# MONITORING THE TRANSITION TO A LOW-CARBON ECONOMY

a strategic approach to local development

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Authorised for publication by Sergio Arzeni, Director, Centre for Entrepreneurship, SMEs, Tourism and Local Development

# Executive summary

Green growth is an ambition and challenge for many local areas and regions. The ambition comes from the desire to act on climate change and take advantage of the positive external environmental and economic factors that can flow from these activities. The challenge lies in managing policy action on climate change in a time of competing policy demand, including the impacts of economic downturns, unemployment and demographic change.

Green growth means growing the economy in an environmentally sustainable way involves promoting growth and development while reducing pollution and greenhouse gas emissions, minimising waste and inefficient use of natural resources, maintaining biodiversity, and strengthening energy security. The impacts of climate change and activities to reduce carbon emissions are as evident at local levels as they are at national or global levels. However, to date, much of the attention on understanding these impacts and customizing policy to balance negative impacts, has taken place at the national or sectoral level.

## Local indicators for green growth

This publication details results from an OECD LEED project that investigates key indicators of area-based transition to a low-carbon economy. The objective of the project was to provide defined measureable indicators at the regional/ local level that can inform over time transition to low carbon-economic and industrial activities addressing two aspects of green growth economy; fostering job creation, and economic development in the new areas of growth and sustainable development.

The indicators of green growth need to measure progress of regional/ local level transition to a low-carbon economy. These indicators will need measure progress over a variety of different regions with different starting positions, regional assets and national and industrial contexts and be able to track progress over time in these regions over time, demonstrating progress on transition to a low-carbon economy and providing input into policy development at the regional level to accelerate this transition.

Regions exist with an established industrial structure. This may change and evolve over time and the objective of this research is to highlight ways in which this evolution may be adjusted and supported to maximize the opportunities that transition to low carbon economy can generate. This publication is organised on a thematic basis and the following conclusions and policy lessons are given in the four thematic areas.

## Conclusions and policy lessons

### 1. Clean-tech clusters as mechanisms for local green growth

Clustering and specialization are well acknowledged routes for localized economic development. The industrial transformations associated with the move to a low carbon economy mean that many regions are looking to develop and encourage clean industry clusters within their boundaries.

Clustering and specialization is most successful when developed from existing capabilities and assets, and significant investments are made in developing the 'connective tissue' or linkages that support the cluster. Also significant, is the institutional make-up and competence at local, regional and national levels, but most specifically at the local/ regional level that also contributes heavily to the success of the clustering activities.

### 2. Indicator development in cross-border regions

Cross-border regions or geographic circumscriptions hardly ever coincide with any single data gathering 'institution'. This creates problems of data availability, data (in) consistency, and hence comparability, making it difficult to compose reliable and useful indicator sets at the cross-border region level, and even more problematic to compare various regional dynamics.

Measuring and monitoring local cross-border projects and dynamics can be a complex and difficult process. An important reason for this complexity is that, more often than not, very little attention has been paid in the early planning and conceptualisation stages of projects to the need for indicators to monitor the co-operative projects.

### 3. Transition in regions with carbon intensive assets

The move to low carbon economic and production activities can be alarming for communities that have carbon intensive assets. These assets are a major component of the local economy; provide employment, and considerable flow on economic activity to the rest of the community. However the transition to low carbon economy can also be a major opportunity for transformation of economic activity that can revitalize a region, provide new and better employment conditions and provide opportunities for skills development and increased knowledge intensity of firms.

These assets can also be used to trade-off for greater investments in protecting the environment, sustainable land use, greener management of public resources, more parks and natural reserves. The strength of this negotiating position requires a shared understanding of the types and level of trade-offs that are acceptable. To reach a shared position requires engaged, representative and knowledgeable stakeholders to come to agreement and advocate for this position.

### 4. Indicator development and dashboard visualization

Many local entities engaging in low-carbon economy (LCE) transition or green growth processes are already measuring and monitoring what they are doing to some degree. However, measurements, indicator development, and reporting are neither coherent nor compatible. There is also little meaningful knowledge exchange based on solid comparison. Dashboard visualisation was used in this research to comparatively analyse the case study regions. The dashboard takes the indicators one step further and helps the information to be summarised and communicated.

Agreement on a set of common indicators and the mechanisms for measuring and populating these indicators firstly requires stakeholder engagement and agreement to inform and validate the indicator selection process. Through the deliberative process of deciding 'what' to measure, monitor and use as indicators for performance, stakeholders can develop a shared understanding and responsibility for developing and populating indicators. This in turn flows into the activities and responsibilities of the institutions from whence these stakeholders come (public, private, public) and develop a platform for co-operation and coordination.

Measuring carbon emissions is going to be the most vital performance metric and indicator development needs to provide a method by which to do this at the local levels, and in such a way that it takes into consideration the local context. There is an important role for policy in prioritising the development of indicators to track progress, particularly given the amount of investment being made in each of these areas to facilitate transition. An important action for local authorities in partnership with regional and national authorities will be to identify and resource appropriate institution/s to collect and report this data in a consistent format, which provides comparative analysis on headline indicators at the local, national and international level.

# ACKNOWLEDGEMENTS

This report is the result of an international project of the OECD Local Economic and Employment Development (LEED) Committee on "Measuring the potential of green growth: Towards a local transition to a low-carbon economy" in collaboration with partners and experts from Belgium, Chile, Denmark, Germany, Luxembourg and the Netherlands. It presents results and policy recommendations from the analysis of several regions in these countries. The report is the result of combined efforts and strong co-operation between country delegates to the LEED Committee, local authorities/stakeholders and local and international experts participating in the project. The study has been conducted with the support of the European Commission, DG Employment, Social Affairs and Inclusion and participant country institutions.

The report was prepared by Cristina Martinez-Fernandez, OECD LEED Programme, which is supervised by Sylvain Giguère, Head of the LEED Division, and Sergio Arzeni, Director of the Centre for Entrepreneurship, SMEs and Local Development and Head of the LEED Programme. Samantha Sharpe (consultant) of the University of Technology, Sydney provided research and editorial assistance. We are grateful for the revisions made by the following LEED Delegates and experts: Mr Robert Strauss of the European Commission; Dr. Lutz Franzke, Mayor of Königs Wusterhausen and Bertil Haack of the Technical University of Applied Sciences, Wildau (Germany); Dr Alwine Woischnik and Mr Cristóbal de la Maza of the Division of Information and Environmental Economics, Ministry of the Environment, Chilean Government; Mr Klaus Rovsing Kristiansen and Mr Kim Bek of Copenhagen Capacity (Denmark), Mr Jan Van Laarhoven, Secretary General of the Benelux Union, Mr Luc Willems, Deputy Secretary General of the Benelux Union, and Mr Hans Mooren of the Secretariat-General of the Benelux Union; Dr Paul Swaim of OECD Employment and Social Affairs Directorate; Dr Ziga Zarnic of the OECD Environment Directorate, Ms Gabriela Miranda of the OECD Global Relations Secretariat.

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# 1. Monitoring the local transition to green growth

*Abstract*
*This chapter provides an introduction of main issues of green growth transition at a local level. The most keenly felt impact will be in the labour market and can include employment generation and destruction and skills acquisition and gaps. The implications of these labour market impacts will be felt in economic activity and development but also in the spatial distribution of innovation activity and how discussions of advantage and disadvantage. The chapter concludes with a summary of the rest of this publication.*

## The green transition and its challenges

Global warming and the emergence of the green economy have supplied added pressure to OECD economies to de-carbonise their economic activities. This, together with the global financial crisis, has led to critical rethinking of our economic growth model and our consumption and production practices. The recent OECD Environmental Outlook 2050 (OECD 2012) describes the fundamental demographic and economic forces that will shape the globe in the four decades to 2050:

- An additional 2 billion people will need to be accommodated, with rising living standards across all countries and a quadrupling of global GDP.
- Increasing life expectancy will mean that for some countries over one quarter of their population will be aged over 65 years, for other countries, particularly developing countries, young populations and workforces will be a competitive advantage.
- By 2050, the majority (70%) of people will be living in cities, placing greater emphasis on the need for solutions to air pollution, traffic congestion, and the management of water, waste and energy in urban environments.

Responding to climate change is a challenging paradox – for the majority of people the costs of inaction on climate change appear to be a long way into the future, yet the costs of action need to start being paid for now.

There is also a high degree of uncertainty around which actions in the long-term will prove most successful. With all of these risks, businesses and governments at all levels find it difficult to act. These uncertainties include technological choices and the irreversibility of these choices.

## Some benefits available now

There are widespread benefits in an early transition to a low carbon economy that are immediately available, and through current activities. These benefits have been purely speculative until recently. However, we are now starting to obtain substantive evidence of the positive industrial dynamics that can be achieved (Kammen, Kapadia and Fripp 2004; Pearce and Stilwell 2008; IEA 2009).

The analysis of 13 independent reports and studies carried out by Kammen, Kapadia and Fripp (2004), on the economic and employment impacts of the increased clean energy in Europe and the United States showed that increasing the use and production of renewable energy had a positive impact on employment. The UNEP (2008) estimates that with an increasing move to renewable energy these industries will create 20.4 million jobs net by 2020. Another study shows the value of Environmental Goods and Services (EGS) has almost doubled from $548 billion in 2004 to a forecast of over $800 billion by 2015 (Selwyn and Leverett, 2006).

These figures are starting to turn the perception of climate change policy action from that of a 'job killer' to a 'job creator' (Martinez-Fernandez et al 2010). Significant investments, despite the on-going financial crisis and economic downturn, continue to be made in encouraging green growth.

## Encouraging Green growth and the need for indicators of transition

Green growth means fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. To do this growth must act as a catalyst for investment and innovation, which will underpin sustained growth and give rise to new economic opportunities (OECD 2011).

The OECD Green Growth Strategy, delivered at the 2011 OECD Ministerial Council Meeting, conceives green growth as way to pursue economic growth and development, while preventing environmental degradation, biodiversity loss, and unsustainable natural resource use (OECD 2011).

Achieving greener growth will involve capitalising on opportunities to develop new green industries, jobs and technologies, as well as managing the transition for greening the more traditional sectors and the associated employment and distributional effects. It will require adopting new technologies, developing new products and supporting new patterns of demand from households, companies and governments.

However, there is very limited information regarding how progress can be made when standards and measures are uncertain and based on traditional measures of economic activity. While efforts at the national level are progressing, and many initiatives can be found at the local level, there are a significant number of inconsistencies, and a lack of agreement concerning the indicators needed to analyse, amongst other questions: How do local economies, firms, clusters and regional ecosystems adjust to low-carbon activities? How are local labour markets making the transition? How do firms re-structure their organisation and production processes? How do skills, education and training systems adapt to the development of new areas of growth?

The need for measurable indicators has been well established within the framework of the strategy, targeting four areas of analysis (see Figure 1.1):

- Changes in productivity in the use of environmental assets and natural resources;
- Natural asset base;
- Environmental dimensions of quality of life;
- Policy responses and economic opportunities.

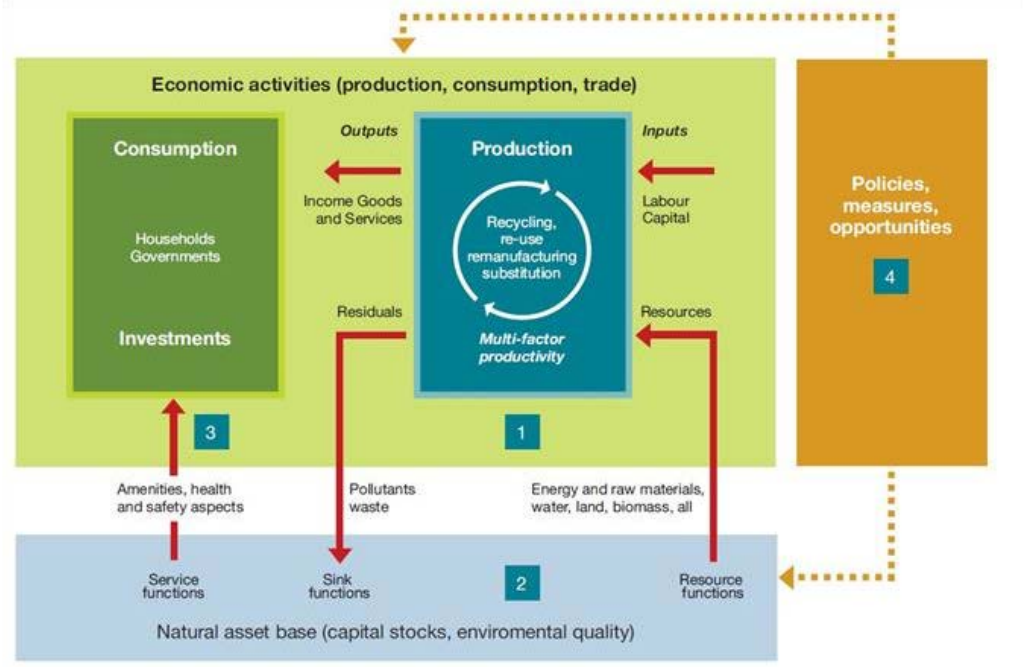
This monitoring will be essential for policymakers at national levels to create and implement green growth strategies. The progress towards green growth will not be equally distributed within countries; therefore it is also important that progress be monitored at the local and regional levels. The central tenet of the green growth framework is the recognition of natural capital as a factor of production and its role in enhancing well-being (OECD 2011b). This provides a new dimension for understanding growth and is a counterpoint to how economic activity has been measured and understood throughout much of the modern era, with gross domestic product (GDP) being the central metric for understanding economic performance.

The weakness with the GDP approach is that it fails to account for depletion of the stocks of natural assets in the current production and consumption regimes, and how these natural stocks are just as important and relevant to current and future growth as capital and labour stocks. Natural capital stocks include natural resource stocks (both renewable and non-renewable), land, and ecosystems (as shown in Figure 1.1.).

Alongside recognition of the natural asset base within the economic model, the indicator framework also includes an understanding of policies and measures that can provide a balance between the factors of economic activity. Public policy is needed to provide incentives and market structures, which will allow trade-offs between production, consumption and the natural asset base to be made over longer periods of time, as well as the encouragement and incubation of innovations that provide for a more efficient, less burdensome use of our natural capital in the future.

The green growth framework understands growth not only through the prism of economic activities of production consumption and trade, but also through the inter-relationships of these activities with our natural asset base and the public policy measures and mechanisms available to our governments.

**Figure 1-1 The OECD Green Growth framework**




Source: OECD Green Growth Strategy (2011)

The OECD has identified seven main sources of green growth (OECD 2011b):

- Productivity enhancements through greater efficiencies of resource use;
- Innovation in addressing environmental problems spurred by policies and frameworks encouraging conditions for innovation;
- New markets from the demand for 'green' technologies, goods and services, and the job growth opportunities these new markets will bring;
- Confidence from investors with greater predictability and policy stability;
- Stability of macro-economic conditions and reducing the price volatility around resource costs;
- Resolution of resource bottlenecks (including human capital resources) that can make new investments more costly;
- Resolving imbalances in natural systems that will reduce the risks of more profound and abrupt changes to the natural environment through climate change.

The transformation of industries will have a large impact on regional and local ecosystems for employment creation, development of skills and green entrepreneurship. However, although there are significant upsides for some local areas and regions, for others the positive effects of the low-carbon transition will be outweighed by negative job losses.

A solid empirical foundation by which to understand how the low carbon transition will unfold at the regional and local level is still lacking. The "*Indicators of local transition to a low carbon economy*" project is part of an effort to provide more empirical evidence at the local level.

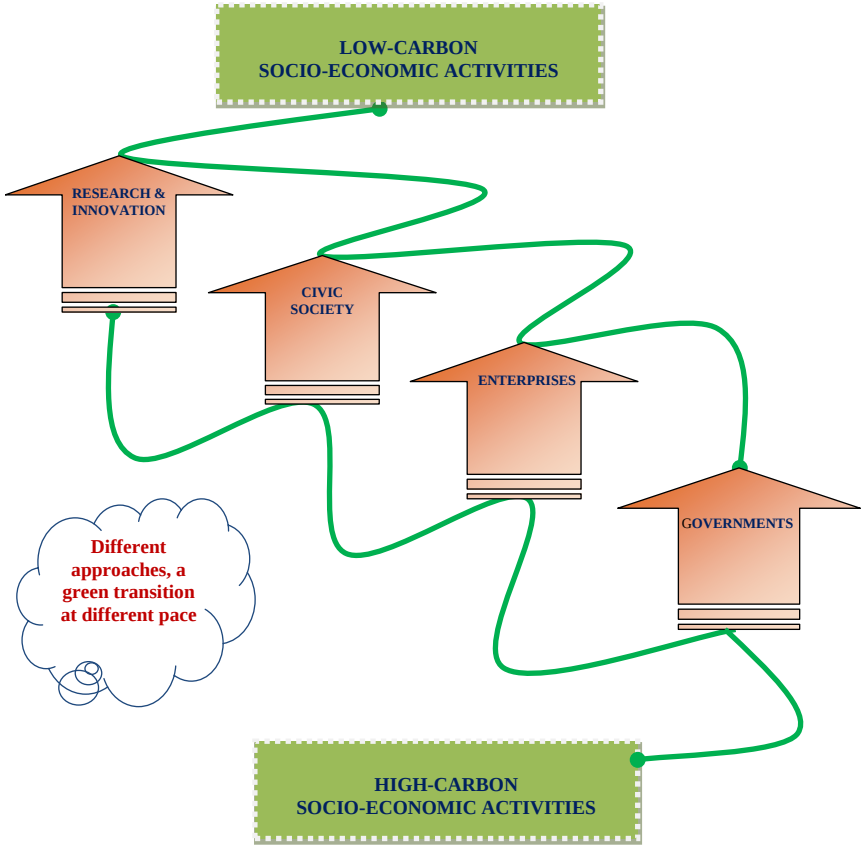
The identification of indicators is therefore imperative in order to measure economic progress towards low-carbon activities in such a way that policies, strategies and programmes can be periodically informed by data that is solid and comparable yet relevant to the local area, industry clusters and regional ecosystems under analysis.

## Differential pace of transition

The 'transition' from a high-carbon to a low-carbon economy is taking place in different environments and at a varying pace, as the Rio+20 conference clearly shows: efforts led by researchers and innovation, by the civic society (NGOs, Trade Unions, community groups), the corporate world (large firms and SMEs), and governments are happening at different levels and not necessarily along the same pathways, although the goal is the same.

Figure 1.2 exemplifies the multiple paths and pace of transition, as well as the different participants and drivers involved. Governments have different pace for action at the various levels of jurisdiction, businesses face many challenges operating within the uncertainties and risks of the low-carbon transition. There are, however, two other factors to consider in this transition: civil society and citizens' demands and frontier research and innovation activity.

Figure 1.2. **Transition pathways to a low-carbon economy**




*Source:* OECD (2013a)

## Different pace but interconnected pathways

As this green momentum continues to gather pace, individual governments and companies continue to activate green mandates and green projects. From the planning and building of green cities in the Middle East and China to countries such as New Zealand and Australia implementing Emission Trading Schemes. This change is taking place in a highly charged and competitive marketplace - companies competing against other companies. Wind energy companies such as Germany's Siemens, Denmark's Vestas, China's Suzlon and the United States' General Electric are currently battling for supremacy in the global economy.

Countries are also competing head to head as they attempt to give their own domestic companies a head start in an emerging and lucrative marketplace of the future. During the global financial crisis of 2008, the United States introduced a $US80 billion green stimulus package only to have China introduce a $US217 billion green package of its own. The European Union in turn responded with its own green stimulus package of around €23 billion. Such programmes over the past four years have acted as an accelerant for the creation of new products and services and have sped up, for example, the introduction of electric vehicles and new fuel cell and battery technologies.

As the world goes green, business and the community are demanding to know how to measure this progress towards becoming more sustainable. Indicators are becoming increasingly important. They form part of the evidence-based framework at the centre of

formulating sound policy, which can then inform practical programmes to meet the community's aspirations for a greener world.

## Local dynamics of green growth

There are two main reasons why monitoring and understanding progress towards green growth needs to be tracked at both the national/ international level and the local level:

- The impacts of climate change will be variable at a local level;
- The impacts of responding to climate change, such as carbon pricing, switching to less carbon intensive energy supply and production, and appropriating the opportunities presented by a transition to a low carbon economy (including both the creation of new employment and industries) will be distributed differently across regions. This will be especially evident in labour markets.

For example, the transition to a green economy will not necessarily mean job losses, but there are some barriers that need to be overcome in order to ensure a successful transition. The need to align local and national strategies towards green growth, build strong partnerships, identify transferable skills, better target up-skilling programmes, support green entrepreneurship, and leverage the role of public authorities in supporting green growth activities are some of the issues that need to be addressed (Miranda et al, 2012).

Therefore, whilst national and international responses are required for carbon emissions mitigation, it is at the local and regional levels that strategies for dealing with the impacts of mitigation action will be required. Of the sources of growth, four have local dynamics that are directly relevant to this project:

- Productivity enhancements through efficient resource use;
- Innovation in addressing environmental problems;
- New markets and employment opportunities from green technologies, products and services; and
- Resolution of resource bottlenecks, including human capital development (e.g. skills and training).

Despite their limited capacities to respond to climate change, especially the mitigation component, with the majority of the effective policy levers existing at the national level in most countries, local authorities do have policy levers available in procurement and energy efficiency activities within their own buildings and urban environments. Local government can encourage the adoption of green skills through promotion of sustainability and triple bottom line reporting, and sustainable practices in the building and construction industry.

## The role for local and regional governments

Local Governments and other institutions will be central agents in the success of the transition of regional areas to low-carbon economies (OECD 2013a, 2013b, 2013c). Local Governments typically hold multiple roles as decision-makers, planning authorities, managers of municipal assets, operators of local energy providers and role models for the public (ICLEI 2012). Local government also has a large degree of influence if not control over land-use

policies, which means they can influence what industries local where, and in some instances set and control the regulatory limits for extraction and discharge activities.

As drivers of change local governments can encourage, enable, measure and regulate the local economy and inform debate on suitable energy options to help cities adapt to new technologies and changing energy requirements (OECD 2013a, 2013b, 2013c). They also have the legislative power to make important decisions, about energy efficiency and the deployment of renewable energy sources. Increasingly these strategies are also being matched to economic development policies.

Local governments can support the establishment of related local renewable energy industries through the creation of cluster initiatives. Clusters work by generating synergies between private and public actors including research and educational institutions. This combination of infrastructure and interactions create opportunities for learning and further specialised development.

Local governments can also stimulate green sectors through public procurement. Public procurement can act as a first and non-price sensitive customer for new green products and services. They can also work to create procurement guides and certification that allow other customers to also buy green without the added expense of the search and verification process. Sub-national governments (local or regional) also design and manage many large public assets such as government offices, schools and other community buildings, so they can influence how these assets are managed, and ensure their procurement policies also encourage greening. They are also involved in the provision of water and waste services and act as key educators and informers to their local communities.

## Summary

The transition to a low carbon economy will present many opportunities for sustainable development. It will also cause change and upheaval; this will be most evident in the labour markets as carbon intensive industries and their associated labour forces become less competitive and decline, and on the other hand low carbon activities growth and their associated employment increases. On the whole it is envisaged that these dynamics will even each other out, but there will be significant requirements for new skills development and re-training.

These activities will not be evenly spatially distributed; different local areas and regions have different compositions of industry and economic activity, and therefore these areas will be either more or less disadvantaged in the transition to a low carbon economy. For this reason local and regional areas will be an important unit of analysis throughout the transition if we are to ensure that the transition occurs at the lowest cost (including social cost) and in good time to avoid dangerous climate change. Local authorities also have an important and influential role to play as regulators, asset owners and potential customers of the green economy.

This publication presents results from a study examining local indicators of green growth. The study had two purposes: firstly to collect and document local pathways to green growth undertaken or in action by selected local areas in OECD countries, second, to develop and trail a method of indicators that supports local understanding and policy action to support green growth at the community scale. This second aim involved taking the green growth indicator framework developed by the OECD for national level analysis and adjusting this to suit local level analysis.

Chapters two, three and four detail case studies of the various local pathways of green growth in the regions that participated in the research. These chapters are organised

around themes including innovation and Clean-technology development, strategies for cross border regions and strategies for regions with carbon intensive industrial assets. These chapters speak to the first aim of the publication –to collect and detail local pathways. Chapter five presents the work and analysis that was developed in each of the case study areas in the second aim of the publication – developing a local indicator framework for green growth.

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# 2. Monitoring clean-tech clusters as mechanisms for local green growth

*Abstract*
*This chapter examines Clean-technology clusters as a mechanism for green growth transition at the local/ regional level. The chapter identifies and analyses the characteristics of Clean-tech sectors, including the path dependent and historical nature of many of these developments. The chapter uses the Copenhagen and Belval case study to illustrate two emerging Clean-tech clusters, and draws policy implications relevant to other local areas considering pursuing cluster strategies for green growth transition.*

Clustering and specialization are well acknowledged routes for localized economic development. The industrial transformations associated with the move to a low carbon economy mean that many regions are looking to develop and encourage clean industry clusters within their boundaries.

Clustering and specialization is most successful when developed from existing capabilities and assets, and significant investments are made in developing the 'connective tissue' or linkages that support the cluster. The chapter looks at Clean-technology cluster development in two local areas; Copenhagen in Denmark and Belval, in Luxembourg. As will become evident from the case study examples path dependency (existing assets and attributes) have a large influence on clustering activity, but this influence can take many years to be felt. Also significant, is the institutional make-up and competence at local, regional and national levels, but most specifically at the local/ regional level that also contributes heavily to the success of the clustering activities.

## Case Study: Copenhagen Clean-tech Cluster[1]

The city of Copenhagen is home to 30 per cent of Denmark's population. The Capital Region of Denmark (including outlying areas) accounts for more than 36 per cent of Denmark's gross domestic product (GDP)[2]. Copenhagen is also the current centre of clean-tech activities in Denmark, with a strong partnership between the city's administration and the private sector.

The City of Copenhagen has formulated an ambitious plan to become the world's first carbon neutral capital by 2025. It has also developed a targeted green growth strategy that seeks to capture the economic gains from this policy by setting up initiatives to encourage new eco-innovations and investments.

Copenhagen plans to achieve carbon neutrality by, amongst other processes, ensuring:

- A carbon neutral district heating system
- Electricity production based on wind and biomass
- Separating plastic from waste to increase recycling

[1] This case study is drawn from OECD (2013a) (Martinez-Fernandez, C.M., S.A Sharpe, M. Munch Andersen, R. Genoff, K. Rovsing Kristiansen) *Measuring the Potential of Local Green Growth: An Analysis of Greater Copenhagen*, LEED working papers, OECD Publishing: Paris.
[2] Statistics Denmark, figures for 2010.

- 20% more passengers in public transport and new fuels in vehicles
- Increasing active transport – bicycling and walking
- Improved energy efficiency in buildings
- On-going support for behavioural and social change programs in households and businesses.

## Climate strategies at city and regional level

The national climate goals of Denmark have set up an ambitious framework to 2050. The City of Copenhagen's climate strategy, launched in 2009, declared the ambition of becoming the first carbon neutral city in the world by 2025. In 2012, a new updated strategy has been launched setting up steps and goals outlining how the city intends to achieve this ambitious goal. Specific success criteria have been formulated already for 2015 and measurable targets set up for 2025.

The strategy's overall aim is to make the Capital Region of Denmark the most climate-prepared and energy-efficient region in Denmark, based on regional and municipal co-operation. The strategy also aims to strengthen the region's ability to proactively address climate challenges and thereby gain a strong position in the international competition between metropolitan regions around green growth and development (Climate Strategy for the Capital Region of Denmark 2012).

