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# green skills

## AND INNOVATION FOR INCLUSIVE GROWTH

LEED
BUILDING MORE & BETTER JOBS

OECD

# Green skills and innovation for inclusive growth

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# Foreword

The greening of the economy is a shared goal for advanced and less advanced economies alike, particularly where sustained and inclusive employment is an objective for policy-makers. However, the challenges of such greening, and the implications for employment and skills, vary across regions and countries.

In the transition from high- to low-carbon production, labour market impacts are becoming more evident and changes will likely affect all workers. However, while these changes may be minor for the majority, they will be substantial for a small number of industries and professions. Preparation for the adjustments is essential to take full advantage of green growth opportunities.

Much has been achieved so far; however, the economic crisis of 2008, and the recession that followed, dramatically affected job prospects in many countries. Today, many of these countries still face the consequences of the crisis, where decisions on trade-offs between austerity measures and economically, socially, and environmentally sustainable growth have been challenging.

Policy-makers today are concerned with how to help their economies to move away from a low-level approach (low job quality, low environment protection, low skills), towards high skills, high productivity, and sustainable economies. In this context, we see the green economy not only as a challenge but also as a great opportunity. However, we must be well prepared to take full advantage of green growth opportunities.

This report is very timely, providing evidence and policy analysis to foster an equitable shift to greener economies and more sustainable societies. Mainstreaming greening in employment and skills strategies requires strong partnerships between public, private and not-for-profit organisations to maximise innovation and to manage smoothly labour market transitions from brown to green energy and employment. It also requires national policy frameworks that are more conducive to the right outcomes on the ground. There is still much to be understood about how training and skills systems contribute to green growth, hence the importance of this report.

When the future of mankind is at stake, the need for proactive and strategic integration, combining employment with climate and energy polices and R&D measures, seems a relatively small but imperative task. We call on those reading this report to join forces for green and inclusive growth.

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*Director, Cedefop*

**Rintaro Tamaki**
*Deputy Secretary-General, OECD*

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We would like to thank all the speakers who contributed papers to the forum. In particular, we acknowledge the contribution of the keynote speakers Rintaro Tamaki, Deputy Secretary-General, OECD, and Christian Lettmayr, Deputy Director, Cedefop; session chairs: Robert Strauss, Directorate General Employment, Social Affairs and Inclusion, European Commission; Marie Etchegaray, Ministère de l'écologie, du développement durable et de l'énergie, French Government; Stefano Scarpetta, Directorate for Employment, Labour and Social Affairs, OECD; and session discussants: Paul Swaim, Directorate for Employment, Labour and Social Affairs, OECD; Jan Corfee-Morlot, Development Cooperation Directorate, OECD; Roland Schneider, Trade Union Advisory Committee to the OECD (TUAC); Nicola Brandt, Directorate for Economics Department, OECD; Kathrin Höckel, Directorate for Education and Skills, OECD; Richard Elelman, Fundació CTM Centre Tecnològic.

Antonio Ranieri, Cedefop, Cristina Martinez-Fernandez, Knowledge-Sharing Alliance, OECD, and Samantha Sharpe, University of Technology Sydney, acted as editors.

# Table of contents

# List of tables and figures

## Tables



## Figures

CHAPTER 1

# The social and employment dimensions of a greener economy

**Antonio Ranieri** and **Cristina Martinez**

The financial crisis posed enormous challenges for European and other OECD countries; the scars are still visible today, with acute unemployment crises in several European countries. According to the latest reports on global economic prospects, growth is expected to pick up speed in the years to come, although the pace of recovery is disappointing, especially in advanced economies (World Bank, 2014; IMF, 2014).

Today, following an extended period of crisis and a few years of painfully slow recovery in many European and other OECD countries, climate change and the urgency of greening the economy are back on the agenda and strongly advocated by the private and civic sectors. 'Business as usual' is no longer accepted as a scenario and now, more than ever, it is apparent that economic growth is an enabler to fulfil social inclusion and environmental goals, not a guarantee.

In this context, reflecting on the role of skills for a greener economy as the linking factor between innovation and equality is a forward-looking task. How are we to make the transition towards a greener economy an exemplary strategy, simultaneously addressing environmental and social inclusion goals? And what is the contribution of innovation, skills and technical and vocational education and training (TVET) policies in this?

Cedefop and the OECD started a discussion in 2012 with international organisations, policy institutions, researchers and practitioners in the first 'green skills' forum. That event initiated an agenda to deepen our understanding of what technical and policy steps are needed for making our economies greener, more sustainable, more inclusive. The first discussion produced the *Greener skills and jobs* report (OECD and Cedefop, 2014) which highlighted the importance of policy integration and coordination, which remains uncertain and fragmented. Two years later, in February 2014, the second green skills forum focused on green skills and innovation for inclusive growth. Over 90 policy-makers, government advisers, employment and policy analysts, researchers, practitioners, and social partners from European countries, the US, India and China, gathered together to discuss progress and to advance the understanding of the social implications of green growth.

The complexity of the issues at hand is reflected in the two main themes discussed during the forum.

(a) How can low-carbon activities be the key to competitive and inclusive growth?
    There is strong evidence that greening jobs and skills contribute to the increased competitiveness and vitality of economies. However, in the current time of high levels of unemployment, it is essential that public policy focuses on the intersection of activities that both decarbonise the economy and lead to inclusive and employment growth, and on the role played by skills and vocational education and training (VET) policies.

(b) What are the new approaches for strategic policy coordination for a low-carbon economy?
    The low-carbon economy does not require a single policy action in just one area, but activity and coordination across a wide range of public policies. This includes horizontal coordination across policy domains and vertical alignment across policy levels (supranational, national, regional and local).

## 1.1. Towards competitive and inclusive green growth

Private and public sectors recognise today that the link between technological development, innovations and the greening of the economy offers unexploited opportunities for economic growth. However, sustainable development is very much about dealing with externalities which create a disconnection between the price we pay for goods and services and their production costs. At local and global levels, the tension between increasing global demand for goods and services and rapid resources depletion can only be addressed through radical change in approaches to production, consumption, processing, storage, recycling and disposal of waste.

Consensus is growing that we must aim for zero emissions from fossil fuels to have an impact on climate change trajectories. Breaking the link between economic growth and energy use is the only possible way to reconcile environmental and economic sustainability in the coming decades.

Innovation uptakes and technological changes have a key role in greening the economy, allowing for improvements in resource efficiency and fostering low-carbon growth.

The impact of environmental innovation is generally positive for productivity and competitiveness, ([1]) and can be a key factor in minimising the cost to the economy of a shift to more environmentally sustainable growth. Cedefop's scenario analysis (Cedefop, 2012) also shows that a more sustainable and energy-efficient economy can be achieved at the same time as employment growth, but this requires greater integration of climate and energy polices with measures to support employment and skills development.

The first green skills forum stressed that optimising public policy coordination is crucial to the transition. The second forum advocated public policy responsibility to encourage economic sustainability and environmentally friendly innovations, by making use of a mix of standards, regulations, incentives and taxes. However, this does not guarantee that environmentally sustainable growth will automatically be job-rich and socially inclusive growth.

## 1.2. Towards policy coherence for inclusive green growth

Many stakeholders recognise that policy coordination and policy integration are essential to speed up greening of the economy and to deliver the so-called 'double dividend' of ecological sustainability and employment growth. This is why the second theme of the 2014 forum focused on the need for greater policy coordination to achieve employment growth and better matching of supply and demand of jobs and skills. Special attention has been given to:

(a) governance, and more generally to capacity building for the creation of networks, partnership, and social dialogue, especially at local level;
(b) labour market intelligence, monitoring and evaluation of policies and measures, and the dissemination of good practices to aid transferability of successful measures and policies.

A well-coordinated approach among international players has often been the missing link in pursuing a common sustainable development agenda. This is why the green skills forum 2014 opened with a moderated discussion among representatives of the interagency working group (IWG) on greening

([1]) See analysis of Copenhagen cleantech cluster (Martinez-Fernandez et al., 2012).

technical and vocational education and training and skills development (Box 1).

Box 1. **The interagency working group for greening TVET and skills development**

In 2011, Cedefop and the OECD, together with the Asian Development Bank (ADB), the European Training Foundation (ETF), the International Labour Organisation (ILO), the United Nations Economic Commission for Europe (UNECE), the Unesco International Centre for TVET and Training (Unesco-Unevoc), and the United Nations Institute for Training and Research (Unitar) set up a cooperation body, the interagency working group (IWG) for greening TVET and skills development.

The IWG is convinced that a collaborative effort is required to meet the challenges involved in greening TVET and skills development.

The IWG advocates international partnership and cooperation for promoting the necessary capacities in TVET and skills development, allowing a rapid and equitable shift to greener economies and more sustainable societies.

The IWG supports initiatives for greening TVET and skills development by raising awareness, providing advocacy, sharing and disseminating good practices, knowledge and expertise, and works under the umbrella of the IWG on TVET.

In 2013, at the request of the G20 development working group under the human resource development pillar, the IWG put forward a set of policy recommendations on greening TVET and skills development: *Meeting skill needs for green jobs* (IWG on greening TVET and skills development, 2013).

The participation of the IWG in the green skills forum provided an important opportunity for the IWG members to present and discuss a set of policy recommendations for meeting skill needs for green jobs, jointly prepared and building on lessons learned in the course of their initiatives and research activities in different geographic and thematic areas (IWG on greening TVET and skills development, 2013). The shared strategic vision, which underpins all IWG members' work, is summarised in the following key challenges:

(a) the green transition inevitably brings structural shifts in employment, both between and within occupations, even though occupational changes may occur at different rates and in different ways, depending on context;

(b) as a consequence, the implications of greening the economy for skills and training needs vary considerably, both among and within countries, depending on their economic structure and institutional arrangements as well as on their levels of development and the composition of their labour markets;

(c) notwithstanding these variations, all countries, from the poorest to the wealthiest, and from the least to the most economically developed, recognise the importance of environmentally sustainable growth. However, the impact of the transition to green growth is a key concern for policy-makers in countries at all stages of development, especially in the current economic climate of high unemployment and underemployment in many countries;

(d) two main challenges related to employment changes and skill requirements are identified to help the transition towards a sustainable economy: (i) the emergence of skills bottlenecks in many countries can be a serious impediment to green investment and growth; (ii) workers losing 'brown' jobs are not always are able to walk into green alternatives, especially low-skilled and medium-skilled workers. In this context, current labour market information is not sufficiently up to date or appropriately organised in most countries;

(e) labour market and skills policies that support smooth and just transition will be an essential component of green growth strategies. Employment opportunities can contribute to more sustainable and inclusive growth for all, provided some critical issues relating to the development of appropriate skills are taken into account;

(f) lack of coordination between skills and environment policies prevents the implementation of ambitious green growth strategies. Few countries have put in place green job skills development strategies. This failure is mainly attributable to weak coordination between national and/or local strategic planning and labour policies, and between different actors and stakeholders within individual policy areas.

The green skills forum 2014 provided a platform for discussion and sharing ideas and practices suitable to:

(a) informing on policy approaches and practices tackling key skills issues for green growth;

(b) comparing methods and tools for monitoring and evaluating labour market developments;

(c) showing how research can support better targeted policy–making and skills strategies;

(d) identifying gaps in knowledge and providing guidance for future research and collaboration for transitioning to a low-carbon economy.

## 1.3. Governments as integrators of capabilities for green and inclusive growth

The distributional impact of green growth remains an area of concern as it is unclear how many jobs it involves, the characteristics of the jobs, the conditions and quality of the jobs, and whether it will be possible to address issues of income inequality.

Helping countries to make a strategic green transition requires policy coherence between ministries to foresee how changes in the market will impact employment and inclusive growth. The multiple dimensions of greening our economies, and the uncertainties of the impact on labour markets of distributional issues, need knowledge sharing alliances to document policies that work (and where) and policies that do not.

While policy coherence for green and inclusive development is a necessary condition to move forward, the private sector must be included, in all national contexts; the goal to achieve green and inclusive growth applies even to countries still ‘developing’.

Green and inclusive growth requires transformation of our production and consumption systems. It includes opportunities for all in society but requires an integrative, continuous approach. Policy institutions can also learn from organisations in the private sector about how to bring policy coherence to their work structures, providing a framework that supports green talent and competences, from those in the early stages of education to the older workers in our labour markets.

Countries also need to balance and empower TVET systems to act as catalysers of greening jobs and skills today and tomorrow. All jobs need to be part of the process, not just those linked to renewable energies but all sectors and at all levels, to align skills provision and demand with green innovations in the market.

The papers collected in this publication provide new insights for policy-making and help inform future work on the transition of labour markets to greener employment growth. They discuss specific developments in the following areas: water, wind energy, climate change mitigation, eco-innovation, education and training systems, green job creation, building and construction, low-carbon and inclusive strategies, and greening development strategies.

The success of the forum also lies in the opportunity for participants from all over the world to discuss topics of mutual interest, learn from each other on equal footing, and improve their capacity to address social and employment dimensions of a greener economy.

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CHAPTER 2

# Climate change mitigation and induced structural adjustment in the markets for labour

**Gerald A. Meagher, Robert A. Wilson** and **Janine Dixon**

Reducing greenhouse gas emissions without reducing economic growth requires advances in technology (which reduce the emissions intensity of industrial production) and/or policy measures to promote structural change (which shift the composition of production in favour of less polluting industries). Both of these must inevitably proceed in an environment of structural change driven by various other economic forces. This paper analyses the effects of mitigation policy on employment within a framework that recognises the historical structure of the economy and its likely future development in the medium term. Specifically, the paper investigates the imposition of a tax on the employment of labour by each industry in proportion to the emissions per hour of labour input used in the industry. It shows show that long-term trend changes in industrial structure may negate the efficacy of environmental policies that are driven by plausible notions concerning green jobs.

## 2.1. Introduction

If a labour market policy is going to reduce greenhouse gas emissions, its effect must fall into one or more of three broad categories: a reduction of aggregate employment; technical change which reduces emissions with no change in employment; or a change in the distribution of employment in favour of industries with relatively low emission intensity. Policies designed to promote green jobs tend to fall into the last of these categories.

In a high-profile joint report by the United Nations Environment Programme green jobs were 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, 2008, p. 3).

The report (UNEP, 2008, p. 5) suggests the following policies to drive employment in green jobs:

(a) subsidies: phase out subsidies for environmentally harmful industries, and shift a portion or all of those funds to renewable energy, efficiency technologies, clean production methods, and public transit;
(b) carbon markets: fix the current shortcomings inherent in carbon trading and Kyoto-protocol-related innovations such as the clean development mechanism, so that they can become reliable and adequate funding sources for green projects and employment;
(c) tax reform: scale up eco-taxes, such as those adopted by a number of European countries, and replicate them as widely as possible. Eco-tax revenues can be used to lighten the tax burden falling on labour while discouraging polluting and carbon-intensive economic activities;
(d) targets and mandates: ensure that regulatory tools are used to the fullest extent in the drive to develop greener technologies, products, and services, and thus green employment. This includes land-use policies, building codes, energy-efficiency standards (for appliances, vehicles, etc.), and targets for renewable energy production;
(e) energy alternatives: adopt innovative policies to overcome barriers to renewable energy development, including feed-in laws that secure access to the electrical grid at guaranteed prices;
(f) product takeback: adopt 'extended producer responsibility' laws (requiring companies to take back products at the end of their useful life) for all types of products;
(g) eco-labelling: adopt eco-labels for all consumer products to ensure that consumers have access to information needed for responsible purchasing decisions (and hence encouraging manufacturers to design and market more eco-friendly products);
(h) R&D budgets: reduce support for nuclear power and fossil fuels and provide greater funding for renewable energy and efficiency technologies;
(i) international aid: reorient the priorities of national and multilateral development assistance agencies, and export credit agencies, away from fossil fuels and large-scale hydropower projects toward greener alternatives.

The primary motivation of many of these policies is to induce producers and/or consumers to change their behaviour so that employment is redistributed in favour of green jobs.

In many analyses of green jobs, and certainly in the UNEP report, it is implicit that 'greenness' can be identified as an intrinsic property of each job taken separately. However, employment in a particular job is connected to a varying extent to employment in all other jobs via labour markets. These market links may subvert the objectives of employment policies if those policies are pursued in isolation. It is the contention of this paper that policies designed to mitigate climate change are unlikely to be successful if they are pursued on a job-by-job or case-study basis. Further, labour market links are also likely to be important for the formulation of training policies intended to support the transition to a green economy.

Here, the effects of labour market links are investigated in a more restricted environment than that considered in the UNEP report: a green job is taken to be one which is responsible for the emission of a relatively small amount of greenhouse gases per hour of employment. To promote employment in green jobs thus defined, a tax is imposed on the employment of labour by industries in proportion to the amount of greenhouse gases they emit. The effects of imposing the tax are reported as deviations from the Cedefop medium-term (2009 to 2020) employment forecasts for the UK described in Wilson et al. (2010). The model used is a revised version of the computable general equilibrium (CGE) labour market extension to the Cambridge Econometrics E3ME model ([2]) described in Meagher et al. (2012). The tax is assumed to be returned to producers in such a way that aggregate employment remains unchanged, so the focus of the analysis is on the structural, rather than the secular, implications of mitigation policy for employment growth.

The remainder of the paper is organised as follows. Section 2.2 describes the method for determining the emission intensity of employment. Section 2.3 introduces adjustments to the model required to impose taxes on employment. Section 2.4 presents results and Section 2.5 has concluding remarks.

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([2]) Energy-environment-economy model of Europe (multisectoral macroeconomic model).

## 2.2. Emission intensities

The emission intensities used in this paper are adapted from data prepared for a major study of climate change mitigation undertaken by the Australian Treasury (2008). The original data consist of estimates of the amount of greenhouse gases emitted by each industry per unit of its output. According to these data ([3]), the aluminium industry is only a moderate emitter of greenhouse gases (rank 12 of 53 industries). However, it uses large amounts of electricity in its production, and electricity has the highest emission intensity. A better indicator of the influence of the various industries on atmospheric pollution can be obtained by attributing the emissions associated with the production of intermediate inputs to the using industry. According to adjusted emission intensities, aluminium, rather than electricity is the worst polluter, with the intensity for electricity being more than halved. Similarly, some of the emissions produced by sheep and cattle are attributed to meat products and textiles, clothing and footwear, some produced by dairy are attributed to other food products, and some produced by gas supply are attributed to private heating. On the other side of the pollution ledger, some of the reduction in emissions resulting from production in forestry are now attributed to the industries which use forestry products as inputs, particularly wood products and paper products. The change to the accounting system reduces the range of the emission intensities by more than half.

Policy proposals for climate change mitigation are often based on identifying jobs that can be considered to be green in some *a priori* sense. Once identified, the jobs are then recommended for government support of one kind or another as a way of reducing emissions. However, as the UNEP example shows, the definition of greenness can be quite loose. It may reasonably be thought that an employment classification based on emission intensities would provide a more rigorous definition of 'greenness', and hence a more reliable guide as to the contributions that various jobs might make to the mitigation process.

The first step in determining a suitable classification is to convert the intensities per unit of output to intensities per unit of employment by industry, using Australian data on labour-output ratios in 2009-10. These intensities are then assumed to apply in equal measure to the UK. The classification used in

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([3]) A longer version of this paper is available in Meagher et al. (2014). It contains several tables which support the statements made here.

the Cedefop forecasts for the UK contains 41 industries. It can be made to conform to the Australian classification if both are first aggregated to a common classification containing 30 industries. The same intensity has been assigned to all UK Cedefop industries which make up an industry in the common classification.

Greenhouse gases are emitted by industries, so the emission intensity of an hour of labour is taken to depend only on the industry in which it is employed and not on the occupation or skill of the associated worker. In Table 2.1, this assumption has been used to convert the intensities by industry into intensities by occupation. The range is again reduced significantly due to averaging.

In column 4 of Table 2.1, the occupations have been ranked from most polluting (22, stationary plant and related operators) to least polluting (1, armed forces) according to their emission intensities. It is this ranking which determines the 'greenness' of an occupation for purposes of the present analysis.

## 2.3. Adapting the Monash labour market extension model

The Cedefop labour market forecasts, referred to in the introduction, were produced using a modular modelling approach with two major components:

(a) an multisector macroeconomic model of 29 European countries (E3ME), primarily developed and operated by Cambridge Econometrics;
(b) a labour market extension, referred to as the Warwick labour market extension (WLME), primarily developed and operated by the Institute for Employment Research at the University of Warwick.

The countries are treated as an integrated system in E3ME but the extension is applied to each country separately. Forecasts of employment by industry are determined by E3ME; forecasts of employment by occupation and qualification are determined by WLME.

In the simulations reported here, the WLME has been replaced with an alternative extension which uses CGE modelling techniques ([4]). This extension has been developed primarily at the Centre of Policy Studies at Monash University and is referred to as the Monash labour market extension (MLME).

([4]) The term CGE is used here in a generic, rather than a descriptive, sense to indicate a style of economic modelling.

## Table 2.1. **Emission intensities per unit labour input by occupation, UK, 2009**

| Code | Occupation | (1) | (2) | (3) | (4) |
|---|---|---|---|---|---|
| | | Direct | | Adjusted | |
| | | Intensity | Rank | Intensity | Rank |
| 1 | Armed forces | 0.0026 | 27 | 0.0057 | 27 |
| 2 | Legislators and senior officials | 0.0125 | 24 | 0.0137 | 25 |
| 3 | Corporate managers | 0.0237 | 13 | 0.0242 | 13 |
| 4 | Managers of small enterprises | 0.0149 | 21 | 0.0161 | 23 |
| 5 | Physical, mathematical and engineering science professionals | 0.0407 | 7 | 0.0342 | 7 |
| 6 | Life science and health professionals | 0.0197 | 17 | 0.0209 | 17 |
| 7 | Teaching professionals | 0.0192 | 18 | 0.0209 | 16 |
| 8 | Other professionals | 0.0131 | 23 | 0.0157 | 24 |
| 9 | Physical and engineering science associate professionals | 0.0361 | 9 | 0.0325 | 8 |
| 10 | Life science and health associate professionals | 0.0206 | 15 | 0.0203 | 19 |
| 11 | Teaching associate professionals | 0.0205 | 16 | 0.0237 | 14 |
| 12 | Other associate professionals | 0.0154 | 20 | 0.0174 | 22 |
| 13 | Office clerks | 0.0216 | 14 | 0.0208 | 18 |
| 14 | Customer services clerks | 0.0415 | 6 | 0.0313 | 10 |
| 15 | Personal and protective services workers | 0.0158 | 19 | 0.0188 | 20 |
| 16 | Models, salespersons and demonstrators | 0.0046 | 26 | 0.0082 | 26 |
| 17 | Skilled agricultural and fishery workers | 0.0824 | 3 | 0.0309 | 11 |
| 18 | Extraction and building trades workers | 0.0245 | 11 | 0.0227 | 15 |
| 19 | Metal, machinery and related trades workers | 0.0416 | 5 | 0.0407 | 5 |
| 20 | Precision, handicraft, craft printing and related trades workers | 0.0296 | 10 | 0.0243 | 12 |
| 21 | Other craft and related trades workers | 0.0095 | 25 | 0.0439 | 4 |
| 22 | Stationary plant and related operators | 0.1147 | 1 | 0.0754 | 1 |
| 23 | Machine operators and assemblers | 0.0243 | 12 | 0.0722 | 2 |
| 24 | Drivers and mobile plant operators | 0.0712 | 4 | 0.0576 | 3 |
| 25 | Sales and services elementary occupations | 0.0143 | 22 | 0.0177 | 21 |
| 26 | Agricultural, fishery and related labourers | 0.0899 | 2 | 0.0324 | 9 |
| 27 | Labourers in mining, construction, manufacturing and transport | 0.0361 | 8 | 0.0394 | 6 |
| 28 | All occupations | 0.0246 | | 0.0246 | |

NB: Emissions are measured in kilo tonnes of $CO_2$ equivalent. Labour is measured in thousands of hours. Adjusted intensities are obtained by attributing the emissions associated with the production of intermediate inputs to the using industry.

*Source:* Meagher et al., 2014.

Compared to the WLME, MLME relies less on time series extrapolation and more on explicitly modelled economic behaviour. It describes the operation of 27 occupational labour markets. On the demand side of these markets, labour belonging to different occupations can be converted into effective units of industry-specific labour according to constant elasticity of substitution (CES) functions. On the supply side, labour by skill can be converted into labour by occupation according to constant elasticity of transformation (CET) functions. Relative wage rates are assumed to adjust to clear the markets for labour by occupation. The complete set of equations which makes up the MLME model is set out in Meagher et al. (2012).

The WLME includes a module which 'balances' the demand for labour by occupation, derived from the E3ME forecasts, with the supply of labour by occupation derived from separate projections of employment by skill. If the balanced E3ME-WLME forecast is interpreted as a market clearing forecast, technical change can be introduced into MLME such that E3ME-MLME reproduces the Cedefop forecasts. This procedure is described in Meagher et al. (2013). The Cedefop forecasts are the base case simulation in the present analysis.

The base case is to be compared to a mitigation scenario in which taxes are introduced to induce a change in employment away from industries producing high levels of emissions. To that end, two new equations are introduced into MLME:

Equation 1. **Demand for labour by industry *i***

$$d_i = d - \sigma^s\left[p2_i - \sum_{k=1}^{IND} SH_k p2_k\right] + a_i - \sigma^s\left[a_i - \sum_{k=1}^{IND} SH_k a_k\right] \qquad (\text{all } i \in IND)$$

where

$d_i$ is the change in demand for labour by industry *i*,

$d$ is the change in demand for labour by all industries,

$p2_i$ is the change in the average hourly wage rate (tax inclusive) for labour in industry *i*,

$SH_i$ is the share of industry *i* in total cost of employing labour,

$\sigma^s$ is the elasticity of substitution of labour between industries,

$a_i$ is industry-*i*-augmenting technical change in employment.

Equation 2. **Tax inclusive average wage rate for labour in industry *i***

$$p2_i = SH_i^p p1_i + SH_i^T t_i \quad (\text{all } i \in IND)$$

where,

$p1_i$ is the change in the average hourly wage rate (tax exclusive) for labour in industry *i*,

$t_i$ is the change in the specific tax on employment in industry *i*,

$SH_i^p$ is the tax-exclusive cost of employing labour in industry *i* as a share of the total cost,

$SH_i^t$ is the tax on employing labour in industry *i* as a share of the total cost.

The equations in MLME are expressed in terms of percentage changes of the variables: the system computes the percentage changes in the endogenous variables in some period arising from changes (shocks) to the exogenous variables. The coefficients in the system are shares. Sets, coefficients and parameters are denoted by upper-case or Greek symbols. The convention is adopted that lower-case symbols denote percentage changes in the levels of the variables represented by the corresponding upper case symbols, that is, the notation assumes y=100 (dY/Y). The levels variables Y do not appear in the equations but they will be used in the discussion which follows.

Equation 1 maintains that, if there is no technical change (i.e. the $a_i$ are all zero) and there are no changes in the relative wage rates $P2_i$ (i.e. the $p2_i$ are all zero), a 1% increase in the aggregate demand $D$ for labour leads to a 1% increase in the demand $D_i$ or labour by each industry *i*. If, however, the average wage rate $P2_i$ for industry *i* rises relative to the aggregate wage rate, i.e. if $p2_i > \sum_{k=1}^{IND} SH_k p2_k$ , the demand $D_i$ by industry *i* will increase less rapidly than $D$. Employment will be substituted against industry *i* in favour of other industries. If substitution is difficult, i.e. if the elasticity of substitution $\sigma^S$ is small, the amount by which $d_i$ exceeds $d$ will also tend to be small. Note that wage cost shares are to be used in computing the aggregate wage rate for industry *i*, i.e. $SH_k = P_k D_k | \sum_{l=1}^{IND} P_1 D_1$ .

Now suppose that the wage rates $P_k$ and the aggregate demand $D$ are constant but technical change is taking place. If the change is *i*-augmenting at the rate of 1%, (i.e. $a_i = -1$ and $a_k = 0$ for $k \neq i$ ), then demand for labour by industry *i* falls by $\left(1 - \sigma^s(1 - SH_i)\right)\%$ i.e. by less than 1%. The *i*-augmenting technical progress induces some substitution in favour of industry *i* and away from industry $k$, $k \neq 0$. Note that the demand for labour by industry $k$, $k \neq i$, falls by $\sigma^s SH_i$ %.

If employment by industry is set at the levels forecast by E3ME and the $a_k$ made endogenous, MLME determines the technical change regime $\hat{a}_k$, say, implicit in those forecasts. That is, if the $a_k$ are set at the levels so determined, MLME will reproduce the E3ME industry forecasts. In the forecasts reported in the next section, $a_k$ is always set equal to $\hat{a}_k$.

In equation 2, the change $p1_i$ in the wage rate $P1_i$, for industry *i* is obtained by averaging the changes in the market-clearing occupational wage rates using the relevant cost shares for the industry. The change $p2_i$ in the wage rate $P2_i$ is obtained by taking a weighted sum of $p1_i$ and the change $t_i$ in the specific tax levied against employment in industry *i*. The total tax on employment is set at 5% of the total (tax exclusive) cost of employing labour. It is distributed between the industries in proportion to their emission levels as determined by the intensities shown in column 3 of Table 2.2 and their employment levels in each year of the base-case scenario.

