundamental logic which can be summarised as:

- responding at the territorial level to the failures of markets and/or national government policies to provide what is required in the territories;
- responding to the challenges of globalisation with rapidly changing markets and technologies where the success depends on the quality of their local environment which provides the context in which they operate;
- adding value to employment and environmental policies designed and implemented by national governments by:
 - generating additional proposals for action by local-level actors and by mobilising resources and competencies in the territory to help achieve them;
 - tailoring policy solutions towards the district needs and circumstances of the territory;

- enabling an active form of citizen participation at the territorial level and thus widening participation in processes of change within the economy and the society;
- improving territorial governance through involving stakeholders in the formulation and delivery of policy making;
- providing a forum for consensus-building and the promotion of a strategic territorial approach;
- contributing to synergies between different actors operating within the territory and to a level of co-ordination between agencies and policies that was not achieved with segmented and sectoral policies established at national level with insufficient regard for local conditions;
- facilitating co-ordination in action and thus realising benefits from avoiding overlap and duplication.

In addition to this more fundamental logic of bottom-up approaches, a number of specific reasons for pursuing specific forms of territorial initiatives can be identified.

Business-oriented initiatives, such as supporting start-ups, inter-firm networking or clustering; the main interests are strengthening the competencies of existing firms, encouraging self-employment and the creation of new jobs, attracting inward investment and releasing supply-side improvements in terms of hard and soft infrastructure for businesses.

Public sector initiatives: their most pervading concerns are job creation and reintegration of disadvantaged groups into the labour market as well as improvement of the quality of the physical fabric of a territory.

Third Sector initiatives aim at responding to needs that are not met either by the market or by the Welfare State. As governments face increasing difficulties in meeting the welfare needs of our societies, third sector organisations are playing a key role in providing additional social and community services that neither the state nor the market can supply.

With respect to multi-sector partnerships there is a growing consensus that activities to achieve sustainable territorial development need to be multidimensional in their scope, including a concern with a broad range of economic, social and environmental issues of a territory, and must be based on broad, multi-partner partnerships, including representation of business, public, voluntary and community interests. In the case of watershed partnerships, the conflict of these diverse interests is sought to be solved through an elaborate mediation process.

3.3 Bottom-up approaches aiming at integrating employment and environmental objectives: available evidence

This section will be primarily concerned with similarities and differences in experiences of bottom-up approaches seeking to address unemployment, social exclusion and environmental degradation.

The section is based on examples of bottom-up approaches in OECD countries identified by literature review, official information, country case studies and internet search. These examples do not claim to be models of bottom-up approaches focusing on the integration of employment and environmental objectives, nor have they been chosen on the basis of a systematic analysis of all possible cases. The examples were selected to include, if possible, a range of bottom-up approaches in each country conforming as closely as possible to the working definition of bottom-up approaches described earlier. Although emanating from a wide range of areas, the examples possess certain common

characteristics, those of a bottom-up approach, an innovative quality, the promotion of an integrated action strategy and the search for an enlarged partnership.

The case studies are grouped into the following categories:

- Europe, for all EU member countries;
- NAFTA, for the three North American countries;
- Japan/Oceania (JP/OC), consisting of Japan, New Zealand and Australia; and the
- Central Eastern European Countries (CEECs).

The presentation and analysis is to serve rather as a source of information and inspiration on a number of appropriate experiences and to offer a better understanding of the challenges, opportunities and constraints associated with bottom-up approaches. The list of bottom-up approaches identified and selected for this analysis, including those where case studies were undertaken, is given in the Annex II.

3.3.1 *The Location of Territorial Initiatives*

The selected territorial initiatives include 169 European and 49 non-European cases. An overview is presented in Figure 3.2.

Territorial initiatives have been developed especially in locations where unemployment, social exclusion and environmental problems are geographically located. These generally range from inner city and urban areas, to old industrial regions, rural regions and localities, and coastal regions (Figure 3.3).

There is often a close linkage between the formation of territorial initiatives and a local socio-economic or environmental crisis, but a crisis does not inevitably trigger the formation of partnerships. Local communities in crisis need to retain a sufficient social cohesion and purpose for partnerships to develop (Geddes, 1998). Partnerships may not emerge in areas, however, where crisis has reigned for generations or is spatially so diffused that local leadership is hard to establish.

Similar to the European initiatives, initiatives outside the EU tend to develop primarily in urban/industrial and rural areas. Only within the CEECs, 60% of all initiatives focus on regional issues. The significance of watershed areas (focus of 12% NAFTA countries and 20 % JP/OC) will be further evaluated.

Figure 3.2: Location of Territorial Initiatives aimed at linking Employment and Environmental Objectives

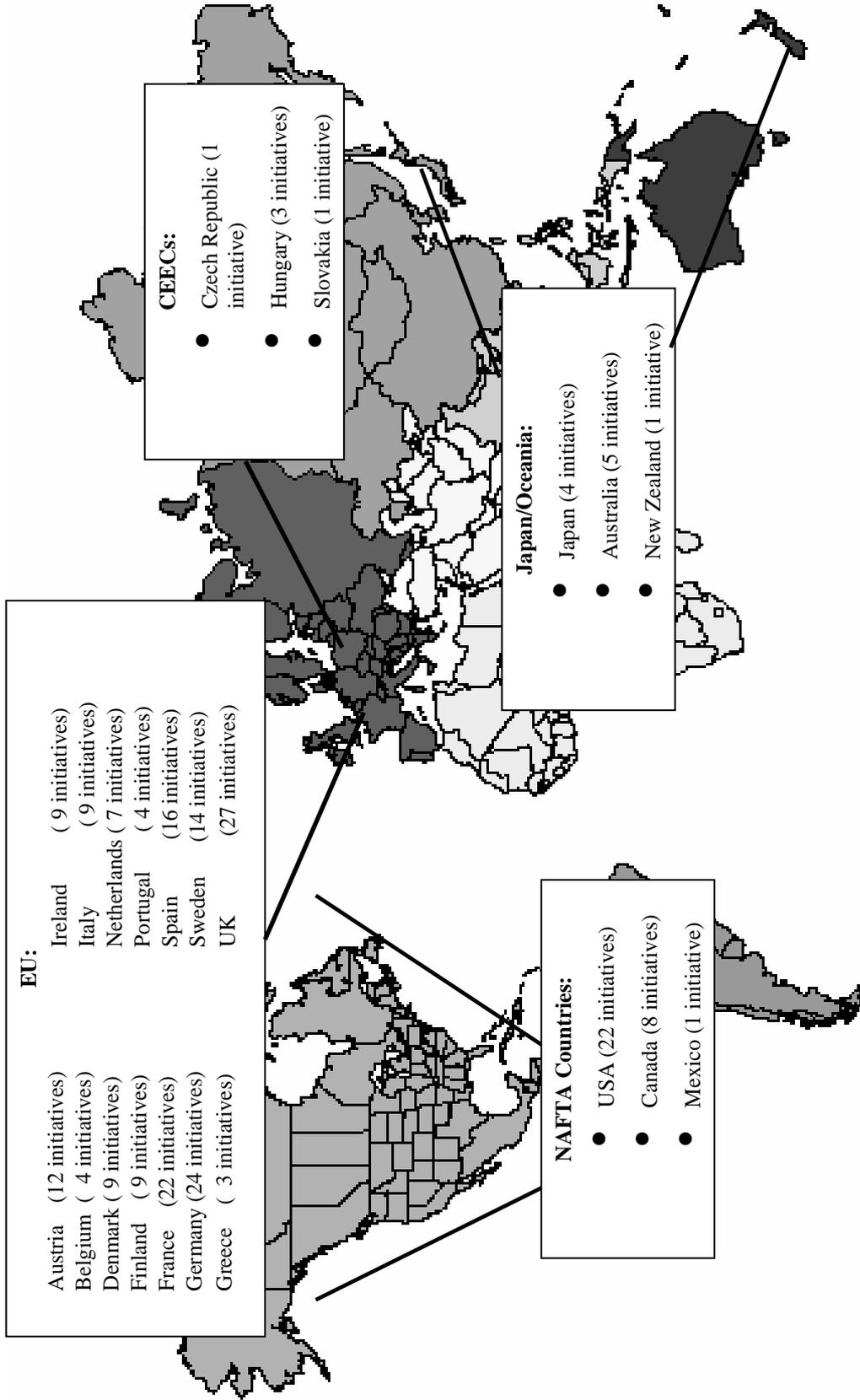
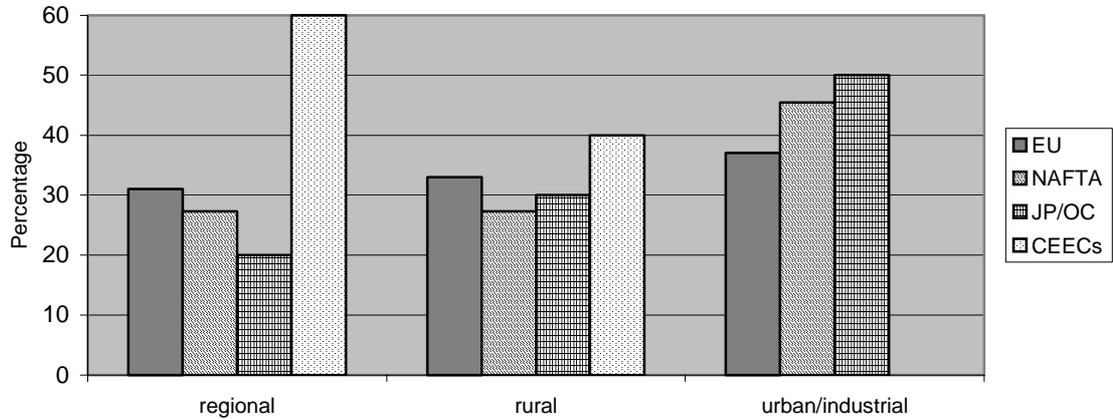


Figure 3.3: Geographical context of territorial initiatives aimed at linking employment and environmental objectives



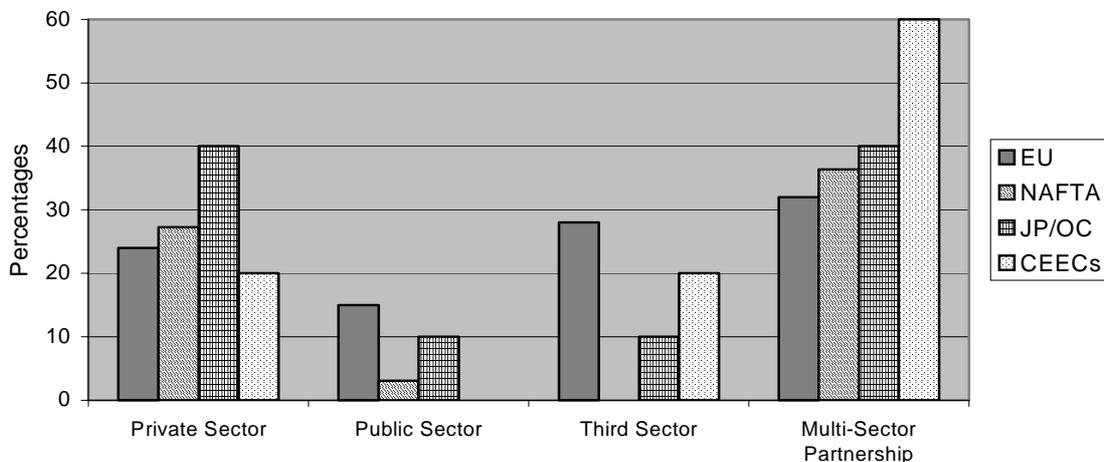
3.3.2 *The Sectoral Focus of Territorial Initiatives*

The research shows that the impetus for the formation of territorial initiatives can come from many sources: private sector, public sector, third sector, multi-sector partnerships.

Figure 3.4 shows the sectoral focus of territorial initiatives focusing on environmental and employment objectives. Within the EU, nearly one fourth of all initiatives identified in the research focus on the private sector, mainly inter-firm networks in the eco-industry or initiatives to increase opportunities in the area of organic farming, cleaner production and green technology. The strongest impetus comes from multi-sector partnerships followed by third sector initiatives.

Compared to the European initiatives, the distribution among sectors is a lot less even among the non-EU countries. The concentration is again on multi-sector partnerships and the business sector, but public and third sector partnerships are under-represented or even missing.

Figure 3.4: The sectoral focus of territorial approaches aimed at linking employment and environmental objectives

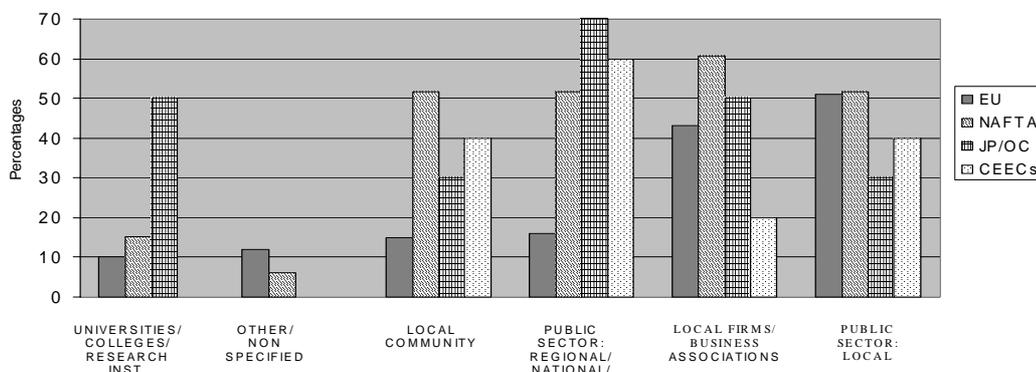


3.3.3 The Partners in Territorial Initiatives

The interests represented in territorial initiatives are extremely diverse. Figure 3.5 shows the extent to which different partner interests are present in the territorial initiatives included in the research. Local public sector authorities and the private sector are represented in the majority of the European initiatives identified in the research, ranking between 40 – 50 % of all initiatives. Private involvement in particular is increasingly promoted by EU programmes, and by some national government programmes.

In some European countries, the participation of different tiers of government in “vertical partnership”, from the local to the regional or national or even to the EU level, is also a major feature. Regional, national governments and/or EU institutions are partners in 17 % of all cases, giving local initiatives a better access to EU or national resources and decision-making.

Figure 3.5: The main partners in territorial initiatives aimed at linking employment and environmental objectives



The involvement of local community organisations and interests as partners is a feature of 13 % of the European initiatives in the research. The direct representation of community interests as partners is therefore not a feature of all local initiatives. In some, local interests are indirectly represented by elected local politicians, or even more indirectly by officials from local public authorities. Local communities may only be consulted or represented in specific projects, but not in the main partnership structure. Alongside local authorities and firms, other local public or quasi-public institutions (such as universities, colleges, research or training institutions) are also frequently represented in territorial initiatives.

While in European countries, public sector and private businesses are identified as the major partners, NAFTA countries show a 50 – 60% representation of local community, regional/national/local as well as private firms in their initiatives. Universities and research institutions are surprisingly underrepresented despite the large academic communities in both Canada and the US.

Japan and Australia represent universities and research institutions in 50 % of their initiatives and also demonstrate a high involvement of regional/national public sector as well as private business sector. The CEECs demonstrate high public involvement, 40 %, coupled with regional, national and local public sector interests, 60 %. Private businesses and firms are represented to a smaller degree which could be explained by high economic uncertainties and fear of risks.

The direct involvement of local communities is notably stronger in the non-EU initiatives, especially in NAFTA countries and the CEECs.

3.3.4 *The Environmental Focus of Territorial Initiatives*

Territorial initiatives vary greatly in the scope and focus of their environment-related activities. The research shows the diversity of the strategies, action plans and activities (see Figure 3.6).

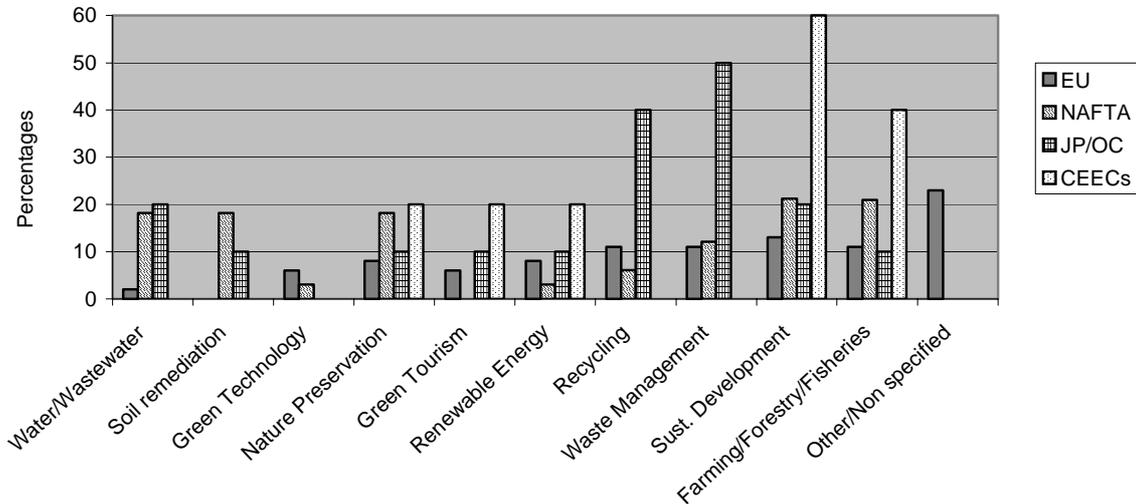
The foci within European countries are very diverse and range from environmental management training, green products marketing (other than organic produce), noise reduction and air pollution measures to clean-up programmes, environmental consulting and green education (over 20 % Other/Non specified).

The focus on recycling (40 %) and waste management (50 %) in Japan/ Oceania stems mainly from increased efforts of Japanese partnerships – usually in form of eco-industrial parks – to achieve “Zero emission”. Lack of landfill space and incineration capacity translated the “Zero emission” program, which originally included all emissions, to a “Zero waste” mission. Brownfield redevelopment initiatives make a significant contribution in heavy industrialised countries such as Japan, United States and Canada (10 – 20%) and are responsible for soil remediation.

Watershed partnerships represent a near 20 % focus in NAFTA countries and Australia/New Zealand, but are totally absent in European countries (except for one Swedish case, see Appendix).

Many initiatives also have more than one environmental focus, often by accident. Most waste management initiatives, for example, are inextricably linked to recycling or repair activities, nature preservation to green tourism, or sustainable development to renewable energy, green technology and ecological building. The research also shows that initiatives in which activity is focused on more specific environmental issues are paralleled by multidimensional approaches. These latter include Local Agenda 21 initiatives and initiatives focusing on regional sustainable development.

Figure 3.6: The environmental focus of territorial initiatives aimed at linking employment and environmental objectives



3.3.5 The Employment Focus of Territorial Initiatives

The research suggests that local/regional initiatives aimed at linking employment and environmental objectives tend to focus on the creation of new jobs (Figure 3.7). The distribution of *local* initiatives by categories of employment measures is provided in Figure 3.8.

Figure 3.7: The employment focus of territorial initiatives across the EU

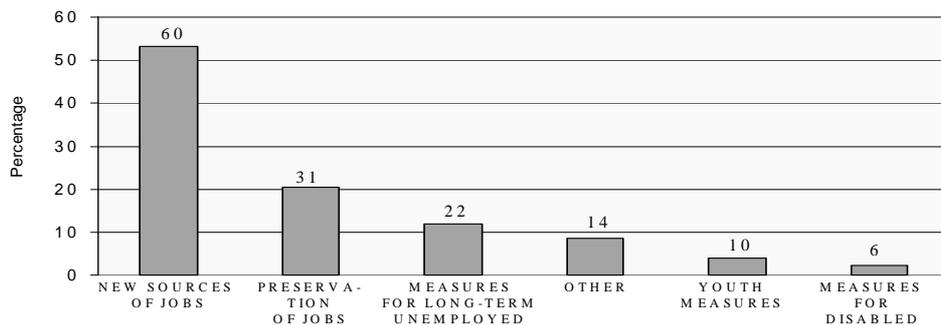
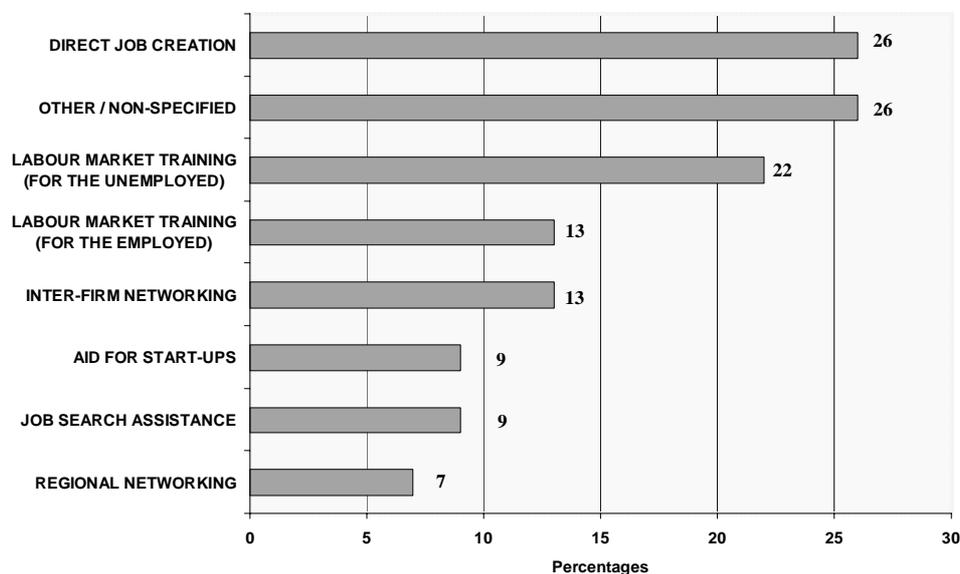


Figure 3.8: Territorial initiatives across the EU aimed at linking employment and environmental objectives by categories of employment measures



3.4 Impacts of Bottom-up Approaches

3.4.1 *The limits of evaluating the impacts of bottom-up approaches*

Evaluating the impacts of territorial initiatives is inherently difficult. Nonetheless, detailed analysis of impacts is essential to guide and consolidate the partnership process and to ensure the achievement of goals and the effective use of financial and other resources.

