



PBL Netherlands Environmental  
Assessment Agency

# Green gains

IN SEARCH OF OPPORTUNITIES FOR THE DUTCH ECONOMY



# GREEN GAINS

In search of opportunities for the Dutch economy

PBL  
Netherlands Environmental Assessment Agency

## **Green gains – In search of opportunities for the Dutch economy**

© PBL Netherlands Environmental Assessment Agency

The Hague, 2014

ISBN: 978-94-91506-62-8

PBL publication number: 1262

### **Corresponding author**

ton.manders@pbl.nl

### **Authors**

Aldert Hanemaaijer, Ton Manders, Otto Raspe

Martijn van den Berge, Laurens Brandes, Stefan van der Esch, Jos Notenboom and Melchert Reudink

### **Acknowledgements**

PBL wishes to thank Herman Stolwijk (formerly of CPB), Rick van der Ploeg (University of Oxford), Richard Tol (University of Sussex) and Marko Hekkert (Utrecht University) for reviewing the draft report. Thanks also go to the Scientific Council for Government Policy (WRR) and government departments, particularly the Ministry of Economic Affairs, the Ministry of Infrastructure and the Environment, and the Ministry of Finance for their involvement and comments. Special thanks go to Netherlands Statistics for providing us with data on the cleantech sector.

### **English translation and editing**

Serena Lyon, Annemieke Righart

### **Graphics**

PBL Beeldredactie

### **Photography**

Filip Franssen / Hollandse Hoogte (p.29, p.42); Koen Verheijden / Hollandse Hoogte (p.37); PlantLab (p.38); Inge van Mill / Hollandse Hoogte (p.48); Laif / Hollandse Hoogte (p.59); ThinkStock / iStock (p.63); Caro Bonink / Hollandse Hoogte (p.71)

### **Production coordination**

PBL Publishers

### **Design and layout**

Textcetera, The Hague

### **Printing**

Haveka, Alblasserdam

This publication can be downloaded from: [www.pbl.nl/en](http://www.pbl.nl/en).

Parts of this publication may be reproduced, providing the source is stated, in the form: Manders, T. et al. (2013), *Green gains – In search of opportunities for the Dutch economy*, The Hague: PBL Netherlands Environmental Assessment Agency.

PBL Netherlands Environmental Assessment Agency is the national institute for strategic policy analyses in the fields of the environment, nature and spatial planning. We contribute to improving the quality of political and administrative decision-making, by conducting outlook studies, analyses and evaluations in which an integrated approach is considered paramount. Policy relevance is the prime concern in all our studies. We conduct solicited and unsolicited research that is both independent and always scientifically sound.

# Contents

FOREWORD 5

TRENDS 7

1 THE PATH TO A GREENER ECONOMY 13

2 COMPETITIVENESS AND GREEN INNOVATION IN THE NETHERLANDS 23

3 INNOVATION AND OPPORTUNITY 35

4 BUSINESS DRIVERS AND BARRIERS 47

5 GREENING IN NEIGHBOURING COUNTRIES 57

6 TIME FOR GOVERNMENT ACTION 75

REFERENCES 91

NOTES 99



# Foreword

A strong Netherlands that is ready for the future: a fine ambition. But what would this future look like? Is it a future with a strong economy, or one with a small environmental footprint?

5

This report attempts to bridge the gap between these two – seemingly opposing – ambitions. The reason for this is simple: whoever wants to remain competitive in the 21st century is going to have to use energy and other natural resources in a much more efficient way. Ignoring nature degradation and climate change will have higher costs as a future consequence. We therefore need to become greener; not only for the good of the environment, but also for our economy. This calls for different products and production processes.

An earlier PBL trends report (*Changing track, changing tack; Dutch ideas for a robust environmental policy for the 21st century*) focused on what the Dutch Government, public and businesses could and should do to in a structural approach to tackle the environmental problems of this century. One important issue related to this, is how to guarantee prosperity for the coming generations as we travel along the road towards a low-carbon economy, while also ensuring a radically more efficient use of natural resources. This is the challenge we face.

This trends report, Green gains, focuses on the interface between greening and competitiveness, and in particular on the opportunities provided by greening to ensure continued earnings for the future. It describes the current position of the Netherlands, also in comparison with other countries, names obstacles and barriers that companies face in attempting to realise their green ambitions, and looks beyond the Dutch borders to learn from other countries. Based on this analysis, the report outlines policy opportunities for encouraging a transition towards a green, innovative and competitive Dutch economy.

Although the Netherlands is in a strong position in several areas, we lag behind when it comes to green innovation. Therefore, we risk losing our strong competitive position. The Netherlands, at the moment, is not ready for the future; other countries seem to be more aware of this need for greening. For example, Germany and Denmark are quite a bit further in that transition.

In the coming years, innovation will be the key to change. If we are to take the ambition of becoming sustainable seriously, we need to review our innovation system. A green growth strategy must attempt to link green innovation to the already existing strengths of the Netherlands. There are plenty of opportunities, but if we are to reap the fruits we need to take action today. This calls for an active government role.

Professor Maarten Hajer  
Director-General  
PBL Netherlands Environmental Assessment Agency

# Trends

## 1. Greening of the economy is necessary

7

If we fail to use raw materials much more efficiently than we do today and cannot limit climate change and a further degradation of nature, we are putting our future economic growth at risk. Greening of the economy, therefore, is necessary, and companies need to switch to different products and production processes. The transition will also cause a shift in competitiveness. Some countries and companies do have that future in mind and are already working on such a transition. If the Netherlands wants to remain competitive, it will also have to do so.

## 2. The Netherlands is vulnerable

The Dutch economy and particularly its exports rely heavily on sectors with a high energy and material consumption, making the Netherlands vulnerable to increasing raw-material prices and supply shortages. For example, the minerals, food production and processing, chemicals, metal and transport sectors are important. The Dutch economy seems to be less well-equipped than other strong economies to make the transition towards cleaner and more efficient products and processes, as the Netherlands is lagging behind in green innovation. Relatively few sectors

are able to combine a comparative advantage with a leading position in new clean and efficient technologies. Sectors that are currently doing well but lag behind in green innovation may lose their competitive position in the future.

### 3. Germany and Denmark are ahead

Successful countries, such as Germany and Denmark, began earlier with the transition towards a green economy, focus more on doing so, and have ambitious, long-term targets in place. They invest more in research, and public funding of innovation has a greater focus on greening. In Denmark, the government actively supports SMEs with regard to innovation and entering international markets. In Germany, there is guaranteed, long-term support for green electricity generation, although this has also had its problems, reflected in the German *Energiewende* with its high costs and problems with integration in the electricity grid.

These countries have made clear choices, based on their strengths. For example, greening of the German economy is inextricably linked to the ambition to keep the manufacturing of high-technology products inside the country. This 'Made in Germany' policy is successful and is being applied consistently. Related factors, such as education and business culture also receive attention, so that greening and competitive power are broadly anchored in policy.

### 4. Greening as well as earning

Greening is going to cost money, but it is able to strengthen our competitive position. Clean and efficient technologies can produce financial advantages, and there is a rapid worldwide growth in markets for clean and efficient products. Opportunities may lead to benefits if the Netherlands makes clever use of its innovative power, economic structure and export position. There are at least three promising themes for the transition towards a greener economy. These themes are strongly linked to agriculture and industry, but developments in these sectors also provide opportunities for expanding the Dutch services sector. Broad themes enable cooperation between sectors, and much innovation comes about at the interface between sectors.

#### a) The bio-based economy

A bio-based economy uses crops and biomass for food, feed, materials, chemicals, energy and fuel as efficiently as possible. The Netherlands is holding some winning cards, with strong research and competitive positions in biotechnology, food chemistry, agri-food and chemicals. Given the right amount of innovation, the agri-food and chemicals sectors could successfully make the greening transition. The challenge is to create strong links between the agri-food sector, which is already innovative and competitive, and the chemicals sector, which although strong is not a leader in green innovation.

### **b) The sustainable built environment**

The Netherlands has a strong knowledge base in technologies that are applied in the built environment; in particular, in energy and lighting technology, as well as in energy saving within the built environment. The relatively dense urban structure may become a breeding ground for innovations and applications in this area. As yet, the Dutch construction sector shows too little innovation and too little activity on an international level. However, Dutch architects and designers enjoy international recognition for their innovation and imagination. The theme of the sustainable built environment could be promising if the construction sector would be able to benefit from the success of those renowned architects.

### **c) The circular economy**

The circular economy is based on the reuse of products and raw materials. The Netherlands has a sound knowledge base in this field; in production technology – as noted in the previous two themes – but also in knowledge relating to product design, which is important for the reuse of materials. It is an international leader in recycling and waste processing, which is a good basis for making the transition towards a circular economy.

## **5. Companies need to focus on exports and green innovation**

There are two main pathways to success. Companies and sectors that display green innovation but have no comparative advantage yet need to improve internationalisation and attempt to increase their presence on international markets. Companies and sectors that are strong but not green need to make the transition towards greening. This will require a green innovation strategy. Of course, companies and sectors that are currently green and competitive need to ensure they maintain their position. This will not take place of its own accord, but the government can help by encouraging green exports and innovative power.

A successful green innovation system is based on entrepreneurship, investment in research and the dissemination and marketing of knowledge. This is where the Netherlands lags behind its neighbours. There are relatively few new companies – particularly knowledge-intensive companies – in the Netherlands, and even fewer that have the ambition to grow. Furthermore, SMEs could be much more active on an international level.

Supporting young and green innovative companies in the form of loan guarantees or temporary funding would help. It is also important that the government does not hinder such companies. Another way of helping would be to continue the Green Deals to detect and remove as many greening obstacles as possible.

## 6. Strong green innovation policy essential for green growth

Without focused government policy, not enough green innovation will be achieved. Pricing or implementing standards would be effective, particularly with regard to innovation along the beaten path (efficiency improvements). However, more is required for totally new products and production processes (radical green innovation) as uncertainties are large and markets often lacking.

A successful innovation system requires concerted action by entrepreneurs, research institutes and the government. Various elements play a role in this:

### **Green innovation should be leading**

It would help if the Netherlands were to set a green ‘dot on the horizon’ and, similar to other countries, focus its innovation policy more on societal objectives, such as greening. This would show that the Netherlands is ambitious in its transition towards a green economy and that it wants to be a leading competitive country. Such an ambition would firmly encourage businesses to focus more consistently on greening, based on the three themes of built environment, bio-based economy and circular economy.

### **Create more mass**

It is important to ensure that the available energy and financial resources do not become too fragmented. Create more mass is important. This certainly applies to investment in research – a particular problem in the Netherlands. Government-funded research and development (R&D) as a proportion of total government spending has decreased in recent years. This is higher in Denmark and Germany, where spending is even increasing. Government investment can boost innovation and strengthen competitive power, as shown for example by the knowledge development related to the Delta works.

Although the market for green products is still small, the government could help through a sustainable procurement policy. Higher product standards, for example, based on the costs of a product over its lifetime, could encourage sustainable innovation and increase the market for sustainable products.

### **Greater focus on challengers**

Challengers to the established order should be the focus of innovation policy. After all, much radical green innovation comes from small, new, fast-growing companies. SMEs also often find it difficult to obtain funding and lack specific knowledge and expertise.

**Link up with strong regions**

Companies working on clean, efficient technologies (cleantech) are concentrated in knowledge-intensive regions with a good competitive position; in particular, Brainport Eindhoven and the southern and northern wings of the Randstad. National policy on innovation and entrepreneurship, therefore, should be based on regional strength, which means investments should be focused on certain regions.

**In conclusion: the Netherlands needs a green growth strategy**

A green growth strategy tries to link green innovation to existing Dutch strengths. The Netherlands does not need a new industrial policy as much as it needs a stronger, greener innovation policy. This also requires innovation in current policy. For example, the top sector policy could focus more on green innovation and its marketing. This would demand an increase in public funding, and more focused choices within innovation policy. If this innovation is linked to the promising themes for the Netherlands, there is much to be gained. Creative, small companies also need to be given space. After all, investing in innovation and a green growth strategy now will pay off in the future.



# 1 The path to a greener economy

## The need for a greener economy

13

Anyone who invested in coal mines and steam engines in around 1800 was standing at the forefront of the industrial revolution. In the 20th century, it was natural gas and petroleum that was responsible for an economic growth spurt. Now, anyone who wants to ride the wave of green growth of the 21st century needs to invest in sun and wind. Or, as climate adviser Lord Nicholas Stern put it, ‘The key message (...) is important and clear: a great competitive margin in the world is going to be over carbon and energy productivity. Countries that slip behind (...) are going to damage themselves and their competitiveness and prosperity in the coming years.’

It is becoming more and more widely accepted that we need to change the way we use energy and resources. However, where several decades ago the message mainly came from the environmental movement, it is now also being spread by large companies and international organisations, such as the World Business Council for Sustainable Development (WBCSD), the OECD, the World Bank and the IMF. Economic growth has led to climate change, resource depletion and biodiversity loss, and continued unbridled growth will make much greater demands of the Earth system (OECD, 2012a). The growth seen in China and India is unprecedented,

and the upcoming middle classes in these countries are demanding more and better food, housing, cars and infrastructure. This, in turn, requires more energy, more resources and more water.<sup>2</sup>

Continuing along existing trends will damage the ecological base on which the economy rests, putting future economic growth at risk. We therefore need to use natural resources more efficiently; in short, greening is necessary.

### **Green ‘confusion of tongues’**

The terms ‘greening’ and ‘competitive power’ often are used with ease, but much less often explicitly defined. In this report too, the intention is not to provide a comprehensive definition. However, it would be helpful to explain our interpretation of these terms – in other words, to provide a fairly loose definition.

**Greening** is the more efficient use of natural resources and the restriction of damage to the environment. Natural resources include a broad collection of renewable and non-renewable resources – not just energy, metals and other minerals, but also water, land and biotic raw materials such as wood. Greening does not however guarantee that certain targets, such as the 2 °C climate change target or biodiversity targets, will be achieved. However, greening is a step along the path towards reaching these targets. Many other greening-related terms are also used, such as resource efficiency<sup>3</sup>, absolute (and relative) decoupling<sup>4</sup>, the circular economy<sup>5</sup> (including cradle to cradle), the bio-based economy<sup>6</sup> and the blue economy.<sup>7</sup> Although the emphasis differs, they all have the common denominator of greening. Greening can be achieved by:

- A more efficient use of raw materials to produce goods and services, an example being Tata Steel’s Ultra-Low CO<sub>2</sub> Steelmaking Technology which eliminates the need for the pre-processing of cokes and iron ore but allows them to be used directly.
- Reuse of raw materials, with recycling and waste processing being obvious options. The concept of the circular economy takes this a step further by separating use and ownership.
- Find substitutes for polluting or scarce raw materials. For example, glass fibre can be used instead of copper for data transfer, and aluminium instead of copper in power transmission lines.
- Reduce the demand for polluting goods and services (change preferences), for example through mobility and dietary changes.

**Competitiveness** is also a loosely defined concept. Competitive power relates to the ability of companies, sectors, regions or countries that are exposed to regional or international competition to generate added value and work opportunities. Competitiveness is a relative

The greening challenge is huge. In its vision for 2050 (WBSCD, 2010), the WBSCD names the following required steps:

- a four-fold to ten-fold efficiency improvement in resource use;
- a halving of global greenhouse gas emissions compared with 2005;
- a doubling of agricultural production with no increase in the amounts of land and water required;
- an end to deforestation and an increase in the yield from tree plantations.

concept, as it is about the position of a company or country in relation to others. Very often, as in this report, it is expressed in terms of export: the extent to which a company or sector is able to sell its products and services in other countries. This can be influenced by product differentiation, service, design, novelty, reputation and reliability; all aspects that are relevant to competitiveness. However, competitiveness is also largely about costs. The competitive position of a company will only improve if the company concerned is able to reduce its costs to a greater extent than its competitors. By the same token, a company that lags behind other companies in the sector that have managed to reduce their resource use will see its competitive position suffer if it does nothing. If, for example, every company were to react in the same way to a decrease in the price of raw materials, little would change in terms of competitive position.

**Green innovation** involves both developing new clean and efficient technologies and disseminating and applying existing knowledge. Although incremental innovations (improvements to existing products and processes) are important, they are not enough. What is more important is radical innovation: the creation of completely new products, services and processes. Eco-patents are a measure of green innovation, but cover only part of the palette.<sup>8</sup> In this report, we also consider patents relating to biotechnology. Also, we do not just look at patents as a measure of innovation; process developments and the successful introduction of new products to the market are also considered.

The term **cleantech** (clean technology) is also used in this report. Cleantech focuses on the provision of clean technology solutions. It is a subset of the wider environmental sector and covers activities related to renewable energy systems and energy saving, environmental consultancy, engineering and other services, environmental technology construction activities and the production of industrial environmental equipment.<sup>9</sup>

Finally, the term green race is also used. This is a metaphor for a race in which companies, sectors or countries compete to hold or improve their competitive position, in particular with respect to the greening elements that contribute to this. It is not a single match, but a constant competition that can be won at various levels, such as on company or sector level.

Furthermore, the challenge differs from traditional environmental issues, to which successful policy responses have been found in recent decades.<sup>10</sup> The global scale at which current environmental issues play out means that we are faced with a dilemma: we will only remain within the limits of the carrying capacity of the planet if most countries work together. At the same time, there is the fear of a unilateral greening policy in fact disrupting competitive relationships,<sup>11</sup> as stricter regulations and higher taxes could result in higher costs, although the theory is not clear-cut, and opposing hypotheses for now are rampant (see Text Box: Green growth a utopia?). For example, although the Pollution Haven hypothesis suggests that countries could profit from not introducing a strict greening policy (as this could attract investments from polluting sectors) research shows that these effects are small (BIS, 2012). The Porter hypothesis, on the other hand, assumes that a tightening of environmental standards would encourage innovation and so possibly result in a competitive advantage. However, findings in support of either hypothesis are as yet inconsistent.

While governments struggle with the greening challenge, individual companies increasingly often invest in greening as they become convinced that this will pay off in either the short or the long term. These initiatives offer an attractive prospect for meeting at least part of the challenge.

## The winners and losers of greening

A world that uses its natural resources more efficiently will alter the competitiveness landscape. After all, a green economy will demand new and/or different goods and services, and production processes will need to change. This will affect not just a few sectors, such as the energy sector, but the economy as a whole. It will not be sufficient to make only small adjustments, and the fundamental changes that are required will provide both opportunities and risk.

Greening may strengthen a company's competitiveness. After all, there are valid economic reasons for being much more critical of resource use and material flows. Using energy and materials more efficiently than competitors can reduce costs; especially, if raw-material prices remain high. Companies that have more control over their raw materials will therefore most certainly have a competitive advantage. In addition, rapid growth is taking place in markets for clean and efficient products – an interesting prospect in these lean economic times. Since 2007, the global market for environmental technology and resource efficiency (green and cleantech) has grown by almost 12% annually (BMU, 2012). Companies, thus, can ride this green wave.

From a more negative perspective, not taking part in the transition presents certain risks. Companies that fail to participate could become victims: they will be vulnerable to higher raw-material prices and will fall behind competitors that are

more successful in the transition towards a greener economy. This could mean that sectors that currently hold a strong position could find themselves in difficulty in the future.

## Green ambitions in the Netherlands

The Netherlands, similar to many other countries, has large 'green' ambitions. The ambition to be one of the most competitive economies in the world is increasingly often linked to a green growth strategy; see for example the Kamerbrief Groene Groei: voor een sterke, duurzame economie (Parliamentary letter on Green growth: for a strong, sustainable economy) (EZ, 2013). Or, as expressed in the Coalition Agreement, 'The innovative power of the business community, knowledge institutions and the government will be focused on the transition towards a sustainable economy and green growth, also with an eye on strengthening the competitive power of the Dutch economy.'

When looking at the Netherlands, in this respect, the first impression would be that other countries are better at greening. For the United Kingdom, calculations show that about 8% of its national income was earned through green activities in 2012 (BIS, 2013). The number of these activities also increased; the production of green goods and services was one of the few growth sectors in 2012. The BIS analysis shows that the United Kingdom is a leader in this respect, whereas the Netherlands holds 24th place. Meanwhile, China leads in investments in renewable energy and green innovation, and is a major exporter of clean technologies. The impression that the Netherlands is lagging behind is strengthened when we consider the rapid developments in green technology taking place in Germany. Here, in addition to renewable energy use, there is a more efficient use of energy and materials, and sustainable transport, water treatment and material cycles (in particular waste recycling). In 2011, 1.5 million people were working in green jobs in Germany, and green technology was responsible for more than 10% of GDP (BMU, 2012). Another example is Denmark. The OECD is full of praise for the opportunities provided to green companies and technologies in Denmark, and the way in which greening has worked as a magnet in attracting foreign investment; particularly in Copenhagen (OECD, 2012b).

The Netherlands, however, also has positive examples of companies that benefit from the transition towards greening. The Netherlands is a major investor in Germany's energy transition (Energiewende), with Tennet investing about six billion euros in offshore infrastructure for wind at sea<sup>12</sup> and Heerema Fabrication Group building the required electrical substations. Construction of the newest platform alone is providing jobs for hundreds of workers.<sup>13</sup> The Global Cleantech 100 published by The Guardian also includes many promising Dutch companies: Avantium uses biomass to replace oil in the production of materials and fuels, and Lemnis Lighting produces LED lighting for the horticultural sector. Other

companies focus on the reuse of materials. Desso, for example, produces carpet tiles based on the cradle-to-cradle principle.<sup>14</sup> Philips has developed a concept whereby it no longer sells light bulbs, but light. The light bulbs remain the property of Philips and are returned to the company after a few years of use. Large companies such as Unilever, AKZO and Philips also score well in the Dow Jones Sustainability Index. It seems that these multinationals are able to combine greening with successful business models.

### **Green growth a utopia?**

Few would dispute that the greening of the economy is worth it in the long term (CPB, 2011). However, green growth goes a step further, as it suggests that jobs and value added are also delivered in the short term, and that the competitiveness of businesses is strengthened. To support the claim that greening also positively affects economic growth in the short term, the World Bank (Hallegatte et al., 2011) names three arguments:

1. a green Keynesian spending impulse in times of recession, a good example being the insulation of existing homes.
2. the increased consideration of the value of our natural capital in financial decisions. For example, cleaner air results in less disease and less sickness absence, which benefits prosperity.
3. green growth may reinforce technological developments and therefore boost future growth (Porter and van der Linde, 1995).

However, the claim that greening goes hand in hand with short-term growth is not undisputed. The (orthodox) belief that strict environmental policies slow down rather than boost short-term growth, still applies. After all, costs come before the profit. Nor is it the case that greening automatically results in the much desired growth and jobs. There are winners, but also losers. Companies fear that greening will push up costs and, thus, will put them at a competitive disadvantage. For example, energy-intensive companies, such as in the chemicals and steel industries, are saddled with higher costs due to European climate policy. This fact may cause companies to relocate to regions with a less strict regime.

Past experiences with waste prevention and energy saving, however, have shown that win-win situations are in fact possible, although not at an unlimited scale. This certainly applies to the national level; more jobs are created, while other jobs are lost through greening. Green growth therefore needs to be seen primarily as a structural reinforcement for the long term, and not as an answer to the current crisis. In addition, this crisis does not make it easy to focus on green growth. Financial resources and budgetary leeway are limited, after all. On the other hand, the current recession does offer opportunities for eliminating existing inefficiencies. This is the moment for encouraging polluting companies to change, so that they do not become a victim of the 'green shake-out'. It therefore would seem that a strategy focused on green growth makes sense, particularly at this point in time.

