TNO Quality of Life

Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek / Netherlands Organisation for Applied Scientific Research

TNO report

Biobased economy – Exploring the opportunities for the Netherlands

Bijlage 3

Public policy instruments to support a bio-based economy

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Summary

This report deals with the public policies that national governments in Europe use to implement their policies in the field of biobased economies. It is the third and last part of the project on 'Biobased economy – Exploring the opportunities for the Netherlands'. In the first two parts biomass-based products (chemicals, fuels, materials) have been selected that have the most commercial potential and the highest industrial relevance for the Netherlands.

First of all, this report provides an overview of the public funding instruments that are used in five European countries (Belgium, France, Germany, the Netherlands and the United Kingdom) by the national governments to stimulate the development, production and use of biomass-based fuels, chemicals and materials. Second, it presents recommendations to the Dutch government on how to support the development, production and use of the selected biomass-based products.

Inventory of public funding instruments for a biobased economy in Belgium, France, Germany, the Netherlands and the United Kingdom

For each country a description of the funding instruments is presented that provides a short description of the programme, the running period, the budget, the types of applications, the type of instrument and the goals of the instrument. Seven types of goals have been distinguished: support the development of human resources, stimulate research and development, collaboration of academia with industry, valorisation, demonstration and production.

The table below shows for each country the number of programmes identified and the goals that are addressed by these programmes. The table shows that in the Netherlands, as in all other countries, there is a strong focus on the support of research and development in the field of biomass-based products.

Policy goals: / **Countries:**	**Human Resources**	**Research & Development**	**Collaboration with industry**	**Valorisation**	**Demonstration**	**Production facilities**	**Other: ….**
Belgium: 8 programmes	2	7	4	6	1	0	6
France: 10 programmes	0	10	10	7	2	0	9
Germany: 11 programmes	0	7	7	5	3	1	4
The Netherlands: 13 programmes	2	6	1	1	4	3	3
United Kingdom: 10 programmes	0	6	2	2	1	1	2

However, the Dutch research programmes do not have additional programme parts that address additional goals as is the case in Belgium, France and Germany where the R&D-programmes often also have components that address cooperation with industry and valorisation. This is less evident in the Netherlands and other countries; here industry can be involved in the priority setting process, but does not play an active role after priorities have been set. In general our inventory shows that programmes or schemes that stimulate demonstration projects and investment in production facilities are less often used. The Netherlands is an exception to this rule as compared to other countries its policy profile is much more balanced. It also has a considerable number of funding instruments that deal with the last part (pilot, demonstration, production) of the biobased products development chain.

Recommendations for new Dutch policy instruments to support a biobased economy

The recommendations on which policy instruments the Dutch government best could use, address the most important barriers (technological barriers, high development and production costs, small market, low return on investments) for the successful market introduction of the group of products/product groups that have a combination of the most commercial potential and the highest industrial relevance for the Netherlands.
A combination of strategies is used: 'picking the winners' (focused at the Top 3 of the group of very relevant products) and 'supporting the potentials' (focused at the group of 3 relevant products). The potentials will never make it without government support; the winners can in principle without, but by implementing the proposed recommendations processes can be accelerated and a biobased economy being realised more rapidly. The other six very relevant product/product groups are located between the former two groups and can benefit from the instruments that are proposed for these two groups.

The set of proposed policy instruments includes both specific and generic instruments.

Picking the winners:

- Demonstration projects for development and testing of large scale production processes of second generation bioethanol production;
- Research programme aimed at the development of improved and cheaper cellulases;
- Research programmes for the development of processes for the production of non-food grade variants of lactic acid and poly-lactid acid and modified starch;
- Demonstration projects to test the large scale production processes of lactic acid and poly-lactid acid and modified starch;
- Investment schemes to build these large scale production processes of lactic acid and poly-lactid acid and modified starch.

When the production of bioethanol, cellulose and poly-lactid acid have become substantial economic activities this also will stimulate the production of other biobased products, since these three forerunners will organise and facilitate the import, collection, cultivation, transportation and pre-treatment of biomass for other biobased products. Therefore, the proposed recommendations could be the starters of a biobased economy.