Before turning to the main findings from the case studies, it is important to stress some caveats concerning the reliability of the information that can be drawn from the case study summaries.

1. In assessing the impact, the research must draw on existing monitoring or evaluation undertaken for the territorial initiatives. In some of them, especially those which participated in specific EU or other national programmes and where significant financial resources have been deployed, objectives have been precisely specified, and monitoring procedures have sought to measure concrete progress in achieving such targets. For other territorial initiatives, however, little or no evaluation has been undertaken, partly because the funding programmes did not require a systematic evaluation of the employment or environmental impacts, partly because the initiatives did not have the resources to be able to carry out detailed monitoring or evaluation.
2. Most evaluations are undertaken by the initiatives themselves. While there are good reasons for this, it does give rise to concerns about independence and credibility for findings. Therefore, where evaluations are undertaken by the initiatives, it appears to be important to check whether there has been any external audit of the result.

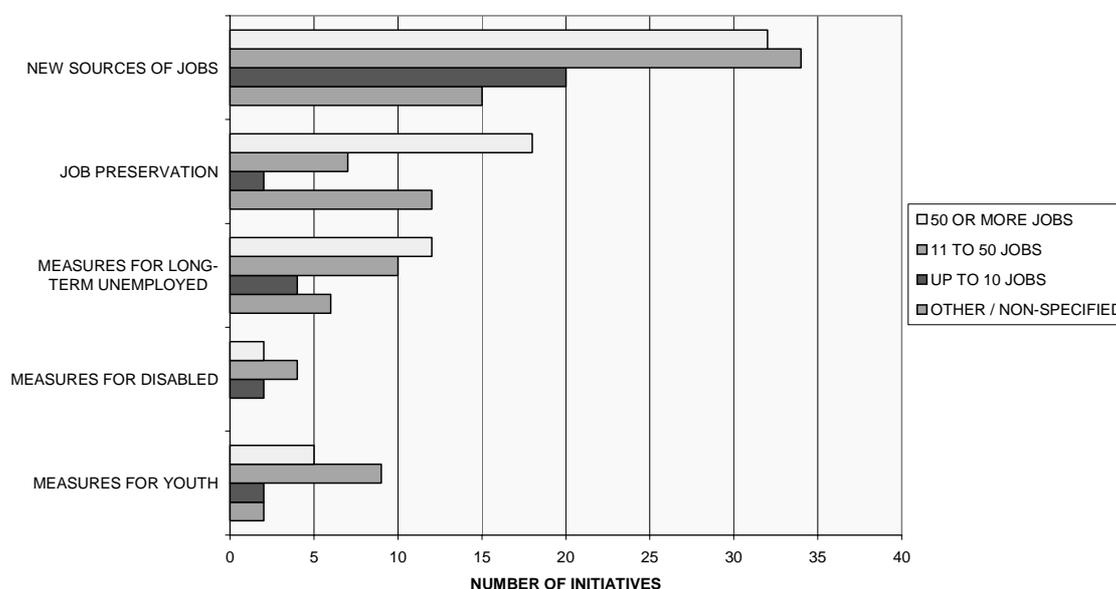
3. There is little evidence on the *long-term effects* of territorial initiatives. The vast majority of available evaluations only provide evidence on short-term effects, covering at best one to two years or the period of funding by a specific programme. This may well be too short a period for a full assessment of the impact of a territorial initiative.
4. The available evaluations do not measure the *net effects* of the initiatives on aggregate employment and unemployment in the respective regions. Therefore, the evaluations do not determine whether the jobs would have been created anyway in the absence of the local initiative (so-called dead-weight effects), whether improved employment prospects for the target group come at the expense of worsened employment prospects for other unemployed or employed (so-called substitution effects) or whether the new jobs have displaced, or have been substituted for, jobs elsewhere in the economy (so-called displacement effects).
5. Impacts are invariably expressed in terms of employment and/or environmental outcomes with little or no quantitative data available to assess the impacts of territorial initiatives as discussed in the next sections. It would be useful for instance to have an indication of how many partners tend to be involved, how many individuals receive a training, etc.. However, these outputs are not the only objectives of bottom-up approaches. A territorial initiative is in fact a much broader process with wider impacts, such as capacity building, policy co-ordination, participation, governance, policy mainstreaming, etc. These impacts should not be ignored.
6. Since there is a broad range of objectives and outputs that should be measured, there are not only difficulties of quantifying some types of benefit but also attributing them to specific activities of a territorial initiative or to other players. Furthermore, there is not only the problem of a diversity of objectives, but also the problem of moving targets. Since many initiatives depend on a changing resource base, there is a constant need to keep up with changing requirements of different funding programmes, modifications on the initiative's objectives, changes in the pattern of partner representation, and the emergence of new structures and procedures.
7. While the evaluation results tell quite a lot about which measures work, they are not very instructive as regards the question why do certain approaches work for some groups and not for others, and in what circumstances? The evidence is simply not there for the moment.

Overall, valuation of impacts should not be thought of as providing precise answers, but rather as a framework for making judgements on an initiative's effectiveness in meeting its various goals and for assessing its relative strengths and weaknesses.

3.4.2 *Impacts on Employment*

Bottom-up approaches are not an end in itself, but a means of contributing to solutions to the locally pressing problems of unemployment and social exclusion. A number of initiatives aiming at new job opportunities have been able to demonstrate that they have contributed to local job creation, while other initiatives appear to have had some, though limited, success in maintaining jobs in sectors and regions where the impact of industrial change has created major employment problems (Figure 3.9).

Figure 3.9: Employment impacts of territorial initiatives across the EU aimed at linking employment and environmental objectives



Other local initiatives can demonstrate some success by ensuring employment for the most disadvantaged in the local labour market: the young, the disabled and the long-term unemployed. In the majority of cases, the trend is towards the proliferation of small initiatives, each one creating a few jobs, rather than the creation of large numbers.

One example of a very successful job creation scheme is the WISE group in the U.K. (see Box 3.1). The WISE Group uses government programmes supporting environmental improvement or housing insulation to provide training and work experience for long term unemployed. Trainees are paid full wages and are often able to find permanent employment after finishing the programme.

Other local initiatives have found it much more difficult to make an impact on unemployment, although this was a significant objective. They had to recognise that many of the important determinants of unemployment and employment lie outside their remits and localities.

Territorial initiatives have been established as responses to the problems in specific territories, and often as pilot, experimental or model actions. They do not exist in all areas, and are unlikely to ever do so. The area-based nature of the initiatives also means that such initiatives do not necessarily help to tackle more dispersed problems of unemployment and social exclusion within larger areas or largely prosperous areas and are not necessarily focused on areas with the highest unemployment rates or the greatest needs in term of social inclusion.

Looking at the type of employment measure in the initiatives included in the research, some initiatives have achieved considerably more than others. Here, the initiatives identified in the research support by and large the findings from the relevant evaluation literature (OECD, 2000).

Box 3.1: The WISE Group, United Kingdom

W.I.S.E. gives unemployed people in Glasgow, Scotland, on the job training and improves their employability and job seeking skills (such as CV preparation, interview techniques). The work itself is run by the sub-projects Heatwise, Landwise, Tree Wise, Wise Recycling and Newham Wise.

In Scotland the concept of an Intermediate Labour Market (ILM) originated as early as 1984 when the original company, Heatwise, started to provide work experience for unemployed people while undertaking insulation work for Glasgow City Council.

Most of the activities are directed towards housing estates with limited standards in insulation and problems related to low safety, lack of green areas, etc. These activities include energy saving via installation of insulation measures; energy advice and auditing; promotion of energy saving awareness and dissemination activities; and introduction of security systems.

In 1987, Landwise was set up as another core business in the urban regeneration sector. Landwise focused on the regeneration of the urban environment through physical improvements, mainly back yard refurbishment for the Glasgow City Council. As Landwise steadily developed, partnerships with the local economy were initiated and it became involved in custom-built training programmes for the local growth industries.

Finally some new subsidiaries, Treewise, Wise Recycling and Newham Wise, were established in order to diversify activities to other environment-related fields and to test the Wise Group model in England.

Like the Glasgow Works venture, the Wise Group aims to deal with the problem of long term unemployment by creating an ILM that, with the help of partnerships, combines training, work experience and personal development.

In 1996, 1,065 people were employed, including 186 permanent staff and 879 trainee participants, 40% of whom had been unemployed for more than two years. In 1996, 57% of the people (506 trainees) who left the Wise Group succeeded in finding a job in the first labour market or entered further education.

Sources: European Academy of the Urban Environment (1997), Birkhoelzer et al. (1998).

3.4.3 Impacts on the Environment

The research is inconclusive in regards to the environmental outcomes of the initiatives identified in this study. There is little or no quantitative data available on environmental benefits of the initiatives included in the research. Most of the information is on the environmental focus of the planned activities and only a few cases provide some qualitative information on the expected/real effect of these activities. It is, therefore, unclear how effective the initiatives have been in environmental terms.

One of the cases providing some quantitative and qualitative environmental information is the Industrial Symbiosis in Kalundborg (see Box 3.2), which demonstrates how waste reduction was sought through material exchange among industries.

Box 3.2: Industrial Symbiosis in Kalundborg, Denmark

Kalundborg is an example of five major industrial enterprises to form an eco-industrial network: the electricity producing Asnaes Power Station, the plasterboard producer Gyproc, the floor treatment company A/S Bioteknisk, the refinery Statoil and the pharmaceutical and biotechnological company Noco Nordisk.

At first, the project was a matter of business advantage. It seemed financially relevant to transform industrial by-products from one company into raw material for the process of another. This project, springing from a purely private initiative, developed spontaneously over nearly a thirty-year period around these five companies. Today there are nineteen product exchanges done a day (water, energy and waste).

The Kalundborg water tables, for example, are low and the companies decided to reduce their water extraction by re-using their processing water as much as possible. The water coolant at Statoil is thus used to produce steam for the turbines at the power plant, which enables Asnaes to reduce its consumption of ground water by 60%. There is also the transfer of gypsum, which is produced by processing the flue gas from Asnaes and sold to Gyproc, a plasterboard manufacturer, to replace natural gypsum. This system of material exchange is estimated to save around 15 million dollars per year.

Source: DATAR/OECD (2001)

3.5 Analysis of factors for the success of territorial initiatives

Identifying critical factors for successful territorial initiatives is a challenging task. The heterogeneity of objectives, timeframes, local circumstances etc. leads consequently to a variety of factors. A set of factors that can be viewed as having contributed to the success of territorial initiatives can however be put forward in the light of the experiences reviewed. These findings generally support those from the relevant literature such as the study from Kurz *et al.* (1999) on German initiatives or the classification of success factors made by Leach and Pelkey (2001) with regard to watershed partnerships.

3.5.1 Internal success factors

A number of internal factors were identified as contributing to the success of local initiatives as well as framework conditions. It should be recognised, however, that there is no single model and that these factors are only some of the ingredients to a successful initiative.

Internal success factors include:

- *The mobilisation of local stakeholders:* The success of the initiatives reviewed in the study has been related to their ability to stimulate participation from local actors. Of particular importance has been the investment of local individuals in the initiation and sponsoring of projects. Consultation process and the setting up of networks of particular interest groups may be used to mobilise local people. However, this type of capacity building involves changes in attitude and the development of competencies.
- *Leadership:* Leadership has been another important factor in the success of territorial initiatives although it has taken a variety of forms. A useful way to engage stakeholders of a territory is through the participation of a local leader –an individual or organisation– with credibility in the geographical area or sector. However, the basis of the initiative should gradually be broadened so that a group dynamic process can develop.

- *Partnership and networking:* A central lesson of the research has been the importance of partnership and networking to the success of territorial initiatives. Partnership contributed to the co-ordination of policies, the mobilisation of local resources, the tailoring of policies to local needs. One essential factor in making partnership structures work is to identify the right partners and the study suggested that successful partnerships tend to be based around a limited set of core partners strongly involved and providing and significant resources.
- *Professional management:* The success of many experiences has drawn heavily on the professional skills of their managers and staff who play a significant part in supporting the territorial initiatives, especially at early stage, and mobilising the stakeholders to develop and support appropriate partnerships and networks. The recruitment and training of managers and staff is therefore an important factor of success.
- *Communication:* Another central lesson from the research is that communication and review mechanisms are crucial in order to maintain commitment and input from the partners. It is also important to review lines of communication to ensure that all partners are kept informed and involved, with good horizontal relationships between partners and good vertical relationships between leaders and managers. Successful territorial initiatives have also developed a permanent communication system with their environment to provide visibility that may enhance the participation of other stakeholders and sponsors.

3.5.2 *Framework conditions*

Experience with territorial initiatives has clearly shown that success or failure of projects are due not only to the right combination of individual partners, their involvement and their ability to co-operate. It is equally important to create favourable framework conditions. These include:

- *The support of regional opinion leaders:* One essential requirement is to include the political decision-makers early in the process as they can become crucial multipliers for the networks.
- *The-orientation of business and regional development* is also important to support initiatives as well as the *strengthening of demand-side market forces*.
- *Legal framework:* Another key factor is the existence of a legal framework. Territorial initiatives develop in a certain legal framework which influences the relations to existing institutions; the choice of the appropriate form of organisation; and, the support to private individuals, companies and institutions involved in regional networks. Until now, regional networks active in regional management have not been legally established⁸. When setting up the legal status of regional networks various forms of organisation can be considered including: a form subject to public law or under law (e.g. a registered association) or a public-private partnership (e.g. a non-profit limited firm).

⁸ France is an exception with the provision made in the law of 1999 (Loi d'orientation pour l'aménagement et le développement durable du territoire) according to which municipalities are given the option of co-operating with each other and other regional players in order to develop projects and to form more or less formal organisations to put them into practice.

3.6 Conclusions

A great variety of territorial initiatives aiming at integrating employment and environmental objectives in OECD Member countries exist. These can be distinguished for instance according to the type of stakeholder involved (e.g. private, public, third sector) or the focus of their environment-related activities (e.g. recycling, nature preservation). The initiatives reviewed in the three OECD regions (North America, Europe and Pacific) indicate some similarities between countries with respect to the type of partners (i.e. mainly multi-sector) or in terms of geographical context (i.e. primarily developed in urban/industrial areas). Differences between countries experiences tend also to exist with for instance more watershed partnerships in the non-EU initiatives as well as a strong direct involvement of local communities. In all cases, some factors appear as key in the success of territorial initiatives: endogenous ones such as the mobilisation of local stakeholders, and more exogenous ones like the support of regional policy leaders or the existence of an appropriate legal framework.

Data on the employment and environment impacts of the initiatives identified in the study remains however very scarce and, when available, show mixed results. Bottom-up approaches are not an end in itself, but a means of contributing to the locally pressing problems of unemployment and social exclusion. A number of initiatives have contributed to local job opportunities, while others appear to have had some, though limited, success in maintaining jobs in sectors and regions where the impact of industrial change has created major employment problems.

Other local initiatives can demonstrate some success by ensuring employment for the most disadvantaged in the local labour market: the young, the disabled and the long-term unemployed. In the majority of cases, the trend is towards the proliferation of small initiatives, each one creating a few jobs, rather than the creation of large numbers.

Territorial initiatives have been established as responses to problems in specific territories, and often as pilot, experimental or model actions. They do not exist in all areas, and are unlikely to ever do so. The area-based nature of the initiatives also means that such approaches do not necessarily help to tackle more dispersed problems of unemployment and social exclusion within larger or more prosperous areas.

Thus, territorial initiatives do not appear as a universal panacea for challenges in regional development, employment, social inclusion and environment. Nor are they an alternative to the traditional top-down approach to employment and environmental policy but rather a supplement. Nevertheless, exchange of experience between countries and regions should help improving the effectiveness of these approaches. Future analysis on the effects of territorial initiatives on employment would benefit from the greater availability of quantitative data and the existence of ex-post evaluations of country experiences.

CHAPTER 4: ECONOMY-WIDE EMPLOYMENT IMPACTS OF ENVIRONMENTAL POLICIES USING ECONOMIC INSTRUMENTS

4.1 Introduction

The resurgence of environmental concerns following the Rio Summit in 1992 came at a time when many OECD members, and virtually all European countries, were suffering high unemployment rates. The question promptly arose, therefore, as to the impact that environmental policies might have on employment.

Consequently, one might have expected employment impacts to be used as an important indicator in the evaluation of environmental policies, and yet this has seldom been the case. In fact, while the field of environmental policy is extremely broad, covering the whole range from waste treatment and water purification to measures to combat climate change, employment impact studies have for the most part focused only on this latter area. However, most of the models used for evaluating climate change policies are general equilibrium models, and in most of them the labour market is assumed to be in equilibrium, *i.e.* unemployment is “voluntary” in the sense that the representative agent has made his choice between the utility of his real wage and the disutility of work. While it is true that in most of these studies welfare rises with employment, it is generally the change in welfare – and not the change in employment – that is the focus of attention⁹.

There is a great variety of studies of employment impacts of environmental policies, ranging from local sectoral policies concerning wastes, water and local atmospheric pollution, to global phenomena such as the greenhouse effect. Some studies only focus on the *direct* employment impacts, e.g. the number of persons employed in water treatment services or in waste management. Other studies do also include more *indirect* impacts, such as the employment required to produce the equipment used in e.g. water or waste treatment. Such studies would, however, often neglect any *macroeconomic feedback*, for example related to the (negative) employment impact stemming from the taxation that is needed to finance the environmental policy in place.

Such macroeconomic feedbacks are included in *econometric models*, for the most part based on a demand-driven view of the economy, where the market for goods and the market for labour are in a situation of disequilibrium, and in *general equilibrium models*, which are based on equilibrium in all markets. In both types of models, *substitution* and *income* effects play a major role, including substitutions between energy and other factors of production, between energy-intensive final goods and others, transfers of income, and the labour market’s reaction to these changes.

Most research studies and applied models assume that technological progress is “exogenous” and therefore constant: when an environmental constraint is introduced, the “technical”¹⁰ response of

⁹. It is symptomatic that *The Energy Journal* devoted a special issue to the costs of the Kyoto protocol in 1999, presenting results from the major models without ever mentioning employment.

¹⁰. Apart from income effects, decisions to produce more or less, *etc.*

agents is to substitute, i.e. to reduce the purchase of some goods and services, and to increase the purchase of others. Making technical progress endogenous expands the possible responses of firms to include R&D and technological innovations. While this behavioural broadening should lead to some alleviation in the costs of environmental policies, it is not evident what impact this will have on total employment. Certain authors find that the effects of induced technical progress will be negligible compared to those from factor substitutions, while others think that technical progress in environmental activities can be seen as a proxy for general technical progress, with larger impacts on competitiveness and growth.

Evaluations taking into account the macroeconomic effects of environmental policies discussed in this chapter are generally distinguished from approaches using *partial* equilibrium models for which various methods can be identified: purely statistical -involving the counting of jobs directly related to environmental activities (see Chapter 2)-, using input-output models which allow to account for the indirect employment effects of environmental policies by for instance increasing the demand for certain intermediate goods and service¹¹, and finally technico-economic models¹².

The structure of this chapter is as follows: Section 4.2 gives a brief overview of the findings of economic theory concerning the so-called “double dividend” hypothesis. The remainder of the paper describe assessments of the employment impact of environmental policies. Assessments using econometric models are discussed in Section 4.3 while section 4.4 presents findings from some studies where general equilibrium models have been applied. Section 4.5 briefly addresses employment impacts of assuming technological progress influenced by the environmental policies being applied and conclusions are summarised in Section 4.6.

4.2 The “double dividend” hypothesis¹³

Before examining the different approaches to evaluate the economy-wide employment impacts of environmental policies in general, this section focusses on the double dividend debate, that is to say on the *second* dividend effect of resulting from the implementation of environmental policies generating a revenue such as environmental taxes and tradable permits (auctioned)

Pearce (1991) suggested that environmental taxation could lead to a “double dividend”, as they would not only produce improvements in the environment, but also generate substantial amounts of revenue. This revenue would allow governments to reduce the rates of other, distorting, taxes and hence improve economic efficiency.

¹¹ Environmental policies can also lead to indirect employment by increasing the demand for certain. Input-output models can be used to describe such interactions, but in general such models will not include any macroeconomic feedback mechanisms. The results of such studies should therefore be interpreted with great caution. One example is a study by Scheelhaase (2001) estimating the employment effects of a policy aiming at reducing carbon dioxide emissions in Germany where the employment effect is estimated to be positive with some major sectoral variations.

¹² The technico-economic models (e.g. MARKAL, PRIMES, POLES) are often based on a detailed description of the energy system and offer a precise description of the evolution in energy-related employment resulting from a change in policy. The study by Cebryk *et al.* (2000) that used the CIMS and MARKAL models to examine the employment effects at the sector level of implementing the Kyoto protocol in Canada is an example.

