



# GREEN RESEARCH

- Status and Perspectives



Ministry of Science  
Technology and Innovation



---

Green Research  
- Status and Perspectives

English summary

Published by:  
Ministry of Science

Ministry of Science,  
Technology and Innovation  
Bredgade 43  
DK-1260 Copenhagen K

Tel: 3392 9700  
Fax: 3332 3501

The strategic paper was published in Danish by the Danish Ministry of Science, Technology and Innovation in October 2009. This paper is a shortened version of the paper in English and is available only on the web.

The publication can be downloaded from:  
<http://www.vtu.dk>

---

---

**Green Research**  
- Status and Perspectives

English Summary

---

## Contents

---

>

1. Introduction	5
2. Background	6
3. A good starting point	7
4. Six key strategic research areas	9
5. A comprehensive green research and innovation effort	11

---

---

## 1. Introduction

>

---

In October 2009 the Danish Ministry of Science, Technology and Innovation published the strategic paper "Green Research – Status and Perspectives". The paper was drawn up in order to pinpoint important green research areas and to put forward the direction of future efforts in research and innovation.

A green research and innovation effort is to contribute to the development of new knowledge and technology that reduces the impact on nature, the environment and the climate by, for example, cut down pollution or the consumption of resources. It could consist of, for instance, developing environmental and energy technologies as well as new solutions in the fields of traffic, production and agriculture.

The central vision in the publication is that Denmark should develop into an international centre for green research and innovation. The effort is to contribute to addressing both Danish and global climate and environmental challenges. It will simultaneously be an important investment in export and employment – and thereby in Denmark's future growth and welfare.

After the publication of the strategic paper, more than DKK 700 million has been earmarked for a comprehensive green focus in the period 2010-2012. This includes strategic research funds for climate and climate adaptation, environmental technologies, food and sustainable transport and infrastructure. The resources also include testing facilities for climate technologies as well as research and innovation in the field of ecology.

The new funds supplement existing support for green research, including more than DKK 120 million for research in new environmental technologies in 2009 and separate funds for energy research and development and demonstration of DKK 750 million in 2009 and DKK 1 billion in 2010. In 2010 a separate decision is to be made concerning resources for the energy area. The new green focus is to be financed within the special Danish globalisation pool for research, entrepreneurship and education.

---

## 2. Background

<

---

The world of today is marked by great environmental, climate and energy challenges. The climate of Earth is changing and the UN climate panel points out that the changes are predominantly man-made. At the same time the world's resources of fossil fuels are running out. Therefore the world is facing a great need to reduce the impact on the environment, pollution and the consumption of resources.

It is the ambition of the Danish Government to make Denmark a green growth nation. The Danish point of departure is good, but if the opportunities in a green growth agenda are to be exploited, focused research and innovation efforts are needed.

New knowledge and new technologies are a precondition for meeting the global challenges. The OECD states that without research and development it will not be possible to a sufficient degree to prevent and reduce greenhouse gas emission, reduce energy consumption and minimise hazardous environmental impacts. New knowledge and new innovative solutions can contribute to minimising burdens on nature, the environment and the climate and the consequences of these burdens.

It is crucial to act now and prioritise the green area in research and innovation efforts, thereby contributing to solving the world's climate and environmental challenges. This would simultaneously be a significant investment in future growth and welfare.

---

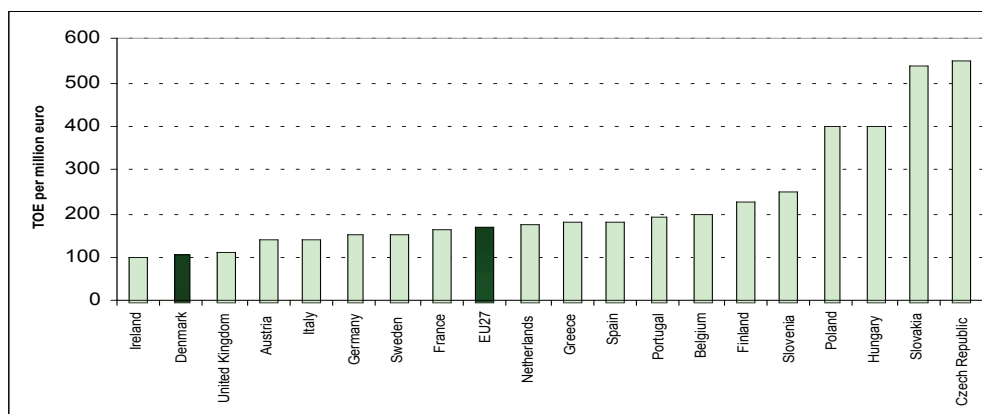
### 3. A good starting point

>

---

Already today Denmark holds a strong position in the green area and has the possibility of developing its position as a green pioneer country as both developer and user of new knowledge and technological solutions. Since the 1980s, Denmark has succeeded in maintaining respectable economic growth at the same time as energy consumption has largely been constant and greenhouse gas emission has been reduced. Denmark and Ireland are the countries in Europe with the best energy efficiency, which means the lowest energy consumption in relation to GDP, cf. figure 1. One of the explanations of Denmark's good placing is that as far back as the 1970s the Folketing (Danish Parliament) commenced energy and environmental regulation and gave incentives for green research and development and the development of efficient infrastructure etc.