The capital region is already well prepared when it comes to climate adaptation and climate prevention. All 29 municipalities in the region have prepared local climate plans and 26 municipalities have joined the Denmark Society for Nature Conservation Climate Municipality initiative. Many local authorities are well advanced, having undertaken energy renovations of their buildings as well as strengthening efforts to reduce CO2 emissions from the region's 12 hospitals and other major institutions (Climate Strategy Copenhagen 2012).

Public-private collaborations and inter-municipal and regional co-operation are seen as essential for the contribution to innovative solutions, a strengthening of green industrial competitiveness, and green growth. This regional agenda is not aimed at replacing local efforts but rather supplementing, supporting and inspiring local environmental initiatives.

The strategy calls on the municipalities to co-operate around five specific areas:

- A region prepared for climate change;
- Environmentally friendly transport;
- Reorganisation of energy systems away from fossil fuels;
- Energy efficient buildings; and
- Climate friendly and green procurement.

## Development of the Copenhagen Clean-tech Cluster

The establishment of the Copenhagen Clean-tech Cluster must be viewed within the wider international trend of the greening of the economy, perhaps one of the most profound pervasive changes of the modern economy (Andersen 2012). Today, green growth is high on the worldwide political agenda, receiving targeted investment funding and widespread policy support. But this is a very new agenda.

Traditionally, the environment has been considered a burden to business rather than a business opportunity. In contrast, the environment and renewable energy has been high on the policy agenda for decades in Denmark. However, it has taken a long time, in Denmark as well as elsewhere in the world, to realise the economic potentials of the environmental efforts. In reality, there has been a very slow realisation of the green growth potential among both business and policymakers; it has taken 60 to 70 years for clean-tech, or 'eco-innovation', which focuses on the wider greening of technologies and services, to become recognised as a driver of economic development (Andersen 2012).

This is partly due to historical lock-in, partly to considerable organisational and institutional failures in the market. However, once the greening of the economy began to take root in the 1990s, the rate of green business development has been relatively fast, and recently with a pace that has surprised many. The mainstream consolidation of the green growth agenda in the second half of the 2000s came very suddenly, but it illustrates the presence of strong multiplier effects on green economic change (Andersen 2012).

The greening of the Danish economy in modern times can be divided into three major periods. The first period is the long regulatory or reactive phase, where firms started to engage in green R&D, forced to do so by policy making and under influence by green NGOs. This period starts with the emergence of environmental policies in the 1940s and 1950s, which were strongly reinforced in the 1970s due to the energy crisis and the rise of energy policies (as described in the previous chapter,) and further in the 1980s due to escalating environmental problems and rising green NGO movements. This led to a growing market within the traditional clean-tech sector and energy technologies, primarily renewable energy technologies, but little occurred on the business side where firms had reactive or even obstructive strategies towards environmental issues.

The second period starts around 1990. In the beginning of the 1990s, the first shift among businesses could be seen, as pioneering firms began searching for green profit opportunities more generally, starting very small but gaining in volume in the 2000s; propelled by both preventive and supportive policy measures (e.g. support for environmental management systems, eco-labelling, investments in Clean-technologies etc.). At the end of the 1990s, Denmark was among the initial pioneering countries seeking to formulate some of the first green growth policies in the world by the Ministry of Trade and Industry (Andersen 1999)[3].

Interestingly, the green growth agenda was originally picked up at local policy levels. The first green growth initiative in Denmark was 'Green City Denmark Ltd', which existed from 1994-2006, consisting of a network of four municipalities and two regional authorities in Mid Jutland, as well as a number of companies and knowledge institutions, in all 250 members, half of which were companies. The Danish Ministry of Business and Industry initiated Green City Denmark Ltd in co-operation with the Ministry of the Environment and Energy, the aim being to establish a visible showcase for Danish

[3] This 'Green industrial development strategy' was never implemented, however, due to a change of government in 2001 leading to a markedly lower policy emphasis on environmental issues, see Andersen /DTI 1999.

environmental technology and know-how. At the end of the 1990s, the network sought to expand into a national network and other municipalities, including Copenhagen, joined via the so-called 'Eco-link' initiative. Green City Denmark undertook numerous activities, organised around a series of working groups.

The first half of the 2000s is an intermezzo in the Danish greening trend, as a new government placed very low emphasis on environmental policies for a number of years, with negative impacts for the clean-tech sector and wider greening of the Danish economy, and for the Green City Denmark initiative, which died out.

The third period starts in the latter half of the2000s, around 2006-2009, where the green growth agenda rapidly gained stronger policy momentum and became much more mainstream and internationally recognised, including within Denmark. The greening of the economy is becoming apparent, particularly in the affluent economies (Andersen 2012), see also (UNEP/ILO/ITUC 2008; Wagner 2008, 2010; Frondel, Horbach and Rennings 2005, European Commission 2006, Johnstone 2007; OECD 2011).

In Denmark, the government changed its policy during this period and started to embrace the green growth agenda, preparing for Copenhagen to host the much awaited COP15 (the UN's Conferences of the Parties) in December 2009. Copenhagen became a focal point for combating climate change, and promoting green energy solutions. This attention helped galvanise and strengthen the City's efforts to support a more co-ordinated approach to clean-tech initiatives. The establishment of the Copenhagen Clean-tech Cluster (CCC) in 2009 is representative of a new era of more deliberate and ambitious green growth policy making and branding. The new Danish government from 2011 has reinforced this policy line, formulating stronger green growth policies than ever before seen in Denmark.

The rise of the green economy, termed by many a revolutionary or paradigmatic change, is due to long running co-evolutionary changes at the bottom (in knowledge, technologies, organisations) and the top (the institutional setting, not the least of which are policy rationales) (Andersen 2012). Four major international political events have been milestones in the greening of the economy. The first was the UN Brundtland Report (*Our Common Future*) from 1987, which firmly placed environmental sustainability in the international policy arena. The second was the influential UN Rio Conference in 1992, which reinforced the sustainability agenda and, for the first time, incorporated the business perspective and business representatives, leading to the creation of the World Business Council for Sustainable Development in 1995. The third was the entry of pioneering ministries of industry and innovation, and the development by the OECD of new green innovation strategies from the mid 1990s,widening in the latter half of the 2000s. The fourth was the new alliance between energy policy, climate policy and security policy that occurred partly in the lead up to the UN COP15 meeting in 2009, creating a new, very powerful agenda. Environmental sustainability moved from peripheral to central policies via ministries of state and economics (Andersen 2009, 2012).

The actual creation of CCC took place as a partner driven project comprised of eleven core partners ranging from universities, technical advisors, an industry association, a business council, business links, and an entrepreneur organisation within Copenhagen City. Together these partner organisations developed a five-year partnership agreement to provide a range of services on behalf of the cluster, and to fulfil an ambitious charter. This included creating a cluster organisation with a strategy for attracting FDI. It is for this reason that the investment promotion agency Copenhagen Capacity (CopCap), which has a strong track record in attracting FDI and building investment driven partnerships, was chosen to lead the CCC. In fact, these practical and tangible results led CopCap to receive recognition from UNCTAD as the best green investment promotion agency for establishing a clean-tech cluster.

Thus, the CCC's primary aim became the development and promotion of Danish clean-tech companies, organisations, joint ventures, and R&D activities. Its vision is to attract global investors to Greater Copenhagen by developing one of the world's leading clean-tech clusters. Today, CCC is considered the leading local green growth initiative in Denmark, anchored in the Copenhagen area, but with ambitions for covering all of Denmark.

At the same time, several other local green initiatives co-exist within as well as across Danish municipalities or regional authorities, several with a green growth emphasis, such as Gate 21 and Carbon 2020.

Recently, the national 'State of Green Consortium' was established as the official green brand for Denmark. These local and national initiatives illustrate the current strong Danish emphasis on green growth. Please refer to the boxes below for more information on these initiatives. The Copenhagen Clean-tech Cluster co-operates with these initiatives, but to some degree they also compete for attention and resources.

The CCC was initiated through a European Union supported project. Its budget (see Box 3.2) supported the largest project ever undertaken in Denmark using Structural Funds (the Danish Ministry of Research, Innovation and Higher Education 2011).

From the very outset, the partners of the CCC acknowledged that collaborating with global companies and international investors was essential to developing a globally orientated and investment driven cluster. Such global collaborations and investment projects are important because they support the acceleration of new research and development. This results in the rapid transfer and diffusion of ideas, knowledge and capabilities within CCC and its members.

Today the CCC (Copenhagen Clean-tech Cluster 2012)

- Has 610 members, with a combined turnover of €30 million.
- In total, the companies employ a staff of 78,000 and roughly 34,000 of these are working directly with clean-tech-related activities, particularly industries related to environment and energy.
- The companies generate a combined turnover of about €30 billion, of which at least approximately €12 billion is related to clean-tech activities.
- The most prominent sectors consist of energy efficiency and renewable energy, followed by water and wastewater, as well as waste and recycling.

Clean-technology industries have a long history in Denmark; many of them based in Copenhagen where there are some 610 clean-tech companies (Oxford Research 2012). The activities of these companies are deeply embedded in Denmark's knowledge intensive industries. They can be found in industries such as architecture; design and engineering; electronics; ICT, and software and artificial intelligence; all of which are located in the very heart of Copenhagen. They also expand into the regions like Mid Jutland, with its centre for the wind energy industry, or Aalborg University in North Denmark with its expertise in software programming and complex data management. Many of these companies are global leaders in clean-tech development.

Greater Copenhagen's clean-tech cluster cannot be studied in isolation from some particularly Danish characteristics of political and legislative. At the most fundamental level, industry clusters are more than just the sum of their parts. In the case of Copenhagen's Clean-tech Cluster, its internal dynamism is propelled by:

- Regulatory regimes that encourage innovation;
- Supportive industry and clean-tech policy environments;
- Highly specialised and technically sophisticated companies in the forefront of their respective fields;

- Talent that is fostered by well resourced knowledge infrastructure and globally connected centres of excellence; Strong social and community cohesion that can mobilise and marshal the energy and resources of industry and the community; and, perhaps most importantly
  - Changes in behaviour and the solidarity required for the community as a whole to move forward together and in step with each other.

These socio-economic conditions allow Denmark and, in particular Greater Copenhagen, to fast-track the commercialisation of clean-tech products and services, despite having only a relatively small venture capital market. Copenhagen is seen as a test bed for the trialling of new products and services.

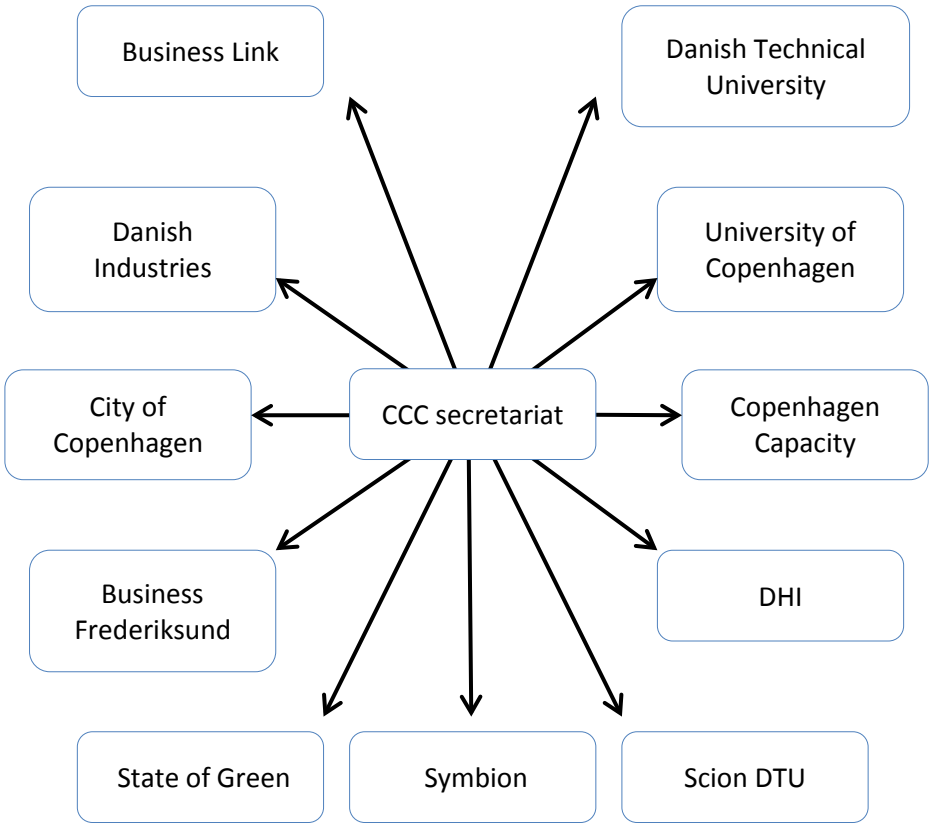
## Greening the whole economy

The economic benefits of a green growth economy are also evident in the industrial growth figures for Copenhagen. Figures 3.1 and 3.1 show how 'green turnover' and exports have grown dramatically over the past five years in the Greater Copenhagen region to a point where they now outperform other key sectors of the economy including: welfare technology; manufacturing; and ICT. In fact, green growth has increased 55 per cent during this period, while green technology export growth has reached an increase of 77 per cent.

**Box 3.2. The funding and governance architecture of the Copenhagen Clean-tech Cluster**

Established in 2009 by Danish clean-tech companies, research institutions and public organisations, CCC was Denmark's largest ever European Union Structural Funds project. With a budget of €20 million over five years, financing is split 50 percent from the European Union (EU), 25 percent from Region Zealand and the Capital Region of Denmark and 25 percent from the founding partner organisations.

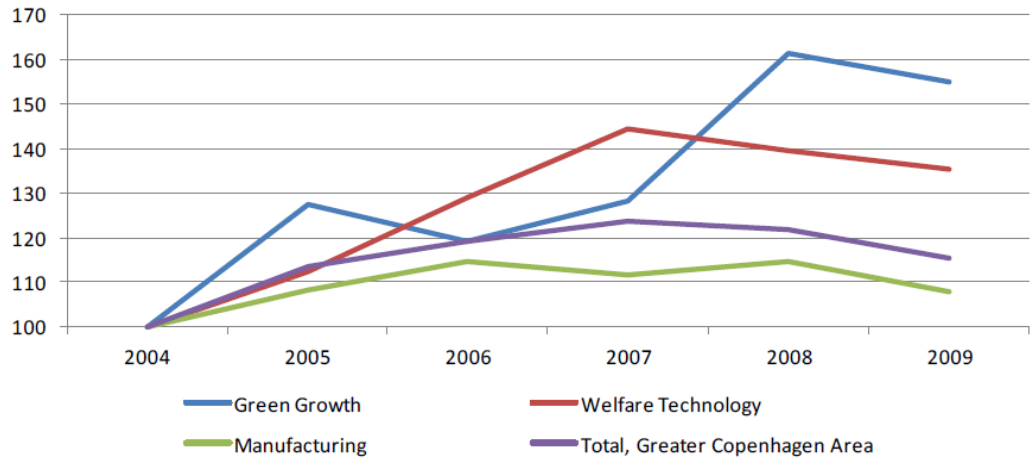
CCC is a consortium based on the triple helix model of university-industry-government interactions, key to innovation in knowledge-based societies (Etkowitz 2002). CopCap is one of eleven founding partners, responsible for the overall co-ordination and facilitation of the cluster, reporting to a board of directors comprised of twelve key stakeholders. The secretariat manages the interface between directors, executive partners, members and stakeholders.




Being a 'project', CCC would not be able to develop new activities and apply for new funding. Consequently, CCC has been established as an association with its own Board of Directors, company registration and the like, making it more operational and able to develop new initiatives. CCC has been able to launch new activities and expand the budget through strategic memberships by Siemens, DONG Energy and the City of Copenhagen, as well as project financing from the Danish Industry Foundation. This is part of a process making the association of CCC a sustainable and self-supporting cluster organisation ready to continue the work of developing and promoting the cluster once the initial project funding runs out in 2014.

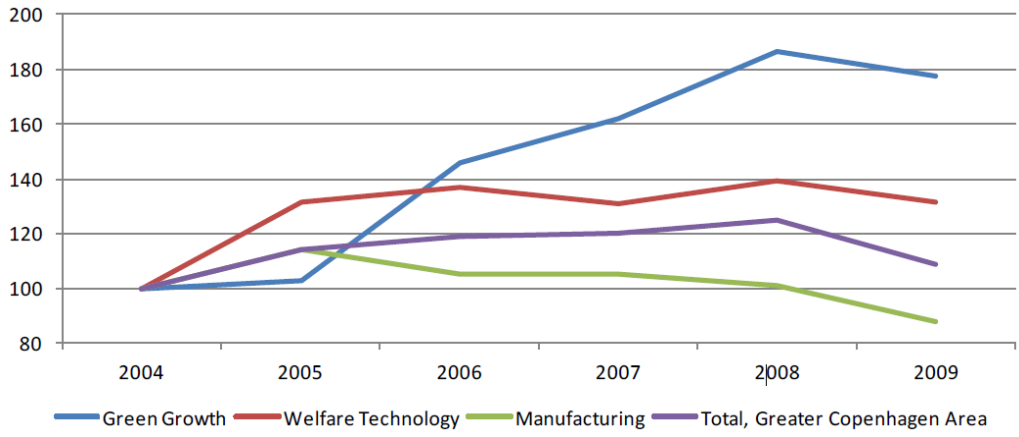
*Source* : Copenhagen Clean-tech Cluster (2012)

**Figure 2-1 Growth rates of turnover in key industries to the Greater Copenhagen Area**




*Source:* DAMVAD (2011) Green growth is defined using the Berkeley Roundtable on the International Economy and the OECD definition of green growth.

**Figure 2-2Export growth on key sectors compared to the Greater Copenhagen area**




*Source:* DAMVAD (2011) Green growth is defined using the Berkeley Roundtable on the International Economy and the OECD definition of green growth.

As illustrated in Table 2.1, green technologies generate revenue for Copenhagen, but also provide the city with a strategic 'green advantage' in one of the fastest growing industries in the world.

**Table 2.1 Growth in turnover in the Capital Region**

| Turnover | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|
| Green Technology | 100 | 127 | 119 | 128 | 162 | 155 |
| Welfare Technology | 100 | 112 | 129 | 145 | 139 | 135 |
| Manufacturing | 100 | 108 | 115 | 111 | 115 | 108 |
| ICT | 100 | 105 | 108 | 129 | 135 | 130 |

1. 2004 is reference year.
Source: Wiking (2011)

## Collaborative approach to cluster creation

Copenhagen has a strong emphasis on collaborative and integrative governance processes involving community, business, government and universities. This triple helix approach has evolved over many years of co-operation and requires a commitment to collaboration processes and inter-sector solutions.

Figure 2.3 outlines some of the governance elements involved in Greater Copenhagen's pathway to a low carbon economy. In reality, this is not a simple hub-and-spoke configuration, as each of these enablers contributes to the whole. And each has empowered the city to develop the competitive advantages required to attract foreign direct investment (FDI), and anchored new export markets.

Copenhagen's governance architecture galvanises partnerships, which is at the heart of Greater Copenhagen municipal co-operation. This enables them to partner closely together across all areas affecting the city: from welfare and housing, to energy, waste management, economic development and attracting FDI. The latter is unique from most cities in the world and is symbolic of an integrated, future-orientated governance structure.

Greater Copenhagen also interfaces with the regional authorities (Denmark has five regions administered by the national government, with one of those being the Copenhagen region – the capital region of Denmark), such as the Væksthus ('Growth house'), which provides extension services to local business. They also have strong project and planning based partnerships with universities, business and national government departments.

Copenhagen hosts the two largest utilities in Denmark: DONG Energy; and Copenhagen Energi. While DONG Energy is the leading actor within energy supply and energy efficiency initiatives, Copenhagen Energy plays a central integrative role in innovation of resource efficiency in energy, waste and water.

Copenhagen Energy supports the Copenhagen climate goal of becoming a CO2-neutral capital by 2025 by focusing on development and testing of future greener supply solutions through an active partnership with not only the municipality, but also with businesses and developers. On the energy side, they work to establish smart energy systems. A foundation of this is the district heating (Copenhagen has 98% supported district heating), which is produced by combined heat and power plants based on biomass and waste. This CHPDH (combined heat and power district heating) is an important power source and a core Danish competence and export product. This system is now being complemented by the introduction of a novel district cooling system in Copenhagen.

On the water side, which is gaining much attention lately due to increasing problems with cloudbursts and flooding in the region, most likely caused by climate change; work is underway to develop an integrated strategy on secondary water and initiating local solutions for utilising rainwater. Copenhagen Energy has, for example, been a pioneer in facilitating household emerging rainwater-recycling technologies; a source that is still prohibited by many Danish municipalities. Maintaining drinking water of a high quality based solely on groundwater usage is a also core priority, and the high quality of the groundwater in the region is illustrated by the fact that this water is only 'simple' cleaned.

In recent years, Copenhagen Energy has established 'delay' basins to ensure that the water quality in Copenhagen harbour is clean enough for swimming. A number of swim basins have been established in Copenhagen harbour, which have become very popular. These basins contribute greatly to the ambience that creates a liveable city in the summer

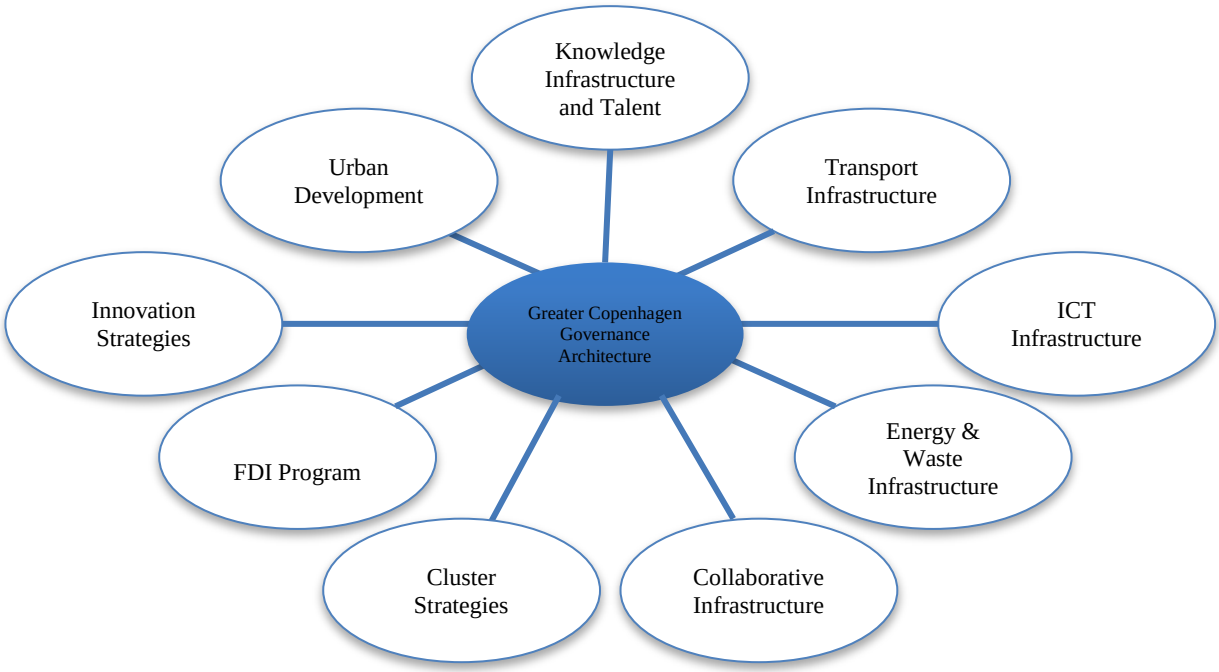
time, and have become an important symbol of the cleanliness of Copenhagen, of which Copenhageners take great pride. This was very evident in the summer of 2012, when the harbour basins had to be closed because flooding caused sewage water to overflow and pollute the harbour water, with Copenhageners demonstrating their awareness and concern about their water.

Copenhagen Energy has also participated in sending delegations to countries such as Brazil and China, and hosting visits from foreign guests. They have also contributed to the Copenhagen Municipality's pamphlet on 'Green solutions', which is used to inform foreign partners.[4] For example:

> In the green district of Nordhavn, Copenhagen Energy is working to introduce smart energy supplies, combining a range of power solutions, i.e. how fluctuating power generation from wind turbines can be integrated with district heating, cogeneration, heat pumps, geothermal heating, and cooling, etc. They do this in partnership with the City of Copenhagen, CPH City & Port, DONG Energy, and the Climate, Housing and Department of Energy. They have also identified a number of projects they work together to realise, such as heat storage, district cooling, low temperature heating, etc. (information sourced from Jörgen Edström, Strategy & Development, Copenhagen Energy 2012).

Hence, the utilities can function both as catalysts for new, and preservers of old, eco-innovations. However, with the growing policy emphasis on local green growth, they are increasingly taking on an enabling role. Realising their importance in this role, an agreement from 2006 committed the Danish electricity, natural gas and oil networks and distributing companies to achieve specific energy saving targets, including carrying out energy efficiency campaigns, with the purpose of influencing consumer behaviour. The utilities are today core actors in energy efficiency activities and innovation, being responsible for more than 50% of the annual energy savings.

**Figure 2-3 Partners in the Clean-tech Cluster development in Copenhagen**




[4] Information provided by Jörgen Edström, Strategy & Development, Copenhagen Energy,

Copenhagen's triple helix approach (government, industry and research) is dynamic in its ability to marshal people, organisations and resources. While many traditional triple helix governance architectures usually undertake partnership activities related to 'co-ordinating', and the more successful ones undertaking 'co-operating', the Greater Copenhagen governance architecture can be defined as 'collaborating'. Modifying an individual organisation's activities in order to collaborate and thus achieve joint goals is a quantum leap – and in Greater Copenhagen's case, one that has been transformative.

Copenhagen seeks, as do several other Danish cities such as Aarhus and Vejle, to adopt a 'smart' approach to urban planning as a new way of meeting the sustainability challenges; seeking to mobilise consumers, institutions and companies in innovative partnerships by advanced used of ICT. This smart thinking seeks to optimise the interaction and integration of existing technical infrastructures and digital solutions. Smart communication via ICT is seen as a link between green technologies, public institutions, private companies and the drive of the consumers towards more sustainable consumption patterns (www.stateofgreen.com/en/press).

## Case Study: Starting a clean-tech cluster from scratch in the Cite des Sciences Belval, Luxembourg[5]

The central focus of the Belval case study was on the re-use of industrial wasteland in Esch-Belval, which is located in the South of Luxembourg and in the core of the Alzette-Belval area. Today, the site of Esch-Belval presents Luxembourg's most ambitious large urban planning project for regional development in the south. Since the turn of the last century, Esch-Belval has been Luxembourg's largest brownfield site, covering an area of approximately 200 ha. 37

Esch-Belval was owned by Arbed, the Luxembourg steel group founded in 1911. In 2002, Arbed merged with the groups Aceralia (Spain) and Usinor (France) in order to form the Arcelor group, which in turn merged with Mittal Steel in 2006 to form today's ArcelorMittal, the world's largest steel producer. In 1997, the last blast-furnace for steel production from ore stopped operations, freeing up a 120-hectare surface area where the blast- furnaces were previously located. The Luxembourg government dedicated the future use of this site to the construction of a Science Park (the 'Cité des Sciences').

ArcelorMittal continues its operations on the adjacent terrain between Esch-Belval and Esch-sur-Alzette, with a factory for electrical steel production and recycling remaining operational on the site. The ArcelorMittal site is not open for public access, so the connections between Esch-Belval and Esch-sur-Alzette have been developed on the Northern and Southern rings of the site. The state government, together with ArcelorMittal, created the public-private company, AGORA, for the development and sale of the 120-hectare large industrial area on the site of Esch-Belval, which was left by ArcelorMittal.