## Green competitive power

It is not yet clear which countries, sectors and companies will be the winners (Fankhauser et al., 2012), or what factors will determine the chance of winning the green race. Green competitiveness is derived primarily from existing comparative advantages, skills and production patterns (Hidalgo et al., 2007).<sup>15</sup> For example, Germany was able to develop its current position in renewable energy due to its existing expertise in mechanical engineering (Huberty et al., 2011). In general terms, however, two success factors can be defined (see too Fankhauser et al., 2012):

1. *Innovation.* Green innovation says something about the extent to which green production can replace conventional products and processes. Innovation may be in the form of a new product, but could also consist of process innovation. Innovation is therefore applied in the broadest sense of the word. There is a strong relationship between innovation, productivity and economic growth.
2. *The current economic structure.* The future position of a country or sector is based on its current competitiveness. It is important to consider not just the comparative advantages, but also the size of the sectors. After all, greening in a large sector would achieve greater results than in a small sector.

## This report

In this report, we focus on the interface between greening and competitive power. How could greening and increased competitiveness go hand in hand? What are the opportunities for the Dutch economy to strengthening competitiveness through greening? Is the Netherlands ready for the future?

It is important to know where the Netherlands stands when it comes to competitiveness and green innovation. Are the export sectors that form the pillars of the Dutch economy ready for renewal? Are companies involved in the transition towards a greener economy to the same extent as those in other countries? Answering these questions, calls for a comparison with other countries.

If the Netherlands wants to lead the way, mediocrity simply will not be good enough. Rather, it will need to look at what seem to be the frontrunners. Germany, Denmark and the United Kingdom are used as references in this report. Similar to the Netherlands, these countries have open, competitive economies in which knowledge and innovation form an important basis for economic growth. However, they seem to be greening their economies more rapidly than the Netherlands.

In reality, it is not countries but companies who compete with one another and who will need to make the successful transition towards a greener economy. The focus in this report, therefore, is on what moves companies to successfully

embrace greening, and what holds them back (see Text Box: Input from innovative companies).

In the process of greening, the starting position of the Netherlands gives cause for concern. It is not among the leaders in all areas, as is shown in Figure 1. The Netherlands is relatively strong in areas such as the waste recycling and green taxation, but in others it lags behind the previously named reference countries.

There would seem to be opportunities for the Netherlands in several fields, such as the bio-based economy, a sustainable urban environment and the circular economy. The challenge is to apply greening in a way that will enable the Dutch economy to profit to the greatest degree, while limiting negative effects as much as possible. Innovation is an important part of this. However, a successful

### **Input from innovative companies**

To gain a better understanding of what drives companies and what holds them back, for this report, six small green innovative companies were interviewed. A conscious choice was made to talk to smaller companies that focus on radical green innovation. The following companies were approached:

- Van Houtum produces sanitary paper products and provides total solutions for the sanitary needs of businesses and institutions. Van Houtum has introduced 'Satino Black' – a line of products fully based on recycled raw materials.
- Desso manufactures carpets and artificial grass and endeavours to base the full production process on the cradle to cradle principle. Their carpet tiles product line is now fully produced in accordance with this principle.
- DyeCoo specialises in techniques for painting on textile based on liquid CO<sub>2</sub>. This method saves significant amounts of water and reduces the discharge of dyes.
- PlantLab focuses on optimising growing conditions for plants through a drastic form of climate control; for example, using LED lighting. This makes it possible to reduce water use by 90%, compared with conventional cultivation methods.
- Ibis Power is developing a system for the conversion of wind energy into electricity that can be integrated into the roofs of buildings (IRWES). The company thus provides a solution for an aesthetic application of wind energy in urban environments.
- Powerhive is developing off-grid solar energy stations for areas in developing countries with no access to an electricity grid. It is possible to purchase a certain amount of electricity using a mobile telephone.

PBL, in addition, also held more general discussions with the World Business Council on Sustainable Development (WBCSD), Shell, DSM and Royal Association MKB-Nederland (the Dutch association of small and medium-sized enterprises). These talks were also used as input for this report on greening and competitive power.

Figure 1

Position of the Netherlands, compared to that of other countries



Last in line



Frontrunner

Resource use and environmental burden

Recycling of domestic waste, 2009



Renewable energy, 2010



Energy use per capita, 2010



Innovation

European innovation index, 2012



Green patents, compared to all patents, 2000–2012



Policy tools

Green taxation, 2010



R & D Expenditure



Last in line



Frontrunner



Source: PBL, based on OECD, 2013

The Netherlands is not at the forefront of greening in all areas.

transition to a green economy will not take place by itself. As this report shows, there is a very clear role for government in this.

What this role could be, was PBL's quest in this trends report, using a highly specific approach. The report focuses on opportunities for the Netherlands in a world that needs to be greener. It, therefore, does not provide a comprehensive answer to many greening-related questions. Whether taking advantage of the opportunities will be enough to meet the global ecological challenge has not been specifically addressed. This trends report does not profess to be a comprehensive study. The aim rather has been to collate a number of signs and trends that challenge us to think further about policy. This certainly applies to innovation policy and how it could be focused more explicitly on greening and on strengthening Dutch competitive power.

## 2 Competitiveness and green innovation in the Netherlands

Is the Netherlands prepared for the emerging green economy? The answer is that this depends on the economic structure and innovative power. Although the Netherlands generally scores well in competitiveness and innovation, it would not seem to be ready for a green future in every respect.

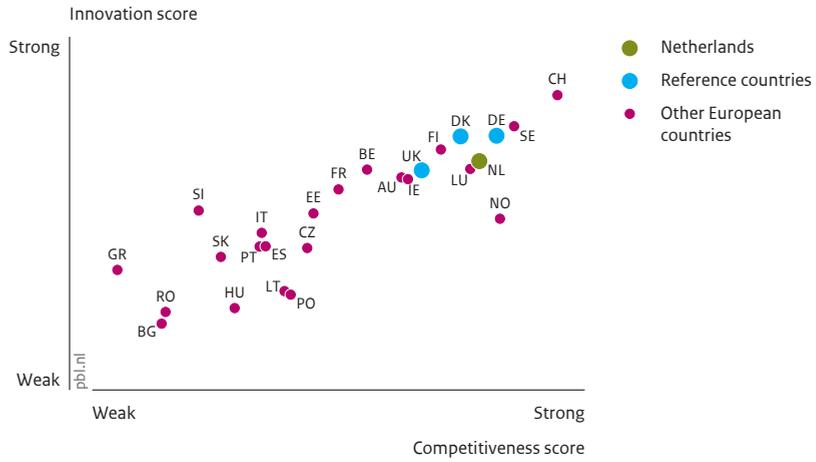
23

### Which countries to look at?

At first glance, the Netherlands would seem to be in a good position. It ranks high on international lists that compare competitiveness (see Figure 2).<sup>1</sup> The Netherlands also is innovative, compared to other countries. This is no surprise, as innovation is important for competitiveness, productivity and economic growth (e.g. see Aghion and Howitt, 1999; 2007).

However, the ranking does not tell the whole story, as some of the countries that top the rankings are active on different markets. This, for example, applies to the Nordic countries, such as Finland. As Dutch companies have less involvement with companies from these countries, it makes more sense to consider the location of the true competitors of Dutch companies – those fishing in the same (economic) pond. This leads to the conclusion that the main competitors are German and UK companies (see Figure 3).

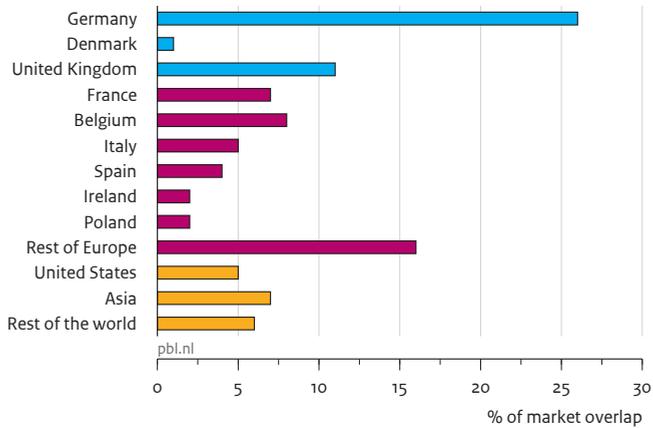
Figure 2  
**Innovation and competition, 2012**



Source: European Union (Innovation Union Scoreboard), 2013;  
 IMD World Competitiveness Center (World Competitiveness Index), 2012

*The Netherlands is one of the most competitive and innovative economies in Europe.*

Figure 3  
**Competition for Dutch exports, 2010**

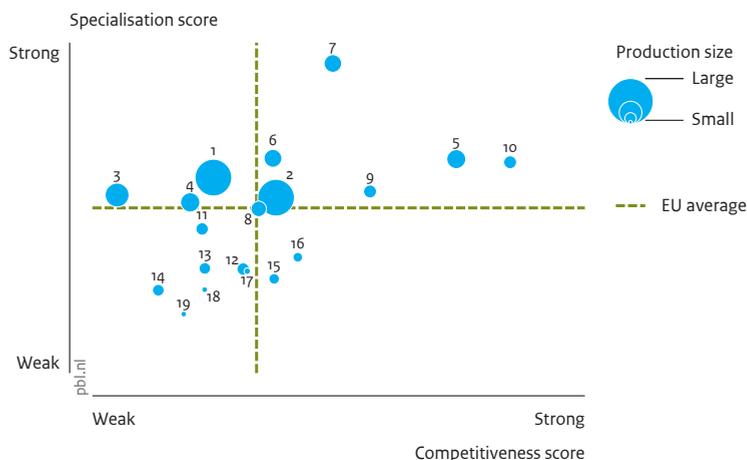


Source: PBL, 2013

*More than three quarters of the main competitors of Dutch export companies are from Europe.*

Figure 4

**Production, export positions and specialisations of Dutch sectors, 2000 – 2010**



Sectors, ordered according to production size

- |  |  |
|--|--|
| 1 Non-profit                                   | 11 Timber, paper and printed media                   |
| 2 Business services                            | 12 Metal   |
| 3 Construction                                 | 13 Electronic and measuring equipment                |
| 4 Financial services                           | 14 Means of transportation                           |
| 5 Food, alcohol and tobacco                    | 15 Machines and appliances                           |
| 6 Chemicals, rubber and plastics               | 16 Trade and maintenance of cars and motorcycles     |
| 7 Minerals (including oil processing industry) | 17 Glass, pottery, cement, lime and plaster products |
| 8 Transport                                    | 18 Furniture and other industry                      |
| 9 Postal and telecommunication services        | 19 Clothing and leather goods                        |
| 10 Agriculture                                 |  |

Source: PBL, 2013

*The Netherlands has a strong export and specialisation position in a limited number of sectors.<sup>3</sup>*

It is therefore relevant to compare the Netherlands with Germany and the United Kingdom, as these are our main competitors. Although Denmark is also interesting, because, just as the Netherlands, it has an innovative, small, open economy. Furthermore, Denmark would seem to be better at making use of opportunities to capitalise on green growth.<sup>2</sup> Moreover, Germany, the United Kingdom and Denmark are all ‘in the same boat’ as the Netherlands; at the moment, all four are competitive and innovative, but whether they will be able to maintain this in an economy going through a green transition is very much the question.

## What are our main sectors?

What are the Netherlands good at? What is the status of Dutch production and export, and what are the specialisations? Production volumes, export positions and specialisation 'scores' for Dutch sectors are given in Figure 4, compared with those of other European countries.

Business services and non-profit sectors are important in the Netherlands, in terms of production volume. As far as exports and level of specialisation are concerned, the country is also strong in the chemicals, agricultural, food and beverage, and alcohol and tobacco industries – all large industrial sectors. In addition to the last three industries, the Netherlands' competitive position is also to a large degree based on the mineral industry, postal and telecommunication services, business and financial services, and transport. Compared with other countries, the Dutch construction sector hardly operates on an international level. It is also clear that the Netherlands has very few comparative advantages as a high-tech country: compared with other countries it produces relatively small amounts of transport equipment, machinery, and electronic and measuring equipment.

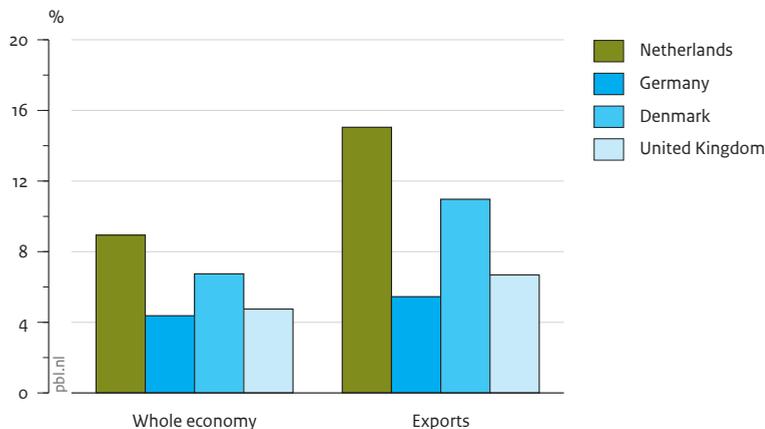
## High energy and material use in the Netherlands

Compared with Germany, Denmark and the United Kingdom, the Netherlands uses large quantities of raw materials, such as energy, metals, other minerals and biotic resources (e.g. wood, fish and agricultural products). Dutch export is particularly resource-intensive (see Figure 5). This is because large energy consumers, such as the chemicals industry, are important in the Netherlands. This is of course related to the geographical position of the Netherlands, as well as its gas reserves. Energy-intensive sectors, such as horticulture, also have a large share in exports.

The high resource-dependency of the Netherlands makes it vulnerable to price increases of natural resources or supply uncertainties. The Netherlands is at a particular disadvantage where other countries are less sensitive to price increases. Although industrial sectors, such as the chemicals sector, are still doing well in the Netherlands, there is a risk of losing this advantage. In many of the Dutch sectors, improvements in energy intensity lag behind developments in other OECD countries (Mulder and De Groot, 2010). Compared with the world top, Dutch industry has become less energy-efficient. In 1999, Dutch industry, on average, was doing 3.7% better than that of the world top<sup>5</sup>; in 2012 it was doing 0.7% worse.<sup>6</sup> The reason for this is still rather speculative; for example, it may have been easier for countries that started from a position that was worse than that of the Netherlands to improve their efficiency. Furthermore, regulation in other countries is often compulsory, whereas in the Netherlands agreements (covenants) are non-obligatory (CE, 2010). Compliance with agreements is therefore also a very important factor.<sup>7</sup>

Figure 5

### Resource share, including energy, in total production costs, 2007



Source: WIOD, 2007

*The Dutch economy, particularly the export sector, is resource-intensive.<sup>4</sup>*

## Green production sector still small

How large is the green economy in the Netherlands? This is a difficult question to answer, because the green economy includes more than the obvious sustainable energy, water treatment and waste processing sectors. In the case of greening, it is not about having certain new sectors alongside the more conventional ones, but of greening within existing sectors. Even in the metal or chemicals sector, production processes can be made greener by using fewer raw materials and reducing the environmental burden.

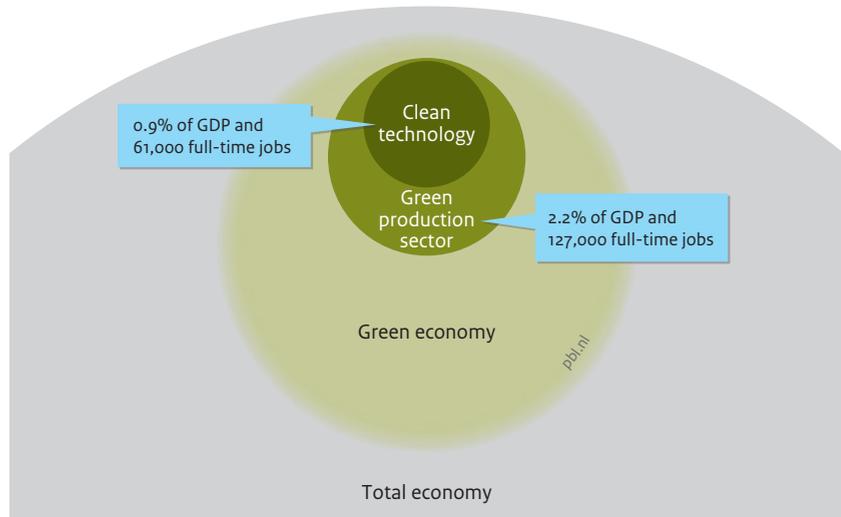
Although it is possible to measure the contribution of typically green activities to the economy, making an international comparison is rather complicated (see Text Box: International comparison of greening difficult).

It is possible to distinguish a green production sector (see Figure 6) within the green economy. This sector includes all the companies and organisations that focus on providing green products and services. The value added of the green production sector was 13 billion euros in the Netherlands in 2010 and represented 2% of the economy (CE, 2013).

Cleantech is part of the green production sector (Figure 6) and covers an even more narrowly defined collection of activities. This sector focuses on the provision of clean technological solutions,<sup>8</sup> such as energy, water, and resource- and water-saving technologies and activities throughout the value chain (R&D,

Figure 6

### Green economy and clean technology in the Netherlands, 2010



Source: PBL, based on CE, 2013

*The green economy includes more than just the clean-technology sector.*

### International comparison of greening difficult

There is no international standard defining 'greentech' and 'cleantech'. Studies into greentech in Germany (BMU, 2012) and environmental goods and services in the United Kingdom (BIS, 2012) are difficult to apply to the Netherlands, due to varying definitions and data availability. For example, the development phase of the value chain and the production phase of electricity from combined heat and power are included in the greentech definition in Germany and the United Kingdom, but not in the Dutch approach, so that the share of GDP is likely to be higher in other countries (CE, 2013). A comparison of the contribution by the environmental sector to the GDP of various countries shows the Netherlands somewhere in the middle, with a contribution similar to Germany (EGSS<sup>9</sup>, Eurostat). Therefore, it would seem that it does not differ too greatly from other European countries, but comparisons are difficult to make; Sweden and Austria, for example, score relatively high because they also include forestry.

A comparison between the Netherlands and other countries highlights the small contribution made by renewable energy in the Netherlands. However, as stated earlier, a green economy and green production sector is about more than just energy. In the Netherlands, waste, waste water and water management are fairly large sectors. However, Danish research shows that the share of green products in Dutch export is very low compared to that of other European countries. The Netherlands, therefore, exports a relatively large amount of 'polluting' products (DEA, 2012a).



*Solar PV innovation moving from panels to foil.*

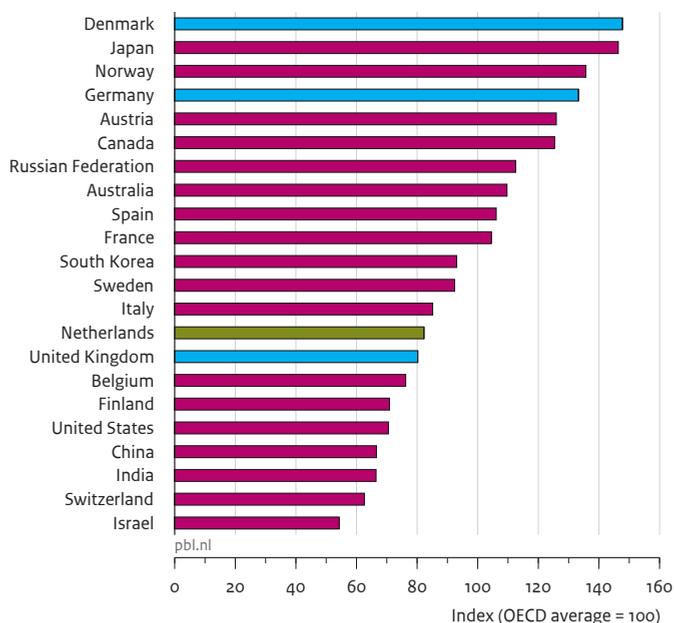
engineering, construction and installation, consultancy). Cleantech companies in the Netherlands represent about 5 billion euros of value added, or almost 1% of GDP. The growth in production value was about 6%, annually, between 1996 and 2010 (CE, 2013).

With almost one per cent of the economy, the Dutch cleantech sector seems to be fairly average in size, in European terms. However, as explained above, international comparison is difficult. What can be seen, however, is that a significant proportion of the value added is earned through consultancy; in the case of water management and resource efficiency, this is even more than 50% (CE, 2013).<sup>10</sup>

The size of the sustainable energy sector is about one third of that of the cleantech sector. In Germany, this is more than half (Roland Berger, 2012). Energy saving is

Figure 7

**Green-innovation index for OECD countries, 2000 – 2010**



Share of green patents in all patents in OECD countries with over 30 eco-patents per year

- Netherlands
- Reference countries
- Other countries

Source: OECD, 2013

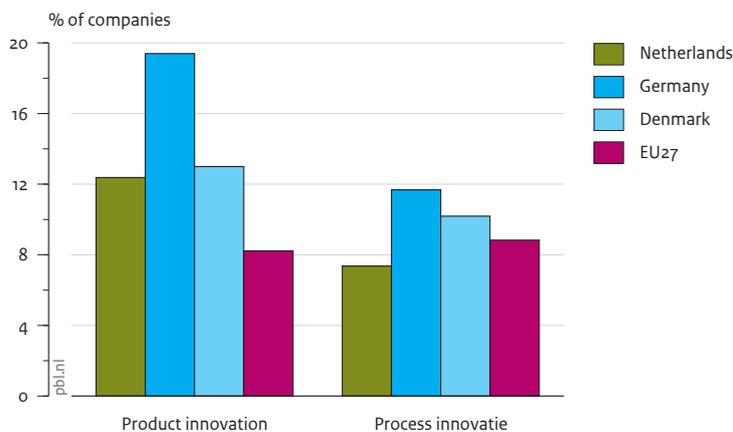
*Dutch innovations show little focus on greening.*<sup>12</sup>

one of the larger segments of the sustainable energy sector and, in general, is locally oriented, due to the focus on the built environment and the installation sector. However, sustainable energy also includes the production of LED lighting, insulation materials and high-efficiency boilers, which is much more export-focused. Certainly when compared with Germany, the size of the Dutch sustainable energy sector is relatively small.

**Dutch innovation not very green**

New and better-applied knowledge could help strong sectors in the Netherlands to improve or maintain their competitiveness. Specific green innovation could enable these sectors to maintain their competitive position in the green economy of the future.

Figure 8  
**Product and process innovations, 2004 – 2008**



Source: Eco Innovation Scoreboard, 2012

*The Netherlands is less innovative than Germany or Denmark.*

#### *Few eco-patents*

A common measure of green innovation is the share of eco-patents per sector.<sup>11</sup> A comparison with the main OECD countries shows the Netherlands at the bottom end of the list as far as green innovation is concerned (see Figure 7). At the top of the list are Denmark, Japan, Norway and Germany. The share of eco-patents is almost twice as large in Denmark and, in absolute terms, 10 times larger in Germany than in the Netherlands.

#### *Product and process innovation lagging behind*

Although patents are an important indicator of the knowledge infrastructure of a country or sector, they do not tell the whole story. For example, the relationship between patents and the successful introduction of new products needs not be very strong. After all, many new products are unpatented. Also, a patent does not always result in a product that can be successfully introduced. In addition, patents are strongly related to technological innovation, and less to service-oriented innovation. Furthermore, skills are often based on established and already implicit knowledge. Finally, companies can also innovate through process innovations and reorganisation.

As far as the number of actual product and process innovations in companies is concerned, the Netherlands lags behind Germany and Denmark (see Figure 8).<sup>13</sup> For example, the proportion of companies introducing new products on the market is much higher in Germany than in the Netherlands; 20% compared to 12%.

