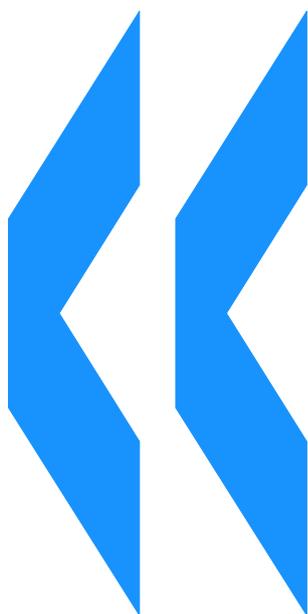


Please cite this paper as:

OECD/Martinez-Fernandez. C, Hinojosa C, Miranda G., "Green jobs and skills: the local labour market implications of addressing climate change", 8 February 2010, working document, CFE/LEED, OECD,
www.oecd.org/dataoecd/54/43/44683169.pdf?contentId=44683170



Green jobs and skills: the local labour market implications of addressing climate change

**Cristina Martinez-Fernandez, Carlos Hinojosa,
Gabriela Miranda**



OECD LEED Programme

TABLE OF CONTENTS

INTRODUCTION.....	5
THE IMPACTS OF CLIMATE CHANGE ON LABOUR MARKETS	7
The impacts of changing consumer habits on labour markets	7
The direct effects of environmental changes on labour markets.....	8
Climate change regulation and labour markets: what to expect?.....	9
THE DYNAMICS OF GREEN GROWTH: GREENING JOBS AND SKILLS	18
A stairway to "Green Utopia"	18
The shades of green and the "green equilibrium"	21
Greening skills and job profiles	25
LOCAL POLICY IMPLICATIONS FOR MANAGING AND ENABLING GREEN GROWTH.....	28
Managing the transition to green growth	29
Enabling green growth.....	31
CONCLUSIONS - EMERGENT POLICY THEMES AND TARGET GROUPS.....	34
REFERENCES	36
GLOSSARY	41
APPENDIX I: LEARNING MODELS - SELECTION CRITERIA MATRIX	43
APPENDIX II: LEARNING MODELS.....	44

Tables

Table 1.	Potential effects of climate change on economic activity & employment in Europe.....	8
Table 2.	Climate change regulation by type of impact on labour markets (examples).....	11
Table 3.	Green job indicators.....	22
Table 4.	Classification of skills at work	26

Figures

Figure 1.	Impacts of climate change on labour markets	7
Figure 2.	A taxonomy of climate change regulation.....	10
Figure 3.	Green dimension of European stimulus funds.....	13
Figure 4.	Green jobs intensity by sector	15
Figure 5.	The stairway to 'Green Utopia'	19
Figure 6.	The facets of eco-innovation	20
Figure 7.	Green equilibrium dashboard	24

Boxes

Box 1. Carbon pricing.....	11
Box 2. Understanding carbon leakage	16
Box 3. A definition and taxonomy of green-collar workers in Australia and New Zealand.....	22
Box 4. The case of "Eolicas de Portugal" (ENEOP)	31
Box 5. The case of "Landcom" in Australia	33

This working paper has been prepared as part of the project Climate Change, employment and Local Development undertaken the auspices of the OECD LEED Directing Committee, within the framework of the OECD's Green Growth Strategy. It will support the discussion at the 56th session of the Directing Committee to be held in Paris on 20-21 May 2010.

Like leaves on trees the race of man is found — Now green in youth, now withering on the ground; Another race the following spring supplies: They fall successive, and successive rise.

Alexandre Pope, 1720

Abstract¹

The impacts of climate change, and especially subsequent mitigation and adaptation policies, on labour markets are still largely unknown despite the recent demand for knowledge production and diffusion on this topic and the increasing avalanche of reports and studies from public and private organisations as well as from community groups. The search for alternative models of growth in the midst of the financial crisis has increased the interest in the "green growth paradigm". This paper discusses some of the impacts of climate change including its regulation on labour markets, the dynamics of green growth at the levels of jobs and skills development, and the local implications for mitigation and enabling green growth. Although the paper does not provide all the answers to the *green enigma* (green jobs will come but how?), it argues that much benefit will come from focusing efforts on the skills transformation tools and initiatives.

¹ The paper has benefited from comments and suggestions from Dr. Tamara Weyman (UWS – University of Western Sydney), Mr. Robert Strauss (Head of Unit, Employment Strategy, CSR & Local Development, DG Employment, Social Affairs & Equal Opportunities, European Commission), Dr. Diana Reckien, (PIK - Potsdam Institute for Climate Impact Research) and Dr Tavis Potts (SAMS - Scottish Association for Marine Science).

INTRODUCTION

1. The global financial crisis has stressed the need to look at our economic growth model through new lenses and a much more critical approach to our consumption and production practices. The opportunity to re-think our global model of growth within the challenge of moving towards a cleaner, low-carbon economy is mobilising intelligence and innovative thinking worldwide to identify policies, measures, and strategies for future green growth. Beyond the volatile elements of these movements, the "Green Growth Paradigm" is a catalyst of solid efforts made by both science and technology actors and community and environmental groups long working to establish environmental issues as a mainstream dialectic in policy environments. Governance has emerged as a critical enabling factor as environmental policy development has moved beyond pure regulatory approaches to the interaction and dynamics between governments, communities and private actors. Importantly, the social institutions to support a broader notion and application of governance are still in an early stage of evolution.

2. Today, there is growing awareness among the political sphere and the general public of the need to reduce the effects of human activities on the environment. The understanding of the vulnerability of natural systems has led to the insertion of climate change mitigation and adaptation policies in some parts of the world and increasing efforts at the top of the international and domestic policy agendas. The key question that will need to be addressed is how climate change and more specifically, climate change regulatory measures, will affect labour markets, workforces and social actors at the local level (Potts, 2010). However, the dynamics of green employment are largely unknown and further in-depth work is needed to guide policy making. For example, adapting labour markets to achieve more jobs and better quality jobs to move towards a low-carbon economy requires strengthening education and training systems as well as supporting skills development activities both at the industry and public sector levels for which we have little knowledge and understanding of the dominant dynamics. In addition there is a lack of clarity around what policy instruments are effective in driving regional and local reform (Potts, 2010). This paper seeks to contribute to the reduction of this knowledge gap, by offering a framework enabling local economic actors to better define green jobs and estimate their real growth potential and contributions within their economies.

3. Climate change itself has different interpretations. According to the Intergovernmental Panel on Climate Change (IPCC) climate change refers to a change in the state of the climate that can be identified (*e.g.* using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. It occurs as a result of internal changes within the climate system or in the interaction between its components, or because of changes resulting either from natural events or human activities. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods (IPCC, 1995).

There is now a virtual avalanche of reports by international agencies, governments, business, labour unions, environmental groups, and consultancies on the technical and economic implications of climate change as well as the consequences of mitigation and adaptation strategies. Many declaim a future of green jobs – but few present specifics. This is no accident. There are still huge gaps in our knowledge and available data, especially as they pertain to the developing world. (UNEP, 2008, p. 3)

4. The economic restructuring brought about by combating climate change, will require significant policy and regulatory intervention in order to minimise the risks and maximise the opportunities as market forces alone will not be able to provide a platform for change. As a result, policy makers face a two-fold challenge: managing transition and enabling green growth. Transition assistance will be of particular importance for regions with high concentrations of high emission producing-industries - as has already been expressed by trade union federations - and will require adopting active labour market and social protection programmes and policies.

5. On the other hand, policy makers at all levels of government also have a role to play in the creation of opportunities for the expansion of green activities and investments; and the reduction of emissions levels within their circumscriptions. The Greater London Authority's low-carbon zones initiative² represents a good example of a locality seeking to enable green growth through policies aimed at increasing household energy efficiency. Improvements in energy efficiency can not only deliver some of the largest and cheapest CO₂ reductions, but can also bring about benefits for employment due to its labour intensity (IEA, 2009). Public policy can therefore effectively trigger demand for new products and encourage investment in green industries while creating employment growth.

6. Although most of the material produced so far deals with employment speculations on whether or not green jobs will be created as a result of climate change, this paper argues that with growing awareness and regulation comes an increase in the transformation of skills and the emergence of new ones; not just for new jobs but critically for the adaptation of occupational profiles to the new market environment of a low-carbon economy.

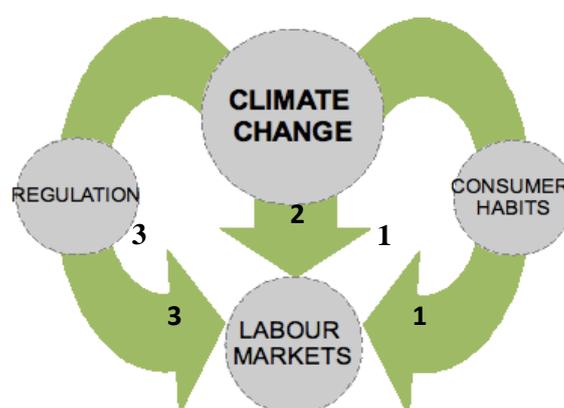
7. This paper is divided into five sections. The next section looks into the impacts of climate change on labour markets, the subsequent section discusses the dynamics of green growth for greener jobs and greener skills, this is followed by a discussion on local policy implications for managing and enabling green growth and the last section offers some concluding thoughts.

² See Appendix II for more detailed information.

THE IMPACTS OF CLIMATE CHANGE ON LABOUR MARKETS

8. Understanding the impacts of climate change on labour markets and the resulting policy implications requires distinguishing the different mechanisms through which this process will take place. Climate change is expected to affect labour markets³ in several ways, each of which will have different implications on businesses and workforces. The following scheme presents the three major channels through which climate change may affect labour markets: changes in consumer habits, direct impacts on natural and built environments, and impacts from regulations.

Figure 1. Impacts of climate change on labour markets



9. This key distinction of the different impacts from climate change is the first element to take into account when analysing the labour market implications of a transition to a low-carbon economy. This section explains these three mechanisms, placing a special emphasis on the impacts of climate change on the regulatory frameworks of OECD countries which are expected to have the most important effects on labour markets.

The impacts of changing consumer habits on labour markets

10. Consumer-driven demand for cleaner products (goods and services) as a result of an increased social awareness of the dangers of climate change will be a key driver of changes in labour markets. Climate change has already begun to modify consumer preferences and habits. The direct impact of this will be a reduced demand for products which are or are perceived to be as damaging to the environment either in their end use or method of production; as well as an increase in demand for energy efficiency and non-polluting products.

11. A recent survey carried out by Eurobarometer shows that 50 per cent of EU citizens are in favour of taxing products with high environmental footprints, and over 83 per cent of respondents declared taking into account the environmental impact of products before purchasing them (Docquier, 2009). These

³ See the glossary for a definition.

market-driven changes are expected to lead to the expansion and to the contraction of certain economic sectors and industries, which is bound to impact labour markets. Activities such as green labelling might need new green analytical skills and more jobs might be created around green labelling but also procurement needs and legal procedures would increase.

12. Another way of influencing the habits of consumers and suppliers in the labour market is through the implementation of “green taxes”. These taxes act as an incentive for industries and businesses to limit their GHG emissions, and for consumers to buy low-carbon products and services. For instance, France has outlined plans to impose a carbon tax on large industrial installations until 2013 when they start paying for emission permit. On the other hand, France has implemented the *malus*, which is an additional tax to be paid by consumers when buying a car that emits more than 160g CO₂/km⁴.

The direct effects of environmental changes on labour markets

13. In addition to changes in consumer habits and preferences, climate change will affect labour markets through the increase in climate change-related natural phenomena resulting from global warming such as floods, heat waves, and falls in precipitation levels. These events will eventually lead to resource and species depletion; and to physical impacts on natural and built environments (Reckien *et al.*, 2009) and human populations.

14. Such events will have a significant impact on labour market conditions of the affected regions. On the supply side, climate change related phenomena will affect workforce availability due to potential food shortages (especially in agricultural regions) and a decrease in the health conditions of the population (ILO, 2008). On the demand side, the viability of businesses and economic activities will be strongly undermined leading to decreases in the demand for labour. Several economic sectors have been identified as highly vulnerable to the direct effects of climate change due to their dependence on regular climate conditions. These include agriculture, tourism, insurance, forestry, fisheries, infrastructure and energy (ETUC, 2009). The following table includes some of the potential direct effects of climate change on economic activity and employment in the agricultural, forestry and fisheries sectors in Europe.

Table 1. Potential effects of climate change on economic activity & employment in Europe

Geographical location	Main climatic drivers	Expected effects on economic activity and employment	Level of confidence
Mid- and high latitude regions	Rising temperature, high atmospheric CO ₂ concentration	Positive impact on agricultural productivity. Positive impact on employment overall.	Medium-high
Southern Europe	Rising temperature	Negative impact on livestock productivity and employment.	Low
Mediterranean regions	Higher fire risk due to rising temperature and droughts	Negative impact on forestry productivity and employment.	Medium
General	Increase in frequency and intensity of extreme weather events	Negative impact on agricultural and forestry productivity, and employment.	Medium-low
Fisheries communities (Iceland, Baltic Sea, Spanish and Portuguese coast notably)	Changes in sea surface temperature, wind regime, water runoff, ice melt, or marine currents	Mix of negative and positive impacts on fisheries productivity and employment depending on the region. Shifts in maritime industries e.g. the Arctic.	Low

Source: ETUC, 2009

⁴ For more information, please refer to the website of the French Ministry of Sustainable Development at: www.developpement-durable.gouv.fr.

15. The direct impacts of climate change will not be limited however to the previously mentioned sectors. Businesses in other industries have also expressed increasing concern due to potential shortages of key inputs as a result of changing climate conditions. A recent case study on the impacts of climate change on large businesses highlights the actions taken by two firms in the food and beverage industry, Coca Cola and Cadbury, including implementing water reduction programmes on sites suffering from water scarcity and offering support for local community projects for water preservation (GHK, 2009a).

16. Specific regions have already expressed their concern in this regard due to their levels of vulnerability and environmental exposure. Pacific island states and the low-lying coastal countries of the Asia Pacific region, for example, are amongst the most vulnerable in the world to natural disasters and are facing shrinkage of their population and economic activity as well as the first climate change refugees. Since 1950, natural disasters have directly affected more than 3.4 million people and led to more than 1 700 deaths in the region (World Bank, 2006). The impacts of non-disaster environmental events such as rising sea levels and shifts in rainfall patterns also have particularly pronounced impacts on the natural and human environments of these countries. Some regions are expected to face serious droughts, while others could lose much of their land to inundation resulting from the rise in sea levels and typhoons. The island of Kiribati for example could experience inundation of up to 50 per cent of its territory by 2050 (World Bank, 2006).

17. As a result of the increased vulnerability of these regions, human health conditions have already begun to decline, particularly due to the increase in climate-related illnesses and health effects such as the Dengue fever (Woodward *et al.*, 1998). In addition, the loss of agricultural land will reduce food availability for the population. According to the United Nations Environmental Programme (UNEP), the Asia Pacific region risks undergoing strong food shortages as food demand is expected to increase by 100 per cent by 2050 while densely populated regions are currently running out of suitable agricultural land (UNEP, 2007).

18. On the other hand, the positive impact on mid and high-latitude regions and the actions taken to adapt to this type of phenomena, particularly through the modification of the built environment and the construction of infrastructure to protect communities from their negative effects, is believed to be a source of potential job growth. The ILO (2008) has stated that major investments in adaptation could offer employment and income opportunities in activities such as extending coastal defences, reinforcing buildings and infrastructure, water management and relocation of exposed settlements. However, there is a high level of uncertainty regarding the possible net job creation effects of these types of investments, particularly if this is done through public spending. Some argue that the positive employment effects brought about by public investment in adaptation measures are counterbalanced by the lost gains brought about by spending reductions in other, potentially more beneficial activities (ETUC, 2009). A recent paper by Schofield and Potts (2009) outlines the potential pitfalls and benefits of reductions in sea ice on maritime development in the Arctic, particularly in terms of international trade. Future development may bring employment and trade benefits but at the risk of environmental and maritime security in a rapidly changing Arctic Ocean region.

