

Unclassified

CFE/SME(2011)9/FINAL

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

04-Apr-2013

English - Or. English

CENTRE FOR ENTREPRENEURSHIP, SMEs AND LOCAL DEVELOPMENT

CFE/SME(2011)9/FINAL  
Unclassified

**Working Party on SMEs and Entrepreneurship (WPSMEE) -  
GREEN ENTREPRENEURSHIP, ECO-INNOVATION AND SMEs**

**Final Report**

*This document contains the final report "Green entrepreneurship, eco-innovation and SMEs". It has been declassified under the written procedure.*

OECD contact: Lucia Cusmano, Executive Secretary to the WPSMEE, Senior Economist,  
([lucia.cusmano@oecd.org](mailto:lucia.cusmano@oecd.org))

**JT03337576**

Complete document available on OLIS in its original format

*This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.*

English - Or. English

## TABLE OF CONTENTS

EXECUTIVE SUMMARY .....	5
CHAPTER 1. INTRODUCTION .....	7
References .....	11
CHAPTER 2. SMES AND ECO-INNOVATION .....	12
2.1. Introduction .....	12
2.2. Eco-innovation: Key terms and concepts .....	13
2.3. Green market size and growth .....	17
2.4. SME participation in green markets and sectors .....	20
2.5. Drivers and barriers to eco-innovation in SMEs .....	23
2.6. Conclusions .....	32
References .....	33
CHAPTER 3. GREEN ENTREPRENEURSHIP .....	36
3.1. Introduction .....	36
3.2. Green entrepreneurs and “pioneer green businesses” .....	38
3.3. Drivers for green entrepreneurship .....	43
3.4. Barriers to green entrepreneurs and green businesses .....	55
3.5. Conclusions and policy recommendations .....	67
References .....	71
CHAPTER 4. SMES’ ADOPTION OF ENVIRONMENTAL TECHNOLOGIES AND SUSTAINABLE BUSINESS PRACTICES .....	77
4.1. Introduction .....	77
4.2. Sustainability and performance: The business case for SME transition to sustainable practices ..	78
4.3. SME uptake of environmental practices .....	80
4.4. Drivers of adoption and transition .....	83
4.5. Barriers to adoption and policy responses .....	87
4.6. Conclusion and policy recommendations .....	98
References .....	100

### Tables

Table 1.1. Profile of case studies across participating countries .....	11
Table 2.1. Categories of green industries .....	16
Table 2.2. Ranking of innovations with environmental benefits in European countries, 2008 .....	23
Table 2.3. Market and systemic failures in eco-innovation .....	29
Table 3.1. Non-technical skills for eco-innovative firms: Evidence from Ireland for .....	61
Table 4.1. How Sustainable Manufacturing creates value for firms .....	78

Table 4.2.	Environmental protection expenditures in Canada's business sector: Distribution of pollution prevention methods by establishment size, 2008.....	82
Table 4.3.	Environmental management practices in Canada's business sector, by establishment size, 2008 .....	82
Table 4.4.	SME projects under the Irish Green Business Initiative, 2011 .....	95

## Figures

Figure 2.1.	Facets of eco-innovation .....	15
Figure 2.2.	Share of firms in different sectors with innovations leading to reduced material / energy use per unit output .....	18
Figure 2.3.	Employment contribution of clean economy segments in the United States, 2010 .....	20
Figure 2.4.	Share of patents held by firms started after 2000.....	22
Figure 2.5.	Drivers that could accelerate eco-innovation in Europe, by firm size in terms of number of employees .....	25
Figure 2.6.	Drivers that could accelerate eco-innovation in Europe, by firm size in terms of annual turnover .....	25
Figure 2.7.	Motivation to introduce an environmental innovation for small firms in European countries, 2008 .....	27
Figure 2.8.	Motivation to introduce an environmental innovation for medium firms in European countries, 2008 .....	28
Figure 2.9.	Motivation to introduce an environmental innovation for large firms in European countries, 2008 .....	28
Figure 2.10.	Barriers to accelerated eco-innovation in Europe, by firm size in terms of number of employees .....	31
Figure 2.11.	Barriers to accelerated eco-innovation in Europe, by firm size in terms of annual turnover .....	32
Figure 3.1.	Typologies of entrepreneurs.....	40
Figure 3.2.	Share of green enterprises (NACE: 25.12, 37, 41 and 51.57) in percentage of total number of enterprises in total economy .....	43
Figure 3.3.	Share of employment in ISIC sectors 37, 41 and 90 in percentage of total economy .....	43
Figure 4.1.	The evolution of sustainable manufacturing concepts and practices .....	79
Figure 4.2.	Changes implemented to reduce material costs in past five years, by type of change, 2011.....	81
Figure 4.3.	Changes implemented to reduce material costs in past five years, by country, 2011 .....	81
Figure 4.4.	Evolution of material costs for European SMEs over past five years, 2011.....	85
Figure 4.5.	Barriers to eco-innovation uptake and development for SMEs: Uncertain demand from the market, 2011 .....	92

## Boxes

Box 2.1.	Eco-innovation targets .....	14
Box 2.2.	A definition and taxonomy of green-collar workers in Australia and New Zealand .....	19
Box 2.3.	Pioneers of innovation in water waste treatment and soil treatment.....	21
Box 3.1.	Successful green pioneers: The Body Shop and Ben & Jerry's .....	41
Box 3.2.	Labelling and certification of environmental goods .....	46
Box 3.3.	Pricing in externalities: Plastic shopping bags in Ireland .....	47
Box 3.4.	New green business models: The case of green ICT .....	48
Box 3.5.	Exploiting a green niche: Patagonia.....	49

Box 3.6.	Educational initiatives to increase environmental consciousness .....	50
Box 3.7.	Promoting networks amongst green entrepreneurs .....	52
Box 3.8.	Bridging the divide between business and research sector: Australia's Researchers in Business Program .....	54
Box 3.9.	Phasing out incandescent light bulbs: Changing customer behaviour and fostering new innovations .....	57
Box 3.10.	USSBA – Green Government Opportunities for Small Businesses website, United States ..	58
Box 3.11.	The Danish Business Innovation Fund .....	58
Box 3.12.	Certification and training for environmental investors in Canada .....	60
Box 3.13.	The Carbon Trust: Entrepreneur's Fast Track, United Kingdom.....	63
Box 3.14.	The Swedish National Energy Administration's broker role in commercialising new eco-innovations .....	65
Box 3.15.	Regulation for innovation: Japan's Top Runner programme.....	66
Box 3.16.	OECD Green Growth Strategy: Environmental policy instruments .....	68
Box 4.1.	Technological approaches to environmental sustainability .....	79
Box 4.2.	Environmental Management Systems (EMS) and ISO 14001.....	80
Box 4.3.	Product-Oriented Environmental Management Systems (POEMS): The Netherland's experience .....	86
Box 4.4.	Step-by-step approach to SME environmental certification: Selected country programmes	89
Box 4.5.	OECD Sustainable Manufacturing Toolkit.....	90
Box 4.6.	Joint Environmental Management Systems: The Sweden's Hackefors' model.....	91
Box 4.7.	Training for employees and managers on energy efficiency: A regional programme in Poland .....	98

## EXECUTIVE SUMMARY

1. Countries around the world are facing an immense challenge: to expand economic opportunities and, at the same time, address increasing environmental pressures. The need for a transition to a greener growth pattern is well recognised, and the OECD has been at the forefront of policy dialogue and knowledge development on how to best make this transition. The OECD Green Growth Strategy, delivered at the 2011 OECD Ministerial Council Meeting, conceives green growth as a way to pursue economic growth and development while preventing environmental degradation, biodiversity loss and unsustainable resource use. It also highlights that, to realise the potential for a more sustainable economy and future that green growth promises, widespread change is required - in the political landscape, in institutions, in the economy and in social values.

2. SMEs account for the great majority of production units and employment across most OECD and non-OECD countries, and as a result their participation in the transition to a greener growth pattern is crucial for the greening of the business sector. While in the short term, costs may be incurred in this transition, in the long term new firms, jobs and industries will be created as eco-innovations and sustainable models upend existing systems across the world economy.

3. As consumers' behaviour and social norms evolve, government interventions 'internalise' environmentally-damaging externalities and promising new eco-innovations are developed, increasing opportunities open up to SMEs and entrepreneurs. The response to these opportunities most often takes the form of incremental innovation. Adaptation by established firms may result in significant change at the aggregate level. At the same time, new and young firms, which often exploit technological and commercial opportunities that have been neglected by established companies, can bring about more radical changes. The emergence of a class of 'green' entrepreneurs – driven by financial profit and environmental consciousness – points to a promising source of bottom-up change to replace the conventional production methods, business models, products, market structures and consumption patterns with superior environmental products and services.

4. This study explores the current and potential future contribution of SMEs and entrepreneurs to eco-innovation and the transition to green growth. It analyses the active participation of SMEs in emerging green industries, the role that green entrepreneurs play in the development and commercialisation of eco-innovations, the uptake of eco-innovations and more sustainable practices by the SME sector at large. With respect to these dimensions, the report illustrates key drivers and barriers, and discusses policies that are being developed to foster entrepreneurial endeavours and support SMEs' transition to sustainable practices, in both manufacturing and services.

5. The OECD Green Growth Strategy suggests that the green transition will require a policy mix that changes across countries, according to local environmental and economic conditions, institutional settings and stages of development. The present study identifies elements of this policy mix that are relevant to foster green entrepreneurship and sustain SMEs' adoption of sustainable practices.

### *Fostering green entrepreneurship*

6. The degree of technological and market uncertainty connected with their business implies that green entrepreneurs generally face more severe barriers than conventional entrepreneurs. These include: the challenge of market creation, financial constraints, skill shortages, maintenance patterns and lock-ins, and regulatory hurdles. The government has a key role to play in ensuring that the conditions are in place for green entrepreneurs to implement new ideas, and for their business to grow and have large-scale impact on consumers, competitors and other market players. The study identifies the following policy priorities:

- *Ensure a supportive framework* for eco-innovation and commercialisation through new business ventures to occur. In the case of green entrepreneurs, enabling investment conditions are key to address the challenges implied by long-term and uncertain technological development and commercialisation, as well as to allow experimentation of new solutions and business models in the market.
- *Address market or systemic failures* that generate barriers to investment and limit returns from green businesses, by reducing their competitiveness vis-à-vis established alternatives. Measures include compliance based mechanisms, such as standards and certification, a predictable and stable regulatory framework, pricing externalities and removing subsidies to resource-intensive options.
- *Ease access to financial, human and knowledge resources* by green entrepreneurs. To address the resource gap policies should support innovative financial instruments, which take into account the long-term horizon of eco-investments. Addressing managerial skills deficits is also important to help green entrepreneurs to overcome difficulties in financial markets. Targeted education and training can improve the capacity of entrepreneurs to gather and manage financial resources, and the understanding of investors of eco-innovative businesses. Improved STEM education and the integration of green components into curricula, at higher education level as well as in vocational training tracks, are crucial to address gaps in technical skills.
- *Create or strengthen green markets.* Government can act as a market “catalyst”, through direct measures such as public procurement, or as a “facilitator”, providing incentives for closer interaction between producers and end-users and for experimenting market solutions to environmental problems. Policies can also contribute to increasing knowledge and confidence in green markets through education, awareness campaigns and certification.

### ***Supporting SMEs’ adoption of environmental technologies and sustainable business practices***

7. The SME sector faces unique challenges to adapt to a low carbon economy, while maintaining or strengthening competitiveness in local and global markets. In particular, SMEs and entrepreneurs have limited awareness of the scale and implications of the low-carbon transition, and limited knowledge, skills and financial resources to adopt integrated and systematic methods to improve sustainability performance. In addition, most SMEs have little awareness about the future needs for new green skills and their investments in green training and knowledge-intensive activities are limited. The present study identifies the following relevant policy areas for sustaining change:

- *Raise awareness and strengthen the business case for sustainability.* Information campaigns and training programmes can improve SMEs’ knowledge about the “whole-life” environmental impact of their activities; toolkits can provide SMEs with information and advice on how to measure their environmental impact, take action to address this, and monitor progress; minimum environmental standards and formal certification requirements can open or strengthen markets for SMEs that adopt sustainable practices.
- *Address SME resource constraints to greening.* To address skill shortages policies should enhance access to formal training programmes, but also hinge on the existing practices of on-the-job training and learning by interacting. In this area, actions at the local level are crucial, as SMEs are most often embedded in local “skills eco-systems”. To address the lack of financial resources, governments should consider encouraging private sector’s funding of SME investments, as well as the direct provision of funding to sustain green oriented strategies at the

firm and the supply chain level. To increase the effectiveness and coherence of investments, access to funding should be complemented with information and business development services.

- *Facilitate SME access to environmental solutions, technical knowledge and specialised inputs.* Governments should facilitate SME linkages with service and technology providers, including research centres and universities, to increase adoption, learning and incremental innovation. As deployment of climate change mitigation and adaptation technologies often depends on the availability of specialised services, including those imported from other countries, strengthening markets for business services and lowering barriers to trade in services is important to increase SMEs' access to specialised knowledge and inputs.
- *Ensure certainty and coherence of regulation and reduce compliance burden for SMEs.* Small businesses are particularly affected by regulatory uncertainty and lack of coherence, due to their limited competences and resources for monitoring the regulatory environment. Inconsistencies and uncertainty across borders represent a critical obstacle for SMEs that operate in international markets. Governments should take action to improve cross-border information and co-ordination. Regulatory programmes should take into account the heterogeneity of the regulated community and different ability to comply with requirements, providing simplified regimes and tools for small, low-risk businesses, which better meet their nature and needs.

## CHAPTER 1. INTRODUCTION

### *Background*

#### *The OECD Green Growth Strategy*

8. At the 2011 OECD Ministerial Council Meeting (MCM), the OECD delivered its Green Growth Strategy, in response to the mandate it received with the 2009 Ministerial Declaration on Green Growth, which recognises climate change as one of the greatest challenges in the global economy (OECD, 2010). The OECD Green Growth Strategy is a horizontal policy framework integrating economic and environmental priorities. It conceives green growth as a way to pursue economic growth and development, while preventing environmental degradation, biodiversity loss and unsustainable natural resource use.

9. Green growth implies *decoupling* economic and environmental performances. Decoupling means both reducing the resource use per unit of value added (*relative decoupling*) and keeping resource use and environmental impacts stable or declining while the economy is growing overall (*absolute decoupling*). Thus, green growth will involve greening traditional sectors and favouring the transition of all economic actors, both producers and consumers, towards sustainable practices. However, it will also entail seizing the opportunities for development of new green industries, adopting new technologies and business models, building up new competencies, upgrading skills and transforming and creating jobs. It will require developing new products and supporting new patterns of demand. The OECD GGS highlights channels for making investment in the environment a driver of economic growth, including through increased productivity – as resources are used more efficiently and made available to higher value uses – greater innovation, the creation of new markets and new job opportunities, more balanced macroeconomic conditions and reduced resource price volatility (OECD, 2011a).

10. The OECD GGS develops an actionable policy framework to deliver the low-carbon transition, which is designed to be flexible enough to accommodate different national circumstances and stages of development. In this respect, green growth is conceived as a strategic complement to existing reform priorities, encompassing a vast number of policy measures including fiscal reform, regulatory policy reform, changes to education, research and innovation policies, jobs strategies, climate change mitigation measures and competition policy.

#### *Delivering green growth: implications and opportunities for SMEs and entrepreneurship*

11. The green growth policy framework represents only the first step of a long-term agenda to support national and international efforts towards the low-carbon economy. The green dimension needs to be mainstreamed across the work of the OECD, in order to help countries begin to implement the recommendations emanating from the GGS. In the framework of the 2011-2012 Programme of Work of the OECD Working Party on SMEs and Entrepreneurship (WPSMEE), the present study contributes to mainstream the green dimension into the SME and entrepreneurship policy area, by examining the implications and opportunities from the green growth transition for SMEs and entrepreneurs.

12. SMEs account for the great majority of production units and employment across all economies, and their participation in the transition to a low-carbon economy is crucial for the greening of the business sector and for the development and diffusion of green skills across industries.

13. Furthermore, entrepreneurs and SMEs can play a key role in the development of new green business models and the expansion of green sectors. Indeed, young and small firms have proved to be key drivers of innovation and growth in the emerging green industries. New and young firms are particularly

important for radical green innovations, as they often exploit technological or commercial opportunities which have been neglected by more established companies or even challenge the business models of existing firms. Growing opportunities exist in the services sectors associated with greener manufacturing. Highly creative and innovative SMEs in the service industry, such as design and architecture firms or bio-energy solution providers, contribute increasingly to eco-innovation and can support and diffuse transformation across a broad range of industries.

14. Increasingly, governments are developing measures to address market and systemic failures that inhibit eco-innovation and its deployment across economic sectors. While extensive work has been done to catalogue and assess government policies to promote eco-innovation and the uptake of sustainable practices in the economy at large, there has been little examination to date of policies directed specifically to SMEs and entrepreneurs, despite their importance in generating and diffusing eco-innovations. The importance of addressing the SME dimension in the green growth debate is increasingly recognised at the national level and in international fora. APEC, for instance, has prioritised green growth in its dialogue on SME policies. The 2011-2012 cycle of the APEC's Daegu Initiative, which favours exchange of information and peer review of SME innovation policies in APEC countries, has evolved into a Green Initiative, entirely dedicated to discuss advancement of SME policies in this area<sup>1</sup>.

15. Knowledge exchange in this area is all the more relevant for policy makers since it appears that the transition to greener growth presents SMEs with greater challenges and obstacles compared to larger firms, often related to resource constraints, skills deficits and knowledge limitations.. This is despite the fact that SMEs are generally more flexible than large businesses in adapting to the fast changing market environment and in seizing emerging opportunities.

### ***Objectives and method of study***

16. The present work investigates the role that SMEs and entrepreneurs can play in developing a more sustainable economy, and the opportunities and challenges that this transition presents them. The work takes into account both the leading role SMEs and entrepreneurs can play in bringing about change, and the adaptation that is demanded to the SME sector to participate in the low-carbon economy. It reviews the policy landscape and identifies innovative government programmes across OECD countries and non-OECD countries to help SMEs and entrepreneurs translate these emerging opportunities into firm and job creation.

17. In particular, the study seeks to:

- i) describe the emergence of green industries and the participation of SMEs and entrepreneurs in eco-innovation
- ii) explore the new entrepreneurial areas opened up by green investment and eco-innovation and the challenges for the development of green entrepreneurship
- iii) identify the main obstacles SMEs and entrepreneurs face in adapting to the requirements of a greener economy and in seizing the opportunities provided by the transition to green growth;
- iv) investigate the policies that are being developed, at national and local level, to foster green entrepreneurship and support adoption of eco-solutions by SMEs, in both manufacturing and services
- v) identify good or innovative policy practices and provide policy recommendations.

---

<sup>1</sup> See [www.apec-smeic.org/dague\\_initiative](http://www.apec-smeic.org/dague_initiative)

18. The study is articulated in three chapters:

- *Chapter 2* on SMEs and eco-innovation illustrates key terms and concepts and provides evidence on the dynamics of green industries and participation by young and small firms. Building on recent OECD work in the field of eco-innovation, it thus sets the conceptual framework of the report and provides an overview of main drivers and barriers to SMEs' engagement in eco-innovation.
- *Chapter 3* on green entrepreneurship describes the phenomenon and the heterogeneity of emerging business models; illustrates typologies of green entrepreneurs and green businesses; investigates the drivers and barriers to the setting up of new businesses in green sectors; describes several policy programmes that address these barriers in different contexts and provides policy recommendations.
- *Chapter 4* on the adoption by SMEs of environmental technologies and sustainable practices investigates the determinants of SMEs' greening; reviews policy approaches and programmes to help SMEs to overcome barriers to adoption; and presents innovative schemes or tools to improve the green performance of the SME sector.

19. The study is based on desk research and business case studies and has benefited from information on relevant policy programmes provided by WPSMEE Delegates and national institutions and agencies engaged in this area. Table 1.1 illustrates the profile of case studies undertaken in a number of OECD countries, to explore emerging business opportunities and new business models, drivers and barriers to SMEs' and entrepreneurs' participation in specific green sectors. The business case studies, presented in the Annex to this report [CFE/SME(2011)9/REV3/ANN], are based on interviews with entrepreneurs and managers, according to a common semi-structured interview protocol, and investigation of secondary sources, including public databases, articles from specialist journals, newspaper archives, official reports and newsletters from private and public organisations.

20. The cases selected are illustrative examples from which key issues for SME eco-innovation and 'green entrepreneurship' can be highlighted and good practices can be learned. In particular, the case studies investigate barriers and drivers to SME and entrepreneur-led eco-innovation in specific green sectors. They also focus on the role government policies and programmes might have played in sustaining eco-innovation activities and innovative start-ups. Also, the cases illustrate failures or difficulties encountered by green entrepreneurs in relation to, for instance, changing market and regulatory environment or accessing finance.

21. The preparation of the report has been guided by an informal Steering Group comprising Australia, Ireland, Italy and United States, and has benefited from input from Delegates to the WPSMEE. The project was generously supported by the Australian Government's Department of Industry, Innovation, Science, Research and Tertiary Education. The study benefited from close co-operation with the OECD Committee on Industry, Innovation and Entrepreneurship (CIIE), the OECD Statistics Directorate and the LEED Directing Committee.

**Table 1.1. Profile of case studies across participating countries**

<b>Country</b>	<b>Company</b>	<b>Sector</b>
<b>Australia</b>	Geothermal energy generation	Renewable energy
	Wave energy generation	Renewable energy
	Solar energy generation	Renewable energy
<b>Canada</b>	Soil treatment	Soil treatment
	Battery systems	Power
	Recycling technologies (plastics)	Recycling
	Solar technology services	Renewable energy
<b>France</b>	Energy saving software	Green ICT
	Sustainable building design	Green ICT
<b>Italy</b>	Refurbished ICT network systems	Green ICT
	Recycling standard not-for-profit organisation	Recycling

22. The report has been prepared and written by Ms. Lucia Cusmano (Senior Economist, Centre for SMEs, Entrepreneurship and Local Development – CFE) and Mr. Benjamin Dean (Consultant, CFE) under the direction of Ms. Miriam Koreen (Deputy Director, CFE). Case studies have been carried out by Prof. Richard Seymour and Ms Heather Robson (Innovation and Entrepreneurship Research Group, The University of Sydney Business School, Australia); Mr. Kartick Kumar (Consultant and former Senior Policy Advisor, Ministry of Health / Ministry of Research and Innovation in Ontario, Canada); Ms. Grazia Cecere (Telecom École de Management, Institut Minés-Telecom, DEFI, and Université Paris Sud 11, France); and Ms. Nicoletta Corrocher (KITeS, Department of Management and Technology, Bocconi University, Italy).

## References

- OECD (2010), "Interim Report of the Green Growth Strategy: Implementing our commitment for a sustainable future", Meeting of the OECD Council at Ministerial Level, 27-28 May 2010, OECD, Paris
- OECD (2011a), *Towards Green Growth*, OECD Publishing, Paris.
- OECD (2011b), *Towards Green Growth: Monitoring Progress*, OECD Publishing, Paris.

## CHAPTER 2. SMEs AND ECO-INNOVATION

### 2.1. Introduction

23. Green growth means expanding economic opportunities while addressing increasing environmental pressures. The challenge of “decoupling” economic and environmental performance can hardly be met by “business as usual”. Significant innovation will be required for a stronger and cleaner growth path, implying both the creation of new products, processes and technologies, as well as their diffusion and application (OECD, 2011a).

24. The innovation environment has changed significantly over the last decades. The increasing role of small businesses in innovation dynamics is related to profound and multi-dimensional transformations in market economies, which have led to a reduced importance of economies of scale in production, management, finance and R&D. A major driver of this has been the reduction in the product standardisation that was, on the other hand, the strength of large firms in the middle of the 20<sup>th</sup> century. As incomes have risen and the taste for variety increased, multiple market niches have appeared, which new and small firms are quick to fill (OECD, 2010). These include traditional product markets, but also, and increasingly so, social goods and services, such as services for the individual and environmental protection (Noya and Clarence, 2007).

25. Furthermore, changing markets, increased competition and new technologies have reduced product life times, demanding rapidity in anticipating or responding to new market needs. New technologies, such as, among others, micro-electronics, have made it possible for small firms in many industries to produce small batches as efficiently as large firms once produced large batches (OECD, 2010). All this has been associated with what has been termed “flexible specialisation”, that is, the capacity of firms and economies to specialise – often through outsourcing and fine division of labour at the local level - produce for niche markets and adapt to rapidly changing market environments (Piore and Sabel, 1984, Scott, 1988; Garofoli, 2002).

26. The ever more important role of small players for innovation is also related to emerging open or network-based modes of innovation. New and small ventures participate increasingly in knowledge networks, not only as knowledge exploiters, but also as knowledge sources and, increasingly, as “bridges of innovation”, which interact with other players as knowledge purchasers, providers and partners. This is the case, for instance of Knowledge-Intensive Business Services (KIBS), firms involved in activities such as consultancy, market research, design, engineering and technical services, which provide specialised knowledge inputs for other service and manufacturing firms, generate opportunities for interactive learning, favour the creation of local linkages and contribute the connectivity of national or regional systems with outside knowledge networks (Muller and Zenker, 2001; Miles, 2005; Corrocher et al., 2009).

27. However, it is important to note that there exists an uneven distribution of small firm innovation, between a few highly innovative firms with high growth potential, and the great majority of SMEs that innovate very little compared to their large counterparts. While some spin-offs and small businesses have been able to capitalise on the advantages from recent transformations, mainly combining intangibles, new technologies and design skills, a large share of SMEs encounter difficulties in adapting to the knowledge economy (OECD, 2010).

28. The present chapter focuses on the participation of SMEs in eco-innovation and emerging green sectors. It illustrates key terms and concepts about eco-innovation, provides evidence on the dynamics of green industries and comments on the key drivers and barriers to SMEs' engagement in eco-innovation. At the same time, it highlights the need to address a knowledge gap regarding the participation of SMEs in eco-innovation and to include an SME dimension in the metrics for measuring the transition to low-carbon economy.

## 2.2. Eco-innovation: Key terms and concepts

29. A number of subtly different definitions of eco-innovation have emerged over the past two decades to distinguish ordinary or polluting industries and activities from those that have some beneficial environmental impact or contribute to sustainable development. Conceptual clarity is a necessary first step in the analysis, although concepts will naturally evolve in line with rapidly changing innovation patterns and industries. This section presents a discussion of these definitions, based on a review of the literature<sup>2</sup>.

30. Eco-innovation is closely related to the development and use of environmental technologies, but it also embraces several non-technological dimensions. Based on the conventional understanding of innovation, as outlined in the *Oslo Manual*, the OECD defines eco-innovation as “*the implementation of new, or significantly improved, products (goods or services), processes, marketing methods, organisational structures and institutional arrangements which, with or without intent, lead to environmental improvements compared to relevant alternatives*” (OECD, 2009a).

31. According to this definition, eco-innovation is distinguished from other types of innovation solely by its environmental effects, whether intended or not. However, eco-innovation can also be defined more broadly than in the conventional sense covered by the *Oslo Manual*, as it also includes changes in ‘institutional arrangements’, together with innovation in products, processes, marketing methods and organisational practices (Box 2.1). The view that changes in social norms, cultural values and institutional structures should be considered, and promoted, as eco-innovations is gaining ground from a policy perspective. This reflects the idea that the greatest potential for system-wide environmental improvements is associated with changes in value patterns, behavioural models, social structures and interactions (OECD, 2009a)<sup>3</sup>.

---

<sup>2</sup> The conceptual framework largely draws on established OECD work, including the extensive analyses carried out by the OECD Committee on Industry, Innovation and Entrepreneurship (CIIE), the OECD Committee for Scientific and Technological Policy (CSTP), and the OECD Statistics Directorate.

<sup>3</sup> The definition of eco-innovation adopted by the European Commission in its Environmental Technology Action Plan (ETAP) is narrower, as it does not include changes in institutions, and highlights the intention of the innovator to target an environmental challenge. Eco-innovation is described as: “the production, assimilation or exploitation of a novelty in products, production processes or in management and business methods, which aims, throughout its life cycle, to prevent or substantially reduce environmental risk, pollution and other negative impacts of resources use (including energy use)”.

**Box 2.1. Eco-innovation targets****Technological eco-innovation**

- *Product*: a technologically new product is a product whose technological characteristics or intended uses differ significantly from those of previously produced products. A technologically improved product is an existing product whose performance has been significantly enhanced or upgraded. Examples from the auto industry are more efficient fuel-injection technologies or energy saving tyres. A novel example of a product eco-innovation is the waterless urinal, developed in Germany, which results in lower water use and no need for acid-based toilet cleaners.
- *Process*: technological process innovation is the adoption of technologically new or significantly improved production methods, including methods of product delivery. One example of a process eco-innovation is 'Biobooster', a solution rolled-out in Denmark to clean and reuse water, based on membrane biological reactors. The process consists of active biomass (bacteria) that remove pollution and filtering membranes to separate water and dirt.

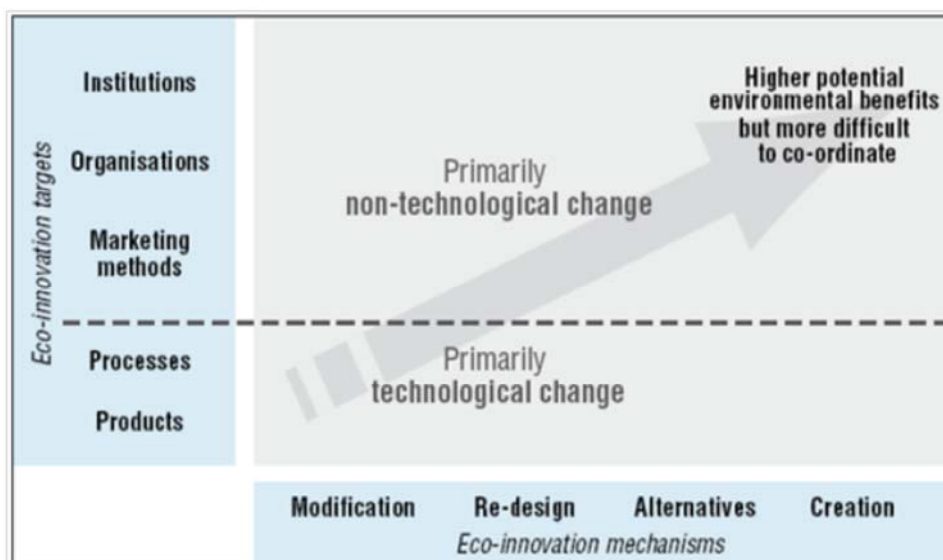
**Non-technological eco-innovation**

- *Organisational*: organisational innovation includes the introduction of significantly changed organisational structures, the implementation of advanced management techniques or the implementation of new or substantially changed corporate strategic orientations. Some of the most novel and successful examples of eco-innovation take existing technologies and combine them with an innovative business model. An example of organisational eco-innovation is *Better Place*, a pioneering US-based start-up, which has launched a new business model to foster adoption of electric cars. This is built around a network of charging stations and battery swapping facilities, and services provided through subscription plans, following the model of the telecom industry.
- *Marketing*: marketing innovation concerns the aesthetic or other subjective qualities of a product, rather than its use, objective performance characteristics, or the way it is produced or delivered. Marketing eco-innovation is implemented for instance through packaging, as firms adopt more environmentally-friendly materials and reduce the amount of packaging for a product.
- *Institutional*: innovations in *informal institutions* are changes in social norms, value patterns and beliefs, which lead to improvements in environmental conditions through social behaviour and practices. Examples are community actions to clean-up the environment, or changes in the choice of transport modes. Innovations in *formal institutions* are changes in roles and relations that typically rely on legal-enforcement, formal agreements or voluntary but formal multi-stakeholder arrangements. The establishment of eco-industrial parks or the development of environmental reporting frameworks are examples in this respect.

Source: OECD (2009a), GTZ (2008), <http://grundfos-biobooster.com>, [www.betterplace.com](http://www.betterplace.com).

32. The dynamics of eco-innovation also differ in terms of the mechanisms by which the novelty is introduced to the market. As the OECD report on Sustainable Manufacturing and Eco-innovation (2009b) illustrates, these can imply modification of practices, re-design of practices, alternatives to existing practices, or the creation of new practices (Figure 2.1). Experience shows that more radical changes in methods usually result in higher environmental benefits (OECD, 2009b).

Figure 2.1. Facets of eco-innovation



Source: OECD, 2009b.

33. In this respect, eco-innovation can also be differentiated in terms of degree of novelty and impact on existing artefacts, processes, organisational practices or technological regimes<sup>4</sup> (Smith, 2009; OECD, 2011a):

- i) *Incremental* innovations occur by modifying existing technology to raise the efficiency of resource and energy use, without fundamentally changing the underlying core technologies or system architecture. An example of incremental eco-innovation is an improvement in the CO<sub>2</sub> emissions of a car engine.
- ii) *Disruptive* innovations consist of changing how things are done or specific technological functions are fulfilled, without necessarily changing the underlying technological regime itself. Disruptive innovations typically, though not exclusively, take the form of changes in organisational practices or business models. For example, Chemical Leasing, a German company, has shaken-up the way chemicals are sold to customers by introducing a business model where the chemical supplier is paid for the service provided by the chemicals and not for the amount of chemicals delivered. This gives the chemical supplier an incentive to make the chemical application as efficient as possible, rather than incentivising profits made from the quantity of chemicals sold (Act-Clean, 2011).

<sup>4</sup> Technological regimes are defined by the combination of factors including: the level of *technological opportunity* (the likelihood of innovating for any given amount of money invested in search), the degree of *appropriability of innovations* (the possibilities of protecting innovations from imitation and of reaping profits from innovative activities), the *cumulativeness of technical advances* (the degree at which today knowledge and innovative activities form the base and the building blocks of tomorrow innovations) and the *properties of the knowledge base* underpinning firms' innovative activities (degrees of specificity, tacitness, complexity and independence) (Nelson and Winter, 1982; Breschi et al., 2000).

- iii) *Radical* innovations occur when an entirely new solution is created and leads to a full-scale shift in the technological regime at the time (Smith, 2009; OECD, 2009a). This has been the case, in recent times, of the revolution in information and communications technologies. Advances in the renewable energy sector such as solar, wind or geo-thermal power come closest to fitting this definition, although they have not yet resulted in a full-scale change in regime.

34. These distinctions are important to recognise because, as is the case with most innovations, eco-innovations are largely incremental in nature, rather than the kind of game-changing innovations that turn entire industries upside down (Kenney, 2009). However, it has been argued (e.g. Freeman, 1996; Kemp and Soete, 1992; Kemp, 1994) that the adoption of eco-efficiency options within existing production modes will not be enough for achieving environmental sustainability. What is needed in addition to these options are more or less fundamental changes in production processes and consumption patterns that are underpinned by alternative technological trajectories (Mulder et al., 1999).

35. There is a clear role for SMEs and entrepreneurs in leading incremental changes, as well as in catalysing radical eco-innovations. Indeed, these innovations tend to challenge existing business models, giving more established firms little incentive to adopt them (OECD, 2011a). Hence, disruptive or radical innovations tend to be pioneered by smaller firms, or new entrants to a market, which often exploit technological or market opportunities that have been neglected by more established firms.

### ***Green sectors or markets***

36. Eurostat (2009) classifies environmental goods and services sectors in two general categories: environmental protection and resource management (Table 2.1)<sup>5</sup>. These categories comprise technologies and products that have an environmental protection or resource management purpose as the prime objective. This is identified mainly on the basis of the technical nature of the activity or the producer's intention, i.e. regardless of the intention of the users.

**Table 2.1. Categories of green industries**

Environmental protection	Resource management
1. Protection of ambient air and climate	1. Management of waters
2. Wastewater management	2. Management of forest resources
3. Waste management	3. Management of wild flora and fauna
4. Protection and remediation of soil, groundwater and surface water	4. Management of energy resources
5. Noise and vibration abatement	5. Management of minerals
6. Protection of biodiversity and landscape	6. Research and development
7. Protection against radiation	7. Other natural resource management activities
8. Research and development	
9. Other environmental protection activities	

Source: Eurostat (2009).

37. A broader definition of green industries is sometimes adopted in country-level studies, which includes a set of 'core industries' (such as waste management and recycling) and a set of 'non-core'

<sup>5</sup> The 2009 Eurostat classification updates the definitions proposed in the 1999 OECD-Eurostat Manual, which identifies pollution management activities and resource management sectors. For details see [http://epp.eurostat.ec.europa.eu/cache/ITY\\_OFFPUB/KS-RA-09-012/EN/KS-RA-09-012-EN.PDF](http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-09-012/EN/KS-RA-09-012-EN.PDF)

industries, in which green components are typically identified by examination of the individual firm's activities. An example is the construction industry, where firms engaged in energy-efficient building are considered environmental, while firms engaged in the construction of roads are not (OECD, 2011b).

### 2.3. Green market size and growth

38. Various studies have been carried out over the last decade to measure the contribution of green industries to the overall economy in terms of output, growth, innovation and jobs, although evidence is still scattered and not comprehensive.

39. Environmental Business International estimated the global environmental goods and services (EGS) industry<sup>6</sup> to be worth USD 548 billion in 2004, with the EU, US and Japan accounting for around 94% of the total, and forecast it to grow by 45% by 2015 (EBI, 2004). In most OECD economies, the EGS industry accounts for 2-3% of GDP (OECD, 2011d). Over the last decade, the environmental protection industry has also grown steadily in emerging markets, reaching 3.3% of GDP in China for instance, according to the Hong Kong Trade Development Council (UKTI, 2008).