¹³ This section draws heavily on Heady *et al.* (2000).

The connection between a double dividend and employment changes arises because *one* possible distortionary effect of taxation is a reduction of employment. Such a reduction in employment could result from taxes that are obviously related to employment – such as income tax and social security taxes – but also from taxes that affect the *real value* of workers' wages, such as value added taxes and excise duties. Thus, one aspect of any double dividend could be an increase in employment that follows from a reduction in one or more of these taxes.

The way by which an environmental tax reform might increase employment depends crucially on whether or not the labour market is in equilibrium at the outset, with demand equal to supply. If there is involuntary unemployment, an increase in employment *requires an increase in labour demand*. This could be achieved by reducing the cost of employing labour, for example by reducing employers' social security taxes. On the other hand, if the labour market is in equilibrium at the outset, with demand equal to supply and no involuntary unemployment, an increase in employment *requires an increase in labour supply*. This could be achieved by increasing the returns to work, by reducing direct taxes on labour income or by reducing sales taxes on goods that workers wish to buy.

In practise, environmental taxes can help *reduce* rather than entirely *replace* other taxes. This means that *the interaction between environmentally related taxes and other taxes* has to be considered.¹⁴

Goulder (1995) made a distinction between a “weak double dividend” and a “strong double dividend” hypothesis. The weak double dividend thesis simply says that it is better to recycle the revenues from environmentally related taxes through reduced rates in distortionary taxes than through lump-sum payments to citizens. Most economic analysts agree on this. The strong double dividend thesis, which is much more disputed, says that replacing some existing taxes with environmental taxes will reduce the distortionary costs of raising a given revenue level. Concerning an “employment dividend”, the strong double dividend thesis would imply that replacing some existing taxes with environmental taxes – in a way so that net public revenues remain unchanged – would lead to a net increase in overall employment.

If a country has adopted a revenue-optimal set of taxes, it is – by the definition used in optimal tax theory – not possible to raise the same revenue at a smaller distortionary cost. In particular, the imposition of a higher rate of tax on a good that damages the environment cannot reduce the distortionary cost of the tax system, and can generally be expected to increase it. This implies that the strong double dividend thesis cannot be true in an economy where the taxes are revenue-optimal.

It is unrealistic to suppose that countries currently have revenue-optimal taxes. If the imposition of an environmental tax moves the tax structure closer to the revenue-optimum, a strong double dividend could be achieved.

^{14.} The importance of the *tax-interaction effect* and a so-called *revenue-recycling effect* was discussed in Goulder et al. (1997) and in Goulder et al. (1999). The tax-interaction effect is the adverse impact in factor markets arising from reductions in after-tax returns to factors associated with the higher production costs caused by any type of environmental regulation. This effect leads to significantly higher efficiency costs of environmental policies than what would apply in a world with no pre-existing taxes. Revenue-raising policies enjoy a revenue-recycling effect that offsets much of the tax-interaction effect, but non-revenue-raising policies (e.g. grandfathered emission permits) have no such offsets. Consequently, for any given target level of emissions reduction, the gross efficiency costs of non-revenue-raising policies are higher than those of revenue-raising policies.

Fullerton and Metcalf (2001) pointed out that pre-existing labour tax distortions are exacerbated by any type of environmental policy that *generates privately-retained scarcity rents* – regardless of whether the policy is revenue-raising or not.

4.2.1 *The case with involuntary unemployment*

In the theoretical models used to analyse the double dividend in the presence of involuntary unemployment, the unemployment is caused by the wage being higher than its market clearing value. For the moment, it is simply *assumed that the real after-tax wage is fixed*. Possible causes for the wage being “too high” are addressed below.

It will generally not be possible to reduce the distortion of the labour market directly by imposing environmental taxes to partly replace e.g. social security taxes paid by the firms. Doing so would increase the cost of goods that workers buy, which would tend to lower real wages. With real wages assumed to be fixed, workers would demand increases in their nominal wages. That would offset the stimulus to employers’ demand for labour given by a reduction in social security taxes. As stated by Heady *et al.* (2000), the move from payroll taxes to environmentally related taxes has not reduced the taxation of workers; it has simply rearranged it.¹⁵

If a move from social security taxes to environmental taxes is to increase employment, the taxation of workers must be reduced. That could be achieved if it is possible to shift of the tax burden from workers to other groups. There are basically three other groups that the tax burden might be shifted to:

- Owners of any other production factors than labour (e.g. capital, natural resources, etc.);
- Other domestic consumers who are not workers (e.g. old-age pensioners, unemployed, etc.); and,
- Other countries, via an improvement in the taxing country’s in term-of-trade.

Introduction of a tax on an environmentally damaging good that was used to reduce labour taxes could move some of the tax burden from workers to non-workers – and so reduce the distortion of the labour market – if there are some persons in the country that live primarily from capital income.

A necessary condition for this is that the capital owners do not emigrate as a result of the tax reform. More generally, it can be possible to shift taxation towards owners of production factors that are inelastic in supply, meaning that the same quantity would be supplied regardless of the price, like an immobile natural resource.

If capital were inelastically supplied – meaning that capital supply does not vary with the return on capital – and capital incomes were currently taxed at less than 100%, and if the production of energy was particularly capital-intensive, a tax on energy could be seen as partly a tax on capital. In this case the imposition of an energy tax, which was used to finance a cut in labour taxes, shifts the burden of taxation away from labour and towards capital, thus potentially creating a strong double dividend.

If, however, capital is rather elastically supplied, perhaps because of the ease of moving it to countries with lower taxes on capital, an environmental tax reform could cause a considerable increase in the distortionary cost – in the form of capital moving abroad. In this case the benefits of the shift in terms

^{15.} Bovenberg and Van Der Ploeg (1998), using a model with exogenously rigid wages, conclude that a high elasticity of substitution between labour and other production factors could reveal an employment dividend.

of increased employment would be smaller. The desirable level of environmental taxation thus depends crucially on the elasticity of capital supply and the current rates of capital taxation.¹⁶

By *not* increasing old-age pensions and unemployment benefits to compensate for the increased price of the environmentally damaging good, one could also shift some of the tax burden away from workers, see Bovenberg (1997). Such a shift in taxation from workers to e.g. pensioners could, however, be in conflict with existing income distribution objectives.

The last group to whom one could shift the tax burden is other countries, when the country applying the environmental policy can improve its terms of trade, i.e. the ratio of its export prices to its import prices. There are two possibilities:

- *A decline in import prices*: this will be the case, for example, with an energy tax that reduces the domestic demand for energy. If such a tax is applied to a major importer or to a group of countries simultaneously, then the import price of energy, net of taxes, can decline and the tax burden will be borne partially by the energy exporting country. At the same time, all energy importing countries will benefit from this windfall. Ligthart (1998) developed a model of this kind.
- The other case is where the country imposing the measure is able to *raise the price of its exports*. This will depend, of course, on the competitiveness of that country's products, the degree of monopoly, the quality of the products, and more generally on everything that has to do with competitiveness, apart from price. This would require that the country indeed has some market power for one or more products – and that this has not already been fully exploited.

The question of how the real wage is determined - and whether or not it would in fact be “fixed” - is important. Authors have distinguished between three models of labour market functioning: the wage bargaining model (De Mooij, 1999), the efficiency wage model (Schneider, 1997)¹⁷ and the job-matching model (Bovenberg and Van Der Ploeg, 1998).

In most models of trade union behaviour, a reduction in unemployment will lead to a higher wage demand. This would reduce the size of an employment double dividend, because any reduction in unemployment will increase the nominal wage, which will in turn increase unemployment. It is, in fact, possible to produce a model in which unemployment cannot be reduced: the entire subsidy to employment is absorbed by an increase in the real wage. However, in most of the literature, the existence of trades unions is shown to reduce the size of any employment double dividend, not to eliminate it.¹⁸

4.2.2 *The case without involuntary unemployment*

When the labour market is sufficiently flexible to ensure full employment – and/or in very long-term analyses – the emphasis in the double dividend literature moves away from employment creation and

^{16.} Ligthart and Van Der Ploeg (1996) investigated shifting the tax burden from labour to capital. This could be possible when it is easier to substitute labour for energy than to substitute capital for energy.

^{17.} Here it is firms – not the workers – that set wages too high for the labour market to clear.

^{18.} Marsiliani and Renström (1997) found that, in a closed economy, the increase in employment will be even greater if the unions have strong negotiating power. This runs counter to nearly all the other wage-bargaining models, such as those of Brunello (1996) and Bayindir-Upman and Raith (1998).

towards the general efficient functioning of markets. The distortion of the labour market is still a major concern, as employment taxes tend to reduce the level of *labour supply* below the optimal level. Instead of a reduction in worker taxation allowing a lowering of labour costs and increased labour demand, the focus is now on the *incentives to work*. A shifting of the taxation from workers to other groups would increase the rewards to working and so increases labour supply, which – in a flexible labour market – leads to greater employment.

Heady *et al.* (2000) refers to a simple model often used to address situations where labour markets are assumed to be in equilibrium, where labour is the only production factor.¹⁹ In this framework, the only (non-environmental) reason for taxing some goods or services more heavily than others is that their consumption is more closely associated with leisure than other goods and services.²⁰ This means that a heavier tax on these goods would *implicitly tax leisure* and encourage people to work more, thus reducing the distortion to labour supply produced by the tax system as a whole. So, if an environmentally damaging good was also a good that is consumed in association with leisure, the imposition of a special tax on this good could have a double dividend.

As taxes on goods that are bought with the income earned by the labour reduce labour supply in a similar way as taxes levied directly on labour, increasing a tax on e.g. energy would also reduce labour supply. However, if energy were particularly complementary to leisure, this effect would be small because people who were deciding whether or not to work more would expect to spend a relatively small proportion of their extra earnings on energy. This means that the disincentive effect of the tax on energy would be less than the incentive effect of reducing taxes on labour, so labour supply would increase and a strong double dividend result.

If the consumption of energy had been particularly substitutable for leisure, the result would have been the opposite: the imposition of an energy tax would have reduced labour supply, because energy would have been a relatively larger part of the expenditure from the possible extra earnings. In this case, there would not be a strong double dividend. Instead, the environmental tax would have worsened tax distortions in the economy.

A case that has been highlighted in the literature is one that falls between these two possibilities: no goods are particularly associated with either labour or leisure (there is “weak separability” between goods and leisure). In this case, uniform sales taxation is optimal. A very small environmental tax will neither increase nor reduce the distortionary cost of the tax system, but any significant tax will be a move away from the optimum and so increase the distortionary cost. It is this that lies behind the main theoretical result of Bovenberg and Goulder (1996), casting doubt on the existence of a double dividend.

4.2.3 Conclusions on the double dividend issue

A strong double dividend cannot occur if the existing tax structure is revenue-optimal. If, as is likely in practice, the existing tax structure is not revenue-optimal, a strong double dividend will occur if the environmental tax reform moves the tax structure in the direction of revenue-optimality.

^{19.} See for example Bovenberg and De Mooij (1994) and Bovenberg and Goulder (1996). In such models, it is – of course – impossible to shift the burden of taxation from labour to other factors of production.

^{20.} In economic terminology, these goods are said to be particularly complementary to leisure. Charter flights to holiday destinations would be one example: The more leisure people have, the more they will travel.

In a situation with involuntary unemployment, employment will only increase if the use of environmental taxes to partially replace existing taxes results in an increased demand for labour. If the labour market is in equilibrium, additional employment could only be caused by increasing labour supply.

There are *no necessary or sufficient conditions* for when an increase in environmentally related taxes combined with a reduction in e.g. payroll taxes will increase employment – in addition to the “first dividend” stemming from an improvement in the environmental situation – but Heady *et al.* (2000) identified *factors that make it more likely*:

When there is involuntary unemployment, the prospects of increased employment are higher if:

1. The environmental tax can be passed on to factors that are inelastically supplied and relatively under-taxed.
2. Non-working households are large enough in numbers, and are significant as consumers of goods produced with the environmentally intensive inputs that are taxed.
3. Through international market power, the environmental tax can raise the price of goods produced with a relatively intensive use of the taxed environmental input.
4. Capital is relatively immobile internationally. In this case it can absorb some of the environmental tax and less of the tax burden falls on factors such as labour.
5. The elasticity of substitution between the environmental input and labour is greater than the elasticity of substitution between energy and capital.
6. The real wage rises little when unemployment falls, so that the reduction in the taxes on labour are not offset by wage rises.

When there is only “voluntary” unemployment, conclusions (1) to (4) still hold, but conclusions (5) and (6) are replaced by: The environmental tax is levied on goods that are more complementary to leisure in consumption than the goods whose taxes are reduced.

4.2.4 The consequences for applied modelling

The various mechanisms presented above allow us to consider different variables that will influence the emergence of an employment double dividend. The theoretical literature, however, frequently fails to separate short-term from long-term mechanisms: in the general equilibrium models particularly, the mechanisms are often presented in reference to long-term situations.

Imposing an environmental tax will affect the purchasing power of the wage, a reduction in social security taxes will raise the labour demand curve, and the impact on employment will be the result of these two counter-moving mechanisms. In this simplified model, everything will depend on whether businesses will pass on lower labour costs through wage increases. Many authors champion this long-term equilibrium scheme, in which any reductions in payroll taxes are redistributed to wage increases. Then the level of employment will not change.

But apart from this long-term equilibrium, the tax burden might be redistributed in the short to medium term between businesses, workers and other players such as the unemployed, pensioners, foreigners, *etc.* Differing mechanisms will influence the final outcome:

- The functioning of the labour market and the way wages are determined will play a preponderant role in distributing the tax burden. In particular, might a reduction in payroll taxes lead to a relatively permanent reduction in labour costs? The most simplified models – econometric ones using the Phillips curve, or general equilibrium ones using the labour supply and demand curves – lead to the same conclusion as the bargaining models with respect to the temporary nature of the decline in the cost of labour. The question relates to the scope and duration of this decline.
- Another important question has to do with substitution of production factors: it concerns energy taxation and reducing the cost of labour. The question of a labour cost/employment link has been the subject of much controversy in the applied studies.
- The transfer-abroad mechanism works via many channels in the applied models: there is the one that operates through the terms of trade (lower prices for imported energy, higher prices for exported goods). In the latter case, it is important whether the export functions have variables representative of non-price competitiveness that depend on the policies in place (like R&D, for example). But more conventional models can also produce an improvement in the external balance, thanks to the possibility of lowering production costs (because of lower labour costs).

Consequently, in different applied models, there are crucial elasticities that will have an important effect on the outcome in terms of employment: the elasticity of the cost of labour to a lowering of payroll taxes, factor substitution elasticities, elasticities in the demand for labour compared to its cost, elasticities of volume compared to the price of external trade functions, etc.

4.3 Evaluations using econometric models

The term “econometric models” is used here to mean applied models where the behavioural equations are established econometrically and where the tradition of neo-Keynesian models is preserved, meaning that total economic activity is constrained by aggregate demand. Section 4.3.1 discusses the general properties of these models, while the following sections describe some studies that have been made on the employment effects resulting from the implementation of economic instruments (e.g. taxation, tradable permits) using such models.

4.3.1 General observations on econometric models

The econometric models are constrained by demand in the goods market, and the structure of that market reflects monopolistic competition. Under these conditions, the price is determined by a mark-up rate applied to the average cost (marginal cost). In the short to medium term, any increase in demand will tend to increase economic activity and employment, and expenditure multipliers are generally greater than unity.

The labour market is described with a so-called Phillips curve, which relates wage increases to the rate of unemployment, sometimes augmented by a labour productivity effect, with indexation to consumer prices. This means that once the level of unemployment declines, the level of inflation will be higher than that in the baseline, competitiveness and output will both diminish over the long term, and hence unemployment come back to the initial level.

Referring more specifically to environmental policies, there will be two predominant effects:

- The income and demand effects will change the level of GDP and employment, through multiplier mechanisms. Waste and water treatment policies fall into this category, since

they require significant expenditures in terms of construction and public works for building or outfitting purification stations.

- Substitution effects will result from using environmentally-related economic instruments that change the price system, in order to encourage actions favourable to the environment: taxes, grants and subsidies, tradable permits, *etc.* Price changes, resulting for example from an energy tax, will trigger substitution effects for both production factors and consumer goods. These are the first consequences. Any employment will first of all depend on factor substitution elasticities, which will be the crucial parameters for evaluation. These parameters are normally estimated econometrically, and will be robust to a greater or lesser degree.

Once the substitutions are made, agents will perceive an income effect that will depend on how easy it is to make the substitutions, but also on the possibility of shifting the burden to other agents. From this viewpoint, any indexing of wages to the consumer price index will play an important role. Similarly, recycling of tax receipts will influence the income effect: it may induce a new substitution effect, if this recycling reduces the cost of a production factor.

Econometric models are particularly suited for short to medium term national policy evaluation and economic forecast rather than long term prediction. If they allow to account for the outcome resulting from rebound effects and to have a dynamic picture of the impacts of a policy, instead of just having a static snapshot; some of their shortcomings include the fact that behavioural change cannot be reflected unless it results from price changes (see also OECD, 1997).

4.3.2 *Evaluating employment impacts using econometric models*

This section presents some simulations of employment impacts of taxes on energy or on CO₂ emissions. Such a tax that might be equated with the introduction of auctioned tradable emission permits (as opposed to quotas that are distributed for free – also called “grandfathered” quotas). The works discussed here indicate that provided the tax revenue is redistributed, that this is done in the form of a reduction in labour costs, and that growth is accompanied by a degree of wage moderation, there could be a temporary employment dividend.

The question of redistributing the tax (or the proceeds from a sale of permits) is crucial when using econometric models. It is important not to create a negative income effect, which would automatically lower the level of GDP in the neo-Keynesian models. This means that all the tax revenue must be redistributed. Theory suggests that it should be done by lightening the burden on the most heavily taxed factor, which in practice is often labour. This would also reinforce the substitution effect.

Simulation results are presented for the following econometric models: HERMES, QUEST, LIFT and PANTA RHEI.

4.3.3 *Simulations with the HERMES model*

The HERMES model is a regional econometric model for the European Union. It is a multi-sector model which distinguishes eight production sectors and where the production function combines different factors of production (i.e. labour, energy, capital). The production function of manufacturing sectors is of a “putty clay” type, i.e. with large substitution possibilities *ex ante* (i.e. before investments in capital equipment has been made) and fixed proportions between production factors *ex post*. This means that the producer is free to alter the combination of production factors (e.g. in response to any price changes) until the investment is made, but not afterwards. The production function, which is based on econometric estimates, shows complementarity between investment and energy use in nearly all European

manufacturing sectors. This means that *an increase in the price of energy will lead to a fall in investment*, for a given level of production. If both investments and energy use decrease, employment would have to increase for a given production level to be maintained.²¹

Three ways of redistributing a CO₂/energy tax were tested using the HERMES model (CEC, 1993):

- The first method was to reduce income taxes enough to offset the levy, but this was accompanied by inflationary pressures that were damaging to foreign trade.
- The second method involved reducing the VAT rate, a move that has a one-off effect of neutralising the price increase induced by the tax, but that has the drawback of stimulating domestic consumer demand, to the detriment of the trade balance.
- The third method was to reduce payroll taxes for employers. This was found to give a fairly permanent employment double dividend: in fact, it combines the advantage of a onetime reduction in production costs and a stronger substitution effect that is favourable to labour by reducing its cost.

In the case of a CO₂/energy tax that is fully redistributed through a reduction in social security taxes (see Table 4.1), the simulations with HERMES indicate that, in total, for 6 European countries, there is a weak increase in GDP, with some differences between countries. The estimated increase in employment is largely due to a substitution effect, caused by higher energy prices and lower labour costs, reinforced by the assumed investment/energy complementarity.

Table 4.1: Results using the HERMES model
Changes in 2001 compared to a base case

	Germany	France	UK	Italy	Netherlands	Belgium	Europe 6
Private consumption	0.3	0.0	-0.6	0.8	0.3	0.2	0.2
Investment	-0.2	-0.1	-0.6	0.8	0.2	-0.2	0.0
Exports	-0.2	-0.3	-0.2	-0.1	0.0	0.2	-
Imports	-0.4	-0.6	-0.4	-0.1	0.6	-0.4	-
GDP	0.2	0.1	-0.4	0.7	-0.2	0.6	0.2
Consumer prices	0.5	0.8	2.1	0.9	0.8	0.2	1.0
GDP deflator	0.1	-0.1	1.7	0.5	0.1	-0.4	0.4
Employment	0.8	0.4	0.6	0.8	0.3	0.9	0.6
Real wage per worker	0.4	0.2	0.7	0.3	0.2	-0.1	0.4
Wage cost per worker	-3.2	-2.9	-3.7	-2.9	-3.5	-4.2	n.a.
Govt. Fin. Bal. % of GDP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ext. Bal. as % of GDP	0.0	0.1	0.3	-0.1	-0.8	0.1	-
Energy consumption	-3.6	-2.8	-3.5	-5.0	-1.7	-3.6	-3.5
CO ₂ emissions	-4.1	-4.7	-4.2	-5.6	-1.9	-5.0	-4.4

Source: Bossier et al. (1993). Numbers have been rounded off here. The results are provided for the year 2001, eight years after the assumed implementation of the tax.

The redistributed tax revenue initially lowers the cost of labour and thus of employment, but it begs a question: can this reduction endure for long in the face of wage hikes – especially when the tax base of the environmental tax will decline over time? Consequently, even if in the short term this wage

²¹. Heady *et al.* (2000) point out that, in view of the chosen substitution elasticities, “the case for a strong double dividend is quite strong” in simulations with the HERMES model.

increase allows real income and consumption to rise, in the long term indexation will lead to a loss of competitiveness and this will return unemployment to its initial level.