Excerpt from an interview with PlantLab:

*'We prefer not to work with patents. First of all, because they are expensive, and secondly also because patents reveal a great deal. And thirdly, in addition to obtaining the patent, you then need to be able to protect it should infringement take place. In fact, a patent is only as strong as the financial capabilities of the owner. We do own a few patents, although these mainly serve to provide a solid basis. Our clients are often large companies that are used to doing business on the basis of underlying patents. This is why we have made sure that some of our technologies are properly patented, but others are simply trade secrets – just our way of working. And we never divulge those trade secrets – although they include many aspects that we find very logical, for something to work, you need to get everything right at the right time, and that is an art in itself.'*

### **Greening not a priority among entrepreneurs and the general public**

There seems to be a lack of urgency among Dutch companies, as far as greening and eco-innovations are concerned. For example, compared to those in Denmark and Germany, Dutch companies see reduced energy and material use as less important drivers of innovation (see Figure 9). This is a worrying fact, because Dutch companies are relatively energy-intensive.

The Dutch appear to be rather negative about the potential of green growth (see Figure 10). The Eurobarometer, a poll of public opinion in EU Member States, shows that the general public in the Netherlands does not attach much importance to green themes, such as the environment, climate and energy.<sup>14</sup> For example, just 7% of the population thought that the environment was an important theme in 2012, compared with 11% in Germany and Denmark (EU Eurobarometer, 2012). In addition, there has also been a conspicuous decline in the sense of urgency in the Netherlands, over recent years.

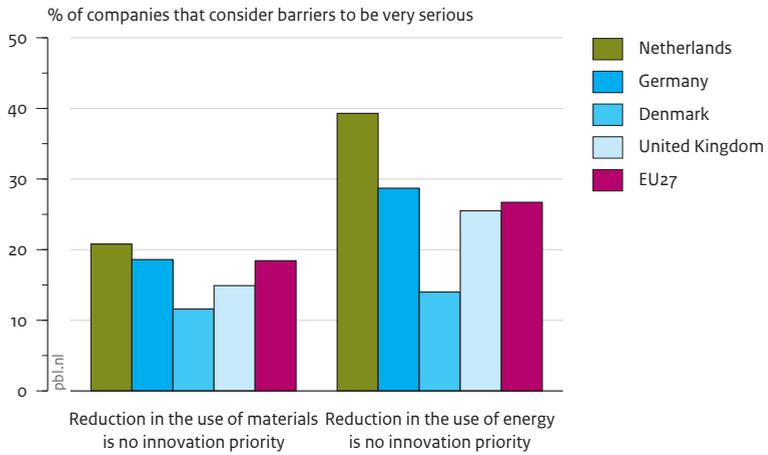
### **A strengths and weaknesses analysis of Dutch industry**

The opportunities that economic sectors have to benefit from greening are largely determined by the speed with which they are able to make the switch to green products and production processes. Green innovation is an indicator, in this respect. Another important factor is the extent to which sectors are able to obtain or hold on to a market share. A measure of this is the existing export position (comparative advantage). The larger the sector, the more favourable its position.

Figure 11 plots comparative advantage (on the horizontal axis) and green innovation (on the vertical axis) for the 15 largest manufacturing sectors.<sup>15</sup> The production volume per sector (indicated by the size of the bubble) is a measure of the share in industrial output in the Netherlands. A higher score (to the right and above the dashed line) indicates a performance that is above average: the green competitiveness of a sector increases the more a sector is placed towards the top right of the figure.

Figure 9

**Main barriers to eco-innovations, 2011**

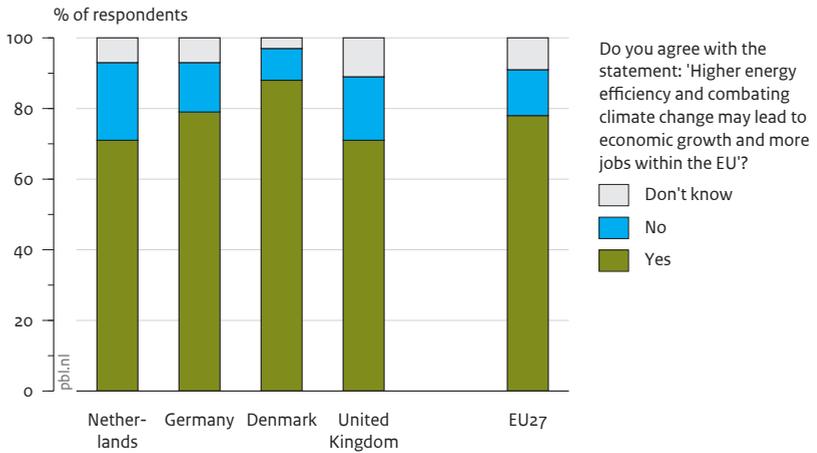


Source: Eco Innovation Scoreboard, 2012

*Reducing material and energy use is no priority for many Dutch companies.*

Figure 10

**Attitude towards greening the economy, 2011**

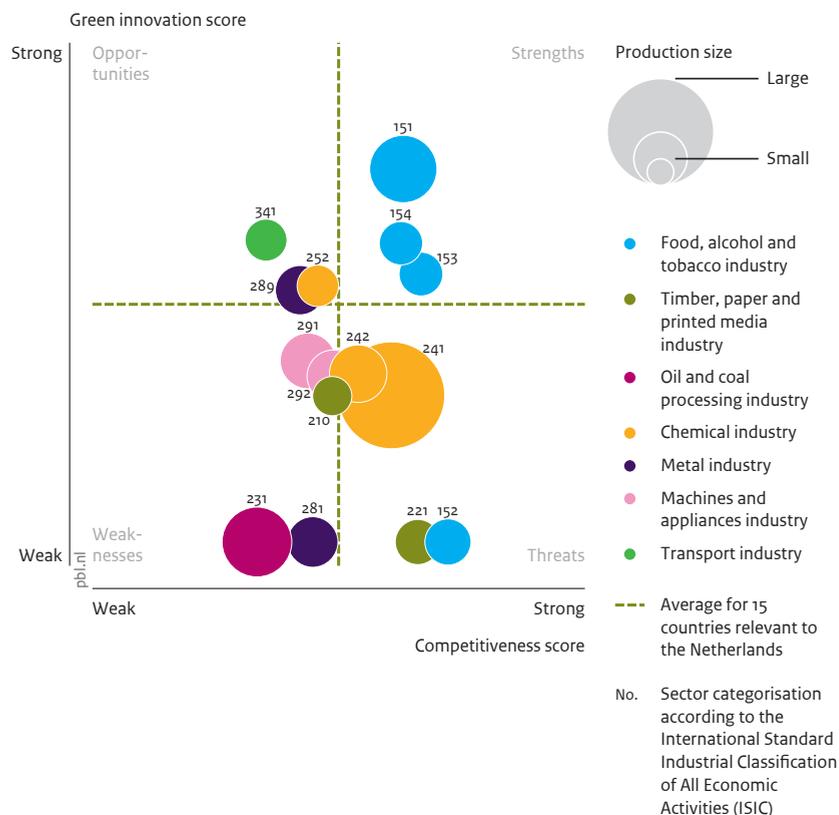


Source: Eurobarometer, 2012

*The Dutch public is sceptical about green growth.*

Figure 11

**Green competitiveness of the 15 largest industrial sectors in the Netherlands, 2005 – 2010**



Source: LSE, 2013

*In the Netherlands, a strong export position is not always related to a strong position in green innovation.<sup>16</sup>*

Food production and processing industries are able to combine a strong export position with a strong position in terms of green innovation. These sectors therefore seem to be ready for the green race. The sectors on the bottom right of the figure are at risk – this applies, for example, to the chemicals industry as a whole. Although these sectors currently have a comparative advantage, they are not leading the way in green innovation. Therefore, they risk missing the boat when the time comes. There are of course companies in the chemicals sector that are doing very well (see Chapter 4). Some parts of the high-tech and materials industry are green, but have as yet no international comparative advantage (top left of the figure). Some sectors that are important to the Netherlands in terms of production value are going to need to take large steps in greening and internationalisation if they are to remain important in the future. Examples are the paper and machinery industry (bottom right). Generally speaking, there is a weak relationship between green innovation and export position.

# 3 Innovation and opportunity

The Netherlands is lagging behind in green innovation (Chapter 2). However, this general conclusion deserves some specification. After all, there are a number of niches in which it does excel, such as biotechnology and lighting systems. If a sector is small and the market share limited – and thus lacking in critical mass – even a high level of innovation in that particular field is not going to achieve very much. Fact is also that sectors that are doing well on an international level are not at the forefront of green innovation. These sectors, therefore, run the risk of being left behind as they will be too slow in making the transition to clean and efficient products and processes.

35

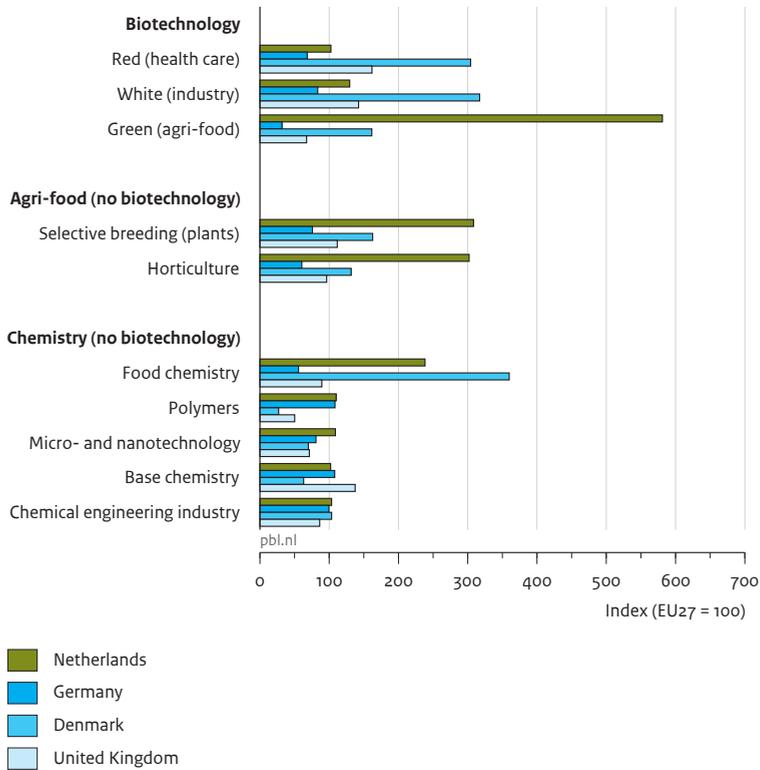
Linking innovative power to existing critical mass will create opportunities. By making use of these opportunities, important sectors in our economy will be able to make the greening transition and enable the Netherlands to remain competitive.

This report identifies and discusses three broad themes that provide companies and sectors with greening opportunities:

- the bio-based economy;
- the sustainable built environment;
- the circular economy.

Figure 12

**Dutch specialisations in the bio-based economy, 1999 – 2009**



Source: REGPAT OECD, 2013

*The Netherlands excels in knowledge related to green biotechnology, plant breeding, horticulture and food chemistry.*

These broad themes are particularly promising. Within these themes, clean and efficient technologies may be developed that result in new products and more efficient processes. Of course, opportunities vary per theme. The bio-based economy, for example, seems to be an open goal; in other themes it would be better – sticking to football terminology – to look for smart combinations and improve ball skills. Opportunities will not seize themselves, but require active government intervention (see Chapter 6).



*Green resources for a bio-based economy.*

## Opportunities for a bio-based economy

A bio-based economy is an economy in which most raw materials are obtained from nature (biomass, or 'green resources') as part of a green or sustainable economy. These mainly renewable resources are used in materials, chemical products, fuels and food products.

The bio-based economy brings the agricultural and chemical sectors together. Agriculture is very important in the bio-based economy, and crops can also be used for non-food purposes. Examples of such other purposes are potatoes, the starch of which is used to make plastic, and sugar beet that is used for making ethanol and raw materials for chemicals and biofuels. Horticulture – as a supplier of high quality plant materials – could also become an important partner for the chemicals industry. Plant breeding and cultivation under controlled conditions can provide the complex molecules that could serve as the building blocks for the production of pharmaceuticals, food ingredients such as vitamins, flavourings and aromas, and ingredients for cosmetics and high quality animal feed. Any waste material left can be fermented to generate bio-energy.

The Netherlands has an excellent knowledge base in areas that are important in the bio-based economy. In a recent study, the Dutch city of Wageningen was shown to be the second centre in the world for biotechnology, after Cambridge in the United States (Heimeriks and Boschma, 2013)<sup>1</sup>. An analysis of patents showed that the Netherlands is a leader in green biotechnology, as well as in plant



*An example of radical innovation is that of vertical agriculture using LED light at PlantLab.*

breeding, horticulture and food chemistry (see Figure 12).<sup>2</sup> Knowledge on green biotechnology may be used, for example, to optimise yields in the agri-food sector or to reduce environmental impacts. The same applies to food chemistry.

Because of its highly developed agricultural, food (agri-food) and chemicals sectors, the Netherlands is in a good position to play an important role in the bio-based growth market (SER, 2010). Given the right amount of innovation, the agri-food and chemicals sectors could successfully make the greening transition. The challenge is to create strong links between the agri-food sector – which is already innovative and competitive – and the chemicals sector, which although strong is not a leader in green innovation (see Chapter 2).

There is much money to be made in the bio-based economy; the unused potential in the European market for bio-based products is estimated at 80 to 120 billion euros (WUR, 2008).

Although the switch to a bio-based economy presents good opportunities for the Netherlands, its potential should not be overestimated. Much is possible, but in practice not always easy to achieve (P+, 2012). For example, it is certain to be another 10 to 20 years before it will be profitable for companies to produce bioplastics from waste. Although it is fairly easy to convert clean raw materials, agricultural waste flows are more difficult to process. These waste flows are not clean, which makes the fermentation processes in reactors 10 to 100 times more susceptible to problems. Also, farmers, wholesalers, factories and supermarkets all need to adjust to the new green agri-chemical sector. The transition to a bio-based economy, therefore, involves more than just new technology; it requires completely new processes and cooperation between various actors who first need to learn to speak each other's 'language'.

Excerpt from an interview with PlantLab:

*'There is much specialist knowledge available that is barely used. If you can be smart about combining such knowledge, the opportunities for new markets are huge. For example, knowledge related to the nutritional value of sports food is so advanced in some sports that making that knowledge available to normal people could make a world of difference to their health. (...) Although the knowledge is available, it is often not applied, and if you would like to apply this knowledge, the question is whether you would be able find existing food products that contain those 'right' nutrients. If not, you would need to cultivate 'to order'. It will of course be a huge challenge over the coming 30 years to link all the fields that currently seem to have nothing to do with each other. The commercial horticulture sector is not really interested in nutritional values. We therefore need to bring these fields together, and as far as opportunities for the Netherlands are concerned, they are huge.'*

The price of fossil fuels will also influence the success of the bio-based economy. As long as it remains relatively low, it will be difficult for bio-based solutions to compete. A recent EU study, for example, shows that bio-based succinic acid, a chemical with a broad range of applications – from plasticisers to perfume – has a market potential of 14 billion euros. However, succinic acid made from petrochemical sources is still 10% to 20% cheaper than that produced by fermenting carbohydrates (bio-based).

## Opportunities for a sustainable built environment

39

Opportunities for a 'sustainable built environment' apply to the whole field of sustainable area development and 'green buildings', and to the application of various technologies for the sustainable development of urban areas.

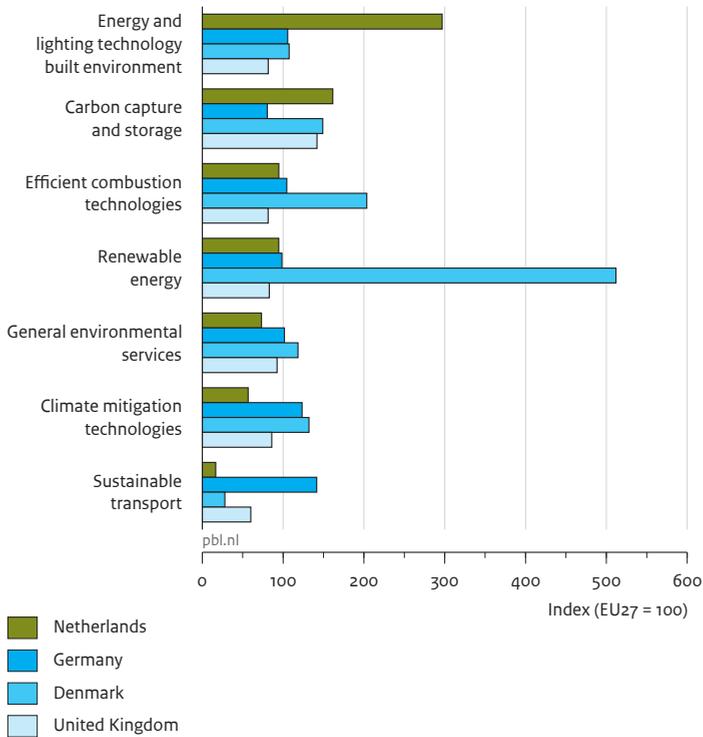
Examples are new energy-neutral buildings and the renovation of offices and homes ('green buildings'). It is not just about insulation, but also about residual heat, energy saving in public lighting, geothermal energy generation and the use of solar panels. A broader interpretation of a sustainable built environment could even include the integration of sustainable transport, housing and work.

With respect to the various niches within green innovation, the Netherlands is seen to be highly specialised in 'energy and lighting technology for the built environment'.

Figure 13 shows that the proportion of Dutch eco-patents in this field is three times the average for the European Union, and much higher than in the three reference countries of Germany, Denmark and the United Kingdom. However, these reference countries of course each have their own specialisations. Denmark, for example, is strong in renewable energy and for Germany this is innovation in sustainable transport. Innovation in energy and lighting technology for the built

Figure 13

Green-innovation index per type of eco-patent, 1999 – 2009



Source: OECD, 2013

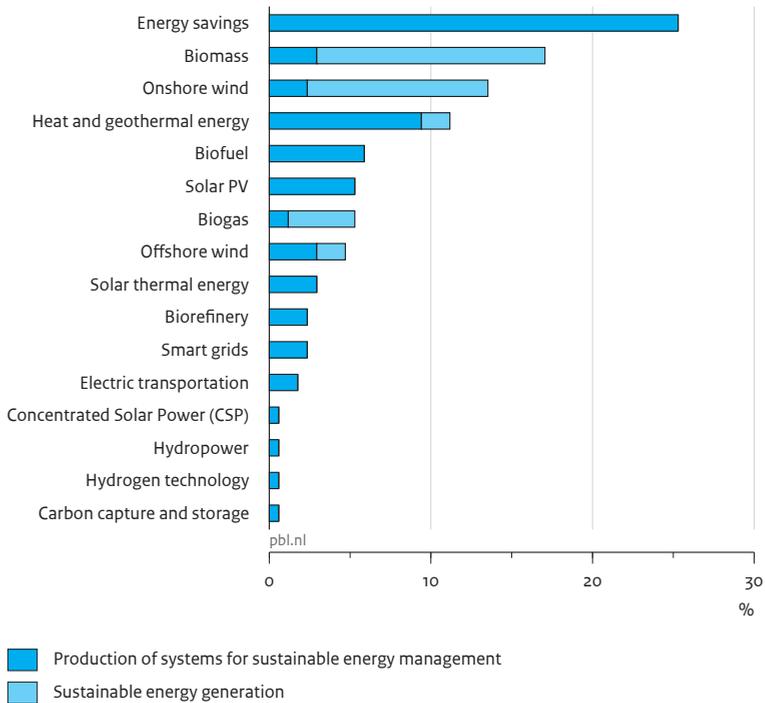
*The Netherlands owns many lighting technology patents.*

environment in the Netherlands is not only strong compared with that in other countries – with one third of all the eco-patents in the Netherlands being related to this field, it also constitutes a large segment within the Netherlands. Philips, with its LED technology, is particularly strong.

Many activities that take place in the environmental sector in the Netherlands are related to the sustainable built environment (see Chapter 2), similar to certain segments in Energy systems and energy savings (the sustainable energy sector). This, therefore, would provide a good basis to build on. The sustainable energy sector accounts for almost one third of the total environmental sector in the Netherlands, representing an added value of about 1.6 billion euros, annually, or 20,000 full-time jobs. Energy saving, in particular through insulation, takes a prominent position in the sector (see Figure 14). Heat and geothermal energy as well as solar

Figure 14

Share of segments in total added value of the sustainable energy sector, 2010



Source: CBS Economic radar for the sustainable energy sector, 2011

*Energy saving is by far the largest segment in the sustainable energy sector in the Netherlands.<sup>3</sup>*

PV (solar panels) are also large segments in the total sustainable energy sector, and both strongly related to the built environment. The Netherlands also has a strong knowledge basis in the field of geothermal energy and solar panels (Ecorys, 2012).

As yet, the ‘sustainable built environment’ is primarily domestically oriented: not much is yet being earned on international markets (Ecorys, 2012). Construction is a large sector, but with little activity abroad. There are, however, possibilities, there is a strong knowledge basis, in the Netherlands, in the fields of ‘building and lighting’ and ‘energy systems’.

In addition to technology, also functionality and design play a role – something that the Netherlands is good at. For example, Daan Roosegaarde shows how innovation and imagination can be combined to design a new world. This area is full of opportunities if we also would build on the successes of our internationally



*In a sustainably built environment, electric vehicles are charged close to home.*

renowned architects. For example, there is Ben van Berkel's green building concept. Being a densely populated country, the Netherlands offers opportunities for applying smart technologies in urban areas; it could be a breeding ground for the development of ideas. Philips, for example, is considering the quality of life in cities in relation to smart technology, in its liveable cities programme.

The construction sector could also benefit from these strengths by entering the international market to create greater earning opportunities. The sustainable built environment theme could provide a platform for this.

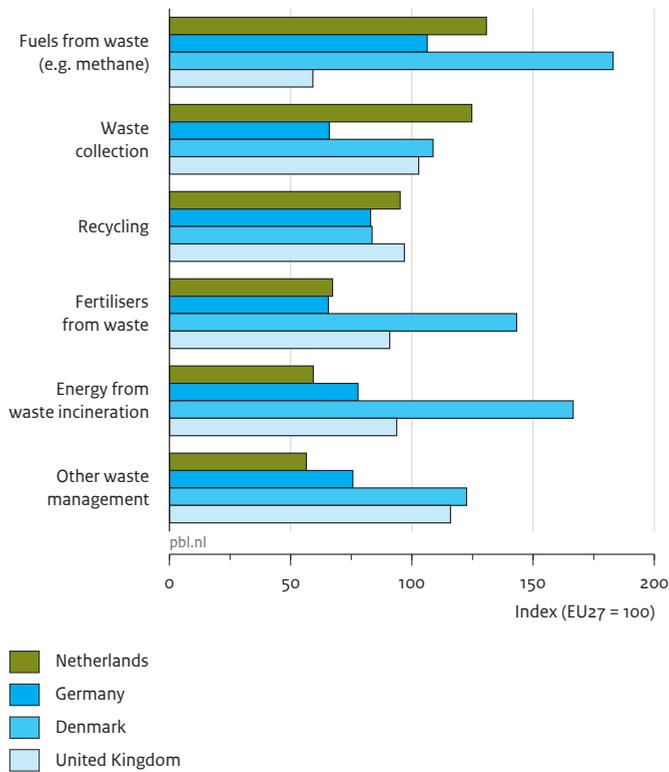
## Opportunities for the circular economy

The circular economy is based on the recycling of products and materials. Waste becomes raw material and material flows are closed (see the text box on the interview with Desso). The Netherlands is an international leader in recycling. Of all the waste that is produced in the Netherlands, almost 90% is recycled<sup>4</sup> (CBS, PBL, WUR, 2012), while in Europe on average only about 40% of waste is being recycled. The Netherlands is also a leader in the recycling of electrical and electronic appliances (Huisman et al., 2012). And there is more good news: of all construction and demolition waste and all car wrecks in the Netherlands, almost 100% is reused or usefully applied elsewhere. In summary, the Netherlands is strong in the reuse of waste, which is reflected, for example, in the amount and growth in added value and the number of jobs in recycling-related sectors<sup>5</sup>. The recycling-related sectors have seen a much stronger growth since 1995 than the Dutch economy as a whole.