## 2.4. The effects of mitigation

Consider first the effects of the emission taxes on employment by industry. When employment growth rates for the UK in the mitigation scenario are compared with rates in the base case, the most important change occurs for electricity. In the base case, employment in this industry contracts by 18.85%. In the mitigation scenario, the contraction increases to 45.81%. Significant declines in employment also occur for oil and gas (-52.46% to -66.62%), basic metals (-33.48% to -44.30%), water transport (-6.67% to -14.28%) and coal (-30.05% to -39.30%). As might have been anticipated, these five industries have the highest adjusted emission intensities.

The industries which benefit the most from mitigation in terms of employment are wood and paper, motor vehicles, insurance, banking and finance and public administration and defence. Four of these industries appear at the bottom of the intensities ranking, the odd one out being motor vehicles.

The effect of mitigation on industry employment can be largely understood in terms of the emission intensities of industry employment. However, employment taxes are levied against emission levels rather than emission intensities. Further, from equation 2 in Section 2.3, the changes $p1_i$, in tax-exclusive wage rate contribute to changes $p2_i$ in the tax-inclusive wage rate, as well as changes $t_i$ in the tax itself. Since it is the tax-inclusive wage rates that determine the redistribution of employment between industries, the ranking of changes in employment does not reproduce the ranking of emission intensities precisely.

The emission intensities are assumed to remain constant from 2009 to 2020; the change in emissions for each industry over the period is given by the relevant employment growth rate. In the base case, aggregate emissions fall by 6.03%. The effect of the taxes is to increase this reduction to 11.59%. In 2020, emissions are 5.92% smaller in the mitigation scenario than they are in the base case. The industry contributions to this difference are dominated by electricity, which accounts for 3.53 percentage points (or 59.55%) of the total reduction of 5.92%.

As some workers belonging to a particular occupation tend to be employed in industries which expand while others are employed in industries which contract, imposition of the tax has comparatively little impact on the distribution of employment across occupations; the relative growth rates in the mitigation scenario are quite similar to those for the base case. The occupations most affected are the ones for which employment is relatively concentrated in single industries and so less exposed to the averaging process: occupation 17, skilled agricultural and fishery workers, suffers the largest fall in employment (namely, a fall of 1.40 percentage points from -4.79% in the base case to -6.19% in the mitigation scenario) because two thirds of its employment is provided by the single industry agriculture. Similarly, occupation 1, armed forces, enjoys the largest increase of 1.73 percentage points because more than 90% of its workers are employed in the single industry public administration and defence. Note that the industry electricity, for which the change in employment of -26.96 percentage points is larger than that of any other industry, does not play any significant role in determining occupation rankings as it supplies no more than about 1% of employment for any of the 27 occupations.

In Table 2.2, employment by occupation in the base-case and mitigation scenarios are compared for the final year 2020 of the period under consideration. Three of the occupations which suffer the largest reduction in employment due to mitigation, 24 drivers and mobile plant operators, 23 machine operators and assemblers and 22 stationary plant and related operators, also appear at the top of the ranking in column 4 of Table 2.1; they have the highest emission intensities. Similarly, occupations 1, armed forces, and 2, legislative and senior officials, which enjoy the largest increase in employment, also appear near the bottom of the ranking in Table 2.1. However, the correspondence between the two rankings is otherwise quite arbitrary. For example, occupation 17, skilled agricultural and fishery workers, with the largest fall in employment, ranks only 11 with respect to emission intensity. Similarly, occupation 19, metal, machinery and related trades workers, ranks 5 on emission intensity but 22 on employment.

Table 2.2. **Employment by occupation, UK, 2020**

| Code | Occupation | (1) | (2) | (3) | (4) |
|---|---|---|---|---|---|
| | | Employment (persons) | | Change in employment (%) | Rank |
| | | Base case | Mitigation | | |
| 1 | Armed forces | 31 343 | 32 401 | 3.38 | 27 |
| 2 | Legislators and senior officials | 35 127 | 35 936 | 2.31 | 26 |
| 3 | Corporate managers | 3 912 781 | 3 911 646 | -0.03 | 13 |
| 4 | Managers of small enterprises | 1 162 209 | 1 162 179 | 0.00 | 15 |
| 5 | Physical, mathematical and engineering science professionals | 1 144 779 | 1 147 176 | 0.21 | 19 |
| 6 | Life science and health professionals | 566 434 | 564 446 | -0.35 | 5 |
| 7 | Teaching professionals | 1 103 303 | 1 110 537 | 0.66 | 24 |
| 8 | Other professionals | 1 918 894 | 1 918 091 | -0.04 | 12 |
| 9 | Physical and engineering science associate professionals | 762 538 | 762 157 | -0.05 | 11 |
| 10 | Life science and health associate professionals | 895 198 | 892 959 | -0.25 | 6 |
| 11 | Teaching associate professionals | 282 439 | 281 839 | -0.21 | 8 |
| 12 | Other associate professionals | 3 217 417 | 3 217 861 | 0.01 | 16 |
| 13 | Office clerks | 2 634 253 | 2 647 264 | 0.49 | 23 |
| 14 | Customer services clerks | 935 287 | 934 338 | -0.10 | 10 |
| 15 | Personal and protective services workers | 3 718 365 | 3 709 177 | -0.25 | 7 |
| 16 | Models, salespersons and demonstrators | 1 955 543 | 1 960 040 | 0.23 | 20 |
| 17 | Skilled agricultural and fishery workers | 365 800 | 360 419 | -1.47 | 1 |
| 18 | Extraction and building trades workers | 1 504 689 | 1 508 926 | 0.28 | 21 |
| 19 | Metal, machinery and related trades workers | 630 823 | 633 891 | 0.49 | 22 |
| 20 | Precision, handicraft, craft printing and related trades workers | 70 839 | 72 242 | 1.98 | 25 |
| 21 | Other craft and related trades workers | 117 991 | 117 985 | 0.00 | 14 |
| 22 | Stationary plant and related operators | 154 053 | 153 508 | -0.35 | 4 |
| 23 | Machine operators and assemblers | 520 789 | 516 567 | -0.81 | 3 |
| 24 | Drivers and mobile plant operators | 1 271 055 | 1 260 477 | -0.83 | 2 |
| 25 | Sales and services elementary occupations | 2 225 239 | 2 226 487 | 0.06 | 17 |
| 26 | Agricultural, fishery and related labourers | 53 599 | 53 660 | 0.11 | 18 |
| 27 | Labourers in mining, construction, manufacturing and transport | 1 274 046 | 1 272 621 | -0.11 | 9 |
| 28 | All occupations | 32 464 844 | 32 464 846 | 0.00 | |

*Source*: Meagher et al., 2014.

Table 2.3. **Wage rates by occupation, UK**

| Code | Occupation | (1) | (2) | (3) | (4) |
|---|---|---|---|---|---|
| | | Wage rate growth 2009-20 (%, per annum) | | Change in wage rate 2020 | |
| | | Base case | Mitigation | (%) | Rank |
| 1 | Armed forces | -9.69 | -9.79 | -1.14 | 11 |
| 2 | Legislators and senior officials | -7.59 | -7.57 | 0.20 | 22 |
| 3 | Corporate managers | 2.80 | 2.78 | -0.23 | 18 |
| 4 | Managers of small enterprises | 3.88 | 3.84 | -0.40 | 16 |
| 5 | Physical, mathematical and engineering science professionals | -0.05 | 0.00 | 0.59 | 23 |
| 6 | Life science and health professionals | 5.05 | 4.84 | -2.17 | 6 |
| 7 | Teaching professionals | -3.07 | -2.98 | 1.06 | 25 |
| 8 | Other professionals | 4.55 | 4.42 | -1.30 | 9 |
| 9 | Physical and engineering science associate professionals | 2.10 | 2.10 | -0.03 | 19 |
| 10 | Life science and health associate professionals | -0.26 | -0.25 | 0.15 | 21 |
| 11 | Teaching associate professionals | 7.98 | 7.55 | -4.28 | 2 |
| 12 | Other associate professionals | 8.52 | 8.07 | -4.47 | 1 |
| 13 | Office clerks | -0.36 | -0.21 | 1.70 | 27 |
| 14 | Customer services clerks | 3.33 | 3.30 | -0.36 | 17 |
| 15 | Personal and protective services workers | 3.78 | 3.71 | -0.73 | 12 |
| 16 | Models, salespersons and demonstrators | 6.97 | 6.79 | -1.85 | 8 |
| 17 | Skilled agricultural and fishery workers | 3.97 | 3.77 | -2.13 | 7 |
| 18 | Extraction and building trades workers | 4.86 | 4.82 | -0.48 | 15 |
| 19 | Metal, machinery and related trades workers | -2.95 | -2.90 | 0.61 | 24 |
| 20 | Precision, handicraft, craft printing and related trades workers | -6.37 | -6.27 | 1.16 | 26 |
| 21 | Other craft and related trades workers | -1.10 | -1.10 | 0.06 | 20 |
| 22 | Stationary plant and related operators | 4.46 | 4.34 | -1.17 | 10 |
| 23 | Machine operators and assemblers | 4.08 | 3.84 | -2.55 | 5 |
| 24 | Drivers and mobile plant operators | 6.58 | 6.20 | -3.76 | 4 |
| 25 | Sales and services elementary occupations | 5.10 | 5.04 | -0.56 | 14 |
| 26 | Agricultural, fishery and related labourers | -5.19 | -5.25 | -0.65 | 13 |
| 27 | Labourers in mining, construction, manufacturing and transport | 8.50 | 8.08 | -4.10 | 3 |
| 28 | All occupations | 4.14 | 4.14 | 0.00 | |

*Source*: Meagher et al., 2014.

More generally, if the occupations identified in the Cedefop forecasts are allocated a 'greenness' property defined in terms of emission intensity, the allocation broadly fails to predict whether employment in an occupation will expand or contract when an emission reduction policy is introduced. Evidently, 'greenness' should not be regarded as an intrinsic property of a job, but as a property that depends on the role played by the job as the economy adjusts to the policy under consideration.

Table 2.3, shows the effects of mitigation on the market-clearing wage rates by occupation. Just as with employment growth, rates by occupation are quite similar for the base-case and mitigation scenarios; so too are the growth rates for wages in columns 1 and 2 of Table 2.3. Column 3 shows the changes in wage rates in 2020 required to clear the labour markets when the mitigation policy is introduced. For occupation 12, other associate professionals, a fall in the wage rate of 4.47% was required; the mitigation policy resulted in a tendency towards excess supply of the occupation, larger than that for any other occupation. Positive (negative) change in column 3 generally indicates that mitigation induces a tendency towards excess demand (excess supply) for the occupation, and the larger the change in the wage rate, the more pronounced is the tendency. In other words, the ranking in column 4 indicates which occupations should be targeted if training resources were to be reallocated to support of the mitigation policy.

Note that, in Table 2.3, the magnitude of the wage rate changes reflects the magnitudes assigned to the elasticities of substitution and transformation between occupations. The higher the elasticities, the easier it is to switch between occupations and the smaller are the wage rate changes required to clear the markets. While the qualitative policy implications of the analysis should be robust to changes in the elasticities, a systematic analysis of the sensitivity of the MLME results to such changes is clearly desirable. Such analysis is planned for future work but, in the meantime, it would be unwise to interpret the wage rate results as unconditional forecasts.

## 2.5. Concluding remarks

This paper has described an application of the MLME to the E3ME macroeconometric model of the European economy. The general purpose of the extension is to elucidate structural pressures in the markets for labour that are implicit in the E3ME projections. Here, it has been used to show that such structural pressures may negate the efficacy of environmental policies that are driven by plausible notions concerning ‘green jobs’.

The extension is based on CGE modelling techniques and its strength lies in its capacity to take into account available information on the structural links between industries, occupations and skills. It also involves parameters, such as elasticities of substitution and transformation, for which data are less readily available, and values for which must be imposed as a matter of judgment. However, the uncertainties associated with such judgements are likely to be minor when compared to the unspecified assumptions required to apply policy in an economy-wide context without the benefit of a formal model.

The particular policy initiative modelled in the paper involves the imposition of taxes on employment by industry. The purpose of the policy is just to redistribute employment from industries responsible for large amounts of pollution to industries responsible for smaller amounts. Its purpose is an exercise in economic analysis and it is not being put forward for consideration as a practical way to reduce emissions. However, as it happens, a practical analysis has recently been undertaken by Cedefop (2013), based in part on new projections using the E3ME model. It would be of some interest to use the projections from this study to drive MLME simulations of the kind considered here.

## 2.6. Abbreviations

| | |
|---|---|
| **CGE** | computable general equilibrium |
| **E3ME** | energy-environment-economy model of Europe (multisectoral macroeconomic model) |
| **MLME** | Monash labour market extension |
| **R&D** | research and development |
| **UK** | United Kingdom |
| **UNEP** | United Nations environment programme |
| **WLME** | Warwick labour market extension |

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(URLs accessed 16.10.2014)


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CHAPTER 3

# Assessment of life-cycle skills and training needs in the renewable and energy efficiency sectors: wind energy, electric mobility, and smart grids sectors

**Ana Cláudia Valente, Ana Rita Domingues, Cândida Soares, Gabriela Prata Dias, Irene Correa, Peter van den Bossche** and **Tomás B. Ramos**

This paper analyses the results of a project developed with the support of the European Commission, Directorate General for Employment Social Affairs and Inclusion, which comprises a short study detailing the assessment of the skills, qualifications and training needs within the wind energy, electric mobility and smart grid sectors. The final results of the project include exchange of best practices and strategic recommendations for policy-makers for training developments as anticipation of relevant factors in the future.

## 3.1. Introduction

The aim of the project is to assess the specific lack of skills, qualifications, training and/or retraining opportunities in the wind and e-mobility sectors. Barriers to their development are also analysed. Attention is paid to vocational training centres and their role on anticipating training and skills gaps. Low skilled, older workers and gender aspects are the focus of specific analysis, to help understand the effect of restructuring caused by transformation into a green economy on these specific groups.

Wind energy is a mature sector and Europe is a global leader in terms of both installed capacity and manufacturing capacity; the sector has significant levels of employment, and shows trends in skills and qualifications. Currently there is extensive construction of wind farms and it is expected that, in 10 years, focus will be on operation and maintenance, as well as employment in decommissioning and renovation. Specific skills are needed, while others will be significantly less demanded or exported.

Electric mobility is less mature industry but one with great expectations for its development. Europe is pursuing leadership in this area, mostly through Member State initiatives. Solid advancement at industrial level is taking place and development in related services is expected to follow the same pace.

According to the European Commission recommendation (2012/148/EU) 'smart grids mark a new development on the path towards greater consumer empowerment, greater integration of renewable energy sources into the grid and higher energy efficiency and make a considerable contribution to reducing greenhouse gas emissions and to job creation and technological development in the Union' (European Commission, 2012, p. 9). Distribution system operators are currently shaping their activities in Europe towards the full roll-out of smart meters and integrating decentralised renewable energy power generation and new forms of electricity storage (such as in electric vehicles).

## 3.2. Technology description for assessing jobs and skills

### 3.2.1. Wind power

Wind is a renewable energy source and can be used by turbines which transform the kinetic energy of the wind into electricity. Wind energy is the fastest growing source of global electricity generation, accounting for about 280 GW (gigawatt) worldwide in 2012 (Frankfurt School, UNEP Centre/BNEF, 2013). Wind turbines, are composed of a rotor with blades, a nacelle and a tower. The wind makes the turbine blades turn and, in consequence, a shaft to spin, connected to a generator that produces the electricity. Large turbines can be grouped together to form a wind power plant, which feeds energy to the electricity transmission grid. Electricity can be generated when wind speeds exceed 13 kilometres per hour (km/h) and most large wind turbines shut down for safety reasons when wind speeds exceed about 90 km/h.

Wind turbines can be installed onshore (on land) or offshore (at sea, not far from the coast), taking advantage of the best wind conditions. Operation and maintenance costs are significantly higher in offshore situations. The countries with the most installed wind power generation capacity worldwide in 2012 were China (75 564 MW (megawatt)), the US (60 007 MW), Germany (31 332 MW) and Spain (22 796 MW) (GWEC, 2013). There are currently about a dozen wind turbine manufacturers in the world, mainly producing in Europe, Asia and America.

Grid connection of wind farms might be an issue as wind resources are often located in remote or sensitive areas, far from the existing electricity grid and consumption centres. The potential synergies between the variability and intermittency of wind generation and the availability of large scale storage at hydrogen are a good solution to avoid supply curtailment.

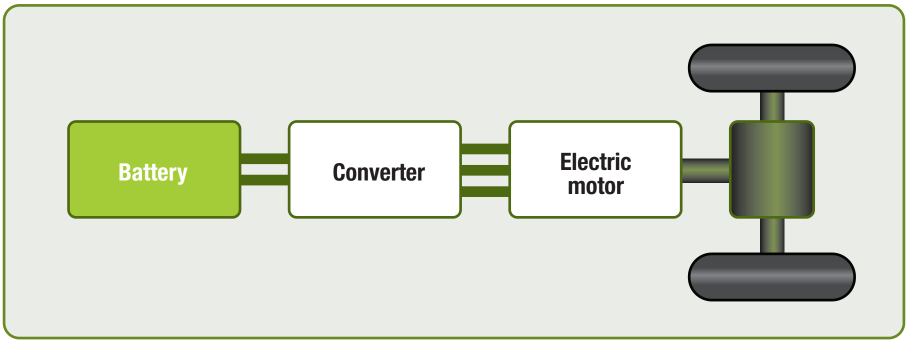
The development of a wind farm has impacts on employment in its different phases. First is production of the rotor blades, the nacelle with incorporated mechatronics, and the steel or concrete tower at the manufacturing plant. Then, special shipments of wind turbine components have to be organised to the place of installation of the wind farm, either onshore (using large trucks) or offshore (using large trucks and boats).

Field research is needed, before installation, on environmental impact assessment studies, wind studies, civil works and electrical works planning. The wind farm installation includes the preparation of the field with pathways and roads, wind turbine foundations and electricity grid extension and substations construction. As soon as the installation is ready, commissioning takes place and the wind farm is taken care of by operation and maintenance personnel.

### 3.2.2. Electrically propelled vehicles

Electrically propelled vehicles encompass both battery-electrics and hybrids. The drive train of a battery-electric vehicle can be represented as in Figure 3.1.

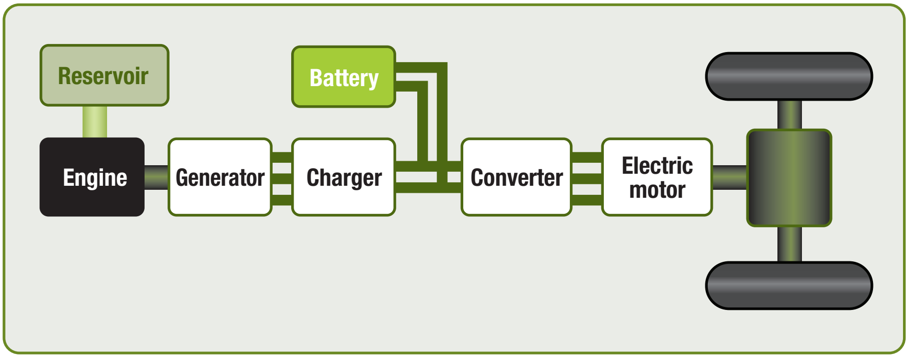
Figure 3.1. **Battery-electric drive train**




*Source:* Authors.

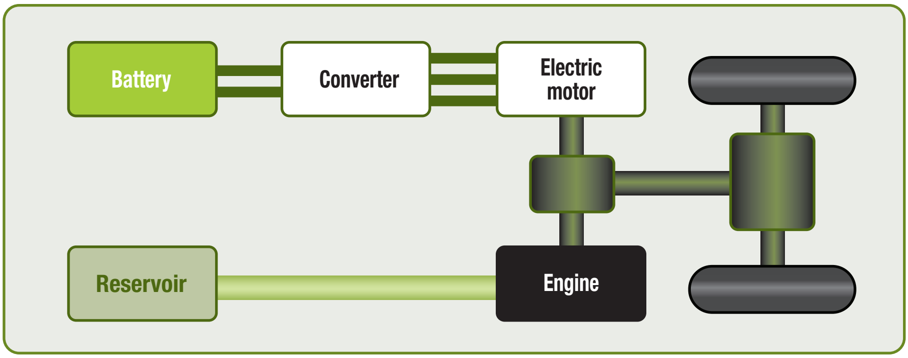
Hybrid vehicles combine several energy sources and can be designed in various drive train ([5]) topologies: series hybrid (Figure 3.2), where the wheels are driven by the electric motor only; parallel hybrid (Figure 3.3), where both motors are mechanically coupled to the wheels; and combined hybrid (Figure 3.4) uniting both systems. The energy source in the hybrid can be an internal combustion engine driving a generator, or a fuel cell, which produces electric energy through an electrochemical reaction.

Figure 3.2. **Series hybrid**




*Source:* Authors.

Figure 3.3. **Parallel hybrid**




*Source:* Authors.

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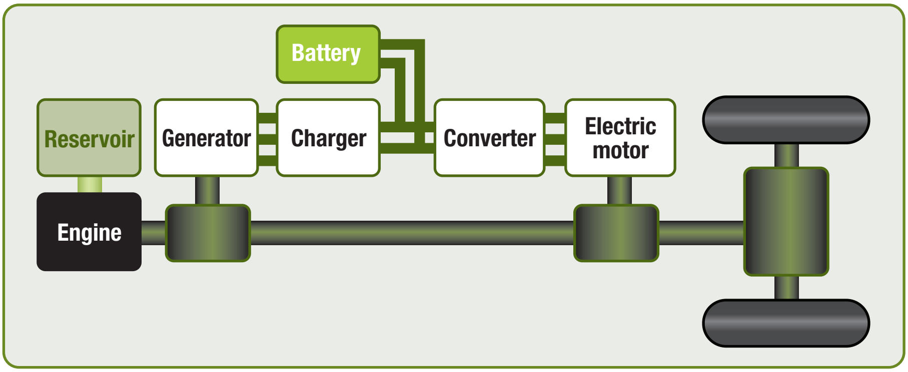
([5]) The 'drive train', in the framework of this text, is the line of components responsible for propelling the vehicle, as in battery – converter – electric motor – transmission – wheels, or other configurations for hybrids.

PREVIOUS CONTENTS NEXT



Figure 3.4. **Combined hybrid**




*Source:* Authors.

The rechargeable energy storage system (RESS), typically a battery, stores the energy needed for vehicle propulsion. Significant improvements in battery technology have allowed the emergence of performant road-going battery electric vehicles, particularly lithium-ion batteries where energy and power densities are significantly higher than for lead-acid or alkaline nickel-based batteries available in the past. Vehicle range has expanded, more energy being stored in the same weight of battery. However, the term 'lithium-ion' represents a whole family of lithium-based chemistries (including lithium iron phosphate, lithium-nickel-manganese-cobalt oxide, and lithium titanate) each with different properties and performance, lifetime and cost. Further, battery cells can be optimised for high energy performance (for long range) or high power performance (for acceleration and climbing), the latter being very interesting for hybrid vehicles. Besides batteries, electrical double-layer capacitors (commonly known as super capacitors) are used as energy storage devices with particularly high power performances.

Today's electric motors are mostly alternating current machines, which removes the complexity and maintenance needs of brushed direct current variants. Feeding an alternating current motor from a direct current source such as a battery is done through power electronic converters; the development of efficient and economic power electronics has made the breakthrough of the alternating current motor for traction possible. The type of motors used are often permanent magnet synchronous motors, due to their high efficiency; other types, such as asynchronous or switched reluctance motors, are also used.

One main advantage of the electric motor is that it is reversible: during deceleration, braking or downhill driving, it acts as a generator, sending current back to the battery. This regenerative braking feature allows substantial energy savings, particularly in dynamic driving conditions.

Battery-electric and plug-in hybrid vehicles replenish their energy from the electric grid and make use of different charging infrastructure options: overnight residential charging at a power of a few kilowatts; opportunity charging at public stations; and fast charging stations for the occasional high power charging boost. Wireless power transfer systems are being developed, obviating the need for cables and plugs. The deployment of charging infrastructure ultimately needs international standardisation efforts, allowing the development of an electric mobility network where users can charge safely and conveniently.

The introduction of electric traction will necessitate the deployment of new skills in the automotive world, in both production and maintenance functions.

### 3.2.3. Smart grids

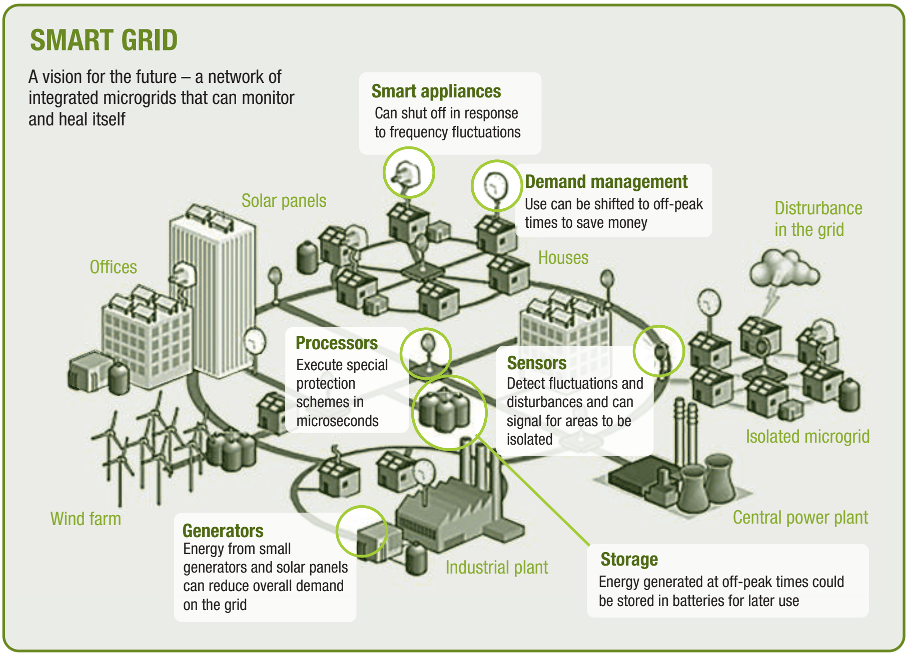
Smart grids represent the new way of managing electricity grids in a low-carbon economy, optimising the use of existing infrastructure through regulation of power flows to meet peak demand, accommodating new volumes of decentralised energy, and improving energy efficiency by managing the consumption patterns of new and existing users connected to the grid (WEC, 2012).

Smart grids include use remote sensors, advanced meters and computer-based controls that are connected to integrated communication networks. They help electricity customers better manage their consumption and distribution system operators better manage the electrical supply infrastructure. (WEC, 2012).

With the dissemination of decentralised energy (renewable energies, storage and combined heat and power), every consumer can virtually become an electricity producer, with the capacity to export to the grid excess electricity. Smart grids have to accommodate to this new way of operating the electricity market.

The introduction of new technological devices into the market is converting the traditional one-directional power grid management into a fully interconnected network (WEC, 2012). Examples include: smart appliances which can shut off in response to frequency fluctuations; electricity storage to be used later; electric vehicles which could work as consumers or suppliers of electricity; and every consumer’s being able to manage energy consumption better, shifting to off-peak times to save money (WEC, 2012).

Figure 3.5. **Vision of a smart grid power system**




*Source:* WEC, 2012, p. 3.

New jobs and skills associated with the introduction of smart grids are deeply related to new skills in IT (information technology), computing and communications. However, decentralised generation also brings into play relevant electricity skills associated with the installation and operation of such equipment.

## 3.3. Project method

As a first stage, a literature review on green jobs and training needs in the renewable energy and energy efficiency sectors was conducted, specifically on wind energy, new vehicle technologies and smart grids. The material collected was analysed using a qualitative content approach, developed according to the methodological recommendations of Bardin (1994), Krippendorff (2004) and Neuendorf (2002). There are many advantages to this method, such as transparency and flexibility (Bryman, 2008).

Case study research to collect data from each country used interviews and focus group discussions with stakeholders. Interviewees were selected to maximise representativeness of the different actors engaged in the targeted sectors: technology providers, manufacturers, local authorities, academia, social partnerships, and non-governmental organisations were included. The interviews comprised general introduction and background, the current state of the sector, and future perspectives and recommendations. In each partner country (Portugal, Belgium and Spain) 10-15 interviews were conducted. Three missions with local site visit were also organised for exchange of good practice, as well as for discussion of new challenges and recommendations.

The skills, qualifications, training and retraining needs related to the energy sectors analysed was supported by a cradle-to-grave approach: the different phases of planning, manufacturing, construction, operation, maintenance and decommission of technologies.

## 3.4. Literature review

### 3.4.1. Background and context

Recent years have shown an increased concern with the environmental impacts of products and activities, which compromise the sustainable use and conservation of ecosystems. It is necessary to reduce these impacts and so workers are needed with skills that enable activities with environmental benefits, as well as reflecting economic and social gains. These types of occupations are often called 'green jobs'. They can be summarised as any job that directly or indirectly contributes to reduction of negative environmental impacts, including emissions and fossil fuel savings.

Green jobs can include the production of heat and power from renewable energies, or the increase of energy efficiency. For example, renewable energy jobs can be classified into jobs related to fuel-free technologies, such as wind power and solar photovoltaics (IRENA, 2011).