Fonds Belval, a public institution in charge of the construction of all public infrastructure and buildings on the site of Esch-Belval was created in 2002. This includes buildings for public administration, a Rockhall, and the "Cité des Sciences" a science,

[5] This case study is draw from OECD (2013b) (Martinez-Fernandez, C., Sharpe, S.A., Bruyninckx, H. & Konig, A.), 'Green Growth in the Benelux: Indicators of local transition to a low-carbon economy in Cross-Border Regions (OECD Local Economic and Employment Development (LEED) Working Papers, 2013/09)', [prepared for OECD], OECD Publishing, Paris, France, pp. 1-147.

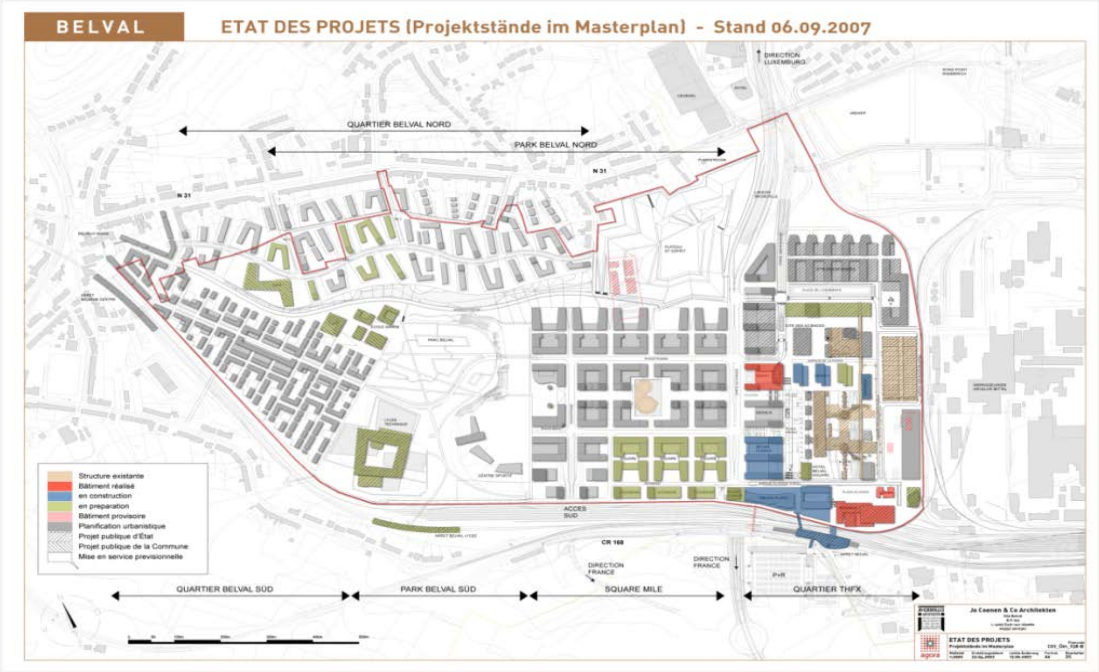
research and innovation park. Figure 2.4 shows a map of the land uses on the site. The main tasks of the Fonds Belval are to draw up detailed construction programmes, conduct feasibility studies, organise architectural competitions, oversee all associated studies and implementation of the building projects, and undertake the financial management and accounting. The development of the "Cité des Sciences" in Esch-Belval was intended to bring research and innovation to this economically deprived area in the South.

The general Master Plan for the Esch-Belval site, which was prepared by the urban planning office 'Joe Coenen' from Maastricht and commissioned by the developer of the entire site, AGORA, is divided into five areas with distinct characters: the Square Mile, Esch-Belval North, Belval South, the Belval Park, and the terrace of the blast-furnaces that will house the "Cité des Sciences". Offices will predominate on the Square Mile, but 20% of the built space will be reserved for apartments, and some space for commercial use. Esch-Belval North provides for more quiet and extensive residential quarters and the more densely settled and lively Belval South foresees spaces for commerce and artisanal activities (see Figure 4.2 Master Plan Belval). Belval Park, covering 33 hectares, connects the residential quarters with the Square Mile, and features a large network of walking and cycling paths, as well as a regional sports complex, and a new school, the Lycée Technique de Sanem.

The fifth area in the Master Plan, the "Cité des Sciences" on the blast furnace terrace, is a flagship project of the Luxembourg government, and is an example of the potential for restructuring industrial wasteland in the south of Luxembourg to foster social and economic development of a region that has long been dependent on the steel industry.

The Fonds Belval will attract both public and private investment. The programme for the "Cité des Sciences" is comprised of plans for: higher education and research; student life; start-up activities; secondary education; public services and administration; and culture, sports and leisure. The total public investment dedicated to the project in 2003 amounted to one billion Euro for all public buildings and the associated infrastructure. The "Cité des Sciences" will be constructed over a 25 year time period and consist of about 25 public buildings on a total surface area of 27 hectares. The Cité will house over 7 000 students as well as 3 000 teachers and researchers. The Terrace will also offer a wide range of opportunities for private enterprises on over 100 000 m2 of built space.

Figure 2-4 Map of the Cite des Sciences




## Green industry development

Central to curbing carbon dioxide (CO2) emissions from industrial activities are plans in Alzette-Belval to promote and leverage eco-technologies for economic development. The main economic activities in the Alzette-Belval area that will benefit from this relate to the construction and renovation sector, but also to recycling and water management. The construction sector has previously flourished thanks to the proximity of the steel industry. Consequently, this sector presents a suitable basis for further development of eco-technologies. Retrofitting of old building stock and changing social practice to improve energy-use will be essential to meet the EU 2020 targets of a 20% reduction of energy-use (compared to 1990 levels). Transportation, and reducing the environmental impact from individual mobility and freight cargo; where possible replacing goods and services from abroad with local products; and recycling practices (e.g. re-use of building materials and establishment of sites for barter) all link in with this field of activity.

## Energy generation for human use, CO2 emissions, and savings measures

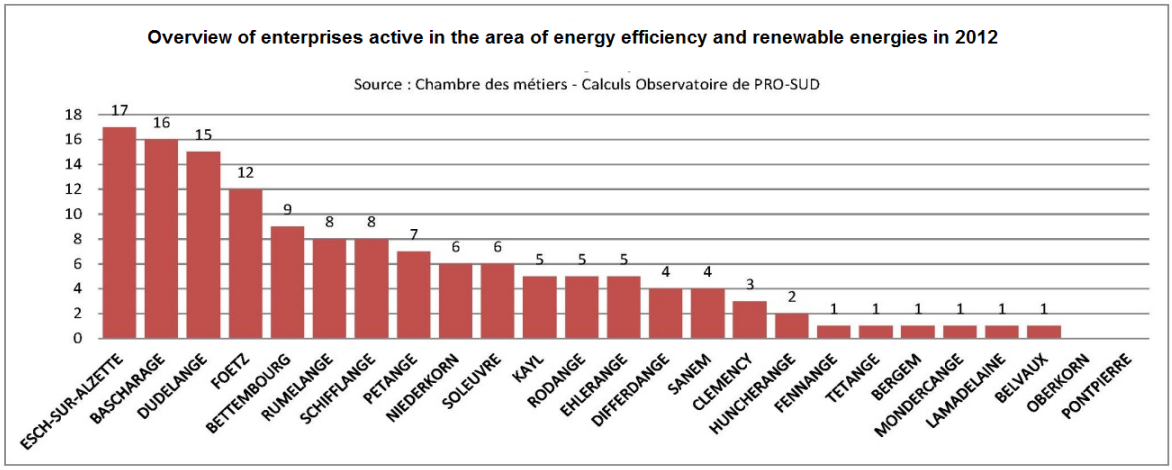
In view of the EU 2020 targets in the area of climate change and energy use, Luxembourg has set the aim of reducing its greenhouse gas (GHG) emissions by 20% compared to levels in 2005 between now and 2020 in the sectors not covered by the European Emissions Trading System (ETS). In the energy field, Luxembourg has committed itself to the following goals: improving energy efficiency by 14.06% by 2016; and sourcing 11% of energy from renewables. The challenge of reducing GHG emissions is at the heart of the work of the "Environment and Climate Partnership", launched in February 2010, which aims to develop the second national action plan for reducing CO2 emissions, accompanied by a national plan for adapting to climate change. Currently (2011), it is estimated that Luxembourg was responsible for just over 12 million tonnes of GHG emissions in CO2 (or 6.2% below their 1990 level).

The following measures were introduced by the government in order to meet the target for increased share of energy consumption from renewable resources: development of renewable energies within the country; addition of biofuels into existing fuels for domestic use; and application of co-operative mechanisms with other member states. In 2011, 2.9% of energy used in Luxembourg was sourced from renewables.[6]

The Alzette-Belval area contributes to this target through Twinerg in Esch-Sur-Alezzte, which is a large combined-cycle gas turbine energy plant that is also able to function on wood pellets, and which co-produces district heating for Esch-Belval through steam production. Twinerg is, however, also a major contributor to GHG emissions in Luxembourg (around 7 to 8% of the total emissions) and in particular within the Alzette-Belval territory. In Schifflange, a biogas combustion plant, MinettKompost, was also recently inaugurated.

Of about 800 firms that are active in the area of renewable energies and energy efficiency, 138 are situated in the south and 30 within the geographic perimeter of this study, as shown in Figure 2.5.

**Figure 2-5 Overview of enterprises active in the area of energy efficiency and renewable energy in 2012**




**Source:** Chambre de métiers – Calculs Observatoire de PRO-SUD

The largest industrial enterprise, consuming the most electricity and resulting in the highest CO2 emissions of any single organisation in the country, is ArcelorMittal. ArcelorMittal has disposed of two sites in the Esch-sur-Alzette area: the production site in Esch-Belval and the research centre in Esch-sur-Alzette (in Belval and Sanem respectively). Steel products including bar steel through to finished beams and sheets are produced on the Esch-Belval site. Steel is one of the most recycled materials in the world and the input at Esch-Belval is 100% steel scrap. Electro-steel production requires carbon electrodes (the devices that produce the arcs within the electric arc furnace), which both consume and produce CO/CO2. Each tonne of steel produced currently results in 2.15 tonnes of CO2 emissions. Approximately 12% more scrap steel needs to be charged in order to produce one tonne of liquid steel i.e. total input is approximately 1.12 tonnes of steel scrap per tonne of liquid steel produced. This is because some iron is lost to slag and dust. Primary liquid iron production (using blast furnaces) is already very close to the physical-chemical limit of the production process (the energy and carbon input required to chemically reduce metal oxides to pure form). This means that large efficiency gains are no longer expected.

[6] Share calculated according to Directive 2009/28/EC

However, during the production and finishing processes, when the liquid steel is turned into more advanced products, there are still areas in which energy recovery can be improved, for instance, by using energy by-products to provide district heating instead of simply burning the residual gas from the coking, sintering and blast furnace processes (although it should be noted that there is already significant progress in this area). Recently in Dillingen (Germany), a power plant has been built that should be able to recover much of the energy from these gases and furnaces, which can then be used for power and heat generation. Also, the composition of the emitted gases is much better than is the case when the gas is simply burned off. However, because this plant is a recent development, it is subject to stricter new EU regulations, requiring the purchase of large numbers of emission certificates for the plant. Thus, while strategies to recover heat and energy, improve air quality, and provide district heating are being implemented, some existing laws are discouraging these efforts.

The activities of the ArcelorMittal Esch-sur-Alzette research centre concern both process and product development, and are dedicated to structurally long-term products. Research subjects include the development of:

- Advanced tools (measurement equipment and models) for intelligent and sustainable production.
- New applications for steel, including new products and technical solutions for easily using steel in construction, in an economic and sustainable way.
- User-friendly software for pre-design to allow engineering offices and architects to more easily use steel in their designs.
- Means to influence international codes and knowledge dissemination through real-life applications, through partnerships with engineering offices and architects.

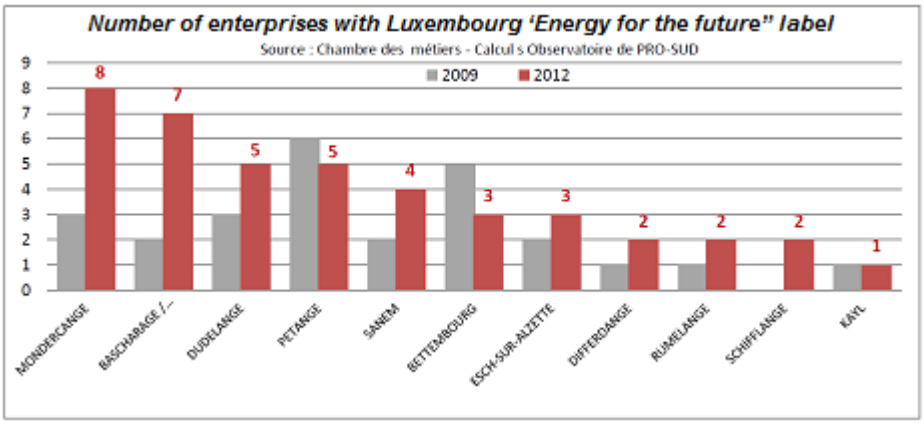
As an international company with industrial operations in more than 20 countries, the company recognises the impact that climate change has on many regions in which it works. They are fully engaged in global efforts to reduce CO2 emissions and mitigate their impact. Their target is to reduce CO2 emissions by 170 kg per tonne of steel by 2020, equivalent to an 8% reduction in normalised emissions from the 2007 baseline.[7] Satellite businesses related to steel-based construction have been formed, which are discussed in the subsequent section.

In order to promote organisational energy-savings schemes, the Chamber of Trades ("Chambre des Métiers") has their own label, 'Energie fir d'Zukunft.[8] The label recognises companies that have acquired the necessary skills as having completed a course of training focused on renewable energies and energy efficiency.9 The label enables customers to easily identify companies specialising in renewable energy sources. It also implies that the firm provides advice and guidance in the selection and installation of their equipment and provides work according to specifications designed to ensure optimum efficiency in the rational use of energy.

[7] http://www.arcelormittal.com/corp/corporate-responsibility/environment/climate-change
[7] http://www.arcelormittal.com/frydek-mistek/pdf/AM_Enviro_Brochure_en.pdf
[8] http://www.cdm.lu/entreprise/conseils-aux-entreprises/exploitation-environnement-energie/energie-et-developpement-durable-pour-particuliers
[9] http://www.cdm.lu/entreprise/conseils-aux-entreprises/exploitation-environnement-energie/energie-et-developpement-durable-pour particuliers.

The Chamber organises specific training modules on development of renewable energy and energy efficiency. This is designed not only to familiarise participants with the support system provided to enable a marketing approach to the individuals concerned, but also to upgrade the participants in the various technological developments of renewable energy sources and energy performance. Of a total of 169 Luxembourg organisations with this label, 15% are situated in the south, and in 2012, seventeen enterprises were certified within the geographic perimeter of this study. Figure 3.6 shows the comparison distribution of labelled enterprises among southern municipalities in 2009 and 2012.

**Figure 2-6 Number of enterprises with the Luxembourg 'Energy for the Futre' label**




Source: PRO-SUD, Indices du Sud 2009 - 2012

## The new role of research and innovation for green industrial development

The "Cité de Sciences" will provide facilities for a large part of the University of Luxembourg, three Public Research Centres - the CRP Gabriel Lippmann, CRP Henri Tudor (who have just committed to a merger in 2016), and the CEPS/INSTEAD (Centre for Studies on Populations, Poverty and Socio-Economic Policies) - as well as a range of other public services such as national archives, a music auditorium, and a national centre for industrial culture. The National Research Fund (Fonds National de la Recherche) authority will also move to Esch-Belval. A predictive exercise informing research priorities, posits research on sustainable resources use in Luxembourg as one of five principal research axes in Luxembourg. Two key priorities within the sustainable resources domain are the sustainable use of energy and also of water. In 2011, the National Research Fund has dedicated 5.4 million Euro in support of research projects in this area.

Table 2.2 provides an overview of all Luxembourg public research institutes and units pursuing research relating to eco-technologies and services, all of which will be clustered on the previous blast-furnace terrace. Most moves are planned to begin in 2014. Some outposts, such as the CRTE, are already in Esch-sur-Alzette, and the CRP Gabriel Lippmann and the Photovoltaic Laboratory (LPV) are already in Esch-Belval. Other research institutes, notably the University and the CEPS/INSTEAD, are also undertaking research that is pertinent to urban and regional development, particularly the development of a sustainable transport network and practices. The University IPSE GEO LAB and the City of Esch-sur-Alzette are also developing an 'Observatoire Belval', which sets out to collect data concerning the question of how the "Cité des Sciences" might affect regional development.

**Table 2.2: Public research institutes pursuing research relating to eco-technologies in 2009 that are already or will be moved to the Cites des Sciences in Esch-Belval**

| Research institutes | Principal competencies related to eco-technologies |
|---|---|
| CRTE – Centre de Ressources des Technologies de l'Environnement (CRP Henri Tudor) | Energy management; renewable energies; sustainable development; eco-conception; eco-construction; sustainable water management; multi-criteria evaluation; Clean-technologies and process engineering; environmental modelling. |
| EVA – Environment and Agro-Biotechnologies (CRP Gabriel Lippmann) | Water; air and soil pollution; renewable energies; ecology; agriculture; waste management; sustainable management of aquatic and terrestrial ecosystem; biotechnologies' application to the agricultural and forest sectors; sustainable land management. |
| CRTIB – Centre de Ressources des Technologies de l'Information pour le Bâtiment (CRP Henri Tudor) | Eco-construction; sustainable development; eco-conception; ICT. |
| ESRU – Engineering Science Research Unit (University of Luxembourg) | Construction and design; energy; renewable energies; environment; automation and mechatronics; development of technological solutions; sustainable use of resources; centre for expertise. |
| IPSE – Unité de Recherche Identités, Politiques, Sociétés, Espaces (University of Luxembourg) | Spatial planning; environmental and economic geography; spatial modelling; urban studies; mobility |
| LPV – Photovoltaic Laboratory (University of Luxembourg) | Renewable energies (photovoltaic systems) |

A challenge will be to develop research and education activities that effectively contribute to the transition to a low-carbon society in the Alzette-Belval area. The University of Luxembourg has a strategic action plan for sustainable development, and is a signatory of the Charter of the International Sustainable Campus Network.[10] The Cell for Sustainable Development has proposed a research project developing social learning processes with local organisations to improve energy-use in highly serviced buildings. One of two main research sites could be in the building of the new Luxembourg Centre for Systems Biomedicine in Esch-Belval. This type of project can also serve as a basis for developing education and training tools and services.

A preliminary requisite is for research that takes account of complex situations in which the prime interest is how human actions affect the material world and its environmental flows. Locally adapted knowledge to address complex local challenges is essential in order to develop more socially robust problem framings than just one or two disciplinary lenses. Interdisciplinary research is needed, to engage natural and social scientists and practitioners in order to characterise and develop solutions in an iterative manner over time. It is therefore proposed to organise events by public research organisations that involve developing participatory process scenarios of "Visions for the future". The other key measures are:

- Keeping track of research projects involving diverse research organisations, other public and private stakeholders and organised civil society;

[10] http://wwwen.uni.lu/sustainability

- Establish databases with monitoring data on adoption of eco-technologies or social change relating to transition; or

- A web-based platform through which citizens and other stakeholders actively learn and engage in complex problem solving by providing feedback on social practice and change as well as suggested solutions. The number of research projects with partners from the Greater Region is an interesting cross-border implication variable.

Also, having a meaningful number of companies in the eco-technology and service sector is important for the transition to a low-carbon society, and dynamics on the number of companies created and closed down per year provide a picture of the number of viable and applicable innovations. Open source co-creative projects are deemed just as important to count as projects that yield patents, as they reflect new attitudes to property and sharing. Again, the share of revenues in eco-technology companies derived from providing services or selling products in the Greater Region is of interest in assessing cross-border developmental dynamics.

## Summary

This chapter has shown two examples of Clean-technology clusters. The examples show different ends of the spectrum in terms of cluster formation, with the Copenhagen Clean-tech cluster well-established and much of the necessary specialisation institutions needed to foster cluster growth over time in place. The Belval Cite des Sciences is still in the early stages of development and institutional development is in very nascent stages.

### Lessons for other local areas on supporting clean industry cluster development

The situation of each local area will be different and this makes it difficult to give prescriptive policy advice from specific case studies. In the process of researching the Copenhagen and Belval case studies a number of policy implications were highlighted and recommendations developed. Some of these recommendations were targeted at the specific institutions and environment of the case, but others had relevance more broadly. The themes of the broader recommendations can be summarised into four points.

#### *Invest in capacity for greening jobs, skills and entrepreneurship*

A transition to a low-carbon economy will not be possible without accompanying labour market measures for workforce skill upgrading. At the same time, and as labour markets are ageing and shrinking, those that are not able to develop 21st century skills are at a higher risk of being left behind and not able to benefit from the new opportunities that green growth offers. A first step in this process is identifying metrics and collecting data that can inform future activities.

While there are several pathways to adjust the workforce to low-carbon economic activities, local areas can take advantage of the existing clean-tech companies to strengthen research co- operation with universities and/or increase their involvement with the cluster's activities.

At the same time that formal university-business collaborations are established, other forms of green skills development can be facilitated through informal knowledge intensive activities. Universities, training institutions, trade unions and business organizations can introduce specific instruments related to green entrepreneurship, encouraging new entrepreneurs to interact with the clean- tech companies through dedicated networking events as a way to stimulate innovation and new business alliances.

Local institutions can help with this focus towards developing green skills by focusing on environmental policies and procedures in order to keep local demand for green development ahead of the international curve. Green public procurement, for example, can be a significant instrument for the local Small and Medium Sized Enterprises (SMEs) providing products and services, influencing the knowledge and skills of their employees to compete for public contracting.

### *Strengthen cross-sector linkages to connect global and local firms*

Place and community space are important for connecting and mobilising activities between core clean-tech companies and other industries and services such as engineering and smart integration manufacturing companies, finance and marketing, and scientific companies. Generating and reinforcing such connections will allow clean-tech firms to maximise the competitive advantages the cluster offers.

### *Supporting green industries and emerging markets*

The transition to a low-carbon economy will see the emergence of new industries and new markets for green products and services. These represent opportunities for firms to grow and develop. However, the process of innovating and commercialising new products in an emerging market is a perilous journey – when customers are not familiar with the unique features of the product, or if the product requires setting a premium price compared to other similar products (even if it performs to a higher standard of efficiency), it can be hard for market penetration to occur.

The risks in this process are higher for small and medium sized firms (SMEs), because they lack the same level of internal resources that large firms have available to support the innovation process. However, as established through the analysis of innovative firms over many years, it is exactly these SMEs who are most likely to be the highly innovative firms, and who seek to introduce new products and processes.

Public policy can play, and indeed does play, a role in the support of these new markets. The most prevalent and effective forms of support to date have been shown to be through government's using their regulatory powers to increase the efficiency standards and emissions reduction requirements of energy, buildings, cars, household appliances, etc. as well as promoting the attractiveness of renewable energy. Public policy can also play a role in supporting new green markets through public procurement. This is where governments act as first, large and/or non-narrow price sensitive customers for new green services and products.

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# 3. Monitoring green growth in cross-border regions

*Abstract*
*Cross-border areas are becoming increasingly important as economic agents, however transition to green growth represents some specific challenges for these regions, including coordination of policy intent and measures across borders and the alignment of labour and skills supply and demand in these areas. In areas such as the European Union where markets, including labour markets are no longer affected by the jurisdictional boundaries of national borders, how does such a diverse institutional setting encourage green growth? This chapter investigates these issues and the emergent policy implications.*

Decarbonising the economic and production systems of the world will have positive impacts in combination, but at a disaggregated level there will be winners and losers. It is essential to understand these differential impacts on local areas so as to ensure they can be best equipped to effectively make the transition and to minimise negative impacts, particularly on the local labour markets.

Cross-border regions, such as the two investigated in this report, have additional levels of complexity when it comes to measuring and monitoring their low-carbon transition. Understanding the dimensions of this complexity and the structure and institutions that are available to help find a path to progress through this complexity is essential for transition in cross-border regions.

The cross-border character of the Benelux region also provides a challenge in data collection. Cross-border regions hardly ever coincide with any single data gathering 'institution'. Moreover, Belgium (Flanders, Brussels, Wallonia), the Netherlands, and Luxembourg have different indicator systems at the national level, and even more so at the more decentralised level. This creates problems of data availability, data (in) consistency, and hence comparability, making it difficult to compose reliable and useful indicator sets at the cross-border region level, and even more problematic to compare various regional dynamics.

There are also the challenges of developing and monitoring low-carbon transitions that exist for all regions, such as building recognition of the importance of indicators into the work and practice of local authorities, and identifying and resourcing appropriate institutions to carry out the collection and reporting of data. Even before one reaches this stage, there is the preliminary challenge of developing appropriate and consistent methodologies for defining and measuring new concepts like green skills and green jobs. It is in addressing this first challenge that the OECD green growth indicator set offers some solutions. Through this research, and that of similar case studies in Copenhagen, Denmark; Berlin, Germany; and Santiago, Chile, the OECD is contributing further to the introduction of metrics that will assist in the measurement of green growth. In addressing the second challenge, this report of two specific cross-border regions in the Benelux offers guidance and highlights policy implications relevant to other Benelux and cross-border regions.

The longitudinal nature of LCE transition means achieving green growth will take decades, and as statistical collections take a long time to develop, the early commencement of the vital work of setting boundaries and initiating actions will help to accelerate the process of developing these metrics.

Local and regional dynamics are essential for green growth and LCE strategies in the cross-border regions. There are several reasons for this:

- The local level is often the level at which broader national LCE policies are concretised, implemented and also (partially) financed.

- Cluster-approaches to industrial (eco-)innovations are often strongly embedded in local approaches towards economic development or conversion. They built on local assets, make use of local resources and have an immediate impact on, or links with local knowledge institutions, local labour markets, etc.

- National or international green growth strategies are often linked to local dynamics such as carbon neutral urban or regional development strategies, or the development and support of local economic growth clusters

Typically, densely populated regions and also regions of relatively 'small' countries have cross-border characteristics existing in their local or regional dynamics. This is certainly the case for most European. Logistical networks, which are crucial for economic performance and competitiveness, also link vital regions in cross-border areas. Railroad systems, inland waterways, coastal transport systems, and highways are essential for the continued linkages between countries. For example, the port region of Antwerp-Zeebrugge-Ghent-Rotterdam. In addition, the cross-boundary character includes metropolitan networks linking Belgium and the Netherlands to the German Ruhrgebiet.

Another example, is the axis that connects Kortrijk (Belgium) to the French metropolitan area of Lille, Roubaix in Nord-Pas-de-Calais. The industrial performance of Luxembourg cannot be fully understood without knowledge of its cross-border connections to the Belgian, German and especially French industrial heartland that surrounds Luxembourg. In fact, it is realistic to say that cross-border dynamics are, and have been, an essential element of the socio-economic functioning of the Benelux countries for centuries.

It would be atypical and unconvincing to conceptualise or approach the transition towards a LCE and the dynamics of green growth in a way that does not recognise the essential dynamics of cross-border interactions. Policy instruments and strategies in the region in fact often support the cross-border considerations, e.g. EU funding for cross-border development such as INTERREG (an initiative designed to stimulate co-operation between EU regions) projects; or initiatives designed to facilitate cross-border exchanges and economic co-operation. Cross-border processes of economic activity and strategic development are therefore an essential part of green growth for the Benelux countries.

## Measuring cross-border green growth: additional challenges

Measuring and monitoring local cross-border projects and dynamics can be a complex and difficult process. An important reason for this complexity is that, more often than not, very little attention has been paid in the early planning and conceptualisation stages of projects to the need for indicators to monitor the co-operative projects. If performance indicators have been part of the project's design at all, they are most often limited to the more traditional indicators of economic performance, and not to the 'green' or low-carbon characteristics of cross-border projects and processes.