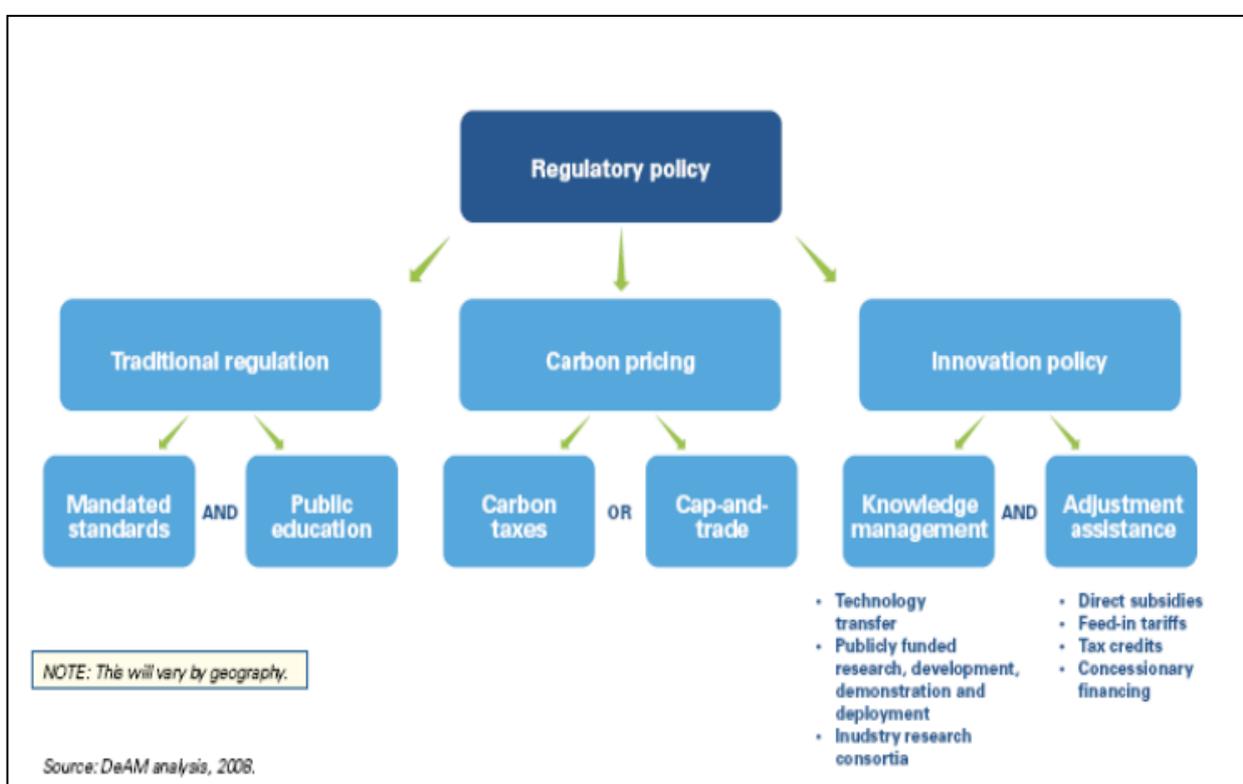
Climate change regulation and labour markets: what to expect?

19. The third and probably by far the most important impact of climate change on labour markets will be the consequence of new and enhanced climate change regulation both at the domestic and international level, particularly carbon pricing measures. This assumption is supported by recent studies on the changes taking place within firms as a result of climate change. The firms' case studies carried out by GHK consultancy found that "the main drivers of change to-date relate to policies rather than to the physical effects of climate change" (2009a, p. 3). This section offers an overview of the climate change

regulatory instruments currently being implemented in OECD countries, as well as on their potential effects on labour markets.

20. Government regulation includes all policy interventions designed to make less likely the occurrence of actions that generate negative spillovers or externalities. By its nature, a regulation restricts an individual or firm from doing what it otherwise would have done (Stiglitz, 2009). It can thus be said that climate change regulation includes all policy interventions directly aimed at reducing negative spillovers or externalities affecting the environment and contributing to climate change. It can present itself under a wide array of forms. Since the late 1990s, increasing concerns relating to climate change led policy makers to begin experimenting with climate change regulatory instruments whose outputs were relatively unknown at the time (Baert, 1999). Since then, we have witnessed the introduction of a wide range of regulatory instruments some of which have proven to be more easily reinforced than others, either because they are more or less intrusive or because of their levels of public acceptance. Figure 2 below summarises climate change regulation.

Figure 2. A taxonomy of climate change regulation



Source: DeAM analysis (2008) in GHK (2009b)

21. Amidst this wide array of regulatory measures, a first distinction can be made according to the type of impact they have on labour markets. While the majority of these measures eventually impact employment, business activities and economic conditions in general, it is important to distinguish those that are directly aimed at modifying labour markets (mainly education and training programmes) from those that are not. This distinction can be illustrated by citing some examples of regulatory measures currently adopted in OECD countries.

Table 2. Climate change regulation by type of impact on labour markets (examples)

INDIRECT IMPACT	DIRECT IMPACT
<p>Czech Republic – Biofuel Blending Requirements: The Czech Government introduced minimum biofuel blending requirements for petrol and diesel used for transport. The obligation is stipulated for companies distributing petrol and diesel transport fuels on the market to assure that a minimum quantity of biofuels is included.</p> <p>France – Sustainable Energy Provisions: The 2009 Finance Law contains various provisions to increase financing for energy efficiency investments and in support of renewable energy which include zero-interest loans for energy efficient housing purchases and 100 per cent loans for energy-efficient renovation.</p> <p>Germany – Special Fund for Energy Efficiency in SMEs: The Federal Ministry of Economics and the KfW bank have established the fund with the objective of allowing SMEs to overcome both information and cost barriers to implementing energy efficient measures. The programme has two components: grants for SMEs to hire consultancy services on energy efficiency and low interest loans for investment in energy conservation measures.</p>	<p>United States - Green Jobs Act (2007): The Green Jobs Act offers grants from the Federal Government given out on a competitive basis to entities to carry out training leading to the development of an energy efficiency and renewable energy industries workforce.</p> <p>Australia - National Green Jobs Corps: Federal funds have been allocated to offer long term unemployed youth 26 weeks of green job training and work experience. Activities include bush regeneration and planting native trees, wildlife and fish habitat protection, walking and nature track construction/restoration; and training and hands-on experience in the installation of energy efficient features for buildings.</p> <p>Spain – Automotive Sector Competitiveness Plan: The plan provides funding for a wide range of projects aimed at increasing competitiveness of the auto industry through improvements in energy efficiency of production processes, products and services. It offers firms the possibility of obtaining grants and loans to improve technical skills of their workforce.</p>

Source: IEA, Climate Change Policies and Measures Database (2009)

22. Perhaps paradoxically however, regulatory measures not directly aimed at modifying labour market conditions have proven, in certain cases, to have stronger impacts on labour markets than those aimed at doing so. The indirect effects of these policies on employment are the result of changes in relative production costs, changes in the demand for products and technologies and the re-orientation of R&D and innovation towards low emission processes (ETUC, 2009). Carbon pricing measures have a very strong capacity to bring about these changes and are therefore given considerable importance in the analysis of the effects of climate change regulation on labour markets (see Box1).

Box 1. Carbon pricing

The two main economic instruments used to reduce Greenhouse Gas (GHG) emissions are carbon taxes and cap-and-trade schemes (also known as emissions trading systems). Carbon taxes involve governments imposing a tax on the amount of emissions produced. These taxes increase the price of using emissions intensive products and thus contribute to the reduction of GHG pollution. Cap-and-trade schemes on the other hand require all emitters to acquire permits for their planned emissions. The government or international institution implementing the scheme establishes an overall target for emissions and then issues a certain number of emission permits according to the target. Permit holders can trade them among themselves and as a result, prices are established through a mechanism of supply and demand (rather than a fixed rate as in carbon taxes) as well as through the tightness of the target established at the outset. Both instruments generate prices for GHG emissions, but do so in different ways. Currently cap-and-trade systems are increasingly the focus of interest in most countries or regions considering market based approaches to reducing GHG emissions.

Source: (OECD, 2008)

23. The effectiveness of climate change regulation measures, as well as their effects on labour markets, varies according to governments' capacities to reinforce them as well as on their binding nature. Regulation that is adopted only as part of a blame avoidance strategy or that is done so by governments not knowing if they possess the necessary capacities to implement and reinforce them tend to have a very limited impact on labour markets. In France for example, despite the 60 000 infringements of environmental protection legislation that are committed every year, only 4 000 of them are effectively sanctioned (Dupont, 2009).

The impact of climate change on the regulatory environment of OECD countries

24. The increasing acknowledgment of the potential negative effects of climate change on social and economic conditions has led governments in OECD countries to strengthen their regulatory frameworks aimed at reducing Greenhouse Gases (GHGs) and eliminating the causes of climate change (mitigation); as well as at addressing the impacts of climate change (adaptation). These actors have now realised that climate change is a problem that requires immediate action and that urgent measures are to be taken if the negative effects brought about by the build-up of GHGs and global warming are to be prevented at a relatively low cost.

25. Several factors account for the sharp increase in regulatory measures to fight climate change over the last four decades, particularly in developed countries. According to David Vogel (2003), the scope and stringency of environmental protection has risen considerably in European countries over the last forty years as a result of three factors: a series of regulatory failures, broader and stronger political support for more stringent and comprehensive regulatory standards, and the growth in the regulatory competence of the European Union.

26. The political clout of initiatives to counteract climate change has also been multiplied thanks in part to a series of studies showing the economic rationality of adopting such initiatives. The Stern Review prepared by Sir Nicholas (now Lord) Stern pioneered efforts to assess the economic impacts of climate change. According to the report, climate change impact will reduce welfare by an amount equivalent to a reduction in consumption per head of between 5 and 20%. The cost of inaction could reach 0.5-1 per cent of global GDP by the middle of the century, while the cost of action (stabilise emissions) would amount to 1 per cent of GDP (Stern, 2006). The OECD has also suggested that immediate action to counteract climate change would give countries 10 to 15 years of "breathing space" during which action would be possible at a relatively modest cost (OECD, 2008).

27. Finally, the widespread belief that "green growth" can act as an antidote to unemployment in the aftermath of the economic and financial crisis has added momentum to existing trends to strengthen climate change regulation frameworks. As seen in Figure 3, considerable sums have been allocated to climate policy objectives as part of the stimulus packages adopted by countries around the world in response to the crisis. During the 2009 Meeting of the OECD Council at Ministerial Level, Ministers agreed on the fact that the crisis represents a good opportunity to introduce policy and regulation reform that will lead the way to an economic recovery consistent with sustainable development generating environmental and employment gains (OECD, 2009b).

Figure 3. Green dimension of European stimulus funds

	Total	Green Funds		RE	CCS	Bldg	Veh	Rail	Grid	W/W
	€ Billion ⁴	€ Billion	%	€ Billion						
EU	30.0	17.6	58.7	0.5	9.7	2.2	1.5	--	3.8	--
Germany	81.0	10.7	13.2	--	--	8.0	0.5	2.2	--	--
France	26.0	5.5	21.2	0.7	--	0.6	--	1.0	3.2	--
UK	23.5	1.6	6.9	--	--	0.2	1.1	0.3	--	0.02
Italy	80.0	1.0	1.3	--	--	--	--	1.0	--	--
Spain	11.0	0.6	5.8	--	--	--	--	--	--	0.6
Other EU States	238.5	4.8	2.0	1.5	--	0.3	3.0	--	--	--
Total EU	490.1	41.9	8.5	2.7	9.7	11.4	6.1	4.5	7.0	0.7
Rest of World	1,670.5	295.1	16.2	26.7	5.9	40.3	6.2	89.6	63.9	62.4
World	2,160.6	336.9	15.6	29.4	15.5	51.6	12.3	94.1	70.9	63.1

RE Renewable Energy
 CCS Carbon Capture and Storage, and other low-carbon technologies
 Bldg Building Energy Efficiency
 Veh Low-Carbon Vehicles
 W/W Water and Waste Management

Sums may not add up due to rounding

Source: HSBC Global Research "A Climate for Recovery".

Source: HSBC Global Research "A climate for Recovery" (2009) in Renner, Ghani-Eneland & Chawla (2009)

The expected impacts of climate change regulation on labour markets

28. Initially, there was widespread belief that climate change regulation was a "job-killer" mainly because of the increasing pressure it puts on firms, and particularly on SMEs. However, there is little evidence that existing regulation has contributed to job suppression, particularly in traditional industrial sectors. Declining numbers of jobs in extractive industries and utilities can be attributed mainly to reasons that have little to do with environmental regulation such as rising automation, restructuring and outsourcing (Renner *et al.*, 2009). A Worldwatch Institute survey has shown that out of 224 permanent plant closings from 1980 to 1986, only 12 cited environmental reasons as a partial move to closure (Kammen *et al.*, 2004). Indeed the decline of old industrial regions needs to be attributed to reasons related to globalisation of production, technological change, footloose industries and productivity changes that led to structural changes with substantial declines of jobs and inhabitants (Martinez-Fernandez, 2009).

29. This lack of evidence has changed the "job-killer" paradigm and instead, a consensus has built up around the idea that climate change regulation and the transition to a low-carbon economy can be a source of job growth (jobs gains will outweigh job losses). Yet, despite increasing work on the subject, this assumption still lacks a solid empirical foundation and seems to lose much of the optimism it gives birth to when analysed closely.

Employment forecasts

30. Quantitative assessments on the impacts of climate change regulation on employment were relatively scarce until today. The information that is available relates mostly to specific economic sectors

rather than labour markets as a whole⁵. The work that has been carried out in this respect however tends to show that despite the risks it entails, the economic restructuring brought about by climate change regulation offers the possibility of obtaining a slight positive net job growth⁶.

31. The analysis of 13 independent reports and studies, carried out by Kammen, Kapadia and Fripp (2004), on the economic and employment impacts of the increased use of clean energy in Europe and the United States showed that augmenting the use of renewable energy has a positive impact on employment. The net positive employment impact forecast of climate change regulation stems from two main assumptions. The first one, as mentioned previously, is that strengthened climate change regulation will lead to the expansion of certain economic sectors, mainly those having to do with the production of Environmental Goods and Services (EGS)⁷. The economic opportunities offered by what some call the expansion of "green industries" can be illustrated by the projections for its growth in the oncoming years. The EGS sector was estimated to be worth USD 548 billion globally in 2004 and it is projected to increase to USD 600 billion by 2010 and just under USD 800 billion by 2015 (Selwyn & Leverett, 2006). The UNEP predicts that given the increasing interest in energy alternatives 2.1 million jobs will be created in wind energy production, 6.3 million in solar photovoltaic and 12 million in biofuels-related agriculture and industry (UNEP, 2008b). The European Renewable Energy Council argues that by increasing the share of renewable energy in Europe to 20 per cent of consumption levels by 2020, there is a potential for the creation of more than 2 million jobs (Renner 2009 p. 10). Finally, previous OECD studies recorded a 1 to 1.5 per cent positive variation in employment in the EGS sector as a result of climate change regulation (OECD, 2004).