Supporting the potentials:

- Research programme for the development of cheap conversion processes for the production of tetrahydrofuran and succinic acid.

Generic instruments include:

- Investment allowance scheme for biomass-based chemicals;
- Governmental procurement for biomass made products;
- Construction of biomass-based chemicals production chains.

By implementing the proposed policies it is expected that these barriers are being levelled in order to get closer to the realization of a biobased economy.

1 Introduction

The Dutch government has the policy objective to stimulate the biobased economy. The use of materials, chemicals and fuels produced from biological materials can save fossil resources, reduce the emission of carbon dioxide, decrease negative effects on the environment and health, support the agricultural sector and can lead to product innovation (in particular in the chemistry sector). Preferably, the production of biobased materials, chemicals and fuels, in particular high value compounds, should be produced in the Netherlands using local feedstock. However, importing of feedstocks will be unavoidable to reach our targets with respect to quantities. The Netherlands is in a good position to develop a biobased economy as it has a high qualified knowledge position at universities, institutes and companies, a strong and productive agricultural sector, a strong chemistry sector and large ports to import biomass (Overheidsvisie, 2007).

Nevertheless, the biobased economy does not develop fast enough. Many biobased products are still more expensive than the conventional alternatives and (expensive) R&D is required to make them more attractive for the market. This is one important factor that slows the introduction of these products. Other factors that retard the developments are uncertainties about raw material prices and legislation, problems to organize the complete production chain and approval procedures. Government intends to stimulate a fast development of the biobased economy, e.g. by R&D subsidies, investment funds, taxes and laws. However, the efficacy of these measures is not known beforehand and depends on the specific problems of each product/market combination.

The questions that are addressed in this project is what are the potential attractive biomass-based products that suit best to the Dutch strengths in this field and which products need government support for its development in order to lead to marketable products.

In order to support the Dutch government's decision making on which measures should be chosen in order to speed up the realization of a biobased economy and more specific to support the development of potential attractive biomass-based products, TNO was commissioned to do a study on the market chances for the biobased economy in the Netherlands. Food and feed products were excluded as well as traditional construction materials. The study was split up in three parts:

1. Inventory of potential attractive products (combined with a production process) that are available or under development, and a pre-selection of the most promising.
2. Market study of selected products based on potential and chances in the market. The products are categorized in three classes: High chance (sells itself without government stimulation; high impact), Medium chance (introduction is promising buts needs government intervention) and Low chance (not feasible).
3. Proposal of which policy instruments the Dutch government can us in order to stimulate 'Medium Chance'-products.

This report presents the results of Part 3.

The first part of this report (Chapters 2 to 6) provides an overview of the policy instruments of national governments in Belgium, France, Germany, The Netherlands and the United Kingdom to stimulate a biomass-based economy. The focus is on

programmes that are running in 2008, the programmes that only recently finished (in 2007) or that soon will start (in 2009). In the introduction of each chapter the historical background of the national policies are addressed, but only very shortly.

The programmes deal with the use of biomass for the production of fuels, chemicals and materials. This biomass can be of plant, animal or microbial origin. The conversion of biomass into a biomass-based product can be biological, chemical or mechanical. Biobased is not the same as biodegradable: many biobased products are biodegradable but not all. Not included are schemes that are an implementation of the European EU directives and targets concerning biofuels. Also no programmes and schemes are included that deal with the use of biomass for bioenergy production through incineration and programmes that focuses on biological transformation processes in chemical production processes (sometimes referred to as biobased processes).