All in all, the 1993 simulations with HERMES found a 0.6% increase in employment in 2001 accompanied by 4.4% lower CO₂ emissions and a 3.5% drop in energy consumption, while at the same time the estimated changes in real wages were moderate. However, it should be pointed out that the best results are obtained for Belgium where the assumption of wage moderation was retained. This emphasises how strongly the scale of any double dividend is related to this assumption.

Another simulation of a later proposal to harmonise energy taxation and to redistribute the proceeds through a reduction in labour taxation leads to similar results (see Bossier et al., 1998).

4.3.4 Simulations with the QUEST model

QUEST is a model developed for the European Union. It is more aggregated than HERMES, and more oriented towards monetary phenomena. The QUEST model does not single out energy in its production function, hence policy-induced substitutions are limited to those sparked by a fall in the cost of labour.

The simulations with the QUEST model (Hayden, 1999) consider a reduction of 8% in CO₂ emissions by 2010, compared to the benchmark year 1990, together with a tax on oil products, the proceeds of which are redistributed by reducing the cost of labour (see Table 4.2). Three scenarios emerge: under the first, businesses alone bear the cost of the tax; under the second it is borne by households; and in the third, where households are taxed, there is also a “social consensus” whereby households agreed to moderate their wage demands.

Under the first scenario, there is a contraction of 1% in GDP, while employment increases slightly (0.1%), thanks to lower labour costs. This significant economic contraction, despite full redistribution of the tax proceeds, leads to a decline in investment (by 3%), because of the lower productivity of capital, which in turn is due to lower use of energy-intensive production modes (a phenomenon that has to be quantified outside the model). This re-establishes the complementarity between investment and energy use that was also present in HERMES.

Table 4.2: Results using the QUEST model
Changes compared to a base case

	GDP			Employment			Inflation		
	2000	2005	2010	2000	2005	2010	2000	2005	2010
Variante 1	-0.2	-0.6	-1	0	0.1	0.1	0	0.1	0.1
Variante 2	-0.1	0	0.4	0.1	0.5	0.9	-0.1	-0.1	-0.1
Variante 3	0.2	0.9	0.9	0.8	1.5	1.3	-0.1	-0.1	-0.1

Source: Hayden (1999)

When the tax is paid entirely by households, there will no longer be this sterilization of a portion of capital. Consequently, GDP rises by 0.4% and employment by 0.9%, because of the substitution effect.

The best results were obtained in the “social consensus” scenario, where employees accept wage moderation. In this scenario, GDP is estimated to grow by 0.9% and employment by 1.3%.

4.3.5 Simulations with the LIFT model

The LIFT (Long-term Interindustry Forecasting Tool) model²² is a large-scale model of the U.S. economy²³. It is a 97-sector inter-industry macroeconomic model which builds up aggregate demand from individual industry demands at a high level of industrial detail. The consumption side of the model has 92 demand categories, arranged in functional groups that allow substitution and complementarity effects to be explicitly estimated. The model also has a highly detailed government sector. Industry wage trends are determined primarily by industry-specific labour productivity equations.

The LIFT model has been used to investigate the effects of a comprehensive approach to climate change and energy policy (Barrett *et al.*, 2002). For this project, an additional module was added to the model to perform carbon and energy accounting by industry, sector, and fuel. The simulation quantifies the impacts on employment, CO₂ emissions and GDP of a combination of different measures which was found to be preferable to a single measure, in terms of employment results (see Table 4.3). The policy package examined in the study, also referred to as the “clean energy policy package” has four components²⁴:

- A market mechanism (i.e. carbon/energy tax) with the revenue returned through a reduction in labour taxes;
- Measures to encourage the adoption of less energy-intensive technologies;
- Transitional assistance for workers impacted by environmental policy (e.g. financial assistance for those laid off, specific assistance to develop new skills); and,
- Measures to preserve the competitiveness of energy-intensive industries (e.g. border tax adjustment on carbon/energy tax payments²⁵).

Table 4.3: Results using the LIFT model
Changes compared to a base case

	2010	2020
CO₂ emissions	-27%	-50%
GDP	0.24%	0.60%
Employment	660	1 400

Source: Barrett *et al.* (2002).

The results of the simulation on the adoption of a comprehensive policy in the United States, combining a tax on the carbon content of fuel and other measures to address climate change, indicate a 27% reduction in CO₂ emissions in 2010 relative to a base case, and a 50% reduction relative to a base case in 2020.

²² The broad characteristics of the model are presented in Barrett *et al.* (2002) and a detailed description of LIFT can be found in Meade (2001).

²³ The Lift model was prepared by the Inforum Research and Consulting Group of the University of Maryland.

²⁴ The measures are assumed to be financed with the proceeds from the carbon/energy tax.

²⁵ Such an adjustment would mean that importers of fossil fuels and energy-intensive bulk materials are required to pay whatever taxes or emissions-permit fees that would have been required had the products been produced in the U.S.

Although the emission reduction effort is significant, the impact of the clean energy package on employment is estimated to be positive with a net job gains rising to around 660,000 jobs in 2010, in comparison with the baseline, and then continuing to increase to about 1.4 million jobs in 2020.

The study suggests that the increase in aggregate employment is mainly due to higher GDP. Other factors include a slight shift in the pattern of growth toward labour-intensive sectors relative to the baseline.

4.3.6 Simulations with the PANTA RHEI model

The PANTA RHEI model is an econometric model for the German economy. It is a detailed multi-sectoral model covering 58 industrial branches (see Table 4.4). In PANTA RHEI, all parameters are estimated by econometric methods using time series of the input-output tables of the German economy. The model has a very disaggregated energy and air pollution module. It is built for medium-term forecasts up to 2020.

One important application of the PANTA RHEI model is the simulation of an eco-tax reform. The article by Bach *et al.* (2002) examined the employment effects resulting from the introduction of the Environmental Fiscal Reform in Germany in 1999 with a gradual phase-in until 2003²⁶. The Law includes supplementary excise taxes on certain energy products.

Table 4.4: Results using the PANTA RHEI model
Changes compared to a base case

	Low energy prices		High energy prices	
	Output	Employment	Output	Employment
Agriculture	-1.3	0.8	-1.1	0.9
Energy	-3.3	-0.5	-2.4	-0.5
Chemicals/primary goods	-0.4	0.5	-0.3	0.5
Capital goods	-0.5	0.3	-0.4	0.4
Consumer goods	-0.7	0.4	-0.6	0.5
Construction	-0.1	1.2	-0.1	1.3
Transport	-0.4	-0.2	-0.3	-0.2
Services	-0.6	0.5	-0.4	0.5
German government	-0.8	0.7	-0.9	0.6

Source: Bach et al. (2002). Numbers have been rounded off here.

The reform had several goals, including reducing the consumption of polluting goods and thereby reducing emissions, but also making greater use of less energy-intensive technologies. The tax revenues are redistributed in the economy in the form of a reduction in social pension contributions.

The proceeds of green taxes are recycled in the form of a reduction in employee and employer pension contributions: this reduction rises from 0.8 percentage points in 1999 to 1.9 percentage points in 2003.

In the short term, the PANTA RHEI simulation indicates a drop of about 1.5% in GDP. Over the medium term, however, *i.e.* to the year 2010, this model produces CO₂ emission reductions of close to 2%.

²⁶

The authors used two macroeconomic models to study the effects of the fiscal reform on the economy, as well as a micro-simulation model for the household sector. In addition to the econometric model PANTA RHEI (Meyer and Ewerhart, 1998), the general equilibrium model LEAN (Welsch and Holster, 1995) that covers two regions (Germany and the rest of European Union) was used.

GDP declines by 0.2% initially and by 0.4% in 2010. Employment initially rises by 0.1%, and by 0.55% in 2010, which amounts to an increase of nearly 250,000 jobs.²⁷

The change in output compared to the baseline situation is negative in all sectors in the PANTA RHEI simulations, while the estimated employment effect is positive for most sectors. In this model, then, the substitution effect between employment and energy outweighs the negative employment effect of a contraction in GDP.

4.3.7 Conclusions from simulations with econometric models

The results of several econometric models indicate that a double dividend might be possible when the proceeds of environmental taxes are recycled in the form of reductions in payroll taxes, which in these models is equivalent to reducing the cost of labour. The double dividend is most important when the reduction in labour costs through such redistribution is significant and lasting.

A double dividend can be reinforced with the introduction of new, less energy-intensive technologies. Moreover, the employment increase can be greater when payroll tax reductions are concentrated on unskilled workers. This impact on taxation can readily be extended to the case of tradable permits, when these are distributed by auction, provided all the revenue from these permits is redistributed in the form of reductions in the cost of labour.

This discussion has been far from exhaustive, but the results from other econometric models provide comparable results in qualitative terms, with similar orders of magnitude for similar exercises²⁸ (see Bosquet, 2000).

These “optimistic” outcomes for the employment dividend must be treated with caution, for they are conditional on two mechanisms: the possibility of lowering labour costs, on one hand, and the elasticity of demand for labour on the other. The first point is disputed in literature on the labour market, and especially in wage negotiation models. Moreover, the Phillips curve, which determines wage growth in most econometric models, casts doubt on the possibility of a long-term reduction, which would render the second dividend temporary in all cases.

4.4 Analyses using applied general equilibrium models

4.4.1 General remarks on general equilibrium models

Applied general equilibrium models assume balance between supply and demand in all markets. The equations in these models assume optimising behaviour: consumers maximise their utility, producers maximise the current value of their revenues. In general, markets operate in pure and perfect competition, with prices equalising the supply of and demand for goods. In certain models, some markets are characterised by monopolistic competition, where prices are determined by a mark-up over marginal cost.

²⁷ It should be kept in mind that the authors model the formation of wages in such a way that an increase in employment does not spark any upward pressure on wages. They stress that if unions were to press for higher wages, this could neutralise the positive effects on employment.

²⁸ Bosquet (2000) notes that of 77 simulations using econometric models, 58 show a positive impact on employment following an environmental tax reform.

These models are usually *calibrated* rather than *estimated econometrically*. This means that substitution elasticities of production functions or utility functions are taken from other studies, while the parameters are adjusted to describe an equilibrium at some benchmark point.

A difficulty relates to the functioning of the labour market. Most of the time, this market is assumed to be in equilibrium at the point where the supply equals the demand for labour. Unemployment is thus voluntary and reflects a demand for leisure. In fact, many general equilibrium models do not deal explicitly with imbalance (unemployment) on the labour market. Many authors simply ignore employment impacts, and give their results in terms of changes in GDP and welfare.

Factor substitutions are often analysed using nested constant elasticities of substitution (CES) production functions. Similarly, consumption is described by nested CES functions. This analysis of agents' behaviour makes it easier to appreciate the effects of economic instruments. For example, the level of the tax or the price of the permits is calculated as the value of a dual variable associated with an emissions constraint.

General equilibrium models can be better suited than econometric models to analyse very long-term impacts of changes in policy. On the other hand, the general equilibrium models are less suitable than econometric models to describe impacts of demand-increasing policies that are applied in a situation with significant un-utilised resources in the economy, because of the strong crowding-out effects that they imply.

4.4.2 *Simulations with the GEM-E3 model*

The GEM-E3 model (Capros *et al*, 1997) has been widely used to assess the consequences of European countries' commitments under the Kyoto protocol (Capros *et al*, 1998, and Fougeyrollas *et al*, 2001). This is a conventional general equilibrium model with perfect competition and equilibrium on all markets. Also the labour market is in equilibrium for most versions. The model is disaggregated into 12 production sectors. It includes an environment module that, based on the energy production system, describes emissions of CO₂, NO_x, SO₂, VOC and particulates.

The parameters of the model that are sensitive for employment effects are the substitution elasticities of the nested CES production functions as well as the (Armington) foreign trade functions, which imply that domestic and foreign goods are imperfect substitutes – and which means that prices may differ between domestic and foreign goods. Moreover, the elasticities of the labour supply and demand functions play an essential role. The utility function takes account of leisure and, indirectly, certain emissions-related environmental externalities are calculated in terms of utility, which allows us to distinguish between environmental welfare and economic welfare.

Several studies have looked at impacts for European countries of implementing the Kyoto Protocol with the help of economic instruments (see Capros *et al*, 1998; Fougeyrollas *et al*, 2001; Van Regemorter, 2002). The only case where a robust employment dividend was obtained is that where tax revenues are recycled through a reduction in payroll taxes (see Table 4.5).²⁹ Real wages rise, but not so much as to cancel the relative reduction in labour costs, because of the magnitude of the energy tax that has been levied and redistributed (nearly 3% of GDP). The rise in the price of energy brings about a slight increase in the GDP deflator and in terms of trade³⁰, as well as in the external balance, in the Capros variant, despite the decline in energy imports. It is thus consumption that “pulls up” the GDP growth rate.

^{29.} Capros also found a very slight employment dividend in the case of grandfathering of emission permits, but Fougeyrollas did not.

^{30.} Heady *et al*. (2000) states that “Ms Van Regemorter has informed us that GEM-E3 does not produce a double dividend for any country if the assumption of EU monopoly power in international trade dropped, because of

Kouvaritakis *et al.* (2003) used an updated version of GEM-E3 to simulate impacts of the proposed EU allowance scheme for electricity and heat generators and energy intensive sectors, combined with a carbon tax levied on all the sectors not covered by the allowance scheme in 2010, the level of the tax being determined such as to reach the Kyoto target. The tax revenue was recycled through a reduction in social security contributions. While the study also presents separate impacts for 14 EU member states (all except Luxembourg), Table 4.6 only presents macroeconomic impacts at the EU level. Also in this simulation there is a small increase in employment compared to the baseline scenario, while both “economic welfare” and “total welfare” decrease slightly.

Table 4.5: Simulations using the GEM-E3 model
Changes compared to a baseline scenario

	2001	2003	2005	2007	2010
Gross Domestic Product	0.0%	-0.1%	-0.2%	-0.3%	-0.7%
Employment (in thousands)	60	290	645	945	1460
Private Investment	0.0%	-0.1%	-0.2%	-0.3%	-0.6%
Private Consumption	0.1%	0.3%	0.6%	0.8%	1.0%
Domestic Demand	0.0%	-0.2%	-0.6%	-0.9%	-1.4%
Exports in Volume	-0.2%	-0.9%	-2.1%	-3.1%	-4.9%
Imports in Volume	-0.1%	-0.5%	-1.0%	-1.5%	-2.2%
Intra trade in the EU	-0.2%	-0.9%	-2.1%	-3.2%	-5.0%
Energy Consumption volume	-0.5%	-2.9%	-6.5%	-9.5%	-14.6%
Consumer price index	0.2%	1.0%	2.2%	3.2%	5.2%
GDP deflator at factor prices	0.0%	0.1%	0.1%	0.2%	0.2%
Real wage rate	0.0%	0.2%	0.4%	0.6%	0.8%
Tax Revenues as % of GDP	0.1%	0.7%	1.7%	2.5%	3.9%
Current Account as % of GDP	0.0%	0.0%	-0.1%	-0.1%	-0.2%
Marginal Abatement Cost (ECU 85/tn C)	6.4	36.7	88.4	139	240
Total atmospheric emissions					
CO₂	-1.0%	-4.7%	-10.0%	-14.0%	-20.0%
NO_x	-0.7%	-3.3%	-7.5%	-10.9%	-16.1%
SO₂	-1.6%	-7.6%	-15.6%	-21.3%	-29.3%
VOC	-0.4%	-1.4%	-3.9%	-6.1%	-9.8%

Source: Capros *et al.* (1998). Numbers are rounded off here.

4.4.3 Simulations with a Swedish general equilibrium model

A general equilibrium model was developed by Hill (1998) to investigate the impacts of the Swedish tax reform. It is a static small open economy computable general equilibrium model where all Swedish industries are price takers in the world market, hence a tax reform will not trigger any terms-of-trade effects. The model has a disaggregation level of 17 sectors to match the environmental and economic accounts of Sweden. An interesting aspect of this model is that it distinguishes between skilled and unskilled workers, on a labour market assumed to be in equilibrium.³¹ This model differs from models used in earlier studies of environmental policies in Sweden (see Harrison and Kriström, 1997) in several ways. The energy sector is for instance more disaggregated which facilitates calculation of changes in emissions and substitution possibilities are extended since they can result from changes in industry output as well as substitution among energy inputs.

its loss of competitiveness. In other words, in this model, the double dividend only exists if some of the tax can be shifted to overseas consumers”.

³¹. Hill (1998) underlines that “The model uses a simple description of the labor market. The unemployment is voluntary, i.e. the consumers supplying their labor or consuming it as leisure and the labor market always clears.”... “The modeling of the labor market is far from satisfactory which should be kept in mind in the following discussion.”

In his study, Hill (1998) examines the effects of achieving a given emission reduction objective using different environmental tax policies relative to using non-revenue raising instruments. Simulations are undertaken for a single emission target level (-15% reduction in CO₂ emissions). Three scenarios are discussed: in the first one, the CO₂ tax is increased from zero to up to 3 times the benchmark tax and some industries are exempted from the tax while in the second, there are no exemptions, and in the third scenario, labour subsidies are given to the “steel and metal sector”, in order to limit negative employment impacts in that sector. In the different scenarios, tax revenues are redistributed in the form of a reduction in payroll taxes on both categories of labour.

Table 4.6: Simulations with the GEM-E3-Europe model
Changes compared to a baseline scenario

	EU CO ₂ allowance scheme plus EU min tax in 2005 and 2010 and domestic CO ₂ tax with SS recycling in 2010 for Kyoto target	
	2005	2010
Macroeconomic Aggregates		
Gross Domestic Product	0.0%	-0.1%
Employment	0.0%	0.4%
Private Consumption	0.0%	-0.3%
Investment	0.0%	-0.3%
Energy Consumption	-1.6%	-8.5%
Exports to RW	-0.1%	-0.3%
Imports from RW	-0.2%	-1.5%
Real Wage Rate	0.0%	0.5%
Relative Consumer Price	0.0%	0.7%
Terms of Trade	0.0%	0.0%
Current Account (% of GDP)*	0.0%	0.2%
Total Atmospheric Emissions		
CO ₂ Emissions	-3.3%	-12.7%
NO _x Emissions	-3.4%	-14.6%
SO ₂ Emissions	-8.7%	-20.1%
VOC Emissions	-0.3%	-9.7%
PM Emissions	-8.4%	-20.7%
Environmental Policy		
Energy Tax (% of GDP)	0.0%	-0.1%
Environmental Tax (% of GDP)	0.0%	1.1%
Reduction of Social Security Rate (in % points)	0.1%	2.3%
CO ₂ average marginal cost (€2000/tn CO ₂)	5.7	34.4
Welfare		
Economic Welfare	0.0%	-0.5%
Total Welfare	0.1%	-0.3%

Source: Kouvaritakis *et al.* (2003). Numbers are rounded off here.

The results of the policy simulations indicate that the tax reforms aggregate effect on total labour demand is small but positive. The total effect is less than 0.25% change in employment in all scenarios. This increase in employment is distributed differently among sectors as a function of the hypothesis selected. Some sectors, such as the metalworking industry, may in fact be heavy losers (see Table 4.7). What is important to note here is that the impact on unskilled labour is better than the impact on skilled labour in all sectors being modelled.³²

³².

The elasticity of substitution between unskilled and skilled labour is set to 1.2 in the model. This means that a 1% increase in the relative cost of skilled labour (compared to the cost of unskilled labour) would increase the relative use of unskilled labour 1.2%.

Table 4.7: Results using a Swedish model
Changes compared to a base case

Sector	15 % reduction of CO ₂ missions with benchmark exemptions maintained.			15 % reduction of CO ₂ missions without benchmark exemptions.			15 % reduction of CO ₂ missions without benchmark exemptions. Labour subsidies in the Steel and metal sector.					
	Output	Unskilled labour	Skilled labour	Capital	Output	Unskilled labour	Skilled labour	Capital	Output	Unskilled labour	Skilled labour	Capital
Petroleum	-15.7	-15.3	-15.4	-14.5	-8.9	-8.6	-8.7	-8.1	-9.5	-9.3	-9.3	-8.6
Gas	-21.2	-20.7	-20.8	-20.7	-17.2	-16.7	-16.8	-16.8	-17.7	-17.4	-17.5	-17.2
Agriculture	-1.4	0.1	0.0	1.1	-0.3	0.5	0.3	0.9	-0.6	0.1	0.1	0.8
Forestry	-0.4	0.2	0.1	0.4	0.4	0.8	0.7	0.8	-0.2	0.1	0.0	0.3
Fishing	-8.6	-5.4	-5.6	-3.5	-3.4	-1.6	-1.8	-0.7	-3.9	-2.3	-2.4	-1.1
Mining	-14.8	-13.4	-13.5	-13.6	-11.1	-9.5	-9.6	-9.7	-12.1	-10.6	-10.7	-10.4
Food & Textile	-0.6	-0.3	-0.4	-0.1	-0.1	0.4	0.2	0.4	-0.4	0.0	0.0	0.3
Pulp & Paper	-0.3	0.2	0.1	0.4	0.7	1.3	1.2	1.6	-0.2	0.3	0.2	0.9
Chemical	-2.5	-1.3	-1.4	-2.4	1.0	2.1	2.0	1.1	-0.6	0.3	0.3	-0.4
Steel & metal	-1.6	0.1	0.0	-3.2	-23.7	-16.2	-16.3	-29.8	-12.4	0.0	-0.1	-23.2
Manufacturing	2.0	2.2	2.1	2.4	0.8	1.1	0.9	1.1	1.0	1.2	1.1	1.5
Electr. & heat.	0.0	2.2	2.1	3.4	0.0	1.2	1.0	1.7	0.0	1.0	1.0	1.8
Water & Sewage	-0.5	0.0	-0.1	0.3	-0.4	-0.1	-0.3	0.0	-0.4	-0.2	-0.3	0.1
Construction	-0.2	0.4	0.3	1.4	-0.1	0.2	0.1	0.7	-0.1	0.2	0.1	0.9
Transport	-5.1	-2.1	-2.2	-6.7	-1.7	-0.1	-0.3	-2.6	-2.3	-0.8	-0.8	-3.0
Trade & Serv.	-0.4	0.0	-0.2	0.3	0.0	0.2	0.1	0.3	-0.2	0.0	-0.1	0.3
Dwelling	-0.1	0.2	0.1	0.2	0.0	0.3	0.1	0.1	0.0	0.1	0.0	0.2

Source: Hill (1998). Numbers have been rounded off here.