32. The second reason that accounts for the forecasts of net positive employment growth as a result of climate change regulation is that production in the EGS sector is generally more labour intensive than in traditional industries. The International Energy Agency (2009) states that the high labour intensity of the EGS sector - and particularly the renewable energy sector - is explained in part by the fact that renewables are not yet cost-effective. This means that these activities require more inputs for a given amount of output. As a result, the IEA estimates that for every billion dollars invested in clean energy technology, there will be creation of 30 000 new jobs (see table below). Additional studies have shown that the renewable energy sector generates more jobs than the fossil fuel based energy sector per unit of energy delivered (Kammen *et al.*, 2004). While labour intensity is higher for the majority of renewable energy activities such as energy efficiency, smart metering and renewable energy production; other activities such as carbon capture and storage (CCS) are much less so due to their capital intensity (IEA, 2009). However the needs in terms of R&D of CCS technologies mean research jobs might increase considerably in this sector to meet the needs of pilot projects. There are currently 66 CCS projects in Europe⁸, which represent 25 per cent of the global total (Global CCS Institute, 2009).

⁵ Considerable work has been done on the impacts of climate change regulation on employment in the energy sector. See work by Kammen, Kapadia & Fripp (2004), Pearce & Stilwel (2008) and IEA (2009).

⁶ Fankhauser *et al.* 2008; UNEP & ILO, 2008; Renner & Ghani Eneland, 2009; Pearce & Stilwel, 2008; ETUC 2006.

⁷ See definition in glossary.

⁸ Distributed as follows: 15 in the UK, 13 in Norway, 12 in the Netherlands, 8 in Germany, 6 in Italy, 4 in Spain, 3 in Denmark, 2 in France, 1 in Finland.

Figure 4. Green jobs intensity by sector

	Job Intensity
Building Refurbishment	high
Switch to Cleaner Cars	moderate
Wind, Solar	high
Smart Metering	high
Battery Development	moderate
Clean Energy R&D	moderate
CCS	low

■ high ■ moderate ■ low

*IEA, 2009

33. These figures must however be dealt with cautiously. Some authors have presented arguments on the dangers of overly-optimistic calculations of job growth as a result of climate change regulation, and of the methods being used to make these predictions.⁹ For example, the French Government has forecast the creation of 600 000 jobs as a result of the 15 programmes included in its environmental protection strategy known as the *Grenelle de l'Environnement* (Présidence de la République, 2009). This prediction has since received significant criticism linked to the methodological rigour used to come up with this figure (Baudet, 2009). Professor Robert Bell, at Brooklyn College, City University of New York, has also spoken against the dangers of the current green growth speculation and stated that “the next four years will be an increasingly frenzied lead-up to a gigantic stock market bubble in renewable energy”. Finally, some studies actually go against the belief that adopting climate change regulation would lead to net job creation. Babiker and Eckaus’ study (2006) shows that the imposition of emission restrictions would lead to a real and direct depressing effect on employment and growth rates in the US.

34. The net employment growth leitmotif of the move towards a low-carbon and sustainable economy should not lead us to underestimate the negative consequences on labour markets of this transition. The imposition of stricter climate change regulation will inevitably lead to significant job losses and increasing social fragmentation if appropriate steps are not taken to avoid this. Trade unions and their confederations are at the forefront of efforts to make sure this dimension of the transition to a low-carbon economy is taken into consideration by policy makers and public authorities. The European Trade Union Confederation for example has highlighted the potential negative consequences of the EU’s climate policy, especially on sectors such as manufacturing and others making heavy use of fossil fuels. They have predicted that as a result of growing climate change regulation, the iron and steel industry could lose some 50 000 jobs out of a total of 350 000 that currently exist (ETUC 2006). In the US, a study conducted by the Worldwide Fund for Nature shows that considerable net job losses in sectors such as coal mining, oil and gas mining, oil refining, electric utilities and natural gas utilities (Kammen *et al.*, 2004) could take place as a result of implementing a series of clean energy policies.

⁹ See Michaels R & Murphy R (2009).

Taking a closer look: How are labour markets going to adjust?

35. The figures presented in the previous section represent a global estimation of the impacts of climate change on labour markets, particularly through quantitative predictions of employment growth. The aggregate net estimations of job growth paint a rather optimistic picture of the changes that labour markets will undergo in the following years. However, the adjustments that will take place within labour markets will leave behind both winners and losers. Understanding the dynamics of these adjustments will be a key step for policy makers seeking to maximise the benefits and minimise the risks of the transition to a low-carbon economy.

36. The United Nations Environmental Programme (UNEP) expects labour markets to be affected in at least four ways as climate change regulation is enforced and the economy is oriented toward greater sustainability (UNEP, 2008a):

- First, in some cases, additional jobs will be created—as in the manufacturing of pollution-control devices added to existing production equipment.
- Second, some employment will be substituted—as in shifting from fossil fuels to renewables, or from truck manufacturing to rail car manufacturing, or from land filling and waste incineration to recycling.
- Third, certain jobs may be eliminated without direct replacement—as when packaging materials are discouraged or banned and their production is discontinued.
- Fourth, it would appear that many existing jobs (particularly plumbers, electricians, metal workers, and construction workers) will simply be transformed and redefined as day-to-day skill sets, work methods, and profiles are greened. (UNEP, 2008a, p. 3)

37. A fifth potential effect is job migration, as an externality of "carbon leakage" could also be added to this list (see box below). However, recent studies show that the impacts of carbon leakage on employment are rather limited. The OECD has predicted that "unless only very few countries take action against climate change, carbon leakage rates and competitiveness effect of climate policies are very small.

38. Additional studies of the economic effects of carbon leakage also tend to show that environmental regulation is not a key consideration for firms making location decisions for the time being (Fankhauser *et al.*, 2008). Therefore, environmental regulations do not seem to directly cause delocalisation of economic activity and associated job losses.

Box 2. Understanding carbon leakage

Carbon leakage refers to "the ratio of carbon emissions increase from a specific sector outside the country (as a result of a policy affecting that sector in the country) over the carbon emission reductions in the sector (again, as a result of the environmental policy)" (IEA, 2008, p. 3). In other words, carbon leakage occurs when economic activity migrates from one country with strict environmental regulation to another country with more flexible or reduced environmental regulation frameworks. The impact on employment is quite obvious: jobs migrate and usually do so at the expense of job quality (decreased wages and working conditions) in the new host country. Low skilled workers tend to be the hardest hit by this phenomenon because while production relocates, the high added-value occupations (design, management, etc.) in these firms usually remain in the country of origin.

39. However the predicted effects on labour markets will vary significantly with time. Fankhauser, Sehlleirer and Stern's (2008) study on climate change, innovation and jobs predicts that:

- In the **short term** jobs will be lost in directly affected sectors and new ones are created in replacement industries. Jobs will be lost in carbon-intensive sectors, which will grow at a slower pace or possibly contract. New jobs are expected to be created in low-carbon sectors which tend to be more labour intensive than conventional sectors (*e.g.* renewable energy vs. conventional energy). The expected net job creation is however likely to diminish as low-carbon technologies become more competitive and technologies mature. As a result, employment gains of this type cannot be sustained over a 10-15 year time span. In addition, due to the reduced mobility of labour and the time it takes to address and reduce skills gaps in emerging sectors, this economic adjustment may cause structural unemployment.
- In the **medium term** the impact of climate change policy will spread across the economy creating and eliminating jobs as behaviour changes and value chains adjust. The impact on employment will depend strongly on external factors such as input prices (gas, oil, etc.) that determine price differentials between low-carbon technologies and conventional solutions, as well as on the regulation policies that lead companies into adopting more energy efficient production practices. The increases in traditional energy prices along with regulation to price carbon will improve the competitiveness of renewable energy technologies leading to employment growth in this sector.
- In the **long term** innovation and the development of new technologies will create opportunities for investment and growth. It is expected that jobs will be created in the research and development of low-carbon technologies. The results of this research will in turn generate new investment and further job-creation in these fields. This virtuous cycle is a clear example of the positive impact that innovation and technological change can have on economic growth and restructuring. However this also implies that as the green economy grows, there will be an increased demand for highly skilled and qualified labour capable of undertaking the increasing technological and innovation demands.

40. To summarise, we could refer to three impacts to answer the question "what are the impacts of climate change in labour markets?". First we have the impact from changing consumer habits which can shift production to more environmentally friendly products, services and organisations. Second, we have the extreme effects of (natural) climate changes in communities that face the gradual disappearance of their traditional way of living (*e.g.* farming or fisheries). Third, we have the regulatory impact from government efforts towards mitigation and adaptation to climate change. The impacts of regulation can be direct or indirect but their effectiveness varies according to governments' capacities to reinforce them as well as on their binding nature.

41. However, what are the effects of climate change regulation on net jobs gain? There is little evidence of climate change regulation producing lay-offs from heavy manufacturing industry or the building and construction industry for example where regulation could have major impacts (*e.g.* inducing more repair and maintenance with buildings and infrastructure). Moreover, there is no strong evidence of how realistic predictions of net job creation are. Taking a closer look at how markets function, it might be the "adjustment" that constitutes an opportunity beyond the creation of new jobs and industries. The dynamics of this adjustment might require investment in training and skills development programmes if the long term sustainability of greener jobs is to be achieved.

THE DYNAMICS OF GREEN GROWTH: GREENING JOBS AND SKILLS

42. Job creation, suppression and adaptation are all part of the dynamics of the transition to a low-carbon economy, but the way these dynamics will actually unfold is still largely unknown. This section conceptualises the main issues relating to this transition and highlights that this analysis requires thinking beyond the traditional boundaries established by the current literature on the subject.

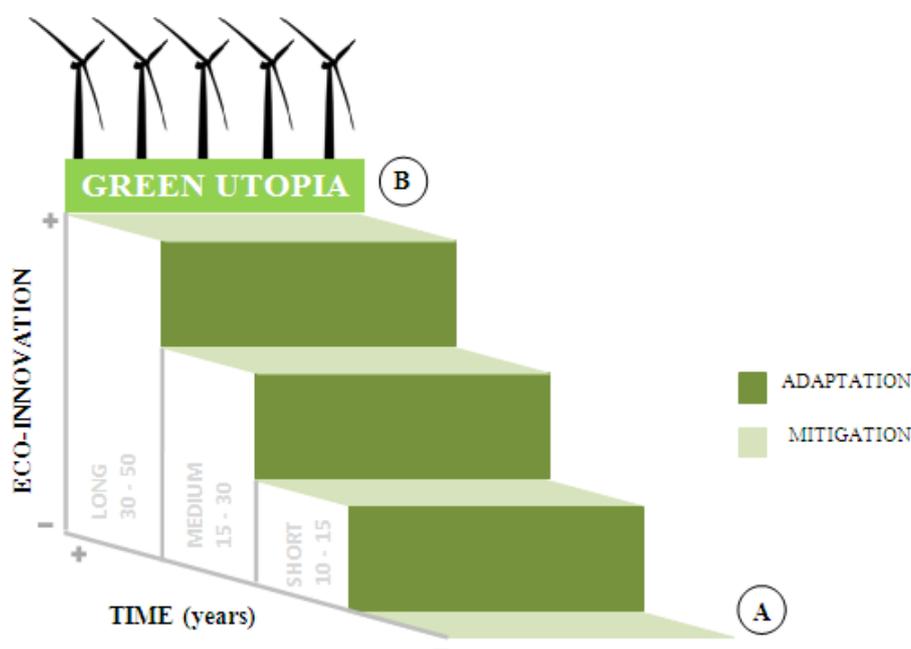
43. There is increasing acknowledgment among academics, international institutions and governments of the high growth potential of green jobs as a result of increased climate change regulation and the need to develop energy-efficient products to replace traditional high-carbon goods and services. The UNEP and ILO state that, "the pace of green job creation is likely to accelerate in the years ahead. A global transition to a low-carbon and sustainable economy can create large numbers of green jobs across many sectors of the economy, and indeed can become an engine of development" (UNEP, 2008a, p. 3).

44. As a result, national and local governments have taken it upon themselves to study the conditions of their labour markets in order to identify high-potential growth sectors in the "green economy" to be targeted in their economic and employment development policies. But what are exactly these green jobs everybody is talking about?

A stairway to "Green Utopia"

45. In current policy literature there is a tendency to use the concept of "green jobs" as a "one-size-fits-all" encompassing notion that covers any job that contributes to improving environmental quality. However, if looked at more closely, it becomes evident that the term is loosely defined which can eventually lead to misconceptions and overly optimistic calculations of the economic and employment growth opportunities created by climate change regulation. Local policy makers will need to better understand what a green job really is before they can design and implement policies and programmes aimed at supporting their growth. However, "green job" is a fuzzy term that needs to be unpacked into a framework of "pure green" and "steps of green". Figure 5 exemplifies the steps to achieve a pure green framework and an interpretation of the number of years needed.

Figure 5. The stairway to 'Green Utopia'



46. The reference point (point B) located at the top of the stairway is what the UNEP describes as "green utopia" which refers to "an ideal state of affairs" in which the economy "does not generate pollution or waste and is hyper-efficient in its use of energy, water, and materials" (UNEP, pg. 35). "Green utopia" could be considered as the long term objective of all society efforts to move towards a "green economy" but not a situation that can be achieved without transition. This is not really a new term; the circular economy has been discussed extensively in developed and developing economies (recently the focus of the 1st Caofeidian Forum in Tangshan, China, September 2009). Point A on the stairway represents current conditions in a particular geographical context.

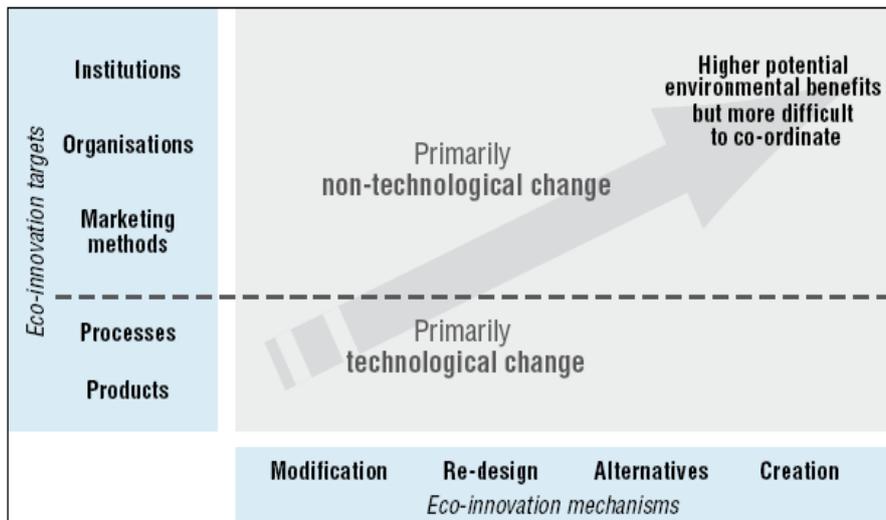
47. The stairway is useful to explain several key considerations that must be taken into account when trying to understand the dynamics of "green growth":

- **Green today and brown tomorrow:** The "green" label is usually added when an industry, firm, job or product is efficient in the use of energy, water and materials. However determining the thresholds between efficient and inefficient can prove to be a difficult task (UNEP, 2008a). Benchmarking using traditional and mainstream standards is usually the way to measure if greater efficiency is achieved. For example, households that run on solar photovoltaic energy are considered to be more energy efficient than households running on electricity produced by carbon; and can thus be considered as "green" households. In this case the benchmark to determine if solar households can be considered as "green" is the fact that most houses currently use carbon-generated electricity to satisfy their energy demands. However, the task becomes increasingly complex when there is more than one alternative in order to carry out the benchmarking procedure. In addition, as eco-innovation and technological advancements generate increasingly efficient production methods and products, what might be considered "green" today (point A of the stairway) will no longer be so in the future. For example, today solar panels are used to capture solar energy and hence, a job in solar panel production/installation is considered to be a "green job". However, a more efficient instrument might be invented in the future to carry out the same task. In this case, the same worker

producing/installing solar panels would no longer be considered as having a "green job". As a result, the "green" label is a "relative and highly dynamic concept" (Worldwatch Institute, 2008, p. 4) and is bound to change as steps are climbed on the stairway to green utopia.