40. According to a study by the Centre for Policy Development, in 2009 the green economy in Australia, as measured by the revenues of companies in the clean-tech, environmental science services, waste disposal services and recycling industries, was worth AUD 33 billion (Eltham, 2010).

41. A study by the United States Department of Commerce (2010) finds that green products and services<sup>7</sup> comprised between 1% and 2% of the total private business economy in 2007, but foresees significant growth potential (US Dept. of Commerce, 2010).

42. Calogirou *et al.* (2010) estimate that the eco-industry of the EU27 had a turnover of EUR 232 billion (2.2% of the GDP) in 2004 and EUR 319 billion (2.5% of the GDP) in 2008. This amounts to a nominal compounded annual growth rate of 8.3%. Corrected for inflation, the annual growth rate in the period was 5.9%. France, Germany, Italy and UK contributed 58% of the turnover in 2008 (61% in 2004).

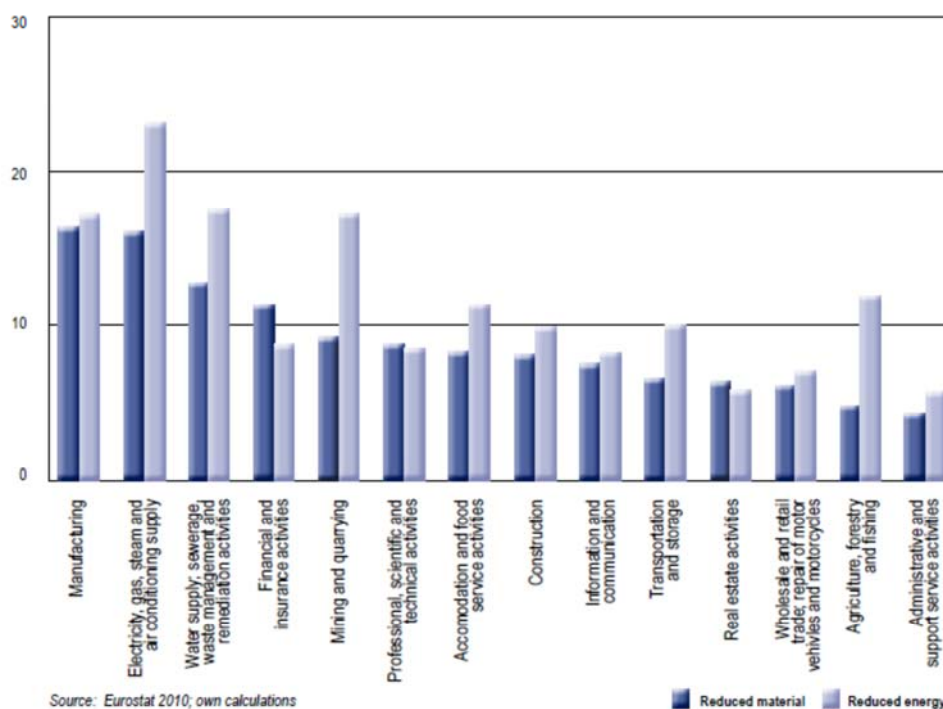
43. Adopting a broader definition of green sectors and activities, the European Commission's '*Eco-Innovation Observatory*' (2010) attempts to provide a more comprehensive picture of environmental activities, by estimating the intensity of eco-innovation across economic sectors (Figure 2.2). The estimate is based on the 2008 6<sup>th</sup> 'Community Innovation Survey' (CIS6), which collects information on firm-level strategies. Eco-innovations are most widespread in the manufacturing industries, such as: electricity, gas, steam and air conditioning supply; and water supply, sewerage, waste management and remediation activities. However, this evidence also reflects the metrics used to identify eco-innovation intensity, that is, the reduction in material or energy use per unit of output.

---

<sup>6</sup> The definition of the EGS industry adopted by the EIB (2004) is similar to the one of green sectors developed by OECD-Eurostat (1999).

<sup>7</sup> Green products and services are defined by the US Department of Commerce as those that conserve energy or other natural resources and those that reduce pollution.

**Figure 2.2. Share of firms in different sectors with innovations leading to reduced material / energy use per unit output**



Source: Eurostat, 2010.

### ***Green jobs***

44. The definition of ‘green jobs’ is a matter of debate, reflecting the complexity of defining green sectors or green activities. There is a general agreement that greening can apply to many different existing professional profiles and skills. This results in relatively broad definitions of green jobs, related to the outcome of the activity rather than the sector.

45. The International Labour Organisation (ILO) defines jobs as green when they help reduce negative environmental impact, ultimately leading to environmentally, economically and socially sustainable enterprises and economies. More precisely, green jobs are defined as decent jobs that:

- reduce consumption of energy and raw materials
- limit greenhouse gas emissions
- minimise waste and pollution
- protect and restore ecosystems.

**Box 2.2. A definition and taxonomy of green-collar workers in Australia and New Zealand**

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

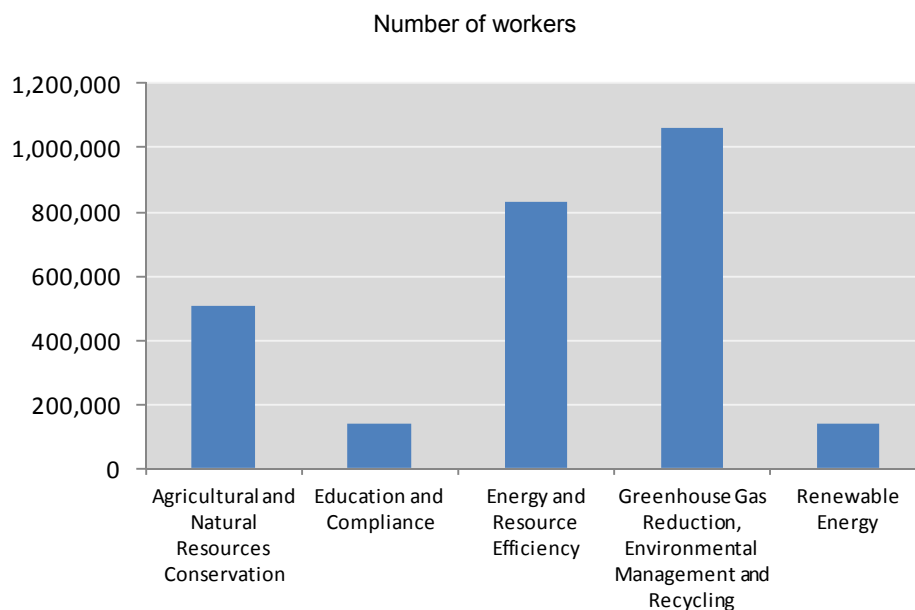
1. Managers, professionals and technicians who work in green organisations or who have green skills and responsibilities within other organisations that may not be considered as green; and

2. Services, clerical, sales and semi-skilled workers who work in green organisations. The question remains as to what can be considered to be a "green organisation".

Source: Martinez-Fernandez et al., 2010 based on Connection Research, 2009.

46. At the country or regional level, a growing number of studies attempt to quantify the creation of "green jobs", with different definitions across studies.

- In Australia, the number of jobs in the clean-tech, environmental science services, waste disposal services and recycling industries was estimated to be 105 000 in 2009 (Eltham, 2010).
- In the EU, estimates have been produced on the 'total direct environmental employment', which includes jobs related to pollution and resources management. In 2004, this employment was estimated to be 2.8 million, increasing to 3.4 million in 2008. The largest subsectors in 2008 was *waste management* with 1.4 million employees (844 000 in 2000), followed by *water supply* with 700 000 (417 000 in 2000) and *recycled materials* with 512 000 (230 000 in 2000) (Calogirou et al., 2010).
- Concerning "green jobs", the 2012 Flash Eurobarometer survey on "SMEs, resource efficiency and green markets" (European Commission, 2012) suggests that green jobs are mainly created in SMEs, as opposed to large firms, and will continue to expand at a rate of 35% over 2012-2014. The US Department of Commerce estimated that, in 2007, the number of green jobs ranged between 1.8 and 2.4 million people, or between 1.5% and 2.0% of the total workforce, depending on whether a narrow or broad definition of 'green jobs' was used (Dept. of Commerce, 2007). A report by the Brookings Institute (2011) estimates 2.7 million jobs in the United States to be part of the 'clean economy' (Figure 2.3). This compares favourably with other major sectors including fossil fuels (2.4 million jobs) and information technology production (4.8 million jobs), but remains a small fraction of the total number of jobs (around 134 million).

**Figure 2.3. Employment contribution of clean economy segments in the United States, 2010**

Source: Brookings Institute, 2011.

#### 2.4. SME participation in green markets and sectors

47. A knowledge gap exists on SMEs' participation, performance and growth in green markets. To address this gap, further improvement in the metrics and measurement tools will be required. The following sections present key evidence from recent studies that mainly focus on narrowly defined green industries, although comparative evidence on their active role in eco-innovation is still scarce.

48. SMEs participate actively in the emerging green industries, such as renewable energy production, smart metering, building refurbishment, cleaner cars, wind and solar installations, and battery development. In particular, the renewable energy sector is extremely fragmented and made up of hundreds of small companies involved in hydropower, photovoltaic, geothermal, bio energy or solar thermal energy (Ernst & Young, 2006). However, as these industries grow and mature, consolidation tends to take place and larger market leaders emerge.

49. On the other hand, in long-standing eco-industries, such as the waste management sector or water supply and waste water treatment, large corporations and their subsidiaries tend to dominate. Nevertheless, even in these more 'mature' industries, start-ups can enter and grow, if they demonstrate the efficiency of new innovative processes. Box 2.3 provides examples of SMEs that have introduced innovative processes in the fields of water waste treatment and soil treatment. The latter case, which is investigated in detail in the case studies Annex to this report<sup>8</sup>, also shows the role environmental regulation can play to encourage changes in business focus by SMEs operating in traditional fields, allowing them to seize rapidly the business opportunities opened up by the new requirements to larger corporations in 'brown sectors'.

50. Smaller firms are more commonly found operating in new, regulation-driven markets. The eco-construction sector is an example of a sector that is integrated into the broader construction industry but is comprised primarily of firms with fewer than 20 employees. These firms typically employ eco-techniques

<sup>8</sup> See Chapter 2 "Cleantech in Canada", [CFE/SME\(2011\)9/REV3/ANN](#)

and standards to meet the high demand for renovation and refurbishment of old structures (Ernst & Young, 2006).

**Box 2.3. Pioneers of innovation in water waste treatment and soil treatment**

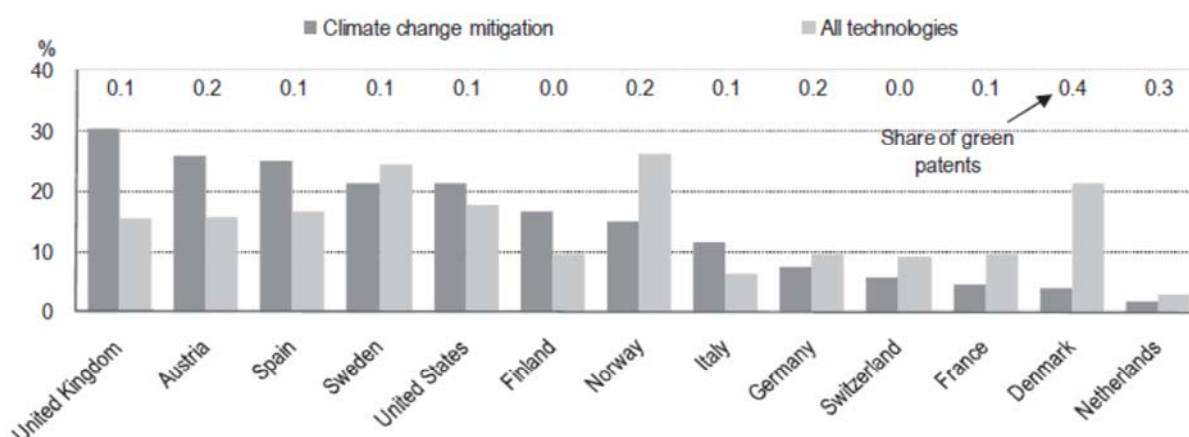
INNOVEOX is a French start-up which developed, in cooperation with a CNRS laboratory at the Polytechnic Institute of Bordeaux, a revolutionary process for treating all types of organic waste. The process destroys all water-based organic and mineral matter by placing it under pressure and at high temperature, and injecting it with oxygen. The water produced from this process can be released directly into the environment or reused, while metals and minerals can be precipitated and reused. After a pilot unit produced efficient results, the first industrial installation was opened in 2011. The company, which comprises experienced professionals from the environment and finance industries, has been granted an exclusive licence worldwide for the relevant patents held by CNRS. The business model is based on invoicing per tonne of waste processed, and the company has been able to raise equity funds for EUR 2.6 million since its creation in 2007.

L'Eau Pure is a small French company specialising in water treatment for public authorities and manufacturers. It has developed a process to reduce levels of arsenic in drinking water networks, which is delivered through compact units. Supported by funding from the FASEP (*French Fund for Assistance to the Private Sector*) it has conducted pilot projects in developing countries, particularly affected by high arsenic concentration in water. These include Vietnam and Bangladesh. Following successful pilots, it has begun commercialising its technology in Vietnam.

Nelson Environmental Remediation (NER) Ltd. is an Alberta, Canada-based environmental projects corporation, which specialises in On-Site Thermal Desorption, a way of eliminating toxicity in contaminated soils. Founded in the 1960s as a farm business, in the 1970s the company moved into construction work and the earth reclamation business at oil extraction sites. In the early 1980s, with the collapse of oil prices, business slowed down and the company refocused on supporting government infrastructure projects. By the early 1990s, construction was a mature and saturated market. As the Environmental Protection and Enhancement Act (EPEA) came into force in Alberta, addressing also the issue of contaminated sites and remediation efforts in areas adversely affected by substance release (e.g. chemical toxins, salt, sand, etc), the company saw an opportunity to enter the remediation business and reinvented itself. In 1994, it acquired its first thermal desorption system and began providing soil remediation services to oil and other extractive companies. The company developed a process-oriented eco-innovation, through the use of technologically advanced Thermal Desorption Units (TDU). This provides, in remote sites and in extreme weather conditions, for the complete remediation of contaminated soils and the destruction of hydrocarbons, thereby removing the environmental threat to water and air.

Source: Le Moci - ADEME (2010); CFE/SME(2011)9/REV3/ANN

51. Although empirical evidence on the role of SMEs and young firms in eco-innovation remains scarce, their participation in green segments can be inferred from indicators of innovation, such as patents, although only technological innovations are captured in this way. For instance, Figure 2.4 illustrates how, in several countries, the share of patents related to climate change mitigation held by firms started after 2000 is higher than the share of patents held by these firms for all technologies.

**Figure 2.4. Share of patents held by firms started after 2000**

Source: OECD, 2011c.

52. Table 2.2 illustrates, for European countries, the proportion of innovation-active firms that have an innovation with an environmental benefit. The evidence, which draws from the EC CIS6, shows that a greater proportion of large firms had introduced environmentally relevant innovations than had small firms. For instance, 47% of large firms introduced an innovation that reduced energy use per unit of output, large firms' most commonly introduced eco-innovation, whereas only 24% of small firms introduced the same kind of innovation.

53. Within the small firm category, approximately one in four firms introduced an eco-innovation. 26% of small firms introduced an innovation that recycled waste, water, or materials. The lowest proportion of small firms (17%) introduced an innovation that reduced the CO<sub>2</sub> 'footprint' (total CO<sub>2</sub> production) by their enterprise. For medium-sized enterprises, the average proportion of firms that had introduced an eco-innovation was slightly higher, with 34% of firms introducing an innovation that recycled waste, water, or materials.

54. It is interesting to note that, across size classes, a relatively less common eco-innovation is the innovation that brings the end-user benefits in terms of improved recycling of product after use.

**Table 2.2. Ranking of innovations with environmental benefits in European countries<sup>1</sup>, 2008**

As a percentage of innovation-active firms, by firm size

Small		Medium		Large	
Innovation	% of firms	Innovation	% of firms	Innovation	% of firms
Reduced CO2 'footprint' (total CO2 production) by your enterprise	17%	End-user benefits, improved recycling of product after use	21%	End-user benefits, improved recycling of product after use	28%
End-user benefits, improved recycling of product after use	20%	Reduced CO2 'footprint' (total CO2 production) by your enterprise	23%	End-user benefits, reduced air, water, soil or noise pollution	31%
End-user benefits, reduced air, water, soil or noise pollution	20%	End-user benefits, reduced air, water, soil or noise pollution	23%	End-user benefits, reduced energy use	36%
Replaced materials with less polluting or hazardous substitutes	21%	End-user benefits, reduced energy use	27%	Reduced CO2 'footprint' (total CO2 production) by your enterprise	37%
Reduced material use per unit of output	22%	Replaced materials with less polluting or hazardous substitutes	27%	Replaced materials with less polluting or hazardous substitutes	38%
Reduced soil, water, noise, or air pollution	22%	Reduced material use per unit of output	29%	Reduced material use per unit of output	42%
End-user benefits, reduced energy use	24%	Reduced soil, water, noise, or air pollution	29%	Reduced soil, water, noise, or air pollution	42%
Reduced energy use per unit of output	24%	Reduced energy use per unit of output	32%	Recycled waste, water, or materials	45%
Recycled waste, water, or materials	26%	Recycled waste, water, or materials	34%	Reduced energy use per unit of output	47%

1. Average of Austria, Belgium, Bulgaria, Croatia, Cyprus<sup>2</sup>, Czech Republic, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia and Sweden.

2. Data note concerning Cyprus:

*The following note is included at the request of Turkey:* "The information in this document with reference to 'Cyprus' relates to the southern part of the island. There is no single authority representing both Turkish and Greek Cypriot people on the island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the 'Cyprus issue'."

*The following note is included at the request of all the European Union Member States of the OECD and the European Commission:* "The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus."

Source: CIS6.

## 2.5. Drivers and barriers to eco-innovation in SMEs

### *Drivers*

55. There is an extensive body of literature on the drivers behind eco-innovation by firms (OECD, 2009a). These are generally classified into the following categories (e.g., Rennings and Zwick, 2003):

- environmental regulation (and taxes)
- demand from users
- increasing market share and capturing new markets
- cost reduction
- image or reputation.

56. Some recent studies and surveys investigate whether these key drivers differ according to firm size. This evidence points to price signals as a key driver for SMEs' engagement in eco-innovation. For instance, the European Commission's survey on *Entrepreneurs' Attitudes towards Eco-Innovation* (European Commission, 2011) identifies the cost of inputs, whether energy or raw materials, as the single most important driver to SMEs' eco-innovation (Figure 2.5). The need to reduce the cost of inputs – or increase efficiency in use – likely reflects the recent increase in level and volatility of energy prices. In particular, current high energy prices and expected future increases in energy prices rank high, with 52% and 50% of SMEs respectively reporting these as very important.

57. The case studies in the Annex to this report provide illustrative examples of eco-innovations which are encouraged by increasing market demand, to both manufacturers and service providers, for cost-saving products or processes. This driver is increasingly relevant, for instance, in the ICT sector, where small and medium-sized software firms have been developing innovative solutions to extend the life cycle of ICT equipments, save energy through cloud computing technology and reduce the costs of e-waste disposal<sup>9</sup>.

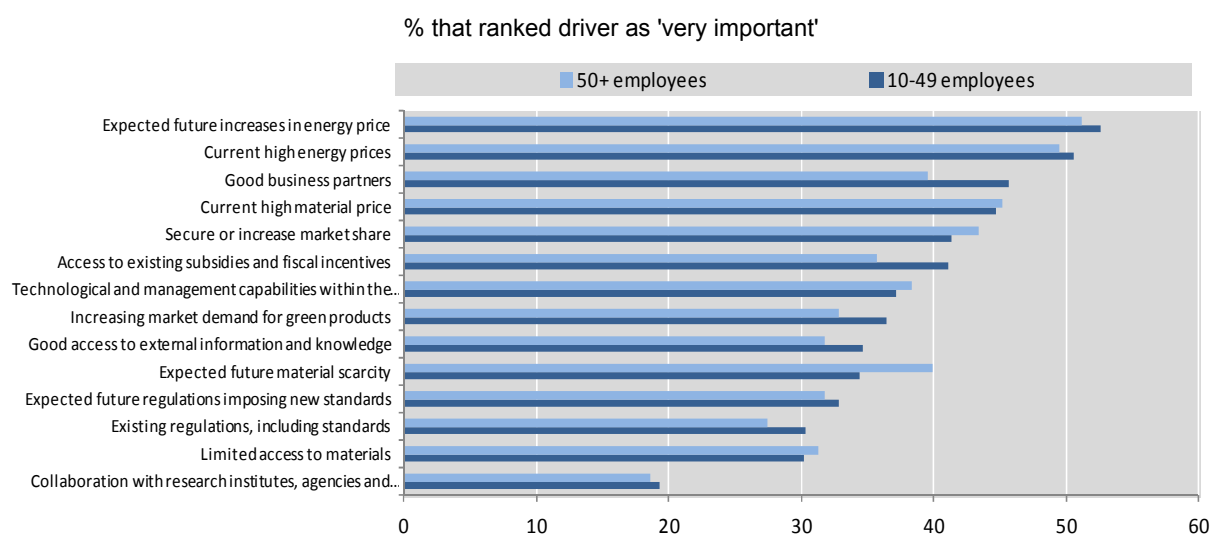
58. The survey by the European Commission shows that the importance of price factors is similar across small and medium-sized firm categories. On the other hand, differences in perception are found with regard to the relevance of existing subsidies and fiscal incentives: smaller firms tend to rank these higher in importance than medium-sized firms (EC, 2011).

59. However, turnover thresholds, rather than size categories based on the number of employees, seem to distinguish small and medium-sized firms more clearly with respect to their attitude towards eco-innovation (Figure 2.6). For instance, firms with annual turnover of less than EUR 2 million are more likely to describe current or future high energy prices as being very important drivers of eco-innovation, when compared with companies to annual turnover in excess of EUR 50 million (EC, 2011). Conversely, firms with annual turnover greater than EUR 50 million rank securing or increasing market share even higher than energy or material costs. That is, it appears that the growth in markets is a highly relevant driver for accelerating eco-innovation for those firms whose sales have already achieved a certain scale. Furthermore, whereas the relevance of existing regulations, including standards, is similar across turnover categories, larger firms appear to be more sensitive to expected future regulations.

---

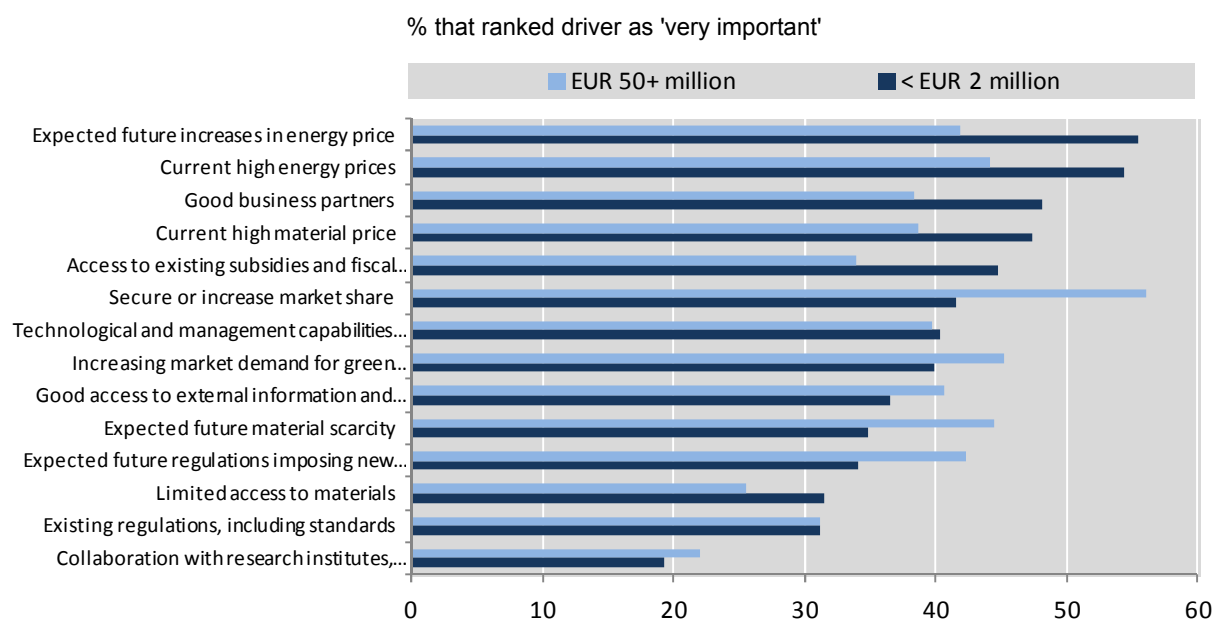
<sup>9</sup> See 'Chapter 2. Green ICT in France and Italy', [CFE/SME\(2011\)9/REV3/ANN](#)

**Figure 2.5. Drivers that could accelerate eco-innovation in Europe, by firm size in terms of number of employees**



Source: European Commission, 2011.

**Figure 2.6. Drivers that could accelerate eco-innovation in Europe, by firm size in terms of annual turnover**



Source: European Commission, 2011.

60. It is worth noting that, whereas good business partnerships are perceived to accelerate eco-innovation, especially by small firms, collaboration with research institutes and agencies is deemed to be very important by a relatively small share of SMEs.

61. It is important to underline that this survey does not differentiate between different types of SMEs in terms of sector or age. It also does not differentiate between different types of eco-innovation

(product, process, organizational or marketing; incremental or radical; adoption or generation). In addition, these findings may conceal inter-country differences across the EU and cannot be generalised to other countries.

62. Though caution is needed when interpreting these figures, the outcomes raise important points of discussion. For instance, the low degree of collaboration between SMEs and research players represents a particular concern, taking into account the nature of the knowledge underlying eco-innovation. Rennings and Rammer (2009) show that energy and resource efficiency innovation tend to be more complex innovation activities that require knowledge inputs from a diverse set of sources. In their study of German firms, they highlight that firms innovating in this area more often rely on suppliers, competitors, universities and public research institutes, although internal capabilities are also relevant, as they typically support absorptive capacity. As Belin et al. (2011) point out, this evidence can be explained by the fact that eco-innovation may require knowledge and competences which are not part of the core competences of the firm. The renewable energy cases illustrated in the Annex to this report<sup>10</sup> also highlight the crucial role for the eco-innovators of collaborative networks along the value chain, including R&D institutions as well as partners in the commercialisation stages.

63. The motivations behind eco-innovation by innovative firms are explored also by the EC CIS6 (Figures 2.7 to 2.9). Interestingly, the ranking of drivers is similar across size classes, although the proportion of firms reporting the relevant motivation does vary.

64. What this evidence clearly shows is that existing environmental regulations or taxes on pollution are currently the key driver for engaging in eco-innovation across all classes of firms: 21% of small firms, 29% of medium firms and 42% of large firms cite this as their motivation (CIS, 2008). It is interesting to note that expectations about future regulations or taxes are relevant to a smaller share of firms, though this motivation is the third cited one across all size classed.

65. The second most important driver for small businesses, at par with expectations about future regulations, is the existence of voluntary codes or agreements for environmental good practice within the relevant sector. This is mentioned by 21% of small firms, 25% of medium-sized firms and 35% of large firms.

66. Current and expected demand is also a relevant driver, although they are most often cited by large firms. This evidence is consistent with other EC surveys on the broadest population of SMEs, which suggest that the growth in markets is a relevant driver for accelerating eco-innovation especially for large firms (see Figures 2.5 and 2.6).

67. However, recent evidence suggests market demand has grown in importance for SMEs. According to the 2012 Eurobarometer survey on "SMEs, resource efficiency and green markets" (European Commission, 2012) the main reason for SMEs in the EU to sell green products or services is demand from customers (48%), although companies' core values (32%) and image (30%) also play a role in this respect. At the bottom of the list of motivations is the availability of government grants, subsidies or other financial incentives for environmental innovation, cited as a key driver by only 6% of small firms, 8% of medium-sized firms and 11% of large firms. It is however important to note that the survey does not distinguish between these different forms of financial support.

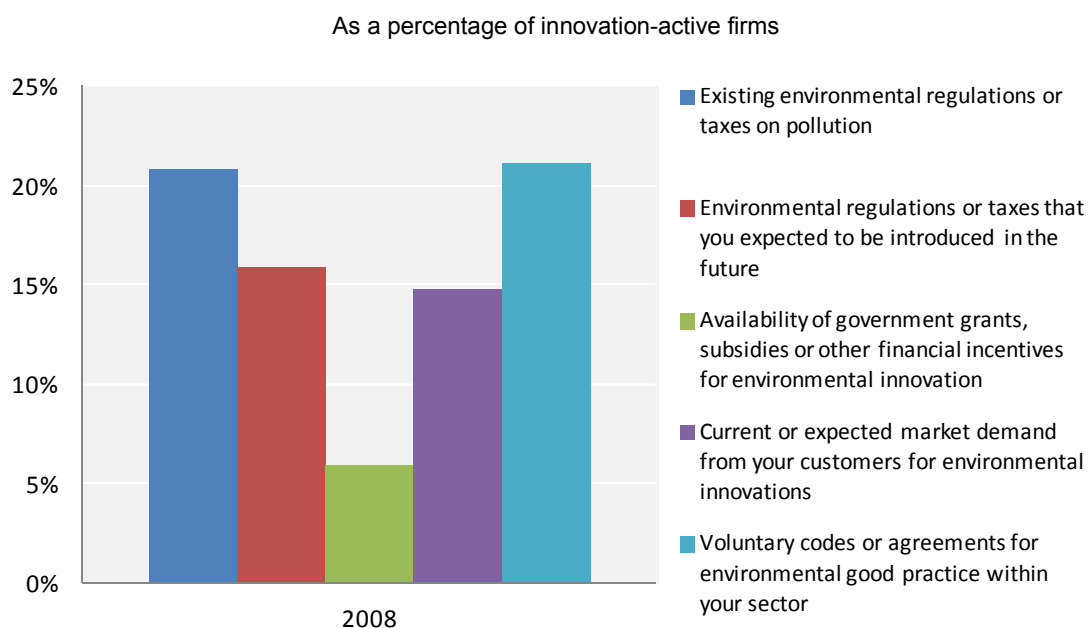
68. Though limited to surveys conducted in the European Union, this evidence suggests that obligations (whether legal or sector-wide 'best practice') and market opportunities (end demand) motivate

---

<sup>10</sup> See Chapter 1 "Renewable Energy in Australia", [CFE/SME\(2011\)9/REV3/ANN](#)

most firms to adopt eco-innovations. These figures also give an insight as to the most effective public policy tools to promote a transition towards a greener and more sustainable economy. In actually motivating firms to adopt eco-innovations in the first place, regulations, taxes or demand-side measures such as public procurement are more likely to elicit a response from firms.

**Figure 2.7. Motivation to introduce an environmental innovation for small firms<sup>1</sup> in European countries<sup>2</sup>, 2008**

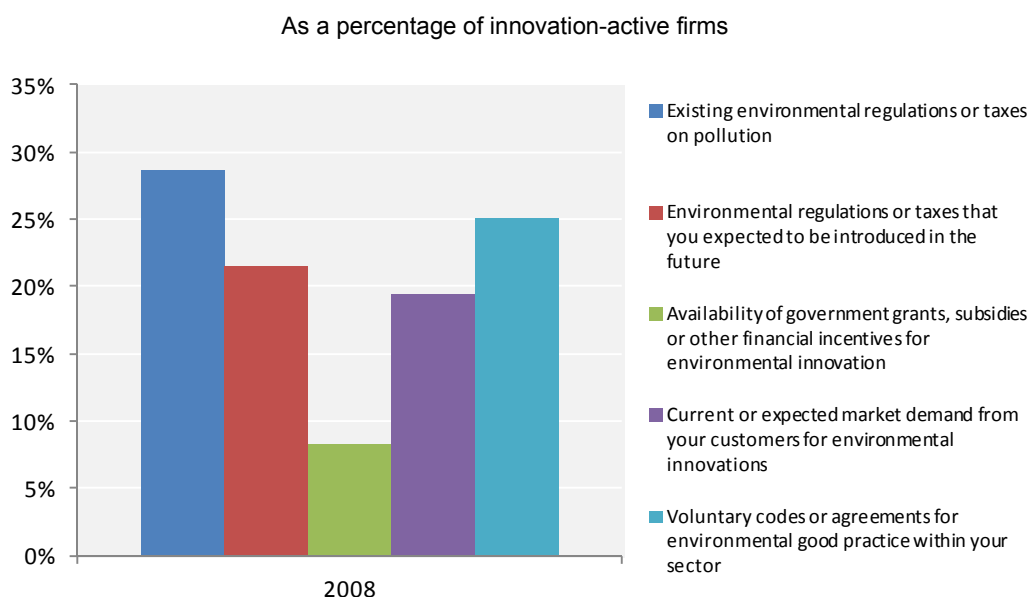


1. Defined as firms with 10-49 employees.

2. Average of Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia and Sweden.

Source: CIS6.

**Figure 2.8. Motivation to introduce an environmental innovation for medium firms<sup>1</sup> in European countries<sup>2</sup>, 2008**

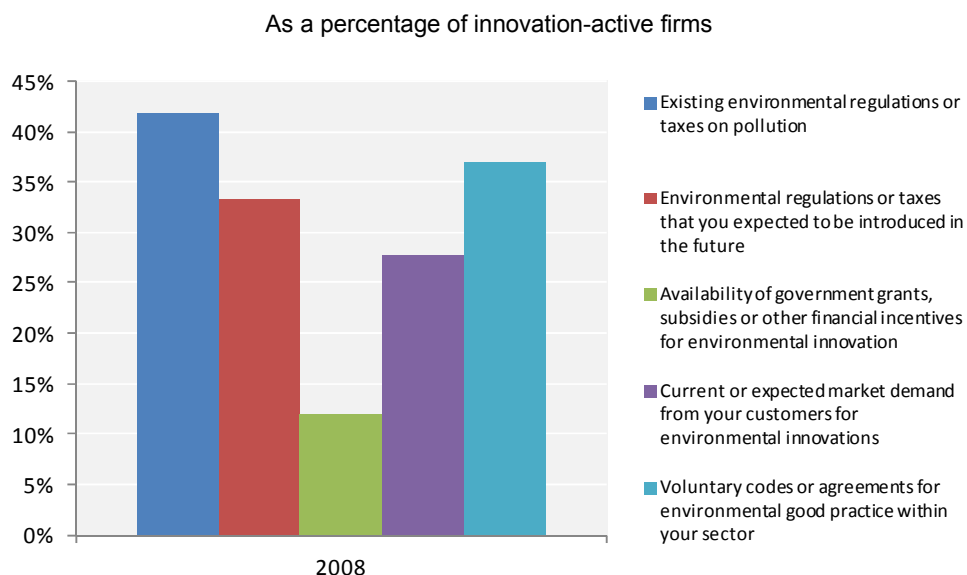


1. Defined as firms with 50-249 employees.

2. Average of Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia and Sweden.

Source: CIS6.

**Figure 2.9. Motivation to introduce an environmental innovation for large firms<sup>1</sup> in European countries<sup>2</sup>, 2008**



1. Defined as firms with 250+ employees.

2. Average of Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia and Sweden.

Source: CIS6.

69. The case studies in the Annex to this report highlight another relevant driver of eco-innovation by SMEs, especially in the cleantech sector: securing Intellectual Property Rights, which can procure a key business advantage. In the field of renewable energy, for instance, the ownership of exclusive rights on a specific technology can allow commercialisation through a combination of organisational forms. As a case in point, Carnegie Wave Energy, the largest wave-energy company in Australia (though a medium-sized company), has been using its exclusive ownership of a technology that converts ocean swell into power and desalinated freshwater to set up Build Own Operate projects, Joint Venture projects, Original Equipment Manufacturer agreements, Technology Licensing Agreements and Operations and Maintenance contracts with licences<sup>11</sup>.

70. However, more study is needed in this area across a broader range of countries, to corroborate the early findings, compare results across economies, and also assess whether SME drivers have been changing over time, as a response to technology and market evolution or as a result of government policies.

### *Barriers and obstacles*

71. A growing body of literature investigates the barriers and obstacles to eco-innovation by firms. The typology used to categorise these barriers differs from study to study, but they can be related to the main market and systemic failures in innovation (Table 2.3).

**Table 2.3. Market and systemic failures in eco-innovation**

Type of failure	Example	Explanation
Market failures	Dominant designs	Can create entry barriers for new technologies due to, for example, the high fixed costs of developing new infrastructures.
	Uncertainty	May be a particularly important barrier in the energy sector, where the high capital costs of investment tend to make investors risk averse towards new technologies.
	Lack of options for product differentiation	Makes it difficult for new entrants to get a return from innovation on their investment. This is an issue for the energy sector where customers value electricity but may not possess the information with which to discriminate between electricity generated from a wind or gas turbine.
Systemic failures	Capability failures	Innovation capabilities may be lacking, for example, through managerial deficits, lack of technological understanding, learning ability or absorptive capacity to make use of externally generated technology.
	Failures in institutions	Failure to (re)configure public institutions such as universities, research institutes, etc., so that they work effectively within the innovation system.
	Network failures	These refer to problems in the interaction among actors in the innovation system and relate to phenomena such as weak links between system actors, missing complementary assets in clusters, etc.
	Framework failures	Deficiencies in regulatory frameworks (e.g. health and safety rules), as well as in other background conditions, such as the sophistication of demand, cultural and social values, can have a negative effect on innovation and economic performance.