4.4.4 Simulations with a Dutch general equilibrium model

Komen and Peerlings (1999) used a general equilibrium model to compare the employment and welfare effects of a “small-user” energy tax, with exemptions for large energy users, that was already in place in the Netherlands, to a hypothetical general energy tax. The broadened tax was calibrated so as to produce an emissions reduction identical to that of the “small user” tax (3.5%). The model contains a great level of detail with respect to emissions and environmental indicators. In contrast to most of the simulation exercises referred to here, different tax recycling mechanisms are considered in this study. The tax revenue is redistributed (i) in the form of a reduction in social charges paid by workers (which leads to a different arrangement of the tax burden on labour, and was necessary because of the great sectoral discrepancies in the tax burden on employers), (ii) in the form of a reduction in taxes on capital.

When the energy tax revenues was redistributed by reducing the burden on labour, employment was estimated to increase in both tax cases, highest in the case of a general energy tax (0.15% versus 0.10%). Welfare is increased by 0.08% in the “small user”- case, while it declines by 0.02% when all industries are covered. The welfare increase is due to the reduction in pre-existing tax distortions. When the proceeds of the tax are redistributed through a reduction of taxes on capital, the welfare effects are negative, particularly when the tax is generalised, because of the tax interaction effect (see Table 4.8).

Table 4.8: Results using a Dutch general equilibrium model
Changes compared to a base case

	"Small-User" Energy Tax	General Energy Tax
Total Employment	0.1	0.15
Welfare	0.06	-0.02
Energy Use		
Coal	-3.0	-2.3
Natural Gas	-4.1	-5.4
Distributed Gas	-6.0	-3.6
Other Heating Fuels	-7.5	-5.1
Electricity	-4.6	-3.0

Source: Komen and Peerlings (1999)

4.4.5 Simulations with the WARM model

To this point, the labour market in the studies examined has functioned under pure competition. Carraro, Galeotti and Gallo (1996) used the European WARM general equilibrium model where wages were negotiated with unions with a certain bargaining power. Employment effects were estimated in a scenario where a carbon tax (based on the 1992 EU proposal) was introduced and recycled in the form of lower taxes on wages.

The study showed that a wage negotiations model produces a situation where the short-term cost of labour may fall: in effect, over this time frame, unions are unable to offset the full impact of lower wage taxes through higher wages. Over the longer term (beyond 3 years in most cases), however, the assumed reduction in wage taxes was found to be completely offset by higher wages, and so the fiscal reform is entirely absorbed by higher net wages. Positive effects on employment from a tax reform were therefore only temporary.

The estimated short-run employment dividend was largest in the countries where authors had calculated that the preference for employment in the union’s payoff function was lowest (e.g. Germany and the Netherlands) and the union’s bargaining power was lowest (e.g. Germany). The tax reform had the lowest simulated impact on employment in United Kingdom. The authors explain this by their finding that this is the country with the highest union bargaining power and one of the highest union preferences for employment.

The authors conclude that the positive gains from tax reform on employment and environmental protection become larger when the labour market becomes more competitive. In contrast they find that the role of so-called endogenous technical progress (see Section 4.6) seems to be negligible.

4.4.6 A case with freely allocated tradable permits

All the studies examined above have focussed on taxes. By analogy, the results can be extrapolated to cases where tradable emission permits are allocated by auction, with redistribution of sales revenues in the form of lower labour costs. On the other hand, when permits are allocated free of charge through “grandfathering”, it is no longer possible to reduce the cost of labour, because the permit allocation does not raise any revenues.

A study conducted for the European Research Network using the GEM-E3 model (CES-K.U.Leuven, 2002) evaluated costs of implementing the Kyoto Protocol in a case where a global rights market is instituted for all European countries and certain accession countries. Permits were distributed according to the European Burden Sharing Agreement for the Kyoto protocol.

For European countries as a whole, a slight but significant decline in GDP in 2010, averaging about 0.5%, was found. The estimated employment effect was much weaker: while the cost of labour is not reduced here, there is a substitution effect due to the higher price for energy use, which limits the decline in employment (see Table 4.9).

4.4.7 Conclusions about analyses using applied general equilibrium models

Using general equilibrium models to assess environmental policies implemented through economic instruments (taxation, tradable permits, *etc.*) leads to similar results, in qualitative terms, as obtained with econometric models, with comparable orders of magnitude obtained. However, very few studies have standardised the implementation conditions for different models to make them truly comparable.

Jansen and Klaassen (2000) attempted a precise comparison of exercises using econometric models and applied general equilibrium models. They study compared the results of the excise tax reforms proposed by the Commission in 1997 and evaluated them using three models: HERMES (econometric), E3ME (econometric) and GEM-E3 (general equilibrium). The results for employment and GDP were very similar with HERMES and GEM-E3, while E3ME indicated somewhat larger impacts.

Bach *et al.* (2002) compared the effects of the German green tax, the proceeds of which are recycled through a reduction in pension contributions (paid by employers and employees) using two models: PANTA RHEI (econometric) and LEAN (general equilibrium), both of them highly detailed. In the short term, PANTA RHEI indicated an employment increase of 0.1% while LEAN found an increase of 0.6%. With a ten-year horizon, both models indicate an employment increase of about 250,000 persons.

Table 4.9: A European permits system simulated with the GEM-E3 model

	Austria	Belgium	Germany	Denmark	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain	Sweden	UK	Hungary	Poland
Macroeconomic Aggregates																
Gross Domestic Product	-0.3%	-0.3%	-0.4%	-0.4%	-0.5%	-0.3%	-1.0%	-0.7%	-0.5%	-0.5%	-0.4%	-0.5%	-0.3%	-0.5%	-0.6%	-1.5%
Employment	0.0%	-0.1%	-0.1%	0.0%	-0.1%	0.0%	0.0%	-0.2%	0.0%	0.0%	0.0%	0.1%	-0.1%	-0.1%	-0.1%	0.2%
Private Consumption	-0.8%	-0.5%	-0.3%	-0.4%	-0.4%	-0.5%	1.7%	-1.0%	-0.5%	-0.4%	0.4%	-0.3%	0.0%	-0.4%	-0.5%	-1.1%
Investment	-0.2%	-0.2%	-0.2%	-0.4%	-0.4%	-0.4%	0.6%	-0.1%	-0.4%	-0.2%	-0.1%	-0.2%	-0.1%	-0.5%	-0.2%	-0.1%
Energy Consumption	-17.3%	-13.7%	-14.1%	-15.1%	-16.5%	-8.6%	-14.6%	-14.7%	-18.8%	-17.2%	-16.0%	-17.5%	-17.8%	-14.4%	-12.8%	-16.6%
Exports	-0.7%	-1.7%	-1.8%	-0.8%	-1.6%	-0.7%	-7.6%	-1.2%	-2.0%	-1.7%	-2.9%	-3.0%	-1.3%	-0.9%	-2.1%	-4.2%
Imports	-1.0%	-1.9%	-1.2%	-0.6%	-1.6%	-1.2%	0.2%	-1.5%	-1.6%	-1.4%	-1.2%	-2.1%	-1.2%	-0.5%	-2.0%	-1.1%
Real Wage Rate	-1.0%	-0.9%	-0.6%	-0.4%	-0.6%	-0.7%	2.0%	-1.4%	-0.5%	-0.5%	0.2%	-0.2%	-0.3%	-0.5%	-1.0%	-0.6%
Relative Consumer Price	1.5%	2.3%	2.2%	1.3%	2.4%	1.6%	5.6%	2.7%	2.2%	1.6%	2.5%	3.1%	1.6%	2.5%	2.5%	2.8%
Terms of Trade	0.0%	0.0%	0.0%	0.0%	1.1%	0.0%	3.3%	1.2%	1.0%	0.0%	1.0%	1.0%	0.0%	-1.0%	0.0%	1.2%
Public Surplus (% of GDP)*	-0.3	-0.3	-0.2	-0.1	-0.4	0.0	-0.3	-0.3	-0.5	-0.4	-0.1	-0.4	0.0	-0.2	-0.3	-0.4
Current Account (% of GDP)*	-0.2	-0.1	0.0	0.1	-0.2	-0.2	0.3	-0.1	-0.3	-0.3	0.1	-0.3	0.1	-0.3	0.0	-0.4
Atmospheric Emissions																
CO ₂ Emissions	-19.5%	-20.9%	-20.1%	-45.3%	-25.1%	-12.4%	-29.6%	-21.1%	-22.4%	-25.2%	-26.4%	-25.4%	-32.5%	-19.3%	-19.2%	-30.4%
NO _x Emissions	-21.8%	-22.7%	-21.9%	-50.2%	-27.5%	-13.6%	-30.9%	-24.1%	-25.4%	-28.6%	-28.1%	-26.7%	-36.2%	-21.4%	-18.6%	-29.2%
SO ₂ Emissions	-33.4%	-33.9%	-23.1%	-63.3%	-32.0%	-17.9%	-40.4%	-30.0%	-30.5%	-45.8%	-29.8%	-31.7%	-45.2%	-24.3%	-30.4%	-33.8%
VOC Emissions	-16.2%	-14.3%	-18.2%	-42.6%	-22.7%	-11.5%	-26.5%	-17.9%	-21.9%	-24.0%	-24.2%	-22.9%	-28.7%	-18.1%	-15.3%	-16.1%
PM Emissions	-35.0%	-34.0%	-23.6%	-63.3%	-32.9%	-17.2%	-40.3%	-35.0%	-28.9%	-41.5%	-33.1%	-32.6%	-48.2%	-25.0%	-25.1%	-33.9%
Environmental Policy																
Marginal CO ₂ abatement cost (Euro95 / tonne CO ₂)	46.6	43.8	41.1	43.2	49.9	52.0	55.0	63.8	43.4	49.1	46.7	43.9	49.9	49.5	26.4	26.4

Source: CES K.U. Leuven (2002). Numbers are rounded off and results for Slovenia have been omitted here.

4.5 Endogenous technical progress

The introduction of new environmental policies is likely to influence the pace and direction of technical progress. On the other hand, technical progress will be a determining factor in evaluating the cost of these policies. In all of the evaluations discussed above, technical progress was exogenous, i.e. it was not sought explained by the model simulation itself. Making technical progress endogenous in economic models can give economic agents an additional way to react for example to an increase in the price of carbon: whereas they previously were limited to making substitutions, their choice is now broadened to include technical progress.

However, there is still a lot of uncertainty about the various links between environmental policies and technical progress. For one thing, it is not obvious whether any technological progress induced by environmental policies would come in addition to, or instead of, technological developments that otherwise would have taken place. Further, it is *a priori* unclear whether any increase in technological progress would tend to increase or decrease employment impacts of an environmental tax reform.

Pfeiffer and Rennings (2001) identified different factors that can impact on employment:

- type of innovation (product or process innovation), its direction (capital or labour saving, skill-biased or neutral) and intensity;
- government policies: subsidies, regulation, norms and standards;
- structure of the labour market, union power, *etc.*;
- structure and degree of competition in input markets; and
- substitution elasticities between production factors, price and income elasticity of demand, as well as the degree of complementarity between existing and new or improved goods.

If a firm invests in a process innovation, this might enhance labour productivity. In this case, fewer workers will be needed to produce the same output. This is the direct effect: if the project is successful, it reduces production costs, which in turn increases demand for the goods produced. The scope of the employment increase resulting from higher demand for goods depends not only on the price elasticity of demand but also on the scope of the price reduction. Thus, if the price elasticity of demand for goods is greater than unity, the increased demand effect will be greater than the substitution effect, and the employment impact will be positive.

The direct employment effect of a product innovation is, *a priori*, positive. If a new product is launched on the market, the new demand will serve to increase employment, but there are also indirect effects on employment, arising from the value of the substitution elasticity between that good and other goods. If the new product is a substitute for older goods, then the marketing of this product will reduce demand for older goods and the indirect effect will be to reduce employment.

4.5.1 Modelling of endogenous technical progress in economy-wide models

There are a fair number of model studies with endogenous technical progress, and they have been summarised by for example Azar and Dowlatabadi (1999), Löschel (2002) and OECD (2002c):

- “Vintage” models with different generations of capital goods. For each “vintage” the rate of technical progress is constant and exogenous, but with variations in the investment rate, the overall trend of technical progress is modified. This category includes, for example, HERMES and OECD’s GREEN (see Oliveira Martins *et al*, 1992) model.

- “Learning-by-doing” models, in the Arrow tradition, make the cost of introducing a technology dependent on past experience, represented here by installed capacity, a “proxy” for knowledge derived from experience. Such models have been used to determine the optimal time paths for environmental policies, see Kouvartakos *et al.* (2000).
- “Technology adoption” models. These models focus on the set of available technologies (some of which are not yet in use), where the introduction of these technologies is dependent on general economic conditions and environmental policies. This category includes many technical-economic models, like the modified HERMES model, MARKAL and, in part, the POLES model (Criqui *et al.*, 1999), as well as the Manne and Richels (1994) models and that of Edmonds *et al.* (2000). These models are often hybrids of “top-down” and “bottom up” approaches, and they may also take into account “backstop” technologies.
- R&D-based “top-down” models, where the evolution of technical progress depends on knowledge variables linked to the accumulation of R&D. In this approach, the endogenisation of R&D decisions results from the optimisation programme of a firm that can choose between different factors of production: the stock of R&D appears in the production function in the same way as other factors. These production functions may be calibrated or estimated econometrically as in the works of Nadiri and Prucha (1999). The exact incorporation of R&D in the production function determines the bias of technical progress. Specifications differ a lot, but they are based on the accumulation of knowledge linked to the accumulation of R&D. This family of models includes the work of Nordhaus and Boyer (1999), Goulder and Schneider (1999), Goulder and Mathai (2000), Buonanno *et al.* (2001), and Fougereyrollas *et al.* (2001). All of these studies involve general equilibrium models. The production bloc of the NEMESIS model presented below also includes a function based on the stock of R&D.

Goulder and Schneider (1999) used a sectoral model to evaluate the R&D effects of emission abatement policies and find crowding-out effects at the sectoral level. They found that technical progress reduces the net costs of environmental policy but increases its gross costs (before accounting for environmental benefits). Goulder and Mathai (2000) used a mixed endogenous technical progress model (R&D and learning-by-doing) to examine the optimal time path for emission reductions, in which learning effects point to the earliest possible introduction of reductions. Nordhaus (2002) used the R&DICE model in which raising the carbon price induces innovation in the form of less carbon-intensive processes. He concludes that price-induced innovation has less influence on the outcome than do substitution effects.

4.5.2 Simulations with the NEMESIS Model

The possible employment implications of climate change policies are of particular concern as underlined at the ninth session of the Conference of the Parties to the UN Convention on Climate Change (COP9), in December 2003, and discussed earlier in the context of the OECD Labour/Management programme on “Climate Change and Employment” (OECD, 2002e).

In order to provide new assessment on the possible economy-wide employment effects resulting from the implementation of climate change policies, a simulation has been undertaken in the framework of the OECD work programme on Environment and Employment using the NEMESIS model. The results of this modelling exercise assessing employment impacts of policies in Europe to limit CO₂ emissions are presented in greater details in the ANNEX IV of the report.

NEMESIS is a regional macrosectorial econometric model for the Europe. The model covers 16 European countries and some developments are underway to extend the geographical coverage to the rest of the world. The model covers thirty production sectors and twenty seven consumption categories. The main characteristics of the NEMESIS model are described in ANNEX III.

The study simulates the economy-wide employment impacts in Europe (including Norway) of achieving a 4.4% reduction in CO₂ emissions in 2010 compared to the baseline. The emissions scenario used is that of the European Environment Agency (EEA, 2002). The simulation focuses on the employment effects resulting from the implementation of economic instruments.

Five scenarios are examined: two correspond to the implementation of a common European CO₂ tax both without recycling (Scenario 1) and with revenue recycling through a decrease in employers' social contribution (Scenario 2), one uses a system of grandfathered tradable permits for households and firms (Scenario 3) while the last two scenarios combine a CO₂ taxation for households with a system of tradable permits for firms considering the case where the revenue is not recycled (Scenario 4) and where it is (Scenario 5).

It should be noted that the modelling exercise does not intend to reflect the actual European Union context. In particular, the simulation was initiated before the finalisation of the EU proposal and the EU's emission trading scheme does not correspond to a scenario tested. Also, the estimated impacts are rather limited – in part because the CO₂ emissions reduction target used for 2010 is small (-4.4%) – and uncertain as the environment-module is not yet operational.

Among the five scenarios proposed, two show a positive net impact on employment for Europe as a whole. These scenarios correspond to the situation where the revenue is recycled in the case of a common European tax (Scenario 2) and in that of a tradable permit for firms and taxation for households (Scenario 5). The results indicate that this positive effect on employment is however transitory in Scenario 2 but could be more durable if the implementation comes along with wage moderation. The effect appears to be more lasting in Scenario 5.

When examining the employment impacts on individual countries, the simulation suggests that, for countries that have baseline emissions in 2010 below their burden sharing commitments, the best impact on employment is achieved in the scenario relying on tradable permits (Scenario 3). The assumption made is that by selling tradable permits firms can reduce their costs and thus improve their competitiveness and increase their employment relative to the baseline scenario. For countries with emissions in 2010 above their burden sharing commitment, the implementation of CO₂ tax when the revenue is recycled (Scenario 2) provides the best effects in terms of employment.

Results on sectoral employment in Europe suggest differences between scenarios, even those which are comparable when considering the employment effects for Europe as a whole. Scenario 2 favours employment by a substitution effect that reduces investment and then employment in the investment sectors and in intermediary good sectors that are related. Policies using tradable permits give more limited differences in sectoral employment.

4.5.3 Simulations with GEM-E3 incorporating endogenous technological progress

The GEM-E3 model's production module has been modified to incorporate some new growth theories (Fougeyrollas et al., 2001). An initial simulation of a tax without revenue recycling indicate that applying the Kyoto protocol in accordance with the European Burden Sharing Agreement and maintaining the constraint after 2010 ("Kyoto forever") leads to a reduction in employment of 437,000 in the case of exogenous technical progress, and of 233,000 in the case of endogenous technical progress, by the year 2020. Tax-related costs are assumed to induce firms to increase their R&D spending, which generates

productivity gains and product quality gains that enhance the competitiveness of Europe vis-à-vis other countries, in the case of exogenous technical progress. Technological improvement phenomena are strengthened by the exchange of goods and technologies among European countries, with common policies mutually reinforcing.

When the tax is redistributed in the form of payroll tax reductions, the R&D efforts among firms are less important and the impacts of endogenous technological change are much less significant. In fact, businesses get back the full tax and thus, overall, receive more than they paid. They will not be inclined, therefore, to make much effort in terms of R&D. The estimated employment change is positive in these models, but the difference is weak: 1634 and 1563 thousand jobs.

A case with tradable emission permits distributed through “grandfathering” falls between the two preceding cases: the incentive to innovate comes from the fact that the virtual price of carbon is equal to the price of emission permits. Total employment is estimated to decrease 350,000 with exogenous technological change and with 250,000 when technological change is endogenous.

Other policies, like grants and other subsidies, can also encourage R&D. A simulation has been made where the tax revenue is recycled through two channels: 30% in the form of an R&D subsidy, with the balance used to reduce payroll taxes. It was found that the increase in R&D will induce competitiveness gains, so that employment in all European countries was estimated to rise by 3900 thousand to 2020, compared to 1600 thousand jobs obtained when all the tax proceeds were recycled through lower social charges.

This result stands in contrast to the relative pessimism of Goulder and Schneider (1999), where energy R&D tends to crowd out general R&D. They found that carbon abatement policies have very different impacts on R&D across industries, and do not necessarily raise the economy-wide rate of technological progress. Focusing only on the sectors with positive R&D impacts can lead to substantial underassessment of the GDP costs of CO abatement policies.

The explanation of this difference lies in the fact that in GEM-E3, R&D covers research in all sectors and not only in energy. A higher energy price is *assumed* to increase this general R&D. Moreover, the production module takes explicit account of spillover effects, which makes R&D support policies more attractive because there is a significant gap between the private and social productivity of R&D.

Finally, the GEM-E3 results were obtained when innovation affected overall factor productivity or product quality. Van Regemorter and Mayers (2002) also used the GEM-E3 model to describe a scenario where labour productivity depends on the health status of the population, which itself is related to environmental variables. This led to a *decline* in employment, compared to the exogenous productivity version of the model.

4.6 Conclusions

Most applied models indicate that an employment dividend is possible when the revenues raised by economic instruments (taxes or auctioned emission permits) are recycled in the form of lower labour taxation, and particularly in the form of reduced payroll taxes. An employment dividend is conditional upon a reduction in the cost of labour. The larger the amount to recycle, the larger the employment impact can be obtained. A reduction in labour costs is likely to be only temporary; hence the employment dividend can be expected to disappear over the long run. The models also indicate that employment rises more when recycling is targeted at low wage earners, and more durably when wage pressures remain moderate.