A second, more pragmatic reason for the lack of indicators is that skills in measuring, monitoring and establishing indicators at the local level are often very poorly developed; even in highly developed and affluent regions. Indicator use presupposes data gathering capacity, longitudinal efforts, and much instutionalisation; meaning that indicators

need to become part and parcel of policy processes and the regular practices of bureaucracies, public agencies and private actors alike. Since this is not yet the case, few reliable and robust indicators exist at the local level.

The cross-border character of the region adds another level of complexity to indicator development. Cross-border regions or geographic circumscriptions hardly ever coincide with any single data gathering 'institution'. Moreover, Belgium (Flanders, Brussels, Wallonia), the Netherlands, and Luxembourg have different indicator systems at the national level, and even more so at the more decentralised level. This creates problems of data availability, data (in) consistency, and hence comparability, making it difficult to compose reliable and useful indicator sets at the cross-border region level, and even more problematic to compare various regional dynamics.

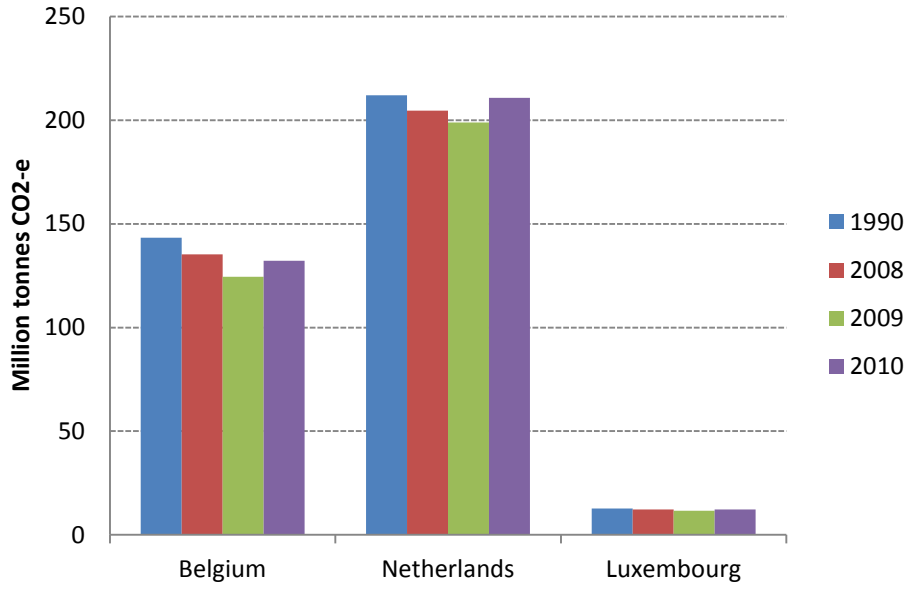
## Case study: Indicator development in the cross-border region of the Benelux Union[11]

The countries within the Benelux Union; Belgium, Luxembourg and the Netherlands; highlight the challenges that individual countries face in working to decarbonise their economies. Each has high emissions profiles that have only declined slightly from 1990 levels. This signifies that one of the most essential future challenges for the Benelux countries will be the need to shift from their current high emissions-based development model, to a low emissions-based model. This will necessitate significant changes within key systems that characterise the model of consumption and production in all three countries. Decoupling of economic outputs from carbon-based energy and other greenhouse gas (GHG) emitting energy forms (which are often industry-related) is therefore the path of the future.

As data from the European Environment Agency (EEA, 2012) shows, of the total emissions profiles of each of the countries (see Figure 3.1) the Netherlands has the highest total emissions, at 210 million tonnes per annum in 2010. This figure is only slightly below the 1990 levels of 211 million tonnes of carbon emissions. Next is Belgium, where emissions have declined from 1990 levels of 143 million tonnes to 132.2 million tonnes in 2010. Luxembourg's emissions are only a fraction of its fellow Benelux Union neighbours, at 12.2 million tonnes in 2010, however, this is only slightly below its 1990 levels of 12.8 million tonnes.

[11] This case study is draw from Martinez-Fernandez, C., Sharpe, S.A., Bruyninckx, H. & Konig, A. (2013), 'Green Growth in the Benelux: Indicators of local transition to a low-carbon economy in Cross-Border Regions (OECD Local Economic and Employment Development (LEED) Working Papers, 2013/09)', [prepared for OECD], OECD Publishing, Paris, France, pp. 1-147.

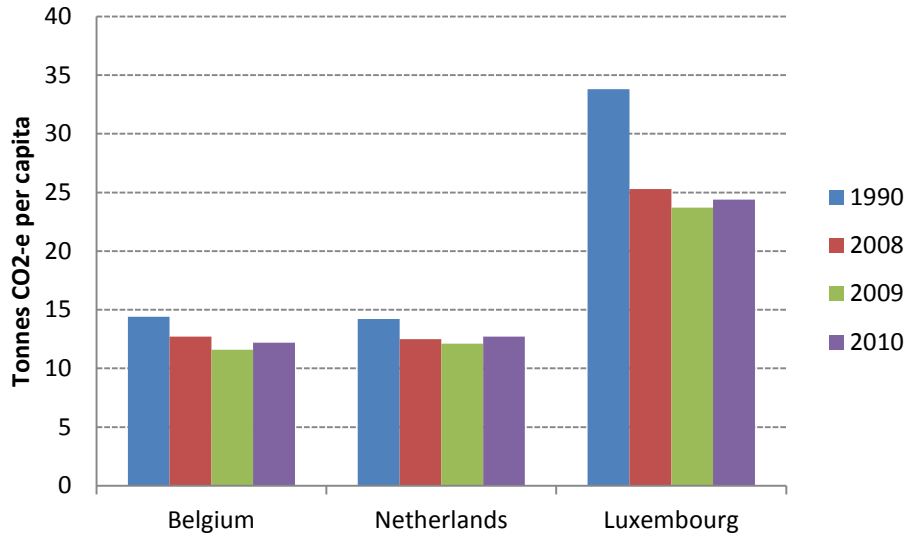
Figure 3-1 Total carbon equivalent emissions in the Benelux countries 1990-2010




Source: European Environment Agency, 2012

However, the emissions profiles look completely different when compared on a per capita basis. As Figure 2.1 also shows, Luxembourg is ranked 24th out of 27 European Union countries for its carbon emissions, whereas the Netherlands is ranked 7th, and Belgium 10th. Figure 3.2 shows the per capita emissions over the same time period (1990-2010). Luxembourg's per capita emissions are well above those of the Netherlands and Belgium, but there were significant reductions in the period between 1990 and 2008 (it should be noted, however, that the high level of per capita emissions is partly due to the fact that road fuel sales to non-residents accounted for more than 40% of the total GHG emissions for Luxembourg).

Figure 3-2 Per capita carbon emissions in the Benelux Union 1990-2010




Source: European Environment Agency, 2012

The Benelux countries share more than the carbon intensity of their economies. All three countries are densely populated, highly urbanised, have very dense logistical networks, have witnessed an economic shift from a mainly industrial society to a post-industrial, service

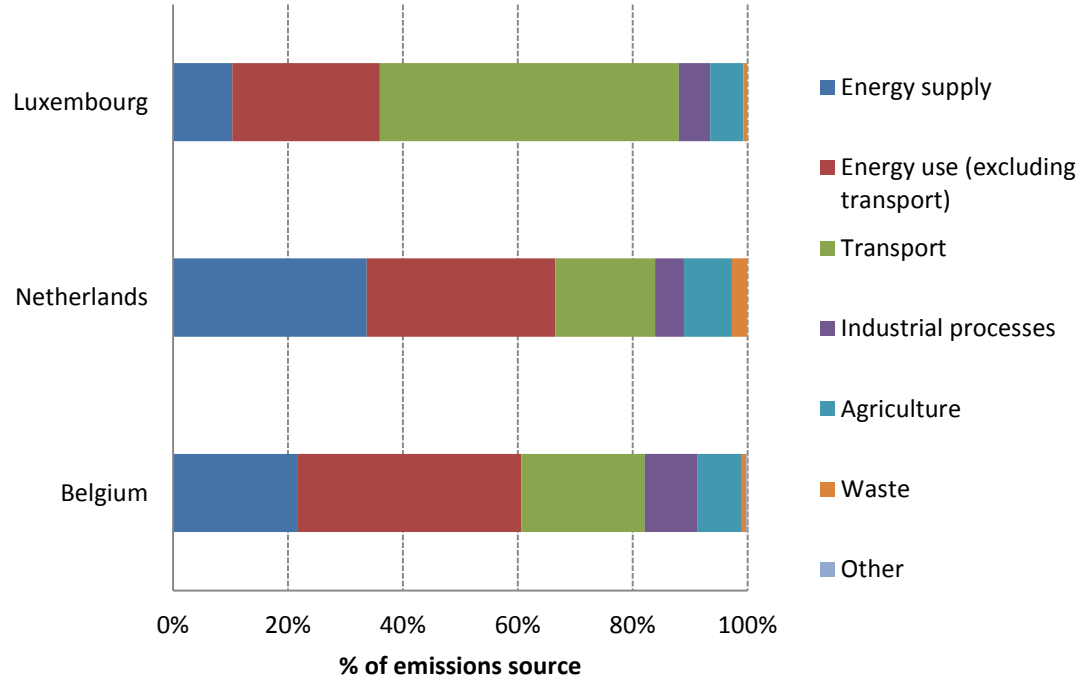
oriented society (however, still with significant heavy industries and industrial production capacity).

Belgium, the Netherlands and Luxembourg also have a very important logistical transit function. The importance of the transport links to Luxembourg can be seen in Figure 2.3, which presents a breakdown of 2010 emissions by source. In Luxembourg in 2010, transport sourced emissions make up more than half (52%) of the total emissions. The high levels of transport emissions are closely associated with a phenomenon known as 'tank tourism'; cars travelling into Luxembourg for fuel.

The Dutch and Belgian seaports (Antwerp, Zeebrugge, Oostend, Ghent, Brussels, Terneuzen, Vlissingen, Rotterdam and Amsterdam) are hubs of European and global significance. They are connected to the European hinterland through an elaborate system of railroads, highways and inland waterways (the densest network of inland navigation in the world). The main international airports of Amsterdam's Schiphol, Brussels' Zaventem, and Luxembourg also serve as hubs for passengers and goods.

It is important to understand the strong cross-border nature of the Benelux member countries' economies. They are strongly intertwined not only with each other, but also with other neighbouring countries. These interconnections find strong expression in regional connections with, for example, the German Ruhrgebiet and the northern French region of Nord-Pas-de-Calais, or the northern French industrial area of Lorraine. In essence, this means that the transition towards a low-carbon economy (LCE) or green growth is intimately connected to the position of Belgium, the Netherlands and Luxembourg within essential networks of economic value creation.

**Figure 3-3 Emissions by source in the Benelux Union 2010**




Source: European Environment Agency, 2012

The shift towards the green economy in the Benelux countries is also strongly linked to other regional elements, of which just a few are named here. The relatively highly educated workforce opens up opportunities for high end, technological and innovation driven

green breakthroughs. The high labour cost per unit, compared to many other OECD or EU countries (and certainly the emerging economies) underlines the necessity of focusing on technological innovation. The specific regional dimensions of climate impact can also be seen as a driving force for specialisation and competitiveness. Belgium and the Netherlands in particular, which are jointly labelled 'The Low Countries', are vulnerable to climate change and can benefit from specific innovation agendas, driven by 'adaptation technology and knowledge' (knowledge and technologies that specifically develop from the need to adapt to climate change rather than just engage in mitigation activities).

In terms of public and private investments in research and development, the Benelux member countries are not near the very top compared to other OECD member states, but instead are situated within the next echelon.[12] The three countries have very good university and research institute systems, and also very significant private sector research and development (R&D) capacities. But compared to the absolute frontrunners such as the Scandinavian countries, there has been less of an explicit link between strong R&D policies and green economic transitions. This leaves room for better policy formulation and coherence between research and development programmes and green growth strategies.

This chapter has been concerned with providing context from the Benelux Union and the two regions that are case study scenarios within this report. The immediate policy implications in each of the two cases, which are likely to also be relevant to other cross-border areas within the Benelux Union, are the additional pressures and complexity that cross-border regions face in the low-carbon transition. These include language barriers, lower education levels among foreign workers, and the need for training to develop new skills required for green growth development.

This cross-border challenge is especially evident when seeking to gather and interpret data on green growth for policy development at the various jurisdictional levels, in order to deliver green growth outcomes to the people and businesses in these cross-border regions.

Another implication is related to the use of green growth as a revitalization strategy in peripheral areas of decline, and monitoring the results in terms of policy effectiveness. One such mechanism could be to stimulate the private sector much more with policy instruments that support small-medium enterprises (SMEs) in order for the area to be sustainable to meet the needs of the population density across borders.

However, consideration should also be given to the significant synergies that can be gained from cross-border co-operation in developing and expanding training schemes. To this end, policy planning related to training and skills development should rely on participatory processes, closely coordinated with existing public and private social partners.

## Existing cross-border initiatives

There are several positive and inspiring examples of local low-carbon or green growth initiatives in the Benelux countries. These range across the full spectrum from fully fledged integrated action plans (e.g. Louvain climate neutral in Belgium, or Nijmegen climate neutral in the Netherlands) to a focus on one aspect of the low-carbon transition, such as innovative climate neighbourhood projects, energy towns and sustainable industrial zones. There are so many in fact, that it is impossible here to provide a comprehensive overview, but noted some illustrative examples are noted below.

[12] OECD (2011) Science and Technology Scoreboard, OECD: Paris

### *The European Covenant of Mayors*

This is one of the most visible low-carbon processes at the local level, and has almost 4 400 signatories, who have pledged that they will contribute at the local or regional level to reach the GHG emission reduction and renewable energy targets of the EU. The 4 400 signatories represent more than 160 million inhabitants. The Covenant in and of itself has created a focal point for local ambitions around low-carbon development and green growth.

Most of the municipalities or other local actors have stated political goals that go much further than the official 20-20-20 goals of the EU. The participants pledge that they will formulate and execute a Sustainable Energy Action Plan (SEAP). The signatories represent cities ranging in size from small villages to major metropolitan areas such as London or Paris, who have signed the Covenant of Mayors on a voluntary basis, and who are committed to implementing sustainable energy policies designed to meet or exceed the EU 20% carbon dioxide reduction objective through increased energy efficiency and development of renewable energy sources. The cities are free to choose the format of their SEAP, as long as it is in line with the general principles set out in the Covenant SEAP guidelines.

Belgium has 62 signatories, the Netherlands 17, and Luxemburg 2. Many of the larger cities (Antwerp, Ghent, Luxemburg, Amsterdam, and Rotterdam) are members, and are developing or already implementing local strategies. There is much detail available on the Covenant's website (http://www.burgemeestersconvenant.eu) about individual cities or provinces, the plans they have submitted, aggregate scores at the country level, however, there are no indicators that allow for meaningful comparison or evaluation of these 4 400 different local processes and policy ambitions, thus illustrating the very real need for more structured information gathering and indicator development.

In addition to the Covenant of Mayors, there are other local examples of green growth processes in the Benelux. The seaports of Antwerp, Rotterdam and Amsterdam, for example, have also engaged in low-carbon plans, in recognition that the recent attention on GHG emissions in the maritime sector (the so-called bunkers), pose serious challenges to their core business. Additionally, public housing corporations are building low-carbon neighbourhoods, and universities are stimulating networks of eco-innovation. Two examples of specific low-carbon initiatives in the cities of Ghent and Leuven are provided in the next scetion.

The city of Ghent, in particular, collects an enormous amount of data. As a signatory of the Covenant of Mayors, Ghent aims to become a sustainable city and to be seen to be such. Currently, the city is focusing on winning the European Green Capital Award 2014, and its application necessitated monitoring of many environmental statistics (Mercy, 2012). Relevant statistic information is given at a city-level on its website http://www.gent.be/gentincijfers/ (Verhassels, 2012). Ghent also has a "milieubarometer" to annually measure several indicators such as carbon dioxide emissions, energy use, domestic waste collection, and air, soil and water quality (City of Ghent, 2012). Despite these records, however, the Ghent environmental agency stated that there are insufficient indicators for green economy and innovation. The reason for this is that these are relatively new domains to measure at the city level. Ghent, because of its knowledge intensive urban reconversion, and its link to the industrial potential for eco-innovation, is very keen to develop indicators that will enable it to measure innovations in the future (Mercy, 2012).

### *Leuven Climate Neutral*[13]

In May 2012, the City of Leuven stated its ambition to become climate neutral by 2030. This high ambition was embedded in a long-term action program called 'Leuven Climate Neutral'.

The political initiative draws on the rich resources of the city of Leuven:

A major research University and Engineering School, with competences in nearly all major areas of eco-technology and innovation, business modelling, participatory methods, scenario building, etc. In fact, the University of Leuven plays an essential role in Flanders and Belgium in providing the knowledge base for the transition to the LCE and Green Growth strategies. It also connects the city to a European and even global network of knowledge institutions.

The presence of a number of very ambitious, significant economic players including the INBEV brewery group, which is the largest brewery group in the world, is headquartered in Leuven. IMEC, which is the largest independent computer chip developer in Europe and which co-operates with all the major ICT companies in the world is also based here. In addition to these major players, Leuven is host to dozens of important high technology, eco-innovation and Clean-technology spin-off companies.

The city of Leuven has a very strong and well developed network of civil society organisations. The program also explicitly involves local non-government organisations, social-economy networks, etc.

The program is translated into working groups consisting of a mix of the above-mentioned groups. Besides the network and process dimensions, Leuven Climate Neutral is also strongly evidence based. A base-measurement of the city's actual GHG emissions, which was undertaken by a specialised consulting firm in co-operation with the university and the Flemish Institute for Technology Development (VITO), provided sounds scientific knowledge and indicators. These are deemed important not only for following up and measuring success (or failure), but also as tools by which to communicate problems, ambitions and success to the local stakeholders.

Linked to this lofty ambition is the very broad scope and encompassing nature of the program. In order to reach climate neutrality, all aspects of the production and consumption habits of the inhabitants and the economic actors will need to be part of the essential transition towards climate neutrality.

### *Ghent's urban innovation path*[14]

The city of Ghent (about 250 000 in habitants) is an older medieval city with very high population density, a major urban industrial past (textiles and other 19th and early 20th century industries), and significant urban conversion challenges, as many of the neighbourhoods are not adapted to sustainable urban patterns of development.

The city of Ghent therefore embarked on a path of urban conversion and sustainability about 10 years ago. Some of the major initiatives taken include restructuring the old inner city

[13] Source: http://www.leuven.be/leven/klimaatneutraal/

[14] Sources: http://www.gent.be/eCache/THE/4/165.html; http://www.gent.be/eCache/WRA/91/009.html

into a zone with very low car mobility. The shift towards a model based on pedestrians, bicyclists and public transportation has fundamentally changed the outlook, feeling and quality of life of the city.

The city has co-operated closely with the University of Ghent on several key aspects of this process. The university has an excellent tradition in the areas of urban planning, eco-technology, and sustainable development. The Centre for Sustainable Development has been a frontrunner in Belgium in the development of indicators for urban sustainability, with a strong emphasis on robust quantification and the processes behind indicator development. This has resulted in the 'Stadsmonitor' or 'Urban Monitor' of sustainability, which has been used by the city to monitor its processes since 2007.

The Monitor consists of 200 indicators, measuring:

- the quality of life in the city; and
- the sustainability of the city's development.

Besides Ghent, other Flemish cities use the monitor, including Antwerp, Brugge, Brussels, Gent, Hasselt, Kortrijk, Leuven, Mechelen, and Ostend.

Ghent has also chosen to follow a path of low-carbon conversion for old neighbourhoods. A striking example is the 'Gasmeterlaan site' which is an old brown-field site in the middle of the town. It was originally used for natural gas storage and other industrial facilities, which caused major soil pollution. The site will be redeveloped over the next decade, and turned into a low-carbon neighbourhood, with more than 500 houses and apartments, a park, facilities such as 'car sharing', cultural and educational facilities, etc. During the project conceptualisation, sustainability and low-carbon potential were essential elements in the formulation of the master plan and the requirements for developers.

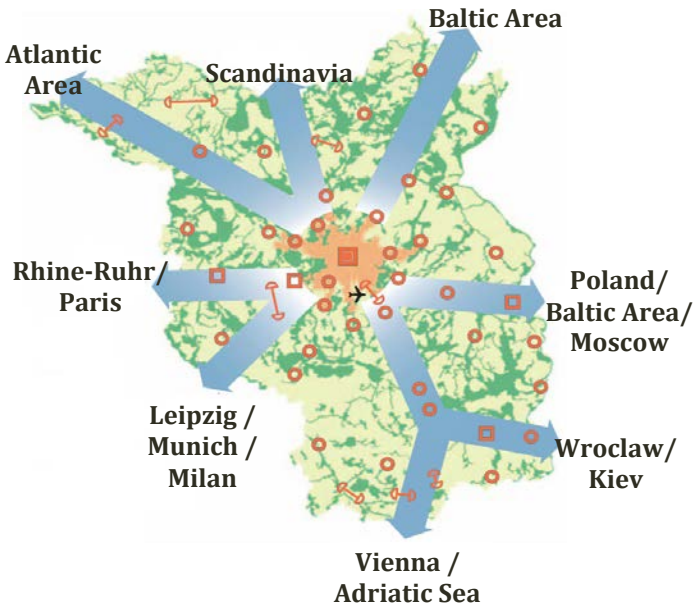
When this neighborhood is completed it will be the largest of its kind in Belgium and undoubtedly an example for urban conversion.

## Case study Berlin, Brandenburg and cross-border infrastructure assets[15]

The Regional Growth Core Schönefelder Kreuz is located in a central position in the Federal State of Brandenburg. In terms of infrastructure, the Schönefelder Kreuz is in the middle of several important transnational traffic and transport corridors (see Figure 3.4). The Berlin-Brandenburg region has 856 km of motorways at its disposal, 2 000 km of waterways and 3 400 rail kilometres in all directions. All important European markets are a lorry day trip from the region (German Capital Region, 2012a).

[15] The case study is drawn from Martinez-Fernandez, C., Sharpe, S.A., Haack, B. (2013), 'Green Growth in the Brandenburg, Berlin: An Analysis of the Regional Growth Core Schönefelder Kreuz (OECD Local Economic and Employment Development (LEED) Working Papers, 2013/11)', [prepared for OECD], OECD Publishing, Paris, France, pp. 1-124.

Figure 3-4 Transnational traffic and transport corridors




*Source:* BRAVORS, 2009.

Another important element of transport infrastructure in the region is the inland port of Königs Wusterhausen. The port has the capacity to handle 3 million tonnes of cargo per annum making it one of the top twenty harbours in Germany, and the largest in the Federal State of Brandenburg (Statistik Berlin Brandenburg, 2011, pp. 10-19). The Port currently has a daily turnaround of 20 inland watercraft, 200 trucks and 7 trains.

Besides airports and inland ports, the railway is one of the most important transport infrastructures for a modern economy. There are three important cargo turnover facilities in the Metropolitan Region Berlin-Brandenburg. One of them is located near the Schönefelder Kreuz; the brand new Cargo Transport Centre Berlin-South in Großbeeren operated by DB Schenker Logistics. It was opened in January 2012 and is a state-of-the-art facility especially in terms of green growth potential.

As the first plant of DB Schenker, the terminal was equipped with a combination of geothermal energy production and innovative air conditioning technology. The location is heated by a low temperature system. The DB Schenker Company plans to reduce all of their carbon dioxide emissions by more than 20% by the year 2020 (DB Schenker, 2012).

## Industry and technology areas

The industry competence fields in the area includes the priorities of logistics, aeronautical engineering, automotive, media/ ICT and biotechnology/ life sciences, as well as for Wildau and Königs Wusterhausen, metal processing (STK, 2012, p. 38). The industry expertise in the Regional Growth Core Schönefelder Kreuz acts as a catalyst for a wide range of start-ups and new settlements in the region.

Logistics is the largest and fastest growing branch in the Regional Growth Core Schönefelder Kreuz. This is mainly due to the existing logistics facilities in the area, the forthcoming Berlin Brandenburg Airport, many service providers which implement more and more complex logistics solutions in the region and the close connection to the Technical

University of Applied Sciences, Wildau with its R&D activities in logistics (complan, 2010, p. 15).

- Aerospace engineering - This sector is already an important priority sector at the site and will receive further positive impetus through the expansion of the BER Berlin Brandenburg Airport. In addition, the site is marked by more important companies in the State such as MTU and Rolls-Royce Germany and a high density of competent expertise at the site (Fraunhofer Institute PYCO) (complan, 2010, p. 16).

- Automotive - In the RGC Schönefelder Kreuz the automotive branch is very significant, too. The most important driver is Daimler with its factory in Ludwigsfelde – the largest automotive factory in the Federal State of Brandenburg (complan, 2010, p. 17).

- Media - This industry focus is only below average due to the heterogeneous and small-scale corporate structure with different business directions. The proximity to Berlin and the scientific orientation of the Technical University of Applied Sciences, Wildau has positive development prospects (complan, 2010, p. 18).

- Biotechnology and life sciences - A strong profile in the field of bioinformatics o determine biosensors and biosystem engineering, focused on the research orientation of the Technical University of Applied Sciences, Wildau. Numerous small and research-intensive companies that co-operate closely with each other are integrated in the current research landscape that characterises the region (complan, 2010, p. 19).

- Metal processing - Despite a stable and expandable base in the RGC Schönefelder Kreuz (especially in Wildau and Königs Wusterhausen) the metal processing industry makes only a small contribution to the economic structure. There are, however, special skills in the field of heavy machine building, accompanied by application-related research activities at the Technical University of Applied Sciences Wildau. The site is characterized by micro and small enterprises involved in research and development to a considerable degree (complan, 2010, p. 20).

## Exports and imports

At the moment there are not enough statistics about export and import at the Regional Growth Core Schönefelder Kreuz. Therefore the statistics from the Federal State of Brandenburg are used.

In 2011 the export volume of the Federal State of Brandenburg reached a total value of 13.5 billion EUR. According to the Statistical Office of Berlin-Brandenburg this exceeded the value of the previous year by 10.0%. Exports to EU countries amounted to 9.1 billion EUR; representing a rise of 7.7% (Gründungsnetz Brandenburg, 2012; Amt für Statistik Berlin-Brandenburg, 2012). The strongest export customer was France followed by Poland and the United States. In 2011 the main exports from the State of Brandenburg were specialized aircraft with a market share of 17.5% of the total export volume, followed by pharmaceuticals (11.9%), sheet-iron or steel (5.0%) and paper, cardboard, plastics, trucks and special vehicles (Gründungsnetz Brandenburg, 2012; Amt für Statistik Berlin-Brandenburg, 2012).

In 2011 the import volume of the Federal State of Brandenburg reached a total value of 18.5 billion EUR. According to the Statistical Office of Berlin-Brandenburg this exceeded the value of the previous year by 27.9% (Gründungsnetz Brandenburg, 2012; Amt für Statistik Berlin-Brandenburg, 2012). The Russian Federation is the most important importing country with a share of the total import volume in 2011 of 38.3%. It was followed by Poland with a market share of 13.2% and the United Kingdom (5.0%). At the top of the imported goods in the state of Brandenburg were oil and natural gas with a share of the total import volume of 38.5%. Aircraft reached a share of 8.8% (Gründungsnetz Brandenburg, 2012; Amt für Statistik Berlin-Brandenburg, 2012).

The efficient infrastructure of the Regional Growth Core Schönefelder Kreuz is a key advantage for export and trade. Of particular significance here is the BER Berlin Brandenburg Airport, the harbour at Königs Wusterhausen, the motorway system and the railway system.