- It takes two to tango – the importance of mitigation and adaption:** Reaching "green utopia" will require implementing both mitigation and adaptation strategies and actions (Patts, Reckien *et al.*, 2010). As shown by each of the stepping stones on the stairway, bridging the gap from point A to point B of the stairway is not possible unless both of these dimensions are taken into account. As stated by the OECD, "mitigation includes all measures taken to reduce negative impacts of human activities on the environment and is achieved by reducing both the energy intensity of GDP and the carbon intensity of energy used" (OECD, 2008a, p. 11). Adaptation on the other hand "consists in deliberate actions undertaken to reduce the adverse consequences [of climate change] as well as to harness any beneficial opportunities" (OECD, 2008b, p. 1). Adaptation is now widely recognised as an equally important and complementary response in addressing climate change as mitigation (OECD, 2008b). The "green" label is therefore applicable to sectors, firms or jobs who contribute to both mitigation and adaptation efforts.
- Eco-innovation - the pillar of the stairway:** There is one underlying element without which the climb to "green utopia" would not be possible. Eco-innovation is the process that allows organisations and industries to gradually improve the standards of efficiency and thus, to reduce society's footprint on the environment. The OECD defines innovation as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations" (OECD, 2009a, p. 2). Eco-innovation is generally the same as other types of innovation except for two key distinctions: it represents innovation that results in a reduction of environmental impact, no matter whether that effect is intended or not; and its scope may go beyond the conventional organisational boundaries of the innovating organisation and involve broader social arrangements that trigger changes in existing socio-cultural norms and institutional structures (OECD, 2009a). Figure 6 shows the main facets of the eco-innovation process.

Figure 6. The facets of eco-innovation



Source: OECD, 2009a.

48. The interrelated dynamics of rapid change in what it means to be "green", both mitigation and adaptation actions, and mechanisms and technological advances through eco-innovations, are some of the key elements of the green-growth package that can help us to recognise what a green job is.

The shades of green and the "green equilibrium"

49. Most definitions used today in the academic literature and public policy define green jobs as any job that helps to go from point A to point B of the stairway. For the purposes of this paper, green jobs are defined as jobs that contribute to protecting the environment and reducing the harmful effects human activity has on it (mitigation), or to helping to better cope with current climate change conditions (adaptation). Below are some of the definitions currently used to describe "green jobs" or "green-collar jobs":

UNEP: Green jobs are defined as work in agricultural, manufacturing, research and development (R&D), administrative, and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect ecosystems and biodiversity; reduce energy, materials, and water consumption through high-efficiency strategies; de-carbonise the economy; and minimise or altogether avoid generation of all forms of waste and pollution (UNEP, 2008a, p. 3).

Apollo-Alliance: Green-collar jobs are well-paid career track jobs that contribute directly to preserving or enhancing environmental quality. Like traditional blue-collar jobs, green-collar jobs range from low-skill, entry-level positions to high-skill, higher-paid jobs, and include opportunities for advancement in both skills and wages. (Apollo-Alliance, 2008, p. 3)

The Michigan Department of Energy, Labour and Economic Growth: Green jobs are jobs directly involved in generating or supporting a firm's green related products or services. The state's green economy is defined as being comprised of industries that provide products or services in five areas: agriculture and natural resource conservation, clean transportation, increased energy efficiency, pollution prevention or environmental cleanup and, renewable energy production. (Michigan Department of Energy, Labour and Economic Growth, 2009, p. 4)

US White House Task Force on the Middle Class: Green jobs involve some tasks associated with improving the environment, including reducing carbon emissions and creating and/or using energy more efficiently; they provide a sustainable family wage, health and retirement benefits, and decent working conditions; and they should be available to diverse workers from across the spectrum of race, gender and ethnicity (United States Department of Labour, 2009, p. 2)

50. According to these definitions, green jobs span a wide array of skills, educational backgrounds, occupational models, and can be found at any point on the supply chain of what are considered to be green firms or businesses. As a result, green jobs "come in a variety of shades as some are more far-reaching and transformational than others" when it comes to the environmental benefit they provide (UNEP, 2008a, p. 4). For example, the manager of a building retrofitting company can be considered to have a green job, but how about someone working in the administration or accounting of the same company? Can an employee of one of the suppliers of the retrofitting company also be considered to have a green job?

51. In some cases, deciding whether a job can be considered as green or not might bring about strong ideological debates signalling that the "green growth paradigm" is questioning broader societal issues such as the current model of economic growth or a focus on sustainable, decent, quality jobs. For example, can a job in the nuclear energy sector be considered as green? Or can an employee working for an industry

producing large amounts of toxic waste be considered to have a green job just because the company is running on alternative energy sources?

52. A wide array of criteria can therefore be used to trace the boundaries between "green" and "non-green" jobs. In order to come up with an adequate definition that corresponds to local economic and employment policy objectives, local policy makers must be aware of this and proceed to prioritise each of these criteria according to their own strategies. Having realised the importance of establishing a clear definition of green jobs in order to obtain baseline data that will help in the design, implementation and evaluation of policies to promote their growth, some organisations have come up with a definition that corresponds to their policy objectives and to existing labour market indicators (see Box 3).

Box 3. A definition and taxonomy of green-collar workers in Australia and New Zealand

Recognising the fact that there is a lack of a standard definition of "green jobs", Connection Research (CR) in conjunction with the Department of Environment and Climate Change and the Environment Institute of Australia & New Zealand developed a definition and taxonomy of green jobs adapted to the economic and institutional context of these countries (Connection Research, 2009). The "Who are the green collar workers?" report takes into account several criteria to define green jobs including: industry, occupation and the environmental or sustainable dimension of the position. As a result, the report offers a two-part definition of green jobs which include:

- i) managers, professionals and technicians who work in green organisations or who have green skills and responsibilities within other organisations that may not be considered as green; and
- ii) services, clerical, sales and semi-skilled workers who work in green organisations. The question remains as to what can be considered to be a "green organisation".

Source: Connection Research, 2009

How can I know if my community has green jobs?

53. To establish how green a job is depends on more than one aspect and to take into account the full spectrum is not an easy, straightforward task, especially when policy makers don't yet have standards that can be applied to sectors and occupations. A set of criteria and indicators for defining how green a job is could include references to the industry, the production method, value-chain position and awareness of the organisation, and the occupational profile, quality and green workload. Based on these criteria, all of which can contribute to making jobs green, policy makers can come up with adapted definitions allowing them to harmonise their local conditions with policy objectives, as well as to facilitate the design, implementation and evaluation of local green economic and employment development policies (see Table 3).

Table 3. Green job indicators

Industry	<p>Sector: The sector or industry refers to the fields of economic activity firms can be categorised into. The sectors most often referred to as "green sectors" or the EGS sector include renewable energy, building, transportation, recycling, food and agriculture, forestry and tourism. These sectors are usually the focal points of studies on green jobs not only because of the nature of the goods and services they are producing, but also because they tend to be labour intensive.</p> <p>Product/service: This refers to the specific output of the businesses in the different industries or sectors. There are specific products and services that can be considered "green" due to the eco-innovative processes involved in their production. For instance, products/services aimed at reducing or limiting the negative impact of human activity on the environment (e.g. energy-efficient home appliances) or at improving the environment directly (e.g. waste recycling services). These might capture changes in human consumption habits as awareness for green products and services increase.</p>
-----------------	--

Organisation	<p>Production method: The production method refers to the environmental quality standards used by firms in their production process. Firms can set in place measures to reduce energy consumption and waste production and build environmentally friendly infrastructure for their production processes. This criterion allows for the classification of jobs in a firm that does not belong to a green sector but uses energy efficient techniques considered to be green.</p> <p>Green awareness: Organisations have different levels of commitment to green and environmental issues (Connection Research, 2009, p. 17). In some cases, the heads of firms are individuals that are deeply committed to the environmental cause and engage in associations, partnerships or community movements to protect the environment. Green awareness is also often reflected in the levels of corporate social responsibility of the organisation. This is often dependant on the history and structure of the organisation (Potts, 2009).</p> <p>Position in the value chain: The implication of a job in the green economy might vary along the value chain of the good or service being produced. A job in a company producing energy efficient automobiles might be considered to be green, but what about a job in the company producing the steering wheel for that specific car?</p>
Job	<p>Occupational profile: This refers to the nature or purpose of the job, irrespective of the sector it is performed in. Almost any occupation can be considered green as long as it contributes to reducing harmful impacts of human activity on the environment, either directly or indirectly. As a result, occupations ranging from managers, to sales workers to labourers can all at some point be considered as being green.</p> <p>Required skills and abilities: Certain jobs require workers to possess certain specialised green skills and abilities. Determining whether a job can be considered as being green can in some cases be done based on the necessary skills and competences required to perform it.</p> <p>Job decency: The UNEP and the ILO have both stressed the fact that “green jobs” need to be decent jobs, <i>i.e.</i> good jobs which offer adequate wages, safe working conditions, job security, reasonable career prospects, and worker rights” (UNEP 2006, p. 4). The Apollo Alliance has also taken up this dimension in its definition of green jobs stating that “if a job improves the environment; but doesn’t provide a family-supporting wage or a career ladder to move low-income workers into higher-skilled occupations, it is not a green-collar job”. Job decency is thus a key dimension of green jobs.</p> <p>Green workload: Some workers may do some of their work in green areas and some of their work in traditional areas (Connection Research, 2009, p. 17). In this case, it is important to adequately measure the part of the workload that is officially dedicated to green tasks in order to determine if the job can be considered as green.</p>

54. Most of the nine indicators listed above are interdependent and cannot always be separated from one another. However certain lines do need to be drawn in order to ensure that what people are currently calling green jobs are in reality jobs that adequately fill at least several of the criteria. Using a single criterion, as is currently being done by many government authorities, poses a series of problems. Doing so might lead to overly-optimistic forecasts of green job creation; support schemes might target certain green sectors while neglecting to ensure that the jobs created are decent quality jobs; and in some cases governments might fail to recognise jobs and firms that are making considerable contributions to preserving the environment, because of the sector they are in or their position in the value chain.

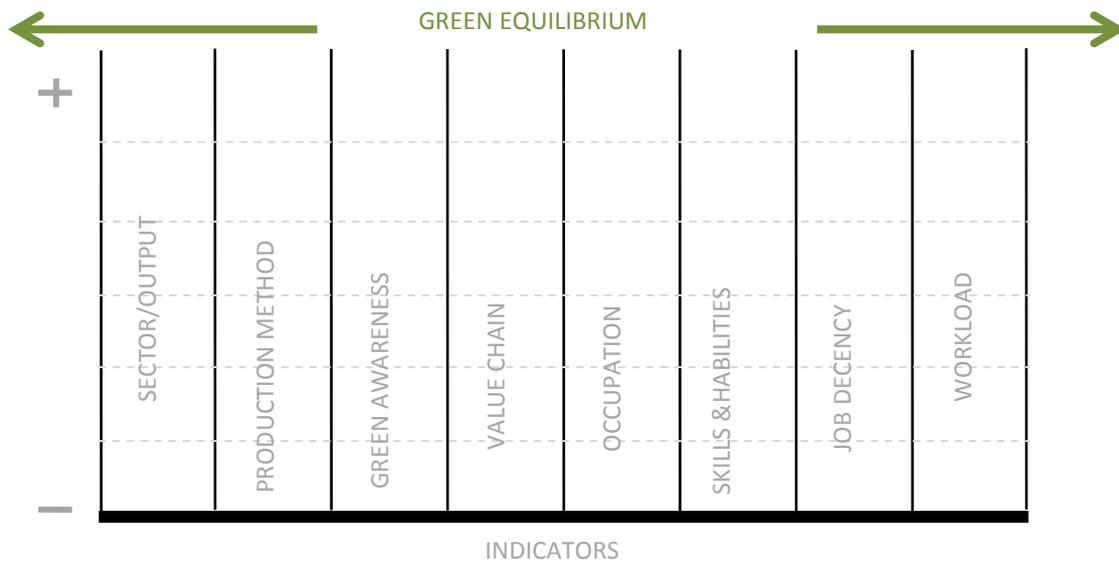
55. The advantages of taking into consideration these criteria when defining green jobs are that it gives a certain degree of flexibility to adapt definitions to local conditions and policy objectives while ensuring that green jobs are created; that the benefits of transition to a green economy are taken advantage of; and that the negative impacts of economic activity on the environment are effectively reduced. For example, a community with a high industrial base in traditional sectors might not necessarily be able to

replace its industries with green industries in the short term. Instead, it might prefer to focus on greening production methods and increasing environmental awareness of firms, two processes that will also create green jobs and contribute to the greening of the economy. Traditionally, the focus is primarily given to private sector jobs within specific sectors such as renewable energy production, transportation or building. However, it is important to know that jobs meeting several additional criteria both in the public and private sectors, are also important not only in terms of employment creation potential, but also in terms of reducing negative effects on the environment and improving the quality of jobs created.

56. To come up with an adequate mix of each of these criteria in their definitions of what a green job should represent, local policy makers can be guided by the "green equilibrium dashboard" presented below. The "green equilibrium" can be described as the state in which all green jobs in a labour market meet all of the criteria listed above. Despite the fact that it is virtually impossible for any labour market to reach the "green equilibrium" in the short term, the green equilibrium scenario serves a good reference point to develop a green labour market.

57. The dashboard illustrated in the following figure is a simple instrument which allows policy makers to measure and quantify the existing green jobs in their labour markets according to their own definitions of green jobs. For example, if an employment agency should launch a survey on green jobs in its locality, it could use the criteria listed above to identify green jobs and to evaluate the conditions of the green economy. Doing so will also allow for the identification of criteria that need to be reinforced and targeted in their employment development policies.

Figure 7. Green equilibrium dashboard



58. The current economic global situation and the growing importance of climate and energy policies make the evaluation of green jobs an important exercise for policy and decision makers. The development of green job indicators is a necessary step towards building a dataset of robust and workable measures to feed into policy development for assessing the creation, substitution, suppression and transformation of jobs. This dataset will also be important to estimate impacts of green jobs on direct and indirect employment, its evolution, the need for new skills, niche market opportunities and the integration of the indicators into the corporate social responsibilities of companies and public service organizations.

Greening skills and job profiles

59. Both the market and regulatory-driven changes in firms and businesses linked to by climate change will lead to the creation of significant skills gaps in labour markets. Neglecting to fill these gaps could limit economic and employment growth, and would also represent an obstacle to broader efforts to fight climate change and the transition to a low-carbon economy. As mentioned by the UNEP, "shortages of skilled labour could put the brakes on green expansion... it is important both to prepare the workforce at large for the skills requirements inherent in green jobs and to ensure that green industries and workplaces do not face a shortage of adequately skilled workers" (2008, p. 8).

60. In order to avoid this from happening, immediate action needs to be taken by labour market institutions and employers in order to provide the adequate workforce training. Specific sectors in different countries have already reported difficulties in finding trained labour for green-related jobs, and a lack of "green skills" in the workforce. The Apollo Alliance (2008) has reported that in the US, the growing green economy faces labour shortages in sectors such as manufacturing, construction and installation, and a 2007 survey of Germany's renewable industry showed companies in this field are suffering from a lack of qualified employees, especially for knowledge intensive positions (UNEP, 2008a).

61. The demand for workers in possession of these "green skills" is expected to increase in the years to come. However a question remains as to what these "green skills" represent. Some argue that "green skills" are simply traditional skills that are put into use in environmental related sectors and activities. For example, a sheet metal worker working for a wind turbine production plant is considered to be in possession of "green skills" due to the fact that he works for a firm belonging to the EGS sector even if the firm considers itself part of the "metal manufacturing" industry and not an environmental company. The implications of this point of view is that filling the skills gap created by the transition to low-carbon economies will require providing more of the already-existing skills on the labour market. A survey study carried out among firms in the EGS sector in the state of Michigan found that despite the need for some specialised green skills, employers stressed the need for basic skills in science, technology, engineering and maths. The study also showed that even for the new jobs requiring highly-skilled workers, the skill sets used by these workers on green projects will be very similar to those required for non-green projects (DELEG, 2009).