### 3.4.2. Green jobs in the energy sector

Renewable energy generates more jobs per unit of energy delivered (per average MW) than the fossil fuel-based sector (Wei et al., 2013; WWF, 2009; Sustainlabour, 2009; Kammen et al., 2004; Engel and Kammen, 2009; Renner et al., 2000). Cost-effective energy-efficiency investments also offer more jobs than the fuel-based sector, due to money saved which is then free to be spent in other sectors of the economy that are more labour-intensive (WWF, 2009).

Even apart from the context of the economic crisis, in recent years in Europe the main job losses have been due to rising automation, restructuring, and outsourcing. Climate policy in general is not responsible for these losses (WWF, 2009, p. 8). An investment in reskilling and re-education of the workers is required in this transition period of job losses (UNEP, 2011, p. 5). According to Martinez-Fernandez et al., ‘jobs will be lost in carbon-intensive sectors […] new jobs are expected to be created in low-carbon sectors, which tend to be more labour-intensive than conventional sectors (Martinez-Fernandez et al., 2010, p. 19). At the same time, the carbon-intensive sector will undergo job shifts (WWF, 2009, p. 6).

Different technologies are related to different types of job. This clear change of economic pattern creates a quest for new skills and occupations. New employment opportunities will appear but advance training of workers is necessary to respond to demand (Sustainlabour and UNEP, 2008).

### 3.4.3. Wind energy sector

Manufacturers and component suppliers are generally the main employers in wind energy (EWEA, 2009a); (Blanco and Rodrigues, 2009); (ESD, 2004); (Singh and Fehrs, 2001), followed by service companies and project developers (Blanco and Rodrigues, 2009). Public policy incentives in Europe have contributed to making the region a pioneer in the wind energy industry (EREC and Greenpeace, 2009), as can be seen in Germany, Spain and Portugal, where wind farms were developed and manufacturing capacities deployed.

This sector demands highly qualified workers (university degrees and dedicated vocational training) for certain phases of project developments, which are beyond the average qualifications of the European workforce (Sustainlabour, 2012; UNEP, 2008). However, jobs that need university degrees do not represent the main workforce in the wind energy sector; this differs from other renewable and green industries such as thermal solar, photovoltaics (Sastresa et al., 2010) and smart grid fields where they represent the majority of the workforce.

### 3.4.4. New vehicle technologies and smart grids

New electrically propelled vehicle technologies, developed mainly by the automotive industry, demand new skills to develop efficient new systems. Current progress in new technologies leads to need for nickel and lithium battery development, with associated employment gains. According to Renner et al. (2008), 150 000 jobs in manufacturing green vehicles are expected to be created in the European Union (EU), though the author does not specify the time horizon for this achievement.

The environmental impacts of the European car industry can be reduced and jobs can be created with the specification of carbon emission standards and related policies for a low-carbon industry. These 'require a […] conversion of auto industry capacities and job skills; and a strategic commitment to a smart grid and other forms of public infrastructure' (WWF, 2009, p. 28).

A smart grid is considered a long-term investment to increase efficiency and reduce energy use that could generate jobs both in direct utility and investments in infrastructure equipment manufacturing (Engel and Kammen, 2009, p. 16). Smart grids are crucial to deal with the intermittent flow of energy from renewable sources (Pollin et al., 2009, p. 17). According to Pollin et al. (2009, p. 28), in the US for every USD 1 million investment in the various industries associated with smart grids, 4.3 direct jobs and 4.6 indirect jobs are created. These jobs require higher qualifications such as university degrees.

### 3.4.5. Women in clean technologies

Manufacturing (Pollin et al., 2009; IRENA, 2011; EWEA, 2009b) and construction (IRENA, 2011) represent the largest share of wind energy workforce. This fact affects the gender balance of wind energy employees because these areas employ a higher proportion of men (Sustainlabour, 2012; ILO, 2001; Blanco and Rodrigues, 2009; EWEA, 2009b).

Women represent less than 30% of the renewable energy sector: 23.6% in Germany (ILO, 2011) and 26.6% in Spain (Sustainlabour, 2012). Further, sectors such as engineering, financial and business services (the better paid jobs) are dominated by men (Sustainlabour, 2009). Where women are employed in the renewables industries it is in lower-skilled positions and dominated by administration occupations (Sustainlabour, 2012).

### 3.4.6. Skills and training needs

Most employment in renewable energy sectors is offered on a long-term contract (83.7%); this is particularly the case in Germany and Spain (Sustainlabour, 2012). Temporary contracts make up 14.1% of employment, followed by contracts for training/internships (0.9%) and freelance contracts (1.2%) (Sustainlabour, 2012). Nevertheless, the share of temporary jobs among subcontractors may be higher (UNEP, 2008).

The renewable energy sector will continue to expand, so workers have to enrol in training to update their capacities and develop new ones. If not planned in advance, this economic adjustment may cause structural unemployment

(OECD, 2012). The new green jobs have to be decent jobs with rewarding wages, career prospects, job security, occupational health and safety and worker rights (Renner et al., 2008); (Martinez-Fernandez et al., 2010).

In 2007, in the EU-27 there were 108 600 direct jobs in wind energy; 37% were related to wind turbine manufacturing, 22% to component manufacture, 16% to wind farm development, 11% to installation, operation and maintenance (O&M), 9% to IPP/utilities, 3% to consultants, 1% to R&D/universities, 0.3% to financial, and 0.7% to others (EWEA, 2009a). Lack of skills for project managers or engineers might be less noted than O&M technicians. More current detailed figures were not available at the time of this project.

Table 3.1. **Lack of skills in wind energy sector**

| Study | Skills needed/lack of skills |
|---|---|
| **Blanco and Rodrigues, 2009** | Project managers, engineers and O&M technicians |
| **EWEA, 2009b** | Project managers, engineers, O&M technicians and site managers |
| **EWEA, 2009a** | Engineers, O&M technicians and site managers |
| **Boettcher et al., 2008** | Project managers, electrical engineers, turbine technicians |

*Source*: Authors.

According to EWEA (2009a), the number of engineers graduating from European universities is not sufficient to meet the needs of the energy sector in Europe, including wind energy. Boettcher et al. (2008) also argued that new graduates do not satisfy the demand for some skills, and that usually companies need to invest in additional training and human resources processes to develop these capabilities and experience in their staff. In the UK wind industry (p. 11), 'employment and skills supply is expected to become more critical over time' (p. 8).

## 3.5. Interview, focus group and site visit results

Historically, the EU has been a front-runner in renewable energy development, as well as in energy efficiency policy implementation. Since about 30 years ago, first with the Delors Commission coordinating Europe, then with the first

Rio Conference in 1992 and finally the Kyoto protocol, the EU has been able to address new themes such as biodiversity, atmosphere and oceans. However, it was only in the first decade of this century that the first quantitative targets for renewable energies were put in place, through the renewable energies directives (2001/77/EC and consequently 2009/28/EC, European Parliament and Council of the EU, 2001; 2009).

Renewable energy and energy efficiency sectors developed fast, mostly due to the effects of public policies implemented in European Member States. Yet, the financial crisis of 2008 and the consequent economic crisis in Europe have not favoured new investments and unemployment has soared. Existing companies have either stabilised and stopped creating jobs (or even decreased) or have turned their activity towards export markets for services and goods.

In countries with financial intervention such as Portugal, and to some extent Spain, the development of new major energy projects is conditioned by the consolidation of national public accounting. Few small-scale demonstration projects are seen in these European countries, with most of the labour force skills used to target exporting goods and services, supplying the parts of the world not suffering from the economic crisis (such as Brazil, China, India, Mexico, Peru, South Africa), which are continuing to invest.

Portugal has already achieved 50% energy supply from renewable energy sources in the first quarter of 2013, mostly based on wind and hydro energy, and consequently reducing energy dependence from imports. Wind energy developments in the country now have little scope for development; however, solar energy still has an enormous potential growth, virtually in every home.

Wind energy is a relatively new industry, still relying much on manpower rather than on automation, at least in the manufacturing of equipment phase. However, as industry managers point out, automation will be soon taking over much of the labour still done manually.

The interviews generally suggested that the education system was responsive to the sectors' past development, with universities launching graduate and postgraduate degrees in these areas. Some university research teams have been very active in joint programmes with industry.

The conclusion from the interviews is that existing qualifications and skills match the current needs of these sectors. Universities are having an active role in education and research in the areas of energy efficiency, renewables and e-mobility. Due to insufficient job creation it is expected that a significant number of graduates and researchers will try to go abroad.

Although high-level education in this field of work is largely available, the labour market still lacks medium-level and operational manpower. These are jobs that do require not academic training but solid technical skills, in areas that can potentially create jobs. There is a need to develop systematic and continuous training in project design, instrumentation, control and ICT and in close relationship with the industry.

The interviews highlighted that energy efficiency should be the top priority for energy policy in Europe, attracting investments at three different levels: processes, systems and devices. For example, at city level, efficiency of transport vehicles is essential but also the design of transportation routes and of the city itself. Action at all three levels will require a combination of regulation, economic incentives and training and education.

Capacities to integrate and redesign electricity grids to accommodate all technologies and energy sources will be critical. High level competences for the convergence of information technologies and green technologies will be essential to integration of renewable energies, electric vehicles and smart grids.

The EU is promoting the rollout of smart meters and, consequently, smart grids. Although some products are already in the market, there is still opportunity for improvement and increased performance capacity from the R&D activities. However, new products and services face difficulty in the market. These items are typically mass-market products, to be installed by virtually every electricity consumer, and so there is a need for commercial investors to bring such products to market. Appropriate companies would typically offer large manufacturing capacity and extensive consumer reach.

The expansion of smart metering is bringing the need for jobs and skills associated with the production of such materials. For distribution system operators, smart meter training is needed, so a labour force with IT skills is becoming a top priority. Concerns were expressed over the speed of deployment of smart meters: if the rollout of these products is very fast, retraining will not be able to keep pace with workers affected as meter reader posts are reduced.

Currently there is still a need for high-level skills in engineering, but combining competence in IT/telecommunications and electrical engineering, as required for smart grids.

Electricity storage is also an area where further research is urgently needed, to meet consumer needs, the increasing penetration of renewables, and the inherent intermittency of renewable generation. Work at R&D level is necessary to improve the performance of electric vehicle batteries and develop prototypes for vans, trucks and buses with electric propulsion.

Automotive industry training centres have several types of professional profiles for risks associated with working on an electric vehicle. Such vehicles have their specific complexity in technology terms, accompanied by new hazards associated with using, repairing or just moving the vehicles.

## 3.6. Recommendations

Based on observations from the exercise, the project team develops the following recommendations.

**Recommendation 1**

National public policy programmes are welcome by the wind industry to support the development and cooperation between companies and academia, to train, recognise and certify competences at medium level. Electricians, machinery operators, project design, instrumentation and control, IT systems and languages spoken are subjects to be developed.

National plans should also be associated with the European strategy to address the specificities of particular country labour markets. These national plans could be based on the national renewable energy action plans and the national energy efficiency action plans coming out of Directives 2009/28/EC and 2012/27/EU (European Parliament and Council of EU, 2009; 2012) respectively and should include the strategic vision and principles for green jobs in both sectors, for the medium and long term. In addition to the main general target and specific objectives (such as by renewable energy source), the plans should highlight strategic priorities and actions for implementation and the guidelines for follow-up monitoring.

**Recommendation 2**

Although the wind power industry typically relies on internal training inside the company (possibly for patent reasons and/or specific internal procedures), dedicated centres for training professionals are being considered and State financial programmes could be an important incentive for their development and export of competences to Europe and rest of the world. Wind power is a global industry.

**Recommendation 3**

Specific training on energy efficiency at university level, targeted at students of architecture and engineering, would bring better performance at system-level (such as cities) and processes (such as industry). In governance, incentives to encourage behaviour change would also improve the whole efficiency of the systems.

### Recommendation 4

Although electric mobility has high development potential, the industry needs public policies to become more supportive, establishing clear master plans. Public administrations should play a reference role, acting on energy efficiency and supporting companies and organisations to invest in e-mobility. Leading by example does not mean additional investment needs and creates jobs (for example using electric vehicles in public fleets). A common European strategy should also be developed or augmented in further reviews of the European Union strategy for sustainable development.

### Recommendation 5

Using government incentives for the faster uptake of new technologies (renewable energies, energy efficiency and electricity storage) would encourage further R&D work and opportunities, as the industry still lacks mass market standard solutions. Publicly funded programmes and industry partnerships should be envisaged to sustain this, targeting market outreach of commercial applications.

### Recommendation 6

Redesigning electrical engineering university curricula to accommodate multidisciplinary skills combining competence in IT/telecommunications, forecasting systems and electricity advanced knowledge would provide the labour market with better skilled professionals for large-scale deployment of smart grids.

### Recommendation 7

Meter reading functions will tend to disappear with the rollout of smart grids. Retraining opportunities should be considered at industry level to avoid job loss.

### Recommendation 8

Public information campaigns and sectoral organisations should address professionals dealing with auto repairs, emergency responders (firemen) and tow truck drivers, alerting to potential hazards when exposed to electric vehicles. Short training sessions to provide more electrical knowledge for vehicle maintenance personnel, traditionally mechanically inclined, should be developed as part of professional responsibility.

**Recommendation 9**

For users of electric vehicles, daily management of the battery load is an important skill and training on how to use these vehicles is needed. A gender-targeted approach to females has demonstrated that this can assist the acceptance of the technology (at least in Belgium, as shown during the interviews).

## 3.7. Conclusions

The deployment of centralised and decentralised renewable energy (solar photovoltaics and wind) has provoked a good response for training and skills development as a consequence of public policies in Europe. High-level education has evolved significantly over the past two decades and most of the demand has been met at this level. However, industry still highlights lack of certain medium-level qualifications, which should be addressed optimally through a combination of public incentives and industry actions.

Industry places a strong focus on IT qualifications of future staff, with the introduction of smart metering and bi-directional energy flows associated with the deployment of decentralised energy. Intelligent ways of following a consumer profile mean grid design and the ability to deal with large amounts of new information will be important skills in the future.

As a general conclusion both for renewable energy and energy efficiency, there will be a shift of skills to new jobs, increasing the importance of information aggregators, data managers, and digital and electrical hardware manufacturers. To complement this, medium-skilled level professionals will also be in demand for operation, maintenance and decommissioning functions.

## 3.8. Abbreviations

| | |
|---|---|
| **EU** | European Union |
| **IPP** | independent power producer |
| **IT** | information technology |
| **O&M** | operation and maintenance |
| **MW** | megawatt |
| **R&D** | research and development |

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CHAPTER 4

# From $sO_2$lutions to green growth: educational measures integrated with green activities

**Bertil Haack**

In 2007, the author realised that most of the Technical University of Applied Sciences Wildau (TUAS Wildau) programmes did not contain green aspects. This highlighted the question of how to enrich degree-level management education programmes with green issues. In response, a research group called $sO_2$lutions was initiated. One of the research approaches of $sO_2$lutions resulted in the formation of FUX, a company environmental index (*Firmen Umwelt IndeX*) ([6]). One aim of this paper is to set down important findings made at TUAS Wildau from the identification of the original training deficits, the response in the form of $sO_2$lutions, and the creation of FUX. The paper details lessons learned and shows present best practices from this case study as guidance to help pave the way towards successful green growth and sustainability. The question of the practicability of these recommendations will lead us to the sustainability strategy of the Federal State of Brandenburg and the final objective of our work, which is to discuss our proposals in light of the State's policies.

## 4.1. Introduction

In the winter term 2007/08, the author realised that the module 'basics of management' as a part of the bachelor programme 'European management' did not include green aspects, despite the growing importance of these activities in management functions (see e.g. Göllinger, 2006; Smith and Perks, 2010). This was unfortunate because, on one hand, green aspects must

([6]) FUX: Firmen Umwelt Index: *home*: http://www.fux-ev.info [accessed 17.10.2014].

necessarily be part of modern management education and, on the other hand, the module description was firmly defined. Therefore, the question was how to enrich the module with green issues without having to change the module description.

In response, a dialogue with students about this situation was initiated, and a working and research group created to focus on the theme of 'sustainable management'. Eight students and the author founded this working and research group which was named '$sO_2$lutions'. The group of students worked on this as an extracurricular activity. The group members defined a working and research plan and performed the planned activities over the past six years.

One of the research approaches of $sO_2$lutions resulted in the formation of FUX. FUX®, has been assigned to, and developed by, the FUX Club, a community founded by industry representatives including members of the TUAS Wildau. This index provides a form of certification for firm-based eco-oriented behaviour of a company or organisation.

One aim of this paper is to set down important findings made on the way from the original training deficits and the response in the form of $sO_2$lutions and the creation of the FUX®. First, we will see that participation in working groups such as $sO_2$lutions can result in significant positive effects, including the development of team and solutions-based further qualifications in members of the research group (Section 4.2). Second, the paper shows that economic interest is a key driver of ecological actions and not vice versa. It is primarily economic interests that lead to addressing environmental aspects, i.e., it is 'economy before ecology' (Section 4.3).

We will take the lessons learned from the arduous development towards sustainability and green growth as an opportunity to show the other objectives of the present best practices in this case study as a guide (Section 4.4). The question of the practicability of these recommendations will lead us to the sustainability strategy of Brandenburg and the final objective of our work which is to discuss our proposals in light of the State's policies and then to an answer, based on experience, to the question 'how can low-carbon activities be key to competitive and inclusive growth?' (Section 4.5). The final section presents conclusions and an outlook for further work (Section 4.6).

## 4.2. From a training deficit to s$O_2$lutions

Sustainability has been a buzzword for many years (Brundtland Commission, 1987) but it seems that practice has been taken up quite slowly. The business world is dominated by the symbol of 'homo economicus' as a focus for entrepreneurial thinking and actions: demands are for the highest possible profits and short-term increases on returns of investment over long-term asset planning, in addition to the economic capital, the maintenance and increase of ecological and social capital declared as business goals. (Haack et al., 2010).

The Organisation for Economic Cooperation and Development (OECD) with their 'green growth strategy [provides for…] concrete recommendations and measurement tools to support countries' efforts to achieve economic growth and development, while at the same time ensure that natural assets continue to provide the ecosystem services on which our well-being relies' (OECD, 2011). In this sense business goals and green growth can be mutually compatible.

Even more than that, we must ensure that corporate objectives and green growth are reconciled: in the long term it would not be reasonable for the economy to retain only their own programmes instead of having projects, for example, in education, politics, nature conservation or development aid in mind, too. Otherwise, this economy would threaten to engross their environment and would degrade all other plans to be residual programmes or utilities. This view of economy would lead the economy increasingly into a critical situation, so that this economy would deprive them of their own base (Remer, 2006; see also the other contributions to Göllinger, 2006; and compare the study Smith and Perks, 2010).

A main consequence is the importance of management skills in linking business and green economic development and, therefore, the need for green activities to be included in management training.

This situation is also reflected in the bachelor study programme 'European management' of the TUAS Wildau. The curriculum represents a classic view shaped by the image of *homo economicus* of the management of European companies and organisations. So far the programme has no course that deals exclusively with the topic of sustainability or aspects of green growth.

The author has responded to this through his role as a university professor by:

(a) including the aspects of sustainability and green growth in the course 'principles of management' since the winter semester 2007/08;

(b) founding at the same, time together with interested students, the work and research group $sO_2$lutions for environmentally sound management.

By participating in $sO_2$lutions, students have the opportunity to be active in business sustainability. It is specifically stated on the $sO_2$lutions website ([7]): 'we are particularly committed to the area of sustainable and environmentally sound management. Our idea is to make a regional contribution to the environmentally oriented actions.'

The commitment of students within $sO_2$lutions is determined by two main pillars: self-organisation and research-based learning. The members of $sO_2$lutions set the topics and issues which they will specifically deal with themselves. They define and organise the resulting tasks with a high degree of autonomy. To be successful, it is necessary for them to employ the relevant working knowledge, methods and tools independently and to analyse critically the results obtained. The role of the author is merely to give them professional input and suggestions for their work and research tasks to support them as a coach in their activities, and to serve as a contact person for the university management and other programmes and departments.

Let us look at two examples to illustrate this approach.

At the time of the founding of $sO_2$lutions the students were not experts in relation to sustainability. Therefore, they decided that acquiring knowledge for sustainability would be the most important measure to be successful in the future. For this purpose, each of them selected an article from Göllinger (2006), tapped this article for herself or himself, and introduced the findings to the other members of $sO_2$lutions.

Later, the students produced several project ideas in a brainstorming session and prioritised according to their own criteria: who would have time for a project; what sort of attention was necessary to achieve the project; and what impact the project would have in terms of sustainability. Some results of this approach are the outcomes (a)-(d) described later on in this section.

This type of learning results in the significant success of $sO_2$lutions seen in the personal development of members: students in $sO_2$lutions develop, in comparison to their peers who are not active in this work, additional expertise on sustainability and green growth, and they 'develop capabilities that go beyond knowledge and methodological knowledge – especially autonomy, but also the emotional and social side of learning – skills that are necessary to be

([7]) sO2lutions: *Homepage der studentischen Forschungs- und Arbeitsgruppe sO2lutions [Homepage of student research and working group, sO2lutions]* http://www.so2lutions.de/ [accessed 26.8.2013].

able to deal with later tasks competently and systematically at work' (Hellermann, n.d.). Working in a team like $sO_2$lutions contributes significantly to improving the skills of team members.

Further outcomes from the $sO_2$lutions project since its foundation in 2007, include ([8]):

(a) FUX®: FUX is a two-part tool for assessing the environmental viability of a company or an organisation. 'The FUX® considers on one hand, the environmental behaviour from the company's organisational perspective (Part I FUX) and actively involves the employees (FUX Part II)' (Dülsen et al., 2012);

(b) lectures and publications: in recent years, members of $sO_2$lutions have held numerous presentations at the annual children's and senior citizens' universities of the TUAS Wildau and at the annual long night of sciences (including the $CO_2$ footprint). Publications such as Haack et al. (2010) have also been published;

(c) photograph exhibition: the $sO_2$lutions members have addressed and presented topics highlighting the environmentally sound actions at the TUAS Wildau through a photograph exhibition. This involves, for example, frugal paper consumption, the use of bicycles instead of cars or coffee cups instead of paper cups, as well as the $sO_2$lutions initiated car-pooling project. Students, employees and guests of TUAS Wildau are given suggestions on how to act in an environmentally friendly manner, which turns out to be just as efficient and therefore economically advantageous;

(d) car-pooling: students can place car-sharing offers and requests on a web page on the TUAS Wildau website designed by $sO_2$lutions ([9]). This is intended to support environmentally friendly mobility and contact between students across the borders of programmes and departments.

The current project of $sO_2$lutions is the 'green school', the goal of which is to strengthen cost-and energy-saving solutions at the TUAS Wildau. The focus is not only on technical solutions but also on the promotion of environmentally conscious thinking and action, including poster campaigns, mini-seminars and workshops. The results should be documented with the aid of an annual environmental report. In addition, the FUX award of TUAS Wildau is planned, and the annual development of the $CO_2$ footprint of the university is to be

([8]) $sO_2$lutions: *Homepage der studentischen Forschungs- und Arbeitsgruppe $sO_2$lutions [Homepage of student research and working group, $sO_2$lutions].* http://www.so2lutions.de/ [accessed 26.8.2013].

([9]) $sO_2$lutions: *Mitfahrgelegenheit [Car-pooling].* http://www.th-wildau.de/so2lutions [accessed 26.8.2013].

represented by an artistically designed sculpture on the university campus. Further detail on these initiatives is provided in the following sections.

## 4.3. The company environmental IndeX: FUX®

The idea for a company environmental index was born in a collaboration between $sO_2$lutions and the Regional Association of Westphalia-Lippe. The desire was to make the environmentally oriented behaviour of employees of a company so transparent and documented so that all workers can be involved, for example through contributing towards energy-saving environmental effects.

Environmental awareness, sustainability and green growth are not matters for staff alone: they are also topics for management. The management must feel a responsibility for the environment and provide the framework in which employees have a realistic chance to act in an environmentally responsible manner, and these actions must have the same (financial) recognition. The approaches of $sO_2$lutions to reward the environmentally responsible behaviour of the employees have since been embedded in a larger conceptual framework. The result is the two-part FUX® (Dülsen et al., 2012).

FUX Part I is a checklist which tests and proves the environmental viability of a company or an organisation. The managers responsible have to self-report, for example, on environmentally oriented management, environment-friendly performance or use of resources, with supporting evidence such as documents, work instructions, and protocols, which can then be assessed against a scale. This self-assessment is checked independently and can lead to a FUX award of bronze, silver, gold or platinum. From the gold level award, a business can become a member of the environmental partnership Brandenburg and, as in the case of relevant investment, can rely on special support from the Investment Bank of Brandenburg (ILB) (Dülsen et al., 2012).

FUX Part II is a tool that, with the help of the employees of a company, can voluntarily optimise and document its ‘green behaviour’. This involves answering twelve questions on a monthly basis covering issues on environmentally oriented behaviour in the workplace. Where the answers are positive, the employees get FUX points credited to their respective FUX accounts. The savings achieved through the sustainable management of employees (regarding the energy consumption of a site in operating costs or material consumption) are distributed annually between the employees engaged in FUX and the company or organisation on a 50:50 or other agreed basis. The FUX-points can be converted into bonuses, in-kind benefits or a budget that the employee can use, for example, for pictures or furnishings for the office, as financial contribution to summer or Christmas parties, or for training or skills development or other similar items (Dülsen et al., 2012).

Currently, FUX Part I is in the practice phase and FUX Part II is in the test phase. The FUX distribution is established nationwide with an emphasis in the States of Brandenburg, Bavaria and North Rhine-Westphalia. Four Brandenburg companies are customers or prospective customers of the FUX. Two of these are anticipated to achieve at least the FUX Gold level award, which would mean for their planned investment, for example for a new logistics centre, they would get significant funding from the ILB, which need not be repaid.

The sales experience and the still fairly small number of interested companies on FUX show that sustainability and green growth is not something that can be taken for granted. It takes a special effort to open up companies and organisations to such aspects: better environmental practices and the resulting improvement of image are often not decisive arguments for the management to invest time and money in the FUX. Interest in the environmental award of the FUX® is nearly always exclusively linked to possible economic benefits. Representatives of small and medium enterprises, as the main target group of the FUX, are particularly interested in the environment award if it leads either to increased ILB grants (see above) or to other financial benefits, for example through resource savings, when these are more than the costs of the FUX award. In placing economy before ecology they indicate that economic incentives are often necessary to initiate environmental action.

Examples from other contexts emphasise this result and show that there is no special FUX feature. A company was interested in building a wind farm in Mecklenburg-Vorpommern, with sixteen wind turbines originally planned to enable the wind farm to operate economically. Meanwhile, it became clear that this number of turbines is likely to cause interference with radar systems for air transport and is therefore to be reduced by almost half. The interest of the company to build the wind farm consequently dropped noticeably. There was also disappointment in the lack of support from the local politicians as the wind farm was seen to be a much-needed source of business tax revenue (Rogmann, 2012).

Similarly, economic benefits play an important role for the Berlin housing association Howoge. The association was given an award in 2013 for their innovative heating system based on gas absorption heat pumps. It offers a significant financial benefit to the tenants as the gas consumption for heating and hot water is greatly reduced. Nevertheless, Howoge is also aware of ecological issues and sees the new heating system additionally as a contributor to the sustainability component (Howoge, 2013; 2012).

## 4.4. Lessons learned and best practices

Three key findings highlight the main lessons learned from this activity.

First, the training deficit – lack of orientation of the course 'European management' of the TUAS Wildau – can be reduced by relatively simple measures and that these activities can result in significant positive effects.

The development of a voluntary working group provides a viable option to address the situation. The group not only worked towards addressing the training deficit in a meaningful and relevant way, but also provided the opportunity for further skills development in the working team involved in $sO_2$lutions, significantly improving their qualifications and skills in sustainability and green growth. Further, beneficial results can be expected from teamwork. This brings us to our first finding.

**Lesson learned 1:**
voluntary activities are a useful instrument. Voluntary activities prove, wherever sustainability and green growth is pursued, to be a useful approach. These measures should be self-organised and set as research-based learning.

It is important that the activities are sufficiently focused.

**Lesson learned 2:**
volunteer activities are targeted, that is, aligned to specific content and challenging results. This orientation contributes significantly to the motivation of the participants and ensures that they can produce very good, usable results, such as the FUX®.

The example of the FUX® clearly shows that an intellectually convincing path toward sustainability and green growth alone is not enough to motivate managers and employees of a company to adopt sustainable practices. The experience with the FUX® specifically shows that there must be significant economic benefits before interest in ecological measures is awakened.

**Lesson learned 3:**
willingness to be ecologically active increases with associated economic benefits. Activities towards sustainability and green growth are powered mostly through the financial benefits expected from it.

This brings us to the question of how this knowledge can be put into practice and what are best practices.

We propose two best practices recommendations. The first two lessons learned provide a relatively simple answer:

**Best practice A:**
setting up a voluntary working group and supporting this group through the involvement of key personnel. A responsible person should initiate a voluntary working group such as s$O_2$lutions and support their activities to the extent that the team is capable of autonomous, goal-directed, research-based learning.

This person may be a professor in a university; in a company or other organisation, a leader of this institution can take the appropriate role.