## Research and development

With the foundation of the Technical University of Applied Sciences, Wildau in 1991, academic teaching and the scientific research and development in Wildau was firmly established. The regional economy and business management benefit directly through close co-operation, attracting young specialists and executives from among the graduates, as well as degree courses tailored to the needs of companies and institutions.

The task of the "TH Wildau Transferstelle" is to initiate technology transfer between the university and the Federal State of Brandenburg companies and to promote relationships between the university and companies. The focus is on small and medium-sized enterprises (SMEs) (complan, 2010, p. 25).

The "Branchentransferstelle Logistik" (BTL) is focused on relationships between companies working in the field of logistics and the University of Applied Sciences, Wildau. Topics are common projects, the development of funding opportunities, and special education programs (complan, 2010, p. 25).

The purpose of the "Service Centre for international Knowledge and Technology Transfer" (SeWiTec) is to carry out discussions between companies and research institutions in terms of support programs for the European Union (complan, 2010, p. 25).

The Fraunhofer Institute for Polymer Materials and Composite PYCO is also present in the area. This Fraunhofer Institute has specialized in the development of high-polymer materials for lightweight construction. Such innovative materials are used particularly in aircraft and vehicle construction.

## Business start-up offers

Two key institutions, which are located in the area surrounding the Technical University of Applied Sciences Wildau Campus are the Technology and Business Incubator (Technologie- und Gründerzentrum, (TGZ) and the Aerospace Technology Centre Schönefelder Kreuz (Zentrum für Luft-und Raumfahrt Schönefelder Kreuz, ZLuR).

Target groups of the Technology and Business Incubator are founders and young entrepreneurs. The focus is not placed on particular sectors. There are currently 28 companies resident in the TGZ. The total number of employees is nearly 150 (complan, 2010, p. 26).

In contrast to the Technology and Business Incubator, the Aerospace Technology Centre Schönefelder Kreuz has a clear focus on companies from the aerospace industry. Approximately 15 enterprises are located in three modern buildings. One important example is the BBAT AG (Berlin Brandenburg Aerospace Technology Public Company). Amongst others this company produces and tests engine components on behalf of Rolls-Royce (complan, 2010, p. 27).

## Regulatory framework

The Federal State of Brandenburg is moving its policies and legislation within the framework of European and national policies and laws. Therefore industrial plants and commercial operations, which have a particular effect on the environment, have to receive an authorization from the Environment Ministry of the Federal State of Brandenburg. The approval process is integrated and includes the different environmental fields, planning permits and occupational health and safety. In some cases this is combined with an Environmental Impact Assessment. Also, a monitoring program has been established by the State where on-site checks are carried out by the responsible authorities to verify that the required measures to prevent harmful environmental effects have been met (Umweltministerium, 2012a).

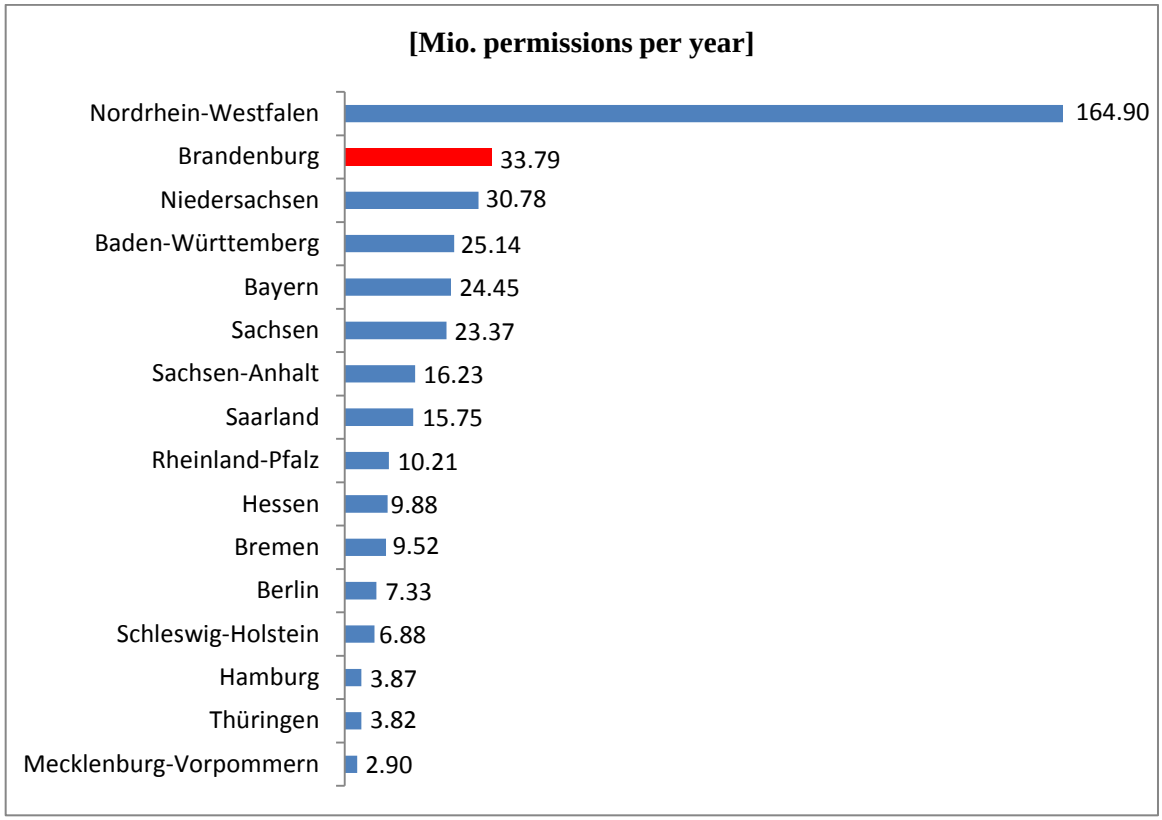
The amount of emissions produced by reportable industrial equipment in Brandenburg is published on the website of the Environment Ministry of the Federal State of Brandenburg (Umweltministerium, 2012b). In addition the Environmental Data Report (Umweltministerium, 2012c), compiled at the request of the state government, is a reference work for all citizens and specialists interested in the environmental situation in the Federal State of Brandenburg. All of the most important data and facts, research results and measurements regarding soil, water, air, and climate, as well as the projects of the State Office of Environment, are presented in this report. It also contains several indicators of the Brandenburg "sustainable development" program, a collaboration between the departments of agriculture, forestry and health (LUGV, 2012).

The State of Brandenburg endorses and supports the European and national efforts for the rapid development of a sustainable energy supply. The objectives include the increase of energy efficiency, developing renewable energies and storage technologies, improving the national electricity grid and the reduction of greenhouse gases. The following national laws (excerpt of the most important) form the regulatory framework in Germany and have strong influences on the energy sector and its stakeholders (Energieland Brandenburg, 2012):

- Renewable Energy Law
- Renewable Energies Heat Act
- Energy Saving Act
- Energy saving regulations
- Energy Management Act
- Combined Heat and Power Act
- Regulation on the production of electricity from biomass

Furthermore, international and national $CO_2$ emissions trading also play a role. The $CO_2$-intense lignite industry in Brandenburg provides a major source of $CO_2$ trading in Germany (compare Figure 2.9) as the two coal-fired power stations "Schwarze Pumpe" and "Jaenschwalde" are situated in the Federal State of Brandenburg. These power plants are two of the ten largest $CO_2$ emitters in Germany. Two thirds of the power generated by the power stations is exported to other Federal States (LUGV, 2011, pp. 12).

**Figure 3-5 Emissions allowances by region in Germany**




*Source:* Ministerium für Ländliche Entwicklung, Umwelt und Verbraucherschutz des Landes Brandenburg, 2008, p. 33.

The Regional Growth Core Schönefelder Kreuz is characterized by a variety of economic options. These options derive both from the favourable geographical location of the RGC Schönefelder Kreuz and from political measures supporting the region. In particular, the political decision to locate the new BER Berlin Brandenburg Airport in Schönefeld, as well as the definition of Regional Growth Cores as part of the promotion policy of the Federal State of Brandenburg, led to a gradual improvement in infrastructure and transport routes. These measures and the possibilities of co-operation between science and industry provide a growing attraction for a wide range of companies. Not every industrial plant or commercial operation is accepted. Companies that have a particular effect on the environment have to receive permission to settle from the Environment Ministry of the Federal State of Brandenburg.

## Summary

Cross border areas are becoming more frequent as markets, including labour markets become less and less bounded by jurisdictional boundaries such as national borders. Stimulating green growth in these areas requires additional effort, due to the complex and sometimes conflicting institutional make-up of these regions. The case studies in this chapter have shown the importance of consensus building around aims and objectives for green growth activities, and then reporting progress on the basis of an agreed set of metric, that are collected by resourced institutions with the ability and authority to collect and communicate progress.

Consensus building and involving stakeholders in determining green growth strategies, appropriate resources, and role of both public and private organizations are

necessary activities for all regions. However in cross-border regions this importance is emphasized further – because without consensus and coordination, failure is likely.

## Lessons for other cross-border regions on green growth strategies

### *Providing consensus on cross-border indicators; what is measured, why and how often, and how they are communicated*

Agreement on a set of common indicators and the mechanisms for measuring and populating these indicators firstly requires stakeholder engagement and agreement to inform and validate the indicator selection process. Through the process of deciding 'what' to measure, monitor and use as indicators for performance, understanding and responsibility for developing and populating indicators. This in turn flows into the activities and responsibilities of the institutions from whence these stakeholders come (public, private, public) and develop a platform for co-operation. The guiding suggestion is to develop indicators in this participatory way early in the process, as they can generate support for the essential goals of the local policy process or project.

### *Defining suitable methodologies and institutions to assess green growth*

Cross-border regions must also deal with complexities arising from the presence of multiple political and policy jurisdictional boundaries all influencing the activities in the one cross-border region. Each jurisdiction has an inherent culture and set of norms that shape their activities, so that even when broad policy objectives across jurisdictions align, the method of achieving these objectives may be different. Where policy objectives do not align, the situation is even more difficult.

Policy co-ordination is an essential element to enable cross-border regions to transition into the low-carbon economy. Cross-border co-operation models need to be strengthened and developed further, to stand as laboratories of co-operation for green growth transition.

Coordinating institutions need to develop cross-border governance models that start to align both policy objectives and policy implementation. New models of partnership and governance need to be found and this requires different types of policy and analytical skills – to bring together existing knowledge to help develop horizontal projects for the cross-border regions. Co-ordination between relevant stakeholders in these planning and implementation processes and within regions can be *ad hoc* if one organisation or group of organisations has the responsibility, authority and resources to engage stakeholders in strategic planning and implementation processes. Institutional and regional boundaries rarely match-up and a pragmatic approach must be developed.

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# 4. Monitoring the transition in areas with carbon intensive industries and assets

*Abstract*
*Each region will have a different pathway to green growth because each place starts with different endowments of industrial and natural assets. The composition of a region's assets will influence the extent of labour and industrial transformation required for low carbon growth. In regions with carbon intensive industrial assets this can seem like a daunting task. This chapter examines the transition to green growth in a number of carbon intensive regions, with the aim to provide evidence that dramatic transition can take place, and guidance to policy makers in similar regions on options for action. Evidence from Brandenburg region in Germany, and Alzette-Belval in the Benelux region is presented.*

The need for customized approaches to green growth at the local level is very evident in regions that currently have, or have a legacy of carbon-intensive industrial bases. For these regions the move to a low carbon economy will be keenly felt in the labour market, the urban infrastructure and composition of the region, and in the economy as a whole, because these carbon intensive industry dominate local economies. This chapter presents three case studies of region's green growth pathways; the first is the Brandenburg region in Berlin. This region is home to the new Berlin airport. Airports and aviation are carbon intensive, but for this region also represents a major source of economic and employment activity, and a source form of firm and knowledge specialization through the aviation cluster that has developed around the airport zone.

The second case study is the cross-border region of Alzette-Belval, on the border of Luxembourg and France and the site of major steel production activities that have been in slow decline over much of the last decade. The final components of steel production are now exiting the region, and the city of Belval is being remade.

The third case study is of local areas in Chile. These areas are balancing demands for economic development and the need to increase standards of living for their population with also managing specific local environmental issues.

## Case study: Brandenburg region and green growth with the new Berlin international airport[16]

### The aviation challenge

Globally transport emissions account for 22% of total emissions (IEA 2012). The majority of this is taken up by road transport, but aviation emissions are also increasing at a

[16] The case study is drawn from Martinez-Fernandez, C., Sharpe, S.A., Haack, B. (2013), 'Green Growth in the Brandenburg, Berlin: An Analysis of the Regional Growth Core Schönefelder Kreuz (OECD Local Economic and Employment Development (LEED) Working Papers, 2013/11)', [prepared for OECD], OECD Publishing, Paris, France, pp. 1-124.

rapid pace. International aviation bunkers[17] emissions grew by 6.7% between 2009 and 2010, and have increased by 78.3% from 1990 levels (to 2012) (IEA 2012).

The aviation industry has however had a strong focus on increasing carbon efficiency within the sector. From 1997 to 2012 international passenger traffic volumes rose by 96% and cargo volumes by 82%, but in the same time period carbon emissions rose by approximately 27% (DB Research 2013). This progress within the aviation industry highlights the complex interactions between 'green' activities in carbon intensive industries. In these situations economic and employment development from carbon intensive industries and assets can be seen as double-edged – they achieve employment and economic activity but contribute to increases in carbon emissions.

## Airports as magnets for economic and employment growth

The growth of aviation services has been credited with increasing globalisation and regional development. Airports are a critical component for connecting people with place, and they make important contributions to regional economic development (Florida et al 2012).

The development potential arising from airports is that they are expensive assets that can attract other types of economic activity, for example retail, accommodation and tourism. Also, because airports operate within a network of other airports, those places designated as hubs are able to attract other and denser economic activities including engineering and servicing activities, allied and supplier services, research and development activities and training and skills development activities. Hub airports are also essential elements of connectedness for cities within the global economy (Neal 2012).

Employment and labour market impacts are one of the major concerns in understanding the impact of the new airport on the Schönefelder Kreuz region in Brandenburg state. The following section defines some of the key concepts of green transition, and the context for policy development at the regional and national level. An important consideration when looking at policy implications is the ability to assess the action taken and measure the impact of activities and be sure progress is being made. Indicator development and ongoing assessment are needed to support these activities, and they need to be carried out at local levels as well as at the more prominent national level.

## BER and green growth

The expected economic and ecological benefits of the new Brandenburg Airport (BER) are:

- The new airport will be an economic driver for the businesses in the Berlin Brandenburg area due to the concentration of aviation activities in one space and due to the efficient/effective connection of the Berlin-Brandenburg region to the rest of the world and
- BER is declared as a green airport with minimized negative impact to the environment and to the people living in the BER periphery.

The substitution of one airport for three will have important consequences for the Berlin metropolitan region and the Regional Growth Core of Schönefelder Kreuz. From the aviation perspective, the concentration of operations in just one airport, together with the recent movement of Air Berlin to join Oneworld, represents an opportunity for Berlin to

[17] International aviation bunkers include deliveries of aviation fuels to aircraft for international aviation. Fuels used by airlines for their road vehicles are excluded. The domestic/international split should be determined on the basis of departure and landing locations and not by the nationality of the airline (Source: IEA).

develop a hub airport with a stronger presence in the long-haul market. This would certainly represent a boost for the region's economy.

From a spatial and regional point of view, the new airport represents a change in the distribution of economic activity and power within the region, meaning a higher concentration of economic potential around the Schönefelder Kreuz. From the viewpoint of the Regional Growth Core, this can translate, not only in the location of new services, companies and production in the area, but it can also represent a challenge in terms of land availability and brownfield developments, an increasing demand for skilled workers, and a higher concentration of the externalities associated with the airport's activity (Suau-Sanchez, P. and K. Mason, 2012, p. 6).

But these are more promises than facts so that two main questions remain with respect to "green growth" in the RGC Schönefelder Kreuz:

- Is the new BER a "green airport"?
- What are the impacts of the new BER with respect to the BER periphery

Although aviation only represents between 1% and 3% of the global CO2 emissions (depending on the data source), from the local standpoint, an airport can diminish considerably the local air quality and represent an important share of the local CO2 emissions.

In the new Berlin-BER airport, the major reduction of CO2 emissions will come from an increasing share of public transport in the ground transportation modal split and a reduction of over 50% of the emissions of the buildings and operations (from 78 300 to 36 700 tonnes) compared to 2010. This will be achieved mostly by an onsite, combined-cycle power station and procuring electricity from regenerative sources. The airport will consider other measures for cutting emissions, including hydrogen vehicles for platform operations and will perform regular air quality assessments with air quality testing units and bio-monitoring of plants and bees.

Although the new Berlin-BER airport markets itself as one of the world's greenest airports, the new airport will essentially be using mainstream technology and thus it will be as green as any other new building, but it will not be a cutting edge airport in terms of green technology or strategy (Suau-Sanchez, P. and K. Mason, 2012, p. 9)

BER is a new airport and in that sense the resource performance of the airport will be improved by the inclusion of standard, higher performance building design and equipment for 2013, but it is unclear what, in addition to this, is innovative and deserving of the label "green". In other words, ecology and sustainability were integrated in the general planning as a routine matter, following established standards – but not conceptualized as a priority (compare (GLBB, 2008a; 2008b; 2008c)). This may represent a missed opportunity.

The growth of air transport contributes to increasing carbon emissions, even if, as noted earlier, the industry itself has enhanced its carbon efficiency at a much higher rate than passenger and cargo growth. So while a new airport may be greener it is still a hard case to sell in terms of ecology and environmental protection. In the light of massive protest against BER's location and expected flight routes, which increase annoyance and emissions (noise and other), it seems an unlikely scenario to communicate a credible green message.

One critical perspective, well-debated in the Berlin-Brandenburg metropolitan region, is that the final location decision maximized rather than minimized the number of people and communities exposed to noise and other emissions. When figures of residents affected by the BER airport are compared to those currently affected by the operations at the three old Berlin airports (Tegel, Tempelhof, and Schönefeld combined); this seems like a

good and green message. However, alternative new airport locations further out in the rural areas could have dramatically reduced the number – with, naturally, longer travel distances to and from the airport, which was not politically acceptable. Alternative locations would have had a variety of other ecological disadvantages, but it cannot be said that, on balance, Schönefeld was the greenest possible solution to the location problem.

BER seems more like a conventional, mainstream, medium-sized, "grey" airport project which so far cannot, and does not, lay claim to being a "green beacon project" – with the understanding that a beacon project is a prominent, high-visibility, large-scale model demonstration of new concepts and technology applications, which has a visionary, stimulating, encouraging effect both for business and public acceptance.

Keeping these aspects in mind, it does make sense to compare BER and the Regional Growth Core Schönefelder Kreuz with the Hamburg aviation cluster's beacon project "Efficient Airport 2030", which places efficiency front and centre – presenting efficiency not only as a means to better use economic resources but also improve ecology and sustainability. Efficiency is well suited to the aviation industry's own economic interests (from aircraft design, fuel use and handling to airport operations like ground connections, passenger and cargo ground transport). Hamburg has rounded up various stakeholders, including R&D institutions and the German air transport research centre DLR to pursue this and deliver measurable indicators. This opportunity does not seem to have been a core ingredient of BER – or has been under-communicated. Thus it appears to be possible that innovative technologies and processes can lead to "greener" airports (DLR, 2012a; 2012b). Therefore a potential recommendation from this research is for communication between the two airport projects on issues related to more modern and innovative ways to build greener airports.

### The airport region – expectations and advertisement, stresses and strains

By 2007 the Metropolitan Area Berlin-Brandenburg – sometimes called "the capital region" – had become a first rate location (Business Location Center, 2012a). It attracts people and companies from all over the world because of the existing opportunities (Business Location Center, 2012b).

As a region with a significant rate of economic growth in Germany, the Metropolitan Area Berlin/Brandenburg offers a lot of opportunities for business success. It is possible to drive international trends and help shape the future in an international atmosphere. The area´s universities and laboratories provide remarkable chances for co-operation with research and academic programmes. The region contains Germany's political centre and therefore enhances companies' reputations internationally and supports high-level contacts. In the future, BER will also provide a high level of accessibility. Attractive commercial sites and affordable office space make launching business in the area that much easier. It is likely that graduates from Berlin's and Brandenburg´s universities will be able to fill the human resource needs of the various businesses surrounding the airport.

Beyond that, the expectation was, and is, that the region´s "excellent transport connections and central position provide a gateway to the new markets in the East. The new airport Berlin Brandenburg International will reinforce its role as a hub of international air traffic. This is of the utmost importance – and not just for commerce. The capital city is a magnet that attracts everyone – and the airport region is its most fertile soil for ideas and investment." (Business Location Center, 2012a).

Schönefeld as a part of the Regional Growth Core Schönefelder Kreuz "is well prepared for its new role as a focal point within the airport region. The value of its proximity to airport and motorway has been recognized for years and close co-operation has been fostered with investors." (Business Location Center, 2012a).

These arguments were the arguments of a very large number of well-known companies and institutions and numerous leaders and experts from science, research, culture, administration, and politics to explain the advantages of Schönefeld. They drew far-reaching economic hope from the new airport BER. The expectations were that BER would be a trigger for innovation:

- making the region Berlin Brandenburg fit for the future,
- increasing the importance of the region as a player in global competition,
- creating a burst of growth because of investments from Germany and from foreign countries, and as a consequence
- driving progress for the municipalities in the BER environment.

To ensure that the demands BBI Airport will be facing are met, the 'Joint Structural Concept for the Area surrounding BBI Airport' was developed. In order to build consensus in the course of the planning process, the Joint Spatial Planning Department brought together relevant stakeholders, including municipal, city and Länder administrators, as well as the administrative districts, the regional planning authorities and the Berlin Schönefeld Airport Company, providing them with the opportunity to state their respective needs and interests. A jointly developed guiding principle set out the basic tenets of the agreed future development of the airport environment.

The area surrounding the airport is exceptionally suited to helping establish the BBI Airport on an equal footing with its international competitors. The Mutual Structural Concept has created "the framework within which the airport region will develop in economic terms, and will ensure the co-operation of all stakeholders in the long term" (GLBB, 2007, p. 3).

The Joint Spatial Planning Department Berlin Brandenburg was and is aware of this double action resulting from building and using the new airport (Becker, C. et al., 2012, p. 16). Therefore the department utilised the expertise of "Regionalwirtschaftliches Gutachten zu den Auswirkungen des Flughafens Berlin Brandenburg auf die Entwicklung der Kommunen im Flughafenumfeld" (Becker, C. et al., 2012). The idea is to utilise this expertise as a basis for balancing the interests of all municipalities, cities, and Länder in the BER periphery – including the Regional Growth Core Schönefelder Kreuz (Becker, C. et al., 2012, p. 16).

This plan has three main goals:

- Creating a complete and consistent database for describing and analysing the economic and demographic development of the airport periphery during the ten years from 2002 to 2012 – the decade before the opening of BER.
- Deriving a forecast of the economic and demographic development of the airport periphery within the next ten years to 2022 – the decade after the opening of BER.
- Describing recent results on the structure's capacity to balance interests between local communities and the airport, and to develop recommendations for the best use of the environment of the BER.

Four challenges exist for integrating the development of the airport into the wider socio-economic processes of green transition in Brandenburg: skills availability and development, quality of jobs created, generating job multiplier effects as an engine of growth, and the future development at the airport as an international hub. Each of these is discussed in further detail in the following section.

### *Skills availability and development*

One of the main concerns of the participants in the workshop organised by this study was related to the need for the region to provide the required skilled workforce for all the knowledge-intensive companies located in the airport region. The region is already in a position to supply highly skilled workers according to the needs and requirements of local industry and firms; e.g. there are strong links between the Technical University of Applied Sciences, Wildau and some industrial and R&D firms in the Schönefelder Kreuz. Likewise, the industrial orientation of an important percentage of the companies is linked with the airport and the aviation industry. Among these firms are the engine manufacturer Rolls-Royce and the polymeric materials producer Fraunhofer-PYCO, which in turn have strong ties with university and academia (Suau-Sanchez, P. and K. Mason, 2012, p. 7).

An ongoing challenge for the region will be finding the right combination of bottom-up and top-down strategies to incorporate green knowledge and skills into the set of skills demanded by companies. The goal is to achieve sustainable demand-led green skills growth rather than the more common situation of supply-led growth.

### *Quality of the jobs and low-skill segment*

While it is true that aviation supports and boosts the economy of regions, the quality of the jobs onsite can be quite poor, especially in the areas of ground handling and retail. Most of these jobs are part-time and very precarious, which represents a threat for the socioeconomic development of the region, not only in the present, but also in the future, as these kinds of jobs make it difficult to, for example, build up pension claims. Therefore, the strategic-policy conclusion is that ongoing opportunities for training and skills development to enable labour force mobility must be part of the overall economic development strategy for the airport region.

### *The airport as an engine of economic development*

There are many existing strong links between several firms and the airports. From the available data examined for this study it is difficult to get a systematic picture of the inter-firm connections in the airport region beyond these few anecdotal cases. The lack of formal co-operation structures and inter-firm connections has ramifications in terms of how embedded the airport is within the region.

There are minimal formal structures for organising the spatio-economic spillover of the airport. One of these is the airport city, which is part of the airport master plan and has a floor area of 210 000 m2, and the AirTown, a private development near the airport including housing, retail and office space (Suau-Sanchez, P. and K. Mason, 2012, p. 8).

Another formal structure for the economic development of the region is the Brandenburg Economic Development Board (ZAB). While the Brandenburg strategic clusters for regional development are synthetics/chemistry, metal, food sector and tourism, the Berlin strategic clusters have a more specialised profile, being the health sector, energy technology, optics, transportation and logistics, and ICT and media. The ZAB is a “one-stop agency for a variety of business support services. It provides assistance in pursuing investment projects in Brandenburg, but it is not a specific agency for the promotion of airport related business nor for the marketing of the airport as a regional business engine. Specific agencies are not as common as should be, but we can find them in some world-class airports, this is the case of

the Amsterdam Airport Area and the Schiphol Area Development Company in the Amsterdam-Schiphol airport" (Suau-Sanchez, P. and K. Mason, 2012, p. 8).

There is mixed evidence of co-ordination between participants and municipalities when it comes to the definition of common strategies and views of the future. The Regional Growth Core strategy itself is a supra-municipal organization based on informal co-operation, it does not have an institutional structure and only has a limited annual budget of 150 000 EUR for strengthening co-operation. The RGC's resources do not extend to providing this co-ordination or provision for data collection.

While this might not be an immediate issue, the organisation of the links and integration of the airport and its carriers with the regional hinterland is essential for the definition of efficient supply-chains that can allow the region and its firms to be competitive in the global markets. Today competition is more between supply-chains than between firms (Kasarda, 2000, 2011). Previous studies show that the airport city concept is already out-dated and that other conceptual visions of the airport-region integration (e.g., city-port, aerotropolis, airport corridor, airport region) are "more helpful for the definition of a vision to take full advantage and return from the airport activity […]" (Suau-Sanchez, P. and K. Mason, 2012, p. 8).

### *The hub ambitions*

The new Berlin-BER airport will provide the quality infrastructure required by airlines to develop a hub. The new airport is already designated as a hub for Air Berlin. Hub status airports can attract denser levels of economic activity to the airport region with the addition of maintenance, engineering, head and back office functions also being sited at the airport. Two limitations of the BER to hub activities have been identified (Suau-Sanchez, P. and K. Mason, 2012, p. 9):

First, the Berlin-BER airport will start operations with a capacity of 27 million passengers when the current traffic in the Berlin airport system is around 24 million passengers. The limited spare capacity could be a threat for the further development of air traffic in Berlin, especially when the plans for further airport development are not scheduled and there are no land-bank measures.