Strongly linked to our international competitiveness is the fact that the Netherlands also has a large international market share and relatively extensive knowledge base in separation technology (the basis of recycling) and the

Figure 15

**Green-innovation index on waste, 1999 – 2009**



Source: OECD, 2013

*The Netherlands is a front runner in some areas of waste processing.*

corresponding logistical system (CE, 2013). The number of patent applications in the Netherlands is relatively high in some areas, such as related to the extraction of methane from fertiliser and waste collection (see Figure 15). However, patents provide only partial insight into innovative power. Much innovation, for example, is involved in the optimisation of logistical systems and implicit knowledge – important aspects that are not always reflected in patents.

So much is recycled in the Netherlands that an actual limit to growth is being reached, and the total amount of commercial waste has barely increased since 2005. One option for further growth in this sector would be to import waste from other countries for recycling. It is of course also possible to export the expertise, knowledge and technology on waste collection and processing.

Excerpt from an interview with Desso:

*'The Netherlands could create many jobs by giving its recycling industry a boost. One problem is that the transport of waste is not allowed. However, the cradle to cradle concept regards waste as 'food'. If we apply this theory, develop separation techniques and increase the tax on raw materials while decreasing that on work, we could become an exporter of raw materials. This will of course involve a huge amount of innovation. What we are currently doing with our water expertise, we could also do with that on recycling. There is so much potential. A huge number of Chinese products are sent to our country, while we try to maintain a manufacturing industry without having the raw materials for it. We should therefore develop an 'unmanufacturing' industry here, and sell the resulting raw materials to China. This would close the loop nicely, and in my opinion the Netherlands could become a leader in this field.'*

There is also an opportunity for the Netherlands to link its good position in recycling to the transition towards a circular economy. Recycling is the first step in this process. Making use of the potential of the circular economy implies an even greater focus on 'creating value' from existing waste flows. Now that it largely has the hang of reducing the environmental footprint, the challenge for the Netherlands is to create value ('there is no such thing as waste', or 'waste is resource'). For example, making better use of existing biotic waste flows (e.g. from crops, processing in the agricultural industry and the end user) could provide the Netherlands with an additional one billion euros, annually. And the opportunities related to a circular economy in general could provide over seven billion euros for the whole of the Dutch economy (TNO, 2013). Greater emphasis on value creation, here, is in line with future prospects for companies. At the same time, of course, reducing the environmental footprint remains important.

The reuse of raw materials is very important for Europe and the Netherlands if a greener economy is to be achieved, as this will enable increasing the lifetime of scarce resources. The significance of reuse is expected to increase over the coming years, given the strong increase in the demand for materials, combined with high future prices. More importantly, this also creates a great opportunity, as Europe has a large share in the global waste market and this market is growing rapidly (CE, 2013).

The strong position of the Netherlands in recycling offers a solid basis with respect to this growth market. A transition towards a more circular economy will also produce savings; it has been calculated that by switching to a circular economy, companies in the European Union could save over USD 460 billion each year (EMF, 2012).

What can the Netherlands do to grasp such an opportunity? After all, other countries also recognise this potential.<sup>6</sup> Should the Netherlands succeed in further



### **From a linear to a circular economy**

The current world economy is based on the linear model of ‘buy, use, throw away’. This model is now threatened by the limited availability of natural resources combined with growing demand, climate change and the toxicity of materials. The circular economy replaces the concept of ‘finite lifetime’ with recovery, represents a shift towards the use of renewable energy, eliminates the use of toxic chemicals (which limit reuse), and aims to eliminate waste through the superior design of materials, products, systems and – within these – business models (EMF, 2012).

In a circular economy, the emphasis is on raw materials and closing the loop, with a focus on product design to prevent waste or enable the reuse of product components. This approach requires more collaborations in the production chain and, often, more long-term relationships between companies. A more radical interpretation of the circular economy includes a shift from product ownership to product use, in which the raw materials remain the property of the manufacturer. Often, this has direct consequences for the earning models of companies. Monthly payments, for example for lighting or furniture, or paying per wash, mean that earnings are more evenly spread throughout the year.

### **Examples of the circular economy in the Netherlands**

More and more companies and regions are demonstrating that a circular economy is possible. At Desso, old carpeting is safely reprocessed to make new carpet products, or used in other recycling initiatives. The Dutch city of Venlo has a circular industrial estate, partly as a spin-off of the Floriade horticultural show, and the Van Houtum company for many years has been showing us how to make a successful circular business case with paper. And outside the Dutch borders, the Caterpillar company focuses on the reuse of components. It seems that all these companies apply the motto just do it, without letting any obstacles – which they are bound to come across – get in their way. Examples of such obstacles are waste regulations, which hinder the trade and reuse of product components, or the funding of these new business models.

optimising waste collection, there are opportunities for realising added value from existing waste flows. If the marketing of Dutch waste collection and processing knowledge and expertise could be optimised, the focus could be directed to internationalisation. Harmonising European waste policy, including for example stricter waste disposal requirements, could accelerate this process.

### **Other opportunities**

The three themes named here are not exhaustive. Companies are also successful in many other areas, and there are more ways to profit from greening. Some of these possibilities are described below.

- *Cleantech.* This high-tech industry covers a range of clean and efficient technologies. As mentioned above, some of these are directly related to the sustainable built environment and the circular economy. However, there are also companies in the cleantech industry that are active in other areas, such as sustainable mobility and energy systems, although these are relatively small compared with other cleantech segments in the Netherlands. And this is also true, in particular, compared with countries such as Denmark and Germany that have a head start in this sector. For example, electric transport is a highly underrepresented cleantech segment in the Netherlands, as the country lacks a large car manufacturing industry.<sup>7</sup> It would therefore seem to make sense to draw on the strength of neighbouring countries and, for example, benefit from developments in sustainable energy and the automotive sector in Germany, in which the Netherlands has an important role as supplier.
- *Water.* The Netherlands has a long tradition in sustainable water management, such as in coastal defence, flood control, land reclamation and river management, but also in environmental consultancy and waste water engineering, as well as in the production and installation of water-treatment equipment.<sup>8</sup> Water management is inextricably linked to the Netherlands. Worldwide, a good water supply will become increasingly problematic in countries with an increasing water demand due to drought, population growth and increased wealth. Dutch water treatment technology offers opportunities for overcoming some of these problems. However, the potential of this segment seems relatively limited compared with that of the bio-based economy, the sustainable built environment and the circular economy.
- *Benefits.* Greening in other countries also provides opportunities for Dutch sectors that are not necessarily green themselves – the offshore sector and water management being clear examples. The Dutch geographical position and offshore expertise enable the Netherlands to profit from developments in offshore wind. For example, Dutch companies are building platforms and laying cable networks.
- *Green as location factor.* A green location may also attract businesses to an area. Countries and regions compete with each other to attract foreign investment or companies; in particular, because these foreign companies are able to bring in production, jobs and new knowledge. Do green factors such as air quality contribute to the attractiveness of a business location? Although research into this is really still in its infancy<sup>9</sup>, so far, there does not seem to be a very strong link. It would seem that factors other than for instance clean are considered more important when foreign companies choose their new locations.

The three broad themes distinguish themselves from the factors mentioned above because they bring together high mass sectors. These are large sectors, with a large earning potential, possibly on an international level. Combined with the strong knowledge base available, there is much to be gained within these themes.

## 4 Business drivers and barriers

Companies are interested in greening if it fits in with their business objectives and if it is possible to present a healthy business case. This chapter examines what it is that drives companies who are actively involved in greening and the obstacles they meet along the way. Of course, there are also many companies who prefer to wait, for a variety of reasons, but for those who are already going through the greening process, at least three drivers could be identified.

47

### What drives companies to green?

#### **Increasing raw-material prices**

Climate change, biodiversity loss and higher and more volatile raw-material prices make the environment and nature an increasingly common business risk, as companies are the first to experience the effects of price increases for raw materials and energy. For example, Unilever's costs were 1.5 billion euros higher than expected in 2012, and this was due to the increase in raw-material prices (Unilever, 2013).



*Efficient management of water and nutrients by Dutch agricultural companies.*

It is no surprise that companies with relatively high raw-material and energy costs are leading the way in greening. Companies that are able to produce more efficiently have an advantage over their competitors. This is one of the main reasons why companies, such as Unilever, DSM and Heineken, in their production processes are focusing on a more efficient use of energy, raw materials, water and land.

### **New markets**

The market for sustainable products is a growing market. For example, the markets for various sustainable products and clean technologies have grown by double figures in recent years (BMU, 2012). Strong growth is also expected to continue in these global markets over the coming decades (BMU, 2012; KPMG, 2012; WBCSD, 2010). Roland Berger estimates the global green technology market at USD 4,400 billion by 2025 (see BMU, 2012) – reason enough, therefore, for companies to respond to this fast-growing market and to profit from a first-mover advantage (see Text Box: Profiting from growth markets).

### **Image and licence to operate**

Multinationals also have an additional motive; they often have a certain reputation and are pressurised by society and non-governmental organisations (NGOs) to become greener. They are also vulnerable to naming and shaming by NGOs. Multinationals need to prevent negative media attention resulting from not caring for nature and the environment, as this would undermine their licence to operate. On the other hand, a green image can also be an advantage. For example, a sustainable company is more likely to attract motivated new talent than a company that is not green.



### **Benefiting from growth markets: Philips sees profit in LED lighting**

In the 20th century, if you saw a light bulb in the Netherlands you thought of Philips. In the 21st century, the world should think of Philips when it sees an LED light. This benefits not only Philips: lighting is responsible for almost 20% of global electricity consumption, and switching to LED lights will enable significant increases in energy efficiency. In areas without an electricity grid, a combination of solar panels and LED lighting may provide clean, affordable lighting. There are still 1.5 billion people with no access to electricity in the world. Energy-efficient rice cookers and ovens are also green products in which Philips sees global opportunities for setting up successful business cases and to contribute to energy saving.

With LED lighting, Philips is building on one of its existing strengths. Much R&D within Philips was and still is focused on LED, so that the company now holds a strong position in this market. Philips is currently actively highlighting these cost-saving opportunities for cities and towns. Often, street lighting is responsible for more than half of municipal electricity costs. Switching to LED could halve these costs (DSGC, 2012). A widespread switch to LED would also expand the market for Philips. However, the higher purchasing price is often an obstacle for municipalities. On the other hand, the time taken to recover the costs is fairly short for LED lights – about 18 months – and the amount of energy that is saved during the lifetime of a LED light is considerable.

National government can help encourage the switch to LED; for example, through the sustainable procurement of lighting, making decisions based on product lifetime costs (total cost of ownership). The government can also insist on energy-efficient lighting. It also helps if inefficient light sources, such as the incandescent light bulb, are phased out. New earning models may also help LED lighting to become the new standard. For example, Turntoo already makes it possible for offices not to purchase lamps, but to enter into a contract with Philips for the delivery of a certain amount of light per day and per year. This concept is in keeping with the idea of the circular economy and the shift from ownership to use. It also means that the incentive to keep using the most efficient light sources is the responsibility of those who with most knowledge and interest in doing so, increasing the chance of action and success.

Excerpt from an interview with Van Houtum:

*'What are the benefits? In addition to public support, mainly proud employees – leading to greater involvement and more flow in the organisation so that you can achieve fantastic things. This is ultimately what every entrepreneur wants. (...) This is what has given us our unique market position, so that we are seen as a leader and which means that more and more people want to do business with us. (...) It provides us, on the one hand, with a unique market position, and, on the other hand, with continued turnover and a licence to operate.'*

## What types of companies go green?

### Companies take up the challenge

Although greening is not very high on the agenda of most companies, some are increasingly aware that a focus on the environment and nature is part of their public responsibility. Companies that decide to go green are increasingly doing so of their own accord. They no longer wait for government legislation but take the lead themselves.

Various Dutch multinationals are at the forefront of greening. This can be seen, for example, in the fact that several Dutch companies – such as Unilever, Philips AKZO and KLM Air France – belong to the top 19 super-sector leaders in the Dow Jones Sustainability Index (DJSI, 2012). One reason for this is an understanding of the effects of commercial activities on humans and the environment. More and more companies are also taking part in green accounting (see Text Box: Green accounting the new norm?).

### Small and medium-sized enterprises show varied picture

Compared with large companies and multinationals, the picture is much more varied for small and medium-sized enterprises. Many of these companies lag behind when it comes to greening. One of the main reasons for this is that many smaller companies do not have enough time, knowledge and money to actively focus on it. These companies are also often less well-known and therefore less susceptible to naming and shaming. In addition, the strategic orientation of these companies is usually weaker and they are less driven by major global developments, such as resource scarcity (KPMG, 2013). At the same time, it is often the smaller companies that push through true innovation (WRR, 2008). For example, PlantLab uses 90% less water than conventional cultivation methods by optimising growth conditions (see Text Box: Input from innovative companies, Chapter 1).

### **Promising innovations originate from SMEs**

New and young companies are less bound to the established structures. This gives them more space to experiment with techniques and earning models that truly break with existing systems. SMEs see the demand for green growth and clean technology as the perfect chance to develop and scale up their innovative solutions. However, the step from prototype to operational technology is capital-intensive and therefore highly dependent on available funding. Such funding is often hard to find for new, young companies with promising ideas but no proven track record. In addition, getting new technology ready for production often requires close cooperation and the exchange of knowledge with buyers and suppliers. Only when a suitable level of trust has been achieved between these parties will they be ready to walk along the steep learning curve required to scale up new production techniques. In practise, funding and scale-up often take place under the wing of large companies, which often then merge with those promising, innovative, smaller companies.

### **Green accounting the new norm?**

A crucial element in any successful green business model is that considerations of long-term ecological issues be reflected in the day-to-day running of the business. This is important for employees, as well as shareholders and consumers. There is often a lack of understanding regarding the use of raw materials, so that saving opportunities are missed. Such an understanding requires the transparent and reliable reporting of results. After all, 'you cannot manage what you do not measure'. Transparent information on ecological impacts is an important step to be able to make changes. By verifying the ecological data and having it recorded by an accountant, these figures are given the same status and reliability as financial data.

Various Dutch multinationals are already actively collecting information on the effects of their products on people and the environment. They look not only at the effects on profit, but also set targets and measure progress with regard to ecological and social aspects. For example, at Unilever, employees are rewarded not only in relation to financial parameters, but also based on progress in ecological and social objectives. In this way, therefore, green accounting becomes part of the business plan. Putting a price on the impact of the production chain on the environment enables this information to be used in the day-to-day decisions taken by a company, and means it can be explained to shareholders and consumers.

Excerpt from an interview with Ibis Power:

*'We have been to several top sector policy meetings, and each time we see the big companies getting all the money. As a small entrepreneur, you are not going to get anything. The large companies are interested in our knowledge (...) but it's a case of the elephant and the mouse. You just know that in a year's time, all your knowledge will belong to the big companies, so you are better off not joining in.'*

## What stops companies?

Greening does not take place of its own accord. For many companies, the investment this requires forms a serious obstacle. Not only do green investments compete with other, profitable investments, but the ecological impacts also take place in the future. There is generally less urgency for going green among Dutch companies than for companies in neighbouring countries. Also, companies that do invest in greening come across all kinds of obstacles and barriers along the way. Interviews with companies and previous research both have shown that the nature of these obstacles varies widely.

### **Unstable policy and inhibitive regulations make companies reluctant**

Many companies name the lack of a long-term government vision supported by stable policy as a barrier to green investments. This certainly applies to renewable energy. For example, there are companies involved in long-term projects, such as offshore wind, who eventually may receive a subsidy based on a regulation that has already changed twice since it was applied for. So many changes make it difficult to put together a good business case and obtain funding.

Companies that want to invest in the greening of the economy often find their path obstructed by existing regulation. For example, until recently regulations prevented the use of LED technology in street lighting. Another example is that of current waste material regulations preventing companies from being able to make use of the added value of a circular economy. For example, companies need a licence to transport waste, whereas the circular economy sees 'waste' as a raw material.

Although many of these rules were once implemented with a clear, possibly environmental, objective in mind, they now require updating as priorities and insights have changed over the years. In addition, much regulation still sets out the measures to be taken, while companies can work much better with targets. Targets indicate which objectives need to be achieved but give companies the freedom to decide on how they are going to do this. This gives companies more room for applying creative and innovative solutions. With the Green Deal approach, steps have already been taken to identify and remove restrictive regulations (see also Chapter 6).

Excerpt from an interview with DyeCoo:

*'I am quite aware of the principal of co-funding as applied in the policy on top sectors. However, you are always forced to work together with other people, and forced partnerships do not work. In the case of a win-win situation, everything goes OK and if you can get a subsidy for it – even better. However, I would dare to claim that if there is a win-win situation for both parties and no subsidy, they will still go ahead and do it. Personally, I think that many of these kinds of initiatives encourage forced partnerships, along the lines of, "Why don't we get together and think up something to get ourselves a subsidy?"'*

### **Laggards slow down leaders**

Companies that are a household name increasingly feel the pressure to produce more sustainably. However, compared with their competitors, they have little room for manoeuvre to do this. After all, more sustainable production methods require investment and may result in higher production costs. These companies are also at a competitive disadvantage compared with smaller companies that are able to operate 'under the radar' of NGOs.

Large, well-known companies are also aware that greening is an area in which they can set themselves apart from their competitors. These leaders would like to see their efforts (investment) rewarded by a government that tightens regulations and therefore creates a high level playing field, fixing a green minimum standard in the market. Tightening regulations also forces laggards to take the necessary steps as far as greening is concerned. There are also smaller SMEs that are committed to greening but encounter obstacles because they are not very well-known and have a too limited capacity to be able to focus completely on the greening process.

### **Too few pricing incentives**

Negative impacts on the environment and nature are currently insufficiently reflected in the cost price of products. There are therefore too few pricing incentives to encourage companies to use natural resources more efficiently. For example, the currently low CO<sub>2</sub> price in the European Emissions Trading System (ETS) does not encourage companies to invest in clean – more expensive – technology. The readiness of companies to invest in greener processes is therefore discouraged by current pricing incentives. As a result, for example, pilot projects for carbon capture and storage are difficult to get off the ground, partly due to the low CO<sub>2</sub> price. The current CO<sub>2</sub> price in the ETS is about 5 euros per tonne of CO<sub>2</sub>, while many companies require a price of 25 to 30 euros per tonne for a good business case (Point Carbon, 2013).

### **Lack of suitable funding slows innovation**

Young companies with new ideas are an important driver of innovation, but their potential is not made enough use of due to a lack of suitable funding opportunities

Excerpt from an interview with Desso:

*'Meetings are often held between the government and larger organisations, whose budgets are higher than Desso's, and they also have larger means at their disposal. This makes it difficult for Desso to participate. Larger companies generally have staff members who particularly focus on sustainability trends and who attend related meetings. Regretably, at Desso, we often lack both time and opportunity to do the same.'*

(OECD, 2013). Banks would rather invest in companies and technologies that have already been proven, and venture capitalists often demand a large share in the company once it becomes profitable. This is not usually an attractive option for new companies; you do not decide to set up your own company only to hand it over to the whims of the investors. It is also difficult for companies that want to scale up already-proven techniques to generate sufficient funds.

Entrepreneurs believe that the government has a role to play here. The government could be a guarantor for young, innovative companies that require a loan, or create a revolving investment fund for them. Support within the top sector policy is less relevant for small, innovative companies as this focuses on the development of pre-competitive knowledge, while it is exactly this knowledge and know-how that gives small, innovative companies their competitive advantage. They are therefore not keen on sharing it with others. Furthermore, the top sector policy, according to some companies, forces cooperation, whereas cooperation is something that needs to grow based on trust and that cannot be forced.

#### **Need for tailor-made solutions**

Finally, SMEs have a need for tailor-made solutions. Of course, companies that already produce in an efficient way benefit from tighter environmental legislation or from the environmental impact being better reflected in the price. On the other hand, many smaller, innovative companies lack experience, market knowledge and critical mass. As they are so very specialised, the leading SMEs often come up against very specific obstacles. Lack of room to experiment, restrictive regulations and insufficient opportunities for making strategic alliances are examples of this.

This therefore requires a more supportive government that is willing to help look for solutions with these companies. The government could support companies in developing entrepreneurial skills, bring companies in contact with each other and help companies find their way through the maze of rules and regulations.



Excerpt from an interview with Van Houtum:

*'The government and Van Houtum actually have the same objective – we both want to reduce CO<sub>2</sub>. Paper production is a highly energy-intensive process. (...) We now generate the heat required ourselves, using combined heat and power (CHP), which has an energy efficiency of 83%. A power station achieves no more than 50% because it does not use the heat released. (...) However, in the current CO<sub>2</sub> credit system, it would be cheaper for Van Houtum to buy energy produced using coal and to close the CHP plant. (...) This is crazy, as we have the same goal: we want to reduce CO<sub>2</sub>, the government wants to reduce CO<sub>2</sub>, but this is the situation at the moment.'*

Excerpt from an interview with Powerhive:

*'It is clear that, for businesses such as ours, and actually for most SMEs, there is no capital available above and beyond what you can always get from the bank and the Dutch development bank (FMO), for example. FMO starts counting at about 10 million, and the bank goes up to 100,000 – the area in between is therefore very difficult, so you need to be creative.'*



## 5 Greening in neighbouring countries

Much of the income of the Netherlands is being earned abroad. This is by no means a unique situation; neighbours Germany, Denmark and the United Kingdom are also 'open economies'. Previous chapters indicated how these countries are ahead of the Netherlands when it comes to greening the economy. They are aware of the importance of greening, began earlier and focus more strongly on it.

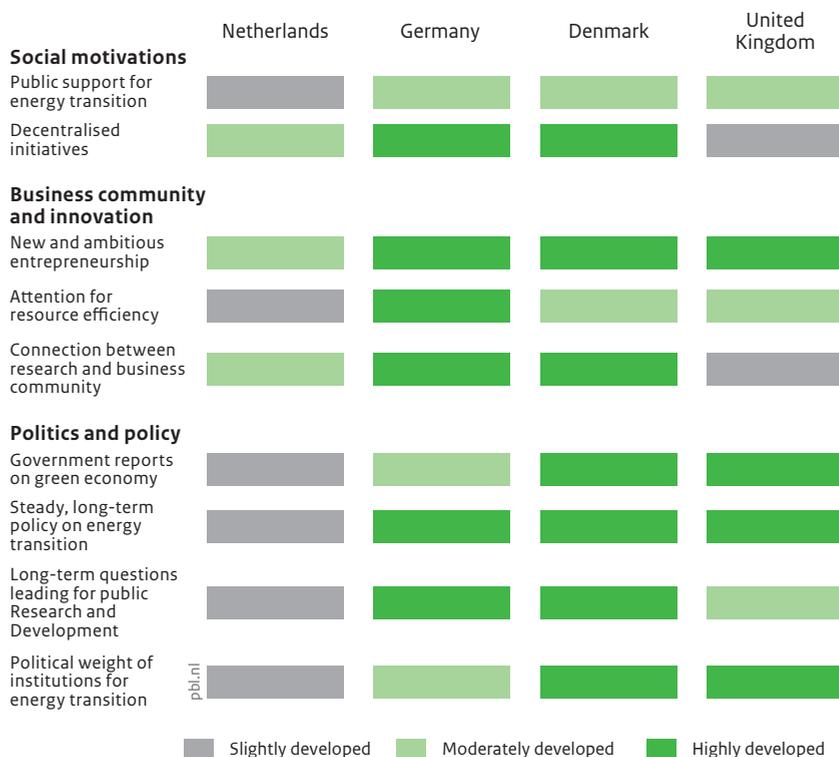
57

Although there are a number of clear similarities between these four countries, there is also great diversity in the approach they take to greening, with different strategies, different technologies and different drivers. Part of the reason for this is that, of course, their economies are not identical. For example, the Netherlands has a relatively large transport and services sector, Germany has a relatively large industrial sector, Denmark a variety of SMEs, and there are not many countries with a larger financial sector than the United Kingdom.