62. On the other hand, there is dispute over the idea that "green skills" represent a completely new set of skills which remain largely absent within existing labour markets. A report published by the European Commission (ECORYS, 2008) states that specific skills will be needed for the growth of the green economy such as knowledge of sustainable materials, carbon foot-printing skills and environmental impact assessment skills. In this case, the challenge of filling the skills gap created by the transition to a low-carbon economy goes beyond ensuring the existence of a qualified workforce in possession of traditional skills. These new skills will thus have to be incorporated into training and education programmes.

63. In most cases however, the new jobs created by the growth of the green economy will require a mix of both traditional and new "green skills". For example, construction companies that carry out building and housing retrofitting will require workers with traditional construction skills and up-to-date training in energy efficiency (Apollo Alliance, 2008). In general, it can be said that for low to middle-skilled occupations, there will be a need for traditional skills complemented by "green skills", most of which can be offered by on-the-job training programmes¹⁰. Higher skilled occupations, such as those found in eco-consulting, will require a broader and more specific set of new "green skills", best delivered by educational and in-depth training programmes.

¹⁰ Sixty-eight per cent of respondents of the Michigan Green Jobs survey indicated that their future employee training needs may be conducted on-the-job (DELEG, 2009).

64. It could be argued that "greening skills" use a higher component of knowledge intensity even in low-knowledge intensive occupations in part because we need "new" knowledge. Perhaps the new "green skills" are of a different nature requiring a "convergence of knowledge" as suggested by a recent OECD study (see table below). The meaning of *skills* refers to the abilities and capacities people have to perform *tasks* that are in demand in the workforce. These skills can be generic or specific regarding functions at work such as managing people, computing, collaborating or dealing with risk and uncertainty or developing a new product or service (Tether *et al.*, 2005). These skills are usually acquired through education, training and/or experience.

Table 4. Classification of skills at work

BASIC SKILLS	
Generic	Oral communication, written communication, numeracy and literacy, general IT user skills and office administration skills ¹¹ .
Routine	Repetitive, more basic, low-knowledge intensive skills (e.g. packing chocolates in boxes in a factory line, making copies using a simple photocopy machine).
ADVANCED / KNOWLEDGE INTENSIVE SKILLS	
Technical	Skills required for problem solving; design, operation, rethinking and maintenance of machinery or technological structures or marketing plans; ICT professional skills, research skills (e.g. work developed by engineers, researchers, marketing professionals) and drafting skills.
Management	Skills for business planning, regulations and quality control, human resources planning (recruitment, training and skills development) and allocation of resources (e.g. management of intellectual property, financial management, firm health and safety operations).
Social and communication	Motivation and appreciation of people's characteristics for individual and team working purposes; customer service; appreciation and communication through networks and value-chain partners (e.g. ability to reach consensus and agreements, ability to recognise individual's talent and team's contributions to common goals).
Multi-language and cultural	Ability to communicate in more than one language, appreciation of cultural characteristics of different ethnic groups (e.g. communication by a customer representative selling products/services in different countries, capacity to incorporate cultural differences in negotiations).
CONVERGING SKILLS	
Entrepreneurship	Specific skills required for creating and running new business ventures and innovative projects in existing firms such as risk assessment and warranting, strategic thinking, self-confidence, the ability to make the best of personal networks, motivating others to achieve a common goal, co-operate for success, and the ability to deal with other challenges and requirements met by entrepreneurs.
Green	Specific skills required to adapt products, services or operations due to climate change adjustments, requirements or regulations (e.g. water purification and site remediation planning/engineering in mining, solar panels installation, wind turbines design, green management, carbon capture and storage techniques).

Source: OECD (2010)

¹¹ IT user and office administration skills are included here as they are increasingly required in the vast majority of jobs as knowledge intensity increases in most industry sectors and occupations; particularly in the service industry.

65. Although each task at work might require a series of skills for its successful accomplishment, skills at work can be broadly classified into the eight groups shown in the table above. As working environments and society develop, this classification will need to be adjusted. For example "green skills" is a recent addition, but this OECD classification is a good reflection of the current working environment. There are three broad skills categories: basic, advanced and converging. *Basic* skills are those more generic and routine skills that can be found in occupations present in most industries and organisations. *Advanced* skills have a higher component of knowledge intensity and can be found in technical occupations and management positions but also refer to social and communication skills needed for team work and specific language and cultural skills that are of growing importance in certain multicultural working environments. *Converging* skills require several of the other skills plus some specific skills for entrepreneurship or for adjusting to the green transformation of jobs or new green jobs.

66. One side of the coin is ensuring the existence of the adequate skills in the workforce to fill the new "green jobs" that will be created. The other side of the coin is the priority of skills upgrading for existing jobs and updating job profiles to include green skills. Some sources point out that new "green jobs" will be a relatively small source of future training demand compared to the "greening of old jobs" (Briggs *et al.* 2007). The ILO has noted that "rather than replace existing jobs with totally different green jobs, it is the content of jobs, the way the work is performed and the skills of workers that will change" (ILO, 2008). These studies also support the assumption that the main impacts of climate change regulation on labour markets are primarily related to skills rather than the actual levels of employment. As a result of the shift to greener production businesses have begun to identify a growing need for skills upgrading. Many businesses have already begun implementing in-house training programmes to re-skill their staff; mainly to increase energy efficiency in production methods (GHK, 2009a).

67. Up-skilling and retraining will be necessary not only for low and mid-skilled workers, but also for managers. The UNEP pointed out that along with the skills gap challenge comes the "management challenge" which consists of "the development of new perspectives, awareness and managerial capacities" (UNEP, 2008a, p. 25). Businesses will need to ensure that their managers are able to learn and understand the new skills needed to respond to the changes taking place within their realms of responsibility; to develop more green-oriented managerial capacities; as well as to make adequate use of the skills their staff has obtained.

LOCAL POLICY IMPLICATIONS FOR MANAGING AND ENABLING GREEN GROWTH

68. The impacts of climate change regulation on labour markets will be felt immediately at local level. The paradox however is that while local governments play a relatively marginal role in designing and implementing climate change regulation, they will play a considerable role in managing transition to a low-carbon economy and enabling green growth. Hence, a local approach to the analysis of the impacts of climate change on labour markets is not only relevant, but necessary for the following reasons:

- Greening the economy will have a particular effect on sectors such as agriculture, transport, extractive industries, construction, manufacturing and services. All of these sectors are extensively engaged in at local levels by SMEs working alone or as part of value chains.
- Local governments play a key role in the transformation and upgrading of the immediate built and natural environment, a key element of green economic growth (Apollo Alliance, 2008).
- Urban centres are the most important consumers of energy. In Europe for example, cities and towns account for 69 per cent of energy use and thus most of the GHG emissions (EEA, 2009).
- Local governments are responsible for a number of public services which are of particular relevance to the fight against climate change such as waste management, public procurement, water resources and public transportation.
- The assumption that the transition to a low-carbon economy will have an overall positive effect on employment is not valid at the local level. As mentioned by ETUC, “aggregate estimates of the impacts of climate change on employment mask local disparities. Although no region will be left unaffected, the effects of climate change are unlikely to be uniform across regions” (ETUC, 2009 p. 15).
- The spatial structure of labour markets is a key element to be taken into account when analysing the impacts of a green economic restructuring.
- Local governments and institutions have a better understanding of local economic and labour market conditions, and are therefore more apt to design strategies for green growth that are relevant for their constituency.
- A critical, often missing, ingredient in the green growth model is the role of bottom up, community driven, business and local authorities engagement towards green innovation (Potts, 2010, forthcoming).
- New environmental policy instruments and social change mechanisms emerge, and are implemented at local levels by local authorities (*e.g.* local branding; eco-innovation networks; and combined reporting on state of the environment and economic development) (Potts 2010).

69. Despite the fact that certain green activities are already beginning to develop as a result of market forces (increased demand for green goods and services, and changing consumer habits) governments are

expected to support the creation and growth of companies in these sectors in order to create new job opportunities for those who will be facing the consequences of economic restructuring. As the UNEP report points out “markets cannot drive the transition [to a green economy]; and neither can they be relied upon to deal with the problems that the transition will inevitably create” (2008a, p. 278).

70. As a result, the transition to a low-carbon economy has direct implications for the actors responsible for designing and implementing economic and employment policies especially at the local level. Choosing the adequate policy tools and programmes to facilitate green growth and reduce negative externalities on labour markets represents a considerable challenge as well as an opportunity for policy makers and relevant stakeholders in these fields. However, those seeking to manage a smooth transition and to avoid negative impacts on the workforce will be faced with difficult decisions as there are several possible approaches that can be taken in order to identify the right target groups and policy fields. As will be seen, there is no one recipe or set of policy tools to do so. On the contrary, a multiplicity of approaches can be taken based on policy objective, priorities and local specificities.

71. Local policy makers will be faced with a double challenge in terms of the policies they will have to design and implement in order to ensure a smooth transition to a low-carbon economy. On the one hand, there will be a strong need for policy intervention in order to reduce the potential negative consequences of green growth on labour markets and promote economic restructuring towards cleaner industries and production practices. On the other hand, local authorities also have a role to play in the creation of opportunities for the expansion of green activities and green investments; and the reduction of emissions levels within their localities.

72. The following section discusses transitional issues of "managing" green growth and issues for "enabling" green growth. To illustrate these two dimensions, a selection of good practice examples (learning models) has been included in the text and in Appendix II. Three main criteria have been used to select these good practices: (1) type of actors involved in the design and implementation of the initiative (public, private and community); (2) the employment dimension (greening jobs and skills, and creating green jobs); and (3) the geographic location - so as to cover a variety of economic and political contexts from South America, European Union and Asia-Pacific (see criteria matrix in Appendix I).

73. Finally, the section will discuss some of the emergent policy fields and target groups of policies aimed at bringing about the transition to a low-carbon economy. These have also been included in each of the good practice examples found in Appendix II.

Managing the transition to green growth

74. The first set of policy implications for local authorities relates to the tools that will need to be adopted in order to successfully reduce the potential negative effects of the transition to a low-carbon economy, especially on the workforce. Trade union federations, labour organisations and international organisations have all strongly emphasised the need for the adoption of adequate policy tools in order to manage a "just transition" for a stronger, cleaner and fairer world economy, so as to protect workers in the shift towards a green economy (TUAC 2009, UNEP 2008b, ILO, 2007, OECD, 2009).

75. The policy implications of managing transition can be divided into two dimensions. On the one hand it implies ensuring that the potential negative effects on the workforce are effectively limited. In order to do so public authorities and relevant stakeholders will have to ensure a supply of adequate skills within the labour force to respond to the new demands of employers, adopt active labour market programmes such as training and skills upgrading, and enhance social protection programmes directed at displaced workers. An example of this type of policy is the Construction Reference Centre established by public authorities

and private sector actors in the Brussels Capital Region¹². The region has put in place training programmes to increase the supply of trained labour in the eco-construction industry. This will allow for a reduction in the predicted skills and labour gaps in the sector, and opens up opportunities for the unemployed.

76. The second dimension of managing transition is the broader scale actions taken to restructure local economies around environmental activities and sustainable practices. As mentioned before, transition assistance will be of particular importance for regions with high concentrations of high emission-producing industries as well as for regions facing the difficulties brought about by the decline of traditional industries. The case of the co-ordinated action taken by Portuguese authorities to develop the renewable energies sector in the former shipyard region of Viana do Castelo illustrates an example of the types of actions governments can put in place in this regard (see Box 4). Another example of transition assistance in this sense is the environmental urban development project set up by the Tangshan municipality in China. This project aims to rebuild and reorganise the region's industries and housing infrastructure based on the principle of the circular economy.¹³

¹² See learning model in Appendix II for additional information.

¹³ See definition in the Glossary.

Box 4. The case of "Eolicas de Portugal" (ENEOP)

In 2005, the Portuguese national authorities launched a bid aimed at awarding the electric power grid connection rights to new wind farms, with the intention of developing the wind energy sector in the country. One of the main criteria used to select the winning project was to use wind energy to leverage the sector through investment and employment in one of the country's underprivileged locations undergoing economic restructuring. Eolicas de Portugal (ENEOP), a joint venture founded by five Portuguese and foreign firms, won the first and largest phase of the bid, obtaining the rights to set up facilities to produce 1 200 megawatts by 2013. Since then, ENEOP has created a state-of-the-art industrial cluster comprised of 7 new plants and R&D and training centres to produce wind turbines. These facilities were all built in the Viana do Castelo region of northern Portugal, a region with a strong industrial tradition whose economic activity strongly suffered from the restructuring taking place during the 1980's. The wider cluster also includes 29 associated companies responsible for the supply of goods and services for the manufacture and installation of wind farms.

Since the project was initiated, 109 per cent¹⁴ of the investment at the core industrial facilities has been undertaken and the project has created 561 direct and 845 indirect jobs. This represents about 82 per cent completion of the initial objectives of the programme. Out of the total job creation, specialised labour represents 78 per cent, and technical labour accounts for 8 per cent (the rest is undifferentiated).

Knowledge Intensive Service Activities (KISA) is significant in the wind industry, providing environmental consultancy and impact assessment but also technical services and power plant maintenance. Of interest is that only 9% of the labour force had the relevant qualifications for the job, their companies will therefore have to provide the training. In fact, training courses were led by those programmes supported by government initiatives for renewable energy in Portugal.

As job requirements for the future are within the "traditional trades", the skills of welders, plumbers and maintenance technicians will have to be adapted to meet the needs of renewable industry.

The implementation of the project required close collaboration between all government levels, as well as increased efforts on behalf of local authorities and local labour market actors to ensure the adequate supply of a trained workforce for the positions created. Below is a summary of the impact of the cluster.

Summary of the main benefits to the local and national economy

Total Investment	EUR 220 m	
Total Added Value	EUR 286 m per year	
Job Creations	1 700 direct, 5 500 indirect	
Balance of Payments	Exports	> 60% of the production (EUR 200m per year from 2010)
	Avoided gas imports	> EUR 100 m per year
	Avoided purchase of CO2 certificates	EUR 24 m per year (1 MtCO ₂ per year)
Local Development	Local taxes	EUR 5 m per year
	Land rents	EUR 3.4 m per year

Source: Prata Dias & Ramos (2010)

Enabling green growth

77. Despite their limited capacities to adopt climate change regulation, local policy makers can create significant opportunities for the expansion of green activities, investments, and jobs; and the reduction of

¹⁴ The investment was more than the original budget.

emissions levels within their circumscriptions. Local governments around the world have been actively involved in the fight against climate change and have expressed their will to continue to do so, and have thus become frontrunners in this field (EEA, 2209a; Potts, 2009). For example, buildings are a major source of GHGs in urban environments with many occupations in the built environment industry requiring skills upgrading to align themselves with sustainability practices and principles. Green skills will need to be built on sustainability and triple bottom line accounting/reporting, supply chain management, town planning, master planning and site and project management (quality assurance and environment management systems). Some of the occupations where green skills upgrading will be required are designers and builders, ecologists (urban waterways reconstruction, wetlands, watercourses), all construction and building trades, industrial designers (eco design principles), solar water heating installers, financial and marketing professionals, and sustainability education and community engagement professionals.¹⁵

78. "Landcom", a government land housing developer operating in the Greater Metropolitan Region of Sydney (Australia), represents a good example of the types of actions being taken by local governments to promote the growth of green activities and green skills through the diffusion of sustainability standards in local economies (see box 5).

79. Other examples of how green growth is enabled at the local level are the City of London Low Carbon Zones, the *cirujeros* (waste collectors and recycle) in Buenos Aires, and the support actions for SMEs in France, Germany and Spain (see Appendix II).