Second, and in relation to the previous point, the limited airport capacity could impact on peak capacity, which is required for the development of hub operations, since the traffic is distributed in a wave-system to allow flight transfer in an efficient time frame. According to Air Berlin, peak capacity would not be an issue in the new airport, since they state that they are already performing hub operations at Berlin-Tegel. Although it is true that one can identify 6 waves of inbound and outbound flights in the Air Berlin Tegel operations, their transfer ratio is only around 5%. Therefore, from an objective point of view, it could not be considered that today Air Berlin has a hub in Berlin in the strict sense of the term. The further integration of Air Berlin into oneworld could provide a boost in the connecting traffic of the airline, which would be beneficial for the region as more long-haul operations could be sustained. From the region's perspective it is important to have realistic expectations of the competitive position of the airport in terms of hub development (Suau-Sanchez, P. and K. Mason, 2012, p. 9).

## Case study: The challenges of industrial legacy in carbon intensive industries in Alzette-Belval[18]

The Alzette-Belval region has a long industrial history in steel manufacturing, but is now seeking opportunities for structural renewal and improving quality of life by moving key public research organisations to the area and creating new opportunities for fostering innovation, education and training. Central local priorities include the development of high quality sustainable new infrastructure on former industrial wasteland and in urban areas, and a transport infrastructure favouring public and low impact transport means. For example, the site of Esch-Belval, which will house the new research and innovation cluster, obtained a gold label in a new German site-sustainability-certification scheme.

Development priorities therefore include energy-efficiency and well-being in the built-environment, the production of green energy, and the promotion of public-private partnerships for research and innovation, skill-building and training. There is general agreement that social aspects, such as providing for affordable green housing and combating youth unemployment, also need to be addressed.

### 'Brownfield' site redevelopments offer opportunities for large-scale land use and building design changes

Land-use and land cover changes from regeneration of industrial wasteland left by the declining steel industry are largely organised in view of sustainable development. Reforestation projects of old mines in the area, which began in the 1990s, are now contributing to increasing air quality and growing local CO2 sequestration rates through photosynthesis. The river benefits from a re-naturation project that is exemplary for the country. The development of parks and areas of environmental protection also offer healthy recreation, improving environmental health. Large parts of industrial wasteland are turned into urban development projects, notably the Belval project, which received a gold label in a pilot certification project applying the certification of sustainability developed by the Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB). With the completion of the master plan, which AGORA anticipates will be finished around the year 2025, there will be 1 400 000 square metres of sustainable housing, offices and retail development.

The road network is consequently becoming denser, which needs to be managed with care. Strategic investment in transport infrastructure, including public transport, will be crucial to channel the significant number of commuters through this area in a more sustainable manner, and will require targeted effective cross-border co-ordination. A mid- to long-term goal to be considered is to develop zero transport emissions for cross-border commuters.

### Implications for the development of these sites

Monitoring and assessing the development of Alzette-Belval as a new urban metropolitan area that is also transitioning to a low-carbon economy includes the rate and pace of land use changes and particularly monitoring land remediation.

[18] This case study is drawn from Martinez-Fernandez, C., Sharpe, S.A., Bruyninckx, H. & Konig, A. (2013), 'Green Growth in the Benelux: Indicators of local transition to a low-carbon economy in Cross-Border Regions (OECD Local Economic and Employment Development (LEED) Working Papers, 2013/09)', [prepared for OECD], OECD Publishing, Paris, France, pp. 1-147

### *Historical and future carbon flows*

Carbon flows in the area are still most affected by the industrial production of steel and electricity. ArcelorMittal is still the area's single largest industrial producer, employer, and emitter of CO2 (approximately 4 metric tonnes of CO2 in 2008), followed by the fairly recently established Twinerg Gas combustion plant that can also run on wood pellets, which provides electricity and district heating in the area of Esch-Belval. Measures and communication of soil pollution from steel production, e.g. looking at heavy metal contamination are recommended, as well as monitoring local air quality (e.g. SOX and NOX). Additionally, the construction sector that co-evolved with the steel industry in the area is strong, and there is also an emerging arts and craft sector, and eco-technologies sector.

The environmental technology sector is one of four priority sectors in Luxembourg's policies on economic development and targeted diversification. A national eco-technology innovation cluster was formed in 2009. Green building in Europe accounts for more than one-third of all non-residential design and construction, and will grow to more than one-half of all construction within the next few years. Further development of this sector could bring a strong growth pathway linked to the research and science cluster.

### *Focus of support on resource efficiency of buildings*

Indicators for tracking energy-use and changes in the carbon efficiency of production will be useful; in particular, if complemented by a carbon stock and flow analysis for the area. Assessing water use and waste production, and the percentage of waste recycled in the building sector, for individual organisations and per resident are also important monitors. Organisations and firms should be encouraged to set themselves zero waste targets. The number of employees, and the longevity of local firms in the eco-technology sector, should be monitored, paying attention also to legal indicators of the transition to new forms of ownership of enterprises managing new common arenas such as utilities (including the number of renewable energy co-operatives).

In relation to the construction sector, by 2015, green buildings will support nearly several thousand workers in a range of occupations including construction managers, carpenters, electricians, architects, truck drivers and cost estimators, among many others in Luxembourg. The increased demand for green building construction has created an increased need for a skilled and trained workforce. According to German construction enterprises, training is essential for getting and maintaining green jobs; 30% of green job workers say they needed additional training when they started and most report that formal education and training programmes will continue to be needed. Hiring firms agree; 71% of hiring decision-makers maintain that being credentialed increases competitiveness. Fostering green skills for inclusive growth is vital, and thus requires addressing the gap in education and unemployment levels between the residents of Luxembourg and foreign nationals in the south.

Policy and programme activities that support the increasing energy and resource efficiency of the built environment (both old and new) are important, and could include the following:

- Energy-efficiency standards of the built environment, old and new, based on regulations and certification schemes.
- Implementation and level of subsidy of retro-fitting programmes for older building stock; mixed-use of new urban development projects (housing and offices).

### *Knowledge transformation with new infrastructure*

The Cité de Sciences in Belval will provide room for a large part of the University of Luxembourg, the Public Research Centres Gabriel Lippmann, and Henri Tudor (who have just committed to a merger in 2016), and the Centre for Studies on Populations, Poverty and Socio-Economic Policies, as well as a range of other public services such as national archives, a music auditorium and a national centre for industrial culture. The Fonds National de la Recherche, the national research funding authority, will also be moved to Belval. A predictive exercise informing research priorities posits research on sustainable resource use in Luxembourg as one of five principal research axes in Luxembourg. Most of these organisations offer education and training relating to sustainable development, with a focus on the construction and energy sector; courses cover needs within diverse jobs in the sector across all levels of education – construction, sales staff, and engineers and architects.

The development of local indicators on green skills and training could be rooted in efforts identifying key skill capacities and skill deficits relating to the transition to a low-carbon economy in the region, in a process engaging all stakeholders, especially social partners. Indicators could include the number of jobs in local eco-technology firms including public services (waste management, water purification, and renewable energy production); the offer of courses in all education and vocational training programmes at all levels; cross-border initiatives on green skills and training, and the number of new professional qualifications obtained; how many employed and unemployed persons have received green training; and the number of training places designed to teach proactive green retrofitting skills. Development of a cross–border eco-innovation training centre was also suggested.

Indicators on research and innovation could include the number of cross-border research projects with private and public partners relating to sustainable energy-use in the built environment; the number of new related patents; and size and longevity, and legal statute of new, relevant enterprises.

### *Co-ordination of transport and commuting infrastructure*

The use of public transport and low impact modes of transport, and research on understanding prevailing modal chains; as well as cross-border co-ordination on policy and investment into the development of transport infrastructure and services are important transitional activities and measures.

In Luxembourg, governance strategies are very much affected by the interactions across the multiple levels of governance, particularly: legally binding requisites to implement EU policies and targets; national versus local level governance; and a mismatch of these levels across the borders in the different jurisdictional contexts. Municipalities should be empowered to contribute to the development of relevant strategies at the national level. There is a need for a local narrative on transitional opportunities and visible, highly salient projects. Participatory governance is needed and requires co-ordinated and (long-term) visions for guidance.

Of interest are several initiatives for local indicators in the area, such as the local indicators of energy production and use, and transport, which are being developed in the framework of the INTERREG IV C Project “EU 2020 going local”. These indicators will likely be developed for the local implementation of the European Energy Awards programme, where the awards present a particular incentive for high levels of municipal engagement to produce such data; as well as indicators for the development of the Eco-cité in France. The European territorial grouping for co-ordination in Alzette-Belval (EGTC) will provide a notable and new tool for cross-border co-ordination, a possible platform for developing

visions and indicators, and follow-up on a cross-border area. Special attention should be paid too more marginalised groups of society, inclusive growth, and the avoidance of a spatial segregation of a green elite.

## Case study: The challenges of managing socio-economic development and environmental management in Chile[19]

The challenge of balancing socio-economic development and environmental protection and management is can be even more problematic in developing and fast growing countries. Chile has demonstrated strong commitment to the Green Growth agenda, and representatives from Chile were close observers on the OECD Local Indicators of Green Growth project. This case study shows the relevance of local indicators in Chile.

Chile is one of the countries with higher economic development in Latin America. The country's GDP has more than doubled in the last 20 years, which has helped to improve the quality of life of its citizens. The Central Bank of Chile confirmed recently that Chile's gross domestic product grew 5.6% in 2012. Thus, the GDP was approximately of 268 billion dollars, which means a GDP per capita of nearly 16,200 dollars (Bank of Chile 2012). Projections of the Organization for Economic Co-operation and Development (OECD) foresee that Chile will lead growth among member countries by 2014.

However, this growth rate has begun to a slowdown in 2013 due to the fall in prices of raw materials and effects of the global economic crisis. Moreover, according to the IMD World Competitiveness Center (WCC) of Switzerland, Chile ranks in 2013 the 30th place (out of 60 countries), which implies a decline as the country ranked 28th in 2012 and 25th place in 2011. As the IMD states, Chile, together with Brazil, Argentina and Venezuela are "all losing ground and being challenged by the emerging competitiveness of Asian nations" (IMD 2013).

Chile is characterized by an open and export-oriented economy, being mining the main exporting sector based primarily on copper. Mining is the corner stone for economic and social development of Chile. As the National Society of Mining (SONAMI, its acronym in Spanish) states, between 2006 and 2011 mining reached 64.3% of total exports (SONAMI 2012). The mining sector also leads foreign direct investment in Chile. According to the Foreign Investment Committee (CIE, its acronym in Spanish), between 2009 and 2012 there was a total FDI of US$ 81,516 million. The ranking was as follows: mining 50.1%, services 26.6%, electricity, gas and water 10.9%, industry 7.9%, construction 2.4%, transport and communications 1.7%, and agriculture and fishing 0.5% (CIE 2013).

### Environmental challenges at the national level

For different reasons, in recent years there has been a major concern of both the public and private sector for reducing the negative impact on the environment, a fact that is manifested, among others, on major investments to prevent or mitigate environmental damage.

The extent of environmental problems in Chile are covered with great detail in the 1st Official Environment Status Report 2011, published by the Ministry of Environment of Chile in 2012 and available in English at the Ministry´s website (Ministry of Environment, 2012). The elaboration of this report responds to Law 20.417 on General Bases of the Environment of 2010 (previously, Law 19.300 of 1994), as well as to the recommendations of

[19] This case study is drawn from Woischnik, A., de la Maza C., Martinez-Fernandez C.M and Sharpe, S.A. (forthcoming) 'Chile's pathway to Green Growth: Measuring progress at the local' (OECD Local Economic and Employment Development (LEED) Working Papers, 2013/**)', [prepared for OECD], OECD Publishing, Paris, France, pp. 1-62

the OECD expressed in its publication "Environmental Performance Assessment of Chile" of 2005.

Two of the most important environmental problems in Chile, are air pollution and soil contamination. The rest of this case study describes these issues in more details before describing local level activities aimed at addressing these environmental issues but by also providing opportunities for employment and economic development in these regions.

### *Air pollution*

Thermal power plants, copper smelters, transport and wood heating are the main causes of poor air quality in Chile. According to estimates, in Chile "at least 10 million people are exposed to an annual PM2.5 average concentration higher than 20 micrograms per cubic meter" (Ministry of Environment 2012: p 53).

This means "that more than 4,000 people die prematurely each year due to cardiopulmonary diseases associated to chronic PM2.5 exposure. This figure represents more than double the number of deaths in car accidents"(Ministry of Environment 2012). Pollution exposure also is associated with other health costs due to its harmful health effects on morbidity events and detriment deeply population quality of life.

Population of 31 cities and municipalities throughout the country is expose to concentrations above 20 micrograms of PM2.5 per cubic meter, the maximum limit laid down in national regulations. Most of these cities are located in the central and southern Chile. Lower income communities are many times the most affected with the concomitant health problems.

Different measures have been adopted to address the serious air pollution problems, mainly emission standards. New regulations to control emissions from power plants [20], smelters[21] and traffic[22], involve approximately 3,000 MM dollars (present value) including investments, operating, maintenance and environmental monitoring costs, over the next 10 years.[23] At a local level, figure 4.1 shows how the Metropolitan Region activated a Prevention and Decontamination Plan (PPDA, its acronym in Spanish) from 1998, updated in 2010 that has allow this area two cut by half PM2.5 concentrations in 20 years keeping high economic growth rates at the same time. It should be noted that the PPDA operates a credit base emission trading system for PM and NOX compensation at the industrial sector.

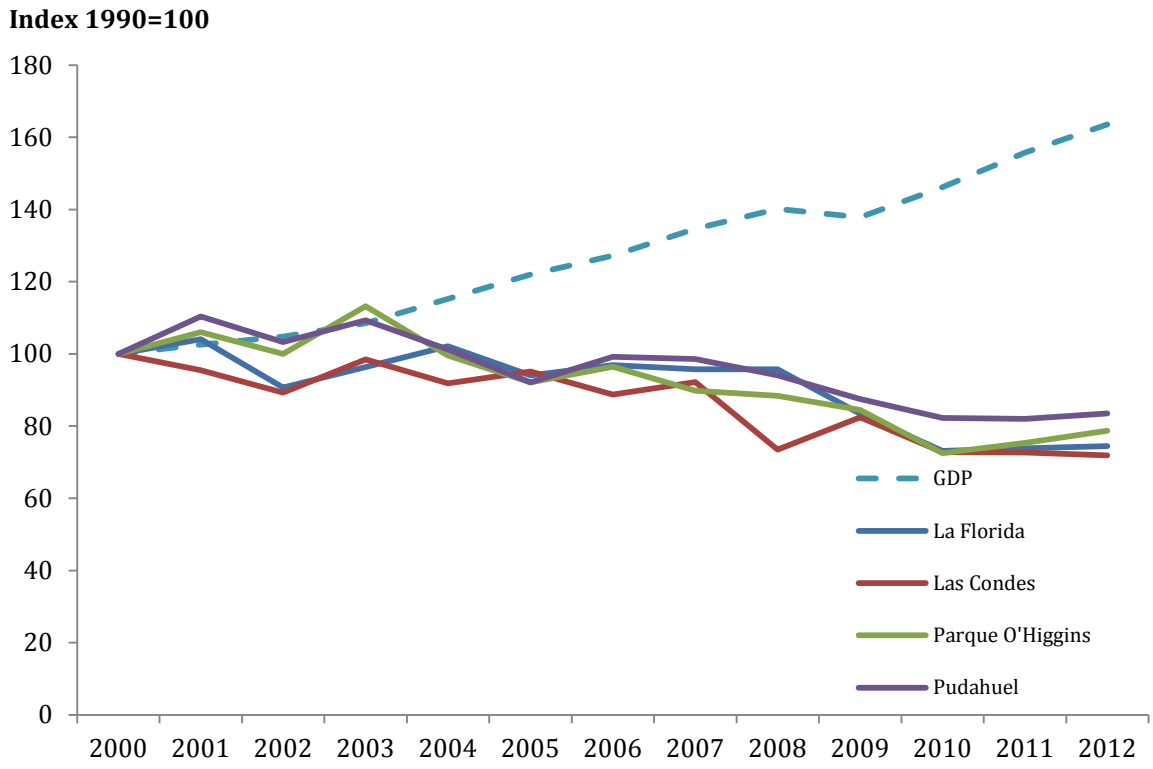
At the south of the country air pollution main responsible is wood consumption for heating purposes. Many measures have been taken to face this challenge namely stricter emission standards for firewood heaters, replacement of existent heaters by less polluting and more efficient ones, incentives to increase availability of dry firewood, labeling schemes, financial aid for home isolation improvements in order to reduce energy demand, as well as educational programs to reinforce community awareness and education. At a local level decontamination plans have been set in place being the one for Temuco and Padre Las Casas in Region IX Araucanía the first to be approved.

[20] Costs associated with the standard: 600 MMUS$, according to the National Commission of Environment (CONAMA). Report: "Análisis general de impacto económico y social de una norma de termoeléctrica". Santiago de Chile, 2009.
[21] Costs associated with the standard: 1.400 MMUS$, according to the Ministry of Environment. Report: "Análisis general de impacto económico y social de la norma de emisión del anteproyecto norma de emisión para fundiciones de cobre y fuentes emisoras de arsénico". Santiago, 2012.
[22] Ministry of Environment. Report: "Análisis general del impacto económico y social de la aplicación de nuevas normas de emisión para vehículos livianos a nivel nacional". Santiago, 2012. Associated costs: 560 MMUS$. – Report: "Análisis general del impacto económico y social de la aplicación de nuevas normas de emisión para vehículos medianos a nivel nacional". Santiago, 2012. Associated costs: 60 MMUS$. – Report: "Análisis general del impacto económico y social de la aplicación de nuevas normas de emisión para vehículos pesados a nivel nacional". Santiago, 2012. Associated costs: 330 MMUS.
[23] Estimations of the Chilean Ministry of Environment

Production and consumption of firewood represents an important energy source in rural and residential areas of several regions from the center to the south and accounts for approx. 20% of the country´s primary energy supply (Ministerio de Energia 2009). In recent years, problems associated with the production and consumption of firewood has become more evident with emissions from firewood burning in the center-south of Chile as the main responsible for the high PM2.5 concentrations. Firewood consumption is a cultural and social issue aggravated by the low relative price of this energy source.

Due to this reality it is urgent to determine a sustainable path for wood burning use emphasizing that on average is a carbon neutral fuel. If is not possible to deal with its local externalities the alternative will be the consumption of fossil fuels and therefore increment CO2 emissions.

**Figure 4-1 PM 2.5 Concentration and GDP in selected communes in the Metropolitan Region (2000-2012)**




Source: MMA 2013 and Banco Central

## *Soil contamination*

Soil pollution is principally caused by waste from industrial processes; mining, agriculture and urban waste, often accumulate without further precautions.

Mining, as explained above, is the most important economic sector in Chile. Besides water pollution (especially through mine tailings) and air pollution associated with smelters; metal mining significantly modifies the landscape and pollute the soil. In recent decades, Chilean agriculture has significantly raised the massive use of agrochemicals (fertilizers and

pesticides), which contaminate soil and groundwater. Landfills, deposits of industrial waste and waste sites of the population, have increased in recent years, some of them in an illegal status.

The Ministry of Environment exposes "that in Chile there is no a detailed diagnosis on abandoned productive activities, thus making it practically impossible to know the amount and characteristics of the contaminated soils and sites" (Ministry of Environment 2012, p: 119).

With respect to the prevention of new contaminated sites, Chile has given big steps with the promulgation of Law 20.551 on Closure of Mining Work Sites that reinforce the "polluter pays" principle. On the other hand, the Supreme Decree N° 78 of the Ministry of Health from 2009 related with the storage of hazardous substances and the Supreme Decree N° 148 of the Ministry of Health from 2003 with respect to the manipulation of hazardous waste has helped to manage the risk of soil contamination.

### Air pollution: Clean wood stoves at Temuco, Region IX Araucanía

Temuco is the capital of the Region La Araucanía and is located 670 kilometers on the south of Santiago. It currently has a population of approx. 250,000 inhabitants. In 2011, the Araucanía Region had the highest poverty rate in the country (22.9%), whereas in the case of Temuco reached 19.5% (at the national level stood at 14. 5% in 2011). The unemployment rate in Temuco was 12.6% in 2011 and 12.1% in the Araucanía Region, while the national rate was 7.7% in 2011 (Ministerio de Desarrollo Social, 2011).

Moreover, Temuco is one of the most polluted cities in Chile mainly because of the use of wood for heating purposes, often with high moisture content, by its population. In June 2013, for a few days an environmental emergence was declared and the use of firewood was banned.

However, to reduce air pollution the Ministry of Environment is implementing several measures, one of which is the replacement of highly polluting stoves through more efficient and less polluting stoves. Following the entry into force of Atmospheric Decontamination Plan in 2010 its establish the replacement of 12,000 stoves. This policy can boost local production of cleaner heating systems and the production of a higher quality biomass fuels.

It should be emphasized that burning of wood is carbon neutral, but if not dealt with local externalities, the alternatives will be the consumption of fossil fuels, and therefore CO2 emissions. Firewood consumption is a cultural and social issue too because the low price of this energy source.

### Soil contamination: Tailings basin clean up at Andacollo, Region IV Coquimbo

Through Supreme Decree No. 8 of 2009, the Ministry General Secretary of the Presidency declared the locality Andacollo and the surrounding areas as saturated zone because particulate matter PM10 (as 24-hour concentration and annual concentration).[24] This area has a population of approx. 10,300 inhabitants.

An emissions inventory prepared by the National Environmental Center (CENMA, its acronym in Spanish) in 2011, estimated that 78% of the emissions are caused by mining activities, and the main source of emissions was identified truck traffic. On the other hand, the

[24] http://seia.sea.gob.cl/archivos/729_Antecedentes_Generales.pdf

emissions generated in the city of Andacollo correspond to powder suspension because of traffic, followed by emissions generated by wind action in the mine tailings.[25]

Mining companies have initiated actions to progress in solving the problem of pollution from mine tailings. One of the initiatives of the company Minera Teck is the implementation of the project "Recovery of Abandoned Tailings Contaminated Soils". The project was submitted to the Environmental Impact Assessment Agency (SEA, its acronym in Spanish) involves an estimated investment of approx. US$ 1 million. The first step is the recovery of the land, followed by the creation of public use areas. In the case of Minera Dayton, the company will implement in cooperation with the Ministry of Environment the "Sanitation Program of Abandoned Tailings in the Andacollo commune", which includes tailings extraction (because the content of mercury), landscape restoration and closure of one of tailings.[26]

The significant investments related to the described initiatives can involve the creation of a significant number of jobs. In addition, it will encourage the development of skills that can be used to implement similar projects in other locations.

## Summary

The move to low carbon economic and production activities can be alarming for communities that have carbon intensive assets, as these assets are likely to be a major component of the local economy, provide employment, and considerable flow on economic activity to the rest of the community. In communities were these assets are providing economic development and employment for first time and are seen as mechanisms for increasing living standards and reducing poverty the alarm can be even greater.

However the transition to low carbon economy can also be a major opportunity for transformation of economic activity that can revitalize a region, provide new and better employment conditions and provide opportunities for skills development and increased knowledge intensity of firms.

The three case studies presented in this chapter provide examples of this. The Brandenburg region has a long history of aviation that will continue with the opening of the new BER airport. This represents a chance for growth in economic activity in this region as carbon pricing forces greater efficiency and innovation in the aviation industry. Brandenburg already has an aviation services cluster in the region but continued support and development of this with partnerships between industry and the local education and knowledge institutions, such as universities and technical colleges will ensure this cluster remains vital and progressive into the future.

In Belval, the decline of the steel industry in the region is literally giving the city the chance to completed remake itself. A large investment of public funds for the redevelopment of a major new residential, educational and industrial precinct will ensure that new industries shape the city's industrial future.

[25] CENMA: "Diagnóstico de Calidad de Aire y Medidas de Descontaminación para Andacollo. Solicitado por la Ilustre Municipalidad de Andacollo". Santiago, 2011

[26] Minería Chilena (magazine): "Plan de Descontaminación de Andacollo. Tras la búsqueda de un aire limpio", N° 377, November 2012. Available at: http://www.mch.cl/revistas/index_neo.php?id=2426

## Lessons for other regions with carbon-intensive assets

### *Making sure the benefits outweigh the costs*

New carbon intensive assets such as airports have negative impacts for the region, which include environmental issues from pollution (including air and noise pollution), congestion and industrial development causing the loss of green spaces. These provide a window of opportunity for the local region to negotiate trade-offs to these downsides. Environmental monitoring and the public reporting and communications of the results of such monitoring is essential to ensure local populations that any negative impacts are kept within acceptable boundaries.

### *Prioritise and support low-carbon community assets as part of the trade-off for future developments*

Trade-offs from higher emissions may include greater investments in protecting the environment, sustainable land use, greener management of public resources, more parks and natural reserves – despite the big physical transformation accompanied by a large airport project. So, the very vulnerability of local communities may turn into an asset and leverage for long-term benefits (10-20 years ahead).

Examples for possible long-term benefits are Sydney and Barcelona. Mainly because of the Olympics in both cities, parts of these cities underwent great changes. Industrial wasteland was changed into Olympic venues, new houses or apartments. Barcelona was able to negotiate great improvements for a beach near the airport, which became a popular and novel attraction.

However, the strength of this negotiating position requires a shared understanding of the types and level of trade-offs that are acceptable. To reach a shared position requires engaged, representative and knowledgeable stakeholders to come to agreement and advocate for this position.

### *Maximizing the transition impact of large projects and infrastructure development*

Major initiatives in green growth activities provide significant opportunities for decarbonisation of the local economies. There is an important role for policy to play in prioritising the development of indicators to track progress in these large projects, particularly given the amount of investment being made in each of these areas to facilitate transition. The scale of this investment provides an opportunity to begin new data collections, as local data collection would only be a small percentage of the total expenditure. The triple helix framework (industry, university, government) offers a method by which to generate this assessment.

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# 5. Guidelines for Local Transition to a Low Carbon Economy: assessing green growth performance

*Abstract*
*This chapter discusses the analysis and monitoring activities required to assess green growth transition with specific focus on indicator framework development at national and local levels and the methodologies and limitations of these approaches. The chapter then details the methodology used in the OECD Local Indicators project and the details reliability of this method in other local areas. Cross-country analysis of the dashboards produced for the five local areas participating in the OECD study highlights the types of data and information available through this form of analysis and identifies common data gaps and issues at the local level.*

At the OECD Ministerial Council meeting in June 2009, Ministers acknowledged that green and growth can go hand-in-hand, and they therefore asked the OECD to develop a green growth strategy. As a part of this strategy, a monitoring framework was established to track how nations are progressing on their low carbon transition.

This framework was developed based on the understanding that the measurement variables of economic growth and development that have been used in the past would no longer be adequate to describe or understand the transition of green growth. The framework allows progress towards green growth to be measured using internationally comparable data, embedded in a conceptual framework that is able to be communicated to a wide audience of policy makers and the public at large (OECD 2011).

These indicators represent a starting point in understanding green growth at the national level, and they will be further elaborated as new data becomes available and concepts evolve. It is important to recognise that no single indicator will be effective in capturing progress towards green growth, and not all the indicators presented are measurable today. The OECD framework contains 25 separate indicators, arranged into five themes. An outline of the indicator framework is shown in Table 5.1.

The five themes covered include: the environment and resource productivity of the economy; the natural asset base; the environmental dimensions of quality of life; economic opportunities and policy responses; and context indicators covering the socio-economic characteristics of growth.