As a result, it is not possible to simply copy the success factors in one country, as these are often linked to country context, culture and historical developments. However, experiences in other countries may inspire us to develop a clear greening strategy. The Netherlands, therefore, can learn from its neighbours.<sup>1</sup> Figure 16 provides an indicative overview of greening conditions and their relative weights in the Netherlands, Germany, Denmark and the United Kingdom.

Figure 16

### Preconditions for greening the economy



Source: PBL, 2013

*In neighbouring countries, many conditions for greening are better than in the Netherlands.*

### Social drivers

Incentives for greening of the economies of Germany, Denmark and the United Kingdom have a long history and are interwoven with a high level of public involvement in environmental and energy issues. In Denmark, as well as in other Nordic countries, most people accept that the quality of the environment contributes greatly to the general quality of life. Although more strongly the case in the 1990s than at present, people in Germany also consider a better environmental quality to be one of the main political objectives (BMU & UBA, 2013).

In these countries, the greening roots lie in the 1970s and 1980s. At that time, Denmark was largely dependent on oil imports for its energy supply, so it had severe problems in the 1973 and 1979 oil crises. This was the impulse for an ambitious energy policy, in which the Danish government focused on supply security, and the general public on improving the environment (DEA, 2012b). The nuclear



*In Germany, farmers now produce solar energy instead of wheat.*

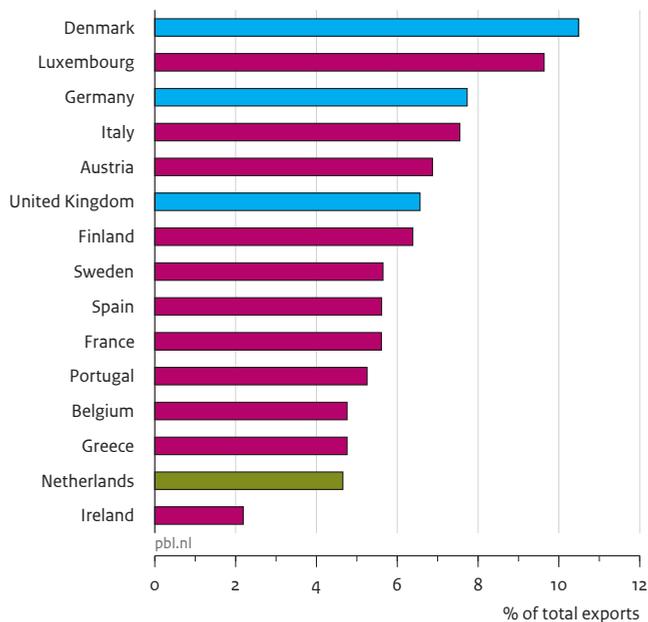
disaster at Chernobyl on 26 April 1986 hit Germany hard and resulted in a general public dislike of nuclear energy ('Atomkraft? Nein Danke'), starting a movement that focused on alternative, renewable energy sources (Hockenos, 2012). The front runner position of the United Kingdom in climate policy goes back to the mid-1980s, and it was Margaret Thatcher who in 1988 upset the, until then fairly tame, climate change debate by focusing on the risks and costs of global warming (Carvalho and Burgess, 2005). Fifteen years later, and for a Labour government, Lord Stern drew up his first report on the social costs of climate change which ultimately led to the 2008 Climate Change Act. The British considered climate change a theme in which their country could play a leading role.

### **Decentralised initiatives**

In Denmark and Germany in particular, public initiatives are an important driver of the transition towards a sustainable energy supply. A stable policy that was developed in these countries in the 1990s provided financial support for the transition towards renewable energy from sun, wind, biomass and hydro-electric power. The general public, farmers, cooperatives and local energy companies were able to invest in renewable energy, on a large scale, and at almost no risk.

Over 50% of the renewable energy installations in Germany are owned by the general public and farmers (Buchan, 2012). However, there are initiatives that go even further. Both in Denmark (Samsø) and Germany (Feldheim and Schönau), examples can be found of local communities that meet their own energy demand using completely non-fossil-fuel technologies that are designed to work together. In a few cases, these communities sell any surplus power, thus creating a local income from energy. These projects show what a decentralised energy supply could be like.

Figure 17  
Green share in total exports in the EU15, 2011



- Netherlands
- Reference countries
- Other countries

Source: DANVAD, 2012

*The share of green goods in its total exports is low in the Netherlands compared with that of Denmark, Germany, the United Kingdom and many other European countries.*

## Businesses and innovation

### Size of the green economy

A substantial part of the economies of Denmark, Germany and the United Kingdom is now green. The green economy in these countries is responsible for about 10% of GDP, although it should be noted that methodology differences make it difficult to give a precise definition of 'green production'.

Denmark recently published its first Green Business Statistics<sup>2</sup> (DEA, 2012a), which show that many sectors in the Danish economy contribute to the green economy. Within the energy sector, the main contribution is from renewable energy technology (including wind turbines); in the environmental sector it is waste management (e.g. waste water treatment plants).

In 2010, the green economy was responsible for a turnover of 33.5 billion euros in Denmark (about 14% of GDP). Of this, 10.7 billion euros was exported, representing 10.4% of total Danish export. In 2010, 106,000 people were working in 22,000 companies fully or partially providing green products or services. At that time, green products made up about 40% of the turnover of these companies. The manufacturing industry in Denmark makes the largest contribution by far to the Danish green economic exports (DEA, 2012a).

According to the Green Business Statistics methodology, within the EU15, Denmark has the largest share of green goods in its total exports. The same statistics put the Netherlands below the EU15 average (see Figure 17).

In the United Kingdom, the government reports annually on the size of the Low Carbon Environmental Goods and Services sector (LCEGS) (BIS, 2011; 2012; 2013). The size of the green economy in the United Kingdom (GBP 128 billion, or EUR 149 billion and 938,000 jobs in 2012) and its growth (4% to 5% annually, since 2009) make it clear that the sector is now very important to the country's economy. Incidentally, the number of LCEGS companies has remained almost constant over the last three years, at about 51,000 – on average, these companies have seen a large increase in turnover. What is striking is that the United Kingdom exports significantly more LCEGS than it imports – the main export countries being China, India and Japan. For the United Kingdom – faced with a chronic trade deficit – the export of green products is therefore another reason to invest further in the green sector. It seems that sub-sectors in wind power, construction technology, alternative fuel and alternative fuel vehicles are doing the best, in terms of turnover. Growth in these sub-sectors is also above-average compared with other LCEGS sub-sectors and provide the most jobs.

According to estimates made by the German Ministry of the Environment (BMU, 2012), Germany currently holds a global market share of about 15% (about 290 billion euros) in green technologies – representing about 11% of GDP. The number of

Figure 18  
**Green competitive position of the 15 largest industrial sectors, 2005 – 2010**



Source: LSE, 2013

*In Denmark and Germany, many of the 15 largest sectors are both internationally competitive and focused on green innovation. This puts them in a good position to profit from the green transition.*



*The United Kingdom is investing in large offshore wind parks.*

jobs related to the green technology sector in 2011, as a whole, was estimated at 1.4 million. If Germany is able to maintain its 15% market share, this will represent a market volume of 660 billion euros for the German green technology sector by 2025 (BMU, 2012).

The German company ENERCON GmbH shows that green business models can be successful. This wind energy company, established in 1984, now holds a market share in Germany of more than 50% of the total wind power market, and more than 7% of the worldwide market share.<sup>3</sup> Siemens AG is a world player in technology, and the technologies that improve the efficiency of energy and materials in production processes form the core of their green portfolio.<sup>4</sup>

### **Green technologies firmly anchored within traditional sectors**

Green technologies are usually firmly anchored in the traditional sectors of the three neighbouring countries of the Netherlands. In Germany, for example, these are the electrical engineering, chemicals, mechanical engineering and automobile industries. This therefore makes it difficult to determine the economic significance of green technology beyond the context of the economic system as a whole. Germany and Denmark are good judges of the opportunities provided by greening for innovation, industrial activities and jobs, as can be seen by looking at the sectors that score best both in terms of competitiveness and green innovation: this includes most of the 15 largest sectors in Germany and Denmark (see Figure 18).

### **Water efficiency in Denmark**

The Danish Government believes that financial instruments can be used to promote the efficient use of raw materials and to tax polluting activities. This also applies to drinking water, which is relatively scarce in Denmark due to the absence of large rivers. To encourage the efficient use of water, the Danish Government has made water expensive through taxation. This has encouraged Danish companies to develop efficient technologies, so that less water is used in production processes. Because water scarcity is an issue in many countries, Danish companies that develop such technologies have opened up an international market. The efficiency technologies have also resulted in many partnerships with companies and research institutions in other countries.<sup>6</sup>

In Germany, the greening of the economy is inextricably linked with the ambitions to be and remain an attractive business location for development and production of technological products and to keep the complete value chain within the country. This 'Made in Germany' policy is successful and applied consistently. In Germany, industry is responsible for 23.8% of the total added value.<sup>5</sup> In the United Kingdom, 'industrial politics' – after having spent several decades on the sidelines – is back at the cabinet table, with a Low Carbon Industrial Strategy (HMG, 2009) and specific strategies for traditional and new sectors (e.g. offshore wind). The United Kingdom has a large offshore wind energy potential, and although the wind turbines are currently built abroad, a big effort is being made to ensure that they can also be built in the United Kingdom, with Siemens and Vestas currently in the race to build local factories. The benefits of greening for industry are receiving an increasing amount of attention in the United Kingdom, largely due to the Confederation of British Industry, the largest British employer organisation (CBI, 2011; 2012).

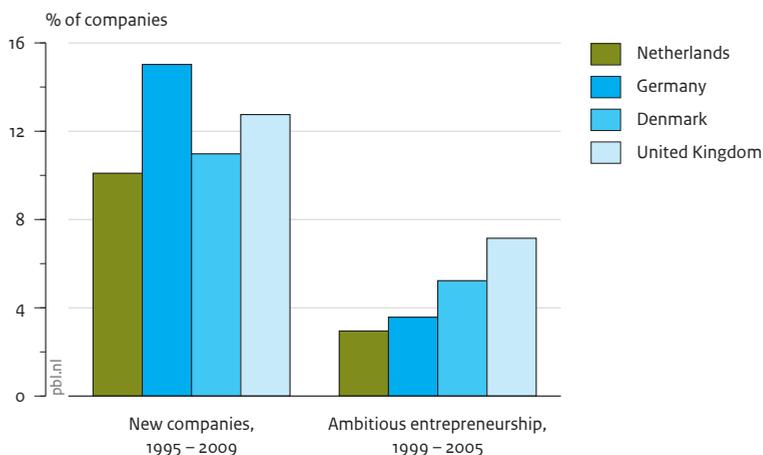
Industry in Denmark, Germany and the United Kingdom is highly dependent on imported energy and raw materials. It is therefore not surprising that, due to shortages and uncertainty on the global raw-material markets, these countries are focusing more clearly on resource efficiency as part of the greening agenda. They make a clear link between resource efficiency and resource security and the business community plays an important role in identifying government strategies (BMU, 2012; DEFRA, 2012; Green Alliance, 2013). The fact that the government has a role to play in promoting resource efficiency, and can therefore boost innovation, is shown for example by the development of water efficiency technology in Denmark (see Text Box: Water efficiency in Denmark).

### **Entrepreneurship**

Entrepreneurship plays an important role in the ability to capitalise on the opportunities that a greening of the economy provides, and in the marketing of green technologies. Various aspects are involved, such as the entrepreneurial

Figure 19

### Share of new companies and ambitious entrepreneurship



Source: GEM, 2011/2012

*The reference countries are characterised by a higher proportion of new companies and more ambitious entrepreneurship.*

opportunities that people see, the entrepreneurial skills they think they have, and the way in which they deal with setbacks. The Global Entrepreneurship Monitor (Xavier et al., 2013) regularly compares the various aspects of entrepreneurship in many countries. In this monitor, the Netherlands is shown to be a country with a relatively well-developed entrepreneurship (measured for example according to the number of start-up companies per year). However, even more people start their own companies in Denmark, Germany and the United Kingdom. In addition to the higher proportion of new companies, there is also more ambition in these countries to make these companies grow – ‘ambitious entrepreneurship’. These differences can be seen in Figure 19 (Kelley et al., 2011; Xavier et al., 2013).

Figure 19 shows the Netherlands lagging behind its large neighbour Germany; in particular, with regard to the proportion of new and fast-growing companies. This has been confirmed in several studies over recent years (Bartelsman et al., 2005; Peeters and Verhoeven, 2005; Stam, 2008; Stam et al., 2007).

Although the Netherlands had relatively few entrepreneurs in the past, this is changing. The number of new companies was above the international average during the last few years, and has increased spectacularly in recent years (Stam et al., 2012; see too Xavier et al., 2013<sup>7</sup>). However, a closer analysis shows that these companies mainly represent self-employed people (with no employees), and largely in knowledge-intensive sectors, such as construction and personal

services. This growth therefore has little to do with innovation (WRR, 2008). In terms of growing or innovative young companies, the Netherlands performs just moderately. This is worrying, because it is these activities that fuel job creation and a further increase in prosperity (Stam et al., 2012).

### **Innovation as precondition for greening**

The innovation system in Germany and Denmark is supported using public funds – with a focus on future social issues related to climate and energy, mobility, the food supply and health care. Despite the economic recession, these countries have increased public R&D spending to about 1% of GDP and in combination with the public and private sectors this totals about 3%. Although the United Kingdom in 2011 set a target for R&D (to spend 2.5% of GDP on R&D in 2014), it actually scored lower than the EU average (1.79% compared with 2.03%), of which the contribution from public funding was less than 10%.

One of the clear differences between Germany and the United Kingdom is in their research focus. In Germany, much research is conducted outside universities, by national government, federal states and the business community (see Text Box: Efficiency of the German innovation system). These institutions carry out both fundamental research (e.g. at the Max-Planck-Gesellschaft) and applied research (e.g. at the Fraunhofer-Gesellschaft). In the United Kingdom, the focus is on university research which is, by definition, more fundamental – think for example of the top universities of Cambridge, Oxford and London.

It would seem that the German institutions have better links with the business community and other fields of practice. The British are therefore looking at ways of copying the beneficial aspects of non-university institutions.

In the Danish system, clusters and knowledge networks play a large role in translating knowledge into economic opportunities. Because of the structure of the Danish economy, SMEs have a central function in this. The business community, research institutions, universities and the government work together in the Copenhagen Cleantech Cluster (CCC) to realise the transition towards a low-carbon society and to make use of corresponding economic opportunities (CCC, 2012). The success of the CCC is attributed to the unique combination of institutions, political objectives, cooperation culture and human resources. This environment has helped Danish cleantech companies to make use of first-mover advantages and attract investment. The International Cleantech Network (ICN)<sup>8</sup>, set up with the support of the Danish Government, aims to help Danish companies enter international markets; without that support this would be difficult; particularly for smaller companies. ICN helps these companies keep pace with international developments and investment opportunities. In recent years, four institutions have been established in the United Kingdom, which all focus on stimulating low-carbon innovation: the Carbon Trust (2001), the Technology Strategy Board (2007), the Energy Technology Institute (2007) and the Catapult

### Efficiency of the German innovation system

Under the title *Vasthoudend Innoveren (Persistent innovation)* (Nijhuis, 2012), the Dutch Advisory Council for Science and Technology Policy (AWT) sketches a picture of an incredibly complex German research landscape. The AWT has identified several success factors, such as the large coordinating role of government in the contact between universities, research institutions and industry; the focus on future issues, new technologies, sustainability and the German energy transition (*Energiewende*); the firm choice for innovation and technology, and large policy continuity, which enable research institutions to make long-term plans. However, there is no strong tradition of people starting up their own companies in Germany and, compared for example with the United States, there is very little venture capital available.

The independent *Expertenkommission Forschung und Innovation (EFI)*, established by the Chancellor of Germany, publishes an annual analysis of the German innovation system. The EFI (2013) found that the focus on innovation has resulted in highly-dynamic research, but that coordination is poor due to the large number of ministries involved and because national government and federal states all implement their own policies. The EFI also made the point that the coordination between climate, energy and innovation policy could be more cost-efficient, and could include stronger incentives for developing new technologies. The German compensation system for renewable energy, according to the EFI, really is a production subsidy with little incentive for innovation. The EFI even observed reduced investment in innovation related to renewable energy and a lock-in in established technologies. According to the EFI, the R&D policies of companies focus primarily on areas in which these companies are already strong, with the risk that new competences are not being developed.

However, although German innovation and research policy may be relatively inefficient, it is stable and therefore largely predictable. German policy sets clear targets for the future and sticks to them.

Centres (2010). Successive UK cabinets have therefore ensured that publicly funded research specifically focuses on green innovation.

If new technologies are to become established on a larger scale, more is needed than money and research and development institutions. Not all the cost-saving potential in green technology is in improvements to the technology itself; much of the costs saving is due to learning effects in the production and implementation of technologies. For example, the task force entrusted with the objective to reduce the costs of offshore wind in the United Kingdom from about GBP140/MWh in 2012 to GBP 100<sup>9</sup> by 2020, has advised that cost reductions through increased competition, expansion and improved cooperation within the value chain should also be considered (Crown Estate, 2012). Furthermore, large-scale pilot projects are unavoidable. However, funding large projects with many unknown risks is a challenge, which is why the UK Government recently set up the Green Investment Bank (see Text Box: The Green Investment Bank).

### **The Green Investment Bank**

The Green Investment Bank was recently set up in the United Kingdom with the objective to generate more private investment in the green economy. The UK Government has provided the bank with GBP 3 billion for the period from 2012 to 2015, to be invested in green projects only.<sup>10</sup>

The Green Investment Bank is intended to help lower the barriers for funding investments in the green economy, so that larger projects – which help expand and accelerate greening – can get off the ground more quickly and with more certainty. The bank has identified several barriers, such as a general reluctance among other banks to provide credit; in particular, in the long term. Green investors are also faced with a lack of experience among bankers and financiers – making it more difficult to make a risk assessment – as well as relatively new project and technology risks.

According to EU regulation on government subsidies, the Green Investment Bank may only fund projects that have received insufficient funding from private banks. The bank is also to operate 'for profit'; standard market interest rates are applied. Even so, there seem to be more than enough eligible projects. For example, the bank was involved in the completion of the funding for a waste project in Wakefield that combines several technologies to recycle and process waste and to use this waste in energy generation. The funding of the project had been under discussion since 2007. However, the involvement of the Green Investment Bank changed the situation for the private banks: the knowledge and the security provided by involvement of this government bank moved other banks to also sign up to the project (Lawson, 2013).

## **Politics and policy**

### **Stable long-term objectives form the foundation**

It is becoming clear that Germany, Denmark and the United Kingdom have set stable, long-term objectives that focus primarily on energy transition (see Table 1). The magnitude and direction of their objectives are fixed, and support for this direction and ambition means that there is no political reward in discarding or adjusting the objectives. These are therefore long-term objectives, with milestones to mark progress along the way: the five-yearly carbon budgets in the United Kingdom and the targets for intervening years in Germany and Denmark.

Table 1 Additional national climate and energy targets for 2050

The Netherlands	Denmark	Germany	The United Kingdom
None	<ul style="list-style-type: none"> <li>• 100% renewable energy</li> </ul>	<ul style="list-style-type: none"> <li>• Greenhouse gas emissions: -80%–95% compared with 1990</li> <li>• Primary energy use: -50% compared with 2008</li> <li>• 60% renewable energy</li> <li>• 80% renewable electricity</li> </ul>	<ul style="list-style-type: none"> <li>• Greenhouse gas emissions: -80% compared with 1990</li> </ul>

However, stable targets do not necessarily produce stable policy. The German double-take on nuclear energy – first the extension to phase out nuclear power stations at the end of their lifetime, and after Fukushima the about-turn to the original phase-out target for 2022 – has created much uncertainty.

In practise, tension often arises between achieving milestones cost-efficiently in the short term and realising long-term objectives. Political and public debate therefore often centres on this tension, and on uncertainties regarding future developments; in particular, in costs and technology. Making large investments now to achieve short-term milestones at the lowest possible cost may hinder innovation in and the implementation of technologies that are important in the long term.

### Support for greening demands continued political focus

It is striking that support for greening (and an energy transition in particular) seems to be greater in the three reference countries than among the Dutch. Partly due to clever political timing and foresight, legislation has been put in place in the three other countries so that a start could be made on an energy transition. In all three countries, energy and climate policies are important political themes. It is, as the Germans say, *Chefsache*.

In the United Kingdom, the Cameron Cabinet will quietly try to tamper with the fourth Carbon Budget if the European Union does not implement more ambitious climate targets, and the development of shale gas has led to much discussion about the way in which climate targets should be achieved. In Germany, support for the *Energiewende* could erode with increasing household energy costs.

Broad support among the general public is a precondition for stable long-term targets. In Denmark, a constant dialogue between government and parliament is required to maintain political support for the implementation of energy and climate policies. The leading position now held by Denmark in several green technologies clearly contributes to this political support for greening. Danish policy up to 2020 has been set out in a political agreement, reached between government and parliament in March 2012.

In the United Kingdom, the awareness is growing that the need to take action on climate change may be too small a basis for maintaining support for the objectives of the Climate Change Act. Therefore, there is an increasing focus on the economic benefits of and opportunities provided by greening. A broader distribution of the obvious benefits of greening also helps, such as creating opportunities for less wealthy households to profit from greening in the energy system through subsidies for solar panels or insulation. In Denmark and Germany, decentralised initiatives, as well as the opportunity for individuals to invest in renewable energy, are important in creating and maintaining public support.

Political and public discussions therefore still take place, but in these three countries it is about how the targets are to be achieved, and no longer about the direction to be taken or the level of ambition for the long term.

### **Greening largely benefits from energy transition policy**

Energy and climate policy is the cornerstone of greening policy in Denmark, Germany and the United Kingdom. The Danish energy policy aims for Denmark to be independent of fossil energy imports by 2050. For many years now, the country has focused heavily on renewable sources (wind and biomass) for electricity and heat. In 2012, 30% of the electricity supply came from wind energy. The extensive district heating network in Storkøbenhavn makes a sustainable heat supply possible through the application of new, innovative technologies (biomass, heat pumps and power-to-heat). Denmark has also managed to limit its energy consumption through the use of energy-efficiency technology. Although the Danish economy grew by 80% between 1980 and 2012, energy consumption remained fairly constant (DEA, 2012b).

Developments in Copenhagen show that other environmental policy areas, such as quality of the urban environment, can also benefit from an ambitious climate and energy policy. The city has set itself the target to be the first climate-neutral capital city by 2025. The programme aimed to achieve this makes it compulsory, for example, for most new buildings to include climate adaptation measures, such as a green roof. This has several positive effects on the environmental quality in the city, such as mitigating increasing temperatures and storing water.

The development of renewable energy from sun, wind, biomass and water plays an important role in the German policy on energy transition – the *Energiewende*. A clear political choice has been made not to include nuclear energy in the



*Most new buildings in Copenhagen must include a green roof.*

country's future energy mix (see Text Box: Costs and benefits of the Energiewende). Meanwhile, with about 25% renewable energy in the 'electricity mix', it is becoming clear that solar panels and wind energy in particular will form the pillars of the future electricity supply<sup>11</sup> (DENA, 2013). This presents Germany with large technological challenges<sup>12</sup> on various fronts. For example, innovation is required to further reduce the costs of individual technologies. Much larger, however, is the challenge to form a sustainable, reliable and affordable energy system with variable wind and solar power as the main energy sources. This implies R&D and innovation challenges in areas such as energy demand management and energy storage. In addition to the energy supply, the Energiewende also provides innovation incentives in the fields of energy efficiency, sustainable mobility and transport, and heat supply. Many German research institutes and companies are focusing their R&D on these challenges.