Source: OECD, 2011a and Arnold, 2004.

<sup>11</sup> See 'Chapter 1. Renewable Energy in Australia', [CFE/SME\(2011\)9/REV3/ANN](#).

72. The European Union's Environmental Technologies Action Plan (ETAP) refers to five categories of barriers to eco-innovation: economic barriers, regulations and standards, insufficient research effort, inadequate availability of risk capital and lack of market demand (EC, 2004; OECD 2009c). To these categories of barriers, Ashford (1993) adds:

- technological barriers: such as the availability of technology for specific applications, the performance capability of technology under certain economic requirements and process and skepticism in performance of certain technologies and therefore a reluctance to invest
- labour force-related barriers: such as the lack of person(s) in charge of management, control, and implementation of waste reduction technology, reluctance to employ trained engineers for the alleged time-consuming design of waste reduction technologies or inability to manage an additional program within the company and, therefore, reluctance to deal with a waste reduction program
- supplier-related barriers: such as lack of supplier support in terms of product advertising, good maintenance service, expertise of process adjustments, etc; and
- managerial barriers: such as lack of top management commitment, reluctance to initiate change in the company based on principle and lack of education, training, and motivation of employees or supervisors.

73. The UK Committee for Climate Change has categorised eco-innovation barriers into a series of market failures that are unique to green innovation. These include: dominant designs in energy and transport markets, uncertainty about future success and long timescales for infrastructure replacement and development and a lack of options for product differentiation that raise the barriers to entry for firms (UK CCC, 2010). Other systemic failures are also identified including capability failures, failures in institutions, network failures and framework failures (OECD, 2011b).

74. Market uncertainty is recognised by the literature as one of the most significant problems hindering greater investments in eco-innovation, and, especially, the development of prototypes into products for commercialisation (EC, 2009). The key link between technological development and commercialisation is at present a major weakness in most green sectors. The lack of financing plays a role, but often, it is itself a result of great uncertainty in the evaluation of uptake prospects for the new technology or model. This is also described as the 'chicken or egg' trap: producers wait until there is a demonstrated demand before they develop and commercialise technologies, but potential customers wait to see the product on the market before expressing intentions to buy it (ten Cate et al., 1998).

75. The case studies on renewable energy in the Annex to this report also highlight the signalling effect that early funding, by private or, more often, public investors can have to attract other funding and allow the eco-innovative firm to move more rapidly from demonstration to full-scale commercialisation. In this field, it is rare for firms to be able to secure debt, as they typically have few tangible assets, erratic cash flows and are often making losses. Equity investors, on the other hand, if available, will look for relatively high rate of returns to compensate for the great uncertainty. It follows that early stage ventures are typically reliant on some form of government funding, in the form of R&D grants or matching grants to develop pilot plants.

76. The effectiveness of matching grants, however, depends also on interest from other external investors, especially in the case of unproven technologies in high capital intensive fields, which may prove more challenging at times of economic downturns.

77. The barriers from lack of external financing seem to be more relevant for SMEs than for large firms. However, more investigation is needed to improve understanding about which of these barriers are the most important obstacles for SMEs seeking to participate in eco-innovation, and if there are other barriers which are specific to SMEs.

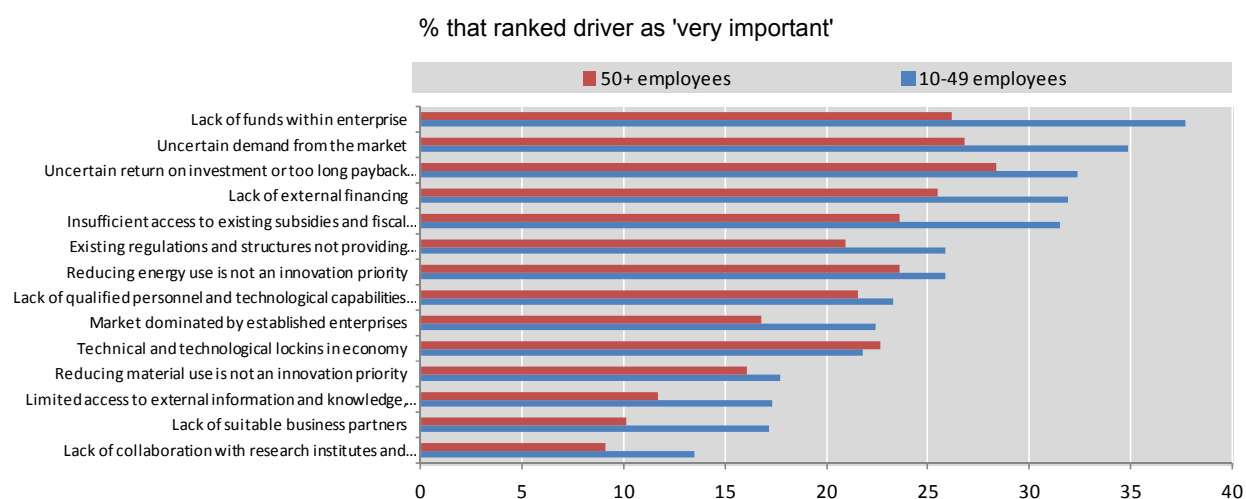
78. In developing its green growth strategy, the Korean Government has identified a number of obstacles to SMEs specifically engaging in eco-innovation (Korean SMBA, 2011):

- i) **Financing constraints**, resulting especially from a lack of equity financing and shortage of loan guarantees for SMEs. The root of these shortages lies in unclear standards for rating the risk of eco-innovative SMEs on the equity-side and a shortage of financial institutions on the debt-side.
- ii) A **shortage of human talent** for SMEs, due to a lack of adequate training institutions and diversion of existing talent primarily to large firms.
- iii) The **marketing and sales of eco-innovations**, as the domestic market is generally too small to support large-scale commercialisation and SMEs often find it more difficult than large firms to internationalise and reap the benefits of global markets.

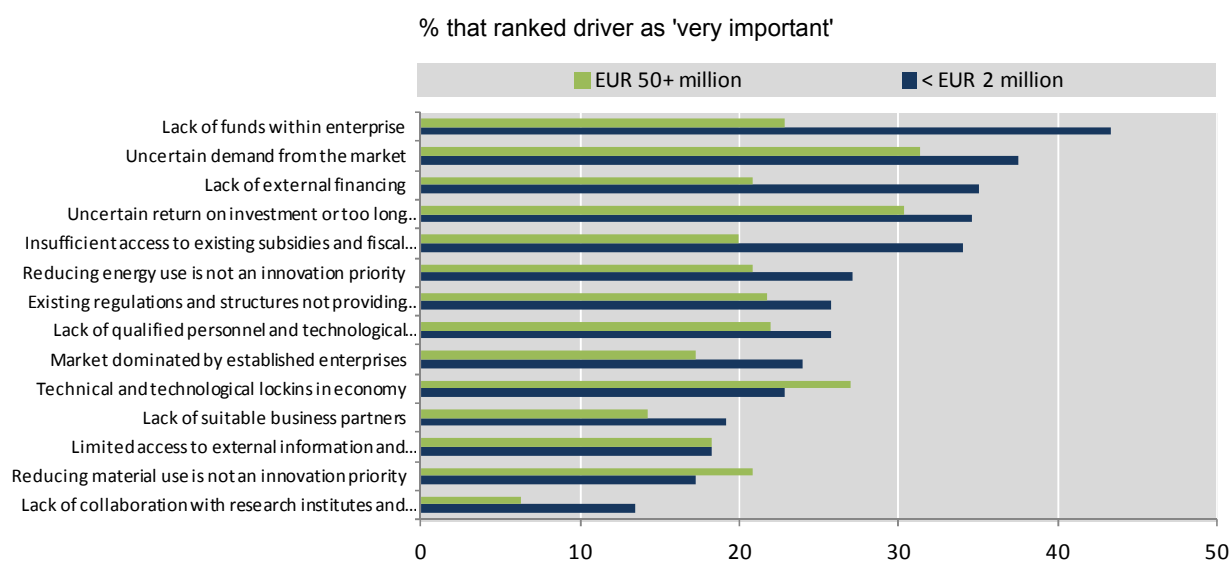
79. In addition to these, the Flash Eurobarometer (European Commission, 2011) highlights the relevance of **demand uncertainty**. This represents one of the top three most serious barriers to eco-innovation as reported by European entrepreneurs and SMEs, just following the lack of funds within the enterprise and preceding the uncertain return on investment or too long payback period (Figure 2.10).

80. The EU survey reveals that, for almost all of the barriers' typologies, small companies are more likely than medium-sized firms to perceive them as serious obstacles to eco-innovation. This finding is robust whether a definition of firm size based on employment or one based on annual turnover is adopted (Figure 2.10 and Figure 2.11).

**Figure 2.10. Barriers to accelerated eco-innovation in Europe, by firm size in terms of number of employees**



Source: European Commission, 2011.

**Figure 2.11. Barriers to accelerated eco-innovation in Europe, by firm size in terms of annual turnover**

Source: European Commission, 2011.

## 2.6. Conclusions

81. SMEs and entrepreneurs are key drivers of eco-innovation. They participate actively in emerging green industries and exploit technological or commercial opportunities that have been neglected by larger or more established companies. However, a knowledge gap exists regarding their participation in eco-innovation, especially non-technological innovation, and in terms of the differences in drivers and barriers to eco-innovation for small and large firms.

82. Evidence suggests that well-designed regulations, industry best practices, pricing of externalities, through taxes for instance, and demand-side measures, such as public procurement, are most effective to elicit SMEs' engagement in eco-innovation. On the other hand, the effectiveness of financial support measures, in the form of grants, subsidies or fiscal incentives, may depend on the provision of complementary advisory and knowledge services.

83. In particular, market creation and development appear to be crucial for accelerating eco-innovation by the business sector. Recent surveys, however, suggest there may be a size threshold for these effects, with larger firms being relatively more sensitive to the growth and consolidation of green markets. The existence of a scale effect warrants further investigation, in order to develop tailored policy approaches. Also, more study is needed to assess whether drivers and barriers for SMEs have been changing over time, as a response to technological or market evolutions, or as a result of government policies.

84. To address this knowledge gap, improvement in the metrics and measurement tools is required, in particular to capture SME participation in non-technological innovation. As part of its Green Growth Strategy, the OECD has developed a conceptual framework and monitoring tools to measure progress towards green growth (OECD, 2011d). Work in this area will need to take account of the SME dimension.

## References

- Act-Clean (2011), "Chemical leasing: Selling Services instead of Barrels", retrieved from [www.act-clean.eu/index.php?node\\_id=359&lang\\_id=1](http://www.act-clean.eu/index.php?node_id=359&lang_id=1)
- Arnold E. (2004), "Evaluating Research and Innovation Policy: A Systems World Needs Systems Evaluations", *Research Evaluation*, Vol. 13, No.1, pp.3-17.
- Ashford, N. (1993), "Understanding Technological Responses of Industrial Firms to Environmental Problems: Implications for Government Policy", K. Fischer and J. Schot (eds.), *Environmental Strategies for Industry: International Perspectives on Research Needs and Policy Implications*, Island Press, Washington, DC, pp. 277-307.
- Breschi S., Malerba F. and Orsenigo L. (2000), "Technological Regimes and Schumpeterian Patterns of Innovation", *The Economic Journal*, Vol. 110, No. 463, pp. 388-410.
- Brookings Institute (2011), *Sizing the Clean Economy: A National and Regional Green Jobs Assessment*, Metropolitan Policy Programme, US.
- Calogirou C., Sørensen S. Y., Larsen P. B. and Alexopoulou S. (2010), *SMEs and the environment in the European Union*, PLANET SA and Danish Technological Institute, Published by European Commission, DG Enterprise and Industry.
- Corrocher N., Cusmano L. and Morrison A. (2009), "Modes of innovation in knowledge-intensive business services. Evidence from Lombardy", *Journal of Evolutionary Economics* 19, 173-196.
- Eltham B. (2010), *Australia's Green Economic Potential*, Centre for Policy Development, Sydney.
- Environmental Business International. (2004). *Environmentally preferable goods and services in the NAFTA Region*. Montreal, Quebec: Commission for Environmental Cooperation.
- Ernst & Young (2006), *Study on eco-industry: Its size, employment, perspectives and barriers to growth in an enlarged EU*, Final report to EC DG Environment, August 2006.
- European Commission (2004), *Stimulating Technologies for Sustainable Development: An Environmental Technologies Action Plan for the European Union*, COM(2004)38/FINAL, Brussels.
- European Commission (2010), *Eco-Innovation Observatory: Annual Report 2010*, Brussels.
- European Commission (2011), "Entrepreneurs' Attitudes towards Eco-Innovation", Flash Eurobarometer n. 315, Survey conducted by The Gallup Organization, Hungary Directorate-General Environment, European Commission, retrieved from [http://ec.europa.eu/public\\_opinion/flash/fl\\_315\\_sum\\_en.pdf](http://ec.europa.eu/public_opinion/flash/fl_315_sum_en.pdf)
- European Commission (2012), "SMEs, resource efficiency and green markets", Flash Eurobarometer n. 342, Survey conducted by TNS Political and Social at the request of the Directorate-General Enterprise and Industry, European Commission, retrieved from [http://ec.europa.eu/public\\_opinion/flash/fl\\_342\\_en.pdf](http://ec.europa.eu/public_opinion/flash/fl_342_en.pdf)
- Eurostat (2009), "The environmental goods and services sector. A data collection handbook", retrieved from [http://epp.eurostat.ec.europa.eu/cache/ITY\\_OFFPUB/KS-RA-09-012/EN/KS-RA-09-012-EN.PDF](http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-09-012/EN/KS-RA-09-012-EN.PDF)

- Eurostat (2010), "Community Innovation Survey 6", retrieved from [http://epp.eurostat.ec.europa.eu/portal/page/portal/science\\_technology\\_innovation/data/database](http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/database) (accessed 28/3/12).
- Freeman, C. (1996). "The Greening of Technology and Models of Innovation", *Technological Forecasting and Social Change* 53:27-39
- Garofoli G. (2002), "Local development in Europe: theoretical models and international comparisons", *European Urban and Regional Studies* 9, 225–239.
- Kemp, R. (1994). "Technology and the Transition to Environmental Sustainability. The Problem of Technological Regime Shifts", *Futures* 26(10):1023-1046
- Kemp, R. and L. Soete (1992). "The Greening of Technological Progress: An Evolutionary Perspective", *Futures* 24: 437-457.
- Kenny M. (2009), "Venture Capital Investment in the Greentech Industries: A provocative Essay", BRIE Working Paper 185, July 2009.
- Korea Small and Medium Business Administration (SMBA) (2011), "Korea: Green SME Support Policies in Korea", presentation by Sang-Tae Kim, Deputy Director at the APEC SME Innovation Conference - Green SMEs: Champions of APEC's New Growth, 19-20 April 2011.
- Miles I., (2005), "Knowledge Intensive Business Services: Prospects and Policies", *Foresight* 7(6), 39-63.
- Mulder, P., Reschke, C., Kemp, R. (1999), "Evolutionary theorizing on technological change and sustainable development", paper presented at the 1st European Meeting on Applied Evolutionary Economics, Grenoble, France, 7–9 June.
- Muller E. and Zenker A. (2001), "Business services as actors of knowledge transformation: The role of KIBS in regional and national innovation systems", *Research Policy* 30, 1501-1516.
- Nelson, R. R. and Winter, S. (1982), *An Evolutionary Theory of Economic Change*, Cambridge (Mass.): The Belknap Press of Harvard University Press.
- Noya A. and Clarence E. (eds.) (2007), *The Social Economy: Building Inclusive Economies*, OECD Publishing, Paris.
- OECD (2009a), *Eco-innovation in Industry: Enabling Green Growth*, OECD Innovation Strategy, Paris.
- OECD (2009b), *Sustainable Manufacturing and Eco-innovation: Towards a Green Economy*, Policy Brief, June 2009, OECD, Paris.
- OECD (2009c), *Eco-innovation in Industry: Enabling Green Growth*, OECD Innovation Strategy, Paris.
- OECD (2010), *SMEs, Entrepreneurship and Innovation*, OECD Publishing, Paris.
- OECD (2011a), *Fostering Innovation for Green Growth*, *OECD Green Growth Studies*, OECD Publishing, Paris.
- OECD (2011b), *Towards Green Growth: Monitoring Progress*, OECD Publishing, Paris.

- OECD (2011d), *Entrepreneurship at a Glance 2011*, OECD Publishing, Paris.
- OECD (2011c), *Better Policies to Support Eco-innovation*, OECD Studies on Environmental Innovation, Paris.
- OECD and Eurostat (1999), *The Environmental Goods and Services Industry: Manual for Data Collection and Analysis*, Paris.
- Piore, M. and C. Sabel (1984), *The Second Industrial Divide: Possibilities for Prosperity*, Basic Books, New York.
- Rennings, K. and Zwick T. (eds.) (2003), "Employment Impacts of Cleaner Production", *ZEW Economic Studies*, Vol. 21, Heidelberg.
- United Kingdom Committee on Climate Change (2010), *Building a low carbon economy: The UK's innovation challenge*, London, July.
- Scott A. J. (1988), "Flexible Production Systems and Regional Development: The Rise of New Industrial Spaces in North America and Western Europe", *International Journal of Urban and Regional Research* 12, 171–186.
- Smith K. (2009), "Climate Change and Radical Energy Innovation: The Policy Issues", *TIK Working Papers on Innovation Studies*, No. 20090101, Oslo.
- ten Cate, A., Harris, J., Shugars, J. and Westling, H. (1998), "Technology Procurement as a Market Transformation Tool", retrieved from [www1.eere.energy.gov/femp/pdfs/techproc.pdf](http://www1.eere.energy.gov/femp/pdfs/techproc.pdf)
- UKTI (2008), *Market opportunities in environmental goods and services, renewable energy, carbon finance and CATs, Country report: China*, October 2008, United Kingdom Trade and Investment.
- United Kingdom Committee on Climate Change (2010), *Building a low-carbon economy: the UK's challenge*, July 2010.
- United States Department of Commerce (2010), *Measuring the green economy, Economics and Statistics Administration*, April 2010

## CHAPTER 3. GREEN ENTREPRENEURSHIP

### 3.1. Introduction

85. The OECD Green Growth Strategy recognises that the decoupling of environmental pressures from economic growth requires radical changes to the landscape of politics, institutions, the economy and social values. These changes cannot be driven solely from the top down; they demand bottom-up engagement and the evolution of many interrelated dimensions. The green transformation ahead requires that social norms and behaviour patterns change, that new business and consumption ideas are explored, and that existing institutions and conventions undergo a radical rethinking (Vaitheeswaran, 2012).

86. Established SMEs and new enterprises can contribute to this large-scale change by way of marginal improvements and radical innovations. Incremental changes to technologies, products, services, organisational forms and business models can be the outcome of deliberate innovation strategies, but also result from the adoption and adaptation of novel solutions generated outside of the firm, as discussed in Chapter 4. The present chapter focuses on entrepreneurial endeavours whose primary purpose is to improve environmental sustainability, through the development of technical or non-technical innovations.

87. Entrepreneurs, as individuals who have a disproportionate ability to drive innovation and, through its implementation, alter socioeconomic systems, can represent a fundamental source of bottom-up solutions to the challenges of the large-scale low-carbon transition (OECD, 2011b). Analysing the changes of the innovation over the last decades, Audretsch and Thurik (2004) and Thurik (2009) describe a shift from a “managed economy”, centred around the key role of science and systematic large firms R&D, to an “entrepreneurial economy”, in which entrepreneurship is one of the foundations of innovation. By serving as a conduit for knowledge spillovers, entrepreneurship links investments in new knowledge and economic growth (Audretsch et al., 2006). New spin-off ventures enable the commercialisation of knowledge that would otherwise remain un-commercialised in large firms, universities and research organisations (OECD, 2010a). New and small firms are often active in breakthrough innovations. In some of the most innovative economies, a non-marginal proportion of patent applications is filed by young firms, although differences across technological regimes and sectors are large (e.g. Malerba and Orsenigo, 1996; Breschi et al., 2000).

88. The entrepreneurial activity, which transforms ideas and resources into a profitable venture, can take different forms, including “intrapreneurship”, that is, entrepreneurial work within existing businesses, and “independent entrepreneurship”, which is expressed through the creation of a new business. Furthermore, innovation and new business development can be initiated by existing enterprises. “Corporate entrepreneurship” is brought into practice as a tool for business development, revenue growth, and profitability enhancement and for pioneering the development of new products, services and processes. As such, it represents a valuable instrument for rejuvenating and revitalising existing companies (Maes, 2004)

89. Recent debate has centred on how entrepreneurship and, in particular, a new group of entrepreneurs, focussed on exploring and diffusing environmental solutions through the market, could help to address market failures and environmental needs, such as mitigating climate change, maintaining biodiversity and providing sufficient clean water supplies (Dean and McMullen, 2007). According to Isaak (1998), this particularly small group of change makers and the new, small businesses they found based on sustainable values or technologies - so-called ‘green-green’ businesses— hold one of the keys to solving environmental challenges. The *OECD Environmental Outlook to 2050* also highlights the role that

innovation in new business models has in providing solutions to key environmental challenges and promoting green growth (OECD, 2012b). While acknowledging the importance of different types of entrepreneurial endeavours for low-carbon transition, the present chapter focuses on green entrepreneurs whose business is founded on sustainable technologies and environmental values.

90. The fundamental changes to existing structures and institutions implied by the transition to green growth open up enormous new opportunities to green entrepreneurs. Green entrepreneurs can carve out new niches in industries, in which the playing field is rapidly changing, as a result of changes in social values and consumption patterns or reforms in the legislative and regulatory environment. At the same time, green entrepreneurship can form the basis of new patterns for green growth as companies' innovations, in the form of environmental solutions and environmentally superior products, substantially influence the mass market (Schaltegger, 2002). Green entrepreneurs pioneer green business practices that eventually are adopted by the wider business community. In this respect, role models and imitation effects can be effective in spreading new ideas and sustainable practices. The success of "green pioneers" can demonstrate the economic benefits that come from being "greener" and in this way provide guidance and motivation to other business people to go green. As Schaltegger (2002) emphasises, green entrepreneurs can create the dynamics of environmental progress by displacing existing conventional production methods, products, market structures and consumption patterns and replacing them with superior environmental products and services.

91. Indeed, business models can contribute to systemic innovation if they are widely diffused and scaled up. Their diffusion and impact is influenced by the framework conditions, which determine the economic viability of the new models. However, new business models themselves may be one of the drivers of change in framework conditions and trigger the emergence of new production and consumption patterns (OECD, 2012c).

92. In spite of the recognised importance of green entrepreneurs in the transition towards a greener growth pattern, the concept itself remains surrounded by definitional uncertainty; there is limited knowledge about the profile of these entrepreneurs and businesses; the barriers and triggers for environmental entrepreneurship are not well known; and the understanding of policies to encourage a greater level of "eco-preneurship" remains limited (Sharper, 2010).

93. This chapter addresses this knowledge gap by reviewing the extant literature and defining green entrepreneurship, on the basis of the entrepreneurs' characteristics and the characteristics of the businesses they start up or run. Furthermore, drawing on the literature and on selected business case studies, the chapter explores the barriers and drivers to environmental entrepreneurship. Throughout the chapter, the role of government and examples of policies to encourage greater levels of green entrepreneurship and successful green businesses are highlighted.

94. In spite of the focus on green entrepreneurs and their businesses, the idea that these lone individuals are the sole contributing force to the proliferation and success of green businesses and eco-innovation needs to be avoided. The literature warns against the risk of placing excessive emphasis on charismatic and pioneering individuals, as this may lead to simplistic solutions to the current set of environmental problems (Gibbs, 2009). Green entrepreneurs, as innovative entrepreneurs in general, operate within socio-economic and institutional frameworks, business networks and support structures (Smith, 2003). The OECD Innovation Strategy highlights that innovation is a highly interactive and multidisciplinary process, which increasingly involves collaboration between a growing and diverse networks of stakeholders, institutions and users (OECD, 2010d). Thus, green entrepreneurs and their businesses are investigated as one, fundamental component of the wider innovation system.

### 3.2. Green entrepreneurs and “pioneer green businesses”

95. This section presents a review of the literature on the concept of green entrepreneurs and the “green pioneer” businesses that they create and run. The purpose of this section is to provide a typology of green entrepreneurs, based on the different prevailing motivations and strategies. The chapter highlights how green entrepreneurs might differ in character and motivation from conventional entrepreneurs. These differences have ramifications for the businesses they found, how these businesses are run and the types of eco-innovations they introduce. By identifying the motivations that underlie the actions of green entrepreneurs, the foundations are laid for the examination of the specific drivers and barriers later in the chapter. These differences are relevant to policy makers interested in supporting the emergence and development of eco-innovative businesses.

#### *Defining “entrepreneurs”*

96. Entrepreneurs are individuals who create or conceive new businesses after observing or identifying a new opportunity or idea. They take on the risks required and assemble the resources (finance, staff, technologies) needed to implement and commercialise these ideas. In this way, entrepreneurs can set new directions, suggest new ways of doing and then successfully become role models to the industry and other actors around them (Sharper, 2010).

97. The OECD-Eurostat Entrepreneurship Indicators Programme proposes the following definitions:

- *Entrepreneurs* are those persons (business owners) who seek to generate value, through the creation or expansion of economic activity, by identifying and exploiting new products, processes or markets.
- *Entrepreneurial activity* is the enterprising human action in pursuit of the generation of value, through the creation or expansion of economic activity, by identifying and exploiting new products, processes or markets.
- *Entrepreneurship* is the phenomenon associated with entrepreneurial activity.

98. Three broad types of entrepreneurs are described in the literature: individuals who create their own business (the conventional *entrepreneur*); individuals who work within an existing enterprise (*intrapreneurs*) (Pinchot, 1985); and individuals who work for non-profit organisations towards the resolution of community problems (*social entrepreneurs*) (Ashoka Foundation, 2003). Furthermore, the literature discusses a particular form of entrepreneurial development, *corporate entrepreneurship*, whereby entrepreneurial activities are established in association with one or more existing organisations (Maes, 2004). This can be the case of new businesses created within existing organisations, whether through internal innovation or joint venture/alliance, or of the transformation of organisations through strategic renewal (Dess et al., 1999). To these traditional types, Sharper (2002) adds an emerging group, *environmental (or green) entrepreneurs*.

### ***Defining “green entrepreneurs”***

99. A number of nuanced definitions of green entrepreneurship have been put forward (OECD, 2011c)<sup>12</sup>. Nevertheless, the definition of the green entrepreneur builds on the general concept of the entrepreneur and, as such, there are a number of similarities. The first of these similarities is that, as entrepreneurs, green entrepreneurs look for new opportunities opened up by changing habits or values, new or changed regulations or the emergence of contemporary problems. They develop a solution or idea and work about gathering the resources to build a sustainable business to address the problem, need or opportunity identified.

100. What differentiates a *green* entrepreneur are the motivations and strategic objectives behind the decision to start a business, as well as the value-based leadership that guides both the entrepreneur and the organisations that he or she runs (Linnanen, 2002). The general consensus is that green entrepreneurs, like any other entrepreneur, identify an opportunity in the market and exploit that opportunity, *but see greater sustainability as one of the goals of their entrepreneurial endeavours*. In this way, they are sometimes considered as a type of social entrepreneur, those who are not driven (strictly) by a profit motive (Parrish, 2008) but by a wider concern for creating solutions to social problems. This does not imply that green entrepreneurs do not have financial return or commercial viability as a motivation, though it may come second to environmental sustainability. This has important ramifications for the drivers for green entrepreneurship, as discussed in this chapter.

### ***Types of green entrepreneurs and their differing motivations***

101. Building on the model proposed by Volery<sup>13</sup> (2002) and the general entrepreneurship typologies developed by Chell et al. (1991), Walley and Taylor (2002) distinguish four types of green entrepreneurs, each of whom is motivated in differing degrees by the profit or environmental motive:

- *ad hoc (or accidental) green entrepreneurs*, who are driven purely by financial gain and whose contribution to sustainability is entirely unintended
- *innovative opportunists*, who are financially oriented, having spotted a green niche in existing markets and setting out to exploit that niche

---

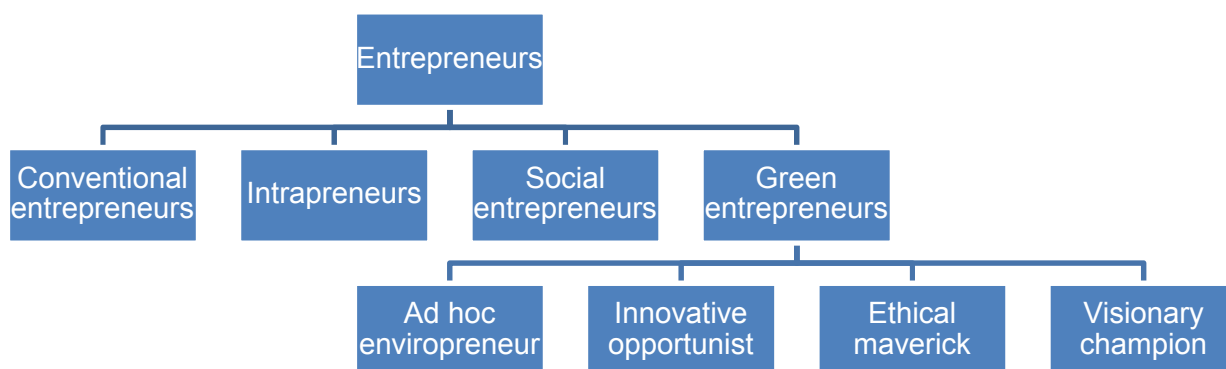
<sup>12</sup> In the literature and in policy documents ‘green entrepreneurship’ is also called, often interchangeably, *eco-entrepreneurship*, *eco-preneurship*, *environmental entrepreneurship*, *sustainable entrepreneurship*, *ecological entrepreneurship*, *enviro-preneurship* and, most originally, *sustainopreneurship* (OECD, 2011f).

<sup>13</sup> Volery (2002) identifies two types of *ecopreneurs*:

- i) “*environment-conscious entrepreneurs*”, individuals who develop any kind of innovation (product, service, process) that either reduces resource use and impacts or improves cost efficiencies while moving towards a zero waste target. Similarly, Isaak (2005) defines an ecopreneur as a person who seeks to transform a sector of the economy towards sustainability by starting business with a green design, with green processes and with the life-long commitment to sustainability.
- ii) “*green entrepreneurs*”, individuals who are both aware of environmental issues and whose business venture is in the environmental marketplace. Such entrepreneurs pursue environmental centered opportunities which show good profit prospects.

- *ethical mavericks*, whose sustainability orientation tends to be influenced by the values of their friends, networks and past experiences; these tend to set up small, niche businesses that rarely grow beyond a small scale due to a lack of financial interest on the part of the founder
- *visionary champions*, who embrace a transformative, sustainability orientation and tend to be driven by a combination of their values and financial return.

**Figure 3.1. Typologies of entrepreneurs**



Source: Ashoka Foundation, 2003; Scharper, 2010; Pinchot, 1985; Walley and Taylor, 2002.

### ***Green businesses and green pioneers***

102. The business developed by green entrepreneurs can differ significantly vis-à-vis conventional businesses. However, important differences also exist within the broad category of “green businesses”, which reflect the motivations and strategic objectives of their founders.

103. Isaak (1998) distinguishes a “green businesses” from “green-green businesses”. The former is seen as a conventional business that has subsequently, “discovered the cost and innovation and marketing advantages, if not the ethical arguments, for greening” their *existing* operations” (Isaak 2002: 82, emphasis added). “Green-green” businesses, on the other hand, can be differentiated in that they start-up from scratch and are system-transforming, socially committed and technologically up-to-date ventures (Walley and Taylor, 2003). Examples of successful businesses that epitomise the concept of a ‘green-green’ business, or “green pioneers”, are The Body Shop and Ben & Jerry’s (Isaak, 1998) (see Box 3.1).

104. The differentiating feature of green pioneer businesses is the environmental values of the entrepreneur. Some of these businesses are founded on the principal of sustainability alone, but other, new green start-ups are founded by financially oriented entrepreneurs who have identified a green niche (Walley and Taylor, 2003). Research suggests that as many “green-green” businesses are set up with entirely economic motives as there are green start-ups established because of wider sustainability goals (Walley et al., 2010).

### **Box 3.1. Successful green pioneers: The Body Shop and Ben & Jerry's**

The Body Shop and Ben & Jerry's ice-cream are two commonly cited examples of businesses that have been founded by what can be considered green entrepreneurs and gone on to large market success, in turn changing the industry around them to be more environmentally friendly.

#### ***The Body Shop***

Founded by Anita Roddick in 1976, The Body Shop's growth over four decades has fundamentally changed the way in which cosmetics are produced and packaged. To begin with, the shop sold a dozen inexpensive 'natural' cosmetics, herbal creams and shampoos, all in simple packaging (unlike the heavy packaging of conventional cosmetic producers).

The environmental values of the enterprise's founder were ingrained into the organisational structure and operating procedures themselves, even as the company grew. The company's mission opens as follows: "To dedicate our business to the pursuit of social and environmental change. We use our stores and our products to help communicate human rights and environmental issues." Franchisees are selected partly upon their 'fit' with Body Shop ideals. Employees are given time off to work on local social projects. The marketing mix comprises cosmetics made from high quality, natural ingredients which do not involve cruelty to animals. Staffs receive regular training, not only on business but also on environmental issues. Body Shop campaigns in favour of many environmental issues such as the preservation of the Brazilian rain forests, 'trade, not aid', recycling and, against animal testing of cosmetics. Today, Body Shop is a global brand with 2 400 stores in 61 countries, is the second largest cosmetic franchise in the world and has been part of the L'Oreal group since 2000.

#### ***Ben & Jerry's***

Founded by Ben Cohen and Jerry Greenfield in 1978, Ben & Jerry's ice-cream made humanitarianism and philanthropy integral parts of their business ethic. The duo found a way to combine profitability with social responsibility and in the process created a progressive new approach to employee management. The first store was opened in 1978. By 1988, President Ronald Reagan named Ben and Jerry the US Small Business Persons of the Year, and by the year's end the company was operating shops in 18 states.

Some examples of the company's social and environmental mission include: an original scoop shop made of recycled materials, creation of a "Green Team" in 1989, focusing on environmental education throughout the company, the use of hormone-free milk in its products and a commitment to reducing solid and dairy waste, recycling, and water and energy conservation at the company's facilities. In 1985, the Ben and Jerry's Foundation was set up to fund community projects with 7.5% of the company's pre-tax profits. A unique remuneration policy was implemented in the company: pay scale in which the highest-paid employee could not earn more than five times the salary of an entry-level worker (that ratio was later adjusted to seven to one in 1990). The company has launched flavours such as Chocolate Fudge Brownie, which contains brownies made by homeless and unemployed workers in Yonkers, New York; Wild Maine Blueberry, made with blueberries harvested by Passamaquoddy Indians; and Rainforest Crunch, for which the company buys Brazil nuts collected in the Amazon rain forest by indigenous peoples, thereby providing an economically viable alternative to deforestation. 60% of the profits from that flavour go to environmental groups dedicated to preserving the Amazon rain forest.

Currently, with annual sales topping USD 200 million, the company is as the world's second-largest producer of super-premium ice cream. The company was sold to Unilever in 1999. The deal called for Ben & Jerry's to be operated separately from Unilever's other ice cream brands allowing Ben & Jerry's to continue to run its business in a socially conscious manner. The founders work with 'Businesses For Social Responsibility', a group that works to promote an alternative business model based on socially responsible business practices.

Sources: Burns P. (2002), *Case Studies in Entrepreneurship: The Body Shop*, Palgrave Publishing, London; Lager F. (1995), *Ben & Jerry's: The Inside Scoop: How Two Real Guys Built a Business with a Social Conscience and a Sense of Humor*, Random House, New York; Entrepreneur.com (2008), Ben Cohen and Jerry Greenfield, retrieved from [www.entrepreneur.com/article/197626](http://www.entrepreneur.com/article/197626) (accessed 18/3/12).

105. By adopting and integrating green values into the organisational structure and processes of the enterprise, green pioneer businesses represent organisational and process eco-innovations in and of themselves. Among the illustrative case studies in the Annex to this report are examples of socially committed and system-transforming start-ups, whose “green values” also emerge from the attention to the environmental impact of their own management practices and daily operations. As pioneers, these businesses can serve as role models to future entrepreneurs and to the existing enterprises in the industry, by proving that financial success and environmental sustainability can be pursued at the same time. In this way, green entrepreneurs and their businesses help to mainstream and legitimise green growth, thereby contributing to a more sustainable society.

106. The concept of “green pioneers” places the emphasis on system-transforming businesses, or radical innovators. It is, however, important to note that green technologies and business practices are often characterised by an incremental pace of change. The large majority of eco-innovative entrepreneurs, or “green entrepreneurs” as above characterised, introduce incremental improvements to existing practices and models. As the OECD Green Growth Strategy underlines, although incremental changes are highly relevant for entering a more sustainable development path, the market potential for more radical and systemic eco-innovations is of particular importance for a long-term transition and transformation towards a greener economy. For this reason, and to complement the perspective provided in Chapter 3, which largely refers to adoption and incremental adaptation, the following paragraphs highlight the role and opportunities for entrepreneur-led systemic change.