**Figure 5-1 Green Growth Indicator framework (national level)**

| Indicator groups | Topics covered |
|---|---|
| 1. The environmental and resource productivity of the economy | • Carbon and energy productivity<br>• Resource productivity: materials, nutrients, water<br>• Multi-factor productivity |
| 2. The natural asset base | • Renewable stocks: water, forests, fish, resources<br>• Non-renewable stocks: mineral resources<br>• Biodiversity and ecosystems |
| 3. The environmental dimensions of quality of life | • Environmental health and risks<br>• Environmental services and amenities |
| 4. Economic opportunities and policy responses | • Technology and innovation<br>• Environmental goods and services<br>• International financial flows<br>• Prices and transfers<br>• Skills and training<br>• Regulations and management approaches |
| 5. Socio-economic context and characteristics of growth | • Economic growth and structure<br>• Productivity and trade<br>• Labour markets, education and income<br>• Socio-demographic patterns |

In creating this indicator framework, there was a conscious effort to be pragmatic and acknowledge that this is an emerging area, and that analysis of green growth will be imperfect until this indicator framework and the data sources upon which it relies mature. However, it is important to attempt to identify and test which areas will work, and to investigate what data is available with which to assess the current situation.

## Creating a Local Green Growth Indicator framework

The previous chapters have outlined the progress of a number of cities on the path to a low carbon future. Throughout this publication, significant evidence demonstrates the impact the green growth ambitions, and the effect that a small geographical area, can have on the emissions profile, labour market and innovation dynamics in local areas.

A critical component of understanding green growth at the local level is assessing how useful the green growth indicator framework developed by the OECD as part of the Green Growth Strategy is at describing and, over time, measuring the green economy transition at the local level. Is the framework increasing understanding of the transition at the local level, and if so in what areas? And if not, what are the important missing elements and how might we start to fill the gaps, whether with proxies or suggestions for further data collection in the future?

In the introduction to this report, the OECD definition of green growth was outlined. This definition acknowledges that green growth has several dimensions, and the opportunities for growth will occur through varying sources including:

- New opportunities emerging from new markets and activities;
- Net growth emerging from greening activities across the entire economy;
- Growth that takes into account the environmental impacts and externalities of our current production and consumption activities.
- Local indicators of green growth will differ from the national level in three areas:
  - Composition of stocks at a defined level of geography;
  - Available policy levers and jurisdictions;
  - Data availability.

Green growth indicators must begin from a baseline. If we are to accurately assess green growth then this baseline will need to incorporate natural assets, including the stocks of renewable and non-renewable resources. Each area also has an array of existing production structures (its production function), including the labour force and capital stock (machinery, built environment etc). These existing activities and assets will shape the trajectory of the local area's pathway to a low carbon future.

Local trajectories will be unique for each area because of the different compositions of stocks and activities. At the national level, the aggregation of these activities masks some of the winners and losers of the transition to greener growth. This makes the importance of understanding and communicating pathways at a local level a different, but no less important, task than at the national level.

The policy responses available to local policy makers to direct the transition pathway are more curtailed than at the national level, for example, most local authorities do not have significant taxation revenue raising powers. However, policy makers at the local level have the ability to interact closely with their citizens, and can influence policy that has a direct impact on the daily way of life, for example through waste, recycling, and active and public transport options. Therefore, the same set of economic opportunities and available policy responses that exist at the national indicator level will not be suitable at the local level. Finally, data on all the measurement variables are not available at the local level. This is where proxies and other future data collection exercises will need to fill important gaps.

Table 5.2 shows the OECD Green Growth Indicator framework and the relevance of indicator variables to the assessment of each of the five regional areas that took part in this OECD study. In assessing each of these variables, the above three constraints were used to filter the indicator framework in order to isolate the variables considered to be the most relevant for understanding low carbon transition at the local level. Each variable is rated Low, Medium or High in terms of its ability to contribute to the green growth assessment at the local level.

The highly rated variables are in labour market characteristics and dynamics (unemployment rates, educational attainment, labour force training and skills development), resource productivity (energy, water and carbon productivity) and the knowledge intensity of the city, which is linked to its ability to embrace green economy opportunities (innovation and patenting activity, size and growth of the environmental goods and services industry).

The effectiveness of policy responses in encouraging these green economy opportunities and ensuring the net economic benefit is captured is also seen as an important measurement variable.

**Figure 5-2 Relationship between local and national green growth indicators**

| | | Copenhagen | Belval | Ghent | Brandenburg |
|---|---|---|---|---|---|
| **Economic growth, productivity and competitiveness** | GDP growth | M | M | M | M |
| | Net disposable income | M | M | M | M |
| | Labour productivity | M | M | M | M |
| | Trade weighted unit labour costs | M | M | M | M |
| **Labour markets, education and income** | Labour force participation | M | M | M | M |
| | Unemployment rates | H | M | M | M |
| | Population growth | H | H | M | M |
| | Life expectancy | M | L | M | M |
| | Income inequality | M | H | M | M |
| | Educational attainment | H | H | H | H |
| **Environmental and resource productivity** | Co2 productivity | H | H | H | H |
| | Energy productivity | H | H | H | H |
| | Material productivity (non-energy) | L | H | L | L |
| | Water productivity | H | M | M | M |
| | Multi-factor productivity | M | L | M | M |
| **Natural asset base** | Freshwater resources | L | M | L | L |
| **Renewable stock** | Forest resources | L | H | L | L |
| | Fish resources | L | L | L | L |
| | Mineral resources | L | L | L | L |
| **Non-renewable stocks** | Land resources - land use state and changes | H | H | M | M |
| **Biodiversity and ecosystems** | Soil resources - agricultural land affected by soil erosion | L | M | L | L |
| | Wildlife resources - endangered species | M | L | L | L |
| **Environmental quality of life** | Environmentally induced health problems - exposure to air pollution | M | H | H | H |
| **Environmental health** | Exposure to natural or industrial related losses | M | H | H | H |
| **and risks** | Connection to sewage treatment | H | H | H | H |
| | Connection to safe drinking water | H | H | H | H |
| **Economic opportunities and policy responses** | Renewable energy R&D | H | H | H | H |
| **Innovation** | Environmental technologies R&D | H | H | H | H |
| | All purpose R&D | H | M | H | H |
| | Environmentally related patents | H | M | M | M |
| **Patents important to GG** | All patents | M | M | M | M |
| | Gross value add of EGS | M | M | M | M |
| **Environmental goods** | Employment in EGS | M | H | M | M |
| **and services** | Official development assistance | L | L | M | M |

| | | | | | |
|---|---|---|---|---|---|
| | Carbon market financing | M | M | M | M |
| **International financial flows important to GG** | Foreign Direct Investment | M | M | M | M |
| | Environmentally related tax revenues | H | H | M | M |
| **Prices and transfers** | Structure of environmentally related taxes | M | M | M | M |
| | Energy pricing | M | H | M | M |
| | Water pricing and cost recovery | M | M | M | M |
| **Training and skills** | Students in EGS | H | H | M | M |
| | Courses in EGS | H | H | M | M |

High (H), Medium (M), Low (L)

The lower rated variables are not considered of lower importance in green growth, but of lower relevance to understanding green growth at the local level, due to the three reasons mentioned earlier (composition of stocks, availability of policy levers, and data availability). For example, indicators for natural assets resources such as forests and fisheries are not applicable to most regions as they do not have these resources (particularly urban ones), regions either do not have the capacity to effectively measure resources within their jurisdiction, or do not have the ability through their policy remit to influence how these natural stocks are used or depleted. Of primary importance in the creation of an indicator set is that it must be able to speak to the experience of the region, to exist within the sphere of influence of local activities, and be pragmatic.

As mentioned in the introduction, the purpose of the "Indicators of local transition to a low carbon economy" study is both to document evidence of specific local areas experience of transition to low carbon economy and to test the applicability of the OECD green growth indicator framework to understand this transition. The aim of the project in total is to advise local stakeholders on what is important to measure at the local level with Copenhagen being one of five test case studies. The results will then inform future OECD on measuring transition to low carbon economy in local areas.

Workshops were held with stakeholder in each of the local areas that participated to determine the significance of the indicator framework and to indicators that may be especially meaningful for understanding local components of green transition. Three groups of indicators were identified:

- Resource efficiency, but extended to include waste efficiency and the level of recycling within the local area;
- Knowledge intensity and green economy opportunities; and
- Policy responses to support green growth.

Development of these areas in partnership with other local areas within the *Indicators for local transition to a low carbon future* project led to the development of a refined set of indicators and data collection. An iterative process between case study areas and the OECD was then pursued to develop these areas into a modified local level indicator framework. Considerations used to shape this framework-included data availability, current and proposed policy activity, and an assessment of the literature on green jobs and skills for data collection methods and options.

The modified local level indicator framework was tested in each of the case study regions. Below are five theme areas for the framework.

1. *The socio-economic context:* This describes the social and industrial characteristics of the area under investigation. As noted earlier, local trajectories towards a low carbon economy will be strongly shaped by the existing industrial and human capital, therefore, it is important to show indicators within this context.

2. *Environmental and resource productivity:* This captures the headline resources' productivity figures for the local area.

3. *Economic opportunities:* This examines the capacity of the local areas to act on the low carbon opportunities, and includes measures for research and knowledge intensity, students and learning, and the value and number of jobs associated with the green economy.

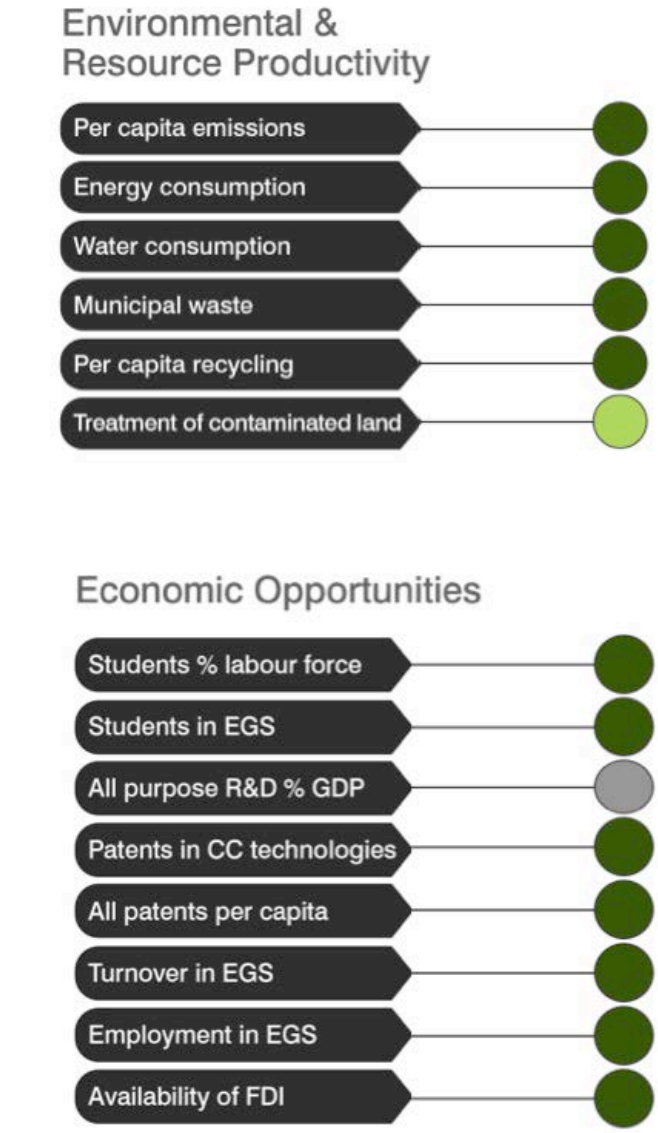
4. *Policy responses:* Each local jurisdiction has different policy levers available to them, but additionally, each jurisdiction has a different pattern of policy action and learning. Green policy is a new area of knowledge and policy development for many local and regional governments; they need to build not only political consensus for action, but also internal capability and capacity of policy design, implementation and evaluation. Theme 4 captures the progress of local policy actors in green policy making.

5. *Skills and training ecosystems:* Skills and training systems can be very path dependent and will require significant momentum and time to change. This theme captures the progress of green skills development in the local areas and the patterns of change in the skills and training ecosystems that will manage this progress.

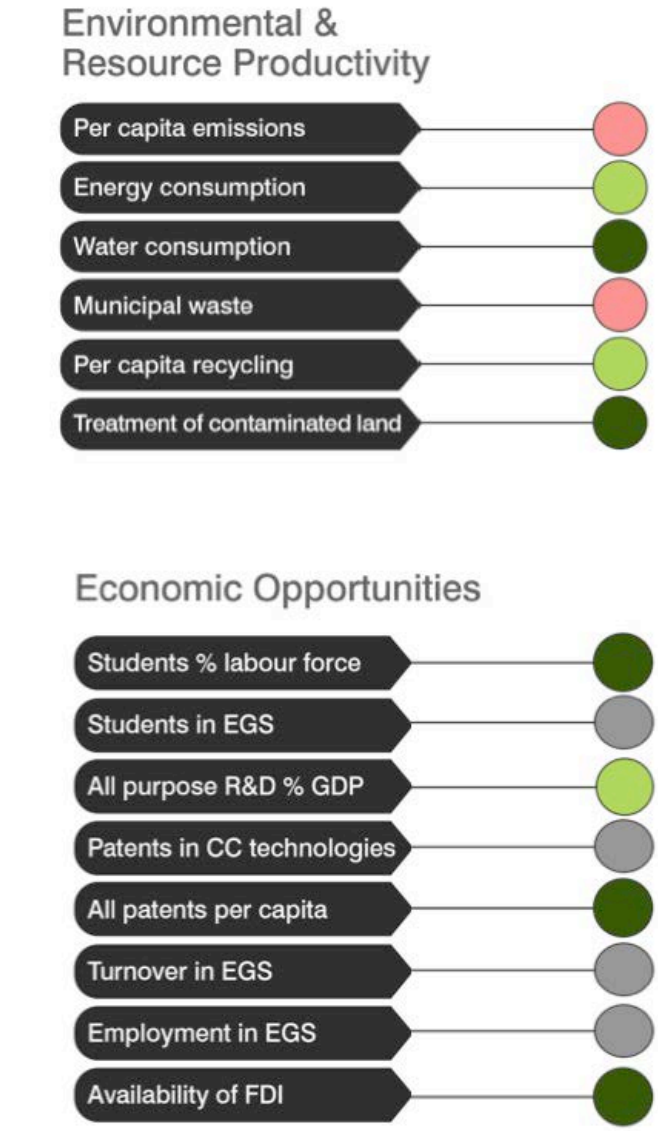
To analyse these further, and to provide a point of comparison across the four case study regions within the whole project, a 'dashboard' data visualisation tool is developed. The dashboard takes the indicators one step further and helps the information to be summarised and communicated. The dashboard tool has been used in numerous global indicator programmes, including the UN Commission for Sustainable Development and the Sustainable Development Index (SDI) in the USA.

The Local indicators dashboards for each of the case study areas are shown below. The data associated with each of the dashboards is provided in Annex A.

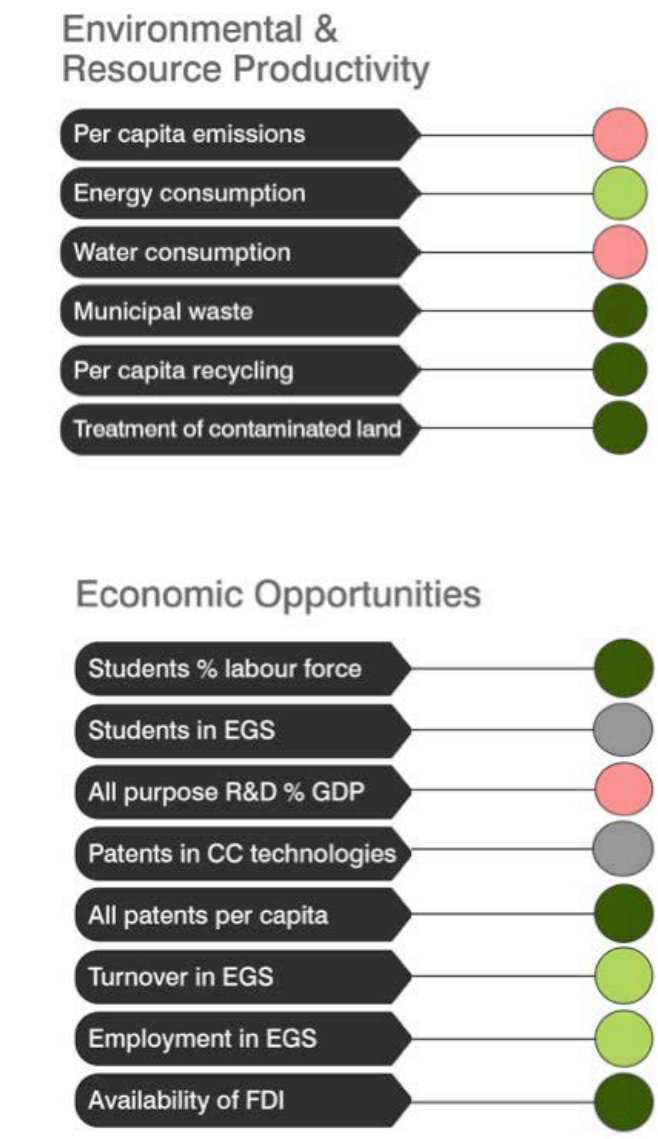
## Copenhagen Green Growth Dashboard



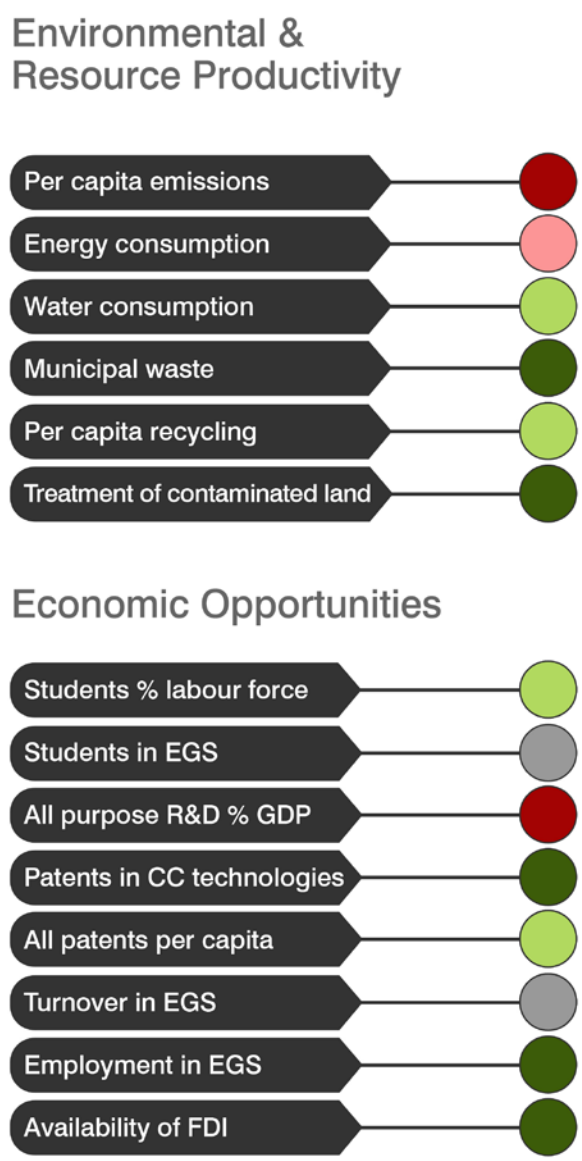
## Belval-Alzette Green Growth Dashboard



## Ghent-Terneuzen Green Growth Dashboard



## Brandenburg Green Growth Dashboard



## Summary

The dashboards show the varied conditions of the local areas that were investigated as part of this project. For some regions, a lot of progress towards green growth has already been made, for example in the case of Copenhagen City. In other areas current industrial composition, or legacies of carbon intensive industries make the transition to lower carbon sources of production a longer journey, such as in the case of Brandenburg and Belval.

There is also differences between the region on the type and availability of data sources to measure progress; some regions are well progressed with institutions and data sources, for example Ghent-Terneurzen. For other regions there were gaps in variables and sources of obtaining this information. In each case of missing information the issue is not just collecting this data, but establishing some protocol and resourcing institutions to be able to collect this data in an ongoing manner.

In each of the cases there were data gaps in the labour market impacts of green growth. In each case it was difficult to quantify the growth of environmental goods and service in terms of both employment growth but also business sector growth (through turnover). Copenhagen was the only city to have all these variables to hand, and this was because City institutions had specifically provided resources for their collection.

These are new areas of data collection, and as such data sets and analysis methodologies are immature; data collection for these variables will increase in frequencies and importance over coming years, and the local areas that prioritise collection now will be at an advantage into the future.

The dashboards can be used to show snapshots of conditions across comparative regions – such as how they have been used in this case. If regions use the dashboard technique over time, then time series data can be used to track progress.

### Lessons for other local areas in indicator development

#### *Approaching local indicators development – A Two-tiered approach to indicator development*

In light of the longitudinal nature of LCE transition, monitoring and indicator development are even more challenging, yet at the same time, necessary. Green growth and LCE transitions will take decades, and in order to know if and which policies, projects or instruments are driving the process in the right direction, valid indicators are indispensable.

It is important to understand that numerous local entities engaging in LCE transition or green growth processes do in fact measure and monitor what they are doing to some degree. Dozens of cities, provinces, and regions across the OECD member countries are working on ‘low-carbon’ futures. Their ambitions by definition include greenhouse gas emission reductions, energy productivity, and carbon intensity etc. Other omnipresent ambitions include the economic benefits connected to eco-innovation and green investments, such as competitiveness and job creation. However, measurements, indicator development, and reporting are neither coherent nor compatible. This also means that at present little meaningful knowledge is exchanged, few lessons based on solid comparison can be learned, and the basis for structured learning is often not present.

One of the essential challenges and difficulties in working with green growth or LCE indicators at the local level is that local realities and local processes of green growth differ widely. As a consequence, the development of indicators needs a two-tiered approach:

- Tier 1: Developing core indicators to measure transition towards the LCE. Suggestions: measure greenhouse gas emissions in the region; carbon intensity of the economy of the region; carbon intensity of employment in the region.

Without these measures, the LCE discourse is meaningless, because they make the link between the 'low-carbon' and the 'economy' parts of the LCE and green growth ambitions explicit. Without cutting the carbon intensity in both relative and absolute ways, the term low-carbon has little policy meaning. Studying the carbon intensity of employment acknowledges the link between the creation of jobs and future considerations.

- Tier 2: Additional regional and/or local indicators can supplement the Tier 1 indicators. This caters for the need to adapt indicators to meet local circumstances, objectives, priorities, and capacity. Given the enormous variety in local projects, this can only strengthen the relevance of indicator sets

The fact that local realities are very different, however, does not mean that learning from shared experiences cannot or should not be possible. In addition, more attention on the process of local indicator development is needed. The 'how' is probably just as important as the 'what' in local indicator development and use. Through the process of deciding 'what' to measure, monitor and use as indicators for goal attainment or performance measures, stakeholders can create networks, a joint purpose and motivation. In other words, policy processes should include indicators that have been developed, validated and measured by stakeholders, both public and private, in a process of co-creation. Additionally, indicators should be developed in this participatory way early in the process, as they can then generate support for the essential goals of the local policy process or project.

One of the advantages of a 2-tier approach, with additional emphasis on the participatory aspects of the process, is that exchange and learning within and between networks/communities of practice on indicators for a green economy and LCE can be formed, regardless of differences in the precise set of locally used indicators.

### *Deliberative and coordinated processes for indicator frameworks development*

Agreement on a set of common indicators and the mechanisms for measuring and populating these indicators firstly requires stakeholder engagement and agreement to inform and validate the indicator selection process. Through the deliberative process of deciding 'what' to measure, monitor and use as indicators for performance, stakeholders can develop a shared understanding and responsibility for developing and populating indicators. This in turn flows into the activities and responsibilities of the institutions from whence these stakeholders come (public, private, public) and develop a platform for co-operation. The guiding suggestion is to develop indicators in this participatory way early in the process, as they can generate support for the essential goals of the local policy process or project.

Co-ordination between relevant stakeholders in these planning and implementation processes and within regions can be *ad hoc* if one organisation or group of organisations has the responsibility, authority and resources to engage stakeholders in strategic planning and implementation processes. Institutional and regional boundaries rarely match-up and a pragmatic approach must be developed. One of the first tasks of such a process of stakeholder engagement could be the dissemination of research results from this project and the creation of an action plan to guide further work.

### *Defining suitable methodologies and metrics to assess green growth*

The indicators collected and analysed through the dashboard highlight areas in which progress is slow, or where the local context in terms of historical industrial legacies or current activity concentrations make local transitions difficult. Transitions will likely be lengthy, but if the progress of (greener) change can be monitored and reported at the local level, then the population and businesses of these areas can see first-hand the potential of the low-carbon economy in their area.

Measuring carbon emissions is going to be the most vital performance metric for assessing the low-carbon transition. Indicator development needs to provide a method by which to do this at the local levels, and in such a way that it takes into consideration the local context. For example, if a large percentage of the carbon emissions of the two areas is from transport and logistics infrastructure, which is clearly not an economic activity that is contained to the local region, but which sits at the regional or national level, then the data must allow this distinction to be made.

### *Identifying and resourcing local institutions to collect and report on indicators*

There is an important role for policy in prioritising the development of indicators to track progress, particularly given the amount of investment being made in each of these areas to facilitate transition. An important action for local authorities in partnership with regional and national authorities will be to identify and resource appropriate institution/s to collect and report this data in a consistent format, which provides comparative analysis on headline indicators at the local, national and international level.

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# Annex A: About each of the case study regions

## Copenhagen

The city of Copenhagen is home to 30 percent of Denmark's population. The Capital Region of Denmark (including outlying areas) accounts for more than 36 percent of Denmark's gross domestic product (GDP)4. Copenhagen is also the current centre of clean-tech activities in Denmark, with a strong partnership between the city's administration and the private sector. Figure 2.1 shows the Greater Copenhagen region.

Copenhagen ranks as one of the greenest and most liveable cities in the world in the same way that Denmark ranks among the top countries in various green innovation indexes (EIO 2010, 2011; Cleantech Group and WWF/Knowles 2012; WWF 2012). A component of the city's green growth policy lies in the creation of the Copenhagen Clean-tech Cluster (CCC), and the Capital Region of Denmark, comprised of more than 600 companies, many of which are global leaders in their field.

Copenhagen[27] has received many awards and high rankings for its green activities including:

- European Green Capital Award 2014 (European Environment Commission)
- The Green Building Award 2012 (the UN City in Copenhagen)
- Sustainability Award 2012 (for the Hilton Copenhagen Airport)
- 2nd in The Copenhagenize Index (after Amsterdam) as the most bicycle friendly big city in the world.
- Bike City Copenhagen, the first city to have been awarded the UCI Bike City label by the International Cycling Union.
- 3rd in quality of life rankings for the world's major cities (Monocle)
- Copenhagen is in the top 25 of the most competitive cities in the world (EIU)
- The easiest place to do business in Europe (The World Bank)
- 3rd in human capital in the World (EIU)

[16] *Source:* **http://www.visitcopenhagen.com/media/leisure-news/news/news/prestigious-titles-and-rankings-to-copenhagen and http://copenhagenize.eu/index/,** WWF 2012**,** EIO, 2011

## The Benelux Union

The Benelux Union is an inter-governmental union of three states: Belgium, the Netherlands and Luxembourg (see map below). The Union was set up by the governments of Belgium, the Netherlands and Luxembourg after the Second World War. The organisation is a pioneer in the construction of co-operative instruments. After the initial common venture in 1944, which was that of a customs agreement, in 1960, the three countries abolished their border controls. With the establishment of the Benelux Convention on Transfrontier Co-operation in 1986, the Benelux countries were amongst the first to implement the Framework Convention of Madrid (1980), which was designed by the Council of Europe to stimulate territorial cross border co-operation.

The population of the Benelux region is over 28 million people. Since its inception in 1944, it has developed into an economic, political and cultural union over the succeeding years. The Benelux Union provides an excellent example of a cross-border region that has developed a sophisticated cross-border institutional make-up.