It is essential that volunteers should be motivated, which is why we speak of a 'relatively light' and not a 'light' response. Motivation for participating in the working group may be the opportunity to acquire skills that others do not have and so gain advantages in the competition for a job or on your own career path.

The implementation of the third finding is more difficult as this is much less about volunteering, and so less about whether own, unpaid labour is invested in a topic; it concerns the money provided for specific actions, and so is a highly sensitive issue. We recommend:

**Best practice B:**
ecologically oriented activities are always supported by appropriate financial incentives. Financial support, such as that mentioned above by the ILB investment promotion, 'sweetens' ecologically oriented economic policies, increasing their attractiveness and motivating companies to (greater) economic efforts.

However, this support can only show sustained effect if the appropriate funding is over a sufficiently long period of time. Unfortunately, the funding guidelines of the ILB expired at the end of 2013 and a negative decision on continuing the funding has been made. Our idea to fix the new funding guidelines from 2014 as its predecessor, so that the environmental award from the FUX® Gold level will still involve gaining financial funding, was not 100% successful: politicians decided mainly to reward energy savings and so to focus on a very small part of sustainability. This decision cannot be seen in the context of the observations we have made so far. It requires a broader perspective than the crucial decision-makers took into account. As this decision significantly affects policy decisions, the 'broader perspective' specifically means that we need to deal with the sustainability policy of the State of Brandenburg and the search for possible answers.

## 4.5. The sustainability policy of the State of Brandenburg

In 2010 the State parliament of Brandenburg commissioned the federal State government to develop a sustainable strategy for the State of Brandenburg (Löchtefeld et al., 2013). In response, the State government of Brandenburg 'decided to establish a strategy for sustainable development of the State of Brandenburg. It should give the State of Brandenburg the impetus to improve the living conditions for the next generations. Civil society, business, academia and communities were invited to take part in developing the framework of the strategy. The basis for the dialogue process was agreed on 8 February 2011 in the *Key elements of a strategy for sustainable development of the Land Brandenburg*. The local and regional potentials, the existing problems and not least, the needs and the personal responsibility of people are up for discussion' ([10]).

In the dialogue over the past two years, the following action points were discussed (Nachhaltigkeitsbeirat, 2011):

(a) economy and employment in the capital region Berlin-Brandenburg;
(b) quality of life for sustainable cities and towns;
(c) Brandenburg as a pioneer in the use of energy and climate change;
(d) sustainable fiscal policy;
(e) communicating sustainable development and promoting a sustainable education landscape.

The dialogue and its results were documented in a final report (Löchtefeld et al., 2013), leading to the design of 'national sustainability strategy

([10]) MUGV: *Landesnachhaltigkeitsstrategie [Federal State sustainability strategies]*. http://www.mugv.brandenburg.de/cms/detail.php/bb1.c.281609.de

Brandenburg' [11]. It was decided that the future funding policy of the State of Brandenburg will be linked with the State's sustainable development strategy and will set incentives, mainly for energy savings partly due to the dwindling energy reserves [12].

Our requirements formulated in Section 4.4 for a continuation of broader financial support for environmentally oriented companies through an appropriate funding programme of Brandenburg organised by the ILB thus failed in parts.

However, the expected and previous projects for sustainability and green growth in Brandenburg (e.g. MWE, 2012a; 2012b) allow the conclusion that the State of Brandenburg in the future will be more open to issues of sustainability and development in working towards green growth. This will not only promote the objectives set out in the present paper framework but will clearly exceed them.

For example, the State of Brandenburg was significantly involved with its regional growth core Schönefelder cross, consisting of the cities of Königs Wusterhausen and Wildau and the community Schönefeld, in an OECD project focusing on 'local transition to a low-carbon economy' [13]. With the participation of the author, a critical inventory of the green growth was carried out in one of the most rapidly developing areas of Central Europe and published together with practical recommendations for action in a report (OECD, 2013).

Participation of political leaders in this project was very high. This was partly due to the involvement of senior politicians (at ministerial level) in events within the project, but is also evident in comments by the Mayor of Königs Wusterhausen, who stressed that the importance for him was not the report itself, but the process of exchange. This gave access to the expertise of the OECD and the practical examples of the other partner regions, especially of Copenhagen and the Benelux countries, which were ahead in the green growth segment.

The practical restructuring of the inland port of Ghent to a biomass model destination and sustainability focus was seen as a template for developing a special site for green growth for new settlements in the port of Königs Wusterhausen – Wildau.

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(11) Idem.
(12) Idem.
(13) OECD: *Partners – Indicators of local transition to US low-carbon economy* (OECD LEED project): http://www.oecd.org/cfe/leed/partners-indicatorsoflocaltransitiontoalow-carboneconomyoecdleedproject.htm#Growth_Core

The mayor also indicated that Königs Wusterhausen has two concrete greenfields eligible for suitable investment, which could not yet be included in the report. First is the production of sustainable composite building materials from industrial waste, and second, a 10 MW solar park with complete memory modules on site. The latter will be unique in central Europe after completion.

There is also a 40 MW wind farm in preparation in the north of the city, with a direct supply to the port of Königs Wusterhausen – Wildau, offering added value in the immediate vicinity of the energy source. Follow-up projects with the OECD are also expected.

## 4.6. Conclusion and outlook

Sustainability and green growth are not self-perpetuating. The current limited examples drawn from the experiences of the author, as well as the large, politically supported projects for sustainability and green growth in the State of Brandenburg, show how low-carbon activities can activities be key to competitive and inclusive growth:

(a) on the one hand, our work illustrates that initiatives and appropriate financial support can result in a significant improvement in personal skills and the ecological behaviour of companies and organisations, along with competitiveness and inclusive green growth. In this sense, the lessons learned and best practices derived from it can be considered as an example for institutions on the road towards green growth;

(b) on the other hand, it is clear that, with the founding of s$O_2$lutions in 2007 and outlined here, successful development blends seamlessly into the sustainability efforts of the State of Brandenburg and can be considered as a form of specification of current sustainability efforts and the future sustainability strategy Brandenburg.

It is expected that s$O_2$lutions and FUX association and similar concepts and activities are also likely to find conditions in the State of Brandenburg that enable them to operate successfully. The State of Brandenburg can thus take (small) steps towards an economically, ecologically and socially sound economic region.

## 4.7. Abbreviations

| | |
|---|---|
| **OECD** | Organisation for Economic Cooperation and Development |
| **TUAS** | Technical University of Applied Sciences |
| **ILB** | Investitionsbank des Landes Brandenburg<br>(Investment Bank of Brandenburg) |

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CHAPTER 5

# India's low-carbon inclusive growth strategy: achieving policy coherence

**Sunita Sanghi** and **Anil Kumar Sanghi**

India's low-carbon inclusive growth strategy (LCIG) envisions poverty reduction and improvement in the human development index as a central theme for sustainable development. The strategy aims at sustainable agriculture, energy security and efficiency, waste management, affordable housing, afforestation and reduction in carbon emission. The LCIG framework highlights the importance of the shared benefits of various sectoral policies in terms of energy security, access to clean energy, employment generation, fuel efficiency, increased agricultural productivity and improvement in air quality. India has adopted a different sectoral programme for the goal of sustainable development, which takes into account variation in energy use by different sectors. This paper examines sectoral policies and analyses integration among them and with macro policy.

## 5.1. Introduction

Poverty eradication and climate change are two of the greatest development challenges and need to be reconciled for inclusive low-carbon growth. India is no exception to this, with high growth and poverty coexisting. In terms of the multidimensional poverty index of the United Nations development programme, in India about 54% of the population is poor (UNDP, 2011) and progress on human development indicators in terms of food security, education, access to health care, and clean sources of energy is slow. According to the integrated energy policy (IEP) (Planning Commission, 2006) about 40% of the population does not have access to clean sources of energy and about 85% rely on traditional sources of cooking, requiring India to grow at 9% over the next 20 years to eradicate poverty and meet human development goals. The IEP (Planning Commission, 2006) emphasises increasing India's primary energy supply by four to five times and electricity generation capacity by six to seven times of its 2003-04 levels to deliver a sustained growth rate of 9% through 2031-32 (Planning Commission, 2014). However, meeting energy needs in low-carbon way to achieve sustainable inclusive growth is a huge challenge.

The key elements of inclusive growth, as identified in the twelfth plan, with ramifications for sustainable development include access to food security; affordable health care; energy security; transport; drinking water; and financial inclusion. The low-carbon strategy in India entails using less energy, improving energy efficiency, promoting/protecting the sustainable use of natural resources, and policies and incentives to discourage carbon-intensive practices. This implies measures to support energy efficiency, expansion in domestic availability, developing alternate fuels modes, with sustainable development strategy woven around these objectives (ESMAP, 2010).

Although India is one of the lowest greenhouse gas emitters in the world, it is highly vulnerable to climate change and has an interest in minimising the risk of negative change (Planning Commission, 2014). India has given voluntary commitment to reduce the emission intensity of its GDP by 20-25% over the 2005 levels by the year 2020, through pursuit of targeted policies. Many sectoral policies and programmes have been introduced, focusing on sustainable inclusive growth to meet the challenge of rapid population growth and urbanisation. The twelfth five-year plan (2012-17) development strategy envisions inclusion and maintenance of ecological balance to create a prosperous self-sustaining society (Ministry of Environment and Forest, 2009). The shared benefit framework discussed both in the twelfth five-year plan and the low-carbon inclusive growth strategy (Planning Commission, 2014) detail qualitative assessment of the joint benefit potential of components of low-carbon strategy: renewable energy missions; technology development in industry; energy efficiency in industry and transport; urban public and non-motorised transport; green building; and standard and labelling programmes in terms of growth, inclusion, local environment and carbon mitigation.

This paper examines components of India's low-carbon inclusive growth strategy: the objectives of the national action plan on climate change (NAPCC) which determines the course of various sectoral and development policies; convergence across sectoral policies *vis-à-vis* sustainable development; and challenges and constraints in achieving these targets and suggests a way forward.

### 5.1.1. India and the climate change

India's concern about degradation of its natural resources (land and forest), access to clean sources of energy, transport, water, food and clean air is of paramount importance as these are critical elements of its inclusive development strategy. Interventions in these sectors, however, have had limited convergence, although efforts have been made for intersectoral policy convergence to improve the human development index of India. The twelfth five-year plan, launched in 2012, emphasised sustainable development for the first time, alongside faster and inclusive development, necessitating policy coherence across sectors without affecting the growth and productivity of the sectors.

India has been part of a number of multilateral environmental agreements, signed the United Nations framework convention on climate in 1992, and acceded to Kyoto protocol in 2002. Against this background, the National action plan on climate change report (NAPCC, 2008) signifies a paradigm shift in approach to policies of climate change and sustainable development, and forms the basis for India's low-carbon inclusive growth strategy. The action plan aims at:

(a) protecting the poor and vulnerable sections of the society;

(b) achieving national growth objectives through a qualitative change in direction that supports ecological sustainability;

(c) deploying appropriate technologies for both adaptation and mitigation of greenhouse gases emissions, extensively and at an accelerated pace;

(d) engineering new and innovative forms of market, regulatory and voluntary mechanisms to promote links in implementation of programmes, international cooperation for research, development, sharing and transfer of technologies facilitated by additional funding and a global IPR regime to bring about a directional shift in the development pathway (NAPCC, 2008).

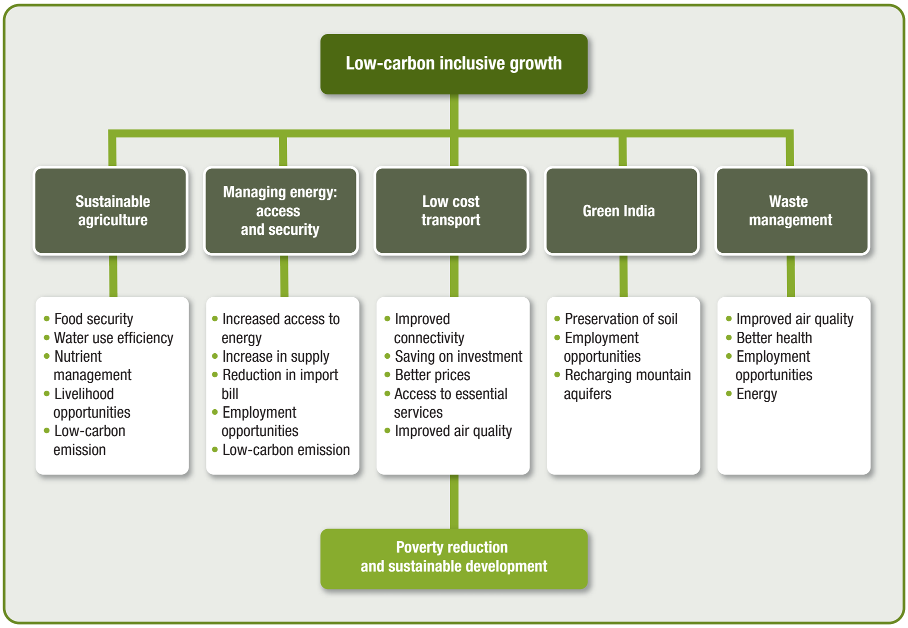
The above objectives are proposed to be achieved through eight national missions: solar energy; enhanced energy efficiency; sustainable habitat; water management; sustaining the Himalayan ecosystem; green India; sustainable agriculture; and strategic knowledge for climate change.

### 5.1.2. India's low-carbon inclusive growth strategy

The low-carbon inclusive growth strategy (Planning Commission, 2011) derives its strength from the NAPCC which lays down the roadmap for reducing India's emission intensity over the period in important sectors, through differential policies based on national priorities of energy, transport, industries, agriculture, and waste management. The strategy suggests cross-sectoral interventions that meet the objective of inclusive growth in the low-carbon ways. For example, in policies in sectors such as land, water and forests, the livelihood considerations, income generation, and poverty alleviation must dominate policy choice, even if it requires overriding carbon emission concerns. Figure 5.1 highlights cross sectoral interventions that meet the objective of inclusive growth in the low-carbon way.

Various sectoral national policies and programme interventions, with implications for sustainability and inclusive growth, have been put in place via policies for environment, energy, agriculture, transport, urbanisation, water, and housing. There are also programmes such as the national food security mission MGNREGA ([14]); affordable health; and access to essential services, to eradicate poverty and improve the human development index. The focus on sustainable agriculture, resource efficiency (linkage of land, water and energy), energy access, industrial efficiency, sustainable transport, afforestation, green building and waste management are initiatives to achieve low-carbon growth with poverty reduction (Planning Commission 2012; TERI, 2012).

Figure 5.1. **Cross sectoral low-carbon interventions for inclusive growth**




*Source*: Based on India's low-carbon inclusive growth strategy (Planning Commission, 2011).

([14]) The Mahatma Gandhi national rural employment guarantee.

It emerges that sustainable development and inclusive growth policies have strong interlinks that must be identified to ensure that development serves both present and future generations. The coherence among various sectoral policies, and of them with macrosectoral policies, is central to achieving low-carbon inclusive growth.

## 5.2. Sectoral links and policy coherence

India's commitment to sustainable development is reflected in the series of legislative, policy and institutional measures at national level for integrating social, environmental and developmental concerns. The country also participates in bilateral and multilateral environmental agreements. The challenges in terms of poverty reduction and sustainable development are sought to be integrated with sectoral priorities: employment generation, access to modern energy sources, soil and land preservation, afforestation, dry land farming, rural connectivity, mass rapid public transport system, and availability of clean drinking water and sanitation. The twin challenges make equity central to all efforts for sustainable development. The NAPCC accordingly emphasises integration of benefits and policies to achieve economic and social development in a sustainable manner for poverty reduction and ecological balance.

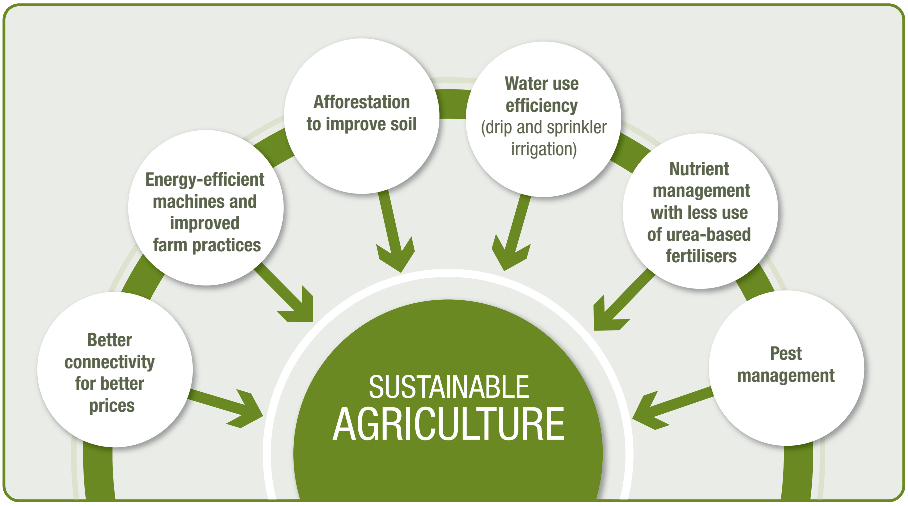
Strategies for sustainable development in agriculture, to arrest soil erosion and depletion of ground water in terms of afforestation and use of organic manures, not only sustain agriculture but improve forest cover, recharge ground water and make available employment opportunities directly and indirectly in different sectors. These links improve the human development index, air quality, agricultural productivity, and access for farmers to low cost transport, and good prices for produce by developing a national agricultural market. Rainwater harvesting improves availability of continued supply of water for irrigation and help in maintaining the ground water level, thereby precluding the effects of soil erosion and also drought. The interdependence among the programmes is visible in MGNREGA, which not only provides employment security but also invests in the preservation and restoration of land, water, and forest to improve livelihood opportunities and food security. Agriculture insurance has helped poor farmers with small size holdings overcome debt problems. This would also help small and medium-sized enterprises (SMEs) grow, alleviating the poverty, energy security and job creation.

Energy efficiency and augmentation of energy resources, through promoting use of renewable sources of energy at affordable prices, is facilitating availability of energy in all sectors and alleviating poverty, a cause and consequence of environmental degradation. Various measures promote the use of renewable sources: setting up the Bureau of Energy Efficiency (BEE); the Energy Conservation Act; energy conservation building code (ECBC) (2005); standard and labelling of appliances, green building, national mission on solar energy; and fiscal incentives in terms of tax and subsidies for solar energy. The improvement in efficiency has a bearing on households, industry, agriculture, and transport on the one hand and import costs, emission level, and production on the other, both in rural and urban areas. Extended use of renewable sources of energy and alternate fuels helps in reducing emissions, dependence on foreign sources for generation of power, saving of foreign exchange, generation of employment in new areas and roles, and managing waste. It also ensures access to energy and increased supply, thereby promoting energy security.

A multisectoral/stakeholder green India mission for forest regeneration envisages a role for local communities/decentralised governance and is based on integrated cross-sectoral approach requiring an effective monitoring framework. Vulnerability and potential are the key driving characteristics of the mission. It is expected to slow down the process of desertification; enhance ecosystem services such as storage (in forests and other ecosystems), hydrological services and biodiversity; along with provisioning services such as fuel, fodder, small timber through agro and farm forestry, and non-timber forest products (NTFPs) (Planning Commission, 2012). Improvement in forest productivity and equity in access to benefit-sharing with local people is expected to improve the livelihood for the natives and the tribes. Tribal families have jointly managed ‘Yepuru’ forests, Nellore District, and Andhra Pradesh for one and half decades; they would be able to get the best price for their product. Remote sensing forest monitoring has been proposed in collaboration with Forest Survey of India, National Remote Sensing Agency and Indian Institute of Remote Sensing. The national green tribunal was set up in 2010 for effective and speedy tackling of cases relating to environmental protection and conservation of forests and other natural resources. It is estimated that there is a potential for capturing an additional 92.3 $MtCO_2eq$ every year, by the year 2023 onwards. This will neutralise the quantum increase in emissions annually by increasing forest and tree cover, planting trees in fringe villages, and replacing metallic furniture (Planning Commission, 2014).

Programmes and policies target eradicating poverty either through direct focus on employment generation, (MGNREGA training and building up of access to poor, Indira Awaas Yojana, scholarship and training scheme), emphasis on health (RSBY) education (SSA, MDMe, RMSA and UHSA), social infrastructure (PMGSY, AIBP, broad band) and food security (public distribution systems are not only helping inclusion but also promoting sustainable growth). There is synchronisation among industrial, environmental, regional development and social policies. Transport sector polices, as an example, have impacts on emission, agriculture prices, improved connectivity, employment generation and income levels. Therefore, there is a need for coordination across all sectors and levels of society at national and subnational levels to see direct and indirect links of different interventions. An example of such links is depicted in Figure 5.2, showing that sustainable agriculture development connects with energy, transport, fertilisers, environment, water policies, as well as having indirect links with credit, R&D, and market polices. Sustainable agriculture also has ramifications for food security and food prices, cropping patterns, and livestock. These links help transform agriculture into a climate-resilient production system that can contribute to economic stability, ensure food security and equitable access to food, preserve soil, increase employment opportunities, aid reduction in carbon emissions and increase productivity and incomes.

Figure 5.2. **Links among sectoral policies**




*Source*: Authors.

There are convergences between the national mission for a green India, national water policy, national mission for enhanced energy efficiency and the national mission on strategic knowledge for climate change. The NAPCC is built on principles of alleviating hunger and all deprivations. The use of clean sources of fuel for cooking will help in restoration of forests, as trees would not be cut for wood. This would have impact in terms of reduction in carbon emissions along with female labour.

The government of India has taken number of policy measures to address these interrelated issues, addressing both demand and supply side management, short- and long-term. The impact in terms of individual programmes can be seen below.

Incentives include tax rebates (direct, sales, custom and excise), subsidies, financing renewable energy projects through the Indian Renewable Energy Development Agency, carbon credits and clean development mechanisms, foreign direct investment (FDI) up to 100%, and generation incentives for wind and solar energy. These have supported increase in access and availability of energy and relative decline in dependence on imported coal for power generation. Different energy efficiency measures in households, industry, commercial building, and transport are leading to a decline in the consumption of electricity (Planning Commission, 2014).

An Odisha evaluation study indicates improvement in the quality of living, substitution of traditional kerosene-based lighting by electric light, increased capacity to make a living through agriculture, entrepreneurial activities, extension of study hours for students, and increased mobility. There is also an increase in the percentage of households using LPG as cooking fuel, from 57% in 2004-05 to 66% in 2009-10. In rural areas, access to LPG has increased from 8.6% to 15.5% in 2009-10. The twelfth five-year plan aims at improving access to energy for both cooking and lighting (Planning Commission, 2012).

Interventions in different sectors have yielded positive results. Bachat Lamp Yojana, aimed at improving energy efficiency in households, has been able to create a large supply of compact fluorescent lamps (CFLs) and good, non-subsidised market penetration. In 2011, nearly 5 million incandescent lamps were replaced by CFLs, saving 231 MU of electricity and 85 MW of installed capacity. There was significant increase in the sales for CFL to 408 million in 2012 from 36 million in 2003 and a significant increase in the sale of labelled appliances. These have resulted in substantial savings. The report of the expert group on low-carbon strategies for inclusive growth (Planning Commission, 2014), indicates a saving of 29.1% in household electricity by

2030 using rated appliances, creating a case for covering more appliances and equipment and creating widespread consumer awareness (Planning Commission, 2014).

Energy efficiency measures in major industries have led to considerable savings (63 billion kWh of electricity, 741 MT of coal, 3 Mt of petroleum products and 7 billion cubic meters of natural gas, Planning Commission, 2014). Micro, small and medium enterprises (MSME), however, require an external push such as a shift to natural gas-based furnaces in the glass industry in Firozabad, and closure of iron foundries in Agra to protect the Taj Mahal (Soni, 2009). Scaling up such efforts requires awareness generation among small enterprises of emerging opportunities. The challenge is to focus on employment, market, credit and technological upgrade strategies. Policies for developing a strong framework for increasing awareness and aiding upgrading of technology in small and medium enterprises are being devised.

In 2009, the Indian network for climate change, Assessment, a body of scientific institutions, was launched to provide guidance to policy-makers. Transparency in environmental and forestry clearance received renewed impetus to promote environmental protection and natural resource management such as the national mission for a green India (2008), the green building mission (2007) and the national green tribunal (2009). The national green mission helps in improving environment, raw materials and job opportunities. State governments have equally been made partner in environmental protection and the 13th finance commission has included environmental and forest issues in its devolution formula. The central government is aiming to create national green accounts, which will help in monitoring the contribution of sustainable policies in the growth process.

In the transport sector, focus is on development of dedicated freight corridors for reducing dependence on road transport and increasing railway use, while compressed natural gas (CNG) buses in large metropolitan areas are reducing pollution. Increasing public transport is providing greater mobility to the poorest sections of society while helping in mitigating emissions from transport sector. The city of Ahmedabad has also set up a network of mass rapid transit system roads. The increasing share of CNG vehicles is helping in improving the quality of air in urban areas and reducing government subsidies on fuel. The substantial increase in CNG cars and taxis in India from about 23 000 in 2001 to more 4-lakhs in 2011 is helping the ecological balance. The CNG bus services operating in 10 cities in five States – Maharashtra, Gujarat, UP, Andhra Pradesh and Delhi – are also helping in reducing emission levels. Government has been supporting the buses under the JNURM ([15]) programme (Planning Commission, 2014). The incentives are also provided for electric vehicles to increase the overall energy efficiency of the transport sector and reduction in energy demand.

As a regulatory signal to manufacturers, fuel efficiency norms/standards have been introduced for new cars and norms have been issued for older cars. There are labels in terms of Bharat stages 1 to 5 which provide information to consumers about fuel consumption of the models. It is expected that the efficiency of vehicles in India would improve in a low-carbon economy.

The increased focus on micro and medium irrigation projects, and public investment in the irrigation projects and repair, renovation and restoration of existing water bodies, is helping in preserving ground water level. The conversion of barren lands in Rajasthan into lush fields and rejuvenating dried up rivers by making johads and small earthen check dams have impacted both climate change and human development (Saxena, 2009). However, the performance in respect of creation and use of irrigation facilities is slow. The steps taken by the Indian Space Research organisation and the Indian Meteorological Department have improved climate data quality and warning systems for advance action.

In the building sector, a number of states have notified ECBCs and other are in the process. Energy intensity norms for different buildings notified by BEE are monitored. The report of the expert group on low-carbon strategies for inclusive growth (Planning Commission, 2014) based on a study conducted by the Malaviya National Institute of Technology, Jaipur, suggests saving in the sector through implementation of ECBC in the country. It indicates that different buildings have different energy-saving potential depending on construction specifications, use, systems and equipment installed, conditioned area and other factors. The energy savings potential ranges from 17 to 42%. The study also indicates that there is more potential for energy saving through adoption of advanced energy conservation measures; however, this might not be financially attractive for the general public at this stage due to their economy of scale. The resulting energy savings mostly offer payback in two to four years. The retrofitting of old buildings can save energy and make economic sense, as in Bombay House where modifications in an existing building have raised the energy performance index from 172kWh/m2/year to 145 kWh/m2/year and the star rating from two to four. Technological change in different industries has brought about savings in energy use and reduced emissions. An estimated cumulative energy savings of 6 686 million tonnes

([15]) Jawaharlal Nehru national urban renewal mission.

of oil equivalent (Mtoe) is expected in the first round of the ‘perform, achieve and trade’ cycle by 2015. However, this does not cover SMEs who are to be incentivised to adopt new energy saving technology, which BEE is trying to do. The increasing pressure on conventional energy sources has made energy conservation a focus. The ‘perform, achieve and trade’ scheme is an example of a certificate-based trading scheme which promotes energy efficiency. The renewable energy certificate mechanism is a market-based instrument introduced to promote renewable energy.

The national clean energy fund (NCEF), announced by the Indian government in its union budget 2010-11, is seen as a major step in India’s quest for energy security and reducing the carbon intensity of energy. The objectives of the NCEF are to fund research and innovative projects in clean energy technologies and to harness renewable sources to reduce dependence on fossil fuels.

The twelfth five-year plan describes a business model for sustainable development in terms of financial and non-financial incentives. The financial incentives include environmental tax on a product that damages the environment in an attempt to reduce its production or consumption. The polluter pays principle is an important instrument; coal cess is a good example of environmental tax imposed by the government of India whose proceeds are channelled to the national clean energy fund. This can be used to help industry adopt technologies which protect the environment by promoting clean energy technologies. The compensatory afforestation fund is a mechanism introduced to attract additional resources in the forestry sector. Money is collected for compensatory afforestation from users of land granted for non-forestry proposes at a rate of USD 13 333 per hectare. The national gene fund has been established to build capacities at Panchayat level for conservation of genetic diversity in indigenous crop varieties.

Non-monitory incentives are policies instruments that have a financial impact and can be used as a bargaining tool by the government to encourage conservation of resources by economy. Activities such as those encouraging judicious use of plastic bags can be rewarded to encourage the practice and an as an example for others.