#### ***Green entrepreneurs and businesses: OECD evidence***

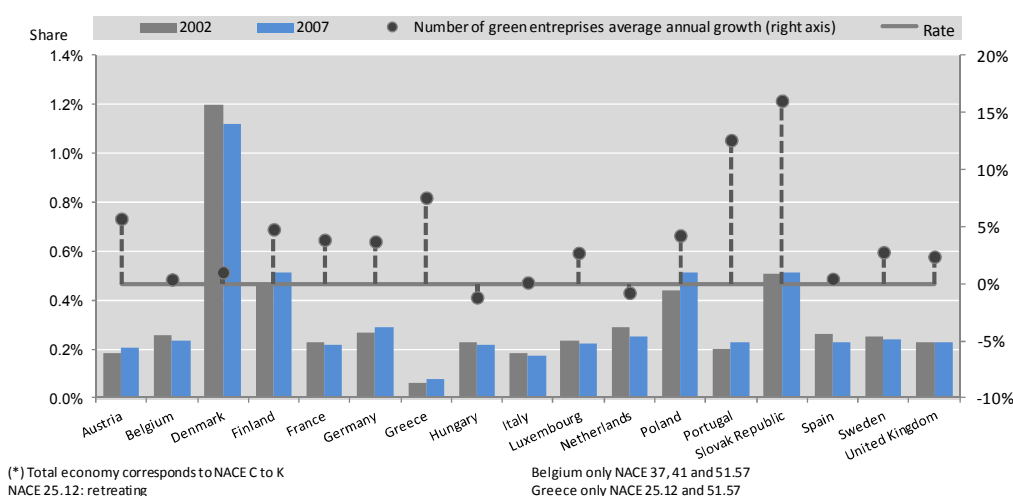
107. The OECD-Eurostat Entrepreneurship Indicators Programme has undertaken recent work to quantify the dynamics of green entrepreneurship and its contribution to employment in OECD countries. For this exercise, green entrepreneurship is intended as entrepreneurship in green sectors (OECD, 2011c). These are defined as “*activities which produce goods and services to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and ecosystems. This includes technologies, products and services that reduce environmental risk and minimise pollution and resources*” (OECD and Eurostat, 1999)<sup>14</sup>. The drawback of this definition is that it is based on the type of *output* produced by the firms, rather than the *process, technology or model* used for production. Furthermore, non-employer businesses are not included in the EIP, thus green businesses, rather than sole green entrepreneurs, are monitored.

108. The proportion of total enterprises that can be considered green varies across the OECD countries surveyed, but generally falls in the range 0.2% - 2% (Figure 3.2). The country with the highest proportion of green enterprises is Denmark, though this proportion declined slightly between 2002 and 2007. The contribution to total employment of these green businesses ranges between 0.5%-2.0% (Figure 3.3), with Hungary and the Czech Republic exhibiting the highest proportion of green employment.

---

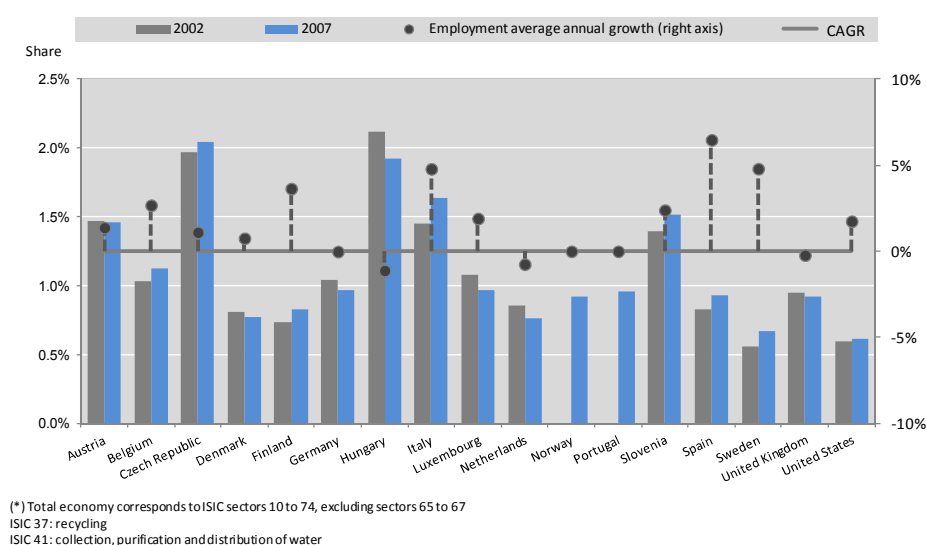
<sup>14</sup> Eurostat (2009) updates the OECD-Eurostat classification, including other diverse activities, such as sustainable tourism, under the two broad areas that constitute the green industries: environmental protection and resource management (see Chapter 2).

**Figure 3.2. Share of green enterprises (NACE: 25.12, 37, 41 and 51.57) in percentage of total number of enterprises in total economy**



Source: OECD, 2011c and Eurostat new Cronos Database.

**Figure 3.3. Share of employment in ISIC sectors 37, 41 and 90 in percentage of total economy**



Source: OECD, 2011c.

### 3.3. Drivers for green entrepreneurship

109. Two key motivations are implied by the OECD definition of green entrepreneur: i) exploiting a new market opportunity; and ii) promoting environmental sustainability. This section examines the main determinants for market opportunities in green sectors and how the values of green entrepreneurs originate and integrate into business models. Throughout this section, reference will be made to empirical evidence derived from case studies in the Annex to this report where relevant. Areas where government policy can promote or hinder the emergence and success of green entrepreneurs and their businesses will also be identified.

### ***Exploiting new market opportunities***

110. Green entrepreneurs identify new market opportunities and marshal resources to exploit these opportunities. Walley and Taylor (2002) identify three typologies of drivers for green market opportunities, which may concur to boost green entrepreneurship:

- i) *compliance-based*, new market opportunities emerging as an outcome of changes to government regulation and legislation requiring environmental improvement
- ii) *market-driven*, new market opportunities emerging from the positive impact that more environmentally beneficial behaviour can bring to customers
- iii) *value-driven*, market opportunities opening up in the face of demand due to changes in consumer preferences and tastes for more environmentally-friendly products or services.

#### *Compliance-based market opportunities: Regulations and standards*

111. Regulations and other compliance-based government policies are a primary driver for demand for eco-innovations (Horbach et al, 2010). Government intervention in this case is typically justified due to environmental damage caused by market failure. One such market failure is associated with public goods and their non-excludability. The absence of property rights means that public goods are open to consumption by all individuals regardless of whether an individual has paid for their use (Cowen, 1988). The lack of property rights implies that each individual has an incentive to exploit a resource as quickly as possible, leading to overuse (the Tragedy of the Commons). Typical examples of public goods prone to market failure include over-exploited fisheries, unsustainable logging of forest and air pollution. Government can address this problem by turning public goods into excludable private goods through the creation and assignment of property rights. In doing so, governments can create a market into which entrepreneurs and businesses can move. Experience however suggests that the engagement of local communities through formal and informal institutions is important to achieve this result (Dietz, et al, 2003)<sup>15</sup>.

112. The cases of green ICT businesses, illustrated in the Annex, show how green entrepreneurs can take advantage of opportunities created by new environmental regulation concerning the disposal of electronic equipment (see Box 3.4). In the field of ICT services, this is also fostered by the demand for customised solutions to specific needs.

113. Opportunities for entrepreneurs may come when governments make legal or regulatory changes to introduce competition into previously monopolistic markets. Monopoly power results in market failure when a natural or legal monopoly maximises profit through the under-provision and over-charging of a good<sup>16</sup>. In these monopolistic markets, the adoption of new, environmentally-friendly innovations may be

---

<sup>15</sup> The experience of property rights for fisheries in Maine, United States, is illustrative in this sense. In order to address the tragedy of commons, one group of fishermen was granted the right to establish property rights to an entire fishery. Where property rights were clearly assigned, individual fishermen took the true social costs (including the effect of 'today's catch' on future supply) into account, thereby eliminating the excessive fishing problem (Wilson 1977). However, over time compliance was low due to the top-down imposition of rules that were not seen as credible by users. This is in marked contrast to the Maine lobster fishery, which has been governed by formal and informal user institutions that have strongly influenced state-level rules that restrict fishing, which met very high levels of compliance (Dietz et al, 2003).

<sup>16</sup> This situation could potentially have positive or negative outcomes for the environment. In industries that are highly polluting, the under-provision and over-pricing of a product may in fact reduce the net

stunted. By breaking the monopolist's position, governments open the door to new and more environmentally-friendly products or services to enter the market. The rise of wind power in the United States in the 1970's is partly attributed to the Public Utility Regulatory Policies Act (PURPA), passed in 1978, which opened the door to electricity supply by requiring utility companies to buy electricity from "qualifying facilities" or independent power producers, which included renewable power plants<sup>17</sup> (Jones and Bouamane, 2011).

114. Market failure can result from imperfect information on the attributes of a particular product or service. This is often the case for the environmental benefits or damage of a product or service or the environmental implications of a method of production. The lack of information limits the possibility for consumers to express their preference for a product that matches their environmental concern. Governments can address this failure through the introduction of standards or certification to provide a signal to consumers of the environmental attributes of the product or service, in this way bridging the information gap. In doing so, these standards and certifications allow green entrepreneurs to differentiate their products when aiming for the "green niche". Canada's Eco-logo and the EU's Ecolabel are both examples of environmental certification programmes introduced by governments to verify that the goods or services in question meet high environmental and performance standards (Box 3.2).

115. The creation of standards and the process of certification can represent new business opportunities in themselves. Indeed, evidence shows that in some cases in which government had not put in place standards or certification systems, the private sector and non-profit organisations stepped in to respond to the market demand for these "signals". In the cotton industry for instance, non-profit organisations, such as the Organic Exchange, have set voluntary industry standards like the OE Blended Standard and OE 100 Standard for 100% organic cotton (Pongtratic, 2007) to allow suppliers to prove the environmental credentials of their products to buyers. In Italy, a non-profit association was set up by local government, chamber of commerce and SME association to guide firms through the stages of product development on the basis of *Design for Sustainability* principles. By using a trademarked labelling and certification system, the association provides information on the environmental sustainability features of the product in terms of material savings, reduction in energy consumption and in CO<sub>2</sub> emissions. By using the information indicated by these standards or certifications, businesses are able to create value out of the environmentally-friendly aspects of their products or services and gain access to a "green niche"<sup>18</sup>.

116. Eco-labelling provides incentives to producers for reducing adverse environmental impact. It does so by raising awareness among consumers and by giving the producers who comply with the labelling requirements a competitive advantage over others (Simi, 2009). The actual impact of eco-labelling on consumer behaviour and market competition, however, depends on its design and on the harmonisation of standards and requirements across countries. First of all, eco-labels are particularly useful as long as they are clear and comprehensible to consumers (OECD, 2011i). In this regard, the proliferation of different eco-labels in the marketplace may weaken the effects of the labelling effort itself, by generating consumer confusion (OECD, 2008). Second, eco-labelling and standards may effectively result in a higher barrier to entry for new entrepreneurs and in a non-tariff trade barrier in specific sectors. Under the WTO, rules related to eco-labels have been developed in order to limit conflicts between standard setting and international trade frameworks and ensure that labelling is non-discriminatory. However, as Simi (2009)

---

environmental damage of the activities due to lower production and consumption of that environmentally-damaging good.

<sup>17</sup> That same year, the Energy Tax Act also offered a 30% investment tax credit for residential consumers for solar and wind energy equipment and a 10% tax credit for business consumers for the installation of solar, wind and geothermal technologies (Jones and Bouamane, 2011).

<sup>18</sup> See 'Chapter 2. Green ICT in France and Italy', [CFE/SME\(2011\)9/REV3/ANN](#).

highlights, most of these agreements were negotiated without specific concern about eco-labelling, so that uncertainty remains about their application to this case. Mutual recognition of eco-labels and greater harmonisation can limit the risk of market segmentation and discrimination.

### **Box 3.2. Labelling and certification of environmental goods**

#### ***EcoLogo Program, Canada***

Founded in 1988 by the Government of Canada but now recognised world-wide, **EcoLogo** is North America's largest, most respected environmental standard and certification mark. EcoLogo provides customers – public, corporate and consumer – with assurance that the products and services bearing the logo meet stringent standards of environmental leadership.

The **EcoLogo Program** is a Type I eco-label, as defined by the International Organization for Standardization (ISO). This means that the Program compares products/services with others in the same category, develops rigorous and scientifically relevant criteria that reflect the entire lifecycle of the product, and awards the EcoLogo to those that are verified by an independent third party as complying with the criteria.

EcoLogo certification criteria documents (CCDs) are developed in an open, public and transparent process, with a broad base of stakeholder participation including user groups, product producers, government / regulators, general science-based representatives, environmental non-governmental organizations (ENGOS), and other environmental advocates. The criteria address multiple environmental attributes related to human health and environmental considerations throughout the life cycle of the product. Currently, there are 122 Certification Criteria Documents addressing over 250 product types.

The total costs depend on the specific product or service and the licensing package. There is an initial verification and audit cost that lies typically between CAD 1 500 – 5 000. The price depends on type and number of products. The travel cost incurred by the auditor is calculated and invoiced separately. Finally, there is a subsequent verification for additional products/services whose cost is typically between CAD 250 – 2 100. An annual license fee also applies and is levied at 0.5% of sales of products qualified and certified by the EcoLogo Program (a minimum fee of CAD 2 100 per product category).

On-going strategic consulting, environmental marketing consulting and market research are all offered in addition to EcoLogo customers.

Source: [www.ecologo.org/en/](http://www.ecologo.org/en/)

#### ***Ecolabel, European Union***

The EU Ecolabel was launched in 1992 when the European Community decided to develop a Europe-wide voluntary environmental scheme that consumers could trust. Its daily management is carried out by the European Commission together with bodies from the Member States and other stakeholders

The EU Ecolabel is recognised across Europe as a reliable and scientifically verifiable way to let consumers know that a company is increasing its environmental sustainability by manufacturing products or providing services of good quality with reduced environmental impact.

The EU Ecolabel is a voluntary label, which means that producers, importers and retailers can choose to apply for the label for their products.

When developing EU Ecolabel criteria for products, the focus is on the stages where the product has the highest environmental impact, and this differs from product to product. Criteria are developed and revised in a transparent way by a group of experts and stakeholders. The criteria have been developed to ensure that the 10 to 20% most environmentally friendly products currently on the market can meet them.

By the end of 2011, more than 1 300 licences had been awarded and there were more than 17 000 EU Ecolabel products on the market. The EU Ecolabel has been awarded to the largest number of products in Italy, France and the UK. Italy has issued more than 50% of the total number of Ecolabel awards, while France and UK total 22% and 9% respectively. The EU Ecolabel currently covers a huge range of products and services, all non-food and non-medical. Tissue paper and all-purpose cleaners each equate to around 10% of EU Ecolabel products, while indoor paints and varnishes make up nearly 14%. The largest product group is hard floor coverings, which total more than 33% of EU Ecolabel products.

The Ecolabel scheme was evaluated in 2005 and found that it was frequently able to produce an improvement in environmental performance (both in terms of the product and the process). The EU Ecolabel is also able to induce an improvement in the performance of other companies in the supply chain of the participants (e.g. providers of intermediate goods and services). The label had as a strong market-related indirect effect on competitors, insofar as the EU Ecolabel is used also by non-participants as a benchmark. Competition and marketing potential were the most powerful drivers for applying for the EU Ecolabel. The improvement of environmental performance was a far less important motivation to adopt the label though the improvement of environmental performance turned out to be an important benefit of the scheme (European Commission, 2005).

Source: <http://ec.europa.eu/environment/ecolabel/eu-ecolabel-for-businesses.html>

*Market-driven opportunities*

117. Market-based drivers consist of opportunities to respond to the need for environmental or greener goods and services perceived by market players, consumers or businesses. These needs can emerge as a result of changes in values and norms, but can also reflect changes in relative prices. In particular, government market-based instruments, such as taxes and subsidies, modify price signals, so that the value or cost of externalities is taken into account and all factors of production, including natural capital, are properly valued (OECD, 2011d).

118. Externalities (both positive and negative) are a cost or benefit of an economic activity that does not accrue to the person or organisation carrying out the activity (Black, 1997). Opportunities open up to green entrepreneurs when governments take action to place a price on these externalities, “pricing” them into the market. As a case in point, the introduction of taxes on plastic shopping bags has opened up a new market for “green” shopping bags, populated by a large number of small enterprises that also offer their customers, mainly retailers, a marketing tool (Box 3.3).

**Box 3.3. Pricing in externalities: Plastic shopping bags in Ireland**

A contemporary example of pricing in an environmental externality involves plastic shopping bags. Plastic bags are environmentally problematic as the bags themselves, once disposed of, pose a threat to wildlife (particularly marine wildlife) and decomposition of the bags takes 450-1000 years (Bushnell, 2011). The fact that this cost does not accrue to either the producer or user of the bags means that the damage caused can be considered a negative externality.

One government induced solution to this problem originated in Ireland where a fee-based approach was introduced in 2002 involving a bag tax of 22 cents being levied on consumers at time of checkout. Within weeks, there was a 94 percent drop in plastic bag use, being replaced by reusable cloth bags. Plastic bags have become socially unacceptable, representing a change in consumer behaviour (Rosenthal, 2008). A large portion of the proceeds then go towards pollution and litter cleanup efforts.

By introducing this top-down measure, the government was able to reduced environmentally negative behaviour, open up a new market for reusable cloth bags and biodegradable plastic bags and spur on another driver of market opportunity for eco-innovations, discussed later in this chapter, more environmentally conscious consumer behaviour and values.

119. The business case studies highlight the opportunities related to the pricing of externalities. In particular, one of the cases in Italy illustrates new opportunities in the ICT sector that result from externality pricing, regulation and cost-saving motives. Green ICT is a rapidly growing sector, in which new business models are emerging. In the case presented (see Box 3.4), the existing obligations related to Waste Electrical and Electronic Equipment (WEEE) Directive on e-waste disposal, a measure intended to internalise the cost of disposal, were a triggering factor for the creation of new ventures, that buy used ICT equipments, “regenerate” and certify components and networks, and sell them at a lower price than brand components. By contrast, in the case of a business in Canada, the lack of pricing of environmental externalities, in this case the lack of obligation for landfill to engage in soil remediation – leading to soil pollution – was indicated as an important barrier to the development of the soil remediation business.

120. The examples above refer to cases in which government intervention to correct market failure can create new opportunities for green entrepreneurs. However, inappropriate government intervention can also lead to the exclusion of more environmentally-friendly innovations and reduce the scope for green entrepreneurship. This is typically the case of subsidies on coal or oil consumption. The IEA has estimated that subsidies to fossil fuel consumption in emerging and developing countries amounted to some USD 409 billion in 2010. The OECD identified over 250 measures that support fossil-fuel production that had an overall value of about USD 45-75 billion a year between 2005 and 2010. These measures encourage

pollution and, by locking-in outdated technologies, limit the space for expansion of alternative green markets (OECD, 2012a, OECD 2012b). Market opportunities would open up were the subsidies that reduce the price of oil for consumers or businesses to be taken away, as alternative suppliers would become more competitive on price.

121. Market opportunities may emerge due to the high cost, or expected future high cost, of energy or raw materials. In fact, cost savings are found to be an important motivation for the adoption by consumers and producers of solutions that reduce energy and material use (Horbach, 2008; Frondel et al, 2007, Horbach et al, 2010). Once material prices reach a convenience threshold, more environmentally-friendly alternatives may be able to compete on price.

122. In some of the case studies conducted, the evolution of market demand, in particular customers increasing awareness of the material and cost savings eco-innovations could bring, were cited as a main driver for green entrepreneurs' businesses. The cost saving motive emerges as an increasingly important factor across sectors, irrespectively of the absolute amount of resource usage implied by the economic activity. The case studies illustrate these opportunities across a range of industries, from the ICT sector, with software providers responding to the users' need to extend the life of ICT equipment and reduce energy consumption when storing documents, to the extractive industry, increasing its demand for cleantech solutions, and transformative investments, at time of favourable trends in oil prices.

#### **Box 3.4. New green business models: The case of green ICT**

Green ICT has recently emerged as one of the most dynamic areas for the development of new business models that respond to environmental needs. Opportunities arise from the role ICT can have for greening the economy at large, as well as from the need to reduce emissions in the ICT sector itself. In fact, this sector is responsible for a significant share of the global carbon footprint. Across OECD economies, ICT consume about 10% of national electricity during the use phase and contribute some 2% to 5% of domestic CO<sub>2</sub>/GHG emissions (OECD, 2010d). As the sector expands, the need for more energy efficient ICT systems becomes more urgent.

The Green ICT sector includes both "green ICT", that is, ICT with superior environmental performance, and "ICT for green", that is, ICT that improves the environmental performance of end-users, such as software for the conception and design of sustainable building. For the present investigation, case studies of "ICT for green" businesses were conducted. Among these is Semantic, an Italian firm which provides solutions to small and large companies to reduce their ICT footprint, while reducing the costs for the acquisition of ICT devices. The business addresses the trade-off between cost efficiency and environmental sustainability by offering business customers refurbished ICT systems. The company tests and regenerates ICT products and network devices (routers, switches, IP telephones, wireless, security products and access servers) of the most important sector brands, and guarantee their functioning along similar terms as the original products. On the side of suppliers, the company takes advantage of the fact that frequently substitution of ICT devices is linked to the re-design of the firms' ICT networks, rather than malfunctioning of single equipment. Hence Semantic's business addresses environmental needs of both customers, allowing them to purchase brand ICT devices at a significant discount (60%-80% on the market price of new products), and suppliers, as they save money on e-waste disposal and profit from selling used products.

During the recent crisis, the company's turnover has grown substantially, as its business model responded to the increasing need to save costs and provided to other businesses a convenient solution to comply with the EU *Waste Electrical and Electronic Equipment Directive* (WEEE Directive).

Source: Annex to this report, CFE/SME(2011)9/REV3/ANN

*Value-driven market opportunities*

123. Recent empirical work has highlighted the role of social and environmental norms and attitudes on consumer behaviour (OECD, 2011f). When consumer behaviour shifts towards more environmentally-friendly consumption patterns, new opportunities to green entrepreneurs open up.

124. The key player in this process is civil society. When awareness of environmental problems grows and becomes a shared value, the purchasing power of the mass market forces businesses to green both their products and their processes. Likewise, when this shift occurs additional pressures are placed on governments to respond to their electorates' concerns. These changes in consumers' knowledge of environmental issues and the environmental impact of their consumption and lifestyle decisions have become more profound in the past decade (OECD, 2011a), though they have been underway since the 1970s and the emergence of the green consumerism movement (Gosden, 1995). The outcome of this movement was the emergence of a 'green niche' of consumers, placing a new demand on corporations and businesses to provide more environmentally friendly products and services (Perkins, 2007).

125. The 'green niches' are composed of customers with a preference for environmentally superior products, who are willing to pay a premium for this added benefit. This group of consumers typically serve as a first foothold for businesses in a new green sector. By targeting and selling to a growing 'green niche', firms can kick-off a virtuous cycle whereby the initial revenues can be invested in subsequent innovations, demonstration and adoption – each time bringing down the cost of technologies and processes, thus making them even more attractive to users (Romani et al. 2011; Gartner, 2012). As more consumers become aware of the product or service, this may enter the mainstream. There are numerous examples of entrepreneurs who have identified a green niche in existing industries and have gone on to turn that green niche into an industry-changing business. Box 3.5 comments the case of Patagonia company, a producer of climbing equipment which succeeded in scaling up the early niche.

**Box 3.5. Exploiting a green niche: Patagonia**

In 1975, Yvon Chouinard established the Patagonia Company with the mission of making high-quality climbing equipment. Patagonia is committed to achieving the triple bottom line: being profitable as well as environmentally and socially responsible in its business practices. Patagonia manages its research and development, design, manufacturing, merchandising and sales of all its products and had revenues of USD 270 million in 2006.

Patagonia has used its environmental achievements (the "Cleanest Line") to differentiate itself in the marketplace and in doing so has received great brand recognition within the apparel industry and amongst consumers (Pongratic, 2007). In line with this, Patagonia has also committed to environmental causes, including the company's programmes for LEED Certified buildings, FSC Certification and Common Threads Garment Recycling Program. Since 1985, Patagonia has pledged 1% of sales to the preservation and restoration of the natural environment and has awarded over USD 40 million in grants to domestic and international grassroots environmental organizations that seek to make a difference in their local communities. In 2002, Patagonia extended their efforts and started a non-profit organization called 1% for the Planet. This non-profit organization encourages other businesses to join the non-profit organization and to donate part of their revenues as well.

Source: Reinhardt et al, 2010.

126. Governments can play a role in bolstering consumers' environmental awareness (OECD, 2011f). Relevant instruments include information campaigns and education. A recent report by UNEP provides recommendations and guidelines on how to best integrate and implement Education for Sustainable Consumption (ESC) in the formal education sector (Box 3.6) Education can steer users' behaviour towards sustainable consumption and raise awareness of what consumers and households can do to reduce the negative environmental impact of their consumption patterns (OECD, 2009a). This concern for the

environment translates into demand for green solutions, such as energy-efficient appliances and renewable energy or organic food, all of which represent new market opportunities for green entrepreneurs.

**Box 3.6. Educational initiatives to increase environmental consciousness**

***United Nations Environment Programme (UNEP)***

UNEP's Division of Technology, Industry, and Economics has released a report for policy-makers and relevant stakeholders on how best to support the shift to sustainable lifestyles, for instance through effective communication and awareness-raising campaigns. Based on the Global Survey on Sustainable Lifestyles (GSSL), the report recognises that the shift towards sustainable lifestyles and consumption patterns is a pre-requisite to the achievement of sustainable development and recommends investment in education, at all levels and in all its forms (informal, formal), professional training and awareness-raising to build capacities for sustainable lifestyles at all levels of society (policy-makers, business sector, civil society, communities, households and individuals).

The UNEP report *Here and Now! Education for Sustainable Consumption* (2010), provides recommendations and guidelines aimed at policy-makers and educators on how to best integrate and implement Education for Sustainable Consumption (ESC) in the formal education sector. In 2005, the UN Decade of Education for Sustainable Development (DESD, 2005-2014) was initiated. The overall goal of the DESD is to integrate the values inherent in sustainable development into all aspects of learning, to encourage changes in behaviour that allow for a more sustainable society. The DESD recognises that achieving more sustainable consumption patterns requires both business practices and government policies that broaden the range of choices and guarantee clear and reliable information open to consumers to make environmentally and ethically sound decisions. Education plays a particularly important role in catalysing this process. Ten points are given to support governments towards the achievement of the DESD goals:

- Ensure that education institutions reflect in their daily management the priorities given to sustainable development.
- Include themes, topics, modules, courses and degrees about education for sustainable consumption in established curricula.
- Encourage research in education for sustainable consumption-related areas.
- Strengthen connections between researchers, lecturers, teacher trainers and socio-economic actors and stakeholders.
- Enhance cooperation between professionals from diverse disciplines in order to develop integrated approaches to education for sustainable consumption.
- Facilitate teaching and teacher-training that strengthen global, future-oriented, constructive perspectives within education for sustainable consumption.
- Reward creative, critical, innovative thinking related to education for sustainable consumption.
- Ensure that education for sustainable consumption respects the importance of indigenous knowledge and recognizes alternative lifestyles.
- Foster intergenerational learning as an integrated aspect of education for sustainable consumption.
- Provide opportunities for practical application of theoretical study through social involvement and community service.

Source: [www.unep.fr/scp/](http://www.unep.fr/scp/)

***United States Environmental Protection Agency (US EPA): Learn the Issues – Green Living***

The US EPA provides a comprehensive library of information on ways for consumers to reduce their environmental impact in all aspects of their daily lives. The section on Shopping<sup>100</sup> provides information on various ways in which consumers can verify the environmental standards of products they buy through sections on greener products, finding ENERGY STAR Products, identifying WaterSense products and buying recycled products.

Source: [www.epa.gov/gateway/learn/greenliving.html](http://www.epa.gov/gateway/learn/greenliving.html)

*Creation of new markets and 'creative destruction'*

127. Market opportunities can be created by green entrepreneurs themselves, through forward-looking vision and innovations that generate new demand. Green entrepreneurs do not just act on existing or new market opportunities, but are also able *to create their own opportunities* either by addressing existing market failures that cause environmental damage or inciting consumers to change their behaviour, resulting in demand for new, green products that do not exist yet.

128. Schumpeter acknowledged that increased market demand alone is not sufficient to stimulate innovation, unless users' preferences are influenced in that direction. In some instances, innovations are so radical that users do not expect them or are able to imagine their market application<sup>19</sup>. Entrepreneurs, as providers and translators of innovation into commercial ventures, can persuade buyers to change their preferences (Anderson, 1998) and in this way create new market opportunities for their eco-innovations.

129. Green entrepreneurs are likewise able to create new opportunities by providing solutions to address negative environmental externalities. This can be technological solutions or non-technological innovations. The Chicago Climate Exchange (CCX) provides an example of the creation of an institution, a market place and its rules, to address an externality and reduce the transaction costs associated with it. The CCX was created by the entrepreneur Richard Sandor to serve as a marketplace for carbon emission credits. The exchange serves as a platform through which members can trade carbon emission allowances, thereby enabling firms with relatively low emission reduction costs to sell credits on the exchange to firms with higher costs. The resulting institution has produced a reduction in the aggregate emissions at the least possible cost. The transaction costs of carbon trading are minimised through the development of uniform carbon commodity standards, legal instruments that provide evidence of ownership, auditing mechanisms, and the actual trading technology which serves as a mechanism of price discovery (Sandor, 2001; Dean and McMullen, 2007).

130. New markets, or market niches, for green entrepreneurs may also emerge from their close interaction with consumers or users, which can favour greater understanding of their attitudes and market behaviour. This is the case of "people-centric" or "user-driven" eco-innovation, whereby the innovator actively screens and/or involves customers and users in the innovation processes. User screening means engaging with users' real-life interactions with products and services, observing them and their interaction products or services to gain insight into both the spoken and on-spoken needs of the users. User participation happens when companies work together with users and invite them in an ideation setting with a focus on tapping tacit knowledge to uncover un-recognized needs in the use situation (Bisgaard et al., 2011).

*Market opportunities from business collaboration and research-industry linkages*

131. Innovation is broadly an interactive process among a wide variety of actors, including entrepreneurs, customers and suppliers, universities, research centres, government agencies, and financial institutions. The transition towards new systems of eco-innovation and green growth will require the formation of new alliances between established and new companies, to go beyond the traditional networks of enterprises that exist today (Keijzers, 2002). The complexity of eco-innovation and the challenges that exist for green products to compete also on price with established alternatives in the market suggest that cooperative efforts will be crucial for green markets to expand. The development and success of the Danish wind power industry is an example in this sense: the decentralised and small-scale firm structure, coupled

---

<sup>19</sup> Akin to Henry Ford's quote: "If I'd asked customers what they wanted, they would have told me, 'A faster horse!'"

with small producers' inclination to work collaboratively, proved highly successful in generating the incremental innovations for wind turbines, which, over time, resulted in reliable and commercially successful machines (Jones and Bouamane, 2011).

132. Evidence from case studies in the Green ICT sector also suggests that collaborative network of SMEs in the same niche industry can support start-ups and business growth. The experience of ICT equipment "regenerators" is one example. By joining an international network of SME partners, small providers are able to meet unexpected or urgent client requests for products that, due to their specificity, cannot be rapidly sourced by one individual firm, and to develop innovative solutions.

133. Research-industry linkages are particularly important for the development of innovations and market opportunities for green entrepreneurs. In one case study in France, a spin-off of an Aerospace research centre developed its business on software for modelling the energy efficiency of buildings. R&D was a major part of the business: 30% of the turnover was invested in research activities and the firm developed a dense cooperative network with major research centres in France that the firm perceived to be crucial for its capacity to propose new products.

134. The relationship with research centres can be particularly relevant at the early stages of the business idea development. This was the case for a Canadian firm involved in the digital mapping of energy resources to identify economic benefit from renewable energy use. In its early stages, it was in need of specialised, quality employees and investors who would understand and back the technology. The company's interaction with research institutions, incubators and innovation exchanges in the local area were extremely important in achieving this goal as these resources were in short supply and difficult to locate for a company operating in such a niche area.

135. Also, universities and research centres can favour spin-offs in the green sector. The Australian experience with renewable energy shows the role that can be taken by scientists and academics in bringing to the market novel solutions, which break with existing technological patterns. Typically, however, the success of these spin-offs depends on the capacity of the scientist-entrepreneur to team up early with experienced management and venture capitalists, in order to address the substantial capital requirements in the field.

136. Governments have a role in fostering the exchange of knowledge and ideas through networks and partnerships. Box 3.7 provides examples of initiatives in Spain, Denmark, Ireland and the United States to build networks among different actors in green industries. Box 3.8 illustrates the Australian initiative, Researchers in Business Program, to support the placement of researchers from universities or public research agencies into businesses, to help develop and implement a new idea with commercial potential. Framework conditions are also important to foster knowledge partnerships, in particular an efficiently operating intellectual property rights system (OECD, 2011e).

#### **Box 3.7. Promoting networks amongst green entrepreneurs**

##### ***Red Empreverde (Green Entrepreneur Network), Spain***

Launched in April 2011, the *Red Empreverde* (Green Entrepreneur Network) is the first platform in Spain for support to entrepreneurs specialised in green business. It is an initiative to promote the creation and consolidation of companies or new lines of business in activities linked to the environment.

It is operated by the Fundacion Bioversidad (Biodiversity Foundation), a public foundation of the Spanish Government under the Department of Environment and Rural and Marine Development. The Foundation collaborates with entities and institutions in the public sector, the civil society and business environment to preserve the natural heritage and biodiversity in connection with the creation of employment, wealth and well-being in the society.

The network welcomes participation by three main groups: entrepreneurs, investors and generally any entity or

institution concerned with green business. Entrepreneurs gain access to consulting and advice to help them develop business plans, incorporate new environmental business lines, information on eco-innovation or sustainability issues and access to finance or investment. A social networking platform and other Web 2.0 tools are employed to bring groups together, share experiences and opportunities.

A contest is also run through the network under three categories: new entrepreneurial initiatives, new green product lines through existing enterprises and existing enterprises (older than 5 years old). To enter the competition, applications simply have to be part of the network and submit an application form with information from their business plan or information about their enterprise. EUR 100 000 are available for in-kind prizes (such as consulting or participation in forums) and EUR 50 000 in cash (EUR 10 000 for 1<sup>st</sup> and EUR 5 000 for 2<sup>nd</sup> place in each respective category). A special prize of EUR 5 000 is given to an enterprise with a concept that contributes significantly to biodiversity.

Source: [www.redemprenderverde.es/](http://www.redemprenderverde.es/)

### ***Copenhagen Cleantech Cluster, Denmark***

The Copenhagen Cleantech Cluster (CCC) is a consortium, established in 2009, based on the triple helix model of university-industry-government interactions. It is endowed with a budget of EUR 20 million over five years, provided by the European Union Structural Funds (50%), the Region Zealand and the Capital Region of Denmark (25%), founding partner companies and the City of Copenhagen (25%). The primary aim of the cluster is to develop and promote Danish cleantech companies, organizations, joint ventures and R&D activities, by also attracting global investors.

The CCC carries out projects in five focus areas: i) Facilitation, through a One Stop Shop, where interested parties can gain an overview and access the cluster; ii) Matchmaking between research institutions, companies and other stakeholders; iii) Test and Demonstration, for cleantech technologies and products, from initial idea to full-scale demonstration; iv) Innovation and Entrepreneurship, through the development of a supportive framework, including a Cleantech Accelerator program, which supports start-ups to access knowledge, skills and potential partners and; v) International Outreach, to support collaboration with cutting-edge international clusters and institutions.

In 2012, 610 cleantech companies operate in the cluster, accounting for a total of 78,000 jobs (about half of these directly engaged with cleantech-related activities), EUR 30 billion turnover (of which about EUR 12 billion related to cleantech activities). The most prominent sectors are energy efficiency and renewable energy, water and wastewater, waste and recycling.

The CCC has recently established a partnership with Denmark's Regional Business Development Centres ('Vaeksthus'), which advises established businesses and manage governmental or regional initiative projects, such as promoting the cleantech companies in the Danish capital region. Vaeksthus Greater Copenhagen runs the programme Cleantech Partnership, which assists a number of selected Danish cleantech entrepreneurs in getting access to highly specialised technical know-how and physical facilities, as well as consultancy relating to scaling up and internationalisation, which are not available through existing entrepreneurship schemes.

Source: OECD (2012), Transitioning to a Low-Carbon Economy. An analysis of Greater Copenhagen, LEED Working Paper.

### ***The Green Way, Dublin's Cleantech Cluster, Ireland***

The Green Way is a collaborative cleantech initiative established in 2010, in the Dublin region, by industry, academic institutions and public/semi-state players, along the "triple helix" model. The Green Way's mission is firstly, to support existing green economy companies and eco-innovation in the region, secondly, to foster and accelerate new job creation in green economy startups and thirdly, to facilitate multinational corporations capable of bringing transformative green economy jobs and investment to the region.