When technical progress is assumed to depend on the environmental policies being implemented, the estimated employment impacts are less consistent. Some econometric studies based on survey data suggest that employment will rise when environmental policy induces product innovations, while it may decline in the face of process innovations, especially when they are accelerated by subsidies.

Most of the models with endogenous technical progress do not focus directly on employment issues; some discount the importance of the effect of technical progress, while others point to a crowding-out effect on overall research and development. This leads to rather limited macroeconomic impacts of technical progress induced by environmental policies. Still other studies indicate that introducing the best available technologies in the energy field could enhance overall economic competitiveness, which also could reinforce the employment dividend.

Yet, these studies on technical progress are fragile. Further progress depends on the development of new models and this in turn is linked to the availability of information on the “drivers” of the appearance and dissemination of innovations.

In all cases, this review of the literature on economy-wide employment effects of environmental policies suggests that the effects are very small.

CHAPTER 5: GENERAL CONCLUSIONS

- *A better set of data on environment-related employment ...*

The first objective of the work programme on Environment and Employment was to provide an update of information on environment-related employment in OECD countries since the 1997 publication, as new data have been collected. The report indicates that environmentally-related activities in the private, public and tertiary sector have become a significant source of employment in a number of OECD Member countries. Existing data show that the direct employment effects in the environmental goods and services (EGS) sector alone vary between 0.4 and 3.0 per cent of total employment; and between 1 and 1.5 per cent in the majority of countries. These figures are meant to be a lower-bound estimate. In particular, areas such as environment-related jobs in the public sector and in the tertiary sector were not taken into account in most countries under review. Moreover, the figures presented do not include indirect and multiplier effects resulting from the first-round effects of direct environment-related employment. Besides, these estimations are largely a function of sectors and workers classifications which are defined as being “environmentally-related” employment.

Compared to the previous statistical update on environment-related employment in OECD countries (OECD, 1997), the analysis underlines significant progress in the quantification of employment based on a broader coverage of Member countries, and improved statistical coverage of sectors and sub-sectors. In addition, a more comprehensive and combined use of various methodological approaches to assess environment-related employment can be noted, as well as the availability of relevant data on a more regular basis. Due to changes in definitions, methods of data collection and the broader statistical coverage, the estimates did not allow comparison with the 1997 survey.

Information related to the qualitative features of environment-related jobs suggests that employment in the EGS sector tends to be polarised into low-skill jobs, in such areas as waste management, and highly qualified labour, such as in the sub-sector of environmental consulting. The share of foreign workers in environment-related activities is found to be above the national average, in particular in the area of waste management and waste sorting. Conversely, available information suggests that the share of female employees in the EGS industry is significantly below national averages.

- *... but improvements still needed.*

In spite of progress made in the quality of data on environment-related employment in OECD countries (e.g. wider coverage, improved methods to collect information), the analysis highlights gaps in availability, reliability and comparability of data. The information on employment in activities associated with cleaner technologies and products in the private sector is for instance scant, and limited data is in general available for the public sector. Also, statistical data on indirect environment-related employment are scarce.

In addition, besides the efforts made to adopt a similar framework (i.e. OECD/EUROSTAT, 1999), differences in methods of gathering information reduces the possibilities of comparative analysis. The development of data collection on environment-related employment in a way that would facilitate

cross country comparison could help the formulation of policies. Also, and perhaps most significantly, it is important to improve the understanding of how data on environmental-related employment can inform public policy analysis.

- *A significant number of local initiatives to integrate objectives ...*

Initiatives to integrate environmental and employment objectives have been mainly based on macro-economic instruments (sometimes called ‘top-down’ approaches) such as using environmental expenditures, as increased public expenditures on environment-related public services, or implementing environment tax reform that would serve employment objectives. However, since the beginning of the 1990’s, regional and local employment projects that rely on the initiative and understanding of the problems at the local-level actors, have become more common. The second objective of this programme was to examine the possible contribution of local/regional initiatives in integrating environment and employment objectives. The review of initiatives applied at a local/regional level underlined the great variety of possible approaches ranging from small, local voluntary organisations and associations or networks of SMEs in the eco-industry to large multi-sector partnerships engaged in Local Agenda 21 or regional sustainable development. These initiatives may be further distinguished according to the type of stakeholders involved (e.g. private sector, public sector, so-called “third sector” or multi-sector partnerships), or their sectoral focus. The experiences reviewed in OECD countries suggest that the strongest impetus for the formation of territorial initiatives comes from multi-sector partnerships. Available evidence indicates that the environmental focus of *local* initiatives is in general very diverse with the exception of the Pacific region where projects tend to concentrate on recycling and waste management activities. Concerning the employment focus, the analysis suggests that local/regional initiatives mainly aim at the creation of new jobs.

- *... but available evidence suggests mixed results on employment benefits.*

Bottom-up approaches appear as a means of contributing to solutions to the locally pressing problems of unemployment and social exclusion. But, while an increasing number of projects are initiated at the *local* level in Member countries, the data allowing for an assessment in terms of employment or impact on the environment is scarce and a better evaluation of these approaches would be much needed. Available material is at this stage inconclusive and suggests that the possible contribution of local/regional initiatives in integrating environment and employment goals remains limited. If some potential exists for combining objectives at the local level, these approaches, far from providing an alternative to top-down approaches, are rather supplementing them. However, as for macro-economic measures, bottom-up initiatives require financing out of general tax base with related effects on employment that need to be assessed adopting the economy-wide perspective discussed below. The report also underlines that the success of such local/regional initiatives depends on a number of key factors like the mobilisations of local stakeholders or the existence of an appropriate legal framework.

- *Economy-wide employment effects of environmental policy are limited*

The analysis of the economy-wide employment impacts of environmental policy, in particular climate change policies, and the question of the possible integration of environmental and employment objectives at the macro-economic level, was another key objective of the programme.

The effects of environmental policies on employment can be evaluated either through partial, micro-economic and sectoral approaches, or through macro-economic approaches. The survey carried out on quantitative studies focuses on macro-economic approaches using either econometric models or computable general equilibrium models. The study highlights the scarcity of studies using employment as an important indicator in the evaluation of environmental policies. In addition, most of the studies focus on climate change policies. The study also underlines the lack of mature debate in the literature on the

potential for a so-called “double-dividend”, where a shift in taxation from labour to pollution in the context of revenue-neutral “green tax reforms” is thought to cause both environmental improvements and increases in employment.

The employment double dividend remains uncertain and small

The results of several econometric models indicate that an employment dividend is possible when the revenues raised when implementing economic instruments - such as taxes or auctioned tradable permits – are recycled in the form of a reduction in labour costs. The employment increase is likely to be greater when payroll tax reductions are concentrated on unskilled workers. However, these findings are conditional on the possibility of lowering labour costs and the elasticity of demand for labour. Using general equilibrium models leads to similar results. When technical progress is assumed to be endogenous, the employment impacts are found to be less consistent. Some econometric surveys indicate that employment may rise when environmental policy induces product innovations, while it may decline in the case of process innovations. Yet, these studies on technical progress are still fragile. Further progress depends on the development of new models and this in turn is linked to the availability of information on “drivers” of the appearance and dissemination of innovations.

If the findings of the literature review on economy-wide employment impacts of environmental policy suggest that an employment dividend may exist in the case when payroll taxes are lowered, and especially when the measures are targeted at low wage earners, the effects are very small. Also, the employment dividend can be expected to be temporary since labour costs are likely to increase in the longer run, as a result of wage pressure. In addition, it should be noted that environmentally related taxes that succeed in changing behaviour will lead to lower revenues.

Some factors identified in the literature as making the prospects of increased employment higher include: wage moderation, high initial taxes on labour, capital relatively immobile internationally and environmental tax that can be passed on to factors that are inelastically supplied and relatively under-taxed. It depends as well on how far is the labour market from equilibrium. Thus, when a double dividend exists, it appears limited and conditional upon a number of prerequisites.

• ***Simulations of climate change policies ...***

The question of the potential impact of climate change policies on employment, which is an important objective of the programme, was also examined by undertaking new modelling simulations. The possible employment impacts of policies in Europe to limit CO₂ emissions were simulated using the Nemesis Model, an econometric model for Europe. Five scenarios were distinguished which do not include the EU’s emission trading scheme as the modelling exercise began before the proposal was finalised: two with taxation, one with tradable permits and two “mixed” scenarios based on permits and taxation.

... indicate that when a positive employment impact exists it is small.

For Europe as a whole, the results suggest that among the five scenarios proposed, two show a net positive impact on employment: the scenario on a common European tax - with revenue recycling – (scenario 2), and the scenario with tradable permits for firms and taxation of households – with revenue recycling (scenario 5). The effect appears less transitory in the second scenario which seems more appropriate for Europe taken as a whole, since it incorporates the substitution effects favouring employment in the first scenario with the less inflationary effects of tradable permits policy.

Findings on individual countries indicate that countries that have baseline emissions in 2010 below their burden sharing commitments tend to achieve the best employment impacts through a tradable permits policy for households and firms, assuming that firms can reduce their costs by selling tradable permits, thus improving their competitiveness and increasing their employment relative to the baseline scenario. In the countries that have baseline emissions in 2010 above their burden sharing commitment, taxation with recycling (Scenario 2) is found to provide the best results from an employment point of view.

Lastly, the results presented for sectoral employment in Europe highlight differences between scenarios. Tradable permits policies appear to give more limited differences in sectoral employment than a scenario where the revenue from taxation is recycled through reductions in employers' social contribution. In scenarios 5 and 2, the increase in employment takes place in the production of consumption goods and in service-related sectors (except transports).

Yet, the simulation exercise concludes that the estimated employment impacts of policies in Europe to limit CO₂ emission are rather uncertain, at this stage of development of the model, and remain small.

Overall, the economy-wide employment effects resulting from the implementation of economic instruments - such as taxes or auctioned tradable permits – inconclusive at present, and the studies suggest that even when the results are positive, the effect is very limited.

- *However, short term transition impacts may be significant*

When looking at the short term and sectoral level, however, the effects of environmental policy on employment may be substantial and there are for instance particular concerns about the impacts of climate change measures on employment as expressed in the Ninth Conference of the Parties to the Climate Change Convention (COP9) in 2003.

The question of transition effects has been studied in previous work, in particular on competitiveness issues resulting from the implementation of environmentally related taxes (OECD, 2001d; OECD, 2002d), and underlined in the framework of the OECD Labour/Management programme on "Climate Change and Employment" (OECD, 2002e). The effects of environmental policy on employment may be particularly acute for energy-intensive industries, with a strong adverse impact on the environment such as heavy industries (e.g. steel, pulp and paper, aluminium). Environmental taxes and other policy instruments may affect competitiveness through a complex set of channels together with other factors such as skills or capital investment for sectoral competitiveness for instance. The fear for reduced competitiveness on the most polluting sectors of the economy appears in certain cases as a major obstacle to the implementation of environmentally related taxes. Applying exemptions and rebates can however create inefficiencies in pollution abatement and undermine environmental effectiveness, but several policy options can be used to reduce the impacts on competitiveness without significantly reducing the incentive to abate emissions.

Measures that may be taken for alleviating the short-term impacts of a change in environmental policy on employment in some sectors or regions include: the integration of environmentally motivated reforms with broader fiscal reforms, the early announcement of the policy change and long-term policy-commitments, active labour market policies targeted at the workers negatively impacted (e.g. specific assistance to provide higher education or undertake vocational training).

Thus, if the analysis indicates that the economy-wide employment impacts of the environmental policies tend to be relatively small, the transition problems that are likely to arise need to be given attention and must be duly addressed. This report underlines the importance to further examine labour

adjustment mechanisms in the transition period when implementing environmental policies as an important and complementary insight. These effects may be particularly acute for energy intensive sectors with a strong adverse impact on the environment, such as heavy industries generally concerned with processing of raw materials or the primary industry involved in natural resource extraction and exploitation (e.g. fishing, forestry and mining).

The use of policy packages and the need to co-ordinate measures

The use of a combination of instruments to reduce the same specific environmental damage or preserve the same environmental resource is common in OECD countries (OECD, 2003b; OECD, 2004). As the objectives of environmental policies tend to broaden with policies aiming at economic efficiency and environmental effectiveness while simultaneously addressing social concerns like competitiveness issues and distributional effects (see OECD, 2002d; OECD, 2003c), policy mixes are more widely used and the complexity of interactions increases.

The report draws attention to the importance of policy packages combining environmental policies with other public policy measures (e.g. public finance, labour market policies, trade policies, industrial and innovation policy) when addressing employment concerns associated with environmental policies. The policy mix used to tackle employment issues may include a variety of measures pertaining to different policy areas.

The impacts of environmental policies on employment will not be the same whether or not the implementation of policy instruments generates a revenue - as in the case of taxes and auctioned tradable permits - and according to how this revenue is recycled, as underlined in the report. Fiscal policy may be used to lower the cost of labour such as, for instance, redistributing the proceeds of the tax (or auctioned permits) to reduce payroll taxes for employers. These measures may be targeted on specific workers (e.g. unskilled). Even if the approach adopted to recycle the revenue is not directly targeted at labour taxes (e.g. reduction in income tax or in VAT rate) it may have an incidence on employment.

Some labour market policies can be implemented like for example adopting policies targeted at wage moderation. Measures may also be taken to alleviate the negative short-term impacts of environmental policies on employment in some sectors or regions, like labour market policies targeted at workers negatively affected by the policy. For instance, specific measures may be used to address labour market rigidities such as low labour mobility or skills specificity characterising some sectors which are likely to be particularly vulnerable to transition costs (e.g. resources-based sectors).

Trade policy measures may be adopted to address international competitiveness concerns for example by introducing border tax adjustment such as corrective import duties (e.g. border tax adjustment on carbon). Other options include the introduction of environmentally related taxes with special provision to protect sectors most vulnerable to international competition. Nonetheless, the economic efficiency, environmental effectiveness and conformity with GATT and WTO rules need to be taken into account.

Specific innovation policies measures can be introduced to develop possible synergies between environmental, labour market and innovation policy. The literature on the employment impacts of environmental innovations at the firm level suggests for instance that in the short term product and service innovations could create more jobs than process innovation. Programmes may be adopted to promote research, development and commercialisation of environmentally-preferable innovations like financial support.

The report highlights as well the importance to ensure the integration and co-ordination of policy instruments. The use of policy packages involves interactions that need to be examined in order to develop complementarities and self-reinforcing mechanisms while limiting possible contradictions. For instance,

measures adopted to lower the labour cost would need to be coordinated with measures which are likely to have the opposite effect such as an increase in the taxes on consumption which will tend to fall primarily on labour.

In addition, the analysis undertaken in the report where both the contribution of “local” initiatives and the use of macro-economic measures have been considered underlines another key level of co-ordination: the coherence between different geographical and institutional levels of intervention (e.g. local, national, international). Local initiatives may for instance have a particular role to play in addressing transition and sectoral issues and would need to be integrated with central government macro-economic policies to complement them. Also, measures may be taken to favour international co-ordination.

The report points out to a number of areas where additional insights would be of particular significance to improve the formulation of policy recommendations to address the employment effects of environmental policies such as the further analysis of the negative short-term impacts measures in particularly vulnerable sectors (e.g. heavy industries, resource-based sectors). It also underlines the importance of gain a better understanding of how to combine policies and co-ordinate measures to better integrate environmental and employment objectives.

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ANNEX I: QUESTIONNAIRE ON ENVIRONMENT-RELATED EMPLOYMENT

In order to complete and update data on environment-related employment in OECD countries, Member countries were invited to reply to the following questionnaire:

1. Are there any statistics, surveys or estimates on environment-related employment effects available for your country (base years: 1997-2000)?

yes

no

If yes, please indicate the sources:

.....
.....

2. Please indicate your country's environment-related jobs for the year (yearly average)

.....
.....
.....

3. Please provide a breakdown by activities and actors

(See Table A1)

**Table A1: Mapping employment-inducing environmental activities
by groups of actors**

Activities	Pollution Management	Cleaner technologies and products	Resource Management	Transversal Activities
Actors				
Business				
Public-private partnerships				
Non-profit organisations				
Public				
Private households				

4. Please provide a breakdown by occupational status

Occupational status	% of persons in environment-related jobs
• Managers	
• Senior professionals and technicians	
• Associate professionals and technicians	
• Foremen, workshop supervisors, skilled workers, etc.	
• Clerks, service workers, sales workers	
• Elementary occupation	
• Apprentices and assistants	

5. Please specify the methodologies used for the data collection.

ANNEX II: LOCAL INITIATIVES FOCUSSING ON EMPLOYMENT AND ENVIRONMENTAL OBJECTIVES: EXPERIENCES IN OECD COUNTRIES³³

1. EU Countries

Austria:

- Eco&Co - Green Technology Network, Graz
- Upper Austrian Renewable Energy Cluster, Linz
- The Tyrolean Energy-Efficient House Cluster
- Eco-Building Project
- Bio Energy Cluster
- Prima Service Corporation Ltd.
- Repair and Service Centre, Vienna
- Eco-Service Ltd., Graz
- Steinbach – Revitalising a Village
- Regional Development Association in Weiz-Gleisdorf
- Territorial Employment Pact in Tyrol
- Ecoprofit, Graz

Belgium:

- Auto Récup Jeunes – Auto Recovery
- Materialrecovery (RECMA)
- Groupe Terre
- Institute Eco-conseil

Denmark:

- Genbyg Timber Store
- Marstal VVS Electric Company
- Industrial Symbiosis in Kalundborg
- Reorganisation of 550 Public Kitchens
- Holbæk Youth Hostel
- Copenhagen Recycling Company
- Nature Preservation Plans in Haderslev
- City Bicycle Project

³³ Sources: Sprenger (forthcoming), OECD (2002a) and OECD (2001a).

- The Promotion of SME's in Viborg County

Finland:

- Green Know-How Turku
- Timber Network in South Ostrobothnia
- Environmental Improvement in East Lapland
- Tampere Employment Programme
- Environment Centre of Lapland
- Metsähallitus' Activities in North Lapland
- The Ecological Village Hendriksdal
- Oulu Region Centre of Expertise
- Big Lakes' Sustainable Tourism

France:

- Energy from Waste Wood – A Network
- Relaunch of Textile Hemp
- The Sainte-Marthe Farm
- SARL Ferme de Vallegrain
- Salt Production in Camargue
- Syndicat Mixte à la Carte du Haut Val de Sèvre et sud Gâtine (SMC)
- Industrial Waste Recycling
- Guerande Peninsula Salt Marshes
- The Green Squad
- The Regional Natural Park in Brenne
- The Regional Natural Park in Lubéron
- Household Appliance Recycling E.N.V.I.E.
- Association Aladin in Toulon
- Association Against Waste, Poligny
- La SCOP EAU-BOIS Landscaping
- Trialp
- Réussir-Environnement
- Bureau for Solidary Action in Sud Audois
- Local Eco-Development in Mèze
- 'Wood as Energy and Local Development' Plan
- The Urban Environment Institute
- Lake Le Bourget

Germany:

- Centre of Environmental Excellence, Berlin
- The Hohenlohe Network
- Rastmarkt Obere Altmühl
- Ecological Strategies for Joineries in Bremen
- Co-operation of environmentally conscious craft businesses
- Innovation and Co-ordination Centre for the Metal Industry
- Competence Network for Waste Disposal in Middle Germany
- Carpet Recycling Europe Ltd.
- National Park Vorpommersche Boddenlandschaft
- Building Components Recycling - BauElementeLager
- Werkhof Darmstadt
- Ecological Employment Initiative Krummenhagen
- Ecological Education in Eco-Tourism
- Association for Employment and Education Inc.
- BauWerkStadt – Constructing Social Housing
- Housing Co-operative on Beutelweg
- Eco Solution
- WTU Job Promotion Enterprise
- Centre of Environmental Excellence Augsburg
- International Building Exhibition Emscher Park
- Ecological Village Brodowin
- Network Coup 21 Nuremberg
- City of Ulm’s Initiative for Sustainable Economic Development
- Eco Centre North Rhine Westphalia

Greece:

- The Society for the Protection of Prespa
- The Ecological Farm of Kria Vrissi
- Cleaner Production Centre in Athena

Ireland:

- Cider Apples Cultivation in Waterford County
- Sustainable Lobster Fisheries in South Kerry
- Outdoor Cut Foliage Production in Kerry County

- Supplementary Income to Dairy Farming
- Organic Horticulture Training Scheme
- Ballhyhoura Development Ltd.
- Corncrake Conservation Project
- Anne Valley Wetland Projects
- Rathgormack Hiking Centre

Italy:

- Ceramic Waste Recycling
- Integrated Environmental Management in Santa Croce sull'Arno
- The Co-operative Movement in Trentino
- Consortium I.C.S
- Consortium Sol.Co Bergamo
- Italia Lavoro
- Wastewater Treatment in the County of Prato
- Territorial Employment Pact of Sangro-Aventino
- Environment Park Turin

Netherlands:

- Zuiver Ei - Biothermal processing
- Direct Marketing of Organic Products: The EKO-Boerderijen Route
- Park & Ride Facility in Slinge
- Environmental Technology Park
- A Clean Zeeland
- The Ecological Value of the Dike Landscape
- Entrepreneurship in Environment, Energy, Recycling and Waste Processing

Portugal:

- Enclave of Services - CERCIFAF
- Employment Centre Curva Quatro
- Employment, Environment and Economy in Franca de Xira
- Restoration of a Windmill, Serra do Caldeirao

Spain:

- Cooperativa La Vall d'En Bas – A Farming Co-operative
- Company L'Arca del Maresme
- Strategic Plan for Malaga

- Cheese Production in La Serena
- Guadiamar Green Corridor Project
- Workshop Schools in Baix Llobregat
- Cleaning Beaches in Cantabria
- Can Ensenya S. A. L. Work Therapy Project
- Community Development Institute, Madrid
- Traperos de Emaus de Pamplona
- Engrunes Foundation, Catalonia
- Ecological Change in Local Agriculture, Sierra de Segura
- The Restaura Natura Programme
- Tourism in the Balearic Islands
- Bilbao Metropoli 30
- Doñana 21 Foundation

Sweden:

- ‘The Waste Mall’ - Container Sopvaruhuset AB
- Alternative Agriculture Production – Raggårdens Produkter Ltd.
- Torfolk Gård Organic Farm
- Tingvall Ecology/Organic Centre
- The Energy House SEAM
- Village Model in Björkshult
- Environmental Consultants Project IdéTorget AB
- Programme Ecologically Sustainable Region
- Programme Chemical Sweep
- Eco Job Agency
- Öhns Gard Farm
- Biofuel Project
- Nature Care Service Skaraborg
- The Em River Stakeholder Association

United Kingdom:

- Westminster Business Environment Network (WBEN)
- Powersave Scheme
- Business in the Environment – Yorkshire and Humber
- Coed Cymru: Managing Native Woodlands in Wales
- South Yorkshire Supertram and the Midland Metro

- The Manchester Metrolink Light Rail System
- Abernethy Forest: The Economic Impact of a Nature Reserve
- Green Gaps Partnership
- The WISE Group
- Landwise Ltd.
- Heatwise Ltd.
- Glasgow Works Programme
- Groundwork Association
- Bootstraps Enterprises
- WyeCycle Waste Reduction
- Lothian and Edinburgh Environmental Partnership (LEEP)
- Antur Waunfawr Community Project
- CREATE Charitable Trust
- Ophne Ltd.
- Barclays SiteSavers
- The Tarka Project
- The Red Kite Project, Wales
- Bradford Business and Environment Forum
- The NADAIR Project, Argyll Islands
- Leicester’s Community Plan
- Regional Environmental Action Partnership
- Dyfi Eco Valley Partnership, Wales

2. NAFTA Countries

United States:

- Industrial Ecosystem Development Project North Carolina
- Fairfield Ecological Park
- Brownsville Eco-Industrial Park
- Monehegan Associates, Maine
- The Menominee Forest, Wisconsin
- Red Lodge, Montana
- Port of Cape Charles Sustainable Technologies Industrial Park, Virginia
- The Civano Industrial Eco-Park, Arizona
- North Carolina’s Environmental Technologies Cluster
- Arlington Jackson Site

- Applegate Partnerships
- Community Garden – Kremmling, Colorado
- The Industrial Plaza of York
- Village Farms of Buffalo
- Chattanooga Venture, Tennessee
- The Eastern Shore of Virginia
- The Malpai Borderlands Group
- The Quincy Library Group, California
- The Voluntary Investigation and Cleanup Program, Minnesota
- The Upper San Pedro Basin Partnership
- The Fox-Wolf River, Wisconsin
- Burlington, Vermont

Canada:

- Community Shared Agriculture
- Burnside Eco-Industrial Park
- Sarcan
- Green Communities Initiative
- Pacific Initiatives
- Edmonton Recycling Society
- A Plan for an Environmentally Healthy Toronto
- Waterfront Renewal: Regenerating Cobourg Harbour

Mexico:

- 01 Urban Animation Project AXIS
- Ecological District Project Nahi Xix
- Sinola Ecoregion
- International Sonoran Desert Alliance
- Asociación Regional Ambiental de Sonora y Arizona (ARASA)

3. ASIA/OCEANIA Countries

Japan:

- Kokubo Eco-Industrial Park
- Ebara Corporation - Fujisawa Eco-Industrial Park
- Kitakyushu Ecotown
- Kawasaki Eco-Town Project

Australia:

- Pajinka Wilderness Lodge
- Homebush Bay Olympic Site
- Forest Campaign
- South West Sustainability Partnerships
- The Murray-Darling Basin Commission

New Zealand:

- Motueka Basin, Integrated Catchment Management
- CENTRAL and EUROPEAN Countries (CEEC)

Czech Republic:

- PermaLot – Project Svojanov
- The Jan Piveèka Foundation

Hungary:

- Amber Trail Greenway Program
- Gyûrûfû Foundation
- Balaton Regional Development Council

Slovakia:

- BIOMASA

ANNEX III: MAIN CHARACTERISTICS OF THE NEMESIS MODEL

General overview

The NEMESIS model (New Econometric Model for Environment and Sustainable development Implementation Strategies) is an econometric model built by a European research consortium³⁴ that was financed mainly by the European Commission³⁵.

The NEMESIS model can be used for several purposes, including:

- Assessment of structural policies, mainly environmental and R&D policies.
- Studies of short and medium term consequences of a wide spectrum of economic policies.
- Macro and sectoral “forecasts” for short/medium-term up to 8 years; building baseline scenarios (for up to 30 years).

Three principal characteristics of the model distinguish it from others used for similar analysis:

- An energy-environment module which transforms activity indicators from the macro model at a sectoral level into energy-relevant indexes with price effects and pollutants emissions: CO₂, SO₂, NO_x, HFC, PFC and CF₆. The environment module is currently being developed.
- Five types of conversion matrices for interlinking: final consumption, investment goods, intermediate consumption, energy-environment and technological transfers. These are necessary because goods/services produced by firms are often used in “bundles” in final demand.
- The supply side block, which incorporates some properties of new theories of growth, for instance: endogenous R&D decisions, process innovations, and technological and knowledge spillovers between sectors and countries.

Geographical coverage

NEMESIS is a large-scale econometric model for the EC 15 countries plus Norway (EC 15+) and some developments are under way to extend the geographical coverage (e.g. the United States, Japan). Regions outside EC 15+ are represented as being exogenous, with some distinction being made between ten world regions (e.g. NAFTA, Japan). Each of the sixteen European countries covered is fully modelled and is essentially linked to others through external trade.

³⁴. Coordinated by the ERASME Team with, for main contributors: Bureau Fédéral du plan (Belgium), National Technical University of Athens (Greece) and Chambre de Commerce et d'Industrie de Paris.

³⁵. Research Directorate, Sustainable Development and Energy unit.

Sectoral coverage

NEMESIS is a multi-sectoral model covering 30 sectors (see Table III.1).

Table III.1: NEMESIS' Sectoral Coverage

1	Agriculture
2	Coal and Coke
3	Oil & Gas Extraction
4	Gas Distribution
5	Refined Oil
6	Electricity
7	Water Supply
8	Ferr & non Ferrous Metals
9	Non Metallic Min Products
10	Chemicals
11	Metal Products
12	Agr & Indus Machines
13	Office Machines
14	Electrical Goods
15	transport Equipment
16	Food, Drink & Tobacco
17	Tex., Clothing & Footwear.
18	Paper & Printing Products
19	Rubber & Plastic
20	Other Manufactures
21	Construction
22	Distribution
23	Lodging & Catering
24	Inland Transports
25	Sea & Air Transport
26	Other Transports
27	Communication
28	Bank, Finance & Insurance
29	Other Market Services
30	Non Market Services

Supply side

One of the innovations introduced with NEMESIS is found in the supply side that was developed for the model. Two original features are worth emphasising include:

- All factor demands are derived from the “Generalized symmetric McFadden” cost function³⁶
- Research and Development engaged by firms is a production factor that allows efficiency gains.

³⁶ Cost function proposed by Diewert and Wales (1987).

Regarding (1), the cost function has a representation under the flexible accelerator form (see Madan and Prucha, 1989; Prucha and Nadiri, 1991) with straightforward expressions for factor demand estimation and implementation in NEMESIS. The cost function uses three variable factors (Labour, Energy and Materials) and two quasi-fixed inputs (physical and R&D Capital).

Regarding (2), the firm's R&D effort will permit an increase in the total factor productivity (TFP) of its inputs, and thus to be more competitive in their market. R&D effort is modelled as dependent on market conditions such that firms increase effort when faced with adverse conditions.

The five equations have been estimated simultaneously for each sector using pooled panel estimation techniques. Most parameters were constrained to have a common estimated value for all countries, while others (constants, etc.) were allowed to be differentiated by country. The use of panel estimation techniques makes maximum use of short time series (here 1981-1996). The use of a flexible functional form for the production/cost equation permits different elasticities and adjustment speeds for production factors in each country, even though some parameters are common.

Consumption characteristics

Aggregate consumption is dependent on expectations of lifetime earnings but with a slow adjustment to changes in current income – implemented using an error correction model (ECM).³⁷ Total earnings are a function of regional disposable income, a measure of wealth for the households, interest rates and inflation (in the dynamic equation only). Variables covering child and old-age dependency rates are also included in an attempt to capture any change in consumption patterns caused by an aging population. The unemployment rate is used, in the short-term equation (only), as a proxy for the degree of uncertainty in the economy. Due to the lack of available data on household wealth, investment in dwellings was used as a proxy for the housing stock. Consistent with the other behavioural equations, the disaggregate consumption module is based on the assumption that there exists a long-run equilibrium but rigidities are present which prevent immediate adjustment to that long-term solution. Again, an ECM specification is used to represent that adjustment process: the econometric equation is derived from the theory of rational consumers, with the restrictions imposed by it implemented in a flexible manner. Altogether, the total aggregate consumption is indirectly affected by 27 different components through their impact on relative prices and total income (to which demographic changes are added).

The allocation of consumption is done through an assumption of group-wise separability, meaning that the consumer faces a decision problem in several stages. In a first stage, the representative consumer decides how much he/she will spend on durable and complementary non-durable goods on the one hand, and non-durable goods on the other hand. In a second stage, he/she decides how to spend the money allocated in the first stage within each group, e.g., how much of the amount dedicated to the durable goods will be allocated to clothing, household utilities and transportation³⁸. A third decision stage takes place in the non-durable goods group. It consists of the choice between necessities (including food, beverages, tobacco, education, rent, health, electricity and other expenditure items) and luxuries (including communication, tourism and domestic services). Once these decisions are made, the demand for each category is allocated to product demands (i.e., the output of firms) using conversion matrices.

³⁷ Many of the adjustments processes modelled in NEMESIS are specified as ECM. This allows the model's long-term properties to be consistent with some economic fundamentals, while the short-term properties are allowed to reflect other considerations.

³⁸ Transportation includes public transportation, equipment (such as cars) and energy, divided into petrol, heavy fuel and oil

Other main features

The **wage equation** is based on a theory of the wage-setting decisions made by utility maximising unions. The unions derive utility from higher levels of employment in the sector and from higher real consumption wages (relative to wages outside the union), subject to the labour-demand constraint imposed by profit-maximisation by the firms. The implication of this form of the wage equation is that conditions in the labour market are critical for determining wages (in the adjustment process, price levels are also important). Indeed, the real wages in a given sector will **rise** if there are: productivity shocks³⁹, changes in the unemployment rate, or changes in the real wage outside that sector.

All **trade** is treated as if it takes place through two channels: intra-EU, and trade to the rest of the world. Data availability was an important factor in this choice – it allowed an emphasis to be put on intra-EU trade flows, which are a large portion of the total trade in the EU. One caveat worth mentioning is that, while it is possible to identify volumes for intra- and extra-EU trade, it is not the case for obtaining **prices** from the databases.

The intra- and extra-EU export volume equations can be separated into two components, income and prices. The demand effect is captured by: a variable representing economic activity in the rest of the EU for intra-EU trade; and a variable representing economic activity in the rest of the world for extra-EU trade (which is exogenous in the current version of the model). Prices are split into two sources of impacts in each of the two equations (intra- and extra-EU trade). For intra-EU trade, they are: the price of exports for the exporting country and the price of exports in other EU countries. For extra-EU trade, price impacts come through: the price of exports for the exporting country, and a rest-of-the-world price variable. The stock of R&D in a country (which, in NEMESIS, is taken relative to the total stock of R&D in Europe in a particular sector) is also included in the export equation in order to capture the role of innovations in trade performance and structural competitiveness.

The import volume equations are the same for both intra- and extra-EU trade. The demand effect is captured through domestic sales by domestic producers; while the price effects are represented in both the import price, as well as the price of domestic sales by domestic producers. The stock of R&D is again included to allow for the effects of innovations on trade performance.

The import and export prices result from an arbitrage between firms engaging in competitive behaviour and those pricing by mark-up – implying that prices do not exactly equal marginal cost. All empirically based equations of the model (except for the supply side) are estimated in an ECM framework.

The main **exogenous variables** of the NEMESIS model are:

- World assumptions: interest (long- and short-term) and exchange rates; activity variables for the rest of the world; wholesale and commodity prices;
- Demographic assumptions: total population; population structure and labour force;
- National assumptions: interest (long- and short-term) and exchange rates; taxation policy (indirect and direct taxes, social security benefits and contributions); government expenditures (defence, health, education, others); and
- Energy-environment assumptions: excise duties; tax rates (carbon and energy taxes).

³⁹. In the current version this effect is bypassed.

ANNEX IV: EMPLOYMENT IMPACTS OF POLICIES IN EUROPE TO LIMIT CO₂ EMISSIONS: SIMULATIONS USING THE NEMESIS MODEL

1 Introduction

In a context where the possible economy-wide employment effects resulting from the implementation of climate change policies are of particular concern, a new simulation has been undertaken in the framework of the OECD work programme on “Environment and Employment” using the NEMESIS model⁴⁰.

The aim of this modelling exercise is to provide a new assessment of economy-wide employment impacts of policies to limit CO₂ emissions. The results of the NEMESIS model which is a new detailed econometric model for European countries provided in this simulation focus on policies in Europe. In the future however, the model will allow broader geographical simulations as it will be extended to other countries including Japan and the United States. Also, though the model allows for an energy environment module this was not operational for the simulation so intra-energetic substitutions in each sector were not possible. As such the results have to be qualified.

The exercise presented here is based on the last emissions scenarios from the European Environmental Agency (see EEA, 2002). The baseline is based on the new medium-term growth perspectives and takes into account spontaneous behaviour in terms of substitutions and technical change.

The simulation focuses on the main estimated impacts on employment due to the implementation of economic instruments (taxation, tradable permits) and examines five different scenarios: two with taxation, one with tradable permits and two “mixed” scenarios, based on permits and taxation. All the estimated effects are rather small.

Section 2 presents the baseline scenario for emissions used in the simulation and the various scenarios tested while Section 3 discusses the results in terms of employment effects. Section 4 draws some conclusions.

2 Scenarios used in the simulation

The baseline scenario

The baseline scenario used for CO₂ emissions is that of the European Environmental Agency (see Table IV.1). The emission reductions countries would have to undertake to fulfil their obligations under the EU burden sharing agreement are significantly smaller than in preceding scenarios for two reasons: the growth forecasts for the medium term have been lowered, while the effects of new measures already adopted before 2001 have been taken into account.

⁴⁰ See Annex I for a description of the main characteristics of the NEMESIS model.

This study simulates impacts for Europe (including Norway) achieving 4.4% reduction in CO₂ emissions in 2010 compared to the baseline. Given the limited size of this reduction, the consequences on economic variables and employment at the European level are limited. This average reduction requirement covers however very different situations amongst European countries. For instance, Germany, Sweden and United Kingdom are estimated to have baseline emissions in 2010 below their burden sharing commitments (by 19.1%, 3.3%, and 1.6% respectively), while Spain and Portugal are estimated to have baseline emissions far above their commitments. Consequently, there will be significant differences in the impacts of climate change policies on economic variables and employment.

As the full effects of applying economic instruments appear after 2010, the simulation has been extended until 2020 based on two hypotheses: (1) without any additional measures, emissions would grow about 0.5% per year after 2010; (2) The emission target remains the same after 2010 (“Kyoto for ever”). This implies a required emission reduction of about 10% compared to the baseline in 2020.

Table IV.1: Assumed CO₂ emission constraints to reach the EU burden sharing obligations related to the Kyoto Protocol in 2010
(Percentage change with respect to the 2010 emissions in the baseline scenario)

Austria	-22.0
Belgium	-19.8
Denmark	-4.1
Finland	-14.2
France	-8.3
Germany	+19.2
Greece	-3.0
Ireland	-19.2
Italy	-13.5
Netherlands	-11.4
Portugal	-19.7
Spain	-22.5
Sweden	+3.3
United Kingdom	+1.6
Norway	-25.2
EU + Norway	-4.4

The different instruments and policies assumed implemented to reach the Kyoto Protocol in 2010, and to maintain the emissions at this level afterwards are now described.

Policies for achieving CO₂ reductions: scenarios tested

It should be noted that the scenarios on the reduction of CO₂ emissions considered in the simulations are exploratory and do not reflect the actual European Union context. In particular, the modelling exercise began before the EU proposal was finalised and the assumptions made do not correspond to the EU’s emissions trading scheme as an actual scenario. For instance, contrary to the current EU tradable permit scheme which only concerns selected sectors, all production sectors are involved in the tradable permit scheme simulated here and households are also included in some scenarios.

This modelling exercise simulates the employment effects of several possible measures to limit CO₂ emissions in Europe. Five scenarios are investigated: two relying on taxes only, and three using tradable permits alone or in combination with taxes:

1. Common European tax rate – without revenue recycling
2. Common European tax rate – with revenue recycling
3. Tradable Permits for households and firms
4. Tradable permits for firms, taxation for households – without recycling
5. Tradable permits for firms, taxation for households – with recycling.

The scenario where the tax revenue is not recycled can be considered as a case where the tax revenue is used to diminish public deficit or debt. In all cases, the tradable permit market is limited to EU countries.

Scenario 1: Common European tax rate – without revenue recycling.

In this scenario, we implement a European CO₂ tax without any redistribution of the revenues of the tax. Employment decreases because the tax increase leads to a cut in demand. Also, the tax increase leads to (delayed) wage increases through assumed indexation mechanisms, which reinforces the loss of competitiveness.

Scenario 2: Common European tax rate – with revenue recycling.

In this scenario, the revenues from increased taxation are recycled back through a decrease in employers' social contributions.

In the three other scenarios examined in this simulation tradable permits are used. It can be complicated to include household emissions in a tradable permits market. The model computes the level of tax that is compatible with Kyoto targets for Europe simultaneously with the whole equilibrium. We assume that this tax is the price of permits and that this implicit price of CO₂ will lead to substitution effects for all agents, households and firms. However, in practice, the implementation of a permits market can be achieved in several ways. For this reason, we treated several cases.

In all cases, permit prices are simulated through a fictive CO₂ tax, equal for all countries. Agents modify their energy demands with respect to this tax. It is assumed that the tax is implemented progressively. We then define (arbitrarily) a path which leads to the fulfilment of the 2010 Kyoto constraint – that is a 4.4% reduction of CO₂ emissions compared to the baseline for EU as a whole plus Norway. In each period, each country is assumed to have an “emissions cap” proportional to their EU burden sharing commitment – and the difference between this cap and their estimated actual emissions determines the amount of permits a country can sell, or will have to buy, in the period up to 2010. The total emissions of a country is allocated proportionally to the different agents – i.e. household and firm. We make similar assumptions for the period 2010-2020.

Scenario 3: Tradable Permits for households and firms.

In this scenario, all the quotas are freely distributed to firms and households by governments (grandfathering). Every agent may buy or sell permits on the market in Europe. For firms, we make the assumption that the sale of permits decreases their costs and their production prices and vice-versa. For households, we make the assumption that buying permits increases their consumption price and vice-versa.

However, we assume that only firms will be active on the market. Households will pay a tax equal to the price of permit computed by the model. We then envisage two additional cases.

Scenario 4: Tradable permits for firms, taxation for households – without recycling

In this case, firms have direct access to the market and households pay a tax on all their CO₂ emissions which is not recycled. Government use a part of this tax to buy tradable permits on the international market if, in their country, households' baseline emissions in 2010 are estimated to be above "their portion" of the total emissions allowed under the burden sharing commitment.

Scenario 5: Tradable permits for firms, taxation for households – with recycling.

This scenario investigates two differences compared with the preceding one. First, the revenues from the taxation of households are totally recycled through a decrease in employers' social contributions. When households' baseline emissions in 2010 are estimated to be above "their portion" of the total emissions allowed under the burden sharing commitment, governments pay for the tradable permits needed. Second, in order to stimulate firms in countries that are estimated to have baseline emissions in 2010 below their burden sharing commitments (i.e. Germany, Sweden and United Kingdom) to intensify their reduction effort, governments keep any the difference between the firms' portion of total allowed emissions under the burden sharing commitment and their portion of the estimated 2010 baseline emissions. These permits are then sold on the market and the revenues from this sale are used to reduce employers' social contributions. So firms are incited to increase employment.

3 Results

We will first present results for Europe as a whole, then country specifics and sectoral results.

*Results for Europe as a whole**Scenario 1: Common European tax rate – without revenue recycling*

The estimated level of the tax is 17.15 € per tonne of CO₂ in 2010, in constant 2002-Euros, and the revenue of the tax represents 0.47% of the European GDP. The model computes, with the emissions coefficients, the increase in energy prices in different economic activities. The increases in energy prices cause substitutions that decrease energy consumption, and the tax level is determined at a European level in order to reach the Kyoto target. The substitution effects are slightly favourable to employment because the assumed cross-price elasticities of labour demand to energy prices are positive, albeit small. The substitution effects also play a role in the consumption behaviour of households, who reallocate their expenses towards goods and services with low energy intensity.