Besides the sectoral links, the low-carbon inclusive growth strategy has implications for the macro polices: labour, fiscal, education and skill, health, land and water resources, R&D, disaster management. The impact on the labour market is in terms of creation of new jobs and change or phasing out of the old jobs/occupations to suit the objective of sustainability, which will open up new and remunerative job opportunities for people. A study from the

Confederation of Indian Industry (CII) on renewable sources of energy has projected creation of 14 million jobs in India over the next 10 years (CII and MNRE, 2010). This would have implications for several areas: education and skill devolvement polices; innovations, research and development, training; robust labour market information system supporting all stakeholders; and financing strategies. India's unorganised mass of small enterprises size poses a problem as this sector contributes most to pollution by using outdated technologies. It requires an external push to achieve both employment and environmental sustainability objectives.

Although there are no specific interventions for addressing green economy needs, the overall skill framework in India is focusing on capacity building for the most vulnerable workers in the unorganised sector. These do not have relevant support to address their vulnerabilities and respond to the consequences of climatic changes. Many work in agriculture and small industries, where initiatives have been taken to conserve energy. This is necessary to avoid skill gaps, high adjustment costs, missed opportunities, accelerate employment growth and expand development. Juan Somavia Director-General of the ILO, in his foreword to the conclusions of the general discussion concerning the promotion of sustainable enterprises, indicated that supportive policies can promote both sustainable enterprises and sustainable development at the same time.

The above analysis highlights the key challenges to be addressed in most sectoral policies: enforcement of the regulatory framework (ECBC; rated appliances; fuel efficiency norms; vehicle label standards); linking incentives to industry with use of clean technologies; capacity building; infrastructure development for non-motorised transport; knowledge dissemination; strengthening supply chain; generating awareness; and robust monitoring and evaluation. Absence of these makes policy integration, at different government levels and sectors, a challenging task.

## 5.3. The way forward

Policy convergence across sectors and at macro level is targeted by focusing on several areas: technology improvements in industry; use of alternative/renewable sources of energy, vehicle fuel efficiency, faster adoption of green building; improving forest cover, use of public and non-motorised modes of transport; and sustainable agriculture development through programmed interventions. It is evident that a shift to sustainable development can help poverty reduction by improving incomes, particularly for large small-holding farmers in the country, and in ecological balance. However, there is a need to generate awareness among the stakeholders about the benefit of energy-efficient and clean technologies. This demands extension of activity in agriculture, capacity building for entrepreneurs using resources and technology, incentives for resource conservation, increased use of renewable sources of energy including Biogas which impacts crop, fishing, soil quality, and addressing energy needs. It is also necessary to have inter- and intra-ministerial coordination for better results and saving financial and natural resources.

The SMEs that dominate in India's industry, both in terms of number and employment, need to be pushed to adopt new, emission-friendly technologies. The cluster approach adopted in India may be one solution, as clusters address common issues such as improvement of technology, skills and quality, market access, access to capital, and creation of common facilities (for testing, training, raw material depots, effluent treatment, and complementary production processes).

Incentives are needed to both producers and consumers to shift to clean sources of energy, to improve social inclusion, and reduce the carbon emission footprint. The government focus on promoting affordable renewable energy, such as through availability of solar lamps, is helping. The new government is also focusing on the solar use, with policy initiatives to develop the grid system and storage for such energy. This would have added impact on the economy in terms of employment. Sustainable development would also improve gender equality in terms of labour required to fetch distant water or fuel for cooking, leaving time for productive economic activity.

Some of the latest initiatives announced by the new government which have bearing on sustainable inclusive development include:

(a) availability of funds for ultra mega solar power states; solar power driven agricultural pump sets and water pumping stations and development of solar parks on the banks of canals; promise of a 'saffron revolution' which includes ambitious targets for small, large and off-grid solar and a switch away from an assumed reliance on coal as the country seeks to deliver on its momentous task of bringing electricity to the entire country;
(b) implementation of a green energy corridor project to support distribution of renewable energy across the country;
(c) creation of the agri-tech infrastructure fund and the national adaptation fund to meet the vagaries of climate change;
(d) setting up mobile soil testing laboratories across the country and provision of a soil health card in a mission mode to each farmer;

(e) increase in the coal tax and widening the scope of expenditure from this fund to include environmental projects and research and development projects in the clean energy and environment sectors. The new government will fund its ambitious Ganga rejuvenation plan with the tax on coal; increase both passenger and freight traffic by increasing frequency and speed of both passenger and freight trains; introduction of high speed train services; increasing intra-urban regional and suburban railway transport and diversifying freight commodity basket from bulk commodities to agricultural perishable commodities.

Sustainable development, social inclusion and transition to greener economy are indispensable. The different policies need to be adopted simultaneously for better results. The NCEF must be used to provide much-needed impetus for the development of emerging renewable and clean energy technologies, and the financial capital to early-stage and high-potential projects. It is important that the government provides easier access to finance through NCEF for the renewables sector.

## 5.4. Abbreviations

| | |
|---|---|
| **BEE** | Bureau of Energy Efficiency |
| **CNG** | compressed natural gas |
| **ECBC** | energy conservation building code |
| **MGNREG** | the Mahatma Gandhi national rural employment guarantee |
| **NAPCC** | national action plan on climate change |
| **NCEF** | national clean energy fund |
| **UNDP** | United Nations development programme |

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CHAPTER 6

# A systemic policy perspective for the transition towards the green economy

**Francesco Crespi**

This paper brings together recent conceptual and empirical contributions, to provide new analytical foundations of systemic public policies for the transition towards a greener economy. In particular, by acknowledging the inherent complexity of system dynamics, the paper highlights the difficulties in developing an integrated framework of policy instruments and the need to take into account their mutual interaction in the effort of favouring sustainable transition. The paper analyses some examples of possible contrasting effects between policies that are crucial for sustaining the transition towards a greener economy: innovation policy, environmental and energy policies, and labour policies. It also elaborates on the notion of transition policy and puts forward the concept of transition system, suggesting the importance of activating learning and adaptive mechanisms involving private agents, policy-makers, scholars and other stakeholders involved in the transition process.

## 6.1. Introduction

The analysis of transition towards a greener economy, the issues related to the emergence and diffusion of environmental technologies and of the simultaneously evolving socioeconomic, institutional and policy contexts are gaining growing attention in academic and policy debate. The role of public policies and governance systems is under particular scrutiny in aiming to understand how to ensure the conditions for fostering economic development while protecting the environment (OECD, 2010; 2011). The notion of sustainable development looks simultaneously in different directions, environment protection and economic growth, which can appear inherently contradictory and irreconcilable (Kates et al., 2005). The introduction of more stringent environmental regulations has been traditionally seen as potentially harmful for industry productivity and competitiveness, as it leads to higher costs for firms (Brock and Taylor, 2005; Copeland and Taylor, 2004). Only if environmental policies are capable of inducing firms to generate innovations in products and processes that positively affect the dynamic efficiency of the economy, may environmental goals become compatible with growth promotion and competitiveness (Porter and van der Linde, 1995).

Despite these potential contradictions, the continuing economic and financial crisis has engendered increasing attention towards a broadly defined transition to the green economy as a powerful mechanism to escape from the current downturn, especially in the European Union context. This implies not only that environmental objectives should be achieved without harming economic competitiveness, productivity and economic growth, but that the framework of policies designed to promote environmental sustainability should be able to sustain economic recovery and employment growth. To reach these objectives, a roadmap for the development and diffusion of environmental-friendly technologies, combined with a coherent and effective governance framework for the achievement of both environmental and economic goals, is widely acknowledged as necessary (European Commission, 2011a; EEA, 2013). In this respect, within an international policy framework that suffers from lack of coordination, the EU has led the way in setting targets, as with the Lisbon agenda and the 20-20-20 strategy on energy, $CO_2$ and renewable energies. The launch of 'horizon 2020' is expected to provide new stimuli for the transition to a resource efficient, low-carbon and more competitive and inclusive economy (European Commission, 2011a).

Though such steps are important, the real outcome of this process is far from being clear for several reasons. First, compliance with the Lisbon agenda has been poor and although the Kyoto targets have been achieved, this was mainly due to the crisis (Borghesi, 2011), and it is not clear whether the 20-20-20 targets will be achieved when the economy eventually recovers from the recession. Second, the link between environmental policy and eco-innovation is still at the centre of economic debate which showed that the drivers of innovations in environmental technologies are multifaceted and touch on various spheres of society and policy-making (Horbach et al., 2012; Costantini and Crespi, 2008; 2013). Only properly designed policies can spur eco-innovations when firms believe that innovation offsets are greater than regulatory costs (Costantini and Mazzanti, 2012). Third, interpretation of environmental and economic consequences due to the introduction and adoption of new environmental technologies is not unambiguous. With respect to the former issue, new technologies can favour the reduction of carbon emissions and the usage of energy, yet gains in the efficiency of energy consumption will result in an effective reduction in the per unit price of energy services, leading to increasing consumption ('rebound' effect), partially offsetting the impact of the efficiency gain in fuel use (Greening et al., 2000). Regarding the economic effects, the macroeconomic impact of eco-innovations is still unclear. The net employment effects of new environmental technologies and sustainable transition is currently under scrutiny as the outcome of a process of creative destruction in which both job creation and job destruction are jointly operating (Horbach et al., 2012).

These considerations draw attention to the complexity of the issues at stake and to the need to develop a broad analytical and policy framework for governing the transition to the green economy, achieving both environmental and economic goals. The aim of this paper is to highlight such complexity and the importance of adopting a systemic perspective to analyse sustainable transition, to identify better the challenges of transition governance and possibly identify useful tools to deal with this complexity.

## 6.2. From market failures to system failures: lessons for the governance of sustainable transition

The traditional foundations of environmental policy relate to correction of market failures by changing the incentives of private sector agents. Market failures may be directly responsible for environmental issues generating suboptimal equilibria due to externality problems (Baumol and Oates, 1988). They may also limit the generation of new technologies because of the public good nature of knowledge and the related problems of appropriability (Nelson, 1959; Arrow, 1962). Hence, market failures may limit the possibility to solve environmental problems through the development of new environmental technologies designed to reduce the environmental impact of economic activities.

### 6.2.1. Systemic approach and policy complexity

A significant body of literature has recently emphasised the shortcomings of standard normative economic theory of both environmental policy and innovation policy in guiding policy-makers in the design and implementation of effective policy tools. This has implications for issues related to achieving sustainable development objectives. A growing body of economic literature suggested that traditional economic approaches are inappropriate for dealing with the dynamics of structural and adaptive changes in economic systems (Rammel and van den Bergh, 2003), while highlighting the potential of evolutionary economics to interpret the process of sustainable development and environmental policies (Kemp, 1997; van den Bergh and Gowdy, 2000; van den Bergh et al., 2007; Nill and Kemp, 2009). According to these contributions, an evolutionary foundation of sustainable development policies should account for concepts such as adaptive behaviour, policy learning, policy interactions, diversity, path-dependence and lock-in. Such an approach takes advantage of lessons emerging from the systemic approach in innovation studies. Innovation policy analyses within an innovation systems framework (Freeman, 1987; Lundvall, 1988; Nelson, 1993; Edquist, 1997) radically challenged market failure rationale for government intervention to promote the development and diffusion of new technologies (Bleda and Del Río, 2013). In the innovation system approach, innovation is conceived as a complex evolutionary process distributed in a system of different agents whose behaviour and interactions are governed both by market forces and by non-market institutions (Metcalfe and Ramlogan, 2005).

Agents' interactions and the institutions governing them determine the innovative performance of the system. The problems affecting performance to be tackled by policy action are mainly associated with coordination issues arising from these interactive behaviours. The systemic framework opens up a new perspective for policy-making in general and, more specifically, for the design of an appropriate policy structure to foster the transition towards the green economy. Systemic thinking implies embedding policies in a broader institutional context, and shifting the policy perspective from a top-down view to a network steering approach. In a systemic setting, governments have to deal not only with 'market failures' but, most important, with 'system failures' (Metcalfe, 1995), problems related to the interactive behaviour of agents operating in the system and the institutions designed for its governance (Edquist, 1997; Metcalfe, 2005). In this context, policy-making is part of and subject to system failures entailing a process of adaptive and learning policy-making, thus acknowledging the challenges of State intervention in a context of economic and policy complexity (Metcalfe, 1995).

Policy-makers, scholars and analysts increasingly focus on challenges stemming from policy complexity, and this appears to be particularly relevant when dealing with sustainable development. The framework of policies designed to promote the transition to the green economy should be able to achieve environmental goals as well as sustaining technological competitiveness, economic recovery and employment growth as interrelated objectives. This suggests a radical shift from classical models of economic policy to a systemic perspective is needed. The former emphasises the clear distinction between different policy goals, as implied by the golden rule of having as many instruments as policy goals (Tinbergen, 1952), while the latter focuses on interactions and interdependencies between different policies, and highlights how such interactions affect the extent to which policy goals are realised.

This shift is exemplified by the increasing interest in the concept of 'policy mix' which, not surprisingly, has registered an early diffusion and development within the literature on environmental policy and regulation (Sorrel and Sijm, 2003). In recent years, several scholars in fields related to analysis of eco-innovation (Kemp, 1997; Rennings, 2000) have focused their attention on the design of policy mix which combines different policy areas, including environmental policy (OECD, 2007; IEA, 2011) and innovation policy (Flanagan et al., 2011). According to this literature, policy instruments must be combined into mixes in ways that address the complex problems related to the sustainable transition process. The choice of instruments is a crucial decision in formulation of policy design. This concerns three main dimensions: first, selection of the specific instruments among the array of different possible instruments; second, the actual calibration of the instruments for the context in which they are supposed to operate; and third, the choice of a policy mix, or set of different and complementary policy instruments, to address the problems identified. The choice of instruments has to consider their individual characteristics, their potential complementarities, and the trade-offs between different policies in relation to the specific mix adopted (Borrás and Edquist, 2013).

### 6.2.2. A new perspective for policy coordination

While this stream of studies appears to be relevant for highlighting the complexity associated with the design of policy mix, it does not fully address some important aspects. First, these studies mostly concentrate on achieving environmental goals and the generation and diffusion of environmental technologies as means to realise these objectives; in so doing, they still limitedly incorporate in their analyses the further policy complexity introduced with the integration of environmental, economic and, in particular, employment objectives. Further, policy mix studies tend to be confined to the analysis of instrument interactions (Rogge and Reichardt, 2013; IEA, 2011) or of the policy processes associated with designing policy mixes (Kallis and van den Bergh, 2013). Finally these aspects may lead to insufficient understanding of the complex nature of policy mixes and their effects, potentially resulting in oversimplified policy recommendations generically suggesting the need for greater consistency and coherence of the policy mix (Rogge and Reichardt, 2013).

Inadequate understanding of policy complexity may erroneously cause seeing policy coordination as the unproblematic outcome of a superior governance system, implicitly assuming a single level of governance managed by a fully rational policy-maker (Flanagan et al., 2011; Kallis and van den Bergh, 2013). In contrast, coordination can, at best, be the outcome of a mutual adaptive process between actors and systems. In this context, analysis of interactions and trade-offs between policy instruments and their impacts on the ultimate policy objectives is crucial if the concepts of policy mix and policy coordination are to be fruitfully developed and operationalised.

## 6.3. Cases of potential negative policy interactions

### 6.3.1. The energy sector

There is a strong need for regulatory strategies to force technological regime shifts in the energy sector. Network economies emerge due to the strong interrelations between technological systems and users, producing continued refinement of the dominant design, which can define a technological trajectory typically affected by lock-in and path-dependence effects (Unruh, 2000). Carbon lock-in seems to be particularly difficult to discard, where progress in environmental-friendly technologies should be supplemented by changes in consumer behaviour and the institutional framework (Unruh, 2000; 2002). The peculiar characteristics of the energy sector explain the coexistence of several different public policies that aim to escape the carbon lock-in. Nonetheless, in the absence of strong coordination between different public energy sector policies, contrasting forces and impacts can negatively affect the final outcome of the adopted policy mix.

The diffusion of carbon-free energy forms and energy-saving technologies is a typical example of the necessary coexistence of alternative solutions to fossil fuel energies. This is evident when energy policies claim to pursue a reduction in greenhouse gas emissions and an improvement in security of energy supply (Costantini et al., 2007). This double outcome should be found in relation to policies supporting both energy efficiency and the production of renewable energy. However, policies that target renewables may not be helpful in achieving objectives in terms of increasing energy efficiency. More specifically, instruments other than the emission trading scheme (ETS) have been found frequently to interact negatively with ETS as they are not aligned to it. According to this view, the use of policy tools different from ETS has increased the cost of climate change policies and left a very low carbon price (Borghesi, 2011). Policies for renewable energies substantially contributed to the declining trend of emission permits prices and to reducing incentives for investments aimed at decreasing emissions for unit of produced energy from traditional plants. The contemporaneous presence of many different policy instruments represents a critical issue for the design of an appropriate energy policy mix and the effective achievement of environmental and technological goals (Abrell and Weigt, 2008; Böhringer et al., 2008).

### 6.3.2. Employment effects of eco-innovation

Willingness to invest public resources on the transition to the low-carbon economy also reflects opinion that such a transformation is likely to increase employment levels at a time of high involuntary unemployment in the current economic crisis (Fankhauser et al., 2008). However, the employment impact of flows of environmental innovations induced by policy actions is far from clear. Despite recent attention of scholars to the theme (Horbach, 2010; Gagliardi et al., 2014), the employment effects of innovations have been studied extensively outside the green economy paradigm. Such studies showed that technological change plays a major role in shaping the quantity and quality of employment. Firm-level studies have shown that innovations in products and in processes generally lead to a positive direct employment effect on the firms that introduce them. Innovative firms tend to increase jobs faster than non-innovative ones. However, sectoral analyses highlighted that innovation appears to have a net job-creating effect in those manufacturing and service industries characterised by high demand growth and an orientation towards product innovation, while new processes generally result in job losses (Vivarelli et al., 1996; Pianta 2001; 2005; Mastrostefano and Pianta, 2009).

When the specific effects of eco-innovations have been addressed it has been found that, while product or service eco-innovation has a significantly positive effect on the probability of an increase in employment, end-of-pipe innovations tend to favour employment decrease (Rennings et al., 2004). This result is confirmed by Horbach et al. (2012), who highlight that the relationship between eco-innovation and employment within a firm strongly depends on the nature of innovation, especially between process and product innovation. As the introduction and diffusion of eco-innovations entail both job creation and job destruction effects, the design of policy mix appears to be crucial to taking account of the potential contrasting effects between environmental, technological and employment objectives.

The impact of eco-innovation on the quality of jobs, the skills and competences required, is another most relevant aspect to consider. The availability of dedicated skills for green jobs plays a crucial role in triggering change and facilitating sustainable transition (Cedefop, 2013). A previous general finding of the literature is that the diffusion of technologies might have strong skill bias and wage polarisation effects (Chennells and Van Reenen, 2002; Acemoglu, 2002; Pianta, 2005; Croci Angelini et al., 2009). These issues might be of particular relevance for policy design as the speeding up of transition processes may contrast with important social challenges such as reducing inequalities and promoting inclusive growth.

## 6.4. Managing sustainable development through transition systems

The examples provided so far confirm the idea that interactions and trade-offs between policy instruments play a key role in the effectiveness of the adopted policy mix. These aspects appear to be of particular relevance when policy measures are adopted to support radical structural change in economic systems that should conduce to a sustainable transformation, contemporaneously promoting economic growth, employment and social cohesion. In this context, the number of policy objectives and instruments increases radically, so that the potential synergies and conflicts between different objectives and instruments may be dramatically high.

Scholars have traditionally underscored the difficulty of addressing coordination problems between different instruments belonging to different policy domains; environmental and energy policies, as well as innovation and technology policies. However, the current policy commitment to promote economy recovery and employment growth, by sustaining the transformation of economic systems into sustainable ones, has put forward the importance of explicitly including in the analysis the labour policy dimension and the relative implications in terms of policy interactions and trade-offs (Cedefop, 2013).

Table 6.1 offers a synthetic overview of common categories of environmental, innovation and labour policy instruments that are supposed to be relevant in managing sustainable transition.

Table 6.1. **Frequent categories in environmental, innovation and labour policy domains**

| | Simple categories | Differentiated categories |
|---|---|---|
| **Environmental domain** | Market/price-based<br>Regulation/command-and-control | • Environmental taxes or subsidies, cap and trade systems<br>• Environmental standards |
| | Soft instruments | • Information and education<br>• Voluntary approaches |
| **Innovation domain** | Supply-side measures/ technology push | • Financial support<br>• Stimulation of cooperation and networks<br>• Provision of public goods<br>• Provision of property rights |
| | Demand-side measures/ demand pull | • Public procurement<br>• Diffusion policies |
| **Labour domain** | Supply side measures | • Labour market reforms<br>• Education and training policies<br>• Tax incentives |
| | Demand side measures/macro and sectoral | • Aggregate demand stimuli<br>• Public procurement<br>• Sectoral incentives, niche strategies |

*Source*: Adapted from Rogge and Reichardt, 2013.

Even limiting attention to these three policy pillars, the difficulties arising in the design of policy mix, and the importance of achieving some form of coordination between different policies, are apparent. A precondition for policy coordination is long-term strategic orientation and the adoption of clear strategic policy frameworks in which long-term environmental objectives are nested with social and economic issues, such as the support of growth, competitiveness and jobs (European Commission, 2011b). A similar long-term perspective has been developed within the systemic approach, where the notion of transition policy has emerged as a useful analytical framework that goes beyond traditional policy approaches in environment, energy and innovation studies (Kemp, 1997; Rotmans et al., 2001; van den Bergh et al., 2007). Transition policy can be defined as the stimulation and management of learning processes, involving different actors and multiple dimensions, preserving the variety of policy and technological options and motivated by a long-term policy objective (Rotmans et al., 2001). Policies and governments are expected to influence or even mould transitions in economic systems, since systemic changes in current technological and institutional systems, as well as in environmental, energy and social systems, are required to achieve long-term sustainability goals. Transition policy must focus on aiding the design and formation of institutional arrangements that promote and support adaptation mechanisms (Metcalfe, 2005; Dopfer and Potts, 2008). Building on this framework, a sustainable transition system can be defined as a set of institutions and organisations whose collective interactions determine the rate and direction of transition processes towards sustainable development.

The (meta)governance of a transition system should aim at aligning and integrating the elements of different policy dimensions supporting sustainable transition. In the example, the elements of the innovation system, the environmental energy system and labour institutions that are relevant to transition, should be coherently managed within the sustainable transition system to promote sustainable development. However, understanding the complexity of links and interactions among different actors and policy dimensions within the transition system, and the subsequent recognition of the problematic outcomes of coordination activities, gives transition policy the primary role of improving and possibly guiding the adaptive and learning capabilities of agents and institutions involved (Metcalfe, 1995; 2005; Bleda and Del Rio, 2013). In so doing, the valorisation of positive feedbacks that may occur in policy-making processes between perceived policy issues, proposed solutions and policy experiences, as well as of cross fertilisation mechanisms between academic and policy debates, are an opportunity to introduce new instruments and modes of policy action. In this context, instruments that share some of the features of the European technology platforms, as a mechanism for bringing together all interested stakeholders to share a long-term vision of sustainable transition, solve particular issues, and develop collective learning activities, may be powerful tools for augmenting policy coordination and promoting green growth.

## 6.5. Conclusions

The transition to the green economy is considered a unique opportunity for contrasting climate change, escaping the carbon lock-in, promoting the generation and diffusion of eco-innovations, relaunching economic growth, improving employment opportunities, and social cohesion. The academic and policy debate on this issue is gaining attention, leading to public investments and the simultaneous implementation of different policies aimed at fostering sustainable transition. This paper contributes to this debate by focusing on the potential contradictions between different policy objectives linked to green growth. In so doing, the analysis emphasised the complexity of designing an appropriate policy mix and the inherent difficulties of coordination activities aiming at reaching a satisfactory level of policy coherence. It offers examples of potentially contrasting policies in the current framework designed to foster the transition towards the green economy.

Such difficulties emerge in the analysis when a systemic framework is adopted, as it allows us to appreciate how the interactions between agents, institutions and policies shape system performances, and how coordination problems arising from these interactive behaviours are a major issue to be tackled by policy action. Building on the key notion of transition policy, the concept of transition system has been put forward, suggesting the importance of activating learning and adaptive mechanisms involving private agents, stakeholders, policy-makers and scholars interested and involved in the transition process.

In the influential *Theory and practice of innovation policy,* Smits et al. (2010) proposed the metaphor of innovation theory and innovation policy as dancing partners, emphasising the process of shared evolution between various actors interested in influencing the rate and direction of technological change. A similar process is needed between actors interested in fostering sustainable transition. However, if environmental, technological and socioeconomic goals have to be contemporaneously achieved, we would probably have to speak of a (much more complex) ballet in which all actors and scholars in different aspects of the transition process evolve together through mutual learning activities and development of adaptive capabilities. In so doing, the performance of the transition system can be improved, building on feedbacks in policy-making processes emerging from different stakeholders and actors involved, as well as on cross-fertilisation mechanisms between academic and policy debates that may lead to the introduction of new instruments and modes of policy action.

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CHAPTER 7

# Employment effects and qualification needs of a transformation to a greener economy

**Frauke Eckermann**

Numerous studies show that environmental protection offers high employment potential. If this potential is to be realised, employees with the necessary qualifications have to be available: conversely, a shortage of skilled personnel hinders company innovation activities and reduces the environmental economy' competitiveness. To illustrate the employment potential of environmental protection, the paper presents quantitative results on employment in the environmental sector in Germany. Information on qualification structures and future qualification needs is essential for a transformation towards a greener economy, but rarely available. This paper identifies central challenges and fields of action for qualification needs, and presents skills needs and qualification requirements in energy-saving building refurbishment.

## 7.1. Introduction

Numerous studies show that environmental protection offers high employment potential. If this potential is to be realised, employees with the necessary qualifications have to be available. Shortage of skilled personnel hinders company innovation activities and reduces the environmental economy's competitiveness. The transfer of green knowledge and skills has the additional effect that it raises awareness of environmental protection and may lead to a higher acceptance of environmental policies.

This paper presents results on quantitative and qualitative aspects of environmental protection and employment, most of which were obtained in research projects commissioned by the Federal Environment Agency of

Germany. The paper identifies central challenges and fields of action for qualification needs for the transformation towards a greener economy. Section 7.2 presents quantitative results on employment in the environmental sector in Germany. The focus of Section 7.3 is skills and the need for training and qualification in environmental protection, in particular in the renewable energy sector and energy-saving building refurbishment. Section 7.4 concludes and provides policy recommendations.

## 7.2. Employment in the environmental sector

Data on employment in the environmental sector are not provided by official statistics, since environmental protection is a cross-sectional task that creates jobs in nearly all sectors of the economy. Therefore, the Federal Environment Agency of Germany commissioned research institutions to estimate the employment in the environmental protection sector in Germany every two years since 2002 using a standardised method (Edler et al., 2009; Edler and Blazejczak, 2012).

Internationally established conventions and methods help to define the environmental economy. According to the criteria set by the Organisation for Economic Cooperation and Development (OECD) and the European statistics authority Eurostat, the classic environmental protection sectors – waste management, water conservation, noise abatement and air quality control – have been joined by new environment-oriented services to the environmental economy which have only emerged clearly in recent years. Examples include energy and facility management, eco-tourism and environment-oriented financial services. Many companies offer activities that are only partly relevant to the environment, such as consultants who also give advice on energy saving or construction trades that also insulate buildings. In such cases it is important to identify precisely the proportion of environmental protection activities.

As with other sectors, environmental protection gives rise to far more jobs than just those directly based in the industry, such as those necessary for production of the intermediate inputs and for exports. Therefore, the method used to estimate employment in the environmental economy in Germany covers direct and indirect employment. This is achieved by a combined demand- and supply-side approach:

(a) demand-oriented estimates use data from official statistics on domestic demand and on exports of environmental goods as a basis for calculating the volume of employment. Model calculations based on input-output analysis are then used to identify direct and indirect employment. Data on environmental employment due to investments, material expenses and exports are based on demand-oriented estimates;

(b) supply-oriented estimates make use of data such as sales revenue or employee numbers. Conventional statistical surveys of these exist in branches such as recycling and other waste management services; other analyses are made from company surveys in the environmental economy, panel surveys by the Institute for Employment Research (Institut für Arbeitsmarkt- und Berufsforschung, IAB) or association statistics. This makes it possible to register employment implications of environment-oriented services and, to some extent, those of renewable energy.

The combination of the two approaches offers a sound overview of employment in the environmental protection sector, though it also requires careful analysis and the elimination of double counting (see also BMU and UBA, 2011).

In 2008 there were nearly 2 million people employed in the environmental sector in Germany, which corresponds to 4.8% of all gainfully employed persons in Germany. This figure reflects gross employment in the environmental sector, that is the number of jobs necessary to produce environmental protection goods and services as a whole. The importance of environmental protection for the labour market in Germany has grown steadily in recent years. This growth in the number of jobs has been largely due to the expansion of renewable energy, the export of environmental goods, and environment-oriented services. By contrast, the importance of the classic environmental protection sectors such as investment in waste disposal, noise abatement, air quality control and water conservation has tended to decline (Edler and Blazejczak, 2012).

Scientific estimates of the employment impacts of renewable energy sources up to 2012 are provided by O'Sullivan et al. (2013). They show that there has been a strong increase in employment between 2004 and 2011 from 160 500 working in the field in 2004 to 381 600 in 2011. Gross employment in 2012 was about 1% lower than in 2011 (377 800 people), caused by the large decrease in photovoltaics that could only partly be compensated by the increase in the wind energy industry.