The Green Way is home to multiple centre of excellence and national research centres. Thus, Irish cleantech companies benefit from access to broad R&D capabilities, as well as from access to potential procurers of cleantech products and services, test beds and a talent pool provided by all cluster members. Cleantech star-ups receive customised help with business models and financing through incubation programmes. Also, a Green Way Cleantech Innovation Campus was launched by Dublin City University (DCU), to strengthen university-industry linkages and to provide companies in the region with opportunities to leverage the research, education and collective resources of DCU and cluster partners.

The Green Way is partner of the Global Cleantech Cluster Association (GCCA) and has actively forged relationships with peer organisations in other countries, including the Environmental Business Cluster in San Jose/Silicon Valley and the China Greentech Initiative in Beijing. The participation to international networks is aimed at exchanging knowledge, finding partners for local companies and developing academic and municipal level linkages.

Source: [www.thegreenway.ie/](http://www.thegreenway.ie/)

**CleanTECH San Diego, United States**

Formed in 2007, CleanTECH San Diego is a private, non-profit member organisation that aims to stimulate the creation and expansion of a clean technology business cluster in the San Diego region. The organisation brings together business and financial leaders, energy companies, academic and research institutes and government and non-profit organisations. Using this network, CleanTECH San Diego works with regional, state and federal policy makers to adopt rules supporting clean technology innovation and commercialisation. It positions San Diego as a source of quality deal flow among green investors and works to bring clean technology research efforts to the region. Some of the initiatives that CleanTECH has been involved in include: the CleanTECH-led San Diego Biofuels Initiative, which received over USD 7.4 million in state and federal funds to develop training programs for the algal biofuel industry and the San Diego Unified School District, which received USD 70 million in Federal Clean Renewable Energy Bonds with CleanTECH's legal, financial, technical, and administrative support. At the beginning of 2012, 825 cleantech companies were members of the not-for-profit.

Source: [www.cleantechsandiego.org/](http://www.cleantechsandiego.org/)

**NorTech, United States**

NorTech is a non-profit, technology-based economic development organisation serving 21 counties in Northeast Ohio. It focuses on the advanced energy and flexible electronics industries. It is funded by public and private partners in Northeast Ohio's business and philanthropic community as well as support from the US Department of Commerce.

NorTech's activities include building relationships among cluster members for funding, research, and business opportunities through events and conferences and engaging federal and state government and policy leaders to develop strategies that enhance the cluster's growth. It has received support as a part of the SBA's Regional Clusters Initiative including technical assistance, business training, counselling, mentoring and other services.

Source: [www.nortech.org/](http://www.nortech.org/) and [www.sbaonline.sba.gov/clusters/index.html](http://www.sbaonline.sba.gov/clusters/index.html)

**Box 3.8. Bridging the divide between business and research sector: Australia's Researchers in Business Program**

'Researchers in Business' (RiB) is a program of the Australian Government's Commonwealth, Scientific and Industrial Research Organisation, which supports the placement of researchers from universities or public research agencies into businesses, to help develop and implement a new idea with commercial potential. The program aims to help bridging the cultural divide between business and the research sector, speed up the distribution of knowledge and expertise, and accelerate the adoption of new ideas and technologies. The program is part of the services offered by Enterprise Connect, an initiative of the Department of Industry, Innovation, Science, Research and Tertiary Education, which delivers a number of targeted support programs to address specific business and regional development needs. Enterprise Connect works through a network of 12 centers located across the country that service SMEs in industries as diverse as manufacturing, clean technology, resources, defence, tourism and the creative sector

The RiB program provides SMEs with matching funding to engage a researcher. The public support amounts to up to 50% of salary costs, to a maximum of \$50,000, for each placement between 2 and 12 months. The program targets firms with turnover or expenditure of more than \$1 million and less than \$100 million in the current financial year or one of the two preceding financial years. It is also requested that the main business activity is in industries other than primary production and that the firm has not received funding for a similar purpose from other government (Australian, State or Territory or Local) programs within the last three calendar years.

The program is delivered through 'facilitators', who connect businesses with researchers from universities or public research agencies with the specific expertise relevant to the needs of the business. The areas covered include:

- product innovation – developing and testing new, or improved products or services targeted to new or existing markets
- process innovation – addressing production or process issues (e.g. improve manufacturing efficiencies or quality through new or improved technologies)
- assist and help local businesses access Enterprise Connect services and other industry programs to increase entrepreneurial capacity
- environmental sustainability – identifying and measuring of pollution, and reducing waste (water, energy, recycling etc.).

Source: [www.enterpriseconnect.gov.au/services/Pages/ResearchersinBusinessGrant.aspx](http://www.enterpriseconnect.gov.au/services/Pages/ResearchersinBusinessGrant.aspx)

***Developing business environmental values***

137. Trying to trace the source of the environmental values and consciousness of green entrepreneurs is a difficult task. While the literature to date is adept in identifying the drivers behind the emergence of new market opportunities for entrepreneurs, the drivers behind the emergence of green entrepreneurs themselves are not well understood (Beveridge and Guy, 2005).

138. Scholars explain the emergence of green entrepreneurial values as a result of internal and external influences on the individual (Walley and Taylor, 2003). The external influences include regulations, economic incentives and the moral demands of consumers. The internal influences include family and friends, past experiences, personal networks and education. A green business will likely only emerge (then be successful) in a society that places value on more sustainable products and services (external influences), but success will depend much on the entrepreneurs' motivations to succeed (Anderson, 1998; Pastakia, 2002).

139. Seminal research on entrepreneurship in green industries, including organic food, sustainable agriculture, natural cosmetics, the built environment, ecotourism, and waste recycling, however suggests that unconventional thinking is important. In his research of entrepreneurial experiences over six decades, Geoffrey Jones from Harvard Business School finds that innovators in all these industries often came from the margins of the business world and even their own societies. Once seen as eccentric or unfeasible business concepts, many of these early ideas have now become part of the mainstream<sup>20</sup>.

140. The emergence of green entrepreneurship has been conceived as the result of an interaction of both internal and external influences. Substantial work still needs to be done to accurately ascertain the drivers behind the environmental values of green entrepreneurs and the competencies and skills that favour the translation of these values into business strategies. Questions for research include: what common value sets inform green entrepreneurship and through what processes are these values developed; how do the practices of entrepreneurship change when driven by different values; what entrepreneurial competences are required for values to turn into entrepreneurial plans?

**3.4. Barriers to green entrepreneurs and green businesses**

141. Most of the general barriers identified for the development of start-up and enterprises, such as finding the right timing for market entry and the need for adequate financial resources, human capital and skills, are also relevant for green entrepreneurs (Linnanen, 2002). However, some barriers are more severe for green entrepreneurs and businesses vis-à-vis conventional entrepreneurs or businesses operating in non-environmental industries. These barriers include: the challenge of market creation, financial barriers (on the demand and supply sides), skill shortages, maintenance patterns and lock-ins, and regulatory hurdles. These barriers are explained below with reference to examples derived from case studies. Examples of government policy responses across OECD countries to address these barriers are also provided.

***Market creation and end-user demand***

142. Green entrepreneurs and enterprises face specific difficulties in ensuring end-user demand. This stems from the challenge of creating a market for a product that often does not exist yet, and from a lack of information on the part of the consumer about the quality and the cost/environmental benefits of that product. Lack of demand for a product or technology leads to a situation where eco-innovations and

---

<sup>20</sup> Geoffrey Jones, Harvard Business School, Research project on "A History of Green Entrepreneurship" retrieved at <http://hbswk.hbs.edu/item/6561.html>

prototypes reside in a ‘valley of death’ between the invention and the commercialisation (OECD, 2011a). If initial demand is present though, even in the form of a small but growing, niche customer group, investment in green technologies and products can rapidly become more profitable, thanks to increasing economies of scale. This in turn prompts innovation, demonstration, experience and learning, which brings down the cost of technologies and processes, thus making them even more attractive to users. In a virtuous circle, this can lead to subsequent innovations, demonstration and adoption (Romani, Stern and Zenghelis, 2011; Gartner, 2012).

143. The key challenge for market creation relates to generating initial demand for a product that does not yet exist (Linnanen, 2002; Beveridge and Guy, 2005; OECD, 2011d). Although in many countries environmental awareness on the part of consumers has increased in recent past decades, the market uptake of environmental goods can still be affected by lack of information and scepticism about the quality and the financial and environmental benefits of eco-innovations (Linnanen, 2002).

144. The businesses case studies on recycling in Italy illustrate this type of difficulty. Firms had trouble selling their product, as consumers did not attribute a positive value to recycled goods, regardless of their quality, price or environmental benefit. The concept of recycling has been associated in the past with low quality products and materials, and even if this preconceived notion is no longer always true, it still affects consumption patterns and limits the expansion of green markets. A Canadian case provides an equally good illustration. The firms struggled with end-user demand because ‘old school’ customers thought a technology that turns waste into plastics was ‘inferior’. The standard assumption of customers was that any product that came from recycled materials should be sold at a discount, not at a premium.

145. Government intervention may be warranted to influence consumer behaviour when: a) consumers do not possess the required information about the cost or environmental benefits of a product or service to make informed decisions about their purchases; or b) entrepreneurs are unable to change consumers’ preferences towards more environmentally beneficial behaviour

146. Direct measures include simply banning undesirable products/services or using levy taxes to dissuade undesirable behaviour, as in the case of incandescent light bulbs (Box 3.9). Indirect measures include consumer policy and consumer education, green labelling and certification.

147. Some governments have also taken initiatives to give visibility to successful green businesses, as a way to raise market attention, but also to highlight good business practices and role models. These measures may also combine the signalling effect with specific support to the firms identified. This is the case of Korea’s Excellent Green Biz program, which fosters exemplary SMEs in terms of green management (SMBA, 2011).

148. In areas where market signals are not fully effective, government can contribute to creating and strengthening new markets for green innovations through standards, well designed regulations and innovative public procurement (OECD, 2011b).

149. Governments may act as a ‘market catalyst’ (Lerner and Sahlman, 2012) for eco-innovations through public procurement. As one of the largest consumers, the public sector is a key source of initial and on-going demand for eco-innovative firms. This is particularly the case in areas such as education (schools) and health (hospitals), but also in construction and transport, where the government is a major or the main market player (OECD, 2011a). By acting as an initial customer, the public sector can ‘kick-start’ the virtuous cycle of innovation, demonstration and adoption. Evidence collected through the case studies suggests that public procurement can be a powerful measure to help build the initial market niches.

**Box 3.9. Phasing out incandescent light bulbs: Changing customer behaviour and fostering new innovations**

Various governments around the world have been implementing measures to curb or ban the use of incandescent light bulbs. The action has been initiated based on the inefficient energy use of incandescent bulbs (90% of the energy is given away in heat) and the presence of more energy efficient alternatives. These measures are intended to change consumers' environmentally damaging behaviour, open new markets to firms and spur on new innovations of the very technology the measure was intended to obsolete.

In Argentina, the sale and importing of incandescent bulbs has been outright banned since 2010. Australia has enacted energy efficiency standards, which effectively disallows the sale of incandescent bulbs after 2010. In the European Union, Ireland was the first country to enforce an outright ban on incandescent and all member states have agreed to a progressive phase-out of incandescent light bulbs by 2012. Switzerland has banned the sale of all light bulbs of the Energy Efficiency Class F and G, which affects a few types of incandescent light bulbs (OECD, 2011f). The United States federal government enacted the Energy Independence and Security Act in 2007, which contains maximum wattage requirements for all general service incandescent lamps. The implementation of this has however been delayed until October 2012 (Isidore, 2011).

In instances where energy efficiency standards have been imposed, these standards have had the additional effect of spurring on new innovations. Large companies and small investors alike have been testing new ways to make incandescent bulbs more energy efficient including adding special reflective coatings to gas-filled capsules that surround the bulb's filament or to the glass coating of the bulb itself (Vestel, 2009).

150. Governments may act as a 'market catalyst' (Lerner and Sahlman, 2012) for eco-innovations through public procurement. As one of the largest consumers, the public sector is a key source of initial and on-going demand for eco-innovative firms. This is particularly the case in areas such as education (schools) and health (hospitals), but also in construction and transport, where the government is a major or the main market player (OECD, 2011a). By acting as an initial customer, the public sector can 'kick-start' the virtuous cycle of innovation, demonstration and adoption. Evidence collected through the case studies suggests that public procurement can be a powerful measure to help build the initial market niches.

151. However, the case studies also highlight some obstacles to entrepreneurs' access to public procurement. In particular, the tendering procedure must be simple and not require large investments in specialised legal or other consulting services for small firms to apply. Case studies point to difficulties for small firms participating in tenders at a regional or national level due to the time needed to apply and specific competences required to file a bid. Secondly, firms that provide eco-innovations are typically operating in industries that evolve fast and, as such, long-term contracts with established providers inhibit the emergence and uptake of new, more innovative products or services being offered by other firms. In one instance, a firm pointed out that many tenders are for new products or processes, at the exclusion of recycled ones. Finally, the information on tenders and application needs to be accessible to small firms. Systems for online information and application have been recently implemented. The website launched by the US SBA in 2011 is an example in this direction (Box 3.10).

152. A novel policy approach to developing demand-based eco-innovation builds on the concept of user-driven innovation. Acknowledging that innovation increasingly occurs in networks that involve a range of stakeholders such as suppliers, customers and end-users, policy programs can facilitate the interaction between business innovators and actual or potential users, for demand-driven solutions to emerge. FORA (2010) identifies four main areas of the user-driven innovation paradigm, which can be addressed by entrepreneurs and by policy makers' supporting measures: i) user tests, which usually take place at the end of the innovation process, when the companies' ideas have been shaped into a testable product or service; ii) user exploration, which, based on the user's intuitive engagement with the new product or service, allows a better understanding of unspoken needs and context of use; iii) user participation, which happens when firms work together with the users at specific development stages, such as engineering or marketing and iv) user innovation, which consists in the direct engagement by experts or advanced users in some of the key steps of the innovation process (Bisgaard et al., 2011).

153. In 2007, the *Danish Enterprise and Construction Authority* launched the Program for User-Driven Innovation with the purpose of strengthening the diffusion of user-driven innovation into the Danish business sector and in the public sector. The project ran from 2007-2009 with a yearly budget of Euro13.5 million. This was then replaced in 2010 by the Euro 100 million biannual program “Fornylesesfonden” (Business Innovation Fund) that has focused on innovation related to green solutions and welfare solutions (Bisgaard et al., 2011). The program supports innovations based on market opportunities and customer needs. Grants are provided to test whether the products/services work in practice in different usage situations, and cooperation agreements with test users is a requirement (Box 3.11).

**Box 3.10. USSBA – Green Government Opportunities for Small Businesses website, United States**

In November 2011 the US SBA and the Department of the Navy announced the launch of a new website focused on providing small businesses with access to green government opportunities. The website serves as a one-stop destination for all things green in small business. It provides a resource through which small businesses can gain access to green contracts, grants and partnerships with the Navy.

The site allows users to connect with other members of the green small business community, browse active federal prospects, find RFPs and SBIR, STTR and ONR grants and search for these prospects using filters such as type of technology or opportunity type. It also provides information about energy and environment news, green business innovations, regulations and events from government agencies.

*For more information see:* <http://green.sba.gov/>

**Box 3.11. The Danish Business Innovation Fund**

The Business Innovation Fund is a Danish government initiative established in autumn 2009 under the Danish Ministry of Economic and Business Affairs. The aim of the Business Innovation Fund has been to promote growth, employment and export by supporting business opportunities, in particular in small and medium sized enterprises, within green growth and welfare solutions, as well as providing support to exploit new business and growth opportunities opened up by the transition in less favoured areas of the country.

The rationale behind the establishment of the fund was to contribute to commercialisation and market maturation of new innovations. Barriers exist that prevent products and services in the early market stage from reaching the market such as lack of initial demand (as there are no references from previous clients, or that the products and services need to be tested and adapted) commonly referred to as the “valley of death”. The Fund’s investments ensured that manufacturers of innovative new products and services are helped across the valley of death and those that are successful are able to sell their products and services in the future. For this purpose, interaction with end-users was required.

Approximately EUR 100 million was allocated to the fund for the period 2010-2012. Private enterprises operating within green business or the welfare area could apply for financial support within three focus areas: innovation, market maturation and change-over.

An independent, professional board of directors was set up for the Business Innovation Fund, comprising a chairman and seven members appointed by the Minister of Economic and Business Affairs. Between them the board members brought broad business insight, knowledge and experience in the areas in focus for the Business Innovation Fund.

Up until 2012, the Business Innovation Fund had received 496 applications. 95 projects had been supported by the fund with a total amount of investment of EUR 60 million. The Fund ended its operations in December 2012.

Source: information supplied by the Danish Business Innovation Fund.

***Finance: Demand and supply-side constraints***

154. Access to finance represents one of the key barriers to eco-innovation. The reason for this relates to the relative immaturity of the eco-innovation market and the associated problems in accurately pricing

the risk of investments of eco-innovations. In the case of green entrepreneurs, obstacles might arise also from peculiar specific business culture and mismatch with the typical investment criteria used by venture capital and institutional investors.

155. The financial barriers that beset green entrepreneurs are similar to those facing all entrepreneurs and start-up firms operating in highly innovative industries. Financing problems are particularly acute for new entrants as they typically have a limited track record and limited internal funding to draw upon (OECD, 2011b). The finance barrier is in part linked to the market creation barrier identified in the previous section, where entrepreneurs must create a market for a product that does not yet exist. In instances where the market creation challenge coincides with the requirement of high-level capital investments, SMEs end up hitting barriers in procuring sufficient finance to bring their product through to the commercialisation and production phases (Linnanen, 2002), as is also clearly illustrated in the case studies about renewable energy generators in Australia. If subject to regulatory uncertainty, this market barrier becomes larger.

156. However, there are some specific problems for green entrepreneurs, related to their unique values, niche 'green' markets, high capital costs implied by certain technologies with long and uncertain development horizons and, in some cases, limited managerial skills. These problems lie partly on the supply side where green entrepreneurs and businesses have difficulty finding investors who: a) share their environmental objectives and ideals; and b) have knowledge about green markets as well. Financiers may perceive environmental businesses to be subject to additional financial burdens and less likely to grow and provide an adequate financial return on their investment (Cohen, 2006). On the demand-side, investors have difficulty finding enterprises run by green entrepreneurs that possess the skills to understand the realities of financial markets.

157. Venture capital has often been cited as a potential source of funding for green entrepreneurs, although venture capitalists might be diverted to other investment categories due to relative unattractiveness of growth rates for green investments and the slow pace of incremental improvement that characterises green technologies (Kenney, 2009). The period of time required for an eco-innovation to be brought from product development to market breakthrough, typically 5-10 years, is longer than the period a typical VCs would aim to exit from the investment, which is normally 2-3 years (OECD, 2011b). The integration of non-financial indicators into firm performance (the triple-bottom line: environmental, social and financial value) also makes concrete, clear performance indicators of the firm difficult to define. The consequence of this is that the conclusion of whether a green business is indeed 'well run' or 'poorly run' is open to multiple interpretations (Linnanen, 2002).

158. For small scale eco-innovations or individual green entrepreneurs, venture capital may not be the most appropriate source of funding. Venture capital investments typically do not take place in the seed stage but come much later, once the innovation has been proven and previous rounds of capital have been raised. Therefore, a first gap emerges in taking an innovation from seed stage through to development. This phenomenon is particularly evident in the case of VC/private equity investments in renewable energy worldwide: the bulk of equity investment has been flowing into private equity expansion capital investments, rather than the early stage or late stages (OECD, 2011b; UNEP and Bloomberg New Energy Finance, 2011).

159. In the face of this difficulty, Randjelovic et al (2003) find that high-net worth individuals (angel investors) are an emerging channel of finance for green entrepreneurs and start-ups. Angel investors may seek sustainability-related investments because of their environmental and social beliefs coupled with an understanding of the potential double-dividends. The OECD (2011g) also recognises the important role of angels in funding new and innovative small firms and recommends that governments use tax incentives, co-investment funds or support for angel associations to promote their development.

160. A number of innovative financing instruments have emerged in recent years that seek to generate blended value (triple bottom line) instead of an exclusive financial return. In this way, they take the environmental impact of an investment into account in the investment criteria and returns on investment. Six particularly interesting and promising sources of financing that fall into this category are: venture philanthropy; impact investing; repayable grants, subordinates and unsecured long-term debt; and ethical or social capital markets (OECD, 2009b). Impact investing funds operate in a similar way to venture capital funds but integrate social and environmental returns into their investment criteria. Governments can play a role in promoting these innovative investment instruments by offering fiscal incentives to attract investors, including traditional tax credits and subsidies, and enabling tax legislation; or by offering forms of credit enhancement (e.g. through loan guarantees) (OECD, 2009b).

161. To address the lack of knowledge about green or eco-innovative businesses, programmes have been launched in some countries to improve expertise amongst investors, including official training or certification programmes by public or private bodies (Box 3.12).

**Box 3.12. Certification and training for environmental investors in Canada**

The David O'Brien Centre for Sustainable Enterprise in cooperation with Finance and Sustainability Initiative Montreal has created in Canada the Sustainable Investment Professional Certification Program (SIPC). The SIPC is the first professional designation of its kind, offered through a University Business School, specifically geared towards investment professionals. This program offers basic sustainability training to business professionals with 70 to 80 hours of self-study curriculum material, online study guidance, certification testing, culminating in the Sustainable Investment Professional Certificate. It is a self-study program modelled on other professional certifications.

Upon completion of the SIPC Program the Certified Investment Professional will be qualified to:

- Make informed choices regarding investment opportunities that take into account environmental, social, ethical, and governance considerations.
- Provide investment advice that considers a person's personal values, along with their financial goals.
- Practice and be knowledgeable of sustainability initiatives in the business world and the benefits that encompass a newly evolving concept.

Source: <http://johnmolson.concordia.ca/en/faculty-research/research-centres/david-obrien-centre-for-sustainable-enterprise/sustainable-investment-professional-certification>

162. Where financial markets are under-developed for investments in green businesses, governments can play a role in catalysing the market, by providing risk capital through a professionally managed fund or through a 'fund-of-funds' model. Some recent examples of approaches to finance green businesses include the state of Connecticut (US), which established a Green Bank to reinforce expanded private capital investment in energy efficiency and renewable power generation. The United Kingdom also launched a Green Bank, and Australia recently created the Clean Energy Finance Corporation (Esty and Charnovitz, 2012). The Carbon Trust in the United Kingdom has been adept in its ability to provide finance for eco-innovative firms and, as the market for private finance providers has developed, step back and reduce public funding in favour of private providers.

163. Denmark created in 2009 a 'Business Innovation Fund' to support innovation projects and activities preparing the introduction of innovative green solutions and welfare solutions to the market (see Box. 3.11). As of 31st December 2012, the Business Innovation Fund ended its operations. A new fund has been established in 2013 under the name 'The Market Maturation Fund'. This fund will support activities preparing the introduction of innovative solutions to the market, including, as the in earlier scheme, green solutions and welfare solutions. Also in 2013, the Danish government has established the Green Transition

Fund which will provide funding for late-stage development of innovative solutions intended to increase resource efficiency, as well as funding for innovative green business models.

### *Management and technical skills*

164. Entrepreneurs and innovative businesses might be limited in their performance and capacity to grow by the lack of technological understanding and competency to develop eco-innovations, learning ability or the ‘absorptive capacity’ to make use of externally generated knowledge. This obstacle is commonly referred to as *capability failures* (OECD, 2011a). Green entrepreneurs in particular may encounter a shortage of required skills in terms of: the availability of qualified personal in possession of ‘green skills’<sup>21</sup> and lack of management skills for running a business.

165. In many industries where green entrepreneurs or environmental businesses operate, the skills requirements are highly specialised and thus often in short supply. The Confederation of British Industry identifies skills gaps affecting the supply of technical specialists, designers, engineers, and electricians, “as well as appropriately trained sales staff in the retail sector, and project managers specialising in delivering a range of mitigation and adaptation solutions” (CBI, 2007).

166. In a study on the future skill needs of firms in the eco-innovation sectors, Forfas, in Ireland, has identified a number of non-technical skills required for eco-innovative firms (Table 3.1).

**Table 3.1. Non-technical skills for eco-innovative firms: Evidence from Ireland for**

Skill	Description
Communication	Ability to present oral and written information and self-presentation.
Teamwork	Working with others on projects
Problem solving	Ability to identify problems and create innovative solutions.
Maths proficiency	A key requirement across all occupations
Applying theory in practice	Ability to apply theory and concepts to real world situations.
Corporate governance	Protect and enhance the company’s reputation in emerging sectors.
Commercial awareness	Understanding the costs and benefits of technical decisions.
Remote working	Ability to work alone and working on sites in remote locations.

Source: Forfas, 2010.

<sup>21</sup> Debate continues as to whether ‘green skills’ are traditional skills that are put into use in environmental related sectors and activities or as a completely new set of skills which remain largely absent within existing labour markets (OECD, 2010c).

167. Although governments have been taking action to address the emerging skill mismatch (OECD, 2010c), uncertainty remains around the actual effects of the transition to green growth in terms of jobs and skills and thus, what solutions will be most effective. The OECD Reassessed Jobs Strategy (RJS – OECD, 2006) provides a useful framework for identifying policies that can reconcile the vigorous process of “creative destruction” required to achieve green growth with a high level of employment and shared prosperity<sup>22</sup>. A number of suggestions have been made including improve STEM education for researchers and high-level technical works, the integration of green components into MBA studies and vocational training tracks for traditional trades (OECD, 2011h).

168. Green entrepreneurs themselves may lack the requisite managerial skills to successfully run a business. Indeed, the ethical values of the green entrepreneur represent both a driver and a possible limit to growth or financial sustainability. It is precisely the unique values and motives of green entrepreneurs that allow them to challenge the lock-in of dominant institutions and technologies and thereby catalyse large scale transition to more sustainable growth (Parrish and Foxon, 2009). However, this strong commitment may impede their ability to make difficult but necessary compromises found in other areas of businesses, such as hiring and employee retention (Linnanen, 2002; Beveridge and Guy, 2005).

169. The case studies provide evidence of managerial deficiencies of start-up firms operating in a green niche. Firms in Canada, France and Italy highlighted the difficulties for green SMEs in finding human capital with the experience and willingness to engage with small businesses. In one case, in Italy, the company highlighted their difficulties early on in marketing their ideas and maintaining effective relationships with suppliers, users and business partners due to staff and skill shortage. Over time, these competencies were filled through greater use of social networking platforms and social media.

170. Targeted education and training programmes have been developed in various countries to address the shortage of ‘green skills’ or deficiencies in green businesses’ managerial skills. For instance, the UK government has recognised that business management skills may be lacking on the part of green entrepreneurs and, through the Carbon Trust’s Entrepreneur Fast Track, seeks to provide targeted consulting services, networking opportunities and grant funding (Box 3.13).

171. In 2012, the Danish Government launched a pilot scheme for the promotion of innovative green business models, which also addresses the need for developing business management skills in green enterprises. Ten companies have been selected on the basis of an application to participate in the first phase of the pilot scheme. In phase 1, the companies receive financial support and support from specialists for the development of a business plan and a business case. A number of companies participating in phase 1, which will be concluded by June 2013, will subsequently be selected to participate in a second phase of the pilot scheme. In phase 2, the companies will receive funding to help them implement the business model

---

<sup>22</sup>

According to the OECD Reassessed Jobs Strategy three policy areas should be given priority in order to promote a *smooth* and *just* transition:

- A strong skill development system and active labour market programmes that facilitate a quick re-integration of jobseekers into employment are key supply-side policy elements for reinforcing the structural adaptive capacity of labour markets.
- On the demand side, moderate employment protection and strong product market competition are important supports for vigorous job creation as environmental policies and eco-innovation create new green competitive niches.
- Policies that increase the adaptive capacity of labour markets need to be combined with flanking measures, such as unemployment insurance and in-work benefits, which assure that dynamism is not achieved at the cost of excessive insecurity or inequality for workers and their families.

developed in phase 1. The pilot scheme will be evaluated by Deloitte and the lessons learned will be used to design future initiatives aimed at promoting innovative green business models.

**Box 3.13. The Carbon Trust: Entrepreneur's Fast Track, United Kingdom**

As a part of its mandate to contribute to lower carbon emissions and low carbon technologies, the Carbon Trust offers an 'Entrepreneur's Fast Track' which is a customised package of commercial advice, networking opportunities and grant funding to small enterprises developing low carbon technologies in Great Britain.

Technical consultancy services are provided up to the value of GBP 70 000 for services such as: advising on patenting and intellectual property strategies, developing an investor ready business plan and pitch, providing expert engineering, modelling and product development, meeting product tests and regulations and assistance with scale-up for manufacture. Networking opportunities are with investors and industry partners through Carbon Trust contacts. Grant funding is for research and development projects of up to 60% of project costs.

The programme is open to any UK based microenterprise or small enterprise where any intellectual property being developed or exploited. This may include: entrepreneurial start-up businesses, existing businesses wishing to grow through the development of a novel product or service, university spin-outs, corporate spin-outs, commercial opportunities being developed within a university that are not yet incorporated into a dedicated company, but where the assistance is intended to lead directly to commercial outcomes for the UK, such as the formation of a company or a licensing deal, and where the arising intellectual property is retained by the university or its spin-out company for the carbon-saving application(s).

Source: Carbon Trust (2012), Entrepreneur's Fast Track, retrieved from [www.carbontrust.co.uk/emerging-technologies/fast-track/pages/default.aspx](http://www.carbontrust.co.uk/emerging-technologies/fast-track/pages/default.aspx) (accessed 5 March 2012).

***Maintenance patterns and lock-in***

172. To set up and successfully implement eco-innovations, green entrepreneurs must overcome the 'maintenance patterns' that cause resistance by individuals and institutions to change. They must also find a way to overcome the transition failures and 'lock-in' effects of existing technologies, which can be particularly difficult in green sectors such as energy and water.

173. 'Maintenance patterns' are efforts to maintain or stabilise systems of the past. These patterns are characterised by an inability to imagine beyond that which is already perceived and lead therefore to a strict adherence to the usual way of doing things (Linnanen, 2002; Beveridge and Guy, 2005). These patterns exist in the every-day behaviour of individuals or in the actions and processes of public institutions and private companies. Green entrepreneurs, in their quest to make a more sustainable future, must break these past habits and replace them with their new products, markets, jobs and solutions.

174. Forms of 'maintenance patterns' in the behaviour of consumers and existing institutions were observed in cases in France and Italy. Companies operating recycling businesses had trouble convincing their customers, both public authorities and private consumers, which recycled devices still met high quality standards, in this way dispelling preconceived notions of recycling practices. Likewise, pre-existing contractual relationships between public authorities and suppliers meant that demand from the public sector was limited even in instances where the public authority might want to move to more environmentally-sustainable practices.

175. Transition failures may also impede green entrepreneurs to introduce eco-innovations. Network failure arises when innovation systems fail to take on board new technological opportunities because they are too expensive or incompatible with the existing production processes and technologies in the firm (Arnold, 2004; Smith, 2000). Closely related, 'lock-in' failures may prevent new markets from developing when dominant designs make the entry barriers for new technologies too high. High entry costs may exist for new technologies. Similarly, high costs may exist for users to switch to these new technologies.

Emerging eco-innovations may fall into a vicious circle where they are not adopted because they are too expensive, but at the same time they are too expensive because they have not yet been adopted (OECD, 2011a). 'Lock-ins' were identified in at least one case study where public institutions and companies were bound by an existing ICT platform and software.

176. To limit the incidence of lock-in phenomena, governments should ensure well-designed regulations and standards or that incentives are in place for continuous innovation in specific markets (OECD, 2011a). Also, setting minimum performance levels, instead of precise technical specifications, can keep windows open to new solutions and eco developments.

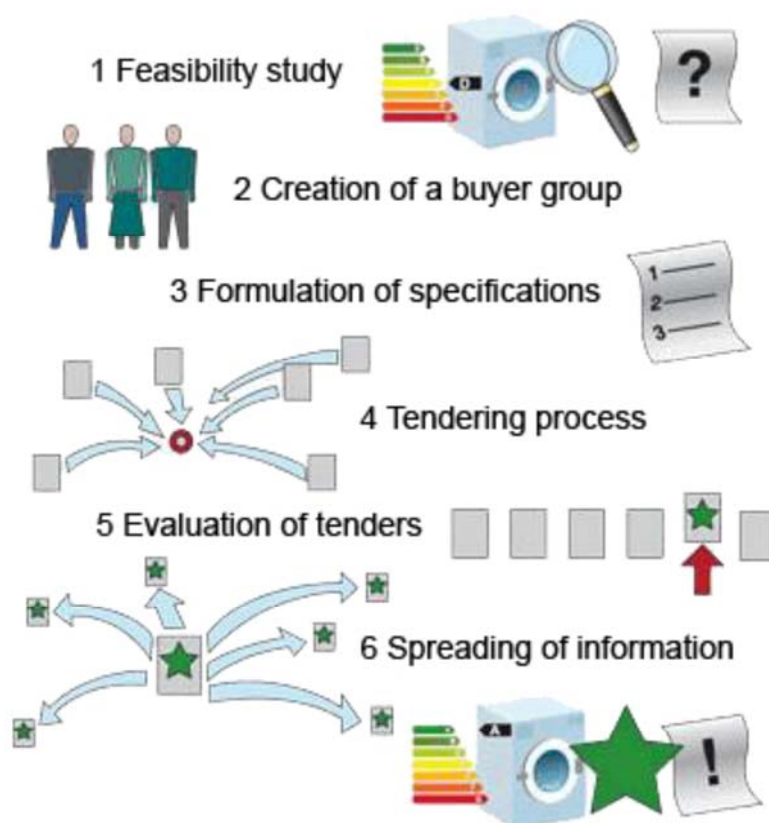
177. There are serious difficulties in overturning an entrenched technology. By their very nature, entrepreneurs challenge the status quo ('lock-ins') and as such help break entrenched technologies. There are some ways policy can help this process. Regulations have been used in the past to help coordinate agents in their technology choices or as a forcing mechanism, such as is the case of incandescent light bulbs (See Box 3.9). Policies can help by creating a market niche, through public procurement or by bringing together demanders and suppliers of new technologies. The public procurement scheme managed by the Swedish National Energy Administration conceives the public player as a facilitator for matching demand and supply (Box 3.14). Green marketing could be used to broker contracts between users who want environmentally friendly services and suppliers of these services, as the UK's Carbon Trust does through its Carbon Now programme. Policy might also have a role in providing information on new technologies and making that information public (Cowan and Kline, 1996).

**Box 3.14. The Swedish National Energy Administration's broker role in commercialising new eco-innovations**

In 1988, the Government of Sweden launched a technology procurement programme for energy efficiency, since 1998 run by the Swedish National Energy Administration (STEM). The purpose of the technology procurement programme is to bring eco-innovative products to the market (supply-side) and to get a market uptake of these products (demand-side). The public agent plays the role of a facilitator of product innovation and product commercialisation and does not purchase the innovation process or the final commercial product. Spending on prototype development and test series is paid by the companies participating in the technology procurement programme.

A six-step procurement process is followed including: a feasibility study, the creation of a buyer group, formulation of specifications, a tendering process, evaluation of the tenders and subsequent promotion and distribution of information on the technology procured.

Past competitions have included procurement of: energy-efficient water mixers; control and monitoring systems for office buildings; and energy-efficient ovens, refrigerators and freezers (European Commission, 2009).



Source: European Commission, 2009 based on STEM's website at: [www.energimyndigheten.se/](http://www.energimyndigheten.se/)

***Regulatory hurdles***

178. Although regulation can be a key driver of eco-innovation and open up new markets for entrepreneurs, poorly designed regulation can represent a major obstacle to the development of green entrepreneurship. For instance, product market regulations that do not allow for competition or reinforce the position of incumbent firms act as barriers to green entrepreneurs and the eco-innovative businesses

they create. This is particularly pertinent for eco-innovative industries as competition is often least robust in network industries which have large environmental impacts (the electricity sector) or control strategic environmental services (such as water) (OECD, 2011d). Environmental regulation may also protect incumbent firms when they impose more stringent requirements on entrants than incumbents, discouraging both firm entry and exit. Appropriate pro-competitive regulation which ensures wide access to networks by competing providers would help open up market opportunities to new firms and entrepreneurs (OECD, 2011d).

179. The speed at which new, innovative industries develop can outpace the changes or evolution in regulation. If such rules may not be sufficiently up-to-date, new and innovative firms may find that their business model is not compatible with existing regulations (OECD, 2011a; OECD, 2011d). This problem may be addressed by regulation policies that allow and indeed create incentives for entrepreneurs' anticipatory change, as in the case of regulations that set minimum performance standard levels. This approach is adopted in many countries, including Australia, the EU and the US. However, setting an appropriate minimum performance level may not be easy and its effects on costs need to be considered (OECD, 2011a). An alternative approach is the creation of a 'front runner-desk', as in the case of the Top Runner programme implemented by Japan, which does not prohibit any specific product, but creates incentives to balance less efficient products with advanced eco-solutions (Box 3.15).

**Box 3.15. Regulation for innovation: Japan's Top Runner programme**

Japan's Top Runner programme is a regulatory scheme designed to stimulate the continuous improvement of the use-phase energy efficiency of products within selected segments of markets for vehicles, household and office appliances, among others. Through Parliamentary decision in 1998, the programme is incorporated as an element of the Japanese Law Concerning the Rational Use of Energy (the Energy Conservation Law). It is administered by the Agency for Natural Resources and Energy under METI, the Ministry of Economy, Trade and Industry. In 2006, 18 product categories had been brought into the Top Runner scheme.