¹⁵ Workplace Research Centre – University of Sydney, Strategic Economics, Energy Solutions, *Going with the Grain? Skills and Sustainable Business Development*, a report to the NSW Board of Vocational Education and Training, March 2007, p. 105.

Box 5. The case of "Landcom" in Australia

Landcom is a government owned land and property developer operating in Sydney and the surrounding Greater Metropolitan Region in the state of New South Wales (NSW). Landcom's main mission is to increase the supply of homes, improve housing affordability and protect the environment of the region. Over the past decade, sustainability has become a central organising principle for its planning, operations and partnerships with the public sector. Landcom is required to operate according to commercial principles, yet it is one of the main agents that promote the government's land development and environmental policy. This position has allowed Landcom to diffuse its guidelines for sustainability, design, demonstration projects, policies and practices across the development and construction industries, resulting in new specialist and sustainability jobs in firms and the growth of training and sustainability skills in traditional building and construction occupations. For example, all major developers in Sydney have now followed Landcom's lead and appointed sustainability directions.

Some of the major principles implemented by the corporation include water sensitive and sustainable urban design, storm water management, water and energy consumption reduction standards, reusing and recycling construction and demolition materials, and native vegetation and riparian corridor management.

All tenders for Landcom projects are required to respect these principles, and many of them are stipulated as mandatory in awarded contracts. As a result, Landcom provides a link between the government's social, environmental and economic objectives and the commercial objectives of the private sector.

One of the tools used by Landcom in its efforts to increase sustainability of its land development projects is BASIX (Building Sustainability Indicators), which requires 40 per cent improvements in GHG emissions and water management across all new housing in NSW. An interesting feature of BASIX is that the final policy encouraged building designers and households to develop customised solutions to meet reduction targets rather than focusing on a "one-size-fits-all" policy. By doing this BASIX is driving innovation and demand for new skills across the building industry, impacting training and re-training of plumbers, electricians, carpenters and builders.

In late 2009, Landcom launched a Sustainability Assessment Tool PRECINXTM, a mathematical planning and design tool that evaluates the sustainability of a neighborhood or large urban development project. The tool addresses key challenges including carbon intensity and environmental performance, costs and affordability, and evaluates livability indicators for a range of development scenarios in a given location. Consistent with the innovation model outlined above, Landcom worked closely with government departments, consultants and industry to develop and test the product. PRECINXTM comprises six interdependent modules: onsite energy embodied CO₂, water, transport, housing diversity and storm water. These modules feed into four key performance indicators: Greenhouse Gases (tonnes CO₂/per year), Potable water (kL H₂O/year), Total Affordability (\$/week) and Vehicle Hours Travelled (hours/week). The aim is to give a comprehensive picture of sustainability, from a climate change, broader environmental, social and economic perspective, for major development projects.

Source: Larcombe (2010)

CONCLUSIONS - EMERGENT POLICY THEMES AND TARGET GROUPS

80. As discussed in this paper, the transition to a low-carbon economy and its implications for local labour markets requires a multi-dimensional analysis that goes beyond traditional sectoral thinking. This aspect can also be seen through the multiplicity of possible approaches that can be taken when designing public action strategies to manage the transition and enable green growth. Emergent local policy implications of the transition to a low-carbon economy can be identified in terms of policy fields and possible target groups for designing public intervention as follows.

81. Emergent policy themes include:

- *Training and skills development*: Ensuring the existence of adequate skills within labour forces will reduce the risk of a rise in unemployment rates, enable green growth and satisfy demands of employers.
- *Business support and entrepreneurship*: Public support in this field will facilitate internal adjustments within existing businesses to maintain and increase competitiveness and productivity; but will be also important for the creation of new "green" business activities to generate economic activity.
- *Employment and green jobs*: The public sector can define and implement customised labour policies that facilitate the expansion of a green workforce to reach a critical mass on green capabilities at the local level. A focus on good quality and decent jobs would be important.
- *Eco-Innovation*: As previously mentioned, innovation is one of the key drivers of green growth. Policy instruments may be adopted to seek to support R&D and innovation in specific sectors, particularly the development of more energy-efficient or clean technologies.
- *Environment (cross-cutting)*: Environmental and sustainability initiatives in fields such as urban planning, waste management, public utilities, public transportation, all of which are part of the realm of responsibilities of local governments, would also contribute to public efforts to the transition to a low-carbon economy.

82. In addition to the different relevant policy fields, policy approaches can vary according to the selected target groups, including:

- The *sectoral* approach: Targets specific industries, such as the renewable energy, construction or automobile industry.
- The approach by type of *employer*: Targets specific types of employers such as large businesses, SMEs or the public sector.
- The *territorial* approach: Targets specific territories and might be done on a variety of scales (local, national, regional) but the three levels need to apply relevant knowledge and co-

ordination. Partnerships have an important role to play in co-ordinating the interventions and ensuring that they meet priority needs.

- The *consumer* approach: Targets the final consumer, notably through its habits and preferences. This would be particularly important to stimulate a cleaner demand (consumer) that will result in the supply (industry) of more clean products and services in the market.

83. Designing an integrated strategy for managing and enabling green growth requires taking into account a multiplicity of the previously mentioned policy fields and target groups. This strategy needs to take a multi-stakeholder approach. An integrated and horizontal approach that associates the highest number of actors responsible for designing and implementing policies and initiatives, as well as the most relevant stakeholders, will have higher chances of success than a more fragmented approach. Successful experiences have shown that re-skilling of the workforce, while keeping up productivity levels in the greener economy and expanding to new economic activities requires the public sector to work in partnerships with unions, the business sector, the education sector, and other local institutions.

84. As it has been discussed, the need to match future skills needs with the demand of businesses to produce greener products and services will be a challenge for businesses and the labour market in general. Labour market institutions at the local level will bear the price of having to cope on one side with overarching regulations (*e.g.* national) that will impose restrictions in terms of production processes and economic activity, while seeking to implement incentives to modify consumer habits and therefore stimulate greener business activity. Three issues appear to be essential to guarantee a smooth adaptation of the labour markets to the greener demands.

85. Firstly, the transformation of jobs and the emerging skills requirements in the context of a greener economy will have to be identified and supported, both from inside the firms and in the labour market to achieve economic growth in the green economy. A better understanding of the direct (*i.e.* market demand) and indirect (*i.e.* through regulations) impacts of climate change on existing job profiles and on the skills needs for new green activities is necessary so that labour market agents define and implement the right policy mix to ensure having the pertinent workforce.

86. Moreover, as businesses and other stakeholders face the challenges of complying with climate change stipulations and regulations, many economic opportunities may arise. If consumer habits are modified accordingly, the whole supply system (products and services) can expand significantly. With the right set of incentives and by showing the example, public authorities at the local level can stimulate the transformation of consumer habits and assist businesses in seizing the opportunities arising from a greener market.

87. Finally, there are various mechanisms and practices that could be used to facilitate transformation and adaptation of local labour markets to greener demands. As labour markets evolve, businesses and other stakeholders will have to adjust their production methods and outputs. Public authorities could play a key role in assisting economic agents adapt their activities in order to maintain and create quality jobs that are relevant to the current situation.

88. In conclusion, the green economy can become a unique opportunity for businesses, civil society and the public sector to generate economic activity in a sustainable way. Further analysis is required on the new skills needs and the transformations that will take place in the labour markets in order to make the right policies. The OECD LEED Project on Climate Change, Employment and Local Development [CFE/LEED(2009)11] aims to look at these from an international perspective, based on quantitative and qualitative analysis of participating countries, leading to a set of policy recommendations that could be implemented in the context of environmental constraints.

REFERENCES

- Apollo Alliance (2008), *Green-Collar Jobs in America's Cities*, United States.
- Babiker M. & R.S. Eckaus (2006), *Unemployment Effects of Climate Policy*, MIT Joint Program on the Sciences and Policy of Global Change, Report No. 137, MIT, Cambridge.
- Beaudet, M.B. (2009), "Doutes sur la création des 600 000 emplois verts", *Le Monde*, 30 July.
- Bell R. (2009), available at <http://robertibell.com/thegreenbubble.html>, accessed 15 August 2009.
- Bettencourt *et al.* (2006), *Not if But When, Adapting to Natural Hazards in the Pacific Islands Region*, World Bank, East Asia and Pacific Region, Pacific Islands Management Unit.
- Black, J. N. Hashimzade, and G. Myles (2009), "A Dictionary of Economics", Oxford Reference Online, Oxford University Press, Bibliothèque Sciences Po, <https://aces-distant.sciences-po.fr:443/http/www.oxfordreference.com/views/ENTRY.html?subview=Main&entry=t19.e1748>, accessed 5 January 2010.
- Briggs C., *et al.* (2007), *Going with the Grain? Skills and Sustainable Business Development: Project Report*, Workplace Research Centre, University of Sydney, Australia.
- Connection Research (2009), "Who are the Green Collar Workers?", Department of Environment and Climate Change NSW and the Environment Institute of Australia and New Zealand, Australia, available at: [www.eianz.org/sb/modules/news/attachments/71/Greenper cent20Collarper cent20Workerper cent20reportper cent20Final.pdf](http://www.eianz.org/sb/modules/news/attachments/71/Greenper%20Collarper%20Workerper%20reportper%20Final.pdf), accessed 26 October 2009.
- DELEG (Department of Energy, Labour and Economic Growth) (2009), *Michigan Green Jobs Report 2009*, Michigan, available at: www.michigan.gov/documents/nwlb/GJC_GreenReport_Print_277833_7.pdf, accessed 2 October 2009.
- Docquier, J. (2009), "45per cent des Français favorables à une taxe carbone", *Les Echos*, 31 July 2009.
- Dupont, G. (2009), "Les infractions à l'environnement restent peu sanctionnées", *Le Monde*, 5 August 2009.
- Durlauf, S. and L. E. Blume (2008), "The New Palgrave Dictionary of Economics", Second Edition.
- ECORYS (2008), "Environment and Labour Force Skills: Overview of the Links between the Skills Profile of the Labour Force and Environmental Factors", Report for the European Commission DG Environment, Rotterdam.
- EEA (2009a), "Urban Frontrunners - Cities in the Fight against Global Warming", June, available at: www.eea.europa.eu/articles/urban-frontrunners-2013-cities-and-the-fight-against-global-warming, accessed 10 October 2009.
- EEA (2009b), "Cities of the Future - How will European Cities Adapt to New Climate Conditions?", June, available at: www.eea.europa.eu/articles/cities-of-the-future-2013-how-will-european-cities-adapt-to-new-climate-conditions, accessed 10 October 2009.

- ESCAP (2000), Ministerial Conference on Environment and Development in Asia and the Pacific 2000, available at: www.unescap.org/mced2000/, accessed 20/08/2009.
- ETUC (2006), "Climate Change and Employment: Impact on Employment in the European Union-25 of Climate Change and CO2 Emission Reduction Measures by 2030", available at: www.tradeunionpress.eu/Web/EN/Activities/Environment/Studyclimatechange/rapport.pdf, accessed 5 November 2009.
- Fankhauser, S., F. Seheiler, and N. Stern (2008), "Climate Change, Innovation and Jobs", *Climate Policy*, Vol. 8, pp. 421 – 429.
- GHK (2009a), "The Impacts of Climate Change on European Employment and Skills in the Short to Medium-Term: Company Case Studies", Final Report, Vol. 1, May 2009, London.
- GHK (2009b), "The Impacts of Climate Change on European Employment and Skills in the Short to Medium-Term: A Review of the Literature", Final Report, Vol. 2, May 2009, London.
- Global CCS Institute (2009), "Strategic Analysis of the Global Status of Carbon Capture and Storage, Report 1: Status of Carbon Capture and Storage Projects Globally", Camberra, available at: www.globalccsinstitute.com/downloads/Reports/2009/worley/Foundation-Report-1-rev0.pdf, accessed 5 January 2010.
- Green Jobs Act (2007), Washington D.C., United States Congress.
- Grimshaw G. (2009), "The Proposed Carbon Pollution Reduction Scheme: How does it Work and What are the Possible Implications?" *New Planner*, No. 80, September, pp. 14-15.
- IEA, "Climate Change Policies and Measures Database", available at: www.iea.org/textbase/pm/index_clim.html, accessed on 6 Jan 2010.
- IEA (2008), "Issues behind Competitiveness and Carbon Leakage, Focus on Heavy Industry", IEA Information paper, October 2008, Paris.
- IEA (2009), "Ensuring Green Growth in a Time of Crisis; The Role of Energy Technology", available at: www.iea.org/Papers/2009/ensuring_green_growth.pdf, accessed 5 November 2009.
- ILO (2007), "Decent Work for Sustainable Development - The Challenge for Climate Change", Working Party on the Social Dimension of Globalization, November 2007, Geneva.
- ILO (2008), "Global Challenges for Sustainable Development: Strategies for Green Jobs", ILO Background note for the G8 Labour and Employment Ministers Conference, May 2008, Japan.
- IPCC (1995), "Climate Change: A Glossary by the Intergovernmental Panel on Climate Change", available at: www.ipcc.ch/pdf/glossary/ipcc-glossary.pdf, accessed 6 January 2010.
- Kammen D., K. Kapadia, and M. Fripp (2004), "Putting Renewables to Work: How many Jobs can the Clean Energy Industry Generate?", Energy Resources Group, Goldman School of Public Policy, University of California, Berkley.
- Larcombe, G. (forthcoming), "Landcom – A Best Practice Case Study in the NSW Property and Building Industries"..

Local Government Denmark (2009), "Session Summaries from Local Government Climate Change Leadership Summit", 2-4 June 2009, Copenhagen, Denmark.

Martinez-Fernandez, C. (2010), "Skills and Employment Strategies in Resource-Intensive Cities: A Global Perspective", in O. Hamm and C. Gräwe (eds.), *Bergbau Folge Landschaft/Post Mining Landscapes*, Jovis-Verlag: Berlin.

Michaels, R. and R. Murphy (2009), "Green Jobs Fact or Fiction? An Assessment of the Literature", January 2009, Institute for Energy Research.

OECD/EUROSTAT (1999), "The Environmental Goods & Services Industry: Manual for Data Collection and Analysis", OECD, Paris.

OECD (2004), "Environment and Employment: An Assessment", Working Party on National Environmental Policy, Environment Policy Committee, May 2004, OECD, Paris.

OECD (2008a), "Climate Change Mitigation: What do We Do?", OECD, Paris.

OECD (2008b), "Economic Aspects of Adaptation to Climate Change: Costs, Benefits and Policy Instruments", OECD, Paris.

OECD (2009a), Policy Brief, June 2009, OECD, Paris.

OECD (2009b), "Conclusions and Green Growth Declaration", adopted by the Council at Ministerial Level, 25 June 2009, OECD, Paris.

OECD (2009c), "The Green Growth Race", *OECD Observer*, No. 273, June 2009, pp.47 - 49.

OECD (2009d), "Policy Brief", August 2009, available at: www.oecd.org/dataoecd/1/40/43656443.pdf, accessed 28 August 2009.

OECD (2010), *Entrepreneurship, SMEs and Innovation*, OECD, Paris.

Patt, A., *et al.* (2010), "What Can Social Science tell us about Meeting the Challenge of Climate Change? Five Insights from Five Years that Might Make a Difference", In: M. Hulme and H. Neufeldt (eds.), *Making Climate Change Work for Us - European Perspectives on Adaptation and Mitigation Strategies*, Cambridge University Press Cambridge, pp. 369-388.

Pearce, A. and F. Stilwel (2008), "Green-Collar Jobs: Employment Impacts of Climate Change Policies", *Journal of Australian Political Economy*, December, No. 62, pp. 120-138.

Pollin, R. and J. Wicks-Lim (2008), "Job Opportunities for the Green Economy: a State-by-State Picture of Occupations that Gain from Green Investments", Political Economy Research Institute, University of Massachusetts, Amherst.

Pope, A. (1720), "Translation of the Iliad of Homer", Web Editions, Adelaide.