There have been constant improvements to the methodology and data on the environmental protection sector in recent years. However, many new fields – such as environment-oriented insurance and product-integrated environmental protection – are still not included adequately, or even at all, for lack of data. The figure of nearly 2 million people employed in the environmental sector in 2008, therefore, has to be regarded as a very conservative estimate.

The 2008 estimate indicates gross employment in environmental protection. To estimate the net employment effect of environmental policies it is necessary to deduct any potential job losses, such as those due to displacement effects and to cost, price and competition effects. It is not possible to determine these net employment effects by statistical means so estimates use scenario analyses which contrast an actual development (including the environmental measure) with a hypothetical situation (excluding the environmental measure). The difference between the numbers of jobs in the two scenarios represents the net effect of the environmental measure. It follows that net employment effects cannot be estimated for environmental policy as a whole, but only for specific environmental policy measures or instruments.

Studies show that environmental protection measures often have positive net effects on employment; examples are presented in BMU and UBA (2011). This is due partly to the fact that labour-intensive sectors profit from environmental protection to an above-average extent. Environmental protection measures may also replace imports with value added within the country, as in the case of energy-saving investments or increased use of renewable energy sources that reduce consumption of fossil fuels such as oil or gas. In 2010, renewable energy sources alone avoided net energy imports of around EUR 6 billion in Germany. Another example is investments designed to improve resource and material efficiency, rendering raw materials imports – at least partly – unnecessary. Lehr et al. (2011) show in a study for Germany that the promotion of renewable energy sources in 2009 created a net 70 000 to 90 000 jobs. A recent study for Germany by Lehr et al. (2013) shows that an ambitious climate policy will have positive effects on employment, particularly in the construction sector, due to additional insulation.

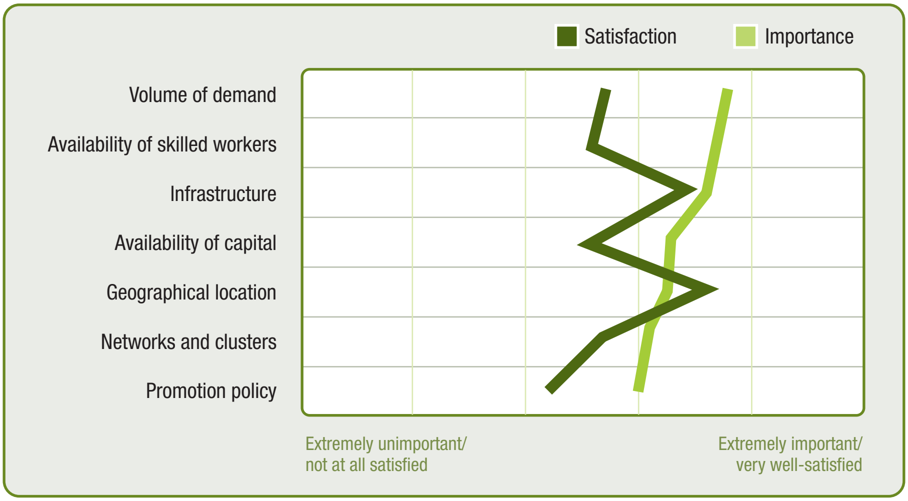
## 7.3. Changing qualification requirements

Restructuring the economy towards a greener economy will result in a greater need for environmental-related qualifications across all industries. A survey among German green tech companies conducted by Roland Berger Strategy Consultants in cooperation with Germany's Federal Ministry of the Environment (BMU, 2009) makes it clear that companies attach great importance to the availability of skilled personnel (Figure 7.1). Demand for their products is the only aspect they consider more important.

PREVIOUS CONTENTS NEXT



Figure 7.1. **Satisfaction of selected location factors in Germany from a business perspective**




*Source:* BMU, 2009, p. 36.

If there is a shortage of personnel trained in the specific skills needed, company innovation activities will start to fall off and the environmental economy runs the risk of not being able to secure and expand its competitive position. Many companies already regard the shortage of skilled personnel as an obstacle to economic development: this trend will be reinforced by long-term demographic change and for economic reasons alone, there is a need to step up efforts to provide environment-related training and qualification. However, such efforts are also an important precondition for Europe to achieve its environmental and climate objectives. Cedefop (Cedefop and ILO, 2010; Cedefop, 2012) show similar characteristics across Europe: the employment potential of environmental protection is increasingly being recognised, but the necessary development of qualifications has yet to be integrated extensively in environmental strategies and programmes. Information on qualification structures and future qualification needs is essential for this, but rarely available.

The qualification profiles required in environmental protection are as varied as the jobs involved. One characteristic of many areas is constantly changing occupation requirements, because the environmental economy typically involves a high level of innovation: technological progress and growing environmental challenges give rise to new requirements. This applies, for example, to the automobile industry, where electric mobility will create new qualification needs along the entire length of the value chain (Barthel et al., 2010). This example also illustrates the fact that an environmental protection qualification is not confined to the classic environmental protection fields, but reaches into many occupations. It is, therefore, not enough simply to modify vocational and academic training for young people entering the labour market for the first time: it is also essential to promote life-long learning. A number of university degrees and courses on environmental topics have emerged already, but the challenge remains to introduce environmental topics into mainstream training and degree courses (European Commission, 2013). While more students studying environmental subjects can be observed, there is further need for qualified personnel. The notion of an environmental job is abstract to many, particularly young people, and the general lack of technical skills also holds for the environment sector, so action must include motivating (young) people to take up environmental jobs.

The survey by Roland Berger Strategy Consultants (BMU, 2009) identifies another green skills dissemination path, as research projects performed by large research institutions become more frequent. Academics from such institutions that move on into industry can use their specialist knowledge to drive innovation.

Table 7.1. **Qualification structure of employees in medium-sized companies in the environmental sector in Germany 2011**

| | Male | Female | Total |
|---|---|---|---|
| University degree | 12.6% | 4.5% | 17.1% |
| University of applied science degree | 7.7% | 2.9% | 10.6% |
| Intermediate qualification level (master craftsperson, etc.) | 8.4% | 1.3% | 9.7% |
| Vocational training school degree | 37.2% | 12.5% | 49.7% |
| Unskilled | 11.0% | 1.9% | 12.9% |
| **Total** | **76.9%** | **23.1%** | **100.0%** |

*Source:* Wackerbauer, 2014, p. 5.

A recent survey by Wackerbauer (2014) among medium-sized companies in the environmental sector in Germany reveals that the qualification structure of their employees is significantly higher than the average of German employees. 27.7% of employees in medium-sized companies in the sector have a university or university of applied science degree, while the average in Germany is 15.1%. The percentage of unskilled workers among employees in medium-sized companies in the environmental sector (12.9%) is also much lower than the average (26.6%); the share of female employees is extremely low (Table 7.1).

In the survey, the question on future demand for employee qualifications was answered with 'constant' or 'increased' for nearly all of the fields by most participants. Only for the unskilled was demand denoted constant or decreasing.

### 7.3.1. Example: renewable energy

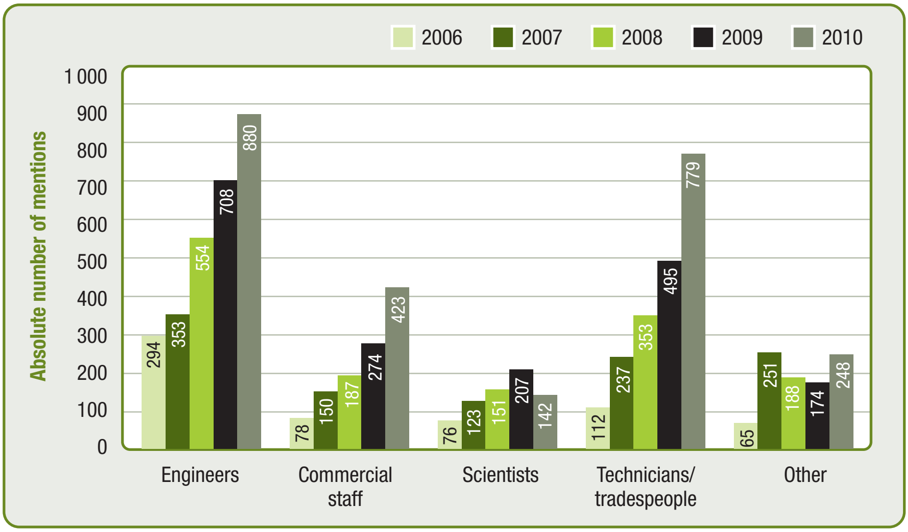
In recent years there has been a very sharp rise in demand for personnel in the renewable energy sector. An analysis of job offers relating to renewable energy shows that it is largely technically oriented qualifications, i.e. engineers, technicians and construction trade personnel, being sought here (Figure 7.2). This is partly due to the great demand for skilled installation and service personnel. Job offers also suggest that the industry is increasingly turning to (non-academic) technicians to make up for the lack of engineers.

A survey of company representatives and experts on renewable energy shows that the knowledge needed for work in renewable energy should be communicated by modifying existing vocational and degree courses, further training measures and supplementary qualifications. The training market has already responded to the increased demand for skilled personnel. The Wissenschaftsladen Bonn (Science Shop Bonn) (2010) found that the number of degree courses relating to renewable energy more than doubled in Germany from 144 in 2007 to 300 in 2010. Bühler (2012) shows that the number has now grown to more than 380 degree courses relating to renewable energy. In addition, cooperation of companies in the craft sector with universities is increasing to prevent skills shortages.

The motivation of young people for climate protection jobs is an important step towards securing the availability of skilled personnel. The Energieparcours-Nordwest ([16]), located in the north-west of Germany, provides an example how this might be achieved. It is a platform that brings together schools and companies of the renewable energy sector. Teaching material is provided that is suitable for different subjects and different age groups and

([16]) Carl von Ossietzky Universität Oldenburg: Energieparcours-Nordwest: http://www.energieportal.uni-oldenburg.de

Figure 7.2. **Basic qualifications required (multiple responses possible) in job offerings related to renewable energy**




*Source:* Ostenrath, 2010, p. 5; BMU and UBA, 2011.

excursions are arranged to companies in the north-western region of Germany. The project is a regional measure for the encouragement of education for sustainable development.

### 7.3.2. Example: energy-saving building refurbishment

Energy-saving refurbishment of existing buildings offers great opportunities for climate protection and employment. Depending on the scenario, savings of between 30 and 70% of greenhouse gas emissions are possible in the buildings sector by 2030 compared with 2010 (UBA, 2009). On average, however, only about one third of the economically worthwhile savings potential in the buildings sector is currently being realised (Kleemann, 2006), one reason being lack of suitably qualified skilled personnel. Greater attention should therefore be devoted to energy-saving issues during initial and further training in all construction trades. Energy-saving building refurbishment also requires more space in the curricula of degree courses such as architecture or construction engineering.

Mohaupt et al. (2011) conducted a survey of experts from companies, associations and initial and further training institutions, focusing on the key questions:

(a) what are the framework conditions, current trends and future issues in energy-saving building refurbishment;
(b) how great is the current and future employment potential in the selected areas of energy-saving building refurbishment;
(c) what skills and competences are expected of those who work in this field;
(d) what are the resulting qualification requirements that vocational training and further education have to meet?

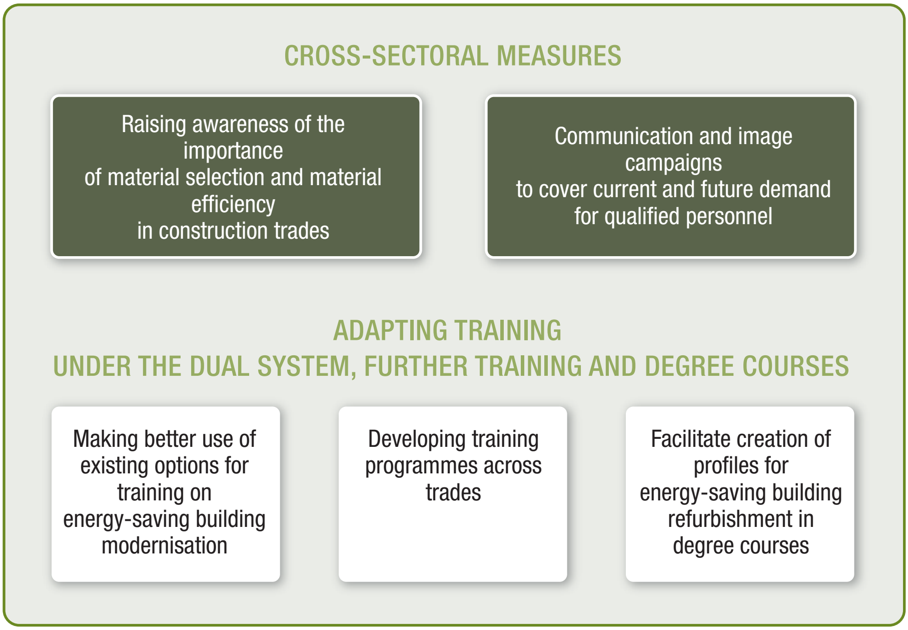
Results were obtained through personal interviews as well as an online survey and an analysis of job vacancies. One challenge that the consulted experts see is the fact that sound basic training is important for the trade and yet the pace of development in the field is fast, which implies that new topics have to be included in training courses. Training in planning and implementing trades is considered to have positive effects on material efficiency. Insulating material, for example, is normally chosen based on thermal conductivity and price; a life cycle analysis including recycling potential is not performed. Awareness of the importance of material selection and efficient use of materials may be raised by training and qualification. The experts identified assistance programmes as an important framework condition for energy-saving building refurbishment. In addition to the direct effects, they trigger additional investments many times the actual amount of assistance. Another important aspect is the legal framework with respect to the rented housing sector.

Current and future employment potential is considered positive, since energy-saving building refurbishment has the potential to secure jobs along the entire value chain. Demographic change, however, is likely to pose a problem for trades. The survey shows that, in addition to specialist knowledge about potential savings and energy efficiency measures, consulting and team skills are of particular importance. The experts also consider coordination between trades and the ability to see the overall picture as essential. The most important requirements from the point of view of the experts working in the sector are, according to Mohaupt et al. (2011) the following:

(a) the overall picture: overview of energy-saving refurbishment as a whole and the resulting requirements to be met by the individual actors;
(b) coordination between trades;
(c) material science, material efficiency: material properties, energy consumption during production, choice of correct materials;
(d) identification of potential savings: knowledge of energy-efficiency measures, savings potential with regard to different materials;
(e) specialist commercial knowledge: not only purchase costs, but also life-cycle costs;

(f) communication and consultancy competence;
(g) management competence;
(h) logistics and construction planning;
(i) legal knowledge: for example, implementing the energy saving ordinance;
(j) financing: financial planning, knowledge of opportunities for assistance: sources of funds, conditions.

Figure 7.3. **Action recommendations in energy-saving building refurbishment**




*Source:* Authors based on Mohaupt et al., 2011.

There should therefore be offerings in initial and further training which promote the interaction of planning and implementing trades. Choice of construction materials should take account of the entire life cycle, including energy consumption and resource consumption in the manufacture of building materials or insulating materials and their recycling properties. Since the advice given by the planning and implementing trades influences the choice of materials, it makes sense to provide special qualifications in this field. The experts confirm that the view that qualification should be brought about by modifying existing occupations, instead of creating new ones, also applies to energy-saving building refurbishment. Acquiring qualifications should take the form of sound specialist upgrading. The five action recommendations arising from these requirements are summarised in Figure 7.3. and include cross-sectoral measures as well as those directly related to adjusting courses: initiate communication and image campaigns to cover current and future demand for qualified personnel; make better use of existing options for training and further education on energy-saving building refurbishment; raise awareness of the importance of material selection and material efficiency in construction trades; develop, test and evaluate cross-trade further education and training; and support creation of profiles for energy-saving building refurbishment in degree courses.

## 7.4. Conclusions and policy recommendations

Properly trained, skilled employees are an important precondition for further growth of employment in the environmental protection sector. Lack of skilled specialists is already impeding development. This problem will be exacerbated by demographic change. Greater attention should therefore be devoted to energy-saving issues during initial and further training in vocational training and degree courses, to make the most of the opportunities that environmental protection offers for the labour market. Starting points to counter skill shortages and skill gaps could be:

(a) **forecast future skills and occupational demands.**
Information on employment potential and qualification needs is in short supply in most countries. More research on other aspects, including the questions of which skills and qualifications are needed in which sector, is required. This includes international cooperation on definitions and estimation methods;

(b) **motivate (young) people to take up an 'environmental job'.**
The notion of an 'environmental job' is abstract to many, particularly young people. In addition to improved data on the qualifications needed in a green economy, better communication on the need for transformation towards a green or low-carbon economy, as well as the relevant qualifications, is essential. The need for action encompasses motivating (young) people to take up 'environmental jobs'. To achieve this, parents and teachers also have to be informed.

(c) **adjust training and degree courses.**
It is often not necessary to develop new degrees or professions; adjusting

existing ones is enough. This holds for degree courses as well as training programmes. Existing options for including environmental aspects in the curricula also have to be used better. Teacher training plays an important role in this. The adjustment of training and degree courses is also linked to motivating young people to take up environmental jobs. An early involvement of practical sessions during degree courses might motivate students to pursue a certain job.

(d) **support exchange between management personnel.**
The analysis on energy-saving building refurbishment has pointed out the importance of the overall picture and coordination between trades; the advantages of cross-trade or cross-company cooperation go beyond energy-saving building refurbishment. Managers have to be made aware of the need for transition to a green or low-carbon economy and of the advantages of (interdisciplinary) cooperation. Supporting exchange between management personnel might help to increase such cooperation. Networks should be established, as well as specialist exchanges at opportunities such as workshops and seminars. This would allow acquisition of knowledge beyond one's own field and has the potential to foster the development of new and innovative ideas.

(e) **get employees involved.**
It is often the employees who know best which processes can be made more energy- or resource-efficient, which is why it is important to raise their awareness of the need for transformation and to establish corporate culture that enables their participation and adoption of improvements.

There is a need to anticipate the required environmental qualifications and to step up efforts to provide environment-related training and qualification. These aspects should be integrated in environmental strategies and programmes. Implementation of these actions will only be successful if done together by all stakeholders.

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CHAPTER 8

# The ‘build up skills’ initiative: policy coordination to upskill building workers

**Nathalie Cliquot**

This paper ([17]) provides an overview of the activities and achievements realised under the ‘build up skills’ initiative: a strategic European initiative to stimulate the training of craftspeople and other on-site workers in the building sector on the topics of energy efficiency and renewable energy. This paper aims to present the build up skills initiative, its context and specificities. It shows how the initiative has contributed to a major mobilisation in Europe in favour of upskilling the building workforce while facilitating horizontal (energy, employment, education and training) and vertical (European, national, local) coordination of policies. It also presents the initial outcomes and data from the national build up skills reports and examples of roadmap measures identified by build up skills projects.

## 8.1. About the build up skills initiative

The large contribution expected from the building sector to the European 2020 energy objectives and the transition to a low-carbon economy is a major challenge to the construction industry, which needs to deliver renovations offering a high energy performance and new ‘nearly zero-energy buildings’ ([18]).

([17]) This document is based on input provided by 30 national project teams involved in the ‘build up skills’ initiative (list of pillar I project coordinators available at http://www.buildupskills.eu/en/about) and was reviewed by William Gillett (EASME).

([18]) ‘Nearly zero-energy building’ means a building which has very high energy performance, determined in accordance with Annex I to the energy performance of buildings directive (recast). The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including renewable energy produced on-site or nearby (European Parliament and the Council, 2010, Article 2: definitions).

To meet these objectives, major efforts are needed to improve the skills of building workers. From a governance perspective, this requires the involvement of stakeholders and public authorities across several policy domains (energy, employment, education and training).

The build up skills initiative is currently carried out under the framework of the intelligent energy Europe (IEE) programme to unite forces and to increase the number of qualified workers in the building workforce in Europe. The IEE programme is the European Union instrument to support EU energy efficiency and renewable energy policies ([19]).

Build up skills focuses on the continuing education and training of craftsmen and other on-site workers in energy efficiency and renewable energy in buildings and has three components:

(a) national qualification platforms and roadmaps to 2020: this aims to trigger processes to gather all relevant stakeholders in a country to develop a strategy and roadmap, to identify and quantify needs and priority measures. The first phase of these build up skills projects was to complete an analysis of the state of play compiled in a national status quo report. The second phase was to develop a roadmap of priority measures to be taken by 2020;

(b) qualification and training schemes: this component aims to support the introduction of new, or the upgrade of existing, qualification schemes. These should be based on the build up skills roadmaps to 2020. Ten build up skills pillar II projects started in October 2013 and 12 additional pillar II projects started in September 2014. In spring 2015, four projects started on construction skills based on build up skills pillar I, funded by the 'horizon 2020' programme.

(c) Europe-wide support activities: the objective is to support the exchange of best practices through meetings of all participating build up skills projects.

([19]) Since 2003, the intelligent energy Europe (IEE) programme has been one of the EU's instruments to tackle non-technological barriers to the spread of efficient use of energy and greater use of new and renewable energy sources. One of the main objectives of the IEE programme was to promote institutional capacity building by encouraging exchanges of experience and know-how among the main players concerned, business and citizens in general. From 2007, IEE has been included in the overall competitiveness and innovation framework programme (CIP) to contribute to achieving the objectives of EU energy policy and to implementing the Lisbon agenda with a budget of EUR 730 million for 2007-13. The programme is managed by the EASME, which replaced EACI on 1 January 2014, under powers delegated by the European Commission.

### 8.1.1. The EU context: ambitious EU energy objectives and strengthened requirements for the energy performance of buildings

In March 2007 the European Union agreed ambitious EU energy objectives to increase sustainability, competitiveness and security of supply. The EU committed itself to the 20-20-20 initiative: reducing greenhouse gas emissions by 20%, increasing the share of renewables in energy consumption to 20%, and improving energy efficiency by 20%, all by 2020.

The building sector has a particular role to play as it represents about 40% of energy use in the EU, with the largest cost-effective savings potential. In 2009 and 2010, the EU adopted an ambitious vision for the energy performance of its buildings, with the strengthening of the directive on energy performance of buildings (European Parliament and Council of EU, 2010) and the directive on renewable energy sources (European Parliament and Council of EU, 2009). By 2020 all new buildings shall be nearly zero-energy, with intermediate targets by 2015. In parallel, Member States shall draw up national action plans for increasing the numbers of nearly zero-energy buildings. These national action plans shall include policies and measures to stimulate the transformation of existing buildings, which are refurbished, into nearly zero-energy buildings. By 2015, all new buildings and those undergoing major renovation ([20]) must have minimum levels of energy from renewable energy sources. Therefore, a major transformation is expected in the building sector during the next few years.

In 2009, Directorate-General for energy of the European Commission commissioned a study on the training and qualification needs of the building workforce (Ecorys Nederland BV, 2010) to support the major efforts and contribution of the building sector to the energy objectives. The study explored the possibility of a strategic initiative on the qualification and training of building workers under the IEE programme.

The report concluded in March 2010 that the potential target group for such an initiative was around 2.5 million workers across the EU-25 by 2015, representing some 16% of total construction sector employment. Mapping the types of skills needs and the skills profile of the target group, it was estimated that almost 90% of requirements would arise at 'lower and intermediate skills levels'. It also pointed out the lack of data on energy efficiency and renewable

([20]) 'Major renovation' means renovation of a building where (a) the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25% of the value of the building, excluding the value of the land upon which it is situated, or (b) more than 25% of the surface of the building undergoes renovation.

energy sources skills in the building sector. The report highlighted that the EU had already funded a wide-range of capacity building and training activities in the building sector through various actions such as the IEE programme and the Leonardo programme on lifelong learning and the European Social Fund. However, in view of the scale of the transformation expected from the building sector and the strengthening of requirements on energy performance, major additional efforts seemed required for a comprehensive strategy on the qualification and training of building workers.

### 8.1.2. Distinctive features of the build up skills initiative

Following internal inter-services consultations within the European Commission, as well as stakeholder consultations with a selected group of stakeholders during 2010, the concept for a major qualification and training initiative under the IEE programme was refined. It was decided that the initiative would focus on the continuing education and training of on-site building workers and installers. In addition, build up skills would benefit from distinctive features compared to usual IEE projects:

(a) a phased approach with implementation foreseen and announced over a three-year framework, with separate deadlines from the main IEE call for proposals:
   (i) establishment of national qualification platforms and qualification roadmaps to 2020 (pillar I, IEE calls for proposals 2011-12). The maximum duration of such projects was set at 18 months;
   (ii) development and upgrade of qualification and training schemes (pillar II, IEE calls for proposals 2012-13). The maximum duration of projects is 36 months;

(b) national projects complemented by EU exchange activities directly managed by the European Commission and the EACI/EASME. Unlike other IEE projects, a build up skills consortium had to include a team of legal entities from the same country for pillar I projects or from one or several countries for pillar II projects. Compulsory tasks on EU exchange activities were foreseen in the work programme of each project. In addition to EU exchange meetings (two meetings per year), peer review teams of three countries were established to encourage further exchanges;

(c) also for build up skills pillar I projects:
   (i) it was announced that only one project per country would be funded;
   (ii) the EACI/EASME developed a specific guide for proposers, applications forms with detailed requirements (persuading experts from the energy, vocational education and training and the building

sector to participate, set-up of a national qualification platforms open to all interested stakeholders, delivery of a national status quo analysis within the first six months of the project, mandatory endorsement activities to ensure the buy-in of national stakeholders, especially public authorities, mandatory outlines for status quo national reports and for build up skills roadmaps);

(iii) a specific (higher) EU funding rate (90% of eligible costs) was proposed;

(iv) additional promotion efforts for the call for proposals were implemented (specific EU information session in March 2010, 17 national information sessions organised in the countries in collaboration with national contact points of the IEE programme, with the participation of stakeholders from the building and education sectors).

These elements are important as they contributed to the success of the initiative. Build up skills was launched under the IEE work programme 2011 (European Commission, 2011a). The response was outstanding for a first call for proposals, with 41 proposals received from 27 countries. The first 21 build up skills national projects started in November 2011. These were shortly followed by nine additional projects in June 2012 covering the EU-28, Norway and the former Yugoslav Republic of Macedonia.

### 8.1.3. Mobilisation success in Europe

With the objective of gathering stakeholders across several sectors to agree on roadmaps of priority measures by 2020, build up skills was designed as an instrument to mobilise and unite forces to increase the number of qualified workers in the building workforce in Europe.

#### 8.1.3.1. *Mobilisation at national level across the building, energy, and education and training sectors*

A prerequisite for a build up skills pillar I proposal was to involve stakeholders from several sectors: building, energy, and education and training. This could be directly through participation in the project's consortium or through participation in project activities. Proposers had to seek support and provide evidence, through letters of support, with the main organisations involved: relevant public authorities, leading institutions in the continuing training system of the buildings sector, social partners, building industry federations and professional chambers, equipment manufacturers, renewable energy system producers and installers, architects and sustainable buildings experts, accreditation and certification bodies, and potential financing bodies. The stated objective to finance one proposal per country under the initiative, also helped mobilisation, as several national organisations worked towards a single country application.

The organisations directly involved in the consortia of pillar I countries varied across countries; the variety is reflected in the organisations taking the lead for project coordination. Seven pillar I projects were led by national energy agencies, 10 by specialised national energy or building centres, four by organisations involving social partners and directly involved in the qualification and training of workers such as building sector training funds or skills councils, three by education organisations or training providers (universities, technology institutes), and three by professional chambers and associations. One regional authority, one not-for-profit employment organisation and an energy financing institution are among the list of coordinators. The number of organisations involved in the national qualification platforms is provided in Table 8.1.

Table 8.1. **Number of organisations involved in national qualification platforms of build up skills pillar I projects**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **AT** | 80 | **EL** | 47 | **LT** | 25 | **PT** | 34 |
| **BE** | 85 | **ES** | 35 | **LU** | 16 | **RO** | 271 |
| **BG** | 42 | **FI** | 73 | **LV** | 30 | **SE** | 35 |
| **CY** | 10 | **FR** | 192 | **MK** (*) | 80 | **SI** | 37 |
| **CZ** | 58 | **HR** | 60 | **MT** | 65 | **SK** | 31 |
| **DE** | 54 | **HU** | 31 | **NL** | 147 | **UK** | 153 |
| **DK** | 24 | **IE** | 12 | **NO** | 10 | | |
| **EE** | 12 | **IT** | 50 | **PL** | 30 | **Total** | **1 829** |

(*) MK is a provisional code which does not prejudge in any way the definitive nomenclature for this country, which will be agreed following the conclusion of negotiations currently taking place under the auspices of the United Nations.