In iterative cycles, the programme introduces product-specific energy performance requirements, where the basis for the adoption of standards is pre-defined as the *use-phase energy performance of the best technology available on the market at the time of revision*. The key element of the scheme is that it does not impose compliance to the targets for all products. Rather, the targets can be achieved on a weighted average basis. In other terms, manufacturers and importers need to sell products that are more efficient than the target if their offer comprises goods that do not satisfy the minimum targets. The programme undergoes recurring revisions, allowing its scope to be continuously modified. Exact standard levels, along with appropriate target years, are agreed on in extensive consultative processes involving several stakeholder groups. Thereafter, when promulgated by the regulator, the targets become mandatory for all manufacturers and importers in Japan (except for very small actors).

The obligation of compliance with Top Runner regulations rests entirely with manufacturers and importers. Neither retailers, nor product owners or users are targeted.

Source: J. Nordqvist (2006), Evaluation of Japan's Top Runner Programme, AID- EE Project, retrieved from [www.aid-ee.org/documents/018TopRunner-Japan.PDF](http://www.aid-ee.org/documents/018TopRunner-Japan.PDF); OECD (2011a).

180. Clear, simple and stable regulations and market signals are one part of a supportive framework to boost eco-innovation by private businesses (OECD, 2011b; OECD, 2011d). The stability of these signals is important, as it indicates the commitment of governments to move towards greener growth and reduce the uncertainty associated with end-user demand for eco-innovative goods or services. Such signals establish markets for green innovation and enhance the incentives for firms to adopt and develop green innovations by reducing the uncertainty associated with unproven technologies or the development and commercialisation of technologies with a long development horizon.

181. The emergence of new, innovative firms, created or run by green entrepreneurs, requires regulatory conditions that allow firms to quickly and efficiently start up, grow and exit in case of failure. Many regulatory systems impose more stringent abatement requirements on entrants, discouraging both

entry and exit, thus inadvertently slowing the rate of innovation. Simplifying and reducing start-up regulations and administrative burdens can reduce the barriers to entry. Bankruptcy laws play a relevant role in this respect, as punitive conditions on failure of entrepreneurs or unfavourable conditions for the restructuring of ailing businesses can discourage entry in the first place (OECD, 2011b).

### 3.5. Conclusions and policy recommendations

182. Entrepreneurs are agents of change and renewal in the economy and, as such, are important actors in the transition towards a green economy. Entrepreneurial dynamics is fundamental for large scale transformation, as new firms bring new ideas to the market and challenge established patterns. New firms, created or run by green entrepreneurs, often exploit opportunities that have been neglected by more established companies and are a key driver of radical eco-innovations (OECD, 2011b).

183. Green entrepreneurs are a highly heterogeneous group, with different motivations and strategic objectives. They combine to a different degree and in different market contexts financial and environmental motivations. The businesses created by green entrepreneurs embody their environmental values, but also propose innovative solutions to existing and emerging needs, contesting established markets or opening up new market niches. In this sense, as they demonstrate the possibility to combine environmental performance with market targets and profit outcomes, green entrepreneurs can act as a role model and influence market competitors and other potential entrepreneurs, diffusing and scaling up new business concepts, thus contributing to the expansion of green markets.

184. Green entrepreneurs, as innovative entrepreneurs in general, are embedded into socio-economic and institutional frameworks, business networks and support structures. The OECD Innovation Strategy highlights that innovation is a highly interactive and multidisciplinary process, which increasingly involves collaboration by a growing and diverse networks of stakeholders, institutions and users. Therefore, green entrepreneurial dynamics is a dimension of a complex co-evolutionary process, which involves interrelated changes in societal values and institutions, consumption patterns, technologies, linkages and knowledge networks, among others. Changes are required at the broader level to ensure markets and institutional structures are more supportive to green entrepreneurial activities. This implies that a carefully designed *mix of policy instruments* is needed to open up new markets and opportunities to green entrepreneurs and to tackle many of the challenges that new and small green enterprises meet to perform and grow (OECD, 2012b).

185. The OECD Green Growth Strategy suggests that the green transition will require a policy mix that changes across countries, according to local environmental and economic conditions, institutional settings and stages of development (Box 3.16). The following policy areas can be identified to support green entrepreneurship:

- i) *supportive framework conditions* for eco-innovation and commercialisation through new business ventures to occur
- ii) *measures that address market or systemic failures* that generate barriers to investment and limit returns from green businesses, by reducing their competitiveness vis-à-vis established alternatives
- iii) *policies to ease access* to financial, human and knowledge resources by green entrepreneurs
- iv) *direct measures to kick-start green markets* or generate incentives to experiment market solutions to environmental problems (government as ‘market catalyst’).

**Box 3.16. OECD Green Growth Strategy: Environmental policy instruments**

The OECD Green Growth Strategy (OECD, 2011d) makes the case for the adoption of a mix of policy instruments and a multi-dimensional approach, including:

- market based approaches, which target market failures and aim at internalizing environmental externalities (i.e. getting the prices right through environmentally-related taxes and tradable permits)
- regulations and standards, when market failures result in a weak response of agents to price signals or when a complete ban on certain activities is deemed necessary, although the costs of regulation (i.e. additional administrative burden and compliance costs) should not exceed its expected benefits
- support to green technologies and innovation, especially in technological areas whose entry costs are high, but large market prospects and learning-by-doing can trigger a positive dynamics of R&D investments
- information-based instruments, to raise producers' and consumers' awareness.

***Ensuring a supportive framework for the emergence and development of green entrepreneurs***

186. Green innovation thrives in a sound environment for innovation (OECD, 2011b). Green entrepreneurial dynamics demands a business and regulatory environment that is friendly towards firm creation and, if necessary, market exit, to ease the process of firm creation and destruction that drives the emergence of new innovations.

187. The government has a key role to play in ensuring that the conditions are in place for green entrepreneurs to implement radical, new ideas, and for their business to grow and have large scale impact on consumers, competitors and other market players. Core “framework conditions” include sound macroeconomic policy, competition, openness to international trade and investment, adequate and effective protection and enforcement of intellectual property rights, efficient tax and financial systems (OECD, 2011b).

188. In the case of green entrepreneurs, enabling investment conditions are needed to address the challenges implied by long term and uncertain technological development and commercialisation, as well as to allow experimentation of new solutions and business models in the market. In this respect, governments should ensure that financial markets work smoothly to allow exploration and experimentation of eco-innovations. This requires lowering barriers to investment in early and development stages, but also lowering barriers to exit for investors and entrepreneurs. Exit route for investors are in fact a key determinant in their investment strategies (OECD, 2011b). Entry dynamics is fundamental to get new ideas into market, but anticipated difficulties in exiting the market and realize the investment, or particularly punishing conditions in case of failure, can reduce incentives to invest from the start.

***Addressing market failures to create new opportunities for green entrepreneurs***

189. This chapter has identified several sources of commercial opportunities that act as drivers in that they motive green entrepreneurs to start a business and address an environmental or societal need. These can result from government policies intended to address market failures, including:

- creation of property right regimes for public goods, to limit overuse of natural resources
- pricing of negative environmental externalities into the market through, taxes, fees, levies, cap-and-trade schemes, tradable permits, etc.

- design of regulations that address environmental issues, such as energy efficiency, waste disposal, water treatment, etc., based on outcomes, rather than pre-defined technical solutions
- introduction of standards and certifications for environmental goods and services
- ensuring competition in markets through effective anti-trust laws.

190. Compliance-based drivers have proved to be particularly relevant, as they can rapidly shift consumers' attention towards new market options, thus opening up new business niches or enlarging existing ones. Standards and certification may allow to increase consumers' awareness and represent an instrument for entrepreneurs to get recognition and build reputation in markets. Also, regulations and standards can create competition where monopolies existed and attract business entry.

191. Pricing externalities, or removing subsidies to resource-intensive options, can create market room for alternatives developed by green entrepreneurs and new firms, whose opportunities to enter and become competitive are negatively affected by subsidies to established products or technological solutions.

192. However, attracting entrepreneurs and investors into green business demands a predictable and transparent regulatory framework. Furthermore, regulatory conditions should not impose undue burdens on entrepreneurs, especially new enterprises, and should provide sufficient flexibility to take advantage of the benefits of voluntary approaches from the private sector (OECD, 2011d). In fact, compliance with voluntary codes or practices is also an important driver of green change.

### *Easing access to financial, human and knowledge resources by green entrepreneurs*

193. This chapter has identified specific limitations in resources that act as barriers to the emergence of green entrepreneurship and the development of green businesses. Financial capital and skills and competencies are fundamental for green entrepreneurship to develop.

194. To address gaps in technical skills, STEM education should be improved and green components integrated into curricula at higher education level as well as in vocational training tracks for traditional trades (OECD, 2011h).

195. Addressing managerial skills deficits is also important to help green entrepreneurs to overcome difficulties in financial markets. In fact, financial constraints results from limitations on both the supply and the demand side. On the demand side, a limiting factor is the lack of financial and managerial skills by green entrepreneurs, whose environmental orientation does not always combine with attention to investors' requirements or capability to respond to these requirements. Targeted education and training programmes should be developed to address this skills gap and strengthen the capacity to gather and manage resources of environmentally oriented entrepreneurs. Also, measures that facilitate the hiring of qualified staff in small businesses should be encouraged.

196. On the supply side, innovative finance instruments should be promoted, which take into account the long-term horizon of eco-investments and the integration of environmental objectives into green businesses. The role of angel investors can be strengthened through fiscal or tax incentives, enabling tax legislation or loan enhancements. In instances where equity markets are under-developed, governments may provide risk capital through a 'fund of funds' model. Training targeted to investors can help improve understanding of green opportunities and reduce their scepticism with regard to green or eco-innovative businesses. This would also improve the effectiveness of public financial support that requires participation by private investors as a pre-requisite. Matching grants, for instance, may fail to achieve the objective of

promoting green entrepreneurship and easing development and commercialisation of new technology, if the investor community lacks interest in the targeted fields.

197. Governments can also play an important role in facilitating participation by green entrepreneurs to knowledge networks, particularly easing or supporting the creation of linkages with research players. Policies in this direction include funding of collaborative projects, mentoring schemes, green clusters and green incubators, which bring together entrepreneurs, end-users, researchers and financial players, to exchange knowledge and explore technical solutions to existing and emerging needs, and the business ventures that might implement these solutions in markets.

### ***Creating or strengthening green markets***

198. The lack of end-user demand is a major obstacle to the creation and development of green enterprises. Conversely, the opening up of new markets is a very powerful driver for green entrepreneurs. The government can play both a direct and indirect role in creating or strengthening these market opportunities, kicking-off a market development process which should create opportunities for further investments and, over time, self-sustained market expansion.

199. Governments can act as a ‘catalyst’ for the initial demand, creating conditions for initial revenues and investments, experience and learning on the side of the entrepreneur, that should bring down the cost of technologies and processes, thus making the green solution more attractive to other end-users. Also, government demand can work for demonstration to the larger market and build visibility and reputation for new green products or services.

200. The main direct instrument to kick-off markets is public procurement. However, it is important that the process be transparent and competitive, in order to avoid ‘picking winners’ or the risk of early lock-ins. In this respect, selection criteria based on performance and response to problems are to be preferred to detailed technical specifications. Also, administrative burdens related to the tender process should be minimised, as these are often a major obstacle for entrepreneurs to engage in the application process.

201. Public policy can also indirectly facilitate the emergence of market opportunities for green entrepreneurs, which arise when changes in societal values translate into demand for more environmentally-friendly products and services. The present study has highlighted specific information gaps on the side of consumers, which limit opportunities for green businesses to scale up. Measures in this direction include mainstreaming of environmental issues into education, and awareness campaigns on environmental matters. Certification also plays a role in bridging the information gap and giving visibility to novel green solutions.

202. Policy can also foster the interaction between eco-innovators and end-users, facilitating the emergence of products or services based on actual market opportunities and customer needs. Policy measures can help entrepreneurs to improve understanding about users’ perceptions and consumption practices, by supporting initiatives for customers’ screening and their engagement in innovation development or product testing.

## References

- Ahmad N. and Hoffman A. (2008), *A framework for addressing and measuring entrepreneurship*, OECD Statistics Working Papers, 2008/2, OECD publishing, Paris.
- Anderson, A. (1998), *Cultivating the Garden of Eden: Environmental Entrepreneurship*.
- Arnold E. (2004), "Evaluating research and innovation policy: A systems world needs systems evaluations", *Research Evaluation*, Volume 13, Number 1, 1 April 2004, pp. 3-17(15).
- Ashoka Foundation (2003), "What is a social entrepreneur?", retrieved from [www.ashoka.org/social\\_entrepreneur](http://www.ashoka.org/social_entrepreneur) (accessed 26/03/12).
- Atzenhoffer J. P. (2010), *The sustainability of informal property rights in Common Property Resources*, Bureau d'Économie Théorique et Appliquée, University of Strasbourg, Pôle Européen de Gestion et d' Economies, paper submitted to Elsevier.
- Audretsch D. and R. Thurik (2004), "The Model of the Entrepreneurial Economy", *International Journal of Entrepreneurship Education*, Vol. 2, No. 2, pp. 143-166.
- Audretsch D.B., Keilbach M.C. and E. Lehman (2006), *Entrepreneurship and Economic Growth*, Oxford University Press.
- Bisgaard T., Knudsen M., Tanev S., Thomsen M. (2011), *The Challenges of New Innovation Paradigms for the Danish Research and Innovation Policies*, Technology Innovation Management Review.
- Beveridge R. and Guy S. (2005), *The Rise of the Eco-Preneur and the Messy World of Environmental Innovation, Local Environment*, The International Journal of Justice and Sustainability, 10:6, 665-676
- Black (1997), *A Dictionary of Economics*, Oxford University Press, Oxford.
- Breschi, S., Malerba F. and L. Orsenigo (2000), "Technological Regimes and Schumpeterian Patterns of Innovation", *Economic Journal*, 110(463), 388-410.
- Bushnell K. (2011), "Plastic Bags: What about recycling them?", Sierra Club, retrieved from [www.sierraclub.org/sustainable\\_consumption/articles/bags2.asp](http://www.sierraclub.org/sustainable_consumption/articles/bags2.asp) (accessed, 22/3/12).
- Carillo-Hermosilla, de Rio Gonzalez and Könnöla (2009), *Eco-innovation: When Sustainability and Competitiveness Shake Hands*, Palgrave Macmillan.
- California Energy Commission (2012), "California's Energy Efficiency Standards for Residential and Non-residential Buildings", retrieved from [www.energy.ca.gov/title24/](http://www.energy.ca.gov/title24/) (accessed 19/3/12).
- Chell E, Haworth J and Brearley S (1991), *The Entrepreneurial Personality*, London: Routledge.
- Cohen B. (2006) "Sustainable Valley Entrepreneurial Ecosystems", *Business Strategy and the Environment*, 15.1: 1-14.
- Cohen L., G. Musson (2000), "Entrepreneurial Identities: Reflections from Two Case Studies", *Organization*, 71.1: 31-48.

- Cowen R. (1988) (Ed.), *The Theory of Market Failure: A Critical Examination*, George Mason University Press, Fairfax, Virginia.
- Cowen R. and Gunby P. (1996), *Sprayed to death: Oath dependence, lock-in and pest control strategies*, *Economic Journal*, 106:521-542.
- Cowen R. and Hulten S. (1996), *Escaping Lock-In; the Case of Electric Vehicles*, *Technological Forecasting and Social Change*, 53, 61-79.
- Cowen R. and Kline D. (1996), *The Implications of Potential 'Lock-In' in Markets for Renewable Energy*, National Renewable Energy Laboratory, November 1996, NREL/TP-460-22112.
- Dahlman (1979), "The Problem of Externality", *The Journal of Law and Economics*, Vol 22(1), pp141-162.
- Dean T.J., and J.S. McMullen (2007), "Toward a Theory of Sustainable Entrepreneurship: Reducing Environmental Degradation through Entrepreneurial Action", *Journal of Business Venturing* 22.1: 50-76.
- Department of the Environment, Water, Heritage and the Arts (2012), "What You Need to Know – Think Change", retrieved from [www.climatechange.gov.au/en/what-you-need-to-know.aspx](http://www.climatechange.gov.au/en/what-you-need-to-know.aspx) (accessed 20/3/12).
- Dess, G.D., Lumpkin, G.T. and McGee, J.E. (1999), "Linking Corporate Entrepreneurship to Strategy, Structure and Process: Suggested Research Directions", *Entrepreneurship: Theory and Practice*, 23(3), pp. 85-102.
- Dietz T., Ostrom E. and Stern P. (2003), "The Struggle to Govern the Commons", *Science*, Vol. 302 No. 5652, pp1907-1912.
- Dunlap R. (2012), "At 40, Environmental Movement Endures, With Less Consensus", Gallup, retrieved from [www.gallup.com/poll/127487/environmental-movement-endures-less-consensus.aspx#1](http://www.gallup.com/poll/127487/environmental-movement-endures-less-consensus.aspx#1) (accessed 21/3/12).
- Esty D. and Charnovitz S. (2012), "Green rules to drive innovation", *Harvard Business Review*, March 2012.
- European Commission (2005), *EVER: Evaluation of EMAS and Eco-label for their Revision*, DG Environment, Brussels.
- European Commission (2009), "Bridging the Valley of Death: Public Support for Commercialisation of Ecoinnovation", Brussels, retrieved from [http://ec.europa.eu/environment/enveco/innovation\\_technology/index.htm](http://ec.europa.eu/environment/enveco/innovation_technology/index.htm)
- FORA (2010), *Creating new concepts, products and services with user driven innovation*, Nordic Innovation Centre Project Report.
- Forfás (2010), *Future Skills Needs of Enterprise within the Green Economy in Ireland*, November 2010, Expert Group on Future Skills Needs.

- Frondel, M., J. Horbach, K. Rennings (2007), End-of-Pipe or Cleaner Production? An Empirical Comparison of Environmental Innovation Decisions Across OECD Countries, *Business Strategy and the Environment*, Vol. 16 No. 8, 571-584.
- Gibbs (2009), Sustainability entrepreneurs, ecopreneurs and the development of a sustainable economy, University of Hull, UK.
- Gosden R. (1995), "Greening all the way to the bank", *Arena Magazine*, No. 16, April-May 1995, pp.35-37.
- Horbach, J. (2008), *Determinants of Environmental Innovation – New Evidence from German Panel Data Sources*, *Research Policy*, Vol. 37, 163-173.
- Horbach J., Rammer C. and Rennings K. (2010), *Determinants of Eco-Innovations by Type of Environmental Impact: The Role of Regulatory Push/Pull, Technology Push and Market Pull*, Centre for European Economic Research, Discussion Paper No. 11-027.
- Isaak R. (1998), *Green Logic: Ecopreneurship, Theory and Ethics*, Sheffield: Greenleaf
- Isaak R. (2002), "The Making of an Ecopreneur", *Greener Management International*, summer 2002.
- Isidore C. (2011), "Incandescent Light Bulb Ban Put on Hold", CNN Money, available from: [http://money.cnn.com/2011/12/16/news/economy/light\\_bulb\\_ban/index.htm](http://money.cnn.com/2011/12/16/news/economy/light_bulb_ban/index.htm) (accessed 20/3/12).
- Jones G. and Bouamane L. (2011), *Historical Trajectories and Corporate Competences in Wind Energy*, Working Paper 11-112, Harvard Business School.
- Keijzers G. (2002), "The Transition to the Sustainable Enterprise", *Journal of Cleaner Production* 10: 349-59.
- Kenny M. (2009), *Venture Capital Investment in the Greentech Industries: A Provocative Essay*, BRIE Working Paper 185, July 2009.
- Lerner J. and Sahlman W. (2012), "Reviving entrepreneurship", *Harvard Business Review*, March 2012.
- Linnanen L. (2002), "An insider's experiences with environmental entrepreneurship", *Greener Management International*, 38, pp. 71–80.
- Maes J. (2004), "The Search for Corporate Entrepreneurship: A Clarification of the Concept and its Measures", DTEW Research Report 0429, Katholieke Universiteit Leuven, Department of Applied Economics, Organization Studies, Policy Research Center on Enterprises, Entrepreneurship and Innovation.
- Malerba F and Orsenigo L. (1996) "Schumpeterian patterns of innovation are technology specific", *Research Policy*, 25, 451-478.
- Montalvo (2008), "General Wisdom Concerning the Factors Affecting the Adoption of Cleaner Technologies: A Survey (1990–2007)", *Journal of Cleaner Production*, Vol. 16, n° 1, Supplement 1, pp. 7-13.
- OECD (2006), *OECD Reassessed Jobs Strategy*, OECD publishing, Paris.

- OECD (2008), *OECD Environmental Outlook to 2030*, OECD publishing, Paris.
- OECD (2009a), *The Economics of Climate Change Mitigation: Policies and Options for Global Action beyond 2012*, Paris: OECD Publishing.
- OECD (2009b), *The Changing Boundaries of Social Enterprises*, OECD Publishing, Paris.
- OECD (2010a), *SMEs, Entrepreneurship and Innovation*, OECD Publishing, Paris.
- OECD (2010b), *Higher Education in Regional and City Development: The Bio-Bio Region, Chile*, OECD Publishing, Paris.
- OECD (2010c), *Greening Jobs and Skills: Labour Market Implications of Addressing Climate Change*, Paris.
- OECD (2010d), *Greener and Smarter. ICTs, the Environment and Climate Change*, OECD, Paris.
- OECD (2011a), *Driving Eco-Innovation: The Role of Demand-Side Policies*, draft report, DSTI/IND(2011)13/ANN.
- OECD (2011b), *Fostering Innovation for Green Growth*, OECD publishing, Paris.
- OECD (2011c), *Entrepreneurship at a Glance 2011*, OECD publishing, Paris.
- OECD (2011d), *Towards Green Growth*, OECD publishing, Paris.
- OECD (2011e), *Intellectual Assets and Innovation: The SME Dimension*, OECD publishing, Paris.
- OECD (2011f), *Greening Household Behaviour: The Role of Public Policy*, OECD publishing, Paris.
- OECD (2011g), *Financing High-Growth Firms: The Role of Angel Investors*, OECD publishing, Paris.
- OECD (2011h), "Green Growth Strategy Workshop: Summary of Key Outcomes", Council, Room Document 3, 25 February, 2011.
- OECD (2011i), *Greening Household Behaviour*, OECD publishing, Paris
- OECD (2012a), *Inventory of Estimated Budgetary Support and Tax Expenditures for Fossil Fuels*, OECD publishing, Paris.
- OECD (2012b), *OECD Environmental Outlook to 2050*, OECD publishing, Paris.
- OECD (2012c), *Business Models For Systemic Eco-Innovations*, DSTI/IND(2012)3, Paris.
- OECD and Eurostat (1999), *The Environmental Goods and Services Industry: Manual for Data Collection and Analysis*, Paris
- Parrish (2008), *Sustainability-Driven Entrepreneurship: A Literature Review*, SRI Working Paper 9; Leeds, UK: Sustainability Research Institute.
- Parrish, B.D., Foxon, T.J., 2009, "Sustainability entrepreneurship and equitable transitions to a low-carbon economy", *Greener Management International* 55: 47–62.

- Pastakia (2002), "Assessing Ecopreneurship in the Context of a Developing Country: The Case of India", *Greener Management International* 38: 93-108.
- Perkins (2007), *Globalizing Corporate Environmentalism? Convergence and Heterogeneity in Indian Industry*, St Comp Int Dev, DOI 10.1007/s12116-007-9007-3.
- Pinchot (1985), *Intrapreneuring*, Harper and Row, New York.
- Pongtratic M. (2007), *Greening the Supply Chain: A Case Analysis of Patagonia*, IR/PS CSR Case # 07-22, University of California, San Diego.
- Randjelovic, J., A.R. O'Rourke and R.J. Orsato (2003) "The Emergence of Green Venture Capital", *Business Strategy and the Environment* 12: 240-53.
- Reinhardt F., Casadesus-Masanell R. and Kim H. J. (2010), *Patagonia*, Harvard Business School, Cambridge, USA.
- Romani M., Stern N. and Zenghelis D. (2011), "The Basic Economics of Low-Carbon Growth in the UK", Grantham research Institute for Climate Change and the Environment, June 2011, [www2.lse.ac.uk/GranthamInstitute/publications/Policy/briefs.aspx](http://www2.lse.ac.uk/GranthamInstitute/publications/Policy/briefs.aspx)
- Rosenthal E. (2008), *By 'Bagging It,' Ireland Rids Itself of a Plastic Nuisance*, New York Times, published 31/1/08.
- Sandor (2001), "Financial innovation and building institutions", presentation at the University of Colorado at Boulder.
- Schaltegger S. (2002), "A Framework for Eco-Preneurship: Leading Bio-Neers and Environmental Managers to Eco-Preneurship", *Greener Management International*, 38, pp. 45–58.
- Scharper M. (2002), *Making Ecopreneurs: Developing Sustainable Entrepreneurship*, Gower Publishing Ltd, London.
- Sharper M. Ed. (2010), *Making Ecopreneurs: Developing Sustainable Entrepreneurship*, 2<sup>nd</sup> Edition, Curtin Business School, Curtin University of Technology, Western Australia.
- Schumpeter J (1949), *The Theory of Economic Development*, London, Oxford University Press.
- Silverthorne S. (2011), *The Untold Story of green Entrepreneurs*, Harvard Business Review, published September 12, 2011.
- Simi T.B. (2009), "Eco-labels: Trade Barriers or Trade Facilitators?", *CUTS CITEE Discussion Paper 1/2009*, CUTS Centre for International Trade, Economics and Environment, Jaipur, India
- Smith, K. (2000), "Innovation as a Systemic Phenomenon: Rethinking the Role of Policy", *Enterprise and Innovation Management Studies*, Vol. 1, No. 1, pp. 73-102
- Innovation Management Studies*, Vol. 1, No. 1, pp. 73-102.
- Smith, A. (2003) "Transforming Technological Regimes for Sustainable Development: A Role for Alternative Technology Niches?", *Science and Public Policy* 30.2: 127-35.

- Thurik, R. (2009), "Entreprenomics: Entrepreneurship, Economic Growth, and Policy", in Z. Acs, D. Audretsch and R. Strom (eds.), *Entrepreneurship, Growth, and Public Policy*, Ch. 10, Cambridge University Press, Cambridge, pp. 219-249.
- Parrish B. and Foxon T. (2009), "Sustainability Entrepreneurship and Equitable Transitions to a Low-Carbon Economy", *Greener Management International*, Vol. 55.
- Parrish B. (2008), "Sustainability-Driven Entrepreneurship: A Literature Review", SRI Working Paper 9, Leeds, UK: Sustainability Research Institute.
- Perkins R. (2007), "Globalising corporate environmentalism? Convergence and heterogeneity in Indian industry", *St Comp Int Dev*, 42 (3-4). pp. 279-309.
- Pongtratic (2007), "Greening the Supply Chain: A Case Analysis of Patagonia, University of California: San Diego", IR/PS CSR Case # 07-22.
- United Nations Environment Programme and Bloomberg New Energy Finance (2011), *Global Trends in Renewable Energy Investment 2011*, UNEP and BNEF, Frankfurt.
- Walley E. and Taylor D. (2002), *Opportunities, Champions, Mavericks...? The Making of Eco-preneurs*, *Greener Management International*, No. 38 (Summer), pp. 31-43.
- Walley E. and Taylor D. (2003), "The Green Entrepreneur: Visionary, Maverick or Opportunist?", *Manchester Metropolitan University Business School Working paper Series*, ISSN 1478-8209
- Walley E., Taylor D. and Grieg (2010), "Beyond the Visionary Champion: Testing a Typology of Green Entrepreneurs", Chapter 4 in *Sharper M. ed (2010), Making Ecopreneurs: Developing Sustainable Entrepreneurship, 2<sup>nd</sup> Edition*, Curtin Business School, Curtin University of Technology, Western Australia.
- Wilson J.A. (1977). "A Test of the Tragedy of the Commons, in Garrett Hardin and John Baden", eds., *Managing the Commons*. San Francisco: W. H. Freeman, 96-111.
- Vaitheeswaran V. (2012), *Need, Speed, and Greed: How the New Rules of Innovation Can Transform Businesses, Propel Nations to Greatness, and Tame the World's Most Wicked Problems*, HarperBusiness, London.
- Vestel L. (2009), *Incandescent Bulbs Return to the Cutting Edge*, New York Times, published 5/7/09.
- Veitor R. (2008), *Global Power from the Wind*, unpublished paper, 22 May 2008.
- Volery T. (2002), *An Entrepreneur Commercialises Conservation: The Case of Earth Sanctuaries Ltd*, *Greener Management International*, 38, pp. 109–116.

## CHAPTER 4. SMEs' ADOPTION OF ENVIRONMENTAL TECHNOLOGIES AND SUSTAINABLE BUSINESS PRACTICES

### 4.1. Introduction

203. Ensuring that SMEs participate fully in green growth is key to the large-scale uptake of sustainable practices. The sustainability of green growth strategies, as well as the diffusion of their benefits, will depend on the restructuring of the SME sector, including less innovative and more traditional segments. The slow diffusion of sustainable practices and clean technologies across the broad SME population represents a significant obstacle to improving environmental performance while pursuing the objectives of economic growth and job creation.

204. According to a recent study, SMEs account for approximately 64% of the industrial pollution in Europe, which is proportional with their contribution to production and employment (Calogirou et al., 2010). While the environmental impact from an individual company may be low, the overall impact of a sector can be very high. The transition is particularly urgent for SMEs in the manufacturing sector, which accounts for a large part of the world's consumption of resources and generation of waste. Worldwide, the energy consumption of manufacturing industries grew by 61% from 1971 to 2004 and accounts for nearly a third of the global energy usage (IEA, 2007). Likewise, manufacturing industries are responsible for over 20% of global carbon dioxide (CO<sub>2</sub>) emissions and over a quarter of primary resource extraction (UNEP, 2011).

205. Although the manufacturing industry has a large environmental impact, the services sector also warrants in-depth examination and policy attention, as it has been less engaged in environmental investments and measures to improve eco-efficiency. Furthermore, the service sector can be an important vehicle for the diffusion of cleaner technologies across the economy, as in the case of knowledge intensive business services (KIBS).

206. SMEs' transition to sustainable practices can also favour the greening of supply chains; indeed, responding to green requirements is of growing importance for SMEs' participation in *global value chains*. Green-related changes in transnational supply chains can be particularly challenging for SMEs, as they are requested to fulfil highly demanding green quality standards, while facing growing pressures to reduce costs. At the same time, however, these changes offer SMEs opportunities for a low-carbon transition, by enhancing their access to environmentally conscious large firms, knowledge flows and global markets.

207. The adoption of new or improved technologies or practices often implies adaptation to specific business frameworks, and, in some cases, incremental innovation by the adopter. The application of environmental criteria to existing business operations requires exploring new ways to combine existing resources or integrating new ones into established systems and routines (Hart, 1995; Lin and Ho, 2011). In this sense, the adoption activity might require an "innovative approach" or lead, sometimes unintentionally, to an innovation. This chapter focuses on the challenges SMEs face in adopting environmental solutions and adapting to the low-carbon economy.

208. In particular, the chapter investigates the main determinants (drivers and barriers) of SMEs' uptake of environmental technologies and sustainable business practices; the resource requirements for change including knowledge, skills and funding for investment in clean technology and organisational change; and the policies that can support the transition and encourage SMEs to uptake clean technologies and sustainable practices.

#### 4.2. Sustainability and performance: The business case for SME transition to sustainable practices

209. The relationship between firms' environmental performance and financial performance has been the object of extensive research over the last two decades<sup>23</sup>. The business case for environmental sustainability appears to be solid, as most empirical studies find that improving the environmental performance of a firm also improves its financial performance, as measured by key performance indicators such as earnings, return on assets or return on investment (e.g. Weber et al., 2008; Clarkson et al., 2011).

210. The business case for sustainable investments in manufacturing is made strongly in the OECD Sustainable Manufacturing Toolkit (OECD, 2011a), which highlights a direct correlation between good environmental performance and better returns on assets, equity and investment. In addition, the OECD Toolkit stresses the future gains from improving the environmental performance, which are accrued, for instance, by meeting environmental and social expectations ahead of competitors, gaining strategic foresight, staying ahead for regulation or enhancing the relationship with stakeholders (Table 4.1).

**Table 4.1. How Sustainable Manufacturing creates value for firms**

<b>Financial performance</b>	<b>Increase sales</b> – by anticipating and meeting environmental and social expectations better than competitors.	<b>Improve efficiency and productivity</b> – by reducing resource use and waste, and by cutting regulatory burdens.	<b>Reduce dependence on expensive or hazardous materials</b> - by exploring, innovating and introducing greener alternatives.
<b>Business excellence</b>	<b>Stay ahead of regulations</b> – by being proactive and shaping best practice, rather than reacting after changes are implemented.	<b>Win access to capital</b> – by reducing risks in operations, strategy and the supply chain and by developing innovative solutions and new products for market.	<b>Gain strategic foresight</b> – by anticipating how the business can innovate solutions or adaptations to new added value.
<b>Relationships with stakeholders</b>	<b>Enhance reputation</b> – by demonstrating green know-how and setting positive example.	<b>Improve employees' morale and retention</b> – by empowering them to contribute to a better environment and more productive business.	<b>Build better community relations</b> – by demonstrating a responsible and proactive approach to the local environment and people.

Source: OECD Sustainable Manufacturing Toolkit, 2011.

211. However, numerous studies underline that the typology and scope of the environmental investment, as well as the business performance metrics adopted, can result in differences in the benefits accrued. For instance, Bordt et al. (2009) show that investments made in *environmental management* improve both environmental and financial performance of companies. On the other hand, investments in pollution prevention, through the adoption of *cleaner technologies*, improve environmental but not necessarily financial performance. Furthermore, investments in pollution control, through *end-of-pipe solutions*, cannot be directly correlated to improvements in either environmental or financial performance.

212. From the sustainability perspective, *clean technologies* are considered to be a preferred option to *end-of-pipe technologies*, as they eliminate the problem from the start, that is, they prevent, rather than simply treat, the business environmental impact. They do so mainly by optimising processes and substituting materials (Box 4.1).

<sup>23</sup> For a review of the literature and a summary of key findings see OECD (2010), OECD Sustainable Manufacturing Toolkit – Reference Document, Paris, [DSTI/IND\(2010\)8/ANN1](#)

213. However, technological change represents only one dimension of the systemic change that sustainability demands. The empirical studies cited above corroborate the view that green growth, intended as sustainable and wealth creating economic dynamics, requires a systemic approach at the business level. Sustainable practices require that business strategies and management approaches respond to environmental and resource efficiency objectives (Figure 4.1). Many environmental management schemes or assessment methods that developed over the last years are based on the view that an evolution in management, strategy and corporate responsibility should combine with technology adoption to define an environmentally sustainable and financially performing business.

#### Box 4.1. Technological approaches to environmental sustainability

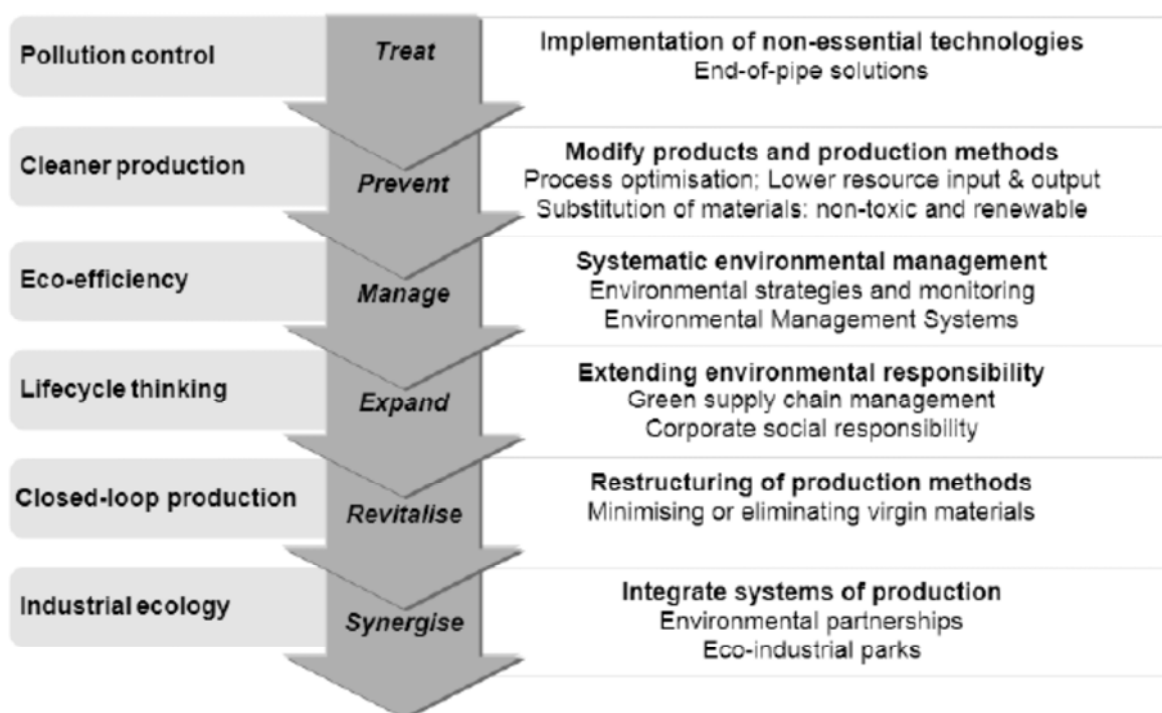
*End of pipe technologies (EOP)* are devices or plants added at the end of the production process with the aim to transform primary emissions into substances easier to handle. They do not involve changes in production processes.