Potts, T. (forthcoming, 2010), "The New Green Deal and Knowledge Intensive Service Activities: A Global and Australian Perspective", in C. Martinez-Fernandez and I. Miles (eds.), *The Knowledge Economy at Work: Skills and Innovation in Knowledge Intensive Service Activities*, Edward Elgar Publishing, UK.

- Potts, T. (2010), "The Natural Advantage of Regions: Linking Sustainability, Innovation, and Regional Development in Australia", *Journal of Cleaner Production*, available at: <http://dx.doi.org/10.1016/j.jclepro.2010.01.008>.
- Prata Dias, G. and T. B. Ramos (forthcoming), *Assessment of Green Employment Impact of Renewable Energies in Portugal at Local Level*.
- Présidence de la République (2009), Déclaration de M. le Président de la République devant le Parlement Réuni en Congrès à Versailles, 22 June 2009, available at: www.elysee.fr/documents/index.php?mode=cview&press_id=2723&cat_id=7&lang=fr, accessed 5 January 2010.
- Schofield, C. and T. Potts (2009), "Across the Top of the World? Emerging Arctic Navigational Opportunities and Arctic Governance". *Carbon and Climate Law Review*, No. 4, pp. 472-482.
- The Guardian (2009), "Boris Johnson Announces London's 10 'Low-Carbon Zones'", 3 September 2009, available at: www.guardian.co.uk/environment/2009/sep/03/london-low-carbon-zones, accessed 10 October 2009.
- TUAC (2009), "Trade Unions Statement to the Pittsburgh G20 Summit: Global Unions Pittsburgh Declaration", available at: www.tuac.org/fr/public/e-docs/00/00/05/57/document_doc.phtml, accessed 20 October 2009.
- UNEP (2008a), "Green Jobs – Towards Decent Work in a Sustainable, Low-Carbon World", report produced by Worldwatch Institute and commissioned by UNEP, ILO, IOE, ITUC, Nairobi.
- UNEP (2008b) Background Paper on Green Jobs, Nairobi.
- United States Department of Labour (2009), "A Woman's Guide to Green Jobs", Washington.
- Reckien, D., T. Grothmann and T. Egli (2009), "Klimafolgen und Anpassungsmaßnahmen in Verkehr und Mobilität", in: T. Grothmann, D. Krömker, A. Hornburg, and B. Siebenhüner (eds.), *KyotoPlus-Navigator - Praxisleitfaden zur Förderung von Klimaschutz und Anpassung an den Klimawandel – Erfolgsfaktoren, Instrumente, Strategie*, pp. 283-334, available at: www.erklim.de, accessed April 2009.
- Renner, M., M. Ghani-Eneland, and A. Chawla (2009), "Low-Carbon Jobs for Europe: Current Opportunities and Future Prospects", June 2009, World Wide Fund for Nature, Brussels.
- Selwyn, J. and B. Leveret (2006), "Emerging Markets in the Environmental Industries Sector", CEED, UK.
- Stern, N. (2006), The Stern Review on the Economics of Climate Change, available at: www.hm-treasury.gov.uk/sternreview_index.htm, accessed 15 August 2009.
- Stiglitz, J. (2009), "Regulation and Failure", in D. Moss and J. Cisternino (eds.), *New Perspectives on Regulation*, available at: www.tobinproject.org/twobooks/, accessed 15 August 2009.
- Vogel, D. (2003), "The Hare and the Tortoise Revisited: The New Politics of Consumer and Environmental Regulation in Europe", *British Journal of Political Science*, Vol. 33, No. 4, October 2003, pp. 557-580, Cambridge University Press.

CFE/LEED(2010)4

Wiener, J. (1999), "Global Environmental Regulation: Instrument Choice in Legal Context", The Yale Law Journal Company, Inc., January, Vol. 108, No. 4, pp. 677-800.

Woodward, A., S. Hales and P. Weinstein (1998), "Climate Change and Human Health in the Asia Pacific Region: Who Will be Most Vulnerable?", Department of Public Health, Wellington School of Medicine, University of Otago, New Zealand.

GLOSSARY

Carbon Leakage - Carbon leakage refers to "the ratio of carbon emissions increase from a specific sector outside the country (as a result of a policy affecting that sector in the country) over the carbon emission reductions in the sector (again, as a result of the environmental policy)" (IEA, 2008, p. 3). In other words, carbon leakage occurs when economic activity migrates from one country with strict environmental regulation to another country with more flexible or reduced environmental regulation frameworks. The impact on employment is quite obvious: jobs migrate and usually do so at the expense of job quality (decreased wages and working conditions) in the new host country. Low skilled workers tend to be the hardest hit by this phenomenon because while production relocates, the high added-value occupations (design, management, etc.) in these firms usually remain in the country of origin (IEA, 2008).

Carbon Pricing - The two main economic instruments used to reduce Greenhouse Gas (GHG) emissions are carbon taxes and cap-and-trade schemes (also known as emissions trading systems). Carbon taxes involve governments imposing a tax on the amount of emissions produced. These taxes increase the price of using emissions intensive products and thus contribute to the reduction of GHG pollution. Cap-and-trade schemes on the other hand require all emitters to acquire permits for their planned emissions. The government or international institution implementing the scheme establishes an overall target for emissions and then issues a certain number of emission permits according to the target. Permit holders can trade them among themselves and as a result, prices are established through a mechanism of supply and demand (rather than a fixed rate as in carbon taxes) as well as through the tightness of the target established at the outset. Both instruments generate prices for GHG emissions, but do so in different ways. Currently cap-and-trade systems are increasingly the focus of interest in most countries or regions considering market based approaches to reducing GHG emissions (OECD, 2008).

Circular economy – An economy that does not produce any emissions of GHGs and has no environmental footprint. It can be achieved through a process allowing industries to complement and take advantage of each other's production cycles, waste and technological development.

Environmental Goods and Services Industry (EGS) – All activities which produce goods and services to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes technologies, products and services that reduce environmental risk and minimise pollution resources (OECD/EUROSTAT, 1999).

Green Growth – Means by which the current economy can make the transition to a sustainable economy. It involves promoting growth and development while reducing pollution and greenhouse gas emissions, minimising waste and inefficient use of natural resources, maintaining biodiversity, and strengthening energy security. It requires further "decoupling" of environmental impacts from economic growth, and greening of consumption and production patterns, while reducing poverty and improving health and job prospects. Green growth means making investment in the environment a new source of economic growth (OECD Green Growth Strategy 2009).

Green Jobs - Jobs that contribute to protecting the environment and reducing the harmful effects human activity has on it (mitigation), or to helping to better cope with current climate change conditions (adaptation).

Labour markets - Places where labour supply is exchanged for a wage. Labour markets can be identified by a combination of such factors as geography (local, regional, national, international), industry, education, licensing or certification, and occupation. More generally, labour market can refer to the processes by which workers and employers are brought into contact, and wages and conditions of work are decided. Some of these involve formal institutions: contacts between workers and employers may be arranged by employment exchanges or agencies, either public or private (Black *et al.*, 2009). In addition, labour market institutions are the organizations and procedures through which workers, firms, and the government affect wages, employment and working conditions. These vary widely across countries and among firms and industries within a country (Durlauf *et al.*, 2008).

APPENDIX I: LEARNING MODELS - SELECTION CRITERIA MATRIX

Learning Models / Selection criteria	Employment Dimension		Actors involved			Strategic Approach		Geographic Location
	Greening jobs/skills	Green job creation	Public	Private	Third	Manage Transition	Enable Green Growth	
El Ceibo recupera Palermo		✓	✓		✓		✓	Argentina
Professional Construction Reference Centre	✓		✓	✓		✓		Belgium
Caofeidian sustainable urban development project		✓	✓			✓		China
Green Energy Lolland-Falster: Regional Energy Plan		✓	✓	✓		✓		Denmark
Performance Bretagne Environnement Plus (PBE+)	✓		✓	✓			✓	France
Bavarian Environmental Agreement	✓		✓	✓			✓	Germany
Training Specialists on Electric Energy Saving	✓		✓	✓	✓	✓		Mexico
IHOBE	✓		✓				✓	Spain
Low Carbon Zones (LCZ)	✓	✓	✓	✓			✓	UK
Peccioli		✓	✓	✓			✓	Italy

The selected learning models usually cover more than one of these categories. For example, the Green Energy Lolland-Falster Regional Energy Plan seeks to manage the industrial transition undergone by the region over the last two decades, as well as to enable green growth by supporting the creation of renewable energy businesses. This project has however been categorised as a "managing transition" project due to the context of economic restructuring of the region it is implemented in.

APPENDIX II: LEARNING MODELS

Country: Argentina
Location: Buenos Aires municipality
Project: El Ceibo recupera Palermo (El Ceibo heals Palermo)

Policy themes				Target Groups		
Training and skills development	Business support and entrepreneurship	Innovation	Environment	Sector	Employer	Territorial scale
	✓		✓	Waste management	NS	Borough

The El Ceibo association was created in 1989 as a community group aimed at improving the living conditions of underprivileged inhabitants of the Palermo and Villa Crespo neighbourhoods of Buenos Aires. Since then, it has implemented activities in the fields of housing, health and education.

The Argentinean economic crisis of 2001 sharply increased the number of inhabitants living in economically marginalised conditions. It led to high unemployment rates and deteriorated living conditions of many of the families living in the Palermo neighbourhood. As a result, many of the people facing these negative conditions became *cirujeros*, informal workers dedicated to collecting recyclable waste to resell for a small profit (a *cirujero* earns on average EUR 80 per month). The city's *cirujeros* operate within the informal economy, usually in extremely precarious health and security conditions. Moreover, the city of Buenos Aires has duplicated the volume of waste it generates since the early 1990's.

Having realised this, as well as the fact that over 35 per cent of the waste produced by the city is recyclable and reusable, the El Ceibo association implemented the "El Ceibo recupera Palermo" project along with municipal authorities in September 2002. As a result, the El Ceibo co-operative was created, regrouping 104 families of members of the *cirujero* community, with the intention of improving the living conditions of these workers and increasing environmental awareness among the local population. The recycling centre set up by the co-operative employs 50 people, with wages that range between EUR 200 and 400 per month.

Traditionally, each *cirujero* operates individually to both collect and resell waste, and receives a small part of the profit generated by the recycling chain because the higher profits usually come to the private collection centres who act as intermediaries between the *cirujeros* and the final purchasers. Instead, the co-operative has set in place a full chain, from the collection of waste, separation and re-sale to the final purchaser. It has organised the *cirujeros* around this chain, allowing them to become more productive, increase their wages and occupy a formal place in the economy. In addition, the co-operative has put in place an environmental awareness campaign among the residents of the Palermo neighbourhood, which explains the need to reduce the amount of waste produced as well as the ways to separate it at home to facilitate recycling.

The first phase of the project is considered to be a pilot programme, with the hope of replicating it in other parts of the city. As cited by Cristina Lescano, former *cirujera* and now member of the El Ceibo Co-operative: "We have the experience and technical know-how obtained from the project. We know that our

project is solid and can be replicated. Other organisations can take up this model, we hope we can co-operate with them to articulate this proposal”.

Project implementation required close co-operation between local community organisations, the inhabitants and local authorities. The municipality of Buenos Aires put a former ware-house at the disposal of the co-operative to collect and separate the waste brought in by the *cirujeros*. Greenpeace Argentina also participated in the project.

Sources:

Eco2site (2003), "El ceibo recupera Palermo", available at: www.eco2site.com/trash/elceibo.asp, accessed: 21 January 2010.

France 2 (2009), "Argentine: l'eternel espoir?", *Un oeil sur la planète*, January 4, available at: <http://oeil-sur-la-planete.france2.fr/59925689-fr.php>, accessed 13 January 2010.

Country: Belgium
Location: Brussels capital region
Project: Professional reference centre for construction (PRCC)

Policy themes				Target Groups		
Training and skills development	Business support and entrepreneurship	Innovation	Environment	Sector	Employer	Territorial scale
✓			✓	Construction	NS	Regional

The PRCC is a joint initiative launched by the construction sector (trade unions, federations, clusters and associations) and public authorities in the Brussels capital region. The project is part of the Employment Plan for Brussels (*Plan d'Emploi pour les Bruxellois*) and the Economic and Employment Contract (*Contrat pour l'Economie et l'Emploi*), two of the pillars of the region's employment and economic development strategy. The PRCC's main objective is to reduce skills and labour gaps in the construction sector by providing adequate training, particularly in eco-construction. As a result, the projects main goals are to:

- Improve the supply of training by identifying and developing new training fields and training modules which favour innovation and growth.
- Serve as a common platform for co-operation between employment and training services, educational institutions and the construction sector; as well as providing co-ordination for existing training programmes.
- Promote employment by matching training and education programmes to businesses' needs.
- Study and analyse technological advancements in order to anticipate training needs and skills gaps in the labour market.

During its first year in operation the programme offered courses on isolation and waterproofing, techniques for installation of solar photovoltaic panels, energy efficiency for housing and buildings; and handling and operation of environmental materials.

By doing so, the project has trained a number of professionals in the field of eco-construction and renewable energy technologies within the local labour market, in anticipation of skills and workforce demands as expressed by employers. The programme was initially run for one year starting in September 2008. Total funding, which amounted to EUR 200 000, was provided by Bruxelles Environnement (the Region's energy and environmental agency), ACTIRIS (Regional public employment service) and the Fund for Professional Construction Training (*Fonds de Formation professionnelle de la Construction*).

The PRCC has allowed for the effective anticipation of skills and labour shortages in the construction sector, due to the increase of activities in the field of eco-construction, renovation and retrofitting. This example of horizontal co-operation between the multiple stakeholders (public and private) offers employers an external source of training free-of-cost, and has also favoured the re-introduction of marginalised and low skilled individuals to the labour market.

Sources:

Bruxelles Environnement, Centre de Référence Professionnel de la Construction, available at:
www.bruxellesenvironnement.be/Templates/Professionnels/informer.aspx?id=3780&langtype=2060
 accessed 13 January 2010.

Country: China
Location: Tangshan
Project: Caofeidian sustainable urban development project

Policy themes				Target Groups		
Training and skills development	Business support and entrepreneurship	Innovation	Environment	Sector	Employer	Territorial scale
		✓	✓	Multiple	NS	Municipal

The city of Tangshan is located in the Bohai Bay area of the Province of Hebei. Located approximately 250 km north of Beijing, the city is home to 7.29 million inhabitants (3.06 living in the urban core) and is part of the triangle of economic growth poles along with the Pearl River Delta (south) and the Changjian River Delta (North). The city is a major centre for energy and raw material production and extraction in the country. It has considerable reserves of coal, iron and oil and fosters industries such as iron and steel processing, coal electric power, building materials, machinery and petrochemicals. Tangshan also hosts one of the major ports in China.

The municipality of Tangshan has begun work on a major urban development project in the Caofeidian peninsula known as the "international eco-city". The peninsula (previously an island, now linked to the mainland) was mainly a brownfield site, having hosted a number of industrial and mining infrastructures and facilities.

This project has two main components: the development of a renewed industrial site and a residential area. The industrial site is being developed to host activities in the modern logistics, iron and steel, petrochemicals, equipment manufacturing and high-and-new technologies sector. Taking advantage of the bay's deep waters, the project will also develop the city's port infrastructure and capacities. The site will also host a 150 sq. km. housing complex that will house more than 1 million people. In addition, the municipality has built the South Lake Eco-city (housing, parks and recreational facilities) on a former brownfield site.

The project is expected to represent a 1 trillion RMB investment by 2020 and is financed in its majority by the Chinese national government and the Tangshan municipality. However, Swedish, Japanese and Singaporean investors are also present.