**Figure 1: Denmark's energy consumption in relation to GDP**



Source: Eurostat September 2009

Danish research in green areas is internationally recognised, and Danish enterprises are ahead with respect to the development of climate and environmentally friendly technologies and products. The area of energy is one of Denmark's key green positions of strength, not least due to a number of industries in such fields as production, transmission, distribution and energy service. A recent estimate shows that Denmark's export of energy technology in 2008 amounted to DKK 64 billion compared to a mere approximately DKK 5 billion at the beginning of the 1990s. This means that Danish export of energy technology – of which the wind power industry comprises a considerable part – has become bigger than Danish export of oil and gas. At the same time the possibility of maintaining the high growth rates looks promising

In the field of energy, wind is a good example of an area where already today Denmark is an international centre for green research and innovation. Wind power is an industrial position of strength and the Danish wind power branch constitutes a centre of competence for wind power in the world. The strong

---

<

---

Danish research environments in the area of wind energy and good experience of close interaction between research, industry and energy policy have made it attractive for international wind energy companies such as Suzlon of India and Gamesa of Spain also to locate key research and development activities in Denmark.

To maintain and develop Denmark's international competitiveness in knowledge and development of new technologies and methods, it is necessary to support existing strong research environments and build up new ones. As illustrated by the example of the Danish wind power industry, this requires close cooperation between public research institutions, private enterprises and authorities, as well as close integration of research, innovation and policy. Attracting talented researchers and students, a research infrastructure of the highest international calibre, and exchange of knowledge with leading international research environments are, at the same time, key preconditions for establishing strong green research environments in Denmark.

---

## 4. Six key strategic research areas



---

Strategic research is research that takes place in a problem-oriented context, not a discipline-oriented context. This means that strategic research often spans several disciplines and is carried out in a matrix organisation across public and private-sector institutions where disciplines or subjects are included as required. In this connection, six key strategic research areas have been identified. They are as follows.

### *Energy systems of the future*

The effort is to contribute to the development of competitive and sustainable energy technologies and systems that can meet the increasing energy demand and limit the negative environmental consequences connected with the production and consumption of energy

### *Future climate and climate adaptation*

This effort aims at acquiring knowledge of the processes that create climate change, the effects of climate change locally and globally, and intelligent climate adaptation, which includes developing innovative social and societal solutions.

### *Competitive environmental technologies*

The effort is directed at the development of new technologies that are less injurious to the environment than existing alternatives. These could be technologies to reduce air, water and soil pollution. This could be, for instance, by means of purification or the like, more environmentally friendly products and production processes, or better resource management.

### *Bioresources, food and other biological products*

The effort aims at research that contributes to the development a competitive and sustainable bioresource industry through the development of new methods and technologies for sustainable biological production. Key promising areas are not least ecological agriculture and food production and connections between food production and bioenergy.

### *The production systems of the future*

The effort is aimed at furthering the utilisation of new knowledge and sustainable production in Denmark, including contributing to the reduction of energy consumption, the amount of waste and environmental impact from businesses, as well as contributing to better health and working environment. It can take place by, for instance, developing new production technology and integrating this with enterprises' organisation and management systems.

### *Sustainable transport and infrastructure*

The effort aims at improving and optimising the existing transport systems but also at radical innovation. Research can be directed at, for example, the development of new, more environmentally and energy efficient progressive technologies and alternative fuel technologies, or the interaction between forms

of transport, the balance between collective and private transport systems, and the development and exploitation of information and communication technologies for application in intelligent transport systems.

The six strategic research themes described in the above text were identified in a process leading to the publication of "RESEARCH2015 – A Basis for Prioritisation of Strategic Research" in May 2008. The RESEARCH2015 catalogue is the result of an extensive process of dialogue that has involved a great number of ministries, organisations, research councils etc. This makes the catalogue a good point of departure for identifying special research needs and positions of strength with respect to green research and innovation. In the process 21 themes were identified on the basis of several societal considerations such as economic growth and health. What the six themes have in common, however, is that an effort within them will contribute to supporting the ambition of Denmark as a green growth nation.