But the bulk of the impact comes from the revenue effect. First, taxation reduces disposable income of all agents, which in turn decreases demand. Wage indexation related to changes in consumption prices limits the impacts on households' disposable incomes.⁴¹ The wage indexation will, however, increase the cost for firms. The loss of competitiveness induced by the increase in energy prices emphasises the contractive effect. A subsequent rise in unemployment slows real wage increases (through the assumed Phillips-curve relationships) and in turn reduces consumption compared to baseline. At the end of the simulation horizon, the decrease in employment is slightly lower than the decrease in GDP.

⁴¹. In fact, indexation is delayed, and there is thus a slight decrease in real wages.

Table IV.2: Scenario 1: Main European Results
(Percentage changes with respect to the baseline scenario)

	GDP	Consump.	Invest.	Import	Export	Consumer Price	Employment	Tax rate, in 2002-Euros	Tax Revenue In % of GDP
2010	-0.25	-0.23	-0.14	0.20	-0.52	1.14	-0.19	17.15	0.47
2020	-0.83	-0.87	-0.61	0.46	-1.50	2.92	-0.66	43.27	0.98

Scenario 2: Common European tax rate – with revenue recycling

At the beginning the main effect of the reduction in employers' social contributions is a substitution favourable to employment. The higher the tax revenues raised through the carbon tax, the more favourable will the net employment effects be.

The impacts on competitiveness will depend on several effects:

- The decrease of social contributions.
- The indexation of wages.
- The increase in energy prices.

The net impact on wages will depend on the assumed Phillips-curve effects and on the indexation of wages to consumption prices – which is total, but delayed. The net impact on competitiveness can be favourable for some countries at the beginning (due to indexation delays), but is always very weak. But the bulk of effects come from the substitution from energy-intensive to less energy-intensive products when energy prices increase. This substitution tends to increase employment demand, and – with rising household incomes – consumption. Rising employment will, however, due to the Phillips-curve effects, quickly entail a loss in competitiveness, and for this reason the net impact on GDP will become negative in 2013 for Europe as a whole, and total employment will be lower than in the baseline after 2016.

The estimated tax level is 17.77 € per tonne of CO₂ in 2010 and the tax revenue represents 0.49% of GDP. It is marginally higher than in the preceding case, because the revenue recycling increases growth. The employment gain was estimated to equal 0.04% in 2010, while a decrease in total employment of 0.02% was found for 2020.

Table IV.3: Scenario 2: Main European Results
(Percentage changes with respect to the baseline scenario)

	GDP	Consump.	Invest.	Import	Export	Consumer Price	Employment	Tax rate, in 2002-Euros	Tax Revenue In % of GDP
2010	0.01	0.03	-0.04	-0.10	-0.12	0.37	0.04	17.77	0.49
2020	-0.09	-0.02	-0.24	-0.19	-0.45	1.05	-0.02	46.49	1.04

Scenario 3: Tradable permits for households and firms

In this simulation, effects are very weak because transfers are weaker than in the taxation case. We observe for Europe as a whole a very slight increase in employment 0.01% in 2010. A purchase of permits by firms increases their production costs while a sale of permits decreases production costs. The overall effect is almost neutral for Europe as a whole, despite some differences between countries. But households are mainly permit buyers and this increases consumption prices. Towards the end of the simulation period, wage indexation on consumption prices entails competitiveness losses and the estimated net impact on employment is marginally negative from 2016.

Table IV.4: Scenario 3: Main European Results
(Percentage changes with respect to the baseline scenario)

	GDP	Consump.	Invest.	Import	Export	Consumer Price	Employment	Permit Price
2010	0,02	0,03	-0,03	-0,09	-0,02	0,04	0,01	20.65
2020	-0,03	0,00	-0,12	-0,10	-0,17	0,40	-0,02	55.67

Scenario 4: Tradable permits for firms, taxation for households – without recycling

This scenario is the worst of the mixed tradable permits taxation scenarios, because the revenues of households' taxation are not recycled. Of course, there is no employment dividend and this policy is the most expensive in terms of employment except, of course, for the pure taxation scenario. In fact, mechanisms are rather similar to the pure taxation scenario. The CO₂ tax paid by households increases consumption prices and wages through the assumed Phillips-curve mechanisms. Hence, despite the fact that firms do not pay any tax, they suffer a loss in competitiveness, because of the increase in wages costs. Notice, however, that firms that have emissions lower than the amount of permits they were allocated for free at the outset limit this negative effect on competitiveness by selling permits.

Table IV.5: Scenario 4: Main European Results
(Percentage changes with respect to the baseline scenario)

	GDP	Consump.	Invest.	Import	Export	Consumer Price	Employment	Permit Price
2010	-0.09	-0.09	-0.05	0.04	-0.20	0.62	-0.08	20.32
2020	-0.35	-0.37	-0.24	0.15	-0.63	1.65	-0.28	54.11

Scenario 5: Tradable permits for firms, taxation of households – with revenue recycling

In this scenario, firms buy or sell tradable permits while households are taxed for their CO₂ emissions; the revenues from taxation are recycled through a reduction in employers' social contributions. This scenario is estimated to give a weak (0.04%), but durable positive net impact on employment. This is because the use of tradable permits entails a smaller loss in competitiveness than taxation, and because the revenues from households' taxation are used to create an incentive for employment. This incentive is weaker than in the case of pure taxation recycled by reductions in employers' social contributions (Scenario 2), but it is also less inflationary, because the increase of employment is more gradual and because firms are not taxed.

Table IV.6: Scenario 5: Main European Results
(Percentage changes with respect to the baseline scenario)

	GDP	Consump.	Invest.	Import	Export	Consumer Price	Employment	Permit Price
2010	0.02	0.02	0	-0.10	-0.02	0.29	0.02	20.66
2020	0.03	0.06	-0.07	-0.20	-0.09	0.70	0.04	55.70

Results on employment impacts on individual countries

Scenario 1: Common European tax rate – without revenue recycling

In this case, differences between countries stem mainly from differences in tax revenues. The tax rate is assumed to be identical in all the European countries, hence the amount of revenue it raises in percent of GDP varies across countries due to differences in emissions levels and in marginal cost curves. Results on employment are related, roughly speaking, to the tax revenue in % of GDP.

We can notice that, in each country, the percentage decrease in employment is less than the percentage losses in GDP (see Table IV.7). This is due to the small substitution effect described above, and to productivity impacts on employment.

Table IV.7: Country Results for Scenario 1: Common European tax rate without revenue recycling

Countries Main Results (2010, % Deviation w.r.t. the baseline)

	EU	AT	BE	DK	FI	FR	GE	
GDP	-0.25	-0.24	-0.50	-0.17	-0.20	-0.17	-0.32	
Employment	-0.19	-0.20	-0.43	-0.11	-0.16	-0.15	-0.24	
	IR	IT	NL	NO	PO	SP	SW	UK
GDP	-0.12	-0.23	-0.45	-0.17	-0.25	-0.18	0.00	-0.29
Employment	-0.07	-0.14	-0.30	-0.11	-0.23	-0.16	-0.03	-0.24

Countries Main Results (2020, % Deviation w.r.t. the baseline)

	EU	AT	BE	DK	FI	FR	GE	
GDP	-0.83	-0.83	-1.24	-0.62	-0.79	-0.71	-1.02	
Employment	-0.66	-0.71	-1.13	-0.39	-0.64	-0.62	-0.85	
	IR	IT	NL	NO	PO	SP	SW	UK
GDP	-0.46	-0.81	-1.07	-0.55	-0.82	-0.82	-0.16	-0.89
Employment	-0.26	-0.53	-0.78	-0.39	-0.70	-0.69	-0.16	-0.81

Scenario 2: Common European tax rate – with revenue recycling

In this scenario, the CO₂ tax creates inflationary pressure and reduces growth, while the cut in employers' social contributions increases labour demand through the substitution effects and helps preserve competitiveness. It is the relative size of these effects that determine the net employment impacts. We can notice that it is in countries that have committed to the largest emission reductions compared to

the baseline developments that the net employment impact is found to be positive. It is in these countries that the scope for reducing employers' social contribution is the largest. Moreover, since price impacts on wages are assumed to be delayed, reductions in wage costs are greater than the increase in nominal wages. This creates a transitory virtuous spiral, leading to an increase in employment and then in final consumption. Hence, growth is pulled up by households' consumption. Nevertheless, this is not a permanent impact, because of the assumed Phillips-curve mechanisms. For example, in Finland, unit labour costs and employment increase until 2016. This leads to an increase in real disposable income, and later in consumption, GDP and employment. But the wage spiral gradually increases unit labour costs and employment decreases, entailing a reduction of GDP compared to the baseline. The same mechanisms apply for Portugal, Spain and United Kingdom but later on (unit labour cost begins to grow again at the end of the period).

Table IV.8: Country Results for Scenario 2: Common European tax rate with revenue recycling

Countries Main Results (2010, % Deviation w.r.t. the baseline)

	EU	AT	BE	DK	FI	FR	GE	
GDP	0.01	-0.05	-0.10	-0.08	0.05	0.01	-0.09	
Employment	0.04	-0.03	-0.06	-0.03	0.08	0.01	-0.04	
	IR	IT	NL	NO	PO	SP	SW	UK
GDP	0.04	0.06	-0.18	-0.12	0.22	0.17	0.00	0.08
Employment	0.06	0.12	-0.05	0.00	0.16	0.13	0.01	0.07

Countries Main Results (2020, % Deviation w.r.t. the baseline)

	EU	AT	BE	DK	FI	FR	GE	
GDP	-0.09	-0.25	-0.33	-0.34	-0.07	-0.10	-0.37	
Employment	-0.02	-0.23	-0.26	-0.19	0.00	-0.09	-0.26	
	IR	IT	NL	NO	PO	SP	SW	UK
GDP	-0.02	0.06	-0.45	-0.31	0.33	0.39	-0.10	0.09
Employment	0.06	0.22	-0.20	-0.07	0.24	0.29	-0.07	0.06

Scenario 3: Tradable Permits for Firms and Households

This is the first scenario that we present with the influence of the European burden sharing, which determines the initial allowance of tradable permits. We can see that countries that in the baseline have emissions in 2010 below their burden sharing obligation (Germany, Sweden and United Kingdom) are estimated to increase their employment. One can also notice that countries which will have to reduce their emissions most significantly compared to the baseline developments (Portugal and Spain) are estimated to experience the strongest reductions in employment.

Table IV.9: Country Results for Scenario 3: Tradable Permits for Firms and Households**Countries Main Results (2010, % Deviation w.r.t. the baseline)**

	EU	AT	BE	DK	FI	FR	GE	
GDP	0.02	-0.04	0.00	0.05	0.01	-0.02	0.11	
Employment	0.01	-0.04	-0.04	0.03	0.01	-0.02	0.09	
	IR	IT	NL	NO	PO	SP	SW	UK
GDP	0.00	-0.01	-0.04	-0.14	-0.09	-0.09	0.05	0.04
Employment	0.00	0.02	0.00	-0.07	-0.07	-0.09	0.02	0.02

Countries Main Results (2020, % Deviation w.r.t. the baseline)

	EU	AT	BE	DK	FI	FR	GE	
GDP	-0.03	-0.24	-0.09	0.04	-0.11	-0.15	0.29	
Employment	-0.02	-0.22	-0.20	0.08	-0.09	-0.17	0.29	
	IR	IT	NL	NO	PO	SP	SW	UK
GDP	-0.09	-0.10	-0.20	-0.35	-0.43	-0.42	0.13	0.04
Employment	-0.05	0.01	-0.06	-0.23	-0.31	-0.40	0.06	-0.01

Scenarios 4 and 5: Tradable permits for firms, taxation of households

These two last scenarios combine tradable permits for firms and taxation for households.

Table IV.10: Country Results for Scenario 4: Tradable permits for firms, taxation for households without recycling**Countries Main Results (2010, % Deviation w.r.t. the baseline)**

	EU	AT	BE	DK	FI	FR	GE	
GDP	-0.09	-0.19	-0.24	-0.02	-0.09	-0.13	-0.07	
Employment	-0.08	-0.15	-0.25	-0.02	-0.08	-0.12	-0.06	
	IR	IT	NL	NO	PO	SP	SW	UK
GDP	-0.04	-0.04	-0.22	-0.13	-0.16	-0.07	0.03	-0.12
Employment	-0.03	-0.02	-0.15	-0.09	-0.13	-0.08	-0.01	-0.12

Countries Main Results (2020, % Deviation w.r.t. the baseline)

	EU	AT	BE	DK	FI	FR	GE	
GDP	-0.35	-0.63	-0.66	-0.19	-0.47	-0.52	-0.24	
Employment	-0.28	-0.54	-0.71	-0.08	-0.38	-0.47	-0.15	
	IR	IT	NL	NO	PO	SP	SW	UK
GDP	-0.19	-0.20	-0.53	-0.38	-0.52	-0.39	0.03	-0.37
Employment	-0.12	-0.08	-0.35	-0.29	-0.40	-0.37	-0.03	-0.38

In Scenario 4, the revenues of the taxation are not recycled. Total employment is estimated to decrease in all countries, with differences between countries somewhat similar to Scenario 3.

In Scenario 5, we combine tradable permits for firms with taxation of households recycled through a reduction in employers' social contribution and an extra incentive for employment⁴² in countries that are estimated to have 2010 baseline emissions below their burden sharing commitments. One can note that the impact on employment in Germany and in Sweden in this scenario is less favourable than in Scenario 3, where both households and firms took part in a tradable permits system: the increase.

Table IV.11: Country Results for Scenario 5: Tradable permits for firms, taxation for households with recycling

Countries main Results (2010, % Deviation w.r.t. the baseline)

	EU	AT	BE	DK	FI	FR	GE	
GDP	0.02	-0.11	-0.10	0.02	-0.02	-0.01	0.03	
Employment	0.02	-0.09	-0.11	0.01	-0.01	-0.01	0.04	
	IR	IT	NL	NO	PO	SP	SW	UK
GDP	0.01	0.08	-0.10	-0.13	0.03	0.03	0.03	0.06
Employment	0.02	0.09	-0.04	-0.06	0.02	0.01	0.02	0.03

Countries main Results (2020, % Deviation w.r.t. the baseline)

	EU	AT	BE	DK	FI	FR	GE	
GDP	0.03	-0.35	-0.24	-0.09	-0.20	-0.07	0.04	
Employment	0.04	-0.30	-0.30	-0.01	-0.14	-0.09	0.10	
	IR	IT	NL	NO	PO	SP	SW	UK
GDP	0.01	0.23	-0.23	-0.34	0.03	0.14	0.08	0.14
Employment	0.03	0.28	-0.07	-0.19	0.05	0.06	0.03	0.08

Results on sectoral employment in Europe

We present here sectoral results for the European sectors in 2020. We can notice differences between scenarios, even those which are comparable from the global employment point of view. For instance, Scenario 2 favours employment by a substitution effect that reduces investment and then employment in the investment sectors and in intermediary goods sectors that are related, while in the Scenario 3, these intermediary goods sectors preserve their competitiveness and employment in selling tradable permits; they suffer also less from investment depression.

⁴². The governments sell the "hot air" tradable permits to decrease employers' social contributions.

**Table IV.12: Sectoral Employment in all scenarios
(in 2010 and 2020, in % deviation w.r.t. the baseline)**

	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020
Agriculture etc.	-0.20	-0.81	0.08	0.16	0.04	0.07	-0.04	-0.18	0.07	0.26
Coal and Coke	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oil & Gas Extraction	-0.26	-0.68	-0.19	-0.55	-0.22	-0.64	-0.24	-0.67	-0.21	-0.62
Gas distribution	-1.90	-5.23	-1.77	-4.95	-1.77	-5.07	-1.84	-5.23	-1.78	-5.06
Refined oil	-1.31	-3.76	-1.08	-3.12	-1.07	-3.18	-1.15	-3.36	-1.04	-3.01
Electricity	-0.21	-1.61	-0.07	-1.25	0.51	0.81	0.44	0.61	0.50	0.69
Ferr & Non Ferrous Metals	-0.58	-2.12	-0.47	-1.34	0.10	0.41	0.04	0.20	0.10	0.32
Non Metallic Min. Prod.	-0.51	-1.59	-0.27	-0.91	0.00	-0.08	-0.06	-0.26	0.06	0.05
Chemicals	-0.26	-0.91	-0.06	-0.25	0.04	0.06	-0.05	-0.20	0.04	0.12
Metal Products	-0.29	-0.97	-0.07	-0.33	0.03	0.03	-0.05	-0.22	0.04	0.08
Agri & Industr. Mach.	-0.18	-0.77	-0.03	-0.27	-0.01	-0.09	-0.09	-0.35	-0.01	-0.09
Office Machines	-0.46	-1.77	-0.04	-0.42	0.01	-0.12	-0.22	-0.83	-0.01	-0.14
Electrical Goods	-0.24	-0.98	-0.03	-0.29	0.00	-0.08	-0.09	-0.38	0.00	-0.05
Transport Equipment	-0.16	-0.69	0.01	-0.13	0.02	0.02	-0.05	-0.20	0.02	0.07
Food, Drink & Tobacco	-0.15	-0.61	0.10	0.21	0.06	0.14	-0.03	-0.15	0.07	0.24
Tex., Cloth & Footw.	-0.23	-0.95	0.13	0.22	0.03	-0.02	-0.07	-0.33	0.07	0.24
Paper & Printing Prod.	-0.23	-0.82	0.01	-0.10	0.04	0.08	-0.06	-0.21	0.05	0.14
Rubber and Plastic	-0.27	-0.93	-0.05	-0.28	0.01	-0.02	-0.08	-0.29	0.02	0.03
Other manufactures	-0.20	-0.77	0.06	0.01	0.03	0.00	-0.06	-0.27	0.04	0.10
Construction	-0.16	-0.60	0.11	0.11	-0.01	-0.11	-0.07	-0.28	0.05	0.07
Distribution	-0.26	-0.96	0.02	-0.10	0.00	-0.09	-0.13	-0.48	-0.01	-0.04
Lodging and Catering	-0.19	-0.75	0.14	0.26	0.07	0.14	-0.07	-0.29	0.08	0.23
Inland Transports	-0.31	-1.04	-0.09	-0.38	-0.01	-0.06	-0.11	-0.34	-0.01	-0.03
Sea and Air Transport	-0.45	-1.48	-0.13	-0.56	0.00	-0.07	-0.14	-0.48	0.00	-0.05
Other Transport	-0.39	-1.25	-0.13	-0.52	-0.09	-0.31	-0.19	-0.59	-0.08	-0.23
Communication	-0.20	-0.73	0.10	0.15	0.05	0.07	-0.09	-0.31	0.05	0.15
Bank, Finance and Insurance	-0.22	-0.83	0.10	0.11	0.03	0.01	-0.11	-0.38	0.03	0.09
Other Market Services	-0.22	-0.78	0.07	0.05	0.02	-0.01	-0.12	-0.38	0.02	0.05
Non market Services	-0.08	-0.21	0.03	0.03	0.01	0.01	-0.04	-0.09	0.01	0.02

Scenario 1: Tax Without Recycling

Scenario 2: Tax Recycled through Employers' Social Contribution Abatement

Scenario 3: Tradable Permits for Households and Firms

Scenario 4: Firms Permits and tax without Recycling

Scenario 5: Constraint Firms Permits and tax Recycled through Employers' Social Contribution Abatement

4 Conclusions

- The estimated employment effects are rather uncertain, in part because the environment module of the Nemesis model is not active.
- All the estimated impacts for Europe as a whole are small – in part because limited size of the CO₂ emissions reduction target (-4.4%) used in the simulation.
- The results for Europe as a whole indicate that among the five scenarios proposed, which do not include the EU's emissions trading scheme, two show a positive net impact on employment:
 - Scenario 2: Common European tax rate – with revenue recycling
 - Scenario 5: Tradable permits for firms, taxation of households – with revenue recycling

In the first case, the positive impact on total employment is transitory and disappears as from 2016; in the second case, it seems more durable.

The positive employment impact in Scenario 2 is transitory because the assumed wage indexation and the Phillips-curve effect reduce the competitiveness of European producers. It could be more durable if the environmental policy were accompanied by wage moderation.

- The simulations on the employment effects on individual countries show that countries that have baseline emissions in 2010 below their burden sharing commitments seem to achieve the best employment impacts through a tradable permits policy (Scenario 3). The reason is that we have assumed that their firms can reduce their costs by selling tradable permits, thus improve their competitiveness and increase their employment relative to the baseline scenario.

In the countries that have baseline emissions in 2010 above their burden sharing commitment, taxation with recycling (Scenario 2) is found to provide the best results from an employment point of view.

In the Scenario 3, countries that have baseline emissions in 2010 below their burden sharing commitments use their advantage to increase their competitiveness relative to other European countries. Inversely, Scenario 2, in which the burden sharing agreement doesn't matter, favours countries that must reduce more.

- A scenario combining tradable permits and taxation (Scenario 5) seems better for Europe taken as a whole: it incorporates the substitution effects favouring employment in Scenario 2 with the less inflationary effects of the tradable permits policy in Scenario 3.
- The results on sectoral employment impacts in Europe differ. Taxation recycled through reductions in employers' social contribution causes energy-intensive sectors to decrease their employment, while employment increases in labour-intensive sectors (consumption goods and services except transports). Tradable permits policies give more limited differences in sectoral employment. Both in Scenarios 5 and 2, the increase in employment takes place in the production of consumption goods and in service-related sectors (except transports).