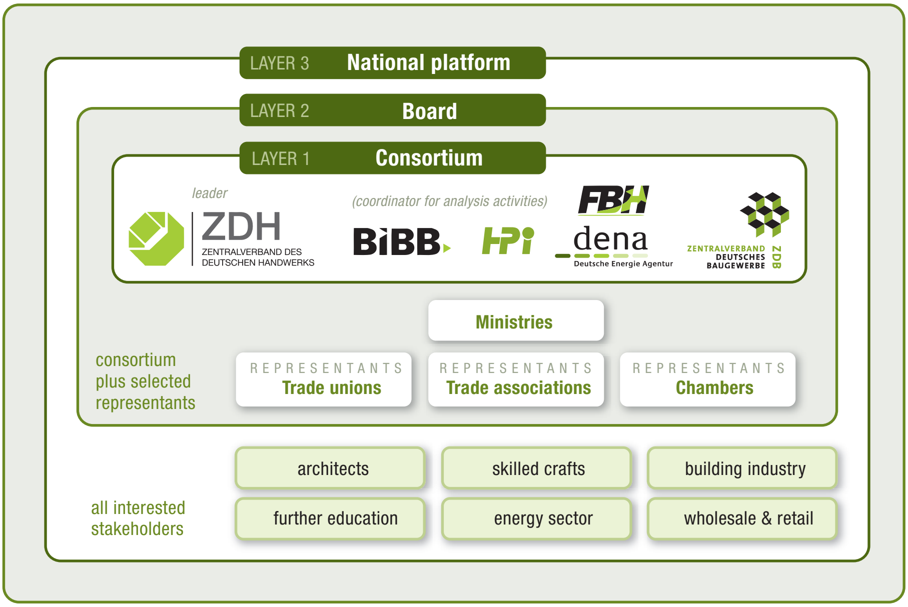
*Source*: Build up skills projects factsheets and reporting to EASME/EACI.

The work programme of all pillar I projects had to be designed for cross-sector mobilisation, for instance by establishing a national qualification platform to develop and validate the findings from the analysis of the state of play (national status quo report) and the roadmap priority measures.

Build up skills has engaged around 1 800 organisations across 30 countries (EU-28, Norway and the former Yugoslav Republic of Macedonia) in national qualification platforms, according to project reporting and preliminary findings.

Some projects included other layers of consultation, such as the German project which also included a board with trade unions and ministry representatives.

Figure 8.1. **Representation of the build up skills German project**




*Source*: Presentation from build up skills Germany at the build up skills EU exchange meeting one, November 2011.

Some build up skills projects included a strong regional dimension such as in Latvia. This was managed by the Latvian planning regions with five regional events and a national one on results of the analysis of national status quo, with at least 350 stakeholders participating. Build up skills France also included a regional consultation, with the organisation of six inter-regional consultation meetings. This is all the more important given that regional authorities are the competent public authorities in charge of continuing education and training.

Build up skills projects not only had to organise and animate discussions and platforms; it was also compulsory to include so-called 'endorsement activities' demonstrating the commitment of key stakeholders to implement the roadmaps. In most countries, this resulted in the support of national authorities and ministries, with letters of commitment to undertake specific measures proposed in the roadmaps.

#### 8.1.3.1. *Mobilisation at European level: EU exchange and use of other policy frameworks and instruments*

In addition to national mobilisation, exchange activities were organised at EU level with a series of EU exchange meetings (November 2011, June and November 2012, April and November 2013). Three representatives of each country build up skills team were invited to take part in each meeting with a request to balance the expertise between building industry experts and vocational education and training. The meetings gathered around 100 participants and were designed to encourage small group discussions, with selection of topics by the participants. The first meetings focused more on project methodology: communication activities, endorsement strategies, methodology for status quo analysis and for analysing skill needs and gaps. The topics addressed evolved to cover crucial aspects of the roadmaps on funding and financing schemes, attracting SMEs to training courses, encouraging public-private partnerships, and the mobility of workers.

Projects were also gathered in peer review teams of three countries, with resources to organise separate meetings and peer coaching.

The initiative also contributed to other EU strategies and policies. The issue of 'skills and jobs' is high on the EU agenda and the Europe 2020 overarching strategy promoting smart, sustainable and inclusive growth. In 2010, the European Commission launched the 'agenda for new skills and jobs' (European Commission, 2010). This initiative is how the Commission will help the EU to reach its employment target for 2020: namely that 75% of the working-age population (20 to 64 years) should be in work. The 'new skills for new jobs initiative' (European Commission, 2008) set out the Commission's agenda for better skills upgrading, anticipation and matching. Skills development forms one of the four main areas of this flagship initiative. More specifically for the building sector, the European Commission published a communication on a *Strategy for the sustainable competitiveness of the construction sector and its enterprises* (European Commission, 2012). Improving the human-capital basis of the construction sector' is identified as a key component of the strategy. The *Energy efficiency plan 2011* (European

Commission, 2011b) also recognises the importance of training and refers to the build up skills initiative as an instrument to 'support Member States in assessing training needs for the construction sector, developing strategies to meet them, and fostering effective training schemes' (European Commission, 2011b), which could lead to recommendations for the certification, qualification or training of craftsmen.

In parallel, the framework for vocational education and training is also evolving, with Member States using the European qualifications framework (EQF) which aims to relate different countries' national qualifications systems to a common European reference framework. This creates opportunities for build up skills projects to develop qualification schemes in line with the EQF, and to use other instruments such as the ECVET voluntary credit system. Considering the mobility of the building workforce, these instruments could aid recognition of qualification and training between different countries and learning environments. All new build up skills qualification and training schemes (pillar II) supported by the IEE programme must be aligned with the new EQF.

## 8.2. Identifying barriers for the training of building workers

Another objective of the build up skills initiative was to identify skills needs and gaps in the building workforce and provide additional data on the qualification and training of building workers (craftsmen and on-site workers). Each project was free to develop its own methodology to gather data, necessary given the different starting points in the countries covered. A common template and outline developed by EASME/EACI aimed to ensure minimum consistency between all projects. A common data factsheet was also requested from all build up skills projects to aid cross-reading of key data.

The analysis of the 30 national status quo reports builds on various data collection and analysis methods. The main sources were companies/employers, social partners, training providers (public and private professional schools, universities, colleges), government institutions (including regional and local authorities and public employment services), building and energy sectors, associations, chambers, federations, consulting companies, research institutes, NGOs, banks, as well as European and international organisations.

### 8.2.1. Characteristics of the building sector and the build up skills target group

The building sector is a major employer in the EU although it is experiencing adverse effects from the economic crisis in several countries. The sector is dominated by micro companies and its structure is fragmented, with complex supply chains. The sector also contributes to the grey economy or the informal economy more generally.

The build up skills target group (craftsmen and on-site building workers) is composed of a relatively high proportion of lower-skilled workers, with a large predominance of male workers.

Several countries refer to building workforce migration. Some (Estonia, Romania) highlight difficulties in avoiding the movement of highly specialised building workers to neighbouring or other EU countries. In parallel, Nordic countries (Norway, Finland and Sweden) note an increase in the number of foreign workers in recent years. In Ireland and Spain, in contrast, the number of foreign workers has decreased significantly with the economic crisis.

### 8.2.2. More than 3 million workers require up-skilling by 2020

Most European countries will experience at least a slight shortage of building workers by 2020 but the need for training of the current workforce is much stronger than the estimated need for additional workers. This highlights the importance of continuing education for the current workforce.

The EU building sector mostly experiences skills gaps (vacancies filled/ jobs done with incomplete skills set) rather than skills shortages (vacancies not filled/ jobs not done due to the lack of people with at least some knowledge, skills and competences). Data from the national status-quo reports suggest an urgent need to upskill the existing workforce, not to retrain it. More than 3 million workers would require upskilling on energy efficiency or renewable energy sources by 2020.

Carpenters and joiners, bricklayers and stonemasons, and building electricians are the most frequently mentioned occupations identified as requiring additional training. When detailed data are provided, these occupations are also those with the highest numbers of workers requiring additional training and with the highest demand expected in the labour market.

However, the national status quo reports also identify specific skills needs for other occupations. Many reports point to the importance of transferable and cross-trade knowledge and skills related to the energy performance of buildings.

The current qualification courses and schemes required for the energy performance of buildings, and the training and accreditation structures for carrying out these courses, are not satisfactory and are underdeveloped, even in countries with highly favourable conditions for adult learning.

This reinforces the need for upskilling of workers, including support for training trainers and improved monitoring systems to prevent skills gaps in the sector.

### 8.2.3. Main barriers to the training of building workers

National status quo reports (Cliquot and Gausas, 2013) also identified the most important barriers to training the building workforce:

(a) administrative, legal and policy-related barriers: the fragmented and unstable political environment is often mentioned as a barrier. This is characterised by, for example, the excessive number of institutions, the lack of coordination of policy implementation, the lack of coherence between policy plans and actions, or frequent changes in policy priorities and decisions. The consequence is lack of predictability in national policy and uncertainty among those operating in it, leading to lower training demand;

(b) market barriers: the market for energy efficiency and renewable energy systems is small and the demand for energy efficiency and renewable energy solutions is limited. This results in low interest in relevant training;

(c) economic and financial barriers: the lack of funds and uncertainty over results also undermine the participation in training schemes. The available support is often short-term, based on one-off schemes and lacks a coherent national strategy. Workers and companies see training as a cost rather than as an opportunity. The economic crisis has increased uncertainty and, coupled with high employee turnover, has reduced the willingness of companies and their workers to enrol in training;

(d) education and training barriers: several reports point to deficiencies in the education and training offer (low quality, outdated programmes, lack of consideration of labour market needs, inflexible training provision and lack of balance between practical and theoretical training) and limited training supply (lack of training courses, on-the job training opportunities and apprenticeship places in the industry) and underdeveloped training infrastructure and materials;

(e) cultural and linguistic barriers: this is particularly important in the context of foreign building workers, as limited language skills often prevent foreign workers from accessing training courses.

### 8.2.4. Overcoming barriers: national 2020 roadmaps

Based on the national status quo reports, all build up skills projects identified priority measures to upskill building workers by 2020. The main measures proposed by all 30 national roadmaps can be divided into four topics:

(a) training: build up skills roadmaps generally propose upgrading training schemes and/or developing new schemes, as well as training for trainers. Training measures include setting up training for new roles in the building sector (quality coaches, mentors), adapting training content for craftspeople (e-learning, practice-oriented, short duration, winter or evening courses), developing specific trade training where there have been gaps but also encouraging cross-trade training;

(b) incentives: alongside the training measures, roadmaps propose boosting incentives for a qualified workforce through improvements in quality control. They also suggest linking several instruments such as public tenders, subsidy schemes for renovation and the energy performance of buildings to the use of skilled workers. Companies working with skilled workers could also benefit from tax and insurance premium rebates.
Making skilled workers more visible on the market through certification schemes or skills cards is also frequently proposed to attract workers to training schemes, while recognition of informal on-the-job training should also be supported;

(c) financing: roadmaps have identified several possibilities to finance training and other measures, such as the use of specific training funds (for instance existing subsidies for the self-employed or paritarian funds, established, funded and managed by social partners themselves), and European funding such as the European Social Fund. Training by professional associations, sometimes based on membership fees, is also proposed.
However, in many cases, it is expected that EU funding will bear the costs of implementing roadmaps through the European Social Fund or through IEE funding for build up skills pillar II projects;

(d) awareness: awareness-raising campaigns, for workers, employers, and building owners, could encourage the use of a skilled workforce.

## 8.3. Conclusions and outlook

The first phase of the build up skills initiative (pillar I) has successfully mobilised more than 1 800 organisations in 30 European countries across various sectors (building, energy, education and training) to boost the continuing or further education and training of craftsmen and other on-site construction workers and system installers in the building sector.

It has helped to identify the scale of the issue (upskilling more than 3 million workers by 2020) as well as the main barriers to training workers. It has triggered commitments by key market players to implement priority measures through endorsement.

It has fostered EU exchanges on common problems across countries (attracting SMEs, funding schemes, and promoting quality in the building sector) and identified relevant topics where further European responses are needed (cross-border mobility of workers and recognition of qualifications).

The second phase of the initiative on qualification and training schemes has started. Ten pillar II projects started in November 2013, 12 in September 2014 and four projects on construction skills, funded by the horizon 2020 programme, started in March 2015. However, although the IEE programme financed the set-up or upgrade of training schemes, as well as other coordination activities, financing for large-scale training of building workers is much bigger and still needs to be secured. This major financing challenge must now be tackled to achieve a smooth transition to a low-carbon economy.

## 8.4. Abbreviations

| | |
|---|---|
| **EACI** | Executive Agency for Competitiveness and Innovation |
| **EASME** | Executive Agency for Small and Medium-sized enterprises |
| **IEE** | intelligent energy Europe |

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CHAPTER 9

# Green skills and training as a starting point for prospective green jobs in the cross-border region Upper Austria and South Bohemia

**Alexander Staufer, Gerhard Zahrer** and **David Lechner**

The need for sustainable system transformation and the associated green skills pushes classical vocational and educational training (VET) to its limits. Specific technical skills can be provided easily within classical VET structures, when a set of skills is already established and reproducible and scalable. The challenges we face, as society and economy, which arise from ecological boundaries, seldom lead to clear tasks on how to tackle these issues and therefore teach the appropriate skills. Further, solutions have to be found, described and designed during the process of vocational and educational systems. An extended set of skills is needed to turn system knowledge into workable processes for companies and policy-makers.

A new green skills approach was tested within the 'interreg' project between Upper Austria and South Bohemia. Since most solutions cannot be found within single organisations, the focus of the project was on regional learning platforms and increasing knowledge production and cooperation among actors from different backgrounds.

## 9.1. Introduction

This paper deals with the key issues of green growth and the required green skills needed to stay competitive in the region. In 2012 the regional government of Upper Austria launched a green job master plan (Land Oberösterreich, 2011). The European cross-border cooperation project 'green skills and training as a starting point for prospective green jobs in the cross-border region Upper Austria and South Bohemia' investigated possible pathways to establish green skills in vocational education and training (VET) for regional companies.

This paper focuses on the key insights of this continuing cross-border project. The main challenge of the project is to implement an already developed green skills approach (Land Oberösterreich, 2011) in the context of local sustainability-oriented performance areas and to link and integrate VET to the regional skill demands of relevant actors, plus to draw conclusions for future VET programmes and new research areas.

## 9.2. Initial situation and research question

Various medium- to long-term strategies for sustainable development have been formulated in recent years. Local, regional, national, European and global institutions have become more aware of the grand challenges and defined targets for sustainable growth based on scientific findings. These macro goals seem to be clear but the different ways and approaches to achieve them at microregional level are still uncertain and the real challenge. The nature and scale of climate change, and the impacts that scarcity of resources and energy will have on the world, are unprecedented; there is no known way of dealing with them. Top-down strategies can lead and support the change towards sustainability, but are not sufficient to enable the societies' potential green transformation. The limits of policy driven efforts, and the lack of historic knowledge on how to deal with these challenges, also defies the classical VET system. Against the backdrop of the major social challenges of sustainability and a viable transformation of society and the economy, significant questions remain on how to influence and to adapt the processes of change.

The leading research questions were defined as:

(a) how can we transfer the (inter-)national goals into local performance areas; and
(b) which skills and VET programmes are required to obtain sustainable transitions?

## 9.3. Research and training design

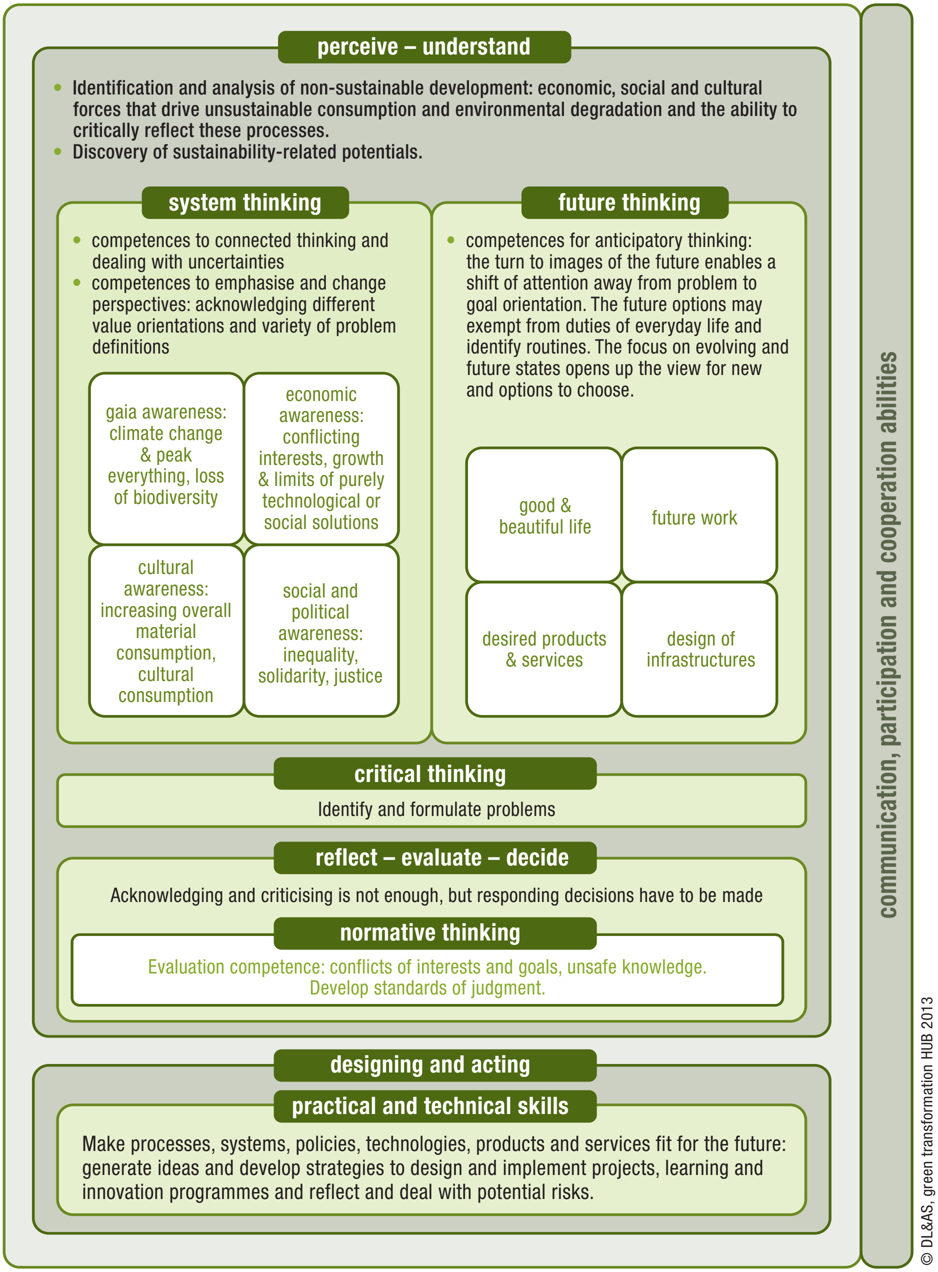
The European cross-border cooperation-project 'green skills and training as a starting point for prospective green jobs in the cross-border region Upper Austria and South Bohemia' is a pilot initiative in Upper Austria and South Bohemia to implement and test how to design a research driven VET programme to establish the appropriate green skills to boost green growth and support the creation of new jobs in a specific region. The VET experiences achieved and know-how established lead to better and more efficient education approaches to accelerate transformation towards sustainability and to meet the EU 2020 goals and the Upper Austrian green job targets.

The project was designed to promote bilateral transfer of know-how to gain transnational experiences in how VET for a greening of society must be taken into consideration and what efforts are needed. The basic positions in Austria and the Czech Republic are very different. In Austria it is widely accepted that greening of the economy is important, even though the directions to follow and the speed of change are highly disputed. Some highly specialised green tech sectors are already established and internationally renowned, and their spheres of interest have reached a relevant public level. In comparison, in the Czech Republic green energy is less developed, is considered as expensive and somehow utopian, so the need to enable a green economy is not of mainstream appeal. These preconditions have led to different strategies and country-specific approaches. This paper focuses more on the Austrian approach, even though many aspects were carried out the same way.

## 9.4. Learning strategy

In advance of this European cross-border cooperation project, the regional government of Upper Austria saw the need to address the green economy better and commissioned the study *Medium-term innovation and qualification requirements/needs in the field of eco-technologies and eco-economy in Upper Austria* (Land Oberösterreich, 2011). This study identified the need for a new integrated learning approach and was led to the green education approach of Lechner. This approach was refined and is now being tested in a pilot learning programme within the scope of the project 'green skills and training as a starting point for prospective green jobs in the cross-border region Upper Austria and South Bohemia'.

Figure 9.1. **Integrated green skills matrix**




*Source*: Authors.

The approach identifies that learning for an accelerating pace of development to a greener society does not primarily need technical skills, but a set of competences that enable people to design and implement solutions in the right direction. Green education programmes, currently offered by several institutions across Upper Austria, have a clear focus on technical skills; these are important and have to be provided, but are not sufficient as a stand-alone solution.

Technical skills have their own delivery logic and companies have good experience and tradition of supporting them, often using professional vocational training institutions. More specialised technical training for new technologies such as software programmes (such as electrical engineering programmes) or equipment (such as photovoltaic installation) are often offered by manufacturers themselves or from related training associations.

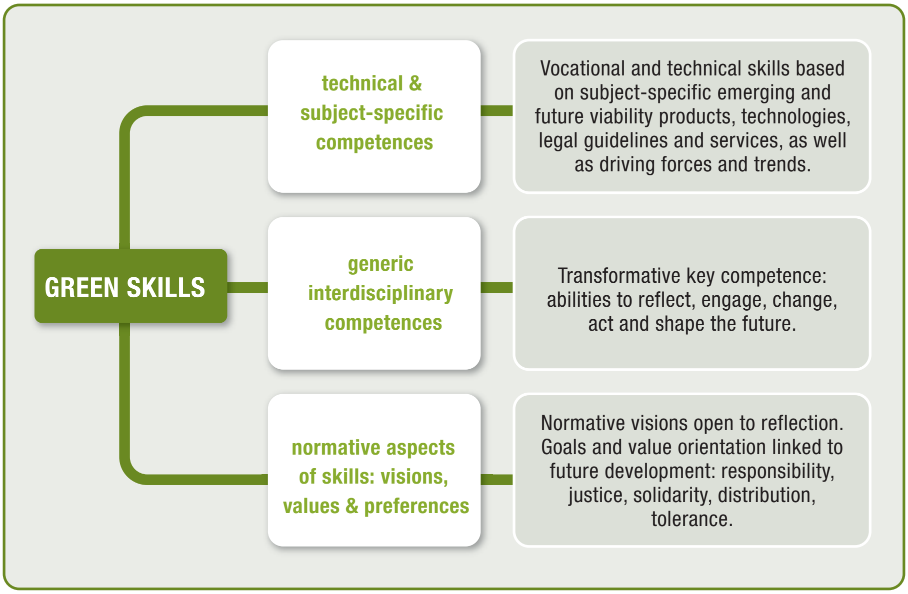
Technical training programmes follow the needs and demands of companies and developing technological trends. They are booked when technological improvements arise, more orders are expected, or current skilled employees retire, and new workers need to be trained to replace them. Such skills have a clear focus of bringing together supply and demand and can be managed relatively well within existing institutional arrangements. They can be described as sector-oriented and addressing individuals.

These green skills learning programmes, do not take into consideration that the needed competences are not solely practical. Training programmes only work well when working practices and related processes have already been established and are part of business routines. The problem intensifies when problems, and therefore solutions, are not even systematically understood. This challenges companies and regions to create adequate learning environments to find own solutions.

More complex problems are characteristic of the green challenge and require new solutions, involving many sectors. These problems cannot be solved within a single company or public institution, but often need a cross-sectoral approach. This demands interdisciplinary skills to create shared problem definitions and shared solving perspectives. New value chains emerge from or transform existing ones, so competences of cooperation and interaction between organisations are needed to devise more sustainable solutions. As a further important category is the normative aspects of skills, these must also be addressed as they reflect societal and cultural values and visions.

## 9.5. Research design

Figure 9.2. **Categorising green skills**




*Source*: DL&AS, translation research and strategy lab, LiquA.

### Methodology and data analysis

Identifying relevant topics was done from comprehensive desk research and interviews with relevant experts (N = 20) from regional, national and international level and from different areas of science, industry and politics. The regional structure of economy of Mühlviertel, in Upper Austria, was analysed and based on identified sustainability and lifecycle-oriented topics. Four relevant evidence-based performance fields were depicted: resource-efficient buildings, energy-efficient buildings, cascading use of bio resources, and food refining strategies. An integrated approach was developed based on the lifecycle model of the green economy and the lifecycle model of buildings.

### Research methods in detail:

(a) research of basic materials, documents and studies;

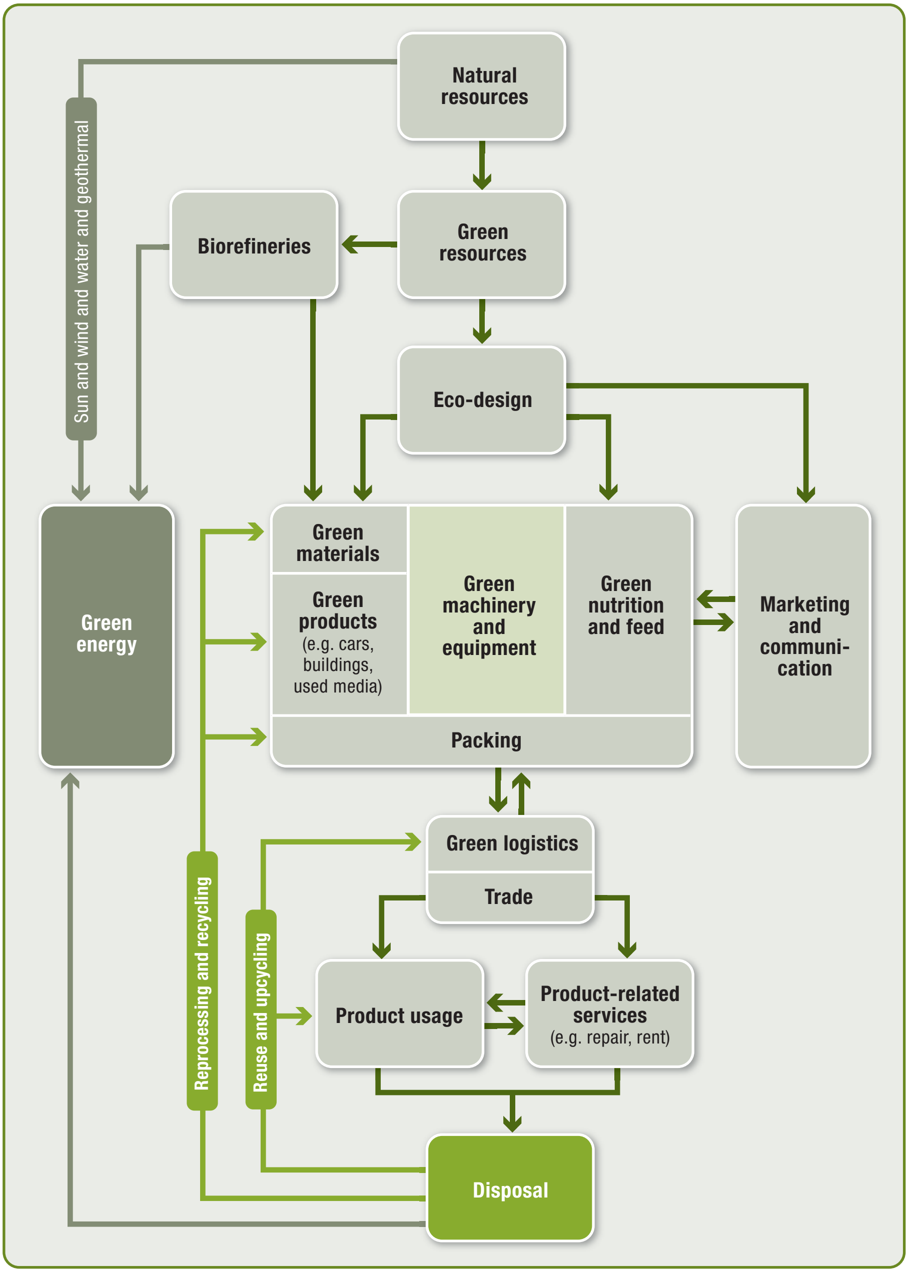
(b) secondary statistical survey of labour market and economic data relevant for analysing structures and developments in the green economy in the region;

(c) in-depth research on selected economic areas (regional performance fields);
(d) stakeholder interviews (N = 20);
(e) quantitative online questionnaire survey of regional green economy enterprises;
(f) regional green employment profile (industry, employment, professional and qualification structure and development, demand for skilled workers, skills needs);
(g) regional innovation and technology fields and requirements (= green innovation matrix).

## 9.6. Regional performance fields

The Mühlviertel region has a less developed manufacturing and service sector. The economic and industrial heart of Upper Austria is mainly based in the areas around the provincial capital Linz; many residents commute between their home and work in the city. The economy is, therefore, more agricultural and trade-related. As good living is of high significance in Mühlviertel, because of the beautiful landscape and cheaper land prices, the building sector is over-proportionally developed. The vast bio resources of Mühlviertel and the related refining sectors are well developed (Manzenreiter, 2009). World leading engineering and manufacturing companies around biomass heating have their head office in the region. Scientific discourse forecasts major and rapid change in agriculture because of resource and energy scarcity and the European strategy of a bio-economy. The region is seeking to understand how these new needs and strategies will transform the sector and its related industries, and how they can create value of the changing requirements. Mühlviertel has great potential to establish a cascade use and lifecycle-oriented bio-economy, which would mean that all participants along the value chain will have to develop new products, services, and processes to find their role and value creation in the evolving economic landscape. As the building sector is the biggest energy and resource consumer, the local building sector also has to transform itself in a low-carbon sector and, with similar transformations ahead to the agricultural sector, is expecting growing interlinking to it.