## Ghent-Terneuzen[28]

This case is located in the province of Eastern-Flanders,home to 1 458 872 inhabitants (Provincie Oost-Vlaanderen, 2012a), of which 243 366 live in Ghent (Studiedienst van de Vlaamse Regering, 2012c). The surface of the province of Eastern-Flanders consists of 300 794 hectares, so the population density of the province is 485 people per km². The population density of Ghent is 1558 people per km².

The size of the city of Ghent is 15 618 hectares (Studiedienst van de Vlaamse Regering, 2012c). The number of inhabitants of Ghent has increased by 7% over the last decade and is expected to keep increasing by another 6.2% by 2020 (Studiedienst van de Vlaamse Regering, 2012c). Compared to the average population growth in the Flemish Region (4.3%), the city of Ghent is a growing city, to which young people in particular are attracted to migrate. In 2010, 10.9% of the inhabitants of Ghent were foreigners, and this number is expected to increase (Studiedienst van de Vlaamse Regering, 2012c).

The province of Zeeland has significantly less inhabitants than the province of Eastern-Flanders. In 2010, 381 409 people lived in the province of Zeeland, of which 54 733 lived in Terneuzen (Centraal Bureau voor de Statistiek, 2012). Its land area is approximately 195 333 hectares (Provincie Zeeland, 2012b), of which 25 140 hectares comprises the city of Terneuzen (Centraal Bureau voor de Statistiek, 2012). The population density of the provinces of Zeeland and the City of Terneuzen respectively are 195 people per km² and 218 people per km².

## Alzette-Belval

This case study is located in the southern region of Luxembourg (Esh-Belval) and the cross-border area in France (Alzette), a 'European Grouping of Territorial Co-operation' area (EGTC) 29 The EGTC comprises four municipalities in Luxembourg and eight

[28] In general, there are no specific data for this region of analysis: whether we delineate it as Euroregion Scheldemond or the Ghent-Terneuzen port area. To overcome this gap in data, data are combined for the provinces of Eastern-Flanders (BE) and Zeeland (NL).

[29] European Grouping of Territorial Cooperation; https://portal.cor.europa.eu/egtc/en-US/discovertheegtc/Pages/welcome.aspx

municipalities in France. The area lies in the centre of a region largely devoted to steel production over the last century. The governance instrument of the EGTC Alzette-Belval is of particular strategic significance for Luxembourg, as it presents a platform in which both the state and municipalities can engage to foster targeted cooperation on key local issues amongst Luxembourg and French municipalities. Cross-border cooperation in this case mainly considers the development of urban areas, transport infrastructures, and green industrial development.

One reason for the selection of this particular area is that Luxembourg's largest state-driven development project 'Esch-Belval' lies in the heart of this territory. This development project of industrial wasteland left by the steel industry includes the building of a City of Science and Innovation in order to promote new knowledge-based development dynamics in an area the fate of which was tightly linked to that of the declining steel industry. A central ambition of this case is thus to consider the development of approaches to assessing and evaluating the influence of this large urban development of industrial wasteland including the building of a Science City on regional economic and social development, also with a view to promoting green growth and transition to a low-carbon economy.

The industrialised southern region of Luxembourg, with an area of 200 km2 and 15 600 inhabitants is the most densely populated in the country, with an average of 761 inhabitants per km2 in 2011. The population density has been increasing steadily, from 670 inhabitants per km2 in 2001 up to 715 in 2007. Between 2001 and 2006 over 80% of the population increase was due to migration. The south is the region in which there is the largest proportion of blue collar workers; in 2007, over 46 % of the population had this status, compared to 37% in the rest of the country.30

With 30 975 inhabitants in 2012, the city of Esch-sur-Alzette is the second largest city in the country, and was for long considered the centre of the Luxembourg steel industry. Since 2001, there was close to a 12% increase in the total population and a 22% increase in the active working population. In 2012, the density of the city of Esch-sur-Alzette, with 2 158 inhabitants per km2, exceeds that of the City of Luxembourg. In 2001, the density was 1 900 and in 2007 it was just over 2 000 inhabitants per km2. This density facilitates the building of effective public transport infrastructure and can create critical mass for innovative housing projects.

The majority of the residents are of Luxembourg (14 209) or Portuguese nationality (10 363). Of note in all statistics for the region is the discrepancy between the Luxembourg nationals and residents of foreign nationality, the majority of which are Portuguese. Figure 2.10 shows the mean age of foreign residents to be about ten years younger than that of Luxembourg nationals. The mean age increased by over one year between 2001 and 2007, and the life expectancy of the citizens is 80 years.

## Brandenburg, Berlin

The Federal State of Brandenburg is one of 16 Federal States of the Federal Republic of Germany. The Federal State of Brandenburg has its own State Government with its own policies, as do the other 15 Federal States. One such policy implemented in 2004 was that the Federal Government started to concentrate on funding 15 so-called Regional Growth Cores (RGCs). The idea is to 'strengthen the strengths', which means to support economic growth and employment and to use subsidies in a more efficient way in each of these RGCs.

[30] PROSUD: Emploi Resident Sud 2007.

Each RGC defined a concept with concrete activities concerning optimisation of infrastructure, development of business parks, personnel development, technology transfer etc. Experts and politicians evaluate the results of these measures periodically. Results to date have been positive. The RGCs are success factors in the economic development of the Federal State of Brandenburg. They will therefore continue over the coming years (see: STK, 2012b; STK, 2012c; STK, 2012d).

Figure 2.1 shows the Federal State of Brandenburg and the capital of Germany, Berlin. Both Federal States contain the metropolitan area of Berlin-Brandenburg, which is the core of the Berlin-Brandenburg metropolitan region. In a broader regional context, metropolitan regions are considered as motors, innovators and problem-solvers. The Berlin-Brandenburg metropolitan region is one of eleven metropolitan regions in Germany. In terms of population, Berlin-Brandenburg is the second biggest metropolitan region. With regard to the number of employed persons who are subject to social security contributions, the region is in fifth position out of eleven and in seventh place concerning gross domestic product (Deutsche Metropolregionen, 2010, p. 5).

The Regional Growth Core Schönefelder Kreuz (highlighted in purple in Figure 2.2) is a part of this Metropolitan Area Berlin-Brandenburg. It is located to the south-west of Berlin in a very central part of Brandenburg and combines the municipalities of Schönefeld, Wildau and Königs Wusterhausen.

The distance between Schönefelder Kreuz and Berlin city centre is about 20 kilometres; the distance between Schönefelder Kreuz and the Polish border in the east of Brandenburg (on the right hand side in Figure 2.1) is about 70 kilometres. Neighbouring communities, including the Growth Core, comprise 100 000 inhabitants. That means that Schönefelder Kreuz has a catchment area of about 110 000 people (RWK Schönefelder Kreuz, 2009, p. 13).

These few facts show that the RGC Schönefelder Kreuz has a prominent position in the Federal State of Brandenburg as well as in the Federal Republic of Germany and in Europe. The following detailed chapters of this regional report underpin this statement. They particularly illustrate that the Regional Growth Core Schönefelder Kreuz is a success story and that the new BER Berlin Brandenburg Airport dominates the RGC´s position. The airport is seen as a major driver of future economic activity in the region.

## Chile

Chile is one of the countries with higher economic development in Latin America. The country’s GDP has more than double in the last 20 years, which has helped to improve the quality of life of its citizens. The Central Bank of Chile confirmed recently that Chile's gross domestic product grew 5.6% in 2012. Thus, the GDP was approximately of 268 billion dollars, which means a GDP per capita of nearly 16,200 dollars. Projections of the Organization for Economic Co-operation and Development (OECD) foresee that Chile will lead growth among member countries by 2014.

However, this growth rate has begun to a slowdown in 2013 due to the fall in prices of raw materials and effects of the global economic crisis. Moreover, according to the IMD World Competitiveness Center (WCC) of Switzerland, Chile ranks in 2013 the 30th place (out of 60 countries), which implies a decline as the country ranked 28th in 2012 and 25th place in 2011.

# Annex B: data Sheets for dashboards

## Copenhagen dashboard data sheets

| Socio-economic context | Copenhagen data | Unit | Source |
|---|---|---|---|
| Entrepreneurship rate | 130 new firms in 2011 | Firms | http://www.ebst.dk/publikationer/ivaerksaettere/ivaerksaetterindex_2011/978-87-92518-69-9.pdf |
| Firm survival rate | 72.30% | % | http://www.ebst.dk/publikationer/ivaerksaettere/ivaerksaetterindex_2011/978-87-92518-69-9.pdf |
| Employment creation | 68,000 less out of 958,235 workforce in second quarter 2011 | Persons in capital region | Statistics Denmark http://www.regionh.dk/NR/rdonlyres/E7C13EC2-D8C7-4CE8-8AA4-E8D46A0A066B/0/Erhvervsanalyse_2011.pdf |
| Productivity | DKK 375000 (2010), 355000 (2009) | DKK/per capita | Statistics Denmark |
| Educational attainment | 49% | Persons aged 25-34 | Regional Konkurrenceevneredegørelse 2011. Erhvervs- og byggestyrelsen. |
| Income per worker | DKK 309.296 per year (2010) | DKK/ employee | http://www.statistikbanken.dk/statbank5a/default.asp?w=1525 |

| Environmental and resource productivity | Copenhagen data | Unit | Source | Comparison | Source |
|---|---|---|---|---|---|
| Per capita emissions | 4.7 | t/per capita | CCC Climate Change Plan http://ec.europa.eu/environment/europeangreencapital/wp-content/uploads/2012/07/Section-1-Local-contribution-to-climate-change_Copenhagen.pdf | Compared to OECD average 10.36137828, 6.11 for Denmark | OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |

| | | | | | |
|---|---|---|---|---|---|
| Energy consumption | 0,4828 PJ per 1 Billion DKK | DDKoutput/PJ | Data on gross energy consumption (846 PJ in 2010) seems only available on national level. Danish GDP in 2010: 1754648 M DKK | Compared with OECD average $6(US) | OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| Water consumption | 41.3 | kL/per capita | Approx. 108L per day per capita – Source: Copenhagen City. Calculated an annual figure in KL for comparison. | Compared with OECD average 870kL/annum, Danish average 130kL | OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| Municipal waste collection | 247 | kg/per capita | http://www.mst.dk/Virksomhed_og_myndighed/Affald/Tal_for_affald/Statistikker_og_ISAG-dataudtraek/ISAG.htm | Compared with OECD 540kg/per capital (2009) and 830kg/capita Denmark | OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| Recycling per capita | 131 | kg/per capita | http://www.mst.dk/Virksomhed_og_myndighed/Affald/Tal_for_affald/Statistikker_og_ISAG-dataudtraek/ISAG.htm | 121t/per capita EU countries (Eurostat 2009) 154kg/c | OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| Treatment of contaminated land | 1 | Binary 1= yes, 0=no | http://www.regionh.dk/menu/Miljoe/Jordforurening/Offentligindsatsi2012/ | 1 | Binary 1= yes, 0=no |

| **Economic opportunities** | | **Unit** | **Source** | **Comparison** | **Source** |
|---|---|---|---|---|---|
| R&D employment | 24.10526316 | Per 1000 employees | http://www.regionh.dk/NR/rdonlyres/E7C13EC2-D8C7-4CE8-8AA4-E8D46A0A066B/0/Erhvervsanalyse_2011.pdf | Compared with 6.3 EU27 average and Denmark 12.3 | OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - ©OECD 2011 |
| Educational Attainment of the workforce (All post secondary school education) | 44.3 | % of work force | Statistics Denmark 2011 | 43.63% (Denmark, 2011) 31% (OECD Average – derived from 35 of 41 member countries 2011) | Source: Denmark figures - http://www.dst.dk/en/Statistik/emner.aspx OECD figures - Education at a Glance 2012: OECD Indicators |
| Students in environmental subjects | | % of work force | No local data sources – National figures use | 0.006% | http://www.kemin.dk/da-DK/KlimaogEnergipolitik/danmark/uddannelseforskningudviklingogdemonstratio |

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|---|---|---|---|---|---|
| | | | | | n/grønne-uddannelser-og-arbejdsmarkeder/Sider/Forside.aspx plus author calculations |
| All purpose R&D | 4% | regional GDP | http://www.ebst.dk/publikationer/RU/regional_konkurrenceevneredegoerelse_2010/kap05.htm | Compared with 2.33 OECD average, 3.03 Denmark (2010) | OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| Triadic patent applications for climate change mitigation technologies | 0.000680042 | per million | OECD Regions at a Glance 2011 | National data, compared with OECD 0.000992 | OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| All patents | Used national level | per mill population | Used national level | Compared with OECD average 37.3, Denmark 50.56 | OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| Turnover of EGS industries | 50,992 | DKK million (2009) | DAMVAD (2011) Green Growth in Copenhagen | 153,745 (million DKK) Denmark (2009) | DAMVAD (2011) Green Growth in Copenhagen |
| Employment in EGS | 24,674 | persons (2009) | DAMVAD (2011) Green Growth in Copenhagen | 76,076 (employees) Denmark (2009) | DAMVAD (2011) Green Growth in Copenhagen |
| Foreign Direct Investment | 1 | Binary 1= yes, 0=no | Copenhagen Capacity, internal data 2012 | 1 | Binary 1= yes, 0=no |

## Benelux Dashboard data sheets

| Socio-economic context | Ghent-Terneuzen data | Alzette-Belval* data | Unit | Source |
|---|---|---|---|---|
| Entrepreneurship rate | 42200-27100 (VRIND 2012) | 678 in 2010 (an increase of 2,7% in firms cf 2006 (2007)) | Firms | Ghent (Flanders region) – VRIND<br>Belval - http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=680&IF_Language=fra&MainTheme=4&FldrName=1&RFPath=43<br>http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=678&IF_Language=fra&MainTheme=4&FldrName=1&RFPath=43 |
| Firm survival rate | 72.1% (alive in 2010 after 5 years) | 55% (2010) | % | Ghent (Flanders region) – VRIND<br>Belval - http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=682&IF_Language=fra&MainTheme=4&FldrName=1&RFPath=7516; |
| Employment creation | na | 6857 | Persons in capital region | Belval - http://www.adem.public.lu/actualites/2013/01/news_12_12/Bulletin_dec_2012.pdf |
| Productivity | na | 82100 € = 111286.55 $ | $US/per capita | Luxembourg - http://www.statistiques.public.lu/catalogue-publications/note-conjoncture-en/2010/Economic-update-2-2010.pdf |
| Educational attainment | 73% | 77.3% (2011) | Persons aged 25-34 | Ghent (Flanders region) – VRIND<br>Belval - http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tps00065&plugin=1 |
| Income per worker/month | 2977 | 3033* | EU | Ghent (Flanders region) – National Bank<br>Luxembourg - http://www.statistiques.public.lu/catalogue-publications/luxembourg-en-chiffres/luxembourg-figures.pdf |

| Environmental and resource productivity | Ghent data | Belval data | Unit | Sources | Comparison | Source |
|---|---|---|---|---|---|---|
| Per capita emissions | 11.81 | 23.1* | t/per capita | Ghent (Flanders region) - VMM Mira data 2010<br>Luxembourg figure – Département de l'Environnement Ministère du Développement durable et des Infrastructures | Compared to OECD average 10.36137828 | 1. OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| Energy consumption | 13.9 | 166.11* | €/PJ | Ghent (Flanders region) - VMM Mira data 2010<br>Luxembourg (2010) - Département de l'Environnement Ministère du Développement durable et des Infrastructures | Compared with OECD average $6(US) | OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| Water consumption | 1160kL | 800kL* (80m3)(2009) | kL/per capita/per annum | Ghent (Flanders region) -VMM Mira data 2010<br>Luxembourg - http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Water_statistics | Compared with OECD average 870kL/annum, | OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| Municipal waste collection | 525 | 237 | kg/per capita | Ghent (Flanders region) - OVAM, 2010<br>Esch Canton (2010) - http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=382&IF_Language=eng&MainTheme=1&FldrName=3&RFPath=65 | Compared with OECD 540kg/per capital (2009) and | OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| Recycling per capita | 374 | 180* | kg/per capita | Ghent (Flanders region) - OVAM, 2010<br>Luxembourg (2010) - Département de l'Environnement Ministère du Développement durable et des Infrastructures | 121t/per capita EU countries (Eurostat 2009) | OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| Treatment of | 1 | 1 | Binary 1= yes, | Ghent (Flanders region) - OVAM, Flemish | 1 | Binary 1= yes, 0=no |

| | | | | | | |
|---|---|---|---|---|---|---|
| contaminated land | | | 0=no | decree on soil sanitation | | |

| **Economic opportunities** | **Ghent data** | **Belval data** | **Unit** | **Source** | **Comparison** | **Source** |
|---|---|---|---|---|---|---|
| R&D employment | 8.5 (2010) | No local data available | Per 1000 employees | Ghent - ECOOM statistics 2011 | Compared with 6.3 EU27 average (Source #1), Netherlands - 4,489 miljoen werkenden Luxembourg national data 6.8 (2009) | 1. OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - ©OECD 2011 |
| Students in the labour force | 4.3% | No local data available | % of work force | Ghent - VRIND | Luxembourg national data 2.39% (2011) University students only | |
| Students in environmental subjects | No local data available | No local data available | % of work force | | Na | No available sources |
| All purpose R&D | 2.01% (2009) | No local data available | Regional GDP | Ghent - ECOOM statistics 2011 | Compared with 2.33 OECD average (2011) (Source #1), 2.8 ,Luxembourg national data 1.68% of GDP | 1. OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| Triadic patent applications for climate change mitigation technologies | No local data available | No local data available | per million | | | 1. http://pdwb.de/nd05.htm#2010 (accessed: 18 February 2013)<br>Source #3: http://www.statistik-berlin-brandenburg.de/produkte/Faltblatt_Brochure/brandenburg_in_Zahlen_de.pdf (accessed: 18 February 2013) |
| All patents | 120 (2008) | No local data available | per mill population | Ghent - ECOOM statistics 2011 | Compared with OECD average 37.3 (2009) (Source #1), Luxembourg national data 61.2 (2010) | 1. OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| Turnover of EGS industries | 13.4 billion (2010) | No local data | $US million | Ghent - LNE | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | available | | | | |
| Employment in EGS | 63400 (2012 - source #1), 36902 (2010 – source #2) | No local data available | persons (2009) | Ghent – Source #1 VRIND report 2012, Source #2 LNE report. | Netherlands - 77000 (2005) national planning bureau | |
| Foreign Direct Investment | 1 | 1 | Binary 1= yes, 0=no | | | |

## Brandenburg, Berlin Dashboard data sheets

| **Socio-economic context** | **Schönefelder Kreuz data** | **Unit** | **Source** |
|---|---|---|---|
| Entrepreneurship rate | 187<br>(Dahme Spreewald; in 2010; ) | Firms | http://www.statistik-berlin-brandenburg.de/produkte/jahrbuch/jb2011/JB_2011_BB.pdf, p. 438<br>(accessed 09 February 2013) |
| Firm survival rate | 96.09% | % | http://www.statistik-berlin-brandenburg.de/produkte/jahrbuch/jb2011/JB_2011_BB.pdf, p. 451 |
| Employment creation | 1971<br>(RGC Schönefelder Kreuz) | Persons in capital region | Regional Report Figure 2.8 – Ratio of employees being subject to social insurance contribution: Municipalities in the BER periphery (2004: 100%)<br>Source: Becker, C. et al., 2012, p. 50. |
| Productivity | $150000<br>(Dahme Spreewald; in 2008) | $US/per capita | http://www.statistik-berlin-brandenburg.de/produkte/jahrbuch/jb2011/JB_2011_BB.pdf, p. 451 (accessed 09 February 2013)<br>1 € = 1.33 $ (http://www.finanzen.net/waehrungsrechner/; accessed 18 February 2013) |
| Educational attainment | Federal State of Brandenburg in 2009: | Persons aged 25-34 | Source: http://www.berlin.de/imperia/md/content/sen-bildung/bildungsstatistik/bildungsbericht_isq_2010.pdf?start&ts= |

| | | | |
|---|---|---|---|
| | Without general education: 1.7%<br>ISCED 2A: 72.7%<br>ISCED 3A: 25.6% | | 1302080419&file=bildungsbericht_isq_2010.pdf, p. 69 (accessed 18 February 2013) |
| Income per worker | $35236 (Federal State of Brandenburg; in 2006) | $US/ employee | http://www.statistik-berlin-brandenburg.de/produkte/jahrbuch/jb2011/JB_2011_BB.pdf, p. 490 (accessed 09 February 2013)<br>1 € = 1.33 $ (http://www.finanzen.net/waehrungsrechner/; accessed 18 February 2013) |

| **Environmental and resource productivity** | **Schönefelder Kreuz data** | **Unit** | **Source** | **Comparison** | **Source** |
|---|---|---|---|---|---|
| Per capita emissions | 22 Federal State of Brandenburg | t/per capita | http://www.mugv.brandenburg.de/cms/media.php/lbm1.a.3310.de/kginv10.pdf; p. 11 (accessed 18 February 2013) | Compared to OECD average 10.36137828, 9 for Germany | 1. OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| Energy consumption | End energy consumption per 1,000 € GDP = 4 PJ (0.10 MToE) | PJ/$1billion $US | https://www.statistik-berlin-brandenburg.de/Publikationen/Stat_Berichte/2013/SB_E04-04-00_2010j01_BB.pdf (accessed 1st July, 2013) | End energy consumption per 1,000 € GDP = 6.36 PJ (EU27)<br>End energy consumption per 1,000 € GDP = 5.9 PJ (Germany) | http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Consumption_of_energy (Accessed 1st July 2013) |
| Water consumption | Water consumption per capita in the Federal State of Brandenburg = 98L/day 35.8kL/annum | kL/per capita/ annum | http://www.epochtimes.de/bundesbuerger-senken-ihren-wasserverbrauch-weiter--498182.html (accessed 1st July, 2013) | Compared with OECD average 870kL/annum, | OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |

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|---|---|---|---|---|---|
| Municipal waste collection | 385kg (2010) | kg/per capita | http://www.brandenburg.de/cms/media.php/lbm1.a.3310.de/bilanz2010.pdf (accessed 1st July, 2013) | Compared with OECD 540kg/per capita (2009) and 597 kg/capita Germany (2011) | OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011<br>http://de.statista.com/statistik/daten/studie/152320/umfrage/kommunales-abfallaufkommen-in-der-eu-27/ (accessed 1st July, 2013) |
| Recycling per capita | 189 Federal State of Brandenburg (2009) | kg/per capita | http://www.mugv.brandenburg.de/cms/media.php/lbm1.a.3310.de/bilanz2011.pdf, Table 6 | 121t/per capita EU countries (Eurostat 2009) (Source #1)<br>282kg/c in Germany (Source #2) | 1. OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011<br>2. http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/8-08032011-AP/EN/8-08032011-AP-EN.PDF (accessed: 18 February 2013) |
| Treatment of contaminated land | 1 | Binary 1= yes, 0=no | Source: http://www.gesetze-im-internet.de/bundesrecht/bbodschg/gesamt.pdf (accessed 18 February 2013) | 1 | Binary 1= yes, 0=no |

| **Economic opportunities** | **Schönefelder Kreuz data** | **Unit** | **Source** | **Comparison** | **Source** |
|---|---|---|---|---|---|
| R&D employment | 10.9 Federal State of Brandenburg | Per 1000 employees | https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/BildungForschungKultur/ForschungEntwicklung/Tabellen/FuEPersonalBundeslaenderSektoren.html (accessed: 18 February 2013) | Compared with 6.3 EU27 average (Source #1) and Germany 20.9 (Source #2) | 1. OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - ©OECD 2011<br>2. http://statistik.arbeitsagentur.de/nn_31966/SiteGlobals/Forms/Rubrikensuche/Rubrikensuche_Form.html?view=processForm&resourceId=210368&input_=&pageLocale=de&topicId=17 |

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|---|---|---|---|---|---|
| | | | | | 362&year_month=201012&year_month.GROUP=1&search=Suchen (accessed: 18 February 2013) |
| Students in the labour force | 6.78% Federal State of Brandenburg | % of work force | https://www.destatis.de/DE/Publikationen/Thematisch/BildungForschungKultur/Schulen/SchnellmeldungAusbildungsberichterstattung5211002117004.html (accessed: 18 February 2013) | 7.49% of workforce in Germany | http://statistik.arbeitsagentur.de/nn_31966/SiteGlobals/Forms/Rubrikensuche/Rubrikensuche_Form.html?view=processForm&resourceId=210368&input_=&pageLocale=de&topicId=17362&year_month=201012&year_month.GROUP=1&search=Suchen (accessed: 18 February 2013) |
| Students in environmental subjects | NA | % of work force | No available sources | Na | No available sources |
| All purpose R&D | 1.5% (2010) Federal State of Brandenburg | Regional GDP | https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/BildungForschungKultur/ForschungEntwicklung/Tabellen/FuEAusgabenUndBIPZeitreihe.html (accessed: 18 February 2013) | Compared with 2.33 OECD average (2011) (Source #1), 2.8 Germany (2010) (Source #2) | 1. OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011<br>2.https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/BildungForschungKultur/ForschungEntwicklung/Tabellen/FuEAusgabenUndBIPZeitreihe.html (accessed: 18 February 2013) |
| Triadic patent applications for climate change mitigation technologies | 3 (2007-2010) Federal State of Brandenburg | per million | http://www.foederal-erneuerbar.de/landesinfo/kategorie/forschung/bundesland/D/auswahl/217-anzahl_der_patente_i/#goto_217 (accessed: 18 February 2013) | 5 (2007-2010) in Germany (Source #1)<br>OECD 0.000992 (Source #2) | 1. http://pdwb.de/nd05.htm#2010 (accessed: 18 February 2013)<br>Source #3: http://www.statistik-berlin-brandenburg.de/produkte/Faltblatt_B |

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|---|---|---|---|---|---|
| | | | | | rochure/brandenburg_in_Zahlen_de.pdf (accessed: 18 February 2013)<br>2. OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011 |
| All patents | 120 (2007-2010) Federal State of Brandenburg | per mill population | http://www.parldok.brandenburg.de/parladoku/w5/drs/ab_3200/3206.pdf (accessed: 19 February 2013) and http://www.statistik-berlin-brandenburg.de/produkte/Faltblatt_Brochure/brandenburg_in_Zahlen_de.pdf (accessed: 19 February 2013) | Compared with OECD average 37.3 (2009) (Source #1), Germany 727 (2007-2010) (Source #2) | 1. OECD Factbook 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011<br>2. http://www.hannover.ihk.de/ihk-themen/innovation-umwelt/innovation/innovationsprozess/schutzrechte-patente/management-tipps/patentstatistikzahlenfuer2011.html?type=123 (accessed: 18 February 2013)<br>and http://pdwb.de/nd05.htm#2010 (accessed: 18 February 2013) |
| Turnover of EGS industries | na | $US million | No local data available | 8% in 2007 and 14% in 2020 estimated (Federal Republic of Germany; p. 30) | http://www.mugv.brandenburg.de/cms/media.php/lbm1.a.2315.de/uwirtschaftbb.pdf (accessed: 19 February 2013) |
| Employment in EGS | 22,000 (2009) Federal State of Brandenburg | persons (2009) | http://www.recyclingmagazin.de/rm/news_detail.asp?ID=14911&NS=1 | 101,608 (2007) | http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_ac_egss1&lang=en (accessed: 18 February 2013) |

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|---|---|---|---|---|---|
| Foreign Direct Investment | 1 | Binary 1= yes, 0=no | https://sixcms.brandenburg.de/media_fast/3246/Entwicklungspolitische_Leitlinien_BB.pdf (accessed 19 February 2013) and http://entwicklungspolitik-brandenburg.mixxt.de/ (accessed: 19 February 2013 | 1 | http://www.bmz.de/de/index.html (accessed: 19 February 2013) |