The key element of the project, however, is that it is being developed under the principle of a circular economy both in its residential and industrial component. This approach aims for zero emissions of GHGs through a process allowing industries to complement and take advantage of each other's production cycles, waste and technological development. As a result, 99.5 per cent of solid waste and 97.5 per cent of waste water are to be recycled once the system is running. This principle will apply to new facilities, but also to existing ones. Campaigns to ensure existing firms respect the principle have been started and are expected to cover 4 591 enterprises in 10 key industries, including iron and steel.

Sources:

Martínez-Fernández, C. (2009), OECD internal communication.

Hooi, A. & W. Xiaotian (2009), "Helming New Waves of Success", *The China Daily*, 15 October.

Bartram, A. (2008), "Tangshan: From Earthquake to Eco-City", *China Economic Review*, 6 August.

Country: Denmark
Location: Lolland-Falster region
Project: Green Energy Lolland-Falster – Regional Energy Plan

Policy themes				Target Groups		
Training and skills development	Business support and entrepreneurship	Innovation	Environment	Sector	Employer	Territorial scale
✓	✓	✓	✓	Renewable Energy	NS	Inter-municipal

The two Danish Islands of Lolland and Falster (Lolland-Falster) are situated in South-Eastern Denmark, and are governed by the municipalities of Lolland and Guldborgsund. The region was hardly hit by rapid economic and social decline during the late 1980s after the closing of a shipyard in the city of Nakskov, and after many of the area's agricultural processing plants moved abroad or laid off workers to rationalise production. However, an ambitious business development policy combined with targeted housing initiatives, allowed the region to attract the attention of *Vestas*, the world's largest wind turbine manufacturer. In 2000, *Vestas* set up a wind turbine production factory in Nakskov which created 650 new jobs. Another 600 jobs were indirectly created in other companies in the area as a result. Since then, the region has implemented actions to further develop the renewable energy sector allowing them to bring unemployment levels below the Danish average by the end of 2006.

Today, the islands of Lolland-Falster produce more renewable energy per inhabitant than any other region of the world. Local renewable energy production entirely covers the area's electricity needs, as well as 75% of total heating needs. The region has thus developed a strong expertise in the planning and implementation of renewable energy facilities such as onshore/offshore wind power, stationary fuel cell applications, wave energy, biomass CHP/district heating, energy storage/demand response systems, and biogas from manure/industrial waste.

Taking advantage of this know-how, as well as of the area's natural assets and the growing international interest in renewable energy and energy efficiency, the municipalities of Lolland and Guldborgsund implemented a strategic plan to further develop activities in this sector. The Green Energy Lolland-Falster strategy and action plan offers a number of suggestions on how to create growth and jobs, increase awareness, and reduce CO₂ emissions based on local pre-conditions and by supporting local renewable energy activities.

Actions mentioned in the document include:

The Lolland Community Testing Facilities (CTF): This initiative uses collaboration between research, business and authorities through Public Private Partnerships (PPP) to combine the common goals of sustainable growth and development. The CTF offers businesses seeking to develop and commercialise new and innovative renewable energy technologies access to 1:1 scale testing facilities and the possibility of shortening development cycles before actual commercialization.

Hydrogen Community: Lolland's Hydrogen Project, which is scheduled to run until 2012, aims to install micro combined heat and power plants, based upon hydrogen and fuel cell technology. The project involves installing a testing facility for production of hydrogen and oxygen, fuel cells for converting hydrogen to electricity and heat, as well as the necessary equipment to ensure that installed devices can provide supply of production to the public energy networks.

LOKE – Lolland Energy Holding: This holding company was founded to finance future regional initiatives related to renewable energy. LOKE's capital amounts to approximately EUR 11 million, and its investment policy favours projects that lead to the creation of local jobs and development of new

educational programmes. LOKE participates in projects with 20-30% co-financing in form of share capital, loans and/or grants.

Sources:

Lollandkommune, "Green Energy Lolland-Falster", available at:

www.bass.dk/en/mediafiles/20/other/gelf_uk.pdf, accessed 24 January 2010.

European Islands Network on Energy and Environment (ISLNET) Lolland-Falster, Denmark, available at:

www.europeanislands.net/?secid=2&pid=49, accessed on 24 January 2010.

Blanco, I. & C. Kjaer (2009), "Wind at work: Wind Energy and Job Creation in the EU", European Wind Energy Association, Belgium, available at:

www.ewea.org/fileadmin/ewea_documents/documents/publications/Wind_at_work_FINAL.pdf, accessed on 15 January 2010.

Country: France/Germany/Spain
Location: Brittany/Bavaria/Basque country
Project: Performance Bretagne Environnement Plus (PBE+)
 Bavarian Environmental Agreement
 IHOBE environmental services

	Policy themes				Target Groups		
	Training and skills development	Business support and entrepreneurship	Innovation	Environment	Sector	Employer	Territorial scale
Brittany		✓		✓	NS	SMEs	Regional
Bavaria		✓		✓	NS	SMEs / Large businesses	Regional
Basque country		✓		✓	NS	NS	Regional

SMEs are particularly vulnerable to the effects of increasing climate change regulation, as well as to the market-related impacts of climate change. As a result, local governments have begun to set in place environmental support programmes destined to help businesses manage their transition towards low-carbon production and operational methods. These programmes offer a good example of the ways in which public intervention can assist SMEs in efforts to comply with new environmental legislation and improve their environmental performance.

The following examples taken from three European regions illustrate some of the services that are currently being offered to SMEs in this regard. The DG Environment of the European Commission has identified six main types of services currently being offered in this field: passive information tools (*e.g.* websites and campaigns); active/direct support and advice (*e.g.* helpdesks, on-site visits); training projects; networking approaches; economic and market incentives; and voluntary schemes.

Performance Bretagne Environnement Plus (PBE+)

PBE+ is a joint initiative between the Brittany Regional Council, national and local authorities. A series of additional actors such as employers, unions, the national agency of environment and energy savings (ADEME), the Chambers of Trade and Commerce, and Electricité de France (EDF) are involved in its implementation. Funding comes mainly from the Regional Council and national government agencies.

PBE+ aims to improve the environmental performance culture of SME's by building networks and facilitating the exchange of experience. Its main objective is to increase awareness of the environmental impacts of industrial activity and promote the implementation of environmental management systems. The actions it undertakes help SMEs better understand the benefits of clean technologies and remediation techniques in their efforts to improve their environmental performances. It offers free-of-cost assistance to carry out environmental self-diagnoses, organises training sessions and conferences, and gives advice on issues such as environmental legislation, ISO 14001 or clean technologies. There are approximately 1 500 companies in the region that belong to the PBE+ network.

Bavarian Environmental Agreement

This agreement was signed between the Bavarian State Government and the Bavarian Business Community (Association of the Bavarian Industry, Association of Bavarian Chambers of Industry and Commerce and the Bavarian State congress of Crafts Representatives). It contains a significant number of initiatives and engagements on behalf of signing parties in order to promote sustainable and environmental practices within industries and SMEs. One interesting aspect of this initiative is that it uses means other

than legal action to achieve its objectives. For example, companies that commit themselves to taking environmental measures and bettering their environmental performance beyond compliance can obtain subsidies or are relieved of certain administrative obligations.

One important element of the Agreement is the assistance and subsidisation in the introduction of environmental management systems in businesses, and particularly SMEs. The regional government has committed itself to subsidising environmental audits by independent consultants that lead to the introduction of an environmental management system (EMAS, ISO 14001 etc.) for enterprises of up to 150 employees and have a turnover of at least EUR 15.3 per year. In exchange for setting up one of these systems, a company is relieved of around 30% of costs. In addition, companies are granted relief from certain administrative burdens such as emission monitoring and reporting duties; inspection of installations under German Water Law; and monitoring duties under waste laws.

IHOBE Environmental services

IHOBE (Public Society of Environmental Management of the Basque Country) is a publicly owned company responsible for delivering regional environmental policy and promoting actions in favour of sustainable growth. As part of this mandate, IHOBE currently offers information and expert advice for businesses from all sectors to help them improve their environmental performance. Examples of these services include:

- **IHOBE-line:** This is a free telephone and internet environmental information service open to all Basque businesses wishing to obtain information on the environment and industry. Trained advisors attending to the phone calls and e-mails offer counselling on issues related to industrial waste management, emission and waste reduction, environmental legislation and environmental management systems (ISO 14001).
- **Ekoscan:** Ekoscan offers counselling and information services for businesses to identify possible changes/improvements in operations leading to economic/environmental gains; to understand how environmental legislation might affect their operations; and ways to implement "Environmental Performance Systems". Companies that comply with the requirements and recommendations of the initial assessment after one year receive the Ekoscan certificate. The cost of the programme is usually covered by businesses. In some cases partial funding (up to 50 per cent) may be awarded by the region.

Sources:

European Commission, Environmental Compliance Assistance Programmes for SMEs database, DG Environment, available at: http://ec.europa.eu/environment/sme/cases/case_study_en.htm.

Country: Mexico
Location: National
Project: Training specialists on Electric Energy Savings

Policy themes				Target Groups		
Training and skills development	Business support and entrepreneurship	Innovation	Environment	Sector	Employer	Territorial scale
✓	✓		✓	Electric energy	NS	Regional

The Fund for Electric Energy Savings (FIDE) was established in 1990 as a joint initiative between the Federal Commission for Electricity (State-owned electric utility company), the Mexican Electric Workers trade union and several members of the business community. This not-for-profit organization's mission is to increase awareness and rationalise the consumption of electric energy among the industrial, business, and agricultural sectors, as well as within public organisations and private households.

The FIDE offers support to specific projects aimed at reducing unnecessary energy consumption, particularly by offering technical advice and financial support to adopt corrective measures and energy-saving technologies. For example, the FIDE currently offers a "seal of quality" to certify energy efficient equipment, materials and technologies that is recognised nation-wide.

As part of its strategic action plan aimed at increasing economic competitiveness through savings in electric energy consumption, FIDE has set in place a programme to train specialists on techniques to rationalise energy consumption and increase efficiency. Even though the project has been launched nationally, it is implemented at the regional level by regional FIDE delegations and partner institutions including the Federal Commission for Electricity, Regional Engineering faculties, and local universities and research centres.

Attendants have the possibility of following either a short (40 hours) or long programme (180 hours). In both cases, an official diploma is awarded by a local Higher Education Institution to the attendees having successfully completed the course. In addition to the specific technical training that is given, there is also diffusion of broader information on the principles of sustainability and environmental protection.

The programme's initial objectives were to train 1 600 specialists throughout the country. In 2008, 807 specialists were trained through the 21 courses offered in 16 states. The programme also provides assistance to participants who express an interest in developing environmental consultancy services as a professional activity. According to FIDE forecasts, this would allow for the further creation of approximately 3 000 direct jobs in the sector.

Sources:

FIDE, Training Specialists on Electric Energy Saving, available at: www.fide.org.mx/english08/26-ts.html, accessed 13 January 2010.

Country: UK
Location: London
Project: Low carbon zones

Policy themes				Target Groups		
Training and skills development	Business support and entrepreneurship	Innovation	Environment	Sector	Employer	Territorial scale
✓		✓	✓	Multiple	NS	Borough

The City of London's Carbon Reduction and Climate Change Strategy is aimed at transforming the city into a leading low carbon capital by reducing emissions levels by 60 per cent by 2025. A study prepared for the London Development Agency and the Greater London Authority underlines London's potential of doing so by winning a considerable share of global forecast spending on the low carbon economy. As part of this strategy, Mayor Boris Johnson announced the creation of 10 low carbon zones in May 2009 whose aim is to reduce the city's CO₂ emissions and household energy spending, spur job creation and innovation, and support the construction industry.

The selection process of the carbon zones was done on a competitive basis. It required boroughs to present a plan to reduce emissions levels by 20.12 per cent by 2012, and mobilise the ensemble of local stakeholders (community organisations, residents, businesses and utilities companies) to reach this objective. The selection panel included public authorities as well as experts from the scientific and academic community.

The government has committed GBP 3 million for the programme, financed mainly through the London Development Agency's budget for climate change. The ten selected zones will each be awarded between GBP 200 000 and 400 000 to develop energy efficiency and consumption reduction measures. The initial phase of the programme covers 13 000 homes, 1 000 businesses, 20 schools, a hospital, as well as places of worship and community centres. The new carbon zones will be set up in the boroughs distributed across the Greater London Metropolitan Area.

Actions cited in the proposals of the winning boroughs include: low cost offers of insulation and heating to low-income households, working with a major local retailer to use its roof space to install photovoltaic panels which can be used to power local homes, making public buildings more energy efficient, working with energy suppliers to upgrade heating systems, setting up electric vehicle charging points, smart metering and energy and carbon assessments. Several low carbon zones have also begun training "energy doctors", residents who are responsible for assessing carbon production and offering advice on measures to increase energy efficiency.

Sources:

City of London (2009), "Mayor Announces £3m to Kick Start 10 'Energy-Busting' Low Carbon Zones in the Capital", Press Release, 1 May 2009, available at: www.london.gov.uk/view_press_release.jsp?releaseid=21901, accessed 12 January 2010.

GREENW (2009), "Green 'Energy Doctors' Advise Residents in New Carbon Zones", Greenwire News Agency, 15 September, London.

Richardson, S. (2009), "Going Green is Right Down your Street; London's Councils are Powering Ahead with Initiatives to Save Energy and Cut Carbon Emissions", *The Evening Standard*, 21 September, London.

Country: Italy
Location: Local
Project: Waste management and local development

Policy themes				Target Groups		
Training and skills development	Business support and entrepreneurship	Innovation	Environment	Sector	Employer	Territorial scale
	✓	✓	✓	Waste management	Public-private company	Local

Twenty years ago, Peccioli, a small Tuscan city of 5 000 inhabitants near Pisa, was confronted with the regional government's proposal to concentrate the waste produced by 40 other municipalities, including Florence, in their municipal landfill. The population was ready to demonstrate against this decision but the Mayor decided to transform the regional decision into a local development opportunity.

To justify the development the citizens were told that the landfill would not pollute and that investments would be made to widen, sanitise and engage in a significant production of biogas, from co-generation of an electric energy plant (to be sold to the National Electricity Company) and a teleheating system for the supply of hot water to the inhabitants.

Profits from the landfill and its electricity production have allowed the municipality to invest in schools, car parks, local infrastructures and social services, thus improving the quality of life in the community. The Mayor became a "collective" entrepreneur on behalf of the local community, playing a coaching and leadership role too often missing in local authorities.

In 20 years, this operation has generated over EUR 250 million and created 300 jobs directly and indirectly. From 1990 to 1997 the landfill was managed directly by the municipality of Peccioli. However, from 1997 the management of the landfill was entrusted to BELVEDERE SpA, a company based on a Public Private Partnership (60% of the shares are owned by the municipality and 40% are owned by almost 1 000 citizens). The company has assets of over EUR 40 million. Since 1997 it has paid an overall dividend of 7% to the shareholders, and it has invested in local development by:

- i) buying 900 hectares and 40 rural properties promoting environmental tourism and ecological farming;
- ii) developing one hectare of land for a pilot solar energy plant;
- iii) establishing a wind turbine energy park in the landfill's recycling plant;
- iv) promoting a co-operative specialised in gardening and cleaning, employing 120 people;
- v) promoting a health-care co-operative to assist handicapped people and their families, employing a staff of 20;
- vi) building the first experimental plant in Europe to test molecular dissociation in waste recycling;
- vii) promoting a co-operative to manage hotels and tourist activities;
- viii) supporting and sponsoring a number of local cultural initiatives such as a Museum of Russian Icons, cultural events and theatres, sport facilities, innovation and research.

The Peccioli landfill energy plant has been certified by the EU Eco-Management and Audit Scheme (EMAS). The City of Peccioli and the Sant'Anna School of Economy in Pisa have been partners for over 15 years, showing how productive the collaboration between a university and its local community can be.

Sources:

Delai, Nadio (2010), Rifiuti e Sviluppo, Il Caso Virtuoso del Sistema Peccioli, FrancoAngeli.