In contrast to Germany, the United Kingdom has explicitly chosen to give the various sustainable energy technologies free rein, and to invest widely in research and development. The British want to keep all options open, up to 2020, after which they will investigate developments in cost prices of various technologies. Scale-ups will subsequently take place – after 2020. There is much less aversion to nuclear energy in the United Kingdom than in Germany, and 'new nuclear' and carbon capture and storage (CCS) systems are seen as essential in achieving the objectives set out in the 2008 Climate Change Act. The UK Government's Carbon Plan also makes it clear that the targets demand broad support – from the energy producers and industry, as well as from the agricultural, forestry and waste sectors, and in terms of resource efficiency (HMG, 2011). In this way, greening in these sectors is linked to the energy transition policy.

### **The costs and benefits of the Energiewende**

The German policy on energy transition – known as the Energiewende – aims for a low-carbon energy system by 2050 and to stop all nuclear energy production by 2022 at the latest. This policy applies to the whole of the energy system, but what stands out most is electricity generation from renewable energy. The milestone of 25% electricity from renewable sources will be reached in 2013 in Germany.

The main legislative instrument is the Erneuerbare-Energien-Gesetz (EEG). This specifies that renewable energy has priority on the grid and stipulates a fixed feed-in tariff for producers, in contracts with terms of up to 20 years. This year (2013), so far, this feed-in tariff has cost about 20 billion euros, a figure that – having deducted the proceeds from selling the electricity – is converted to a price per kilowatt hour on consumers' energy bills.

The costs of the EEG have increased rapidly in recent years, the main reasons being the popularity of the scheme, adjustments to the export tariff lagging behind decreases in technology costs, and increases in the difference between the feed-in tariff for electricity and the price at which it is sold.

However, the Energiewende also has benefits. For example, the widespread use of renewable energy means fewer emissions of greenhouse gases and pollutants, and avoided energy import. The increase in solar and wind energy – with very low operational costs – has resulted in lower energy prices, which mainly benefit industry.

The widespread stimulation of renewable technologies in Germany has initiated world-wide technological development, which has greatly reduced the price of solar panels and on-shore wind energy. German companies also enjoy first-mover advantages on the world market in relation to new energy technologies. The number of jobs in the renewable energy sector in Germany has been estimated at 377,800 for 2012 (O'Sullivan et al., 2013); whereas in 1998 this was only 66,600.

### **Powerful and politically relevant institutions monitor targets**

It is interesting to see that relatively powerful, government-created institutions support climate and energy policy in the United Kingdom and Denmark. In both countries, for example, energy and climate policy are combined in a single body; in the United Kingdom in the Department of Energy and Climate Change, and in Denmark in the Ministry of Climate, Energy and Buildings. The inclusion of energy policy makes the department economically relevant and therefore politically stronger. The Committee on Climate Change is an independent statutory body that provides the UK Government with considered, comprehensive advice on meeting its climate targets. The committee also considers the costs of the transition, which are often claimed to be ridiculously high in the public debate; for example, due to lobbying and a disregard for the learning effects. Similarly, the

government-created Klimakommissionen in Denmark advises the government on climate policy. The Danish Ministry of Climate, Energy and Buildings includes the Danish Energy Agency, which has a large amount of jurisdiction in the implementation of energy and climate policy.

## Lessons for the Netherlands: learning from the neighbours

Looking at the countries that neighbour the Netherlands, the greening of their economies has a long history and is determined by social context, economic structure and the working of the innovation system. Merely copying their successes, therefore, is not going to work. And, as so often in economic development, success is a difficult process with many stops and starts. Research, innovation and new activities are often the result of public concerns regarding the sustainable use of the environment, climate change, biodiversity, resources and energy. Politicians and policies support greening initiatives by stating ambitions and setting targets, ensuring that research and innovation policy are in tune with this, and creating stable and clear market conditions.

Broad public support is required for stability and clarity. However, such support does not develop by itself, but requires political effort. The Netherlands' neighbours may serve to inspire the Dutch greening process, first of all through the clear choices that they have made, based on their own strengths and future challenges. We also see that these countries largely link greening to industrial policy; Denmark and Germany have done this for some time, and the United Kingdom is also starting to do so. Each country therefore has certain inspiring elements to contribute to a Dutch greening strategy:



Germany shows how a demand-driven, future- and continuity-focused R&D policy may result in innovation and economic success. Bringing together universities, research institutes and businesses requires an active government role. The development and widespread implementation of renewable energy technologies is a core element of the greening of the German economy, towards which the country has pursued an active and stable stimulation policy for more than 20 years.



Denmark proves that an ambitious energy and climate policy – an important cornerstone for greening – requires long-term investment in developing and maintaining broad political and public support. In Denmark, the government actively supports SMEs with regards to innovation and entering international markets.



The United Kingdom has carefully put a greening structure in place, such as the Climate Change Act and a single department for climate and energy policy. There are also the Committee on Climate Change and publicly funded research institutes that focus specifically on green technology. An annual government report also monitors developments in the green economy.

## 6 Time for government action

### Three tracks towards strengthening green competitiveness

75

A green growth strategy attempts to link green innovation to the current strengths of the Dutch economy. Much still remains to be done to ensure that businesses are in a good starting position and able to stand up to international competition.

Three tracks can be defined that lead towards green competitiveness (see Figure 20):

1. Greening: ensure that 'grey', currently strong, sectors and companies make the switch to greening. This requires a green innovation strategy.
2. Marketing: ensure that green, innovative companies become more competitive on an international level.
3. Consolidation: green, innovative businesses that are highly competitive need to consolidate their positions. These are companies that are currently in the best position, but require investment to maintain that position.

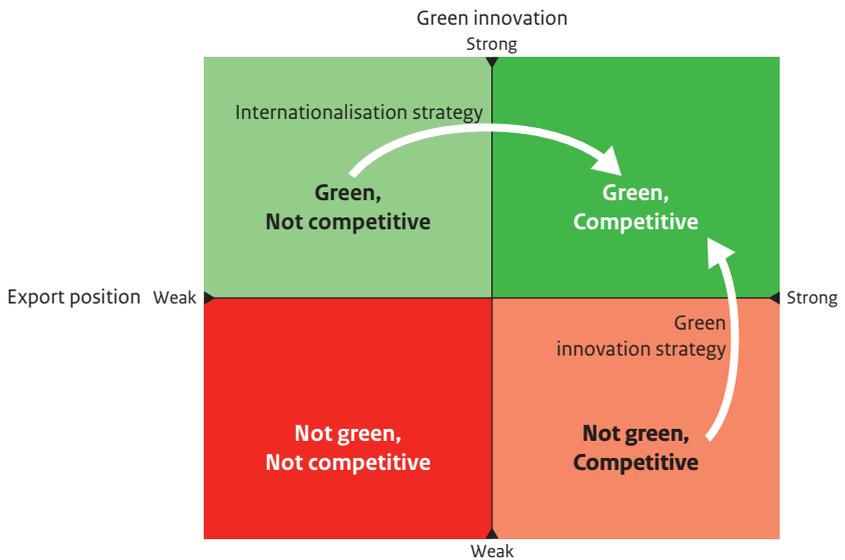
Companies that are currently in a weak position regarding green innovation and international competitiveness are faced with a double challenge.

### The Green Growth letter to the Dutch House of Representatives is a first step

On 28 March 2013, the Dutch Cabinet sent the House of Representatives a letter entitled Groene Groei: voor een sterke, duurzame economie (Green growth: for a strong, sustainable economy). According to this letter, cabinet policy on green growth rests on four pillars: 1) the smart implementation of market incentives; 2) a stimulating legislative framework to support dynamism (e.g. through Green Deals); 3) innovation; and 4) the government as a motivating and supportive network partner. The cabinet recognises important opportunities for green growth in eight areas: energy, the bio-based economy, climate, waste, construction, food, mobility and water.

However, eight different areas means there is risk of a lack of effective decision-making and fragmented policy. Furthermore, not every domain seems to be equally promising in terms of innovation and existing strengths. The Green Growth letter, therefore, does not make any real decisions based on the strengths and potential of the Dutch economy. What is certain is that an individual approach is required if we are to make use of opportunities. In some cases, sectors need to be challenged to innovate more; in other cases, a strategy focusing on internationalisation would be more suitable. The government can help by providing clear innovation incentives; for example, through the stricter application of the time-honoured 'polluter pays' principle, or by encouraging innovation along a certain pathway.

Figure 20  
Challenges for green growth



Source: PBL, 2013

*Different tracks can be followed to strengthen green competitiveness.*

### **Innovation: a role for government**

Companies and sectors that are able to combine a strong export position with green innovation, such as the agricultural sector and the food production and processing industries, have the most chance of profiting from the transition towards a green economy. Some sub-sectors in the high-tech systems and materials sector are already involved in green innovation – for example, companies working in solar panels, heat pumps, insulation and energy-efficient electrical appliances – but they do not yet have any comparative advantage. The situation is different in, for example, the chemicals sector, which is currently strong internationally, but may be unable to maintain its position without more green innovation. Sectors such as that of construction do little on innovation and are barely represented on international markets. Admittedly, sectors that are in a good position on both scores still make up only a small proportion of the Dutch economy. Germany and Denmark have more sectors that combine a good export position with green innovation.

The magnitude of and direction taken by innovation is still not enough to meet the requirements of a green growth strategy. Furthermore, it is not always so that the choices made by companies are also best for society as a whole. The government, therefore, needs to abandon its sideline position. But what is an effective innovation policy? Most importantly, the government should aim to provide the right incentives, also with regard to pricing, as wasteful and polluting activities often represent the cheapest option. Generally speaking, ‘negative external effects’ are not reflected in market prices. This, therefore, puts green technologies at a disadvantage compared with unsustainable alternatives. For example, the effect of fossil fuels, in particular coal, on the climate is insufficiently reflected in the price. This means there is no incentive for companies to invest in energy efficiency and renewable energy (Noailly and Smeets, 2013).

The most obvious solution, therefore, would be to put a price on these negative external effects. Green innovation, therefore, could be encouraged by pricing (through the taxation of tradable rights), or regulating (through licensing or legislation) the use of fossil fuels. In practice, however, there is little political support for these options, as seen in the difficult negotiations taking place regarding the tightening of the European Emissions Trading System (ETS). If pricing is not possible, then support focused on innovation would be the next best policy (Rodrik, 2013).

However, even if it is possible to take the pricing pathway, this still would not be enough, as, in addition to negative external effects, there are also free-rider issues. Generally speaking, companies invest little in product and process renewal because they are not able to profit from all the benefits of such renewal. Furthermore, other companies can benefit from the new knowledge, without having made any investment themselves. Entrepreneurs are particularly reticent with regard to green technologies, as the benefits are felt far into the future and the

market is, as yet, small. This applies, in particular, to more radical innovations for which there are as yet no markets, and the time to recover costs is very long. Companies, therefore, feel less of a commercial incentive in relation to such innovation. A convincing, ambitious and consistent government vision on greening and market creation – along the lines of ‘we need earning as well as greening’ – would provide direction.

Of course, the government can also hinder innovation. After all, it is not just markets that fail. Outdated legislation, often unintentionally, may make experimental, innovative applications impossible. An example is the guideline on lighting public spaces, which hindered the introduction of LED lighting.<sup>1</sup> Import duties on bio-fuels and solar panels also have not been conducive to innovation. Bureaucracy, therefore, limits the sustainable procurement incentive to innovate.<sup>2</sup> The Green Deals policy is a clear step towards defining the obstacles encountered by companies, with a view to removing them wherever possible (see Text Box: Green Deals).

### **Green Deals**

The government is in a position to broaden and intensify the Green Deals pathway. Green Deals are agreements between various parties that focus primarily on removing non-financial obstacles, such as legislation and licensing. These agreements have a considerable effect on other green initiatives. They have been particularly successful in the energy sector; now it is time for other sectors. Green Deals can be essential to the innovation system; for example, in providing experimental opportunities, temporary licences or exceptions to a rule.

Since its start in 2011, the Dutch Government has concluded about 150 Green Deals. The aim is a significant increase in this number in future years and, as well as energy, a focus on other themes such as water, resources, mobility, biodiversity, the bio-based economy, construction and food. In 2011, just one quarter of the Green Deals related to themes other than energy; in 2012 this had already increased to one half.

The second phase of the Green Deal should focus on the anchoring and dissemination of ideas and solutions. Innovative entrepreneurs often see opportunities, but just as often come up against obstacles. By focusing more on new innovative working methods and their dissemination, new ideas and solutions will also have a greater chance of success.

The Green Deal policy could be linked to the policy on green innovation by focusing on the leap from experimentation to implementation. The motto could be ‘do whatever possible’ to achieve the much broader dissemination of innovative processes and working methods.

Figure 21  
Parts of a successful innovation system



Source: PBL 2013, based on Hekkert (2007) and Suurs (2009)

### **More than just innovation**

Although this chapter focuses on the role of innovation, there is more to it than that. It is about strengthening the competitiveness of Dutch companies in the broadest sense. Dutch companies and sectors need to develop their comparative advantage if they are to maintain their footing on the international playing field.

There is also much to be done with regard to the internationalisation of small to medium-sized enterprises (SMEs). In terms of export power, small and medium-sized companies are important for the competitive position of the Netherlands. However, compared with Denmark, the number of exporting SMEs is small.<sup>3</sup> Dutch SME exports are also strongly based on wholesale activities, and less on the export of locally produced goods. There has even been a decline in the exports by industrial SMEs in recent years.

The government has a role to play here. More than 70% of the internationally active companies in the top sectors indicate that they require government support in their international dealings (EIM, 2013b). Examples are export stimulation programmes, trade delegations and information on potential foreign business partners and foreign legislation.

### **An innovation system focused on green growth**

How can we put an innovation system in place in the Netherlands that will provide companies with what they need to maintain their footing on the international playing field? Such a successful innovation system involves more than the pricing of undesirable developments or the subsidy of innovation to steer it in the required direction. Such a system must represent the combined efforts of companies, research institutions, educational establishments, financial organisations, intermediaries and government agencies (Boschma et al., 2002; see Figure 21). Relationships must be formed between all these parties; relationships that have a positive influence on the development, application and dissemination of innovation. Although such an innovation system is based on entrepreneurship, there is also an important role for government.

#### **Entrepreneurship**

Entrepreneurs are at the heart of the innovation system, as they create innovative projects that focus on the development of commercial opportunities. Very often, the small, new companies develop more groundbreaking innovation (WRR, 2008). Furthermore, these companies are important for the valorisation of publicly funded research: the conversion of knowledge into commercially viable products, processes or services (Audretsch, 2003). They, therefore, form the feeding ground for the large-scale development (production and distribution) of innovations, during the course of which larger companies also often become involved. In contrast to large organisations, small companies often have little interaction with

Excerpt from an interview with DyeCoo:

*‘The product must form the basis of the story that you want to tell. If the product has a good story and you know how to present that story, and if you use the right people to do this, you can get everyone interested in it. (...) With a working prototype you have more of a chance to negotiate. I think that the government should provide more support where this is concerned. It could also set conditions, such as, “If we contribute to the construction of a prototype, then we want the technology to be placed on the market as a Dutch product”.’*

policymakers, with the result that legislation often serves the interests of large, established organisations rather than improving opportunities for innovative, new companies (WRR, 2008).

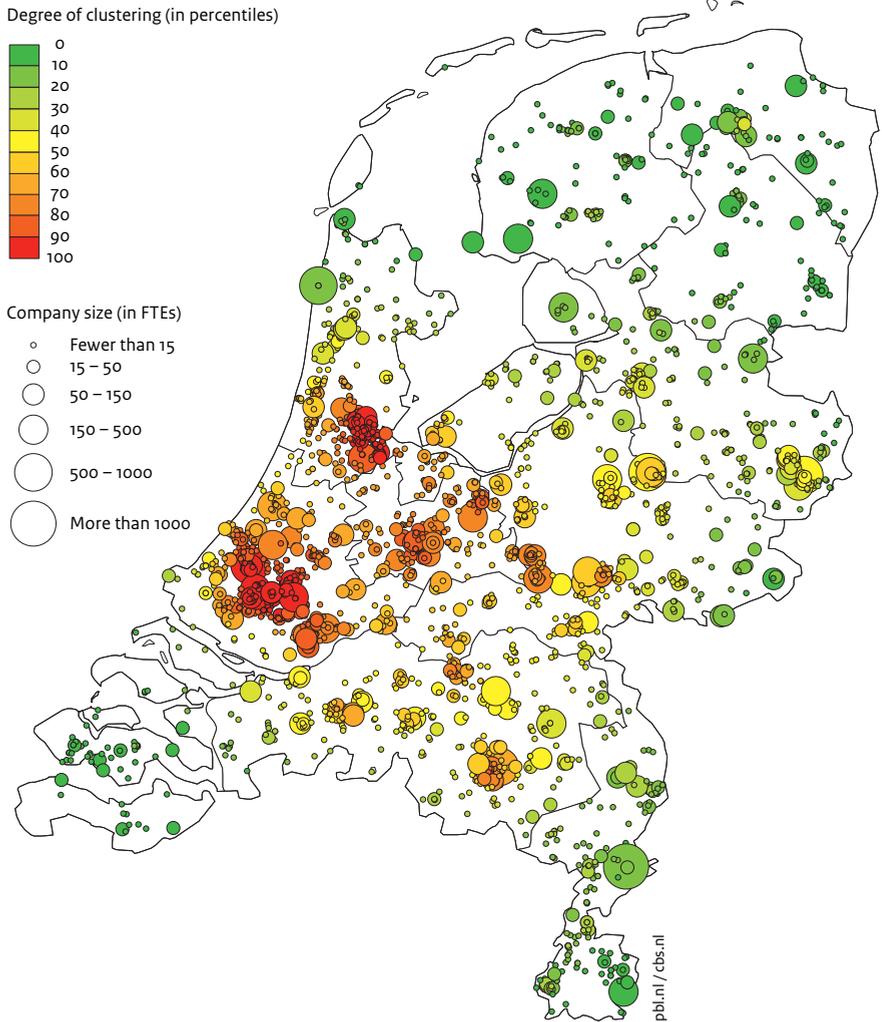
As discussed earlier in this report, the Dutch economy produces relatively few new companies compared with the reference countries, and these companies are also less interested in growth.

### **Regional approach important**

In creating a successful green innovation system, it is not enough to take a macro-economic approach. Cleantech companies are not evenly distributed throughout the Netherlands, but are clustered in certain regions, such as Brainport Eindhoven and the northern and southern wings of the Randstad (see Figure 22). And with good reason: cleantech companies profit greatly – as do all high-tech companies in general – from proximity, due to the exchange of knowledge between them and partnerships, as well as from the specialised labour and supply markets that they create (see Raspe et al., 2013).

International competition increasingly takes place between companies in regions, rather than between countries. In fact, it is the Dutch regions with the strongest international competitive position that house the clusters of cleantech companies (see Raspe et al., 2012). Therefore, as well as stimulating cleantech clusters, in particular, the government could also encourage the necessary spatial conditions in these hotspots. As we know, the international competitiveness of high-tech companies depends primarily on investment in the knowledge infrastructure, the labour market and the physical infrastructure: accessibility by road and international connectivity (Raspe et al., 2012). National innovation and entrepreneurship policy should therefore be based on the power of regions. This means investing in certain regions.

Figure 22  
**Spatial distribution of companies in the cleantech sector**



Source: PBL/CBS, 2013

*Cleantech companies are not distributed evenly throughout the Netherlands but are highly clustered in the northern and southern wings of the Randstad and in Brabant.<sup>4</sup> This map displays cleantech companies in terms of number of jobs and clustering; red represents many cleantech companies nearby; blue represents few.*

### **Stable long-term government targets**

If we want to improve our competitive position, we need to analyse our competitors. Germany, Denmark and the United Kingdom began earlier with preparations for the green race. As they have been in the race for longer, they can now reap the rewards, and focus on it more intensely, based on their comparative advantages. In summary, compared with the Netherlands, these countries have created more 'mass' in 'greening and competitiveness' investment and initiatives, and have embedded it more widely in policy. Also, it is the government that has driven this. These countries have set a clear 'dot on the horizon', based on a vision for a sustainable and competitive economy. The final objective is clear, and the pathway to achieving it much more open, which provides leeway for taking uncertainties into account. There are also some good Dutch examples of successful long-term policies (see Text Box: Dutch examples of successful long-term policies).

### **Dutch examples of successful long-term policies**

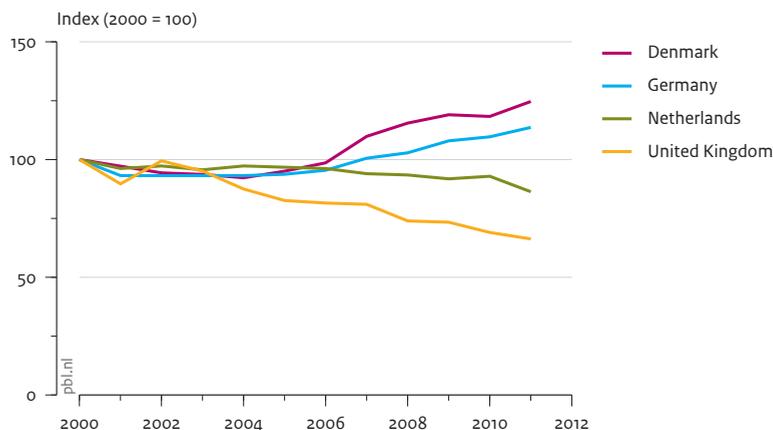
The strict legislation of the Surface Water Pollution Act (Wvo) and related tax scheme have encouraged Dutch companies and water boards to construct water treatment plants for the discharge of their own waste water, greatly improving water quality. As a result, the Netherlands is strong in the production and installation of water treatment equipment and in environmental consultancy relating to waste water treatment. Although most of the turnover of the Dutch water technology sector still comes from the national market (NWP, 2011), the proportion of total Dutch exports is expected to increase.

Reducing the amount of landfill and promoting waste recycling are the two mainstays of Dutch waste policy. There has been a strong policy focus on reducing landfill, mainly by issuing landfill bans and introducing a tax on recyclable or combustible waste. The costs of burning and landfill had already increased due to stricter emission requirements, making the reuse of waste more economically attractive. At its peak, the landfill tax was responsible for almost two thirds of total landfill costs. It is partly due to this that the Netherlands is a leader in recycling. The technology and expertise relating to waste collection and processing could also be exported to other countries.

In the past, policy has strongly focused on waste and water, and, as a result, Dutch companies have a large amount of expertise in these areas, which is also reflected in the number of patents (CE, 2013). This ambitious policy means that the Netherlands now has a good position in these fields, and that it also earns internationally from the production of clean technology and consultancy on water management and technology and waste.

Figure 23

### Share of government spending on R & D in total government spending



Source: Eurostat, 2013

*The share of government spending on R&D is decreasing in the Netherlands and is lower than in Germany and Denmark, where it is in fact increasing.*

### Research & development and dissemination

Research and development (R&D) is an important source of and condition for innovation. To some extent, this takes place within companies. However, the proportion of private investment in R&D is relatively low compared with that of other countries (Dialogic, 2012), certainly that of Germany and Denmark.

Public investment in R&D is also low compared with other developed countries. What is worrying is that government-related R&D (as a share of total government spending) in the Netherlands has dropped, in recent years, from about 1.83% in 2000 (when the Netherlands led in government spending) to 1.58% in 2011. The percentage is not just higher in Denmark and Germany, but it also continues to increase in these countries (see Figure 23). This would therefore seem to suggest that the feeding ground for a competitive and entrepreneurial economy in the Netherlands is getting weaker rather than stronger.