---

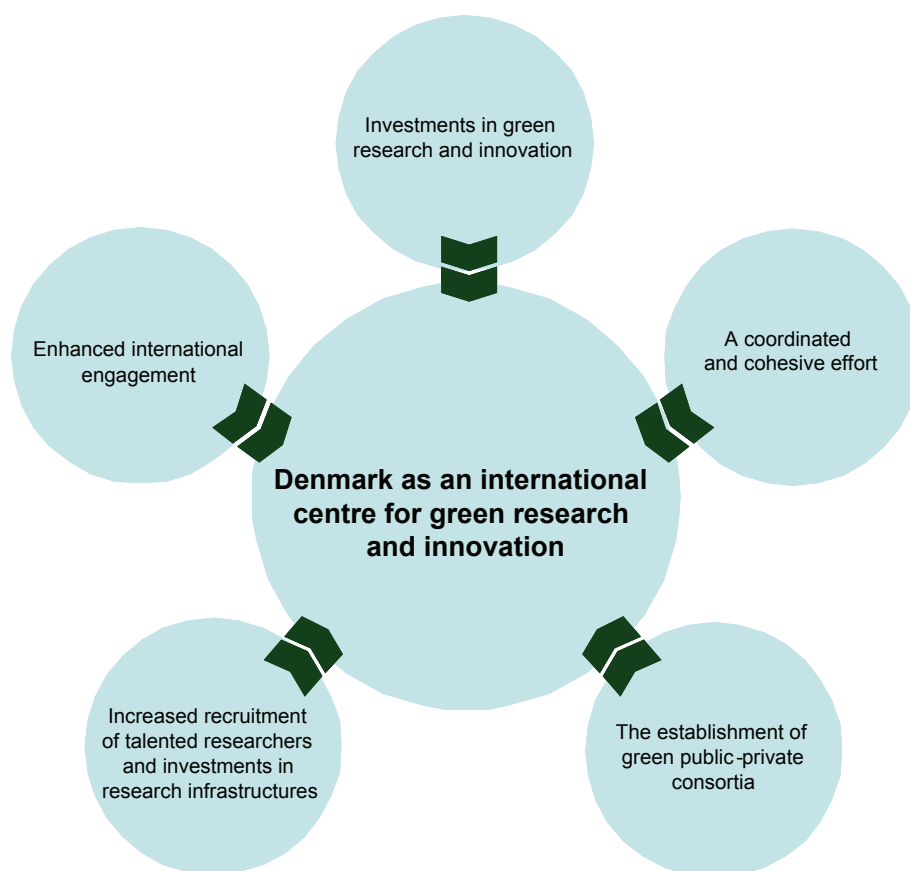
## 5. A comprehensive green research and innovation effort

---



It is the vision of the Danish Ministry of Science, Technology and Innovation that Denmark should be an international centre for green research and innovation. In so doing, Denmark is to contribute to resolving the world's climate and environmental challenges while maintaining and developing the areas that are Danish positions of strength. In the longer term the effort will also contribute to warrant Denmark's future growth and welfare.

Action must be taken in five areas to realise this vision. These are:



### *1) Investments in green research and innovation*

Green research and innovation must be prioritised in the Danish research council system, by businesses and public research institutions, and by increased participation in the EU's research and innovation programmes. Therefore the Ministry of Science, Technology and Innovation will work for continued and increasing prioritisation of research funds for the green area. In addition, the Ministry of Science, Technology and Innovation will continue to support businesses and Danish research institutions with a view to participating in the EU framework programmes as well as actively influencing the formulation of the 8th framework programme in the direction of green research areas.

*2) A coordinated and cohesive effort*

Further cohesion must be created between the public schemes that support the different stages in the innovation process in the green area from research over innovation to development and demonstration. The Ministry of Science, Technology and Innovation will work to strengthen cohesion and coordination between the public efforts – across research councils as well as ministries – that support green research and innovation.

*3) The establishment of green public-private consortia*

The Minister for Science, Technology and Innovation will work to create greater correlation between green research and innovation and in this context will support the establishment of large consortia consisting for example of businesses, universities, technological service institutes and technological networks in green areas of research. A new Danish model to promote the establishment of public-private consortia will take a point of departure in the particular preconditions and conditions obtaining in Denmark.

*4) Increased recruitment of talented researchers and investments in research infrastructure*

Existing and new green research environments must be strengthened and developed through investments in large-scale green research infrastructure and by means of recruiting talented researchers and students. The Ministry of Science, Technology and Innovation will utilise the Danish centres of innovation abroad to an increasing extent to call attention to Denmark as an international centre of green research and education and by this means attract researchers and PhD students to Denmark. At the same time investments in research infrastructure are to ensure that researchers have access to an advanced research infrastructure nationally and internationally, and that Denmark can continue to attract talented researchers from all over the world.

*5) Enhanced international engagement*

If Danish research environments and industry are to manage in the global competition for talent and resources, it will be increasingly necessary to focus the research and innovation effort while simultaneously developing binding collaboration with research institutions abroad. Therefore Danish research institutions must continue to, and to an increasing extent, receive support to exchange knowledge and to cooperate with leading green research environments in other countries in order to strengthen Danish research and innovation. One way of supporting this is through bilateral cooperation agreements on research and innovation. At the same time the Ministry of Science, Technology and Innovation will continue to pursue the potentials in the Danish innovation centres abroad. Innovation centres have already been developed in Munich, Shanghai and Silicon Valley. The innovation centres constitute an effective platform for internationally strategic cooperation between industry and public research institutions in global hot spots.