*Clean technologies* are changes in production processes that reduce the quantity of wastes and pollutions generated in the production process or during the whole life cycle of the products.

Classifications at a more detailed level are also proposed in the literature, highlighting the greater variety and complexity of environmental solutions. Skea (1995), for instance, distinguishes among cleaning technologies, pollution control technologies, waste management clean processes, recycling and clean products.

Source: del Rio, 2005.

Figure 4.1. The evolution of sustainable manufacturing concepts and practices



Source: OECD, 2010a.

### 4.3. SME uptake of environmental practices

214. A growing body of research work suggests that SMEs are much less engaged in environmental measures and sustainable practices than their large firm counterparts. Calogiru et al. (2010) estimate that, in Europe, up to 24% of SMEs actively engage in actions reducing their environmental impact, but only 0.4% adopt a certified Environmental Management System (Box 4.2).

#### Box 4.2. Environmental Management Systems (EMS) and ISO 14001

An Environmental Management System (EMS) is a tool for managing the impacts of an organisation's activities on the environment. It provides a structured approach to planning and implementing environmental protection measures. An EMS integrates environmental management into a company's daily operations, long term planning and other quality management systems. It does so by monitoring environmental performance and easing the identification of areas for improvement, similar to the way a financial management system monitors expenditure and income and enables regular checks of a company's financial performance. The expected outcome of an EMS is *continual improvement* in environmental management.

An EMS is not prescriptive; rather, it requires organisations to take an active role in examining their practices, and then determining how their impacts should best be managed. In fact, EMS certification schemes follow the principle "Plan, Do, Check, Act" defined by the ISO 14001, the international standard that requires the demonstration of measurable continual improvement. *Plan* refers to establishing the objectives and the processes required to meet the objectives. *Do* refers to implementing the processes, which also requires identifying the resources and defining the responsibilities within the organisation. *Check* refers to measuring and monitoring the processes and reporting results. *Act* refers to taking action to improve the performance, based on the monitored results. This might imply feeding back into the planning stage and redesigning the relevant processes and monitoring mechanisms.

However, ISO 14001 is not an environmental management system as such. It does not dictate absolute environmental performance requirements. Organisations are responsible for setting their own targets and performance measures, with the standard serving to assist them in meeting objectives and goals and in monitoring progress.

Although the implementation of an EMS, and the related certification, are essentially a voluntary initiative, they can also become an effective tool for governments to protect the environment as they can assist regulation. For example, regulatory systems can encourage organisations to use EMS to meet standards, by providing incentives for strong environmental performance. Likewise, organisations can use EMS to ensure that their performance is within regulatory requirements, and to keep ahead of more stringent regulations which might be introduced in the future.

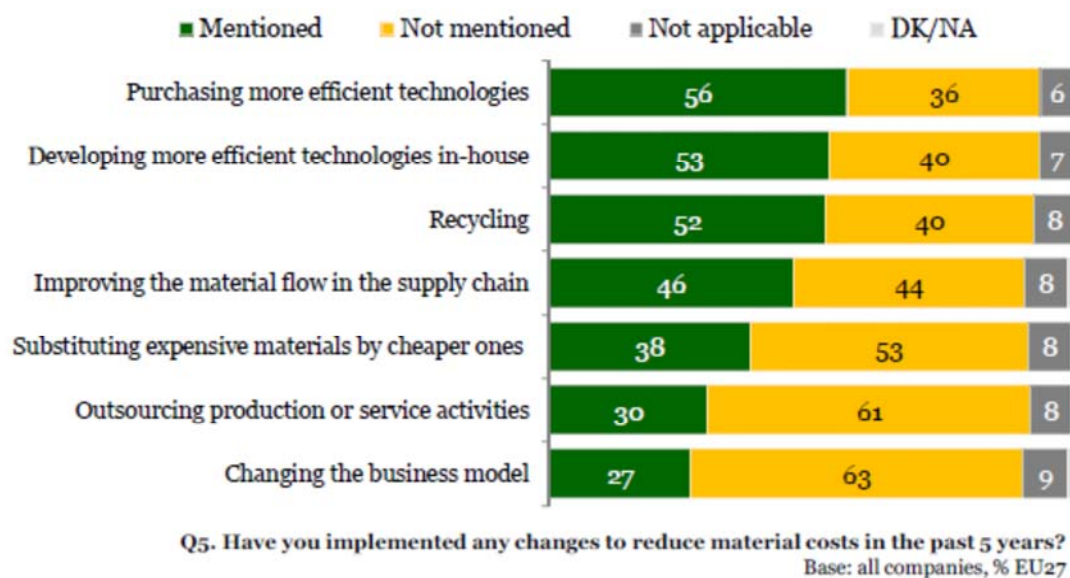
*Sources:* Martin (1998), Calogiru et al. (2010) and Australian Government, Department of Sustainability, Environment, Water, Population and Communities, retrieved from [www.environment.gov.au/land/management/ems/index.html](http://www.environment.gov.au/land/management/ems/index.html).

214. Evidence shows that it is not common for SMEs to engage in integrated management practices and holistic approaches to reduce their environmental impact. Rather, SMEs tend to undertake environmental measures in piecemeal way, often to respond to urgent cost pressures (Revell et al., 2010). The main types of environmental solutions adopted by SMEs are investments in simple clean technologies, closed systems (recycling of water and waste), or relatively low-cost tools, such as energy-efficient light bulbs and waste segregation (Calogiru et al., 2010), that is, *end-of-pipe technologies* rather than *clean technologies*.

215. Evidence from the Flash Eurobarometer (EC, 2011) confirms that changes to SME business models are not the frequent response to improve energy efficiency. According to this survey, the majority of European SMEs have taken action to reduce material costs, mainly by adopting material-efficient technologies, purchasing them in the market or developing them in-house (Figure 4.2). On the other hand, on average, only a third of EU firms have implemented changes in their business model. In this area, however, there are remarkable differences across countries. Among environmentally active SMEs, the share of those that introduced changes in their business model ranges from 15% in Sweden to 56% in Ireland (Figure 4.3).

**Figure 4.2. Changes implemented to reduce material costs in past five years, by type of change, 2011**

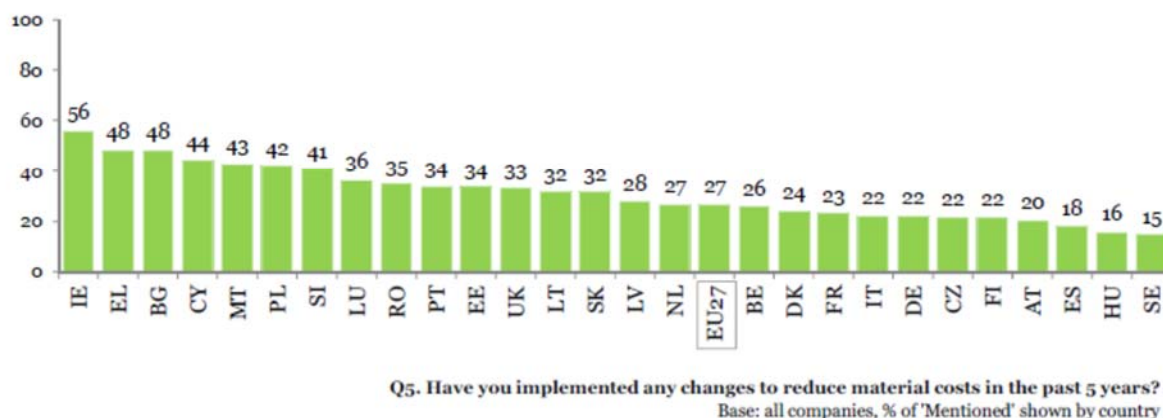
As a percentage of all responding companies in the EU 27



Source: EC, 2011.

**Figure 4.3. Changes implemented to reduce material costs in past five years, by country, 2011**

As a percentage of responding companies that changed their business model



Source: EC, 2011.

216. Table 4.2 illustrates, for the case of Canada, the differences between SMEs and large firms in the adoption of pollution prevention methods. Large firms are overall more actively engaged in environmental protection investments than SMEs. Firms with fewer than 100 employees lag behind especially in the implementation of good operating practices or training.

217. As in the case of the EU area, in Canada the use of environmental management tools is not pervasive among SMEs, which rarely adopt a formal structured approach to planning and implementing environment protection measures, as with life cycle analysis or ISO certification. Although certification is

rare, a non-negligible share of Canadian SMEs adopts environmental management system (EMS) practices (Table 4.3). Nevertheless, the share of firms engaged (12% to 28%) is far smaller than in the case of larger companies (70% to 78%).

**Table 4.2. Environmental protection expenditures in Canada's business sector: Distribution of pollution prevention methods by establishment size, 2008**

As a percentage

	Number of employees per establishment			
	Fewer than 100	100 to 499	500 to 999	1,000 or more
	Percent			
Product design or reformulation	13	15	21	29
Equipment or process modifications	18	25	34	55
Recirculation, on-site recycling, reuse or recovery	37	49	66	70
Materials, feedstock or solvent substitution	17	23	25	47
Improved management or purchasing techniques	23	26	32	44
Prevention of leaks and spills	33	49	72	73
Good operating practices or training	36	54	77	75
Other	6	6	11	25
<b>Total (a)</b>	<b>60</b>	<b>75</b>	<b>88</b>	<b>87</b>

Note. A. Percentage of establishments that used at least one pollution prevention method.

Source: Statistics Canada, Environment Accounts and Statistics Division.

**Table 4.3. Environmental management practices in Canada's business sector, by establishment size, 2008**

As a percentage

	Number of employees per establishment			
	Fewer than 100	100 to 499	500 to 999	1,000 or more
	Percent			
Environmental management system	12	28	70	78
Life cycle analysis	3	6	24	34
ISO 14000 certification	3	13	52	58
ISO 14064 certification	0 <sup>s</sup>	1	2	10
Implementation of a pollution prevention plan	11	20	44	59
Environmental voluntary agreements	5	9	32	37
Green procurement policy	7	9	20	24
Eco-labelling of products	4	6	7	13
Implementation of an environmental supply chain management policy	5	10	13	29
Impacted by a supplier's or client's environmental supply chain management policy	6	9	17	26
Environmental incentives	2	6	16	29
Other	1	2	4	3
<b>Total (a)</b>	<b>26</b>	<b>45</b>	<b>81</b>	<b>85</b>

Note. A. Percentage of establishments that used at least one environmental management practice.

Source: Statistics Canada, Environment Accounts and Statistics Division.

218. In New Zealand, in 2007 there were only 187 adopters of ISO 14001, out of a population of over 334 000 business enterprises, of which 97% with less than 19 employees. As at July 2010, only 17 SMEs were certified by the Government's 'carbonNZero' program, launched in the late 2000s to provide advice to organisations and certify those that became 'Carbon Zero' (Hoskin, 2011).

#### **4.4. Drivers of adoption and transition**

219. The literature has identified a number of factors that motivate adoptions of environmental technologies and sustainable practices by firms. These can be grouped into four broad categories (Park, 2005):

- regulation and financial incentives
- community pressure
- cost saving motives
- market demand and competitive pressure.

220. Increasingly, entrepreneurs are motivated not only by the 'push' of legislation and environmental concern, but also by the 'pull' of potential cost savings, new customers, higher staff retention and good reputation in the market. Greater adoption of environmental technologies has also been facilitated by the availability of technology at increasingly more favourable conditions, in terms of costs but also of adaptability. In fact, compatibility to existing systems and complexity of environmental technological solutions may importantly affect their adoption (Weng and Lin, 2011).

#### ***Regulation***

221. Some SME surveys find that regulation is the single most effective driver of change (del Rio, 2005; Revell and Blackburn, 2007), although effects appear to be more evident in the case of medium-sized firms than small or micro businesses (Dulipovici, 2001). The importance of well-designed regulation is highlighted across studies which cover different geographical areas and countries at different levels of development. Country assessments in Latin America also indicate that sustainable development in the SME sector depends largely on the ability of environmental regulation to drive change in a positive direction, while also promoting modernisation of the productive apparatus (Leal, 2006). In their investigation across nine developing countries, Luken and Rompaey (2008) find that current regulatory requirements are most relevant for pollutant-intensive sectors (e.g. pulp and paper), whereas high costs of production are most important for globally competitive industries (e.g. textiles).

222. Although regulation is key to change, its burden on SMEs needs to be taken into account, as they need to invest time and resources for acquiring relevant information, understanding the implications of new regulation and consistently adapt their products and processes. The capacity to respond to stricter regulation can be a problem above all during the transition, because SMEs are generally short of competences and resources required for monitoring a fast changing regulatory environment and for filtering and understanding the relevant information. Furthermore, the monitoring and reporting on environmental indicators, in compliance with regulation, can impose high costs on resource-constrained small businesses.

223. A recent study on environment-related regulatory burdens for SMEs in five sectors (auto, chemicals, galvanising, non-ferrous metals and laundry) and five countries (Belgium, France, Germany,

Italy and the UK) finds that smaller companies struggle more with regulatory compliance burdens than in the case of other types of regulations. The survey indicates that 71% of SME respondents find compliance very or fairly difficult for environmental issues, vis-à-vis 63% for health and safety and 59% for energy-related regulation (CSES, 2007).

224. A common complaint by small businesses is that keeping up to date with environmental requirements is burdensome, and understanding which requirements apply in their individual context is particularly difficult. Often SMEs feel they are unreasonably expected to cope with the same levels of paperwork and obligations as larger companies (OECD, 2012a).

225. Furthermore, environmental regulation does not guarantee consistent and continual innovation. Drake et al. (2004) emphasise that regulatory compliance can become an end in itself, rather than marking a transition to “ecological modernisation”. Revell et al. (2010) argue that regulation can encourage reactive rather than proactive behaviour, along with antagonistic perceptions of environmental and commercial interests, or government and business interests. For this reason, full engagement between regulators and SMEs is desirable, in order to develop regulatory frameworks that are flexible enough to encourage SMEs to be innovative in their solutions, as well as to help entrepreneurs to understand their regulatory obligations and find solutions for reducing impacts at least cost.

226. Financial incentives can be used to complement regulatory measures, and they are intended to increase the short-term benefits of environmental investments, sometimes supporting actions aimed to comply with new regulation. When they take the form of taxes or fines, they make the environmental impact unattractive or increase compliance costs with regulation (Parker et al., 2009).

### *Community pressure*

227. Actions to improve environmental performance can be related to the SME owner-managers’ environmental commitment. This may respond to personal beliefs and motivations to embrace a transformative approach and sustainable orientation, as well as emerge in response to the community’s perception that businesses have a responsibility to engage in environmental sustainability.

228. Most recent evidence suggests that SME perceptions about costs and benefits from environmental investments have been changing over the past several years, also following increased public concern about climate change and community pressure. For instance, Revell et al. (2010) find that SMEs and entrepreneurs in the UK are more actively involved in recycling, energy efficiency, responsible buying and selling, and efforts to reduce carbon emissions than in the past. Compared to earlier studies, they find that small business owners are more inclined to emphasise their own role in solving environmental problems, rather than putting the onus on government to take the lead.

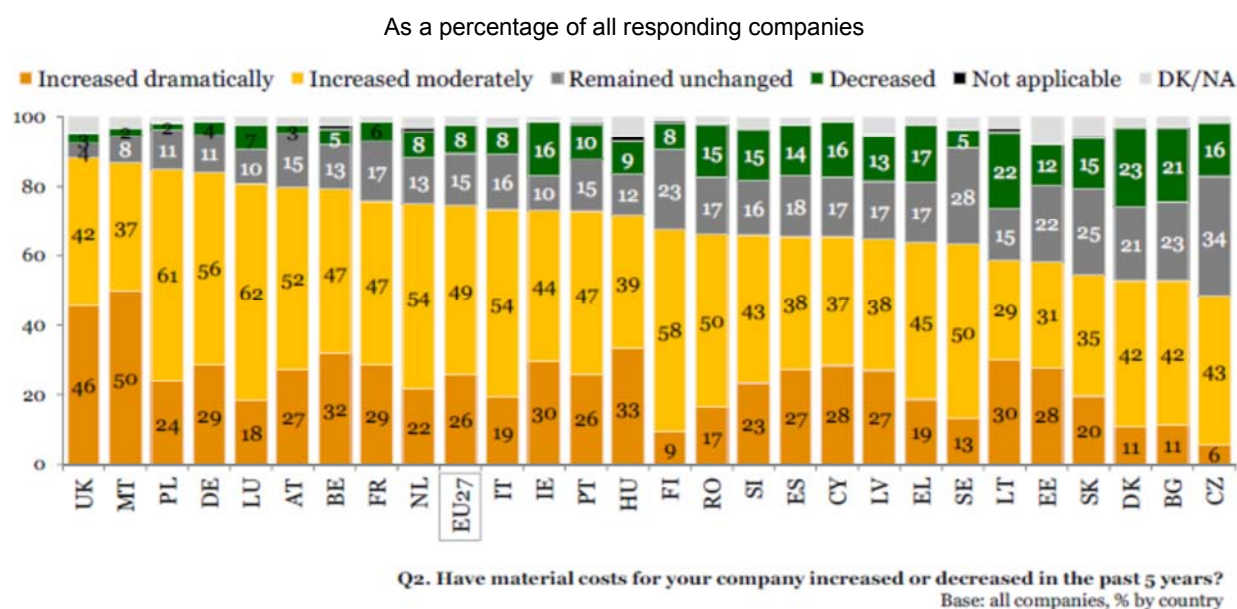
229. Pressure to improve environmental performance can also be exerted by employees and other stakeholders. Henriques and Sadorsky (1999) find that increased pressure from organisational stakeholders (e.g. customers, suppliers, employees, shareholders) and community stakeholders (e.g. non-governmental organisations, social groups) tends to produce proactive behaviour, whereas environmental reactivity is associated with increased pressure from regulatory stakeholders (e.g. governments, trade associations) and the media.

### Cost saving motives

230. A large number of studies emphasise that adoption of environmental technologies is strongly influenced by the desire to reduce manufacturing inputs and waste treatment costs (Irwin and Hooper, 1992; Porter and van der Linde 1995a, 1995b; Howes et al., 1997; Park, 2005).

231. Recent evidence suggests that the rising cost of energy has increased the SMEs' perception of the benefits of energy efficient solutions (Calogiru et al., 2010). According to the Flash Eurobarometer (EC, 2011), in the EU three-quarters of businesses have experienced an increase in material costs in the past five years. Of the more than 5 000 SME managers surveyed in the EU, 26% said material costs for their company had increased *dramatically*, while 49% indicated there had been a *moderate* increase in such costs. In some countries (e.g. Germany, Poland, Malta and the UK), the perception of increased costs was especially acute, with more than 80% of respondents expressing the view that costs had increased moderately or dramatically (Figure 4.4). Furthermore, almost 90% of SME managers said they foresee price increases in materials in the coming years.

**Figure 4.4. Evolution of material costs for European SMEs over past five years, 2011**



Source: EC, 2011.

### Market demand and competitive pressure

232. Incentives to engage in greening importantly arise from the market place. External sources of pressure for the adoption of sustainable practices include customers' demand for environmental improvement in business processes or for products/services with reduced negative environmental impact (Parker et al., 2009). For instance, Calogiru et al. (2010) find that among European SMEs that adopted EMS certification, the market demand is a relevant driver. In particular, the main motivational factors highlighted by the certified SMEs are: demand from customers; a good management tool (especially in the case of SMEs affected by legislation such as REACH, the European Union's Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals); and a good brand, especially for exporters.

233. However, demand pressures differ across sectors and vary depending on the position of the firm along the value chain. Firms producing final demand goods tend to be more affected by the environmental consciousness of consumers than firms producing intermediate goods (del Rio, 2005). The development of a green “image” or brand may increase revenues if customers are willing to pay a premium for cleaner products/services or processes. In this instance, communication directed to the market becomes a crucial complement to green investments.

234. Market pressures for environmental improvement can also be exerted by other companies along the value chain, as in the case of producers of intermediate goods or companies supplying final market retailers. This is increasingly the case of global value chains, in which environmental standards are adopted or eco-labelling has emerged. These create the incentive, especially for the firms controlling the stages that are closer to market distribution and consumption, to impose strict environmental requirements up in the supply chain.

235. Based on a survey of 142 small and medium-sized suppliers in Korea, Lee (2008) finds that buyer environmental requirements and support are positively linked to their suppliers' willingness to participate in green supply chain initiatives. However, the study also shows that the more abundant resources and organisational capabilities that suppliers have, the more willingly they are to participate in those initiatives. This suggests that buyers' pressure and support are all the more important for small suppliers who lack internal capabilities to define their own greening strategy and adopt pro-active behaviour.

236. Large retail chains increasingly require that their suppliers have an EMS in place, or engage them in Product-Oriented Environmental Management Systems (POEMS) (Box 4.3). In New Zealand, for instance, The Warehouse, the largest department store retailer in the country, annually grades the environmental performance of its suppliers and in 2008-09 carried out on-site grading at 105 factories. The New Zealand Business Council for Sustainable Development (NZBCSD) reported in 2010 that 28% of companies in the country changed suppliers in the preceding 12 months because of poor environmental, social or ethical behaviour. It also expected about one-third of New Zealand businesses to have sustainable procurement policies by the end of 2010 (Hoskin, 2011).

**Box 4.3. Product-Oriented Environmental Management Systems (POEMS): The Netherland's experience**

Product-Oriented Environmental Management Systems (POEMS) are an extension of traditional EMS, which monitor the environmental impacts caused at all life cycle stages of the product. As such, POEMS are intended to provide producers a tool to make environmentally responsible decisions on product development and product strategies, in collaboration with suppliers and customers. Thus, POEMS encourage reduction of environmental bottlenecks in the product life cycle and support concerted action of the various actors involved in this cycle. However, POEMS are not codified by any norms and their application differs widely.

In the Netherlands, in 1995 the government introduced a product policy with the intention of changing the behaviour of producers through a life cycle approach. A POEMS programme, or PMZ (Product en MilieuZorg), was launched by the government, in close cooperation with business. The objective of the PMZ has been to encourage and introduce a process of continuous product improvement and permanent product environmental innovation.

The PMZ has been mainly applied in the construction and industrial sectors, but, since 2000 it has been introduced also in other sectors, such as agriculture, services and transport. The tourism sector represents an interesting case in point. In 2000, the Netherlands Association of Tour Operators (VRO) obliged its members (about 180 tour operators) to implement PMZ to improve the sustainability of products in the tourism chain. The tour operators were asked to contribute especially to the environmental ('planet') dimension of sustainability, but also to take into account the social-cultural ('people') and economical ('profit') aspects of sustainability

Sources: van Berkel et al. (1999); Rinaldi C., "CALCAS Swot", retrieved from [www.estis.net/includes/file.asp?site=calcas-wp3&file=947A7445-E51E-4BCA-A446-F3C890E6F46E](http://www.estis.net/includes/file.asp?site=calcas-wp3&file=947A7445-E51E-4BCA-A446-F3C890E6F46E).

237. Governments can support the diffusion of green practices along the supply chain by encouraging large companies to assist their small suppliers in meeting environmental requirements. In the UK, Zero Waste Scotland concluded voluntary agreements with retail companies to reduce the environmental impact of the grocery retail sector, by targeting, for instance, the growth in packaging along the value chain. The programme is based on a partnership approach and participants are encouraged to pass on the resource efficiency requirements down the supply chain (OECD, 2012a).

238. Market demand for environmental improvements can also come from the public sector, through public procurement. In some countries and in certain sectors, a certified EMS is necessary to bid for public tenders. This is increasingly the case, for instance, in the construction industry at the national (e.g. UK) or local level (e.g. in France, the city of Bordeaux asks that suppliers have an EMS in place and comply with social clauses throughout the construction supply chain).

239. In this framework, rival companies' pressure represents an important driver for SMEs' adoption of more sustainable practices. Environmental improvements in fact can develop into competitive advantage. This is the case when buyers, government, business customers or final consumers, value or require environmental performance, Eco-labelling can represent a way to differentiate from competitors and segment the market. At the same time, environmental cost improvements entail selling products with good environmental performance, for which the market might be willing to pay a premium, at a competitive price (Orsato, 2009).

#### **4.5. Barriers to adoption and policy responses**

239. It is commonly suggested that SMEs encounter more difficulties than large firms in adapting to – or anticipating - the transition to green growth, although SMEs can be more flexible than large businesses in adapting to the fast-changing market environment. The willingness and capability of SMEs to adopt sustainable practices can encounter limitations in size-related resources constraints, skills deficits and knowledge gaps. However, the barriers specific to SMEs also emerge from market uncertainty and risk that small businesses typically find more difficult to assess and handle than large firms.

240. These barriers determine a significant *value-action gap*, that is, even in the case of positive environmental attitudes by SME managers and entrepreneurs, these translate into concrete action only to a limited degree (McKeiver and Gadenne, 2005; Revell et al., 2010).

##### ***Lack of awareness, knowledge and monitoring capabilities***

241. Several studies in the 1990s and early 2000s identified the low awareness of the overall environmental impact of small firms and the low levels of 'eco literacy' as a major hindrance to change (e.g. Hillary, 1995; Rutherford et al., 2005). Hillary (2000, p.18) summarises the evidence on SMEs' environmental practices by concluding that the SME sector is "largely ignorant of its environmental impacts and the legislation that governs it; oblivious of the importance of sustainability; cynical to the benefits of self-regulation and the management tools that could assist it in tackling its environmental performance; difficult to reach, mobilise or engage in any improvements to do with the environment".

242. Although businesses' environmental consciousness has increased over the last decade, several studies show that the majority of SMEs still lack a comprehensive view of their environmental impact and resource usage, which also implies that they are not fully aware of the opportunities to improve efficiency that might come from environmental action, and they do not look for tools or solutions to reduce their impact (Calogiru et al., 2010). For instance, the 2009 SME-Environment survey conducted in the UK by NetRegs shows that the majority of businesses (91%) believe that they did not undertake any activities that were harmful to the environment. This is also an outcome of poor firm-level reporting and monitoring

systems, as SMEs often adopt simplified financial reporting schemes and lack some form of environmental impact monitoring.

243. The SME knowledge deficit concerns both the environmental impact of their activities and the availability of clean alternatives, especially the opportunities for reducing the “whole-life” environmental impact of their activities, from raw material acquisition, through to production, to recycling and to disposal (OECD, 2009a).

244. Also, the level of information about environmental legislation is generally low and lacking, especially when it comes to international regulation. This can be related to poor or incomplete information provided by national and local authorities, but it is also due to SMEs’ lack of capacity to access the relevant sources of information or to process the relevant information input. The European SMEs monitored by Calogiru et al. (2010) seldom have an overview of relevant sources of support (legal and technical) and how these can be used strategically. Furthermore, often the extra costs for hiring external environmental consultants and experts are perceived to be an excessive burden.

#### *Policy responses*

245. Measures to raise awareness and improve knowledge about environmental impact and benefits from monitoring have been implemented in many countries at various levels of government. For instance, as part of its 2011 Clean Energy Future package, the Australian Government established a AUD 40 million Energy Efficiency Information Grants program, to provide information to SMEs and community organisations on practical measures they can take to reduce their energy costs.

246. Actions have also been taken by other stakeholders, including the financial sector. For instance, the Royal Bank of Canada, the largest financial institution in the country, has created an online resource center to support the greening of small and medium-sized firms. This includes a guidebook that provides entrepreneurs with a better understanding of what environmental sustainability is and why it matters, along with the business case and other advice on how to strategically plan for going green. In line with these efforts to provide insights that are relevant to specific industries and to help business owners plan their own environmental sustainability strategies, the RBC has also recently launched four industry-specific reports, which cover manufacturing, logistics, agriculture and retail<sup>24</sup>.

247. Facilitating networking and linkages with other market players is also important to raise awareness and favour knowledge diffusion. Roy and Therin (2008) highlight that SMEs use different knowledge sources when acquiring environmental knowledge. In this process, trade associations and suppliers can play a significant role. Calogiru et al. (2010) find that SMEs that invest in environmental tools and solutions with significant results tend to identify these solutions through suppliers of equipment or through participation in projects aimed at reducing their environmental impact.

248. Australia’s Clean Energy Future package, for example, comprises an AUD 5 million funding over four years to improve delivery of clean technology advice and other non-grant business support programmes to SMEs. These include: Supplier Advocates, a government initiative to support Australian suppliers in the government procurement markets and improve tendering practices; Enterprise Connect, a

---

<sup>24</sup> Royal Bank of Canada: Greening your business: Report on Business and the Environment: Retail 2012; Greening your business: Report on Business and the Environment: Agriculture 2012; Greening your business: Report on Business and the Environment: Logistics 2012; Greening your business: Report on Business and the Environment: Manufacturing 2011. Retrieved at [www.rbcroyalbank.com/commercial/advice/greening-your-business/index.html](http://www.rbcroyalbank.com/commercial/advice/greening-your-business/index.html)

government programme that consists in a network of centres across the country to provide advice to SMEs to undertake comprehensive change in business practices; the Industry Capability Network, a non-profit organisation that groups more than 90 technical consultants in Australia and New Zealand, to support firms in engaging with the supply chain of major projects<sup>25</sup>.

249. There are initiatives in several OECD countries to address the information, resource and capability constraints of SMEs to comply with environmental regulations. These include measures tailored for facilities with low-environmental risk, most of which are SMEs, such as simplified-permitting and activity based requirements with or without mandatory notification of the regulator. In France, for instance, to simplify regulatory requirements for SMEs, a new environmental regulatory regime was introduced in 2009. This is meant for installations that present risk significant enough to justify its prior evaluation, but that can be addressed through a simplified procedure, the ‘registration’. It still requires the submission of an application and a simplified public consultation, but processing time is significantly reduced and predictability of the requirements increased (OECD, 2012a).

250. A large number of programmes have been adopted across countries to support SMEs’ adoption of environmental management systems, in some cases leading to formal certification. These often imply public-private partnership and the engagement of various stakeholders at the local level (Box 4.4). A common feature of these programmes is the gradual *step-by-step approach* to favour SMEs’ adoption of sustainable practices, and, in some cases, EMS certification. In general, these initiatives provide firms with a framework through which their environmental performance can be monitored, improved and controlled. This is also the approach of the OECD Sustainable Manufacturing Toolkit, which provides a set of indicators to measure the environmental performance of manufacturing facilities and identify areas for improvement (Box 4.5).

**Box 4.4. Step-by-step approach to SME environmental certification: Selected country programmes**

In France the “1.2.3. Environment” programme is implemented by the Assembly of French Chambers of Commerce and Industry (AFCI), supported by the French Ministry of the Environment and the French Environment Agency (ADEME). The programme adopts a gradual 3-step approach to facilitate SMEs’ ISO 14001 or EMAS accreditation, focusing on working methods and management, although it does not itself develop the reporting tools required for accreditation.

In Germany, regional agreements have been implemented to guide SMEs towards EMS adoption. An example is the “Bayerisches Umweltsiegel”, a scheme in Bavaria that focuses on hotels and restaurants, implemented by the Bavarian State Ministry of the Environment and Public Health, in cooperation with the local chambers of commerce and the Tourism Marketing Agency. Since 1995, the programme has supported local businesses to improve their environmental performance by using a checklist, reviewing performance and emphasising continuous improvements. As many programmes of this type, however, it is not conducive directly to an EMS certification. It rather focuses on providing simple tools and support to SMEs, in order to raise their environmental awareness and improve their capacity to set and monitor environmental targets.

In the UK, the IEMA (Institute of Environmental Management and Assessment) Acorn Scheme provides guidance to achieve the British Standard BS8555. It comprises six steps and is intended to encourage organisations to demonstrate that they are proactive in their approach to the management of their environmental impacts and are committed to improving their environmental performance. IEMA operates a register of organisations that are monitored by inspection bodies, whose accreditation is performed by the UK Accreditation Service (UKAS). The scheme is particularly, though not exclusively, intended for SMEs, as the phased approach can assist them with resource and capacity management.

Source: EMAS website, <http://ec.europa.eu/environment/emas>.

<sup>25</sup>

See [www.icn.org.au](http://www.icn.org.au)

#### **Box 4.5. OECD Sustainable Manufacturing Toolkit**

The OECD Sustainable Manufacturing Toolkit aims to provide a practical starting point for businesses around the world, mainly SMEs, to improve the efficiency of their production processes and products thereby enabling them to contribute to sustainable development and green growth.

The Toolkit includes an internationally applicable common set of indicators helping businesses measure their environmental performance at the level of a plant or facility. The Toolkit comprises: a Start-Up Guide, which provides easy-to-read guidance to help the entrepreneurs and business managers understand the Basic Issue and start measurement step-by-step; and a Web Portal, which provides detailed explanations of indicators, technical advice on performance management and links to more guidance.

Source: [www.oecd.org/innovation/green/toolkit](http://www.oecd.org/innovation/green/toolkit)

251. Since 1995, the European Commission has developed and extended an EU Eco-Management and Audit Scheme (EMAS), originally restricted to companies in industrial sectors but, since 2001, open to all economic sectors, including public and private services. This is a management tool for companies and other organisations to evaluate, report and improve their environmental performance, along the principles adopted also by the OECD Toolkit. Over time, the scheme has been strengthened by adopting an EMAS logo to signal EMAS registration to the outside world; and by considering indirect effects more strongly, such as those related to financial services or administrative and planning decisions. Participation in the scheme is voluntary and extends to public or private organisations operating in the European Union and the European Economic Area (EEA) - Iceland, Liechtenstein, and Norway. An increasing number of candidate countries are also implementing the scheme in preparation for their accession to the EU.

252. However, the uptake of the EMAS system has been rather slow across European businesses, particularly SMEs, and strongly concentrated in a few countries (Germany, Spain and Italy), which account for about 80% of all registrations. A simplified tool, EMAS-Easy, has been designed to improve environmental understanding and monitoring in small businesses. This is particularly intended for SMEs with a high environmental impact. The scheme is typically facilitated by a consultant in clusters of about five to ten organisations<sup>26</sup>.

253. A cluster approach to EMS certification by SMEs has been developed in Sweden, through the "Hackefors Model" (Box 4.6). This typically includes firms within a limited geographical area, such as an industrial estate. An environmental group is formed consisting of one representative from each participating company (company coordinators), who meet regularly to take decisions related with the implementation of the EMS, and to organise relevant training. The group selects a steering committee, which in turn selects a coordinator, who can also be an external consultant. The central coordinator prepares documents, identifies and communicates common legal requirements, raises interest and commitment, organises meetings and plans environmental training. The documentation of the joint EMS consists of an environmental manual that is common to all companies. If the companies decide to become certified, they can do it simultaneously by being audited by the same certification body. However, each company has an individual EMS. Cost-efficiency, training, coordination and knowledge exchange are some relevant advantages of the scheme, which seems to be particularly suited for SMEs. However, case studies also point at possible shortcomings, such as the excessive reliance on the central coordinator, often from a consultancy firm, which makes the companies dependent on external support (Zobel, 2007).

<sup>26</sup>

See [www.emaseasy.eu](http://www.emaseasy.eu).

**Box 4.6. Joint Environmental Management Systems: The Sweden's Hackefors' model**

The model of joint EMS was first implemented in Sweden in the district of Hackefors by the private company Altea AB, with the idea that a joint process to certification is easier and cheaper for SMEs, provided there is an experienced facilitator or broker. The original Hackefors network consisted of 26 SMEs, from a wide range of businesses, including the manufacturing, transportation, construction and graphic industries. In 1995, these businesses formed an environmental group and implemented a joint EMS in 1997. Since then the use of the Hackefors model has increased rapidly throughout Sweden. There are now some 24 networks and over 400 SMEs using the model to achieve ISO 14001 certification. The company Altea AB acts as consultant and coordinator and sells the Hackefors Model as a service.

Source: <http://ec.europa.eu/environment/emas> .

***Market uncertainty and scepticism about the business case for sustainability***

254. An important relevant barrier to changes in business practices and uptake of environmental technologies is the scepticism about the 'business case' for sustainability. In other terms, environmental measures may be perceived by SMEs to be a drain on profits or to have uncertain financial benefits (Revell and Blackburn, 2007), although most recent evidence suggests that rising costs of energy have increased SMEs' perception of benefits from energy-efficient solutions (Calogiru et al., 2010).

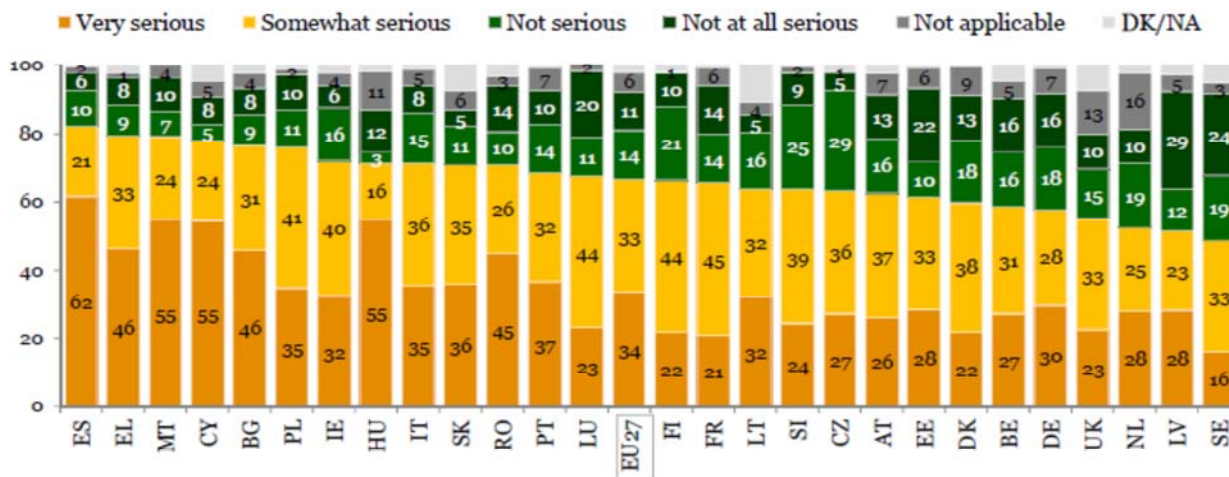
255. For instance, the 2007 NetRegs survey by the UK Environment Agency found that of 4 489 SMEs in 15 different sectors only 13% were motivated to undertake environmental measures to reduce costs (down from 16% in 2005). This is all the more relevant, as Revell et al. (2010) notice, when taking into account that, on the other hand, eco-efficiency tends to be the key promise of government-funded environmental initiatives. Often, SMEs do not perceive the payback from eco-efficiency measures to be worth the investment in time and resources required to pursue them.