The regions have an important role to play in R&D and knowledge dissemination (see Text Box: Regional approach important), as they are breeding grounds for entrepreneurship, and complex research requires proximity to be able to exchange ideas. Proximity also encourages the trust relationships that are so crucial to knowledge-intensive partnerships (for a discussion on proximity, see also Raspe et al., 2013).

### **Mobilising resources**

Financial and human capital are essential for successful innovation. Funding is required, in particular, for subsidies and targeted investments (e.g. in R&D). However, labour market and education policies are also essential to ensure that workers have the skills required for innovation. Creating mass in the resources that focus on innovation would seem to be beneficial. However, it is better to focus on a limited number of areas than to support many different projects and sectors. Three of these areas are named in Chapter 3: the bio-based economy, the sustainable built environment and the circular economy. Green innovation policy would therefore benefit from investing as much financial and human capital as possible in these areas, rather than from spreading resources.

### **Market creation**

To encourage innovation in clean technology and products, it is usually necessary to first create the right market conditions. Tax exemption for innovative projects or making the use of catalytic converters in cars compulsory are examples of this. The government can also increase the sustainability of its own spending and investments, creating a market for sustainable products. This is an approach that works in practice. For example, government policy that focuses on the construction of energy-efficient government offices also spreads to the private sector. Strict government standards therefore encourage innovation and are later adopted elsewhere as the new standard (Simcoe and Toffel, 2012).

Today, in 2013, government procurement in the Netherlands is already almost 100% sustainable. This means that almost all national government procurement meets the minimum sustainability requirements set for each individual product or service. This creates an important minimum standard in the market. Even so, this procurement policy is ready for the next step: setting minimum requirements only encourages innovation that goes no further than this minimum and does not benefit companies that are more sustainable. To encourage sustainability, innovation-focused procurement should be the aim. There is broad support in the Dutch business community for this (VNO-NCW et al., 2011).

This, therefore, requires ambitious criteria to encourage the development of companies that are at the forefront of sustainable innovation. For example, the awarding of contracts can take into account the total cost of the use of a product (including purchase, maintenance and so on); the total cost of ownership. This will mean that the government buys products that score well over the total lifetime of those products – which need not necessarily be those with the lowest purchasing price. Tightening requirements will give the sustainable product market a boost and enable large steps to be taken on the pathway towards a sustainable economy and green growth. Government procurement is worth more than 50 billion euros, annually, in the Netherlands, which means that the government has considerable purchasing power.

Excerpt from an interview with van Houtum:

*'SenterNovem put criteria in place for sustainable procurement, first defining 80 categories. That was too complicated, so they reduced it to 40 groups that described in full the requirements that products had to meet. This had two effects: government officials became less critical and no longer needed to think – they looked at the criteria, ticked a box and said, “now we’re sustainable”, when it is more interesting to create a system in which people are able to work this out for themselves at the product level, to encourage forerunners. The other negative was that sanitary paper was not included in any of the product groups, so that the government looked at its criteria and said, “we don’t need to think about that”. Quite remarkable, because photocopying paper was on the list.'*

A further professionalisation of procurement and encouragement of green innovation are required if the Dutch economy is to be made more sustainable. This, therefore, requires greater clarity with regard to the ambitions and targets of sustainable procurement. In the United Kingdom, the appointment of a Chief Procurement Officer for the whole of the government has been successful, as it has boosted innovation-focused procurement and has led to certain savings.

#### **Focus on interest groups**

If we are to reap the benefits of the innovative power of new SMEs in the Netherlands, R&D resources need to be focused more on this group of entrepreneurs. One option is to put in place a model similar to the Small Business Innovation Research Program in the United States (see Text Box: The Small Business Innovation Research Program).

Of course, there are losers, too – companies that do not manage to change with the times, are too late to do so, or consciously hold onto the tried and tested methods with which they earn a living. The economy of the Netherlands is very much based on fossil fuels, and its companies are not among the front runners of the transition towards more sustainable energy sources. The wider vision for a green and competitive economy, therefore, mainly entails dialogue. Here, too, the government has a responsibility. In some cases, it needs to create a level playing field – establishing the same conditions for all parties. This means a playing field that usually goes beyond national borders – which could require a European, or even global, approach. In some cases, it requires stricter legislation and the pricing of environmentally harmful activities. However, what is mainly required is a government that reduces the large risks and uncertainties faced by companies, which thus would enable new earnings models because the government assumes the risks; for example, through pre-investment. However, this does not change the fact that not everyone can be a winner. Creative destruction also applies, as old production and consumption methods are discarded and demolished. Thanks to innovation, new, attractive alternatives may be built on the ruins.

### **US Small Business Innovation Research Program**

The US Small Business Innovation Research Program (SBIR) was created in the 1980s, based on the idea that new, small, ambitious companies were essential to the competitiveness of the US economy, and that this economy needed a boost (Audretsch et al., 2002). The precursors to this programme had already been developed in the 1960s. Annual turnover in the SBIR totalled about USD 1.2 billion in recent years (Audretsch, 2003), representing about 60% of all government-funded SME programmes in the United States. The total government investment programme is about two thirds as large as the private venture capital part. Here too, and analogous to programmes in Germany and Denmark, programmes are long-term and began early. An analysis of the SBIR shows that the programme has resulted in a significant increase in the number of new entrepreneurs, that without the programme much technology would not have been successfully commercialised, and that it also provides a good example for other entrepreneurs.

There is a similar programme in the Netherlands – the Innovatiefonds MKB+ – which the government uses to provide credit and venture capital for innovation. One of the differences with the SBIR (apart from the size of the budget) is that the SBIR focuses in particular on small companies; half of its budget is spent on companies with fewer than 25 employees and a third on companies with fewer than 10 employees. In the Netherlands, the focus is more on larger companies.

There was another programme in the Netherlands – the Programma Starters Buitenlandse markten (PSB) – which was an export stimulation scheme for SMEs implemented by the Ministry of Economic Affairs. However, although a positive assessment was conducted in 2008, the programme subsequently was not continued. It would be worth considering linking this kind of programme to investments in green innovation.

## **No industrial policy but a green innovation and investment policy**

Recently, there has been renewed interest in the importance of an active role for government in public innovation and renewal. It would be too easy to think that the government could limit itself to supporting innovation through tax measures and mediation. International successful examples, such as Silicon Valley in the United States, as well as recent economic success stories in China, Singapore, South Korea and Brazil, are the result of enormous direct and indirect government investments in innovation (Mazzucato, 2013). The Delta works in the Netherlands are a good example of massive government investment in breakthrough technology: because of the billions that the Dutch Government invested in protecting the country against the sea, Dutch water engineering companies are now worldwide leaders.<sup>5</sup>

The government needs to encourage the development of new, green activities. Although opinions differ, recent literature suggests that stimulating the development of clean, efficient technologies should be an important policy item (Acemoglu, 2012; Rodrik, 2013). This is not a plea for an old-fashioned ‘industrial policy’: it is certainly not about maintaining existing structures, as happened in the shipbuilding industry in the past. A transition towards a green economy demands that new initiatives be given a chance and are supported, at least for a while.

Therefore, innovation policy is required – not industrial policy. The government is not going to take the place of the entrepreneur; after all, it does not have the expertise to make the right choices (‘government cannot pick the winners’), but it could give potential winners the chance to take part in the race. As we are all aware, if the government becomes involved in supporting a sector or a company, it is susceptible to manipulation from companies and lobbyists, so that policy is driven by a specific interest rather than general interest. It would therefore help to choose broader themes.

An offensive innovation policy means daring to make mistakes. After all, no-one has a crystal ball. Too few mistakes points to a government that is not involved. There, therefore, is a need for mechanisms that recognise mistakes and adjust policy accordingly. Fortunately, this is easier than recognising winners. It is however important that ministries have enough knowledge to be able to stand on an equal footing in discussions with businesses.

Given the need for greening, it would be advisable to revise current innovation policy (see Text Box: Top sector policy can be revised). If we as a society envisage a green future, this vision also must shape innovation policy. This is not yet the case. A green future requires more specific investment in green R&D. This applies not to narrowly defined sectors, but rather to broader themes. It is at the interface with traditional activities that the best innovations take place, and precisely those who challenge the established order need to be encouraged. Three promising themes related to opportunities in the Netherlands are described in this report: the bio-based economy, the sustainable built environment and the circular economy.

In renewing innovation policy, we must be aware of open-ended schemes, as any sector that is drip-fed by the government will not survive. Government support, therefore, needs to be temporary, and based on results. The interest of society as a whole must take priority, not the responsible policymakers or the companies that profit from policy. This requires transparency and accountability. Support must also be available for both newcomers and established businesses.

### **Top sector policy can be revised**

Top sector policy is the vehicle in the Netherlands for encouraging innovation. The aim of this policy is to further strengthen the top sectors in which the Netherlands excels on an international level. There are nine top sectors in addition to themes such as the bio-based economy that relate to several top sectors. Within these sectors, the government, the business community, universities and research centres need to work together on innovation. The required plans, measures and agreements are set out in innovation contracts. As far as top sector policy is concerned, these mainly relate to good preconditions rather than subsidies. In addition to subsidies, the other main incentive is tax benefits (WBSO, RDA and innovation box).

*Other countries spend more money.* Compared with Germany and Denmark, we are talking of relatively low figures. In 2013, the Dutch Government, regions and research institutes contributed about 900 million euros. Including contributions such as from WBSO, the total for 2015 will come to about two billion euros.

*Vision for the future must be leading.* Although top sector policy focuses strongly on innovation in general, less attention is paid to green innovation in particular. Even so, the word 'sustainability' is found in every top sector plan. Although the top sectors represent large ambitions, they do not always result in concrete proposals (WUR, 2012). In only three of the nine top sectors, sustainability is an integral part of plans and innovation contracts. The combination of greening and competitiveness is even less often the focus. The choice of current top sectors seems to be largely demand-driven, rather than being based on a vision of where the Netherlands sees itself in the future.

*Choose broad themes.* There is a risk of compartmentalisation. Opportunities do not necessarily arise within a particular sector, but more so from a combination of sectors. The success of greening in strengthening the competitiveness of companies runs right through the sectors. This therefore calls for more structure per theme rather than per sector. A good example that has been addressed in top sector policy is that of the cross-sector bio-based agenda. This is less the case for other themes, such as that of clean technology.

*Greater focus on newcomers.* It is difficult to help small, new, fast-growing companies in gaining a foothold. Greening requires change, and change does not usually come from those who benefit from the status quo.

**In summary**

There is a need for renewed innovation policy in the Netherlands, based on a vision of where it wants to be in the future. A focus is also required on green innovation and its marketing. After all, green innovation is crucial for maintaining a strong competitive position, as the Dutch sectors with a strong competitive position use relatively large amounts of energy and materials. This is a risk in the long term: it will price the country out of the market and make it much less competitive. Green innovation will provide new products and production processes that provide opportunities on growth markets and reduce the dependence on raw materials.

Government is particularly placed to drive innovation and create market opportunities. It is crucial that a link is made with the strengths of the Dutch economy in the transition towards a greener economy. In addition to pricing and regulation, this also requires the subsidy of directed technological change. Ultimately, it is the companies and general public that need to make sure that the transition takes place. An awareness of new stakeholders and local and regional developments, therefore, is also important. In many respects, there is much to gain.

# References

- Acemoglu D, Aghion Ph, Bursztyn L and Hemous D. (2012). The environment and directed technical change, *American Economic Review*, 102(1): 131–166.
- Audretsch DB, Link A and Scott JY. (2002). Public/private technology partnerships: evaluating SBI-supported research, *Research Policy* (31): 145–159.
- Audretsch DB. (2003). Standing on the shoulders of Midgets: The U.S. Small Business Innovation Program (SBIR), *Small Business Economics* (20): 129–135.
- Aghion P and Howitt P. (2008). *The Economics of Growth*, Cambridge MA: MIT Press.
- Aghion P and Howitt P. (1997). *Endogenous Growth Theory*, Cambridge MA: MIT Press.
- Agora (2013). 12 Insights on Germany's Energiewende. A Discussion Paper Exploring Key Challenges for the Power Sector, Berlin: Agora Energiewende.
- Bartelsman E, Scarpetta S and Schivardi I. (2005). Comparative analysis of firm demographics and survival: evidence from micro-level sources in OECD countries, *Industrial and Corporate Change* 14: 365–391.
- BIS (2011). *Low Carbon and Environmental Goods and Services (LCEGS)*, Report for 2009–2010, London: Department for Business, Innovation and Skills, July 2011.
- BIS (2012a). *Cumulative impacts of energy and climate change policies on carbon leakage*, London: Department for Business, Innovation and Skills, February 2012.

- BIS (2012b). Low Carbon and Environmental Goods and Services (LCEGS), Report for 2010–2011, London: Department for Business, Innovation and Skills, May 2012.
- BIS (2013). Low Carbon and Environmental Goods and Services (LCEGS), Report for 2011–2012, London: Department for Business, Innovation and Skills, July 2013.
- BMU (2012). GreenTech made in Germany 3.0, Umwelttechnologie-Atlas für Deutschland. Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, February 2012.
- BMU/UBA (2013). Umweltbewusstsein in Deutschland 2012. Ergebnisse einer repräsentativen Bevölkerungsumfrage. Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU), Umweltbundesamt (UBA), January 2013.
- Buchan D. (2012). The Energiewende – Germany’s gamble, Oxford Institute for Energy Studies SP 26, June 2012.
- Boschma RA, Frenken K and Lambooy JG. (2002). Evolutionaire economie, een inleiding, Bussum: Coutinho.
- Carvalho A and Burgess J. (2005). Cultural Circuits of Climate Change in U.K. Broadsheet Newspapers, 1985–2003, Risk Analysis, Vol. 25, No. 6, 2005.
- CBI (2011). Made to last: creating a resource efficient economy, December 2011.
- CBI (2012). The colour of growth, Maximising the potential of green business, July 2012.
- CBS (2011). Economische radar duurzame energie (Economic radar for sustainable energy (in Dutch)), The Hague/Heerlen: Statistics Netherlands.
- CBS (2012). Environmental Goods and Services Sector. Indicators for the Dutch, The Hague/Heerlen: Statistics Netherlands.
- CCC (2012). Monitor Copenhagen cleantech cluster. Rapporten er udarbejdet for Copenhagen Cleantech Cluster af Oxford Research i samarbejde med Copenhagen Capacity.
- CPB (2011). Groene groei: een wenkend perspectief? Groene groei voorlopig utopisch. Groenere groei wel haalbaar (Green Growth (in Dutch)), Policy Brief, The Hague, CPB Netherlands Bureau for Economic Policy Analysis.
- CE (2010). Convenant Benchmarking Energie-efficiency: resultaten en vrijstellingen energiebelasting (Agreement Benchmarking Energy Efficiency (in Dutch)), Delft: CE.
- CE (2013). Clean en green in de Nederlandse economie. Economische omvang en groeikansen (Clean and Green in the Dutch Economy (in Dutch)), Delft: CE.
- Crown Estate (2012). Offshore Wind Cost Reduction: Pathways Study, The Crown Estate, May 2012.
- DEA (2012a). Green production in Denmark – and its significance for the Danish economy, Danish Energy Agency, Ministry of Climate, Energy and Building, Danish Business Authority, Ministry of Business and Growth, Danish EPA, Ministry of the Environment, November 2012.
- DEA (2012b). Energy Policy in Denmark, Danish Energy Agency, December 2012.
- Dialogic (2012). Wetenschaps, technologie en innovatie indicatoren 2012. Internationalisering en specialisatie van het Nederlandse WTI-systeem.

- Toekomstig menselijk kapitaal in bèta en techniek (Science, technology and innovation indicators 2012 (in Dutch)), Utrecht: Dialogic.
- Kelley DJ, Singer S and Herrington M. (2011). The Global Entrepreneurship Monitor, 2011 Global Report.
- LSE (2013). Position of the Netherlands in the emerging green economy, Grantham Research Institute on Climate Change and the Environment, London School of Economics, June 2013.
- DEFRA (2012). Resource Security Action Plan: Making the most of valuable materials, Department for Business, Innovation and Skills & Department for Environment, Food and Rural Affairs, March 2012.
- DENA (2013). Die Energiewende – das neue System gestalten. Das deutsche Energiesystem im Jahr 2050: klimafreundlich, sicher und wirtschaftlich (The German Energy Transition (in German)), Deutsche Energie-Agentur GmbH, July 2013.
- DJSI (2012). Dow Jones Sustainability Indexes, <http://www.sustainability-indices.com/review/supersector-leaders-2012.jsp>.
- DSGC (2012). Towards Sustainable Growth Business Models, Dutch Sustainable Growth Coalition (DSGC), <http://gpr.turnpages.nl/publicaties/DSGC/201209>.
- Ecorys (2010). Versterking van de Nederlandse duurzame energiesector (Strengthening of the Dutch Sustainable Energy sector (in Dutch)), Rotterdam: Ecorys Nederland BV.
- EFI (2013). Gutachten 2013. Gutachten zu Forschung, Innovation und Technologischer Leistungsfähigkeit Deutschlands (Scientific report on Germany's innovation and technological productivity (in German)), Expertenkommission Forschung und Innovation.
- EIM (2013). Topsectoren in beeld; internationale oriëntatie topsectoren (International focus of Dutch top sectors (in Dutch)), Zoetermeer: Panteia/EIM
- EMF (2012). Towards the Circular Economy, Ellen MacArthur Foundation, <http://www.ellenmacarthurfoundation.org/business/reports/ce2012>.
- Europese Commissie Eurobarometer (2009). Observatory of European SME's, SME Performance Review.
- EZ (2013). Kamerbrief Groene Groei: voor een sterke, duurzame economie (Parliamentary letter on Green Growth: for a strong sustainable economy (in Dutch)), Dutch Ministry of Economic Affairs, <http://www.rijksoverheid.nl/documenten-en-publicaties/kamerstukken/2013/03/28/kamerbrief-groene-groei-voor-een-sterke-duurzame-economie.html>.
- Fankhauser S, Bowen A, Calel R, Dechezleprêtre A, Grover D, Rydge J and Sato M. (2012). Who will win the green race? In search of environmental competitiveness and innovation, Centre for Climate Change Economics and Policy, Working Paper No. 111, Grantham Research Institute on Climate Change and the Environment, Working Paper No. 94.
- GEM (2012). Global Entrepreneurship Monitor 2012, Global Report, Siri Roland Xavier, Donna Kelley, Jacqui Kew, Mike Herrington & Arne Vorderwülbecke. Zie: <http://www.gemconsortium.org/docs/download/2645>.

- Green Alliance (2013). Resource resilient UK, A report for the Circular Economy Taskforce, July 2013.
- Hallegatte S, Heal G, Fay M and Treguer D. (2011). From Growth to Green Growth – A Framework, Policy Research Working Paper 5872, Worldbank, Washington D.C.
- Heimeriks G and Boschma R. (2013). The path- and place-dependent nature of scientific knowledge production in biotech 1986-2008, *Journal of Economic Geography* (1-26).
- Hekkert MP, Suurs RAA, Negro SO, Kuhlmann S and Smits REHM. (2007). Functions of innovation systems: A new approach for analysing technological change, *Technological Forecasting and Social Change*, vol. 74, no. 4, pp. 413-432.
- Hidalgo C, Klinger B, Barabasi A and Hausmann R. (2007). The Product Space Conditions and the Development of Nations, *Science* 317 (5837): 482-487.
- HM Government (2009). The UK Low Carbon Industrial Strategy, UK Government, July 2009.
- HM Government (2011). The Carbon Plan: Delivering our low carbon future, UK Government, December 2011.
- Hockenos P. (2012). Angst or Arithmetic? Why Germans are so skeptical about nuclear energy, Series on the German energy transition (1 of 6). Heinrich Böll Stiftung, Washington D.C.
- Huberty M, Gao H and Mandell J, with Zysman J. (2011). Shaping the Green Growth Economy, A Review of the Public Debate and the Prospects for Green Growth, The Berkeley Roundtable on the International Economy, Prepared for Green Growth Leaders, Preliminary Version.
- Huisman J, Van der Maesen M, Eijsbouts RJJ, Wang F, Baldé CP and Wielenga CA. (2012). The Dutch WEEE Flows, United Nations University, ISP – SCYCLE, Bonn, Germany, 15 March 2012.
- Lawson J. (2013). UK Green Investment Bank, presentation & interview, Department for Business, Innovation and Skills, June 2013.
- KPMG (2012). Expect the Unexpected: Building business value in a changing world, KPMG International, publication number 111274.
- KPMG (2013). Telelens op de toekomst: middenbedrijf houdt zich nauwelijks bezig met 'megatrends' (Tele-lens on the future; business mega trends (in Dutch)), KPMG Accountants N.V LEI (2008) Biobased Economy. State-of-the-art assessment, LEI: The Hague.
- McDonough W and Braungart M. (2002). *Cradle to Cradle: Remaking the Way We Make Things*, MacMillan.
- Mazzucato M. (2013). *The Entrepreneurial State*, Demos: London.
- McKinsey Global Institute (2011). *Resource Revolution: Meeting the world's energy, materials, food and water needs*.
- Mulder P and De Groot HLF. (2011). Dutch Sectoral Energy Intensity Developments in International Perspective, 1987-2005, CPB Netherlands Bureau for Economic Policy Analysis, CPB Discussion Paper, No 190.
- Nijhuis T. (2012). *Vasthoudend innoveren. Een onderzoek naar het Duitse wetenschapslandschap en R&D-beleid (Steadfast innovation (in Dutch))*,

- Adviesraad voor Wetenschaps- en Technologiebeleid, Duitsland Instituut Amsterdam, November 2012.
- Noailly J and Smeets R. (2012). Directing Technical Change from Fossil-Fuel to Renewable Energy Innovation: An Empirical Application Using Firm-Level Patent Data, CPB Discussion Paper 237, The Hague: CPB Netherlands Bureau for Economic Policy Analysis.
- NWP (2011). Water 2020. Wereldleiders in water. De toekomstvisie van de Nederlandse watersector (World leaders in water. Vision on the future of the Dutch water sector (in Dutch)), The Hague: Netherlands Water Partnership.
- OECD (2012a). OECD Environmental Outlook to 2050, OECD Publishing <http://dx.doi.org/10.1787/9789264122246-en>
- OECD (2012b). Measuring the Potential of Local Green Growth, An Analysis of Greater Copenhagen, OECD Publishing. [http://www.oecd.org/cfe/leed/Measuring%20Local%20Green%20Growth\\_Copenhagen\\_29%20January%2013%20FINAL%20for%20Francois.pdf](http://www.oecd.org/cfe/leed/Measuring%20Local%20Green%20Growth_Copenhagen_29%20January%2013%20FINAL%20for%20Francois.pdf).
- OECD (2013). Why New Business Models Matter for Green Growth, OECD Green Growth Papers, 2013-01, Paris: OECD Publishing.
- O'Sullivan, M, Edler D, Bickel P, Lehr U, Peter F and Sakowski F. (2013). Bruttobeschäftigung durch erneubare Energien in Deutschland im Jahr 2012 (in German) – eine erste Abschätzung, Forschungsvorhaben des Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, März 2013.
- P+ (2012). De onstuitbare groei van de biobottle (The unstoppable growth of the bio-bottle (in Dutch)), 3 December 2012.
- PBL (2011). De concurrentiepositie van Nederlandse regio's. Regionaal-economische samenhang in Europa (The competitive position of Dutch regions (in Dutch)), The Hague: PBL Netherlands Environmental Assessment Agency.
- PBL (2012). De internationale concurrentiepositie van de topsectoren (The competitive position of Dutch top sectors (in Dutch)), The Hague: PBL Netherlands Environmental Assessment Agency.
- PBL (2013). Changing track, changing tack; Dutch ideas for a robust environmental policy for the 21st century, The Hague: PBL Netherlands Environmental Assessment Agency.
- PBL & ECN (2013). Het energieakkoord: wat gaat dit betekenen? Inschatting van de gemaakte afspraken (The energy agreement: what are the consequences? (in Dutch), PBL Netherlands Environmental Assessment Agency & The Netherlands Energy Research Centre (ECN).
- Peeters H and Verhoeven W. (2005). Internationale Benchmark Ondernemerschap 2004 (International benchmark Entrepreneurship 2004), Zoetermeer: EIM Business and Policy Research.
- Point Carbon (2013). <http://www.pointcarbon.com/productsandservices/carbon>.
- Raspe O, Weterings A, Geurden-Slis M and Van Gessel G. (2013). The rationale of spatial economic top sector policy, The Hague: PBL Netherlands Environmental Assessment Agency & Statistics Netherlands (CBS).