Figure 9.3. **Life cycle: green economy**




*Source*: DL, green transformation HUB 2013.

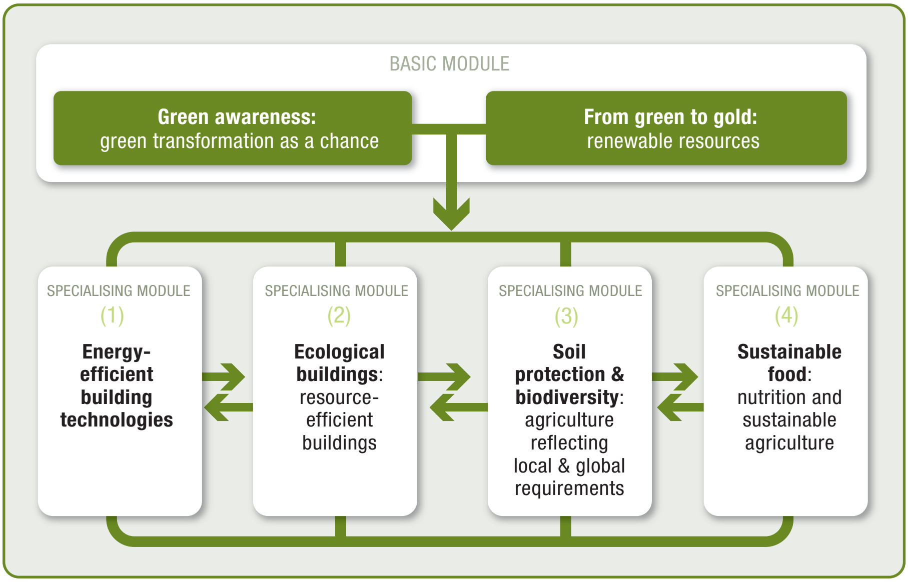
With all these future changes, companies and other actors must create sustainable value streams. VET has to deal with a value-added-oriented view of regional areas of expertise/fields of service and performance. Training programmes have to appeal for relatively different actors and business areas from forestry to construction.

## 9.7. Curriculum development

Regional areas of expertise/performance are transferred into life-cycle-based learning modules along the green economy model. The learning strategy was developed from the transition management approach (Schneidewind, 2013) and the interactive learning for innovation approach (Lundvall, 2010) and aims to generate system, target and transformation knowledge. System knowledge is integrated through the basic green awareness modules at the beginning of the training programme. More specific targeted training focuses on the identified key competences to generate specific technical knowledge and transformation skills to address critical societal matters.

### Structure of the VET program

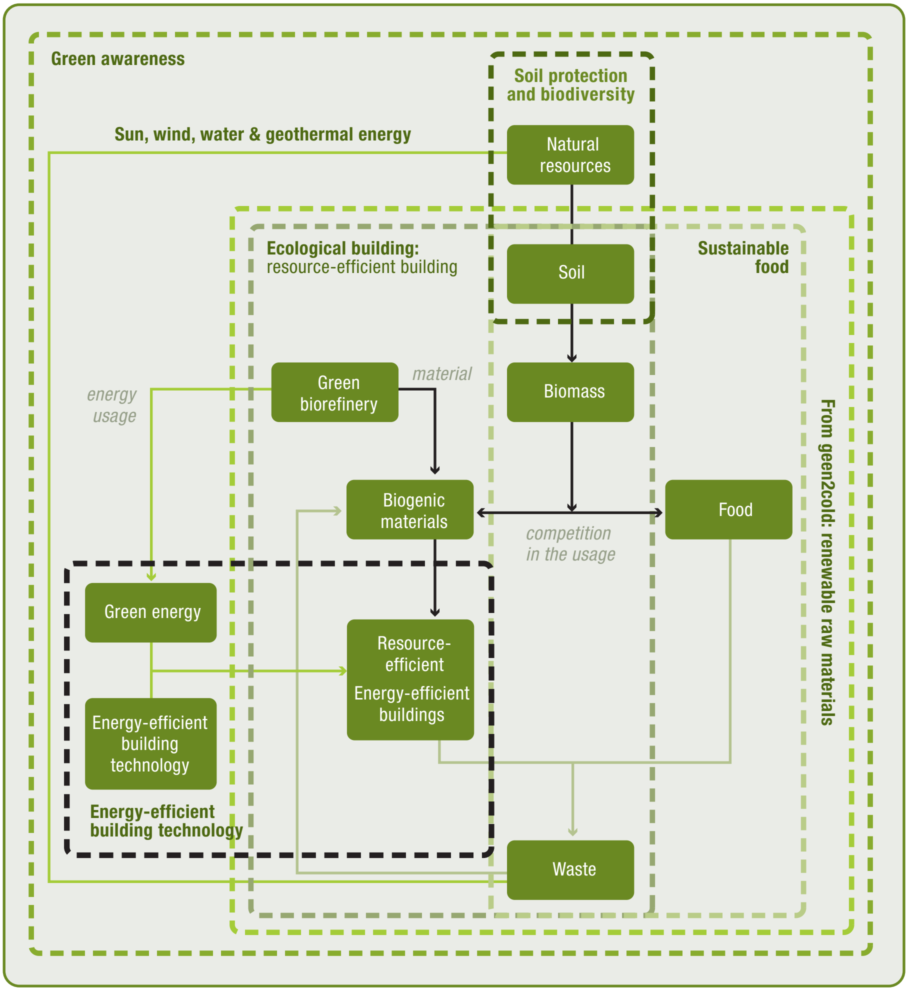
Figure 9.4. **Learning modules**




*Source*: Authors.

The training programme is tested in a cross-sectorial, networked educational approach, taking specific activating learning concepts and arrangements (curriculum opening) into account. The main goal is to create problem-solving strategies and to learn related good practice. For example, innovative building knowledge is obtained through a cross-sector approach and the transfer of the green economy model to the local performance fields and the lifecycle-oriented learning fields.

Figure 9.5. **Life cycle: learning modules**




*Source*: Authors.

## 9.8. Implementation

Two Upper Austrian vocational training organisations (BFI Oberösterreich, LFI Oberösterreich) deliver the training programmes on the Austrian side. The training design has been a challenge for these VET institutions, since this programme is not new only for them, but also for participating companies and public entities. An initial survey of regional companies (N = 120, response rate 40%), was made beforehand to raise awareness in the companies of green challenges, to find out what training activities were relevant for their organisation, and whether their employees will participate in the training programme. The survey responses from the companies were also used to define the best communication channels and the naming of the training programmes.

The emerging value chains will lead to new VET requirements, which will use the established project cooperation between companies and VET providers for future activities in green skills deployment.

As this is a pilot training initiative subsidised by regional government and the European funds for regional development, it has been possible to offer the training programmes free of charge to lower the economic obstacles to participation.

The training modules consist of open classroom training, accompanying web-based technologies (WBT), work-based learning sequences in hands-on workshops in companies, and study trips to areas of interest. In the design of the training programmes, the emphasis was on practical transfer of knowledge in the defined competences. The strengths of this more flexible and responsive approach are that problems which arise during training sessions can be addressed in the course of the programme. An iterative approach to training design has been used for practical training days. All practical training days have always consisted of theoretical input in morning sessions, practical onsite visits during the day, and reflective daily feedback sessions at the end. In these feedback sessions, new or missing practical experiences have been elaborated, defined and became new parts of the training programme. For example the anticipated product life-cycle training programme was transformed to a waste management programme for SMEs. For each special session, domain experts were invited to provide in depth knowledge and practical examples of innovation efforts across Austria and the Czech Republic.

## 9.9. Conclusion

Classic innovation, management and education approaches are being pushed to their limits due to institutional inertia, political resistance and the complexity of interactions and problems that currently face society. Against this backdrop, the challenge is to develop new transformative processes, products and services (open sustainable innovation), based on a new meaning (desirable future), and the involvement of new actors (open sustainable collaboration), and suitable for local and national scales.

In addition to an integrated perspective on economic, technical, environmental and social innovation directed towards sustainability, a challenge is also evident in the design of regional sociotechnical transformation processes as shared research, learning, assessment, decision-making and management processes.

This highlights the following conclusions:

(a) on the one hand, dealing with ambiguous goals, uncertain system knowledge, distributed power systems and associated structures requires the development of long-term visions and goals (future mapping), but also, constant anticipation and adaptation in the case of uncertainties and failures. An essential aspect of this adaptation of systems is learning in experimental spaces and exchange platforms (open collaboration platform);

(b) interactive learning (Lundvall, 2010) and new forms of knowledge/ integration practice and application are of central importance. The processing of social-ecological problems requires a variety of expertise and integration services at institutional, organisational, cognitive and personal level;

(c) a key factor for a successful implementation of the learning platforms is trust building, to ensure openness of participants (companies, regional stakeholders) and to exchange sensible problem definitions and solutions despite commercial competition. To create a cooperative environment can be time-consuming, and is mostly underestimated, but of crucial importance. Using existing networks must be part of the training design process;

(d) in addition to overcoming the barrier between knowledge and lack of knowledge, cognitive integration of different forms of knowledge (scientific and life world, implicit and explicit,) aimed at generating systems, target and transformation knowledge is necessary;

(e) this has an impact on the education and workplace requirements of teaching, and learning processes that cannot be met with the transfer of professional knowledge in traditional forms of teaching in schools, vocational training, academic teaching and general training.

## 9.10. Outlook

VET programmes have to be designed to be more process-oriented and must reflect directly the experiences gained and insights provided during workshops and lectures to aid good knowledge transfer, as well as personal work tasks and agendas for participants. Regions and companies have their own characteristics. Solutions and skills requirements differ, but VET involvement is generally transferable. The educational and scientific task is to create standardised tools that can be used by vocational training professionals to process specific regional and organisational requirements into feasible and workable projects. We think the ecological challenges ahead need regional and local momentum. VET can contribute enormously to this task and help to translate green issues into opportunities that can be tackled.

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CHAPTER 10

# Rethinking the strategy of sustainability education and training in the US higher education ecosystem

**Jacob Park**

With the threats posed by climate change and water/natural resource dilemmas intensifying around the world, finding ways to meet the basic human needs without exhausting our finite resource base will be imperative. Consequently, there has been an increasing call for higher education institutions in the US and elsewhere to develop new sustainability education and career pathway solutions. Higher education ecosystem in the US is confronting complex disruptive changes and this paper examines what these disruptive changes are and how challenges can be more effectively addressed. This paper first examines the three different types of disruptive change (organisational, economic, and technological) and then discusses how these changes can be more effectively addressed by, and in the context of, the US higher education ecosystem.

## 10.1. Introduction

In the US and elsewhere, many projects and initiatives have been launched to position higher education as a more effective institutional change agent in responding to the global sustainability challenge (Cortese and Hattan, 2010): as a community and as individual institutions (Aber et al., 2009), and through collaborative endeavours involving industry (Tripoli, 2008), government agencies (Tripoli, 2010), and community groups (Miller, 2009). Higher education institutions also face intense pressure to provide more, and deeper, sustainability education and career pathways for college and university students and other stakeholders in the US.

The core problem is not that higher education institutions are insufficiently concerned about the global sustainability challenge. The evidence is that higher education institutions are doing a lot in terms of both quantity and quality of their response to the climate change and other global sustainability challenges. There has been interesting research on how to identify a problem-solving framework to integrate sustainability competences (Wiek et al., 2011) as well as research showing that business and non-profit organisations regard critical thinking, complex problem-solving, applied knowledge in real-world settings, and other skills strongly linked with sustainability education to be important for 'long-term professional success in today's global economy' (AACU, 2013).

However, frustrating as it is for people (including myself) who want this basket of problems we refer to as international sustainable development to be addressed now and forever, global sustainability is not something one can just 'solve'; it is not like finding the right medical treatment to bring down a person's fever. There is a wide array of related problems for which a solution may be effective for a limited amount of time (such as a vaccine for a virus) and it's necessary constantly to devise more effective innovations to stay on top of the problem.

The underlying problems of excess resource consumption and ecological degradation have existed for centuries, although understanding the impacts of finite resources has been more recent. The overall framing of what one might call the modern sustainable development dilemma at global level started with the convening of the 1972 United Nations conference on the human environment. However, the terms sustainability and sustainable development did not get used as policy dialogue until the 1987 World Commission on Environment and Development, or what is often referred to as the Bruntland Commission (World Commission on Environment and Development 1987).

The persistence and long-term historical nature of what we refer to as global sustainability does not mean that what the international community is dealing with, as sustainability problems in 2014, are the same as those the international community was trying to deal with even a decade ago. The scope and basic architecture of what is referred to as climate change and other global challenges are changing, often changing so quickly that, to paraphrase an old adage in military strategy, higher education institutions always seem to be fighting the last war. As Barlett and Chase (2013, p. 5) observed: 'the endpoint of the multiple paths to sustainability is elusive because of the dynamic, evolving, and transient nature of our understandings of both the challenges and the solutions, both locally and around the world today'.

This paper will first examine the three different types of disruptive change (organisational, economic, and technological) that are affecting higher education institutions and then discuss how these changes can be more effectively addressed by, and in the context of, the US higher education ecosystem.

## 10.2. Understanding the context of disruptive change

Harvard Business School professor Christensen (1997) argues that as companies focus their attention on their existing customers, they tend to overlook the threat of 'disruption' from their competitors. According to Christensen, a distinction needs to be made between two different types of innovation: sustaining and disruptive. Most product and service innovations are sustaining. They provide better quality or additional functionality for the organisation's current customers and/or stakeholders. Some sustaining innovations are incremental improvements, while others are breakthroughs or leapfrog products or services.

By contrast, disruptive innovations do not typically meet existing customer needs. They may lack certain features or capabilities of established products and services. However, they are simpler, more convenient, and less expensive, so they appeal to new or less demanding customers. The most frequently cited application of Christiansen's analysis in the higher education sector is online education, particularly in MOOCs (massive open online courses) and new for-profit entrants such as Coursera, Udacity, and others.

Whether you agree with the conclusions of a Center for American Progress and Innosight Institute report (2011, p. 2) that 'the theory of disruptive innovation has significant explanatory power in thinking through the challenges and changes confronting higher education', there is no doubt that these competing narratives of how higher education should be governed will only become more important. In the context of sustainability, what have been less discussed are the three different types of disruptive change (organisational, economic, and technological) that are unbundling the traditional purpose and functions of higher education ecosystem in the US.

### 10.2.1. Organisational disruption

Organisational disruption focuses on the core question of what is or should be the purpose of higher education in American society. Louis Menand, Harvard

University professor of English and American literature and language, and a staff writer for the *New Yorker*, once observed that, post-1945, higher education in the US has been guided by two theories of pedagogy (Menand, 2011).

The first theory, which Menand (2011) calls meritocratic, treats college as a 'four-year intelligence' test. Students have to demonstrate intellectual ability over time and across a range of subjects, and the function of a college is to separate the math type from the poetry type and sort students according to their intellectual aptitude. The second theory, which he refers to as 'democratic,' assumes that the ultimate purpose of higher education is to expose future students to academic experiences that will enlighten and empower them as future citizens, no matter what kind of postgraduate career path the students take.

Irrespective of the particular theory, the pressure on higher education to define its purpose has arguably never been this intense. Whether because of the continuing weak economy, rising student debt, or unemployment and underemployment of college graduates, higher education institutions today feel intense pressure to serve as more effective institutional pathways for careers, quality jobs, and economic advancement.

This is not to suggest that colleges and universities in the US have been unconcerned or uninterested in the postgraduate employment and career advancement of their students. Prevailing research suggests that higher education, under certain circumstances, can serve as very effective leverage points for postgraduate employment and career advancement.

According to a 2013 report by the Association of American Colleges and Universities (AACU, 2013), nearly all employers surveyed (93%) said that a 'demonstrated capacity to think critically, communicate clearly, and solve complex problems is more important than (a candidate's) undergraduate major' and an even higher percentage (95%) said that it is important [that] those they hire 'demonstrate ethical judgment and integrity, intercultural skills; and the capacity for continued new learning', all characteristics that can be fostered in higher education, particularly in a liberal arts education setting.

The problem is not whether fostering critical thinking is important for a particular student, an employer, or for society at large. The salient question is whether such attributes as critical thinking can be learned only in a relatively expensive, traditional four-year, liberal-arts educational environment. Can such attributes be developed, for instance, in less expensive, online alternatives (or perhaps an online-traditional hybrid)?

The intense preoccupation of MOOCs and online technology in higher education, coupled with the rising percentage of students in the for-profit postsecondary education sector (from 2% of total undergraduate population in 1990 to 9% in 2009) provides some early clues about the impact of this disruptive change on contemporary higher education (College Board, 2011). This organisational disruption will be particularly intense for liberal arts colleges with small to no financial endowments and who rely on student enrolment for almost all of their operating budgets. The number of colleges that are not meeting their enrolment targets and experiencing budgetary shortfalls is growing and likely to get worse before it gets better.

In the near term, the decline in the total number of high school graduates over the next few years will add to the complexity of trying to address this organisational disruption. Also, by 2019/20 academic year, non-white students will be in a majority of public high school graduates in Arizona, Florida, Georgia, Maryland, and Nevada, with California, Texas, district of Columbia and three other states having already reached ‘majority-minority’ status (Western Interstate Commission for Higher Education 2012).

This demographic shift does not pose a specific challenge per se to the sustainability community, but the limited success the environmental movement in the US has had in meeting the diversity challenge raises concerns over whether higher education institutions will be able to succeed in an area where so many parts of US society have failed.

As Enderle (2007) observed: ‘it is an exciting time to be a member of the environmental movement in the United States. Currently, however, there is a lack of diversity and inclusivity in environmental institutions and our movement. Widespread understanding of the values that diversity can provide is essential to enhancing our collective effort and the world, yet such understanding is still absent in far too many places’ (Enderle, 2007).

### 10.2.2. **Economic disruption**

Another disruptive change is nicely captured in the following headline of a *Wall Street Journal* article, ‘Help wanted: struggles of a lost generation’, which examined the state of jobs and career advancement for young Americans five years after the 2008-09 economic crises (Casselman and Walker, 2013). The article notes that many young people, including college graduates, were still very much struggling with limited career options in this new economic normal. The official unemployment rate for Americans under age 25 was 15.6% in August 2013.

While this was an improvement from the 2010 peak of nearly 20%, this was still more than two and a half times the rate for those 25 and older. The true unemployment rate for Americans under 25 might be well over 20% if it included the hundreds of thousands of young people who have taken shelter from the weak job market by enrolling in an education or training programme or are otherwise too discouraged to look for work. The 2008-09 recession has greatly exacerbated the problem of college-to-career transition for many under 25-year old Americans and it is not clear what the new normal for such transition is or should be (Casselman and Walker, 2013).

Given the challenging of navigating the college-to-career transition in the US and elsewhere, can, and to what degree, will the emerging green jobs and economic sector more effectively address the challenge of unemployment and underemployment, particularly among the young? According to a recent International Labour Organisation report (ILO, 2013), a review of 24 global, regional, and country studies concludes that a greener economy could lead to a net gain of up to 60 million jobs worldwide.

According to this ILO report (2013), this net gain in the greener economy is consistent with the double-dividend hypothesis, which states that economic benefits (in particular employment gains) and environmental stewardship can occur at the same time by complementing environmental reform with labour market and social policies.

Worldwatch Institute (Renner et al., 2008) argues that the pursuit of green jobs will be a key economic driver of the 21st century. 'Climate-proofing' the global economy will involve large-scale investments in new technologies, equipment, buildings, and infrastructure, which will provide a major stimulus for much-needed new employment and training/education opportunities.

Beyond employment in renewable energy industries (which the Worldwatch Institute estimated to be around 2.3 million jobs worldwide in 2008), new building standards that meet higher sustainability performance can develop a new generation of construction jobs. In the case of California, the State's 'core green economy' grew by 53% between 1995 and 2010, while jobs in the wider economy grew by 12% over the same time period (Next 10, 2012).

There are three reasons why growth in green jobs did not achieve the kind of impact that many environmentalists and sustainability experts had initially hoped.

The first is the education and skills mismatch between the type of green economy jobs that are being created and the types of education and skills that current and recent college graduates possess. As in many other sectors of the US economy, the ability to code, manage complex data sets, and familiarity with advance information and communication technology are becoming features of the necessary skills/education for the overall general economy and this is no different for the emerging green economy. How many current students and recent graduates have the necessary experience and skills/knowledge, for instance, to help Google or Yahoo to manage the energy needs of its vast data centres?

The second reason has to do with the impact of what the Bureau of Labour Statistics ([21]) refers to as 'green goods and services' (GGS) can have on the employment landscape of a country as large as the US. The US economy is nearly USD 17 trillion in size and while what the Bureau of Labour Statistics refers to as 'green goods and services' represents an important and growing economic segment, it is not large enough yet to make a quick dent in the unemployment and underemployment outlook.

According to the 2013 update provided by the Bureau of Labour Statistics, GGS employment accounted for 2.3% of private sector jobs and 4.2% of public sector jobs in 2011. The private sector had 2 515 200 GGS jobs, while the public sector had 886 080 GGS jobs. Among private sector industries, construction had the largest employment rate increase, from 7.0 to 8.9 percentage points, while manufacturing had the most GGS jobs (507 168).

The third reason has less to do with the size of the green jobs market and the emerging green economy, and much more to do with the broad employment-economic development nexus. According to a Kauffman Foundation report (Stangler and Litan, 2009), the 2007-09 recession ranks worst in terms of the number of jobs lost (over 8 million), and second worst in the percentage decline (6%), compared to all prior post-World War II recessions.

Young firms (defined as one to five years old) were responsible for the creation of nearly 8 million of the overall 12 million new jobs added in 2007. Between 1980 and 2005, nearly all net job creation in the US occurred in firms less than five years old. Without start-ups, net job creation for the American economy would be negative in all but a handful of years (Stangler and Litan, 2009).

The implications of such research is clear: for a market signal to be strong enough to serve as an enabling factor toward a possible 50% reduction in global greenhouse gas emissions by the middle of the 21st century, and to provide a sustainable economic and employment base for the current and next generation of young people, it may not be enough to just 'green' existing industrial sectors in the hope that this will generate green jobs.

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([21]) Bureau of Labour Statistics: *Green goods and services* (GGS).
http://www.bls.gov/ggs/home.htm

Rather, higher education institutions, in conjunction with private, public, and civil society partners, need to focus their energy and resources on new types of sustainable ventures with global sustainability as its core business model and not as some afterthought articulated in a mission statement.

Imagine if climate change fellowship programmes such as 'community climate change' ([22]), green entrepreneurial incubators such as 'echoing green' ([23]) as well as environmental leadership networks such as the environmental leadership programme ([24]) represent the societal norm rather than the exception?

As Cory Doctorow, author of *Makers*, observed in a 2010 *Wired* magazine article: 'the days of companies with names like General Electric, General Mills and General Motors are over. The money on the table is like krill: a billion little entrepreneurial opportunities that can be discovered and exploited by smart, creative people' (Anderson, 2010).

### 10.2.3. **Technological disruption**

Another disruptive change focuses on technology and its implications for green jobs and the employment sector. The long-term vitality of green jobs and the employment sector is likely to depend on whether the US can effectively design and nurture the next generation of sustainable entrepreneurs, with a special focus on science and technology innovation.

For instance, global commercial investment in clean energy and technology, including early-stage angel and venture capital investment and later-stage financing raised from private equity and public capital markets, has risen from USD 20 billion in 2004 to nearly USD 154 billion in 2010. The US accounted for an estimated USD 30 billion (19% of global share) in clean energy commercial investment in 2010, placing it behind China and roughly equal to the EU. After peaking at USD 34 billion in 2008, US private investments in clean energy technologies declined sharply to USD 20 billion in 2009 during the global financial crisis before recovering in 2010 to reach close to its pre-crisis peak (National Science Foundation, 2012).

While solar, wind, and other clean energy technologies are important sustainability issues, clean energy is not the only important technology-related sustainability issue for higher education institutions. Twelve potentially disruptive technologies are identified by McKinsey and Company, including

([22]) Community climate change: http://www.eecapacity.net/activities/ccc-fellowship/2014-ccc-fellows
([23]) Echoing green: http://www.echoinggreen.org
([24]) Environmental leadership programme: http://elpnet.org/

energy-related innovation such as renewable energy and energy storage. However, there is also mobile internet, cloud technology, automation of knowledge work, the internet of things, advanced robotics, next generation genomics, autonomous and near-autonomous vehicles, advanced materials, advanced oil and gas exploration and recovery, and 3-D printing (Manyika et al., 2013).

3-D printing technologies, or what some technology analysts refer to as, additive manufacturing, may be the most intriguing non-energy technology innovation that has the potential to have a major impact on the US sustainability landscape. While not usually touted as a traditional sustainable technology, the additive manufacturing process can dramatically reduce the amount of waste created in the production of items from furniture to packaging. The result maximises material use, ensuring that no material needlessly goes from welder's torch to junkyard. By using 3-D printing technologies to promote local production and advances in material sustainability, US manufacturing has a real opportunity to be reborn as a hub of 21st century sustainable business innovation (Riley and Park, 2012).

## 10.3. A new strategy of sustainability education/career pathways and workforce development

To embark on a truly sustainable career pathways and workforce development strategy, higher education institutions in the US need to address more effectively three key issues and questions.

First, will there be deeper and more meaningful collaboration between higher education, private sector, government, and civil society in terms of sustainable education and training initiatives? Second, how can higher education institutions help nurture a pipeline for sustainability professional 'talent' for businesses, governments, and civil society groups? Third, how can global and local sustainability concerns be integrated better to student learning?

### 10.3.1. Will there be deeper and more meaningful collaboration?

There are a number of important civil society/non-profit green jobs and employment initiatives such as National Wildlife Federation's greenforce project ([25]) and 'green for all' initiative ([26]). These initiatives/projects are rarely integrated effectively with higher education organisations beyond a select number of two-year community colleges.

The Minnesota-based Itasca project, for instance, has been experimenting with multisector collaborative initiatives for the past decade and one of its key achievements has been the creation of Greater MSP (Minneapolis-St. Paul), a regional economic development partnership that promotes job growth by providing regional marketing and assisting in business recruitment and expansion. One key result has been bringing more than 4 800 jobs and more than USD 450 million in capital expenditures to the Minneapolis-St Paul area (Brainerd et al., 2013).

### 10.3.2. How can higher educational institutions help nurture a pipeline for sustainability professional talent?

Many colleges and universities in the US are already undertaking experiential sustainability educational initiatives, including service and community-based learning, which can, in theory, serve as the basis for, and function as, pipeline for sustainability professional talent for businesses, governments, and civil society groups. The persistent fear that doing anything that is curricular or co-curricular related to career development is the first step toward 'vocationalisation' of higher education in the US has often led to weak or no action.

While higher educational institutions (particularly many two-year community college/associate degree programmes) in the US are doing a better job of prioritising career development as compared to past years, 'for years, most liberal arts schools seemed to put career services offices somewhere just below parking as a matter of administrative priority' (Dominus, 2013, p. 42).

An educational emphasis on making a living does not mean replacing critically important student engagement activities with, say, a resume workshop. Rather, greater integration of making a living with making a

([25]) National Wildlife Federation: *greenforce initiative: advancing greener careers and campuses*. https://www.nwf.org/Greenforce-Initiative.aspx
([26]) Green for all: http://greenforall.org/about

difference might encourage students to think about their postgraduate professional lives in the context of their current academic studies.

Traditional mechanisms such as internships achieve some of these goals, but, as more colleges and universities start to require them, they are starting to function more as a graduation or credit checklist than as an integrative learning experience. A more innovative approach might be for colleges and universities to provide enriched career advising/development functions such as mentoring support that are currently being done by private companies such as PivotPlanet ([27]) which matches people interested in switching careers with mentors who can teach them how to start.

### 10.3.3. How can sustainability concerns be better integrated to student learning?

French (2000) argued that the globalisation of commerce in recent decades has internationalised environmental issues. Mundane features of daily life, from the purchase of household furniture to the type of fish one might have for dinner, can impact the well-being of people and ecosystems on the other side of the world.

Nowhere is the connection between the local and global, more layered and multifaceted than in the case of China. What makes China, as well as the wider Asia-Pacific region, such a fascinating geographic landscape through which to examine the issues of business, sustainability, and globalisation is the multilayered narrative of contrast and diversity?

It is hard to imagine another region of the world in which the impacts of globalisation have had such differential impacts in terms of sustainability and economic development. As Friedman (2005) observed: 'tighter regulation alone won't save China's environment or the world's. And that is why the most important strategy the US, and China need to pursue, in concert, is one that brings business, government, and NGO together to produce a more sustainable form of development – so China can create a model for itself and others on how to do more things with less stuff and fewer emissions. That is the economic, environmental, and national security issue of our day. Nothing else is even close.'

Now that China is likely to be the world's largest economy, at least in terms of purchasing power parity (PPP), what can colleges and universities do to provide more effective means to connect the local and global/China sustainability links in terms of student learning?

([27]) Pivotplanet : https://www.pivotplanet.com

## 10.4. Abbreviations

| | |
|---|---|
| **MOOCs** | massive open online courses |
| **GGS** | green goods and services |

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