256. The lack of customer or supply chain pressure contributes to weakening the business case for environmental investments. Most SMEs do not clearly perceive a market for greener products or demand for cleaner production processes. In other terms, they do not believe that consumers will pay a premium for cleaner production processes. This scepticism was evident in SME surveys conducted in the 1990s and early 2000s. In a review of 33 studies, Hillary (2000) finds that neither supply chain requirements nor consumer driven demand have been exerting remarkable pressure on SMEs to adopt more sustainable practices. A study on Western Australian SMEs finds that a large majority of firms (80%) believe that their clients do not consider environmental factors as a reason for their choice of supplier (Gerrans and Hutchinson, 2000).

257. Over the past decade, awareness about advantages from greening has increased. The rising costs of energy have been a major driver in this sense. However, uncertainty related to market reception and reward for green efforts remains an obstacle. Two thirds of SME managers surveyed across Europe by the recent Flash Eurobarometer (2011) maintain that uncertain demand from the market is a barrier to a faster uptake and development of eco-innovations in their company. The share of those who believe market uncertainty to be a "very serious" or "somewhat serious" obstacle varies from 49% in Sweden to 83% in Spain (Figure 4.5).

**Figure 4.5. Barriers to eco-innovation uptake and development for SMEs: Uncertain demand from the market, 2011**

As a percentage of all responding companies



Q7. I will list you some barriers that could represent an obstacle to accelerated eco-innovation uptake and development for a company. Please tell me for each of them if you consider them a very serious, somewhat serious, not serious or not at all serious barrier in case of your company?  
Base: all companies, % by country

Source: EC, 2011.

258. The role of supply chains in inducing environmental changes by SMEs is also questioned by some empirical studies. For instance, Baylis et al. (1998) suggest that supply chain pressure varies across sectors but that in general larger companies tend to focus on first tier suppliers, which are often large firms, rather than on smaller firms down the chain.

259. Regulatory and technological uncertainties add to the scepticism about customers' demand to lower SMEs investment in sustainable tools. Regulatory uncertainties result from changing environmental regulation, which increases the difficulties for SMEs to monitor the legal framework, as well as the risks perceived of investing in costly technologies or in changing business practices.

260. Technological uncertainties relate to the lack of knowledge about the functioning of relevant technologies, their impact and their maintenance costs, but also to possibly irreversible nature of the investment. Furthermore, the prospects of improvements in the technology and cost reduction may represent a barrier to adoption, since potential adopters may prefer to wait until such improvements or reduction in costs take place (del Rio, 2005). The theoretical literature shows that, with uncertainty and a sunken adoption cost, there exists a significant value to wait for new information (Pommeret and Schubert, 2009).

### *Policy responses*

261. Eco-labelling has emerged as an important tool to promote eco-efficiency and help firms gain visibility and recognition through the market. Governments and trustworthy third-party organisations take the responsibility to set efficient performance standard, test the products and award the labels to show either the energy efficiency savings or the product's carbon footprint. A 'carbon labelling' system has been introduced in countries such as the United Kingdom, the United States, Sweden and Canada, and at the EU

level (See Box 3.2 in Chapter 3). This shows the amount of carbon dioxide emitted during the production lifecycle, distribution, use and disposal of the goods (ESCAP, 2009).

262. Programmes have also targeted linkages along supply chains, to ensure SMEs perceive the benefits from greening and are supported in their environmental efforts by other players. This is envisaged for instance in Korea's "Basic Act on Low Carbon Green Growth". Article 33 of the Basic Act contains provisions for SME support, which include (Lee, 2010):

- i) supporting joint ventures between large businesses and SMEs
- ii) promoting the commercialization of green technologies developed by SMEs
- iii) other measures necessary to promote green technologies and management for SMEs.

263. While being a potentially effective tool for achieving policy goals, eco-labelling might also result in a trade barrier or instrument for discrimination, which may affect SMEs in particular, due to their greater difficulties in navigating complex regulatory environments. Under the WTO, rules related to eco-labels have been developed in order to limit conflicts between standard setting and international trade frameworks and to ensure that labelling is non-discriminatory<sup>27</sup>.

#### ***Costs and financial constraints***

264. The cost burden of environmental investments, including acquisition and instalment of technologies, increased costs of operation and managerial and organisational changes, represents one of the key obstacles to widespread engagement in sustainable practices by the SME sector.

265. The high costs that adoption and adaptation might imply are all the more relevant to SMEs, which are often financially constrained since the profitability from change is likely to occur in the medium to long term. In fact, the payback period for environmental technologies can be particularly long. Even when the entrepreneurs or SME managers are convinced by the long-term prospects of the investment, the firm may not have the financial resources required to meet the high initial costs.

266. According to a recent study in Germany, SMEs consider that a lack of funding is the biggest impediment to their actions to save energy. Amortisation periods are perceived by entrepreneurs to be too long compared with other investments (Prognos AG, 2009).

267. Del Rio (2005) highlights that investment cycles have an influence on the probability of adoption, due to installed capacity and the switching costs implied by the change. For instance, if a firm has recently implemented an end-of-pipe technology, it might be tied financially, as well as technically, to this initial investment and find it difficult to switch to solutions which address the environmental impact in a more systemic manner. Furthermore, switching costs may be high because of the complementarity with other technologies or practices within the firm that would also need to be changed when new solutions are adopted. This is the case, for instance, of cleaner technologies, whereas end-of-pipe solutions can be easily added to existing processes. The more systemic the change introduced, the higher the switching costs, as it involves a higher degree of rupture with the knowledge, complementary technologies and technical skills previously accumulated by the firm.

---

<sup>27</sup> See [www.wto.org/english/tratop\\_e/envir\\_e/labelling\\_e.htm](http://www.wto.org/english/tratop_e/envir_e/labelling_e.htm)

268. For SMEs, the shift to environmental management systems can be particularly costly, as it also requires the adoption of monitoring and reporting tools. In particular, certified EMS appear to be too costly (and complex) for most SMEs (Calogiru et al., 2010).

*Policy responses*

269. The gradual approach to SME certification supported by many national programmes addresses the cost and complexity barriers that SMEs may find difficult to overcome. By defining steps to environmental sustainability and providing SMEs with easy to implement monitoring tools, these schemes allow firms to learn about environmental requirements and benefits and gradually adapt their operations.

270. Specific government funding schemes exist to address the important financial constraints that SMEs meet in their transition to more sustainable practices. However, these are often complemented by or linked with other supporting measures, including information and business developments services.

271. In 2011, the German Federal Government set up an energy efficiency fund out of the Special Energy and Climate Fund, specifically oriented to SMEs. This includes support for adoption of energy management systems, as adapted to the needs of SMEs, and optimising processes in the goods-producing sector. Furthermore, in cooperation with the KfW (a promotional bank of the Federal Republic and the federal states) the Economics Ministry has set up the Special Fund for Energy Efficiency in SMEs, which is intended to enable small businesses to cut their energy costs and to become less exposed to future increases in energy costs. Support is provided in the form of advice on energy and investment in energy conservation measures (BMW, 2011).

272. In 2013, the Danish Government launched a programme for funding SME green transition. Under this initiative, administered by Vaekstfonden, the state investment fund, approximately EUR 6.6 million have been allocated to loans to SMEs. The objective of this measure is to increase resource efficiency by providing funding to SMEs that are developing innovative products or cradle-to-cradle business models. The loans can also be used by companies to enable the take-up of innovative solutions and/or promote increased recovery of resources in production processes. At the end of 2013, the government will evaluate the initiative and possibly consider its extension.

273. In Ireland, businesses, and particularly SMEs, have been targeted by a number of initiatives from state-run organisations, to encourage more environmentally friendly business practices. These have taken the form of direct financial aid for pilot projects or capital expenditure on equipment or technology, as well as the delivery of additional capacity by funding expert consultancy support. The Green Business Initiative, run by the Environmental Protection Agency in Ireland, is an overarching programme containing a number of resource efficiency projects directed at businesses, in particular SMEs. Examples of projects for SMEs and the identified savings in 2011 are set out in Table 4.4.

274. In the UK, the Carbon Trust encourages UK businesses to reduce carbon emissions through funding, supporting technological innovation, and by favouring the adoption of more efficient working practices. For instance, the “Action Energy” Programme provides businesses, industries and public sector organisations with free, practical and impartial help and advice on how to cut their energy costs; “Action Energy Loans” help small businesses make investments in energy efficiency by offering interest-free energy loans to fund the cost of buying energy equipment; and the “Enhanced Capital Allowance Scheme” enables businesses to claim 100% first year capital allowances on investments in energy saving technologies and products.

Table 4.4. SME projects under the Irish Green Business Initiative, 2011

Project	Target	Support	Members	Identified or measured Saving	Return on Investment
Greenbusiness.ie	SME's with a utility spend of more than €30,000 per annum.	Web based audit tools for water, waste and energy, provides tips and resources, and also site visits.	c. 500	c. €4m	11:1
€co-cert	SME's with a utility spend of less than €30,000 per annum.	Fee paying "EMS-Lite" type programme offering site visits and audits.	70	€160,000	5:1
Green Retail	Small and medium-sized shops in retail sector.	Pilot programme aimed at investigating resource efficiency savings.	10	€142,000	3:1
Green Hospitality Award	Hotels and hospitality businesses.	Fee based programme, offering certification for successful hotels or accommodation.	220	€5.58m	12:1

Source: National Waste Prevention Programme Annual Report 2011, Environmental Protection Agency, Ireland

275. Industrial symbiosis, whereby waste from one company is used as an input by another company, is an emerging model to promote resource efficiency and environmental sustainability in the business sector. For instance, in Kalundborg Symbiosis, in Denmark, public and private enterprises buy and sell waste products from industrial production in a closed cycle. The residual products traded can include steam, dust, gases, heat, slurry or any other waste product that can be physically transported from one enterprise to another<sup>28</sup>. The Danish Government has launched a national initiative aimed at promoting the establishment of industrial symbiosis partnerships. A team of regional advisors will identify potential partners for industrial symbiosis projects and facilitate matchmaking activities. The Danish Business Authority can provide financial support to a number of enterprises, allowing them to get specialised consulting services from experts in the process of establishing an industrial symbiosis.

#### ***Lack of human resources, skills and specialised services***

276. Lack of trained human resources and skills is a key barrier to technology adoption in general. In the case of environmental technologies, the issue may be exacerbated by the lack of previous experience and the complexity and sophistication of the relevant technologies or tools. In fact, the problem of skills

<sup>28</sup> See [www.symbiosis.dk](http://www.symbiosis.dk)

does not relate to technology adoption only. Skills shortages also affect the capacity of small businesses to adopt a more comprehensive approach to sustainability.

277. The lack of expertise in environmental management tends to result in reactive rather than proactive behaviour. In particular, entrepreneurs or SME managers that do not feel they have the capabilities to undertake environmental improvements tend to resist voluntary action to change business practices (Revell and Blackburn, 2007).

278. In a 2009 survey on SMEs' approach to energy efficiency in 12 European countries, Eurochambers, the Association of European Chambers of Commerce and Industry, finds that small companies often do not have the capacity to allocate the responsibility of energy issues to one member of the staff (Eurochambers, 2010).

279. Furthermore, SMEs and entrepreneurs are often not aware of the scale of the change to come and the skills requirements it will bring about. Results from an OECD survey of SMEs in New Zealand and the UK indicate that most businesses have little awareness of the impact of environmental regulation in their industry and future needs for new green skills (Martinez-Fernandez et al., 2010).

280. The capacity of SMEs to adopt new or improved environmental solutions also depends on access to specialised services, including those imported from other countries, generally provided by other small businesses. In fact, SMEs often source from external providers knowledge-intensive services, such as those related to the deployment of climate change mitigation and adaptation technologies, including construction, IT, financial, environmental and energy services (OECD, 2011b). In recent years, regulatory reforms have made significant strides in opening services markets. Furthermore, modern information and communication technologies have eased the cost of trading services (OECD, 2012c). However, important barriers to trade in services persist, that limit SMEs' access to specialised knowledge and inputs, which may facilitate the greening of their practices and reduce the costs of adaptation<sup>29</sup>.

### *Policy responses*

281. Governments have been developing or partnering training schemes and technology transfer programmes that address emerging skill needs by the business sector in the green transition and support knowledge dissemination.

282. In the UK, the Secretary of State at the Department of Innovation, Universities and Skills has indicated that skills policy will progressively be moving towards anticipating future skill needs in the green economy (OECD, 2009b). Training and skill developments measures addressed at SMEs are often developed at the local level, that is, in the framework of the local labour markets that are accessed by small businesses. In fact, SMEs are generally strongly embedded in territorial systems, which often represent their main source of information, knowledge and skills. SME skill acquisition occurs in the context of 'skills ecosystems', which involve regional and industry-specific networks that bring together public and private training providers (colleges, universities, etc.), employers, industry representatives, unions, labour market and training intermediaries (temporary work agencies and group training companies), local and regional government agencies and community representatives (OECD, 2010b).

---

<sup>29</sup> The OECD Trade and Agriculture Directorate has launched a project, the Services Trade Restrictiveness Index (STRI), to help policy makers identify measures that restrict trade in services, exchange best practices and focus their reform efforts on priority sectors and measures. For more information, see [www.oecd.org/trade/service/trade/towardsaservicestraderestrictivenessindexstri.htm](http://www.oecd.org/trade/service/trade/towardsaservicestraderestrictivenessindexstri.htm)

283. Martinez-Fernandez et al. (2010) investigate some initiatives undertaken by local authorities in different countries to address the existing skills gap. For instance, in Belgium, a joint initiative was launched by the Brussels capital region authorities and the construction sector (trade unions, federations, clusters and associations), as part of the Employment Plan for Brussels. The programme's main objective is to reduce skills and labour gaps in the construction sector, particularly affected by greening trends, by providing adequate training, above all in eco-construction. The programme offers, for instance, courses on isolation and waterproofing, techniques for installation of solar photovoltaic panels, energy efficiency for housing and buildings, and handling and operation of environmental materials.

284. One of the actions under the EU Environmental Compliance Assistance Programmes for SMEs (ECAP) is to build local environmental expertise available to SMEs. The ECAP is intended to reduce the burden of compliance by designing instruments and policies to integrate environmental concerns into the core of SME activities. The measures include the dissemination of information specifically targeted for SMEs, promoting support networks, and training activities that build local environmental expertise. Funding for the Programme's measures come from the EU "LIFE+" funds (EUR 5 million for 2007-13) with additional funds made available through the Competitiveness and Innovation framework Programme (CIP) and the Structural Funds.

#### *Technology transfer and assistance*

285. In the United States, several hundred government-sponsored programmes exist to provide assistance to industrial firms in linking up with service and technology providers and in adopting new or improved technology. The US Department of Energy sponsors Universities that participate in the Office of Industrial Technologies (OIT)'s *Industrial Assessment Center Program*, to offer free energy, waste and productivity audits to qualifying facilities. Assessments are conducted by local teams of engineering faculty and students from the more than 20 Universities that participate in the programme<sup>30</sup>. Several measures are implemented under the National Institute of Standards and Technology's (NIST) Manufacturing Extension Partnership (MEP) Program, a nationwide network of non-profit centres, whose aim is to provide assistance to manufacturing SMEs. Many of the State Energy Offices nationwide offer some form of technical assistance to local manufacturers, responding to their mission to maximise energy efficiency while promoting economic development, reducing reliance on foreign energy supplies, and improving the environment (Shipley et al., 2002).

286. Within the framework of the European Union's regional policy, numerous regions have implemented measures to stimulate SMEs' uptake of green technologies by supporting science-industry linkages. This is the case of the project on "Efficient use of energy – trainings for employees and managers of SMEs" undertaken in Poland (Box 4.6), and of the EnviroINNOVATE programme implemented in the UK by the West Midland region. This latter, created in 2003, aimed to contribute to enduring engagement between regional Higher Education Institutes (HEIs) and the SME community. It was based on a partnership of seven Universities in the region and was supported by the Environment Agency, Advantage West Midlands, the regional development agency, and several private sector institutions. The services provided included an environmental technologies market review, a technical market appraisal and a technical scoping study to give SMEs access to university testing and analytical services. The project, which started with an EU contribution of EUR 202 372 and attracted investment of EUR 1 711 000 over the four years of operation, was recognised as a best practice by the European Commission, for having made a positive link between innovation resources within universities and the SME population in the area of environmental technologies<sup>31</sup>.

---

<sup>30</sup> See <http://iac.rutgers.edu>

<sup>31</sup> See [www.enviroinnovate.com](http://www.enviroinnovate.com).

**Box 4.7. Training for employees and managers on energy efficiency: A regional programme in Poland**

The Regional Centre for Innovation and Technology Transfer of the Swietokrzyskie region, in Poland, has launched in October 2011 the initiative “Efficient use of energy – trainings for employees and managers of SMEs”, this project is carried out in partnership with the Kielce University of Technology and is supported by the European Social Fund.

The project, which will be carried out through 2012, aims to increase the adaptability of SMEs in Swietokrzyskie region and to upgrade the skills of employees and managers to adjust to the growing legal requirements on energy efficiency in industries and services. Beneficiaries of the project are employees and managers of SMEs in Swietokrzyskie region, working in building construction, services and industries. The trainings offered include:

- i) auditor of energy efficiency
- ii) auditor of energy
- iii) specialist funding for energy efficiency in the enterprise
- iv) influence the selection of materials and technology on energy consumption in construction of buildings
- v) design of passive buildings.

Source: [www.it.kielce.pl](http://www.it.kielce.pl)

**4.6. Conclusion and policy recommendations**

287. SMEs account for the great majority of production units and employment across all economies, and their participation in the transition to a low-carbon economy is crucial for the greening of the business sector at large and for the development and diffusion of green skills across industries.

288. However, the SME sector faces unique challenges to adapt to a low carbon economy, improving energy efficiency and adopting more sustainable business practices while maintaining or strengthening competitiveness in local and global markets. In particular, SMEs and entrepreneurs have limited awareness of the scale and implications of the low-carbon transition, and limited knowledge, skills and financial resources to adopt integrated and systematic methods to improve sustainability performance. Rather, SMEs tend to undertake environmental measures in piecemeal way, often to respond to urgent cost-pressures.

289. Policies are needed to encourage SMEs at large to engage in full-scale change, including new approaches to technology screening and adoption, organizational changes, relationships with suppliers, customers, service and technology providers. The present chapter has identified the following relevant policy areas for sustaining this change.

***Raise awareness and strengthen the business case for sustainability***

290. The low awareness about their overall environmental impact and the skepticism about the economic and financial benefits of greening represent a major obstacle to change by SMEs. Awareness campaigns have been implemented in many countries, although a key driver of change in this regard appears to have been the increasing cost of energy. The cost motives however often lead SMEs to short-term piecemeal or end-of-pipe solutions.

291. Policy measures need to improve SMEs’ knowledge about the “whole-life” environmental impact of their activities. In this respect, a step-by-step approach, increasingly adopted across countries and regions, seems to be effective. Governments should support the diffusion of tools such as sustainable manufacturing toolkits, which provide SMEs with information and advice on how to measure their environmental impact, take action to address this, and monitor progress. The gradual approach should also aim at increasing SMEs’ knowledge and interest about environmental certification and build capabilities to undertake it. Numerous initiatives have been recently implemented in this area. These should be assessed and exchange of best practices should be encouraged, at the national and international level.

292. The market place is the main arena for strengthening the business case for greening. The government can play a role in opening or strengthening markets for SMEs that adopt sustainable practices, for instance by setting minimum environmental standards or demanding environmental certification in public tenders.

***Address SME resource constraints to greening***

293. Lack of trained human resources and skills limits SME capacity to adopt a comprehensive strategy towards sustainability. SMEs generally rely on on-the-job forms of training and learning-by-doing, which exhibit important limitations at a time of substantial shifts in the skills required for responding to new competitive and institutional settings. In addition, most SMEs have little awareness about the future needs for new green skills and their investments in green training and knowledge-intensive activities are limited.

294. Policies should address SME skills shortages, fostering diffusion of information about training opportunities, enhancing access to formal training programmes, but also hinging on the existing practices of on-the-job training and learning by interacting. Actions at the local level are crucial, as SMEs are most often embedded in local “skills eco-systems”.

295. Lack of financial resources also represents a major obstacle to change, which often requires significant investments, to acquire and install new technologies, implement organizational changes, measure progress, and continue monitoring the regulatory and technological environment.

296. Governments should consider encouraging private sector’s funding of SME investments in this area, as well as the direct provision of funding to sustain green oriented strategies at the firm and the supply chain level. The recent experience of government energy efficiency funds suggest that access to funding can be complemented with information and business development services, to increase the effectiveness and coherence of energy efficient investments.

***Facilitate SME access to environmental solutions, technical knowledge and specialised inputs***

297. SMEs often lack knowledge about green technologies and eco-solutions and the capabilities to adopt and adapt them to the firm needs and practices. Governments should facilitate SME linkages with service and technology providers, including research centers and universities, to increase adoption, learning and incremental innovation. SME networking and collaboration should be particularly encouraged, to favour knowledge exchange and the identification of common needs, to which scale-efficient services and technical assistance could respond.

298. SMEs’ access to knowledge intensive services should be supported, as their capacity to adopt improved environmental solutions often depends on the sourcing of inputs from specialised suppliers, in local as well as international markets. Regulatory reforms should aim at increasing competition in the markets for business services, in order to drive down the access costs, but also to broaden the range and the improve quality of the specialised inputs available to SMEs.

***Ensure certainty and coherence of regulation and reduce compliance burden for SMEs***

299. Green innovation and adoption of green technologies and sustainable practices benefit from clear and stable market signals and regulations, e.g. carbon pricing or other instruments addressing the externalities associated with environmental challenges. Stable regulations and market signals enhance the incentives for firms to adopt and develop green innovations, and help to indicate the commitment of governments to move towards greener growth (OECD, 2012b).

300. SMEs may be particularly affected by regulatory uncertainty and lack of coherence, due to their limited competences and resources for monitoring the regulatory environment and for filtering and understanding the relevant information. Inconsistencies and uncertainty across borders represent a critical obstacle for SMEs that operate in international markets and can limit their capacity to enter foreign markets in the first place, as well as their participation in global value chains. Governments should take action to improve cross-border information and co-ordination, and to channel relevant knowledge to SMEs that operate internationally.

301. SMEs often have difficulties in understanding and meeting environmental requirements. In some countries, regulators do not have specific strategies for low-risk facilities, the majority of which are SMEs (OECD, 2012a). Regulatory programmes should take into account the heterogeneity of the regulated community and different ability to comply with requirements, providing simplified regimes and tools for small, low-risk businesses, which better meet their nature and needs.

## References

- Arnold E. (2004), "Evaluating Research and Innovation Policy: A Systems World Needs Systems evaluations", *Research Evaluation*, Vol. 13, No.1, pp.3-17.
- Australian Government (2011), "Clean Energy Future Fact Sheet: Small Business", retrieved from [www.cleanenergyfuture.gov.au/wp-content/uploads/2011/08/110808-small-busines-factsheet.pdf](http://www.cleanenergyfuture.gov.au/wp-content/uploads/2011/08/110808-small-busines-factsheet.pdf) (accessed 23/09/11).
- BMW (2011), *Building on SMEs. Greater Responsibility – Greater Freedom*, Federal Ministry of Economics and Technology, Germany
- Bordt M., Biehl M. and Klassen R.D. (2009), *Targeting Environmental Protection Expenditures in the Manufacturing Sector*, Environ Stats, Statistics Canada
- Business Link (2011), *Enabling the Transition to a Green Economy: Unlocking Green Growth*, Department of Business, Innovation and Skills, United Kingdom.
- Cedefop (2008), "Future Skill Needs for the Green Economy", 6-7 October 2008, Thessaloniki, Greece, available from [www.trainingvillage.gr/etv/upload/etvnews/news/3800-att1-1-focus\\_group\\_reports.pdf](http://www.trainingvillage.gr/etv/upload/etvnews/news/3800-att1-1-focus_group_reports.pdf) (accessed 27/09/11).
- Clarkson P.M., Yue L., Richardson G.D., Vasvari F. P. (2011), "Does it Really Pay to be Green? Determinants and Consequences of Proactive Environmental Strategies", *Journal of Accounting and Public Policy*, Vol. 30, 2011, pp. 122-144
- Connection Research (2009), *Who are the Green Collar Workers?*, Department of Environment and Climate Change NSW and the Environment Institute of Australia and New Zealand, Australia.
- CSES (2007), "Study on Environment-Related Regulatory Burdens for SMEs, Report for the European Commission", DG Enterprise, Centre for Strategy and Evaluation Services (CSES), retrieved from [http://ec.europa.eu/enterprise/newsroom/ef/\\_getdocument.cfm?doc\\_id=3527](http://ec.europa.eu/enterprise/newsroom/ef/_getdocument.cfm?doc_id=3527)
- del Rio P. (2005), "Analysing the Factors Influencing Cleat Technology Adoption: A Study of the Spanish Pulp and Paper Industry", *Business Strategy and the Environment*, 14, pp. 20-37

- del Rio P., Tarancon Moran M.A., Callejas Alninan F. (2011), "Analysing the Determinants of Environmental Technology Investments. A Panel-Data Study of Spanish Industrial Sectors", *Journal of Cleaner Production* 19, pp. 1170-1179
- Dulipovici A. (2001), SMEs: "The Natural Facts", Results of CFIB *Environment Survey*, Canadian Federation of Independent Businesses, retrieved from [www.14000registry.com/pdf/facts.pdf](http://www.14000registry.com/pdf/facts.pdf)
- Eco-Innova (2011), "National Specification for R&D Call 1: Germany Federal Ministry of Education and Research (BMBF)", retrieved from [www.eco-innova.eu/lw\\_resource/datapool/\\_items/item\\_144/nsdocs\\_bmbf\\_final\\_18072011.pdf](http://www.eco-innova.eu/lw_resource/datapool/_items/item_144/nsdocs_bmbf_final_18072011.pdf) (accessed 14/10/11).
- Eltham B. (2010), *Australia's Green Economic Potential*, Centre for Policy Development, Sydney.
- Environment Canada (2011), "The Canadian Environmental Technology Advancement" Centres (CETACs), retrieved from [www.ec.gc.ca/Publications/7CE3DE25-B66A-403F-8086-9BB7A818B67F%5CCanadianEnvironmentalTechnologyAdvancementCentres.pdf](http://www.ec.gc.ca/Publications/7CE3DE25-B66A-403F-8086-9BB7A818B67F%5CCanadianEnvironmentalTechnologyAdvancementCentres.pdf) (accessed 23.09.11).
- Environmental Technology Action Plan (2010), *The Bilbao Declaration on Eco-Innovation: Fostering Eco-innovation in SMEs*, June 2010.
- ESCAP (2009), The 4<sup>th</sup> Policy Forum of the Seoul Initiative Network on Green Growth: "Promotion of Green Industry for Green Growth", United Nations Economic and Social Commission for Asia and the Pacific
- Eurochambers (2010), "Energy efficiency in SMEs: Success Factors and Obstacles – CHANGE Survey", European Association of Chambers of Commerce and Industry, Brussels, retrieved from [www.eurochambres.eu/Content/Default.asp?pageid=232](http://www.eurochambres.eu/Content/Default.asp?pageid=232)
- European Commission (2004), *Stimulating Technologies for Sustainable Development: An Environmental Technologies Action Plan for the European Union*, COM(2004)38/FINAL, Brussels.
- European Commission (2010), *Eco-Innovation Observatory: Annual Report 2010*, Brussels.
- Federal Ministry of Economics and Technology (BMWi) (2011), "High-Tech Strategy for Germany", retrieved from [www.bmwi.de/English/Navigation/Technology/hightech-strategy,did=197896.html](http://www.bmwi.de/English/Navigation/Technology/hightech-strategy,did=197896.html) (accessed 14/10/11)
- Gerrans P. and Hutchinson B. (2000), "Sustainable Development and Small to Medium Enterprises: A Long Way to Go", Hillary R. (ed.), *Small and Medium-Sized Enterprises and the Environment*, London: Greenleaf Publishing, pp.75-81.
- Hart S.L. (1995), "A Natural Resource-Based View of the Firm", *Academic Management Review*, 20(4), pp. 986-1014
- Henriques, I. Y. and Sadorsky, P. (1999), "The Relationship Between Environmental Commitment and Managerial Perceptions of Stakeholder Importance", *Academy of Management Journal* 42 (1), pp. 87-99.
- Hillary R. (ed.) (2000), *Small and Medium-Sized Enterprises and the Environment: Business Imperatives*, Greenleaf Publishing limited, Sheffield, UK

- Hillary R. (1995), *Small Firms and the Environment: A Groundwork Status report*, Groundwork, Birmingham
- Holliday CO, Schmidheiny S, Watts Ph. (2002), *Walking the Talk: The Business Case for Sustainable Development*. Greenleaf: San Francisco.
- Hoskin P. (2011), "Why Business Needs to Green the Supply Chain", *University of Auckland Business Review*, vol. 13, pp. 16-18.
- Howes, R., Skea, J. and Whelan R. (1997), *Clean and Competitive? Motivating Environmental Performance in Industry*, London: Earthscan.
- IEA (2007), *Tracking Industrial Energy Use and CO2 Emissions*, IEA, Paris
- Korea Small and Medium Business Administration (SMBA) (2010), "Korea: Green SME Support Policies in Korea, presentation by Tae-il Kim, OECD Bologna+10 High-level Meeting on SMEs and Entrepreneurship, 17-18 November 2010, Paris.
- Korea Small and Medium Business Administration (SMBA) (2011), "Korea: Green SME Support Policies in Korea", presentation by Sang-Tae Kim, Deputy Director at the APEC SME Innovation Conference - Green SMEs: Champions of APEC's New Growth, 19-20 April 2011.
- Leal J. (ed.) (2006), *SMEs in the Environmental Goods and Services Market: Identifying Areas of Opportunity, Policies and Instruments - Case Studies: Argentina, Chile, Colombia and Mexico*, ECLAC Project Document, United Nations, Santiago, Chile.
- Lee S.Y. (2008), "Drivers for the participation of small and medium-sized suppliers in green supply chain initiatives", *Supply Chain Management: An International Journal*, 13, pp. 185-198.
- Lee T.S. (2010), "Opportunities of Green Growth for SMEs", Presentation at the APEC SME Green Innovation Workshop, Octobre 18-22, 2010.
- Lin C.Y. and Ho Y.H. (2011), "Determinants of Green Practice Adoption for Logistics Companies in China", *Journal of Business Ethics*, 98 (1), pp. 67-83.
- Luken R. and Van Rompaey F. (2008), "Drivers for and Barriers to Environmentally Sound Technology Adoption by Manufacturing Plants in Nine Developing Countries", *Journal of Cleaner Production* 16S1, pp. S67-S77
- Martin, R. (1998), *ISO 14001 Guidance Manual, Technical Report NCEDR 98-06*, National Centre for environmental decision-making research, Oak Ridge National Laboratory, Tennessee Valley Authority, University of Tennessee.
- Martinez-Fernandez, C., C. Hinojosa and G. Miranda (2010), "Greening Jobs and Skills: Labour Market Implications of Addressing Climate Change", *OECD Local Economic and Employment Development (LEED) Working Papers*, 2010/02, OECD Publishing.
- McKeiver C. and Gadenne D. (2005), "Environmental Management Systems in Small and Medium Businesses", *International Small Business Journal* 23(5), pp. 513-537
- Meroni I, De Salvia A, Lollini R, Pollastro MC (2002), "Energy saving by means of innovative building envelope systems", *Environmental Management and Health* 13(4): 373-381.

- Mulder, P., Reschke, C., Kemp, R. (1999), "Evolutionary theorizing on technological change and sustainable development", paper presented at the 1st European Meeting on Applied Evolutionary Economics, Grenoble, France, 7–9 June.
- OECD (2009a), "Sustainable Manufacturing and Eco-Innovation", *Framework, Practices and Measurement, Synthesis Report*, OECD, Paris
- OECD (2009b), *Climate Change, Employment and Local Development: Conceptual Framework*, OECD, Paris, CFE/LEED(2009)11
- OECD (2010a), *OECD Sustainable Manufacturing Toolkit – Reference Document*, Paris, DSTI/IND(2010)8/ANN1
- OECD (2010b), *SMEs, Entrepreneurship and Innovation*, OECD, Paris
- OECD (2011a), *OECD Sustainable Manufacturing Toolkit, Start-up Guide: Seven Steps to Environmental Excellence*, Paris
- OECD (2011b), *Fostering Innovation for Green Growth*, OECD Green Growth Studies, OECD Publishing, Paris.
- OECD (2012a), *Green Transformation of Small Businesses: Achieving and Going Beyond Environmental Requirements*, Environment Working Paper No47, ENV/WKP(2012)6
- OECD (2012b), *Fostering Eco-Innovation: Policy Implications*, DSTI/IND(2012)1
- OECD (2012c), *Small and Medium-Sized Enterprises in Global Markets: A Differential Approach for Services? A scoping paper*, TAD/TC/WP(2012)5
- Orsato R.J. (2009), *Sustainability Strategies. When Does it Pay to be Green?*, INSEAD Business Press Series, Palgrave Macmillan
- Park, S (2005), "A study on the determinants of environmental innovation in Korean energy intensive industry", *International Review of Public Administration* 9 (2), 89–101
- Pommeret A. and Schubert K. (2009), "Abatement Technology Adoption under Certainty", *Macroeconomic Dynamics* 13, pp. 493-522.
- Porter, M.E. and van der Linde, C. (1995a), "Towards a New Conceptualisation of the Environment-Competitiveness Relationship", *Journal of Economic Perspective* 9(4), pp. 97-118.
- Porter, M.E. and van der Linde, C. (1995b), "Green and Competitive. Ending the Stalemate", *Harvard Business Review* 73(5, September- October), pp. 120-134.
- Rennings, K. and Rammer, C. (2009), "Increasing Energy and Resource Efficiency through Innovation. An Explorative Analysis using Innovation Survey Data", *ZEW Discussion Paper*, No. 09-056, Mannheim
- Rennings, K. and Zwick T. (eds.) (2003), "Employment Impacts of Cleaner Production", *ZEW Economic Studies*, Vol. 21, Heidelberg. United Kingdom Committee on Climate Change (2010), *Building a Low Carbon Economy: The UK's Innovation Challenge*, London, July.

- Revell A. and Blackburn R. (2007), "The Business Case for Sustainability? An Examination of Small Firms in the UK's Construction and Restaurant Sectors", *Business Strategy and the Environment*, 16, pp. 404-420
- Revell A., Stokes D. and Chen H. (2010), "Small Business and the Environment: Turning Over a New Leaf?", *Business Strategy and the Environment*, 19, pp. 273-288
- Roy M.J. and Therin F. (2008), "Knowledge acquisition and environmental commitment in SMEs", *Corporate Social Responsibility and Environmental Management*, Vol. 15, Issue 5, pp. 249-259.
- Rutherford R., Blackburn R.A., Spence L.J. (2000), "Environmental Management in Small Firms: An International Comparison", *International Journal of Entrepreneurial Behaviour and Research* 7(6), pp. 310-325
- Shipley A.M., Elliott R.N. and Hinge A. (2002), *Energy Efficiency Programs for Small and Medium-Sized Industry*, American Council for an Energy-Efficient Economy, Washington D.C.
- UNEP (2011), "Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication", United Nations Environment Programme, retrieved from [www.unep.org/greeneconomy](http://www.unep.org/greeneconomy).
- United Nations Environment Programme and Bloomberg New Energy Finance (2011), *Global trends in renewable energy investment 2011*, UNEP and BNEF, Frankfurt.
- van Berkel R., van Kampen M., and Kortman J. (1999), "Opportunities and constraints for Product-oriented Environmental Management Systems (P-EMS)", *Journal of Cleaner Production*, Vol. 7, Issue 6, pp. 447-455.
- Zobel T. (2007), "The 'Pros' and 'Cons' of Joint EMS and Group Certification: A Swedish Case Study", *Corporate Social Responsibility and Environmental Management*, 14, pp. 152-166.
- Weber O., Köllner T., Habegger D., Steffenses H., Ohnemus P. (2008), "The relation between sustainability performance and financial performance of firms", *Progress in Industrial Ecology*, 5(3), pp. 236-254.
- Weng M.H. and Lin C.Y. (2011), "Determinants of green innovation adoption for small and medium-sized enterprises (SMES)", *African Journal of Business Management*, Vol. 5 (22), pp. 9154-9163.