- Porter ME and Van der Linde C. (1995). Toward a new conception of the environment competitiveness relationship, *Journal of Economic Perspectives*, 94: 97–118.
- Rodrik D. (2013). Green industrial policy, School of Social Science. Institute for Advanced Study. Princeton, N.J. written for the Grantham Research Institute project on 'Green Growth and the New Industrial Revolution', Draft July 2013.
- SER (2010). Meer chemie tussen groen en groei: De kansen en dilemma's van een biobased economy (More chemistry between green and growth (in Dutch)), advies 10/05.
- Simcoe T and Toffel MW (2012). Public Procurement and the Private Supply of Green Buildings, NBER Working Paper No. 18385.
- Stam E, Suddle K, Hessels J and Van Stel A. (2007). High growth entrepreneurs, public policies and economic growth, *Jena economic research papers*, No. 2007, 019.
- Stam E. (2008). Entrepreneurship and innovation policy, *Jena economic research papers*, No. 2008, 006.
- Stam E, Bosma N, Van Witteloostuijn A, De Jong J, Bogart S, Edwards N and Jaspers F. (2012). Ambitious entrepreneurship; A review of the academic literature and new directions for public policy, Report for the Advisory Council for Science and Technology Policy (AWT) and the Flemish Council for Science and Innovation (VRWI).
- Suurs RAA. (2009). *Motors of Sustainable Innovation: Towards a Theory on the Dynamics of Technological Innovation Systems*, Utrecht University.
- TNO (2013). Kansen voor de circulaire economie in Nederland (Opportunities for the circular economy of the Netherlands (in Dutch)), Delft: TNO 2013 R10864.
- Unilever (2013). Unilever Annual Report and Accounts 2012, Making Sustainable Living Commonplace, <http://www.unilever.nl/overons/publicaties/unileverwereldwijd/UnileverJaarverslag2012/Default.aspx>.
- Van Ploeg R and Poelhekke S. (2013). Green havens and pollution havens, University of Oxford. <http://www.oxcarre.ox.ac.uk/images/stories/papers/ResearchPapers/oxcarrerp201287.pdf>.
- VNO NCW, MKB, MVO, NEVI & De Groene Zaak (2011). Advies Duurzaam Inkopen (Advice for sustainable purchases (in Dutch)), 11 aanbevelingen voor een ambitieuze aanpak met de markt, The Hague.
- Weastra (2013). WP 8.1. Determination of market potential for selected platform chemicals, Weastra s.r.o, Bratislava | Slovakia.
- WBCSD (2010). Vision 2050 – The new agenda for business, World Business Council for Sustainable Development, Foresight, Canada.
- WEF (2013). The Global Competitiveness Report 2013–2014, World Economic Forum.
- Wiltling H. (2013). Aandeel energie- en materiaalkosten in productiekosten van bedrijven (Share of energy and material costs in corporate production costs (in Dutch) (in press)), The Hague: PBL Netherlands Environmental Assessment Agency.
- WWR (2008). Innovatie vernieuwd (Innovative innovation (in Dutch)). Opening in viervoud, Report no. 80, Amsterdam: Amsterdam University Press.

- WUR (2008). Biobased Economy. State-of-the-art assessment, The Hague.
- WUR (2012). Innovatie en duurzaamheid (Innovation and sustainability (in Dutch)).  
Effecten van het topsectorenbeleid op de kwaliteit van de groene ruimte.
- Xavier S, Kelley D, Kew J, Herrington M and Vorderwülbecke A. (2013). Global Entrepreneurship Monitor 2012.



# Notes

## 1 The path to a greener economy

99

- 1 UK climate adviser Lord Nicolas Stern in *Introduction to The Climate Institute's Global Climate Leadership Review*, <http://www.youtube.com/watch?v=WokDcaxPSMY>.
- 2 This growth is taking place 10 times faster than in the United Kingdom during the industrial revolution, and at a 200 times larger scale (McKinsey Global Institute, 2011).
- 3 Resource efficiency is the sustainable use of scarce natural resources while limiting the environmental burden by as much as possible. The Resource-Efficient Europe Flagship Initiative under the Europe 2020 Strategy supports the transition towards sustainable growth through a resource-efficient and low-carbon economy.
- 4 In the case of absolute decoupling, economic growth is accompanied by a reduced environmental burden; in the case of relative decoupling, the environmental load continues to increase, but at a lower rate than income (GDP).
- 5 In the case of absolute decoupling, economic growth is accompanied by a reduced environmental burden; in the case of relative decoupling, the environmental load continues to increase, but at a lower rate than income (GDP).
- 6 A bio-based economy is an economy in which most raw materials are obtained from nature (biomass, 'green resources') as part of a green or sustainable economy.

- 7 The blue economy is a concept propagated by Gunter Pauli. It advocates that a sustainable economy can be achieved by attempting to use innovations based on nature and by trying to match solutions provided by ecosystems.
- 8 Eco-patents are selected based on the OECD list of environment-related technologies. These are technologies that mitigate the environmental impact of consumption and production. They are divided into seven main categories: general environmental management (e.g. waste management and water treatment), energy from renewable sources (e.g. solar cells and biogas), 'clean' combustion technologies (e.g. residual heat from waste incineration), climate change mitigation (e.g. carbon capture and storage), emissions mitigation (e.g. improved energy storage and fuel cells), sustainable transport technologies (e.g. electric and hybrid propulsion) and energy and light in buildings (e.g. insulation and LED lighting). Patents such as those related to biotechnology, plant strains and food chemistry are not included in this definition. See [http://www.oecd.org/env/consumption-innovation/ENV-tech%20search%20strategies%20for%20OECDstat%20\(2013\).pdf](http://www.oecd.org/env/consumption-innovation/ENV-tech%20search%20strategies%20for%20OECDstat%20(2013).pdf).
- 9 Statistics Netherlands (CBS) regularly collects data on the environmental sector. The environmental sector includes the group of companies and agencies that develop activities related to monitoring, preventing, limiting, minimising or correcting environmental damage to water, air and the soil, and to problems related to waste, noise and ecosystems. CBS defines four sub-sectors as 'cleantech' within this environmental sector, based on the high level of technical expertise required to develop the products and services in these sectors. The cleantech sectors are:
  - Energy systems and energy savings: the production of renewable energy systems (e.g. solar cells and wind turbines), R&D focused on renewable energy technologies, installation activities (e.g. the installation of solar panels) and consultancy activities (e.g. for the development of wind farms).
  - Environmental consultancy, engineering and other services: activities focused on environmental consultancy, environmental engineering, other services related to the environment, and other services related to the management of natural resources (not energy systems and energy saving).
  - Environmental technology construction activities: activities that focus on the manufacturing of construction products for the environmental sector and the management of natural resources. Only those activities provided by the construction sector are included here; activities focused on sustainable energy systems and energy saving are explicitly excluded.
  - Production of industrial environmental equipment: activities that focus on the production of environmental equipment for the environmental sector and the management of natural resources. Only those activities provided by the industrial sector are included here; activities focusing on sustainable energy systems and energy savings are explicitly excluded.
- 10 According to the recently published trends report Changing track, changing tack. Dutch ideas for a robust environmental policy for the 21st century (PBL, 2013a), current environmental policy does not tackle the environmental problems of the 21st century and it is time for a thorough revision of policy.

- 11 For example, it is possible that European climate policy affects the competitive power of energy intensive companies. The European Emissions Trading System (ETS) makes it obligatory for large companies in heavy industry, such as the metal, aluminium and chemicals industries, to purchase emission rights to offset their CO<sub>2</sub> emissions. This results in increased costs compared with foreign competitors and, therefore, reduced production and employment opportunities. Furthermore, the relocation of production may increase emissions in countries outside Europe, and this leakage effect undermines the effectiveness of European policy. Research shows that, on a national level, effects on income and jobs are small (less than 0.5%). However, they can be much larger in specific sectors, such as the cement and aluminium industries (more than 40%). The fear of distorted competition relationships on a national level would, therefore, seem to be somewhat exaggerated. However, it may play an important role for individual companies or specific sectors.
- 12 See <http://perssupport.nl/apssite/persberichten/full/2013/01/16/TenneT+en+Mitsubishi+Corporation+investeren+samenvier+Duitse+offshore-netaansluitingen>.
- 13 See <http://www.trouw.nl/tr/nl/4332/Groen/article/detail/3340902/2012/11/01/Nederland-grootste-investeerder-in-Duitse-Energiewende.dhtml>.
- 14 The cradle to cradle concept is a new way of looking at sustainable design; see also McDonough and Braungart (2002). The core of the concept is that waste is 'food'. After their 'life' in one product, all materials can be reused in another product. This must not involve loss of quality and all the waste products must be either reused or be environmentally neutral.
- 15 Think of a country's specialisation pattern as if it were a jungle, with products being the trees and entrepreneurs the monkeys. Countries then develop because monkeys jump from tree to tree. Trees that are further away are harder to reach. In some parts of the jungle, trees are closer together than in others. The location of the trees that have monkeys in them today is indicative of where those monkeys will be (or jump to) tomorrow (in the spirit of Ricardo and freely adapted according to Rodrik, [http://rodrick.typepad.com/dani\\_rodriks\\_weblog/2007/07/monkeys-trees-a.html](http://rodrick.typepad.com/dani_rodriks_weblog/2007/07/monkeys-trees-a.html)).

## 2 Competitiveness and green innovation in the Netherlands

- 1 Although it is true that, having risen up the World Economic Forum list (WEF, 2013) for many years in a row, the Netherlands has now dropped from fifth to eighth place, there is now less difference between country scores. A small change therefore quickly results in a large jump on the list. More important than the position in a particular year is the fact that the Netherlands has been in the top 10 for many years now.
- 2 It is also for practical reasons that the number of reference countries is restricted to Germany, Denmark and the United Kingdom, although the inclusion of more countries would probably not affect the conclusions.

- 3 Economic activity data collected by PBL (see PBL, 2012 for further information). The sectors in this report are classified based on NACE Rev. 1.1. The sectors are ordered from large to small, based on production volume.

In this report	Description	NACE Rev. 1.1
1	Non-profit	75-93
2	Business services	70-74
3	Construction	45
4	Financial services	65-67
5	Food and beverages; alcohol and tobacco	15, 16
6	Chemicals, rubber, plastic	24, 25
7	Minerals (including petroleum refinery)	10-14, 23
8	Transport	60-62
9	Postal and telecommunications	64
10	Agriculture	1-5
11	Wood, paper and printed media	20-22
12	Metal	27, 28
13	Electronic and measuring equipment	30-33
14	Transport equipment	35, 35
15	Machinery and equipment	29
16	Trade and repair of motor vehicles and motorcycles	50
17	Glass, ceramics, cement, lime and plaster products	26
18	Furniture, other industry	36, 37
19	Clothes and leather goods	17-19

The data have been corrected for re-export. Production is given in consumer prices and therefore includes trade and transport margins. This is because it is not possible to determine internationally consistent trade flows in terms of manufacturing prices without the inclusion of trade and transport margins. In concrete terms, this means that all production related to the trade in and transport of food products, for example, is allocated to the food and beverages industry. As a result, production in the trade sectors is equal to zero and therefore not included in the figure. As far as the transport sector is concerned, only the export that cannot be attributed to domestic products remains, such as the transport of foreign products abroad. As a result, production in the transport sector in the Netherlands is very much underestimated. It is also not always clear how foreign statistics agencies deal with this. This means that care should be taken when comparing transport sectors on an international level.

The specialisation score in the figure has been calculated according to the following:

$$Lq_{is} = \frac{P_{is}}{P_i} / \sum_i \frac{P_{is}}{P_i}$$

$Lq$  represents the production location quotient (in manufacturing prices) for sector  $s$  in country  $i$ .  $P_{is}$  represents the production of a certain sector  $s$  and country  $i$ ;  $p_i$  represents the total production in country  $i$ . This ratio is scaled by the proportion of sector  $s$  in Europe as a whole (EU25). A score above 1 represents relative specialisation. The export position score is calculated in a similar manner (Balassa index), in which  $Ex$  represents export (in consumer prices):

$$Balassa_{is} = \frac{Ex_{is}}{Ex_i} \bigg/ \sum_i \frac{Ex_{is}}{Ex_i}$$

- 4 This concerns energy and other materials. The figure is based on Wiltling (2013).
- 5 The world top is defined as the top 10% of the most energy-efficient companies in the world.
- 6 A prediction based on a study from 2010 (CE, 2010).
- 7 Also see *Het Energieakkoord: wat gaat het betekenen? Inschatting van de gemaakte afspraken* (The energy agreement: what will it mean? An evaluation of the agreements made (in Dutch)) (PBL and ECN, 2013b).
- 8 The cleantech sector includes (1) energy systems and energy saving, (2) environmental consultancy, engineering and other services, (3) environmental technology construction activities, and (4) the production of industrial environmental equipment.
- 9 For more information, please go to [http://epp.eurostat.ec.europa.eu/statistics\\_explained/index.php/Environmental\\_goods\\_and\\_services\\_sector](http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Environmental_goods_and_services_sector).
- 10 This is important as, when discussing renewable energy production, the argument is often presented that this will move to China anyway. Production may indeed shift to China, but the value added related to consultancy and installation and maintenance will remain in the country in which the renewable energy is produced.
- 11 Eco-patents are selected based on the OECD list of environment-related technologies. These are technologies that mitigate the environmental impact of consumption and production. These technologies are divided into seven main categories: general environmental management (e.g. waste management and water treatment), energy from renewable sources (e.g. solar cells and biogas), 'clean' combustion technologies (e.g. residual heat utilisation from waste incineration), climate change mitigation (e.g. carbon capture and storage), emissions mitigation (e.g. improved energy storage and fuel cells), sustainable transport technologies (e.g. electric and hybrid propulsion) and energy and light in buildings (e.g. insulation and LED lighting). Patents relating to biotechnology, plant breeding, food chemistry and so on are not included in this definition. See [http://www.oecd.org/env/consumption-innovation/ENV-tech%20search%20strategies%20for%20OECDstat%20\(2013\).pdf](http://www.oecd.org/env/consumption-innovation/ENV-tech%20search%20strategies%20for%20OECDstat%20(2013).pdf).
- 12 Green innovation is measured using the Green Innovation Index (GII). The GII gives a value for each sector in a country:

$$GII_{is} = \frac{p_{is}^G}{P_{is}} \bigg/ \sum_i \frac{p_{is}^G}{P_{is}}$$

$p_{is}^G$  is the number of eco-patents in a certain sector  $s$  and country  $i$ ;  $p_{is}$  represents the total number of patents in sector  $s$  in country  $i$ . This ratio is scaled by the proportion of green patents in all countries in sector  $s$ .

- 13 Various questions about eco-innovation have also been included in recent surveys.
- 14 See [http://ec.europa.eu/public\\_opinion/cf/](http://ec.europa.eu/public_opinion/cf/).
- 15 To make an estimate of this potential, PBL asked the London School of Economics to conduct an analysis in which highly specific information was linked to sector trade data and production data.

16 The sector classification in this figure is based on the International Standard Industrial Classification; ISIC Rev. 3. Sector codes:

241	Basic chemicals
231	Manufacture of coke oven products
151	Meat, fish, fruit, vegetables, oils and fats
242	Other chemical products
291	General purpose machinery
292	Special purpose machinery
281	Metal products, tanks, reservoirs and steam generators
289	Other metal products
152	Dairy products
221	Publishing
153	Grains, starches, animal feeds
154	Other food products
341	Motor vehicles
252	Plastics
210	Paper

For the calculation of the export position, see the Balassa Index in Footnote 3. This compares the situation in the Netherlands in these sectors with 15 other countries, 6 of which are direct competitors of the Netherlands (Denmark, Ireland, Belgium, Sweden, Finland and Norway) and the 8 large economies (China, France, Germany, Italy, Japan, South Korea, the United Kingdom and the United States).

### 3 Innovation and opportunity

- 1 Heimeriks, G. and Boschma, R. (2013). The path- and place-dependent nature of scientific knowledge production in biotech 1986-2008, *Journal of Economic Geography* (1-26).
- 2 Roughly speaking, white biotechnology is the application of biotechnology in industrial processes, green biotechnology refers to that in agricultural and food production and red biotechnology concerns that in health care.
- 3 The sustainable energy sector includes both the added value of the actual production of renewable energy (exploitation phase) and added value of companies active in the value chain preceding the exploitation phase, such as renewable energy system manufacture, R&D focusing on durable energy technologies, wind turbine transport and biomass trade. Companies and institutions involved in energy saving are also included.
- 4 CBS, PBL and Wageningen UR (2012) Afvalproductie en wijze van verwerking, 1985-2010 (indicator 0204, Version 10, 10 September 2012). [www.compendiumvoordeleefomgeving.nl](http://www.compendiumvoordeleefomgeving.nl), The Hague/Wageningen: CBS, PBL and Wageningen UR.
- 5 For example, companies that collect and process waste and materials to produce secondary raw materials (in preparation for recycling), such as metals, precious metals, rubber, rubble and plastic waste. This also includes the wholesale trade in waste and scrap
- 6 Also see The Guardian (2013) UK recycling industry has potential to create 10,000 new jobs (and corresponding report), <http://www.theguardian.com/environment/2013/jun/11/recycling-industry-10000-jobs-2020>.

- 7 The number of patent applications within the sustainable mobility segment is limited, but this is due to the small size of the car manufacturing industry. The Netherlands does relatively well in traffic and navigation systems (CE Delft, 2013).
- 8 This is also reflected in patents related to water treatment.
- 9 Green policies may attract more foreign investment, as in Denmark. See Van der Ploeg and Poelhekke (2013) for an empirical underpinning of the green haven (rather than the pollution haven) effect based on Dutch data.

## 5 Greening in neighbouring countries

- 1 The information from the literature with regard to greening, innovation and competitiveness in these three countries has been supplemented with interviews held with experts and people involved in greening in the respective countries. PBL is very grateful to these people for sharing their knowledge and insights for the purpose of this report.  
 Germany: Bundesministerium für Wirtschaft und Technologie (Jens Mundheke and Kristin Vetter), Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Max Rathmann),  
 the Dutch embassy in Berlin (Wout van Wijngaarden and Aida Tunovic).  
 Denmark: State of Green (Hanne Roulund), Danish Energy Agency (Henrik Duer), Ministry for Food, Agriculture and Fisheries (Morten Blom Andersen), Ministry for Business and Growth (Kristian Henriksen), Ministry for Science, Innovation and Higher Education (Jesper Rasch), Ministry for the Environment (Anne Marie Zinck), the Danish Environment Agency (Michel Schilling).  
 United Kingdom: Aldersgate Group (Andrew Raingold), CBI (Steven Altman-Richer), Climate Change Committee (David Kennedy), Department of Business, Innovation and Skills (Patrick Walsh and Arjan Geveke), Department of Energy and Climate Change (Thomas Counsell), Green Alliance (Dustin Benton and Jonny Hazell), Green Investment Bank / BIS (Joanne Lawson), the Dutch embassy in London (Henk de Jong, Bas Harbers and Aafke Meelen).
- 2 The Danish Green Business Statistics are based on the 'Handbook on data collection on Environmental Goods and Services' (Eurostat, 2009).
- 3 Information taken from <http://www.enercon.de/de-de/marktanteile.htm>.
- 4 Information from a speech made by Kersten-Karl Barth, director of sustainable enterprise, Siemens AG, during the DIE-KfW-podiumdiskussion Grünes Wachstum in Europa voranbringen – Maßnahmen und Strategien symposium, Berlin, April 2013.
- 5 This figure is from Eurostat. The contribution of industry to the total added value for the other countries is: Denmark 17.6%, the Netherlands 18.5% and the United Kingdom 15.3%.
- 6 Taken from: Danish Water Technology Group (<http://www.dk-export.dk/Water.9594.aspx>) and Denmark at work. Plan for growth for water, bio & environmental solutions. The Danish Government ([www.evm.dk](http://www.evm.dk)).

- 7 The GEM study actually paints a broader picture of the entrepreneurial climate in various countries. Many more indicators than just the proportion of new and fast-growing companies are examined. The Netherlands scores well for some indicators but new and ambitious companies are the main indicators for innovation.
- 8 See <http://internationalcleantechnetwork.com/>.
- 9 These figures are based on the Levelised Cost of Energy, or the cost per megawatt-hour when calculated over the project lifetime (Crown Estate, 2012).
- 10 Under the mandate of the Green Investment Bank, green projects covers three priority sectors (offshore wind, recycling and energy from waste and energy efficiency), plus biofuels, biomass, carbon capture and storage, marine energy and renewable heat.
- 11 More than 20 years of experience with renewable energy in Germany shows that variable solar power and wind energy can make the largest contribution to the electricity supply (AGORA, 2013). Hydro-electric power plays a modest role, due to geographical limitations, and the potential of bio-energy is limited due to sustainability restrictions. However, bio-energy and hydro-electric power are, other than solar power and wind energy, controllable, and can therefore contribute to the better integration of renewable electricity sources in the electricity grid.
- 12 There is also an economic challenge: to develop a new market structure with room for both renewable and other technologies that produces the investment incentives that make the transition to a low-carbon energy supply possible.

## 6 Time for government action

- 1 See <http://www.rijksoverheid.nl/nieuws/2011/05/23/atma-zet-licht-op-groen-voor-energiezuinige-straatverlichting.html>.
- 2 This is the conclusion of Actal, the Dutch Advisory Board on Regulatory Burden, based on research carried out by KPMG (Inhoudelijke nalevingslasten Programma Duurzaam inkomen Overheid: onderzoek naar 4 sectoren), KPMG (2011).
- 3 Comparison with Denmark is particularly relevant here because, similar to the Netherlands, it has a relatively open economy, with a smaller internal market than for example Germany. German SMEs have the benefit of a large internal market, and are therefore less dependent on export.
- 4 See Raspe et al. (2013) for an explanation of how clustering is determined on this map.
- 5 According to innovation expert Frans Nauta in [http://www.vn.nl/Archief/Economie/Artikel-Economie/Kabinet-verspilt-miljarden-aan-bedrijven.htm?utm\\_source=buffer&utm\\_campaign=Buffer&utm\\_content=bufferb1913&utm\\_medium=twitter](http://www.vn.nl/Archief/Economie/Artikel-Economie/Kabinet-verspilt-miljarden-aan-bedrijven.htm?utm_source=buffer&utm_campaign=Buffer&utm_content=bufferb1913&utm_medium=twitter).



There is no guarantee that the Netherlands will be able to hold onto its strong competitive position in the future. We need to be much more efficient in our use of resources such as energy and materials and limit further harm to our ecosystems. This requires clean and efficient products and production processes. Green innovation is therefore essential for preparing the Netherlands for the future. What is the current

state of affairs in the Netherlands? Where do opportunities lie? What can we learn from successful companies and what are leading countries doing to make this green transition? Most of all, what is the role of government in all this? In this report, PBL calls for a broad public discourse on our future economy: one that is based on greening and competitiveness.

**PBL Netherlands Environmental  
Assessment Agency**

Mailing address

Postbus 30314  
2500 GH Den Haag  
The Netherlands

Visiting address

Oranjevuitensingel 6  
2511 VE Den Haag  
T +31 (0)70 3288700

[www.pbl.nl/en](http://www.pbl.nl/en)