For each of the relevant programmes and schemes information is provided on:

- Name of the programme
- Short description of the programme:
- Running period
- Budget
- Applicants
- Type of instrument
- Goals of the instrument
- Information sources

Each country chapter provides a summary by presenting an overview of all instruments and the goals they address. Seven different goals can be addressed, including:

- Human Resources: this includes training and education programmes, but also programmes that attract scientists from aboard.
- Research and development: this includes programmes that fund fundamental research, application oriented/industry relevant research, research infrastructure (technological facilities), competence centres and feasibility studies.
- Collaboration with industry: this includes programmes that (in most cases: also) stimulate collaboration of public research organizations (universities, research institutes) with companies, the formation of networks and partnerships.
- Valorisation: this includes programmes that (also) stimulate the transfer of knowledge form the research part of the program to parties that can valorise and commercialise it. Also programmes that want to create an innovative environment are included under this goal.
- Demonstration: this includes programmes that support the testing of production facilities, demonstration projects, pilot projects.
- Production: these programme support companies, organizations and private persons to invest in the building of production facilities, buying energy saving apparatus.
- Others: In this category programmes are included that have a goal that does not belong to one of the above mentioned categories. In the tables the other goal is specified.

The second part of this report (Chapter 7) holds the recommendations for the Dutch government on how to stimulate the development, production and use of the groups of products that have been identified as very relevant in phase 2 of this project (Medium Chance and High Chance).

The recommendations on which policy instruments the Dutch government best could use, address the most important barriers for the successful production and market introduction of the group of products/product groups that have a combination of the most commercial potential and the highest industrial relevance for the Netherlands.

2 Belgium

2.1 Introduction

Belgium is a federal state, consisting of three communities (Flemish-, French- and German-speaking) and three regions (Flemish, Walloon and Brussels-Capital). The communities are responsible for education and fundamental research at universities and applied research at higher education institutes. The regions are responsible for applied and industrial research, technology development and the promotion of innovation. The federal government is responsible for issues of national importance, such as defence, fiscal policy, social security and justice. The federal government is not allowed to set any priorities for fields of research and innovation, but issues related to the bio-based economy could receive support in the form of finance for federal scientific research institutes and inter-university research groups in the fields of life sciences, exact and applied sciences and human sciences. In this chapter, the relevant policies and instruments are discussed at the level of the federal government, Flanders, Wallonia, and Brussels-Capital.

2.2 Federal government

2.2.1 Background

In 2004, the Royal Flemish Academy of Belgium for Science and Arts published the report 'Industrial biotechnology and sustainable chemistry', in which the government is suggested to initiate a specific industrial biotechnology policy. This resulted, at the federal level by the by the Belgian Minister for Economy, Energy, Foreign Trade and Science Policy, in the establishment of the interdisciplinary platform for industrial biotechnology in January 2005. This 'Belgian Interdisciplinary Platform for Industrial Biotechnology' (BIPIB) does not bring funding, but it brings together actors and disciplines in the field of industrial biotechnology in order to stimulate the adoption of industrial biotechnology.
BIPIB mainly focuses on the following domains:

- The replacement of the conventional, non-biological processes by bio-processes in industrial production processes, with the aim of rendering the process more sustainable, or for the production of (new) materials with a high added value (e.g. medicines, fine chemicals, food additives);
- The production of bulk and other materials (bio-energy, polymers,) starting from renewable resources (biomass and waste).

The domains are represented in three working groups: one on 'Biomass', one on 'Bioprocesses and bio-products', and one on 'Bio-energy'.
BIPIB had to develop a long-term strategy, covering not only research and development aspects, but also an adequate and coherent regulatory environment, as well as the integration of this technology in the industry and society. In addition, BIPIB had to ensure that its activities are linked with similar activities in other countries and with European initiatives in the same field. The three working groups prepared recommendations concerning these issues for each of the domains. BIPIB united all

stakeholders (industry, universities and research institutes, representatives of environmental and consumer associations and the authorities), throughout the different research disciplines, as well as the whole production chain. In November 2005, BIPIB formulated a set of recommendations for the promotion of industrial biotechnology. One of the main recommendations was to establish a specific research programme for industrial biotechnology, organised by the regional governments (BIPIB, 2005).

Regarding the promotion of the use of biofuels, Belgium follows the EU directives and targets. In 2006, the federal government initiated a law on biofuels (Wet betreffende biobrandstoffen), which includes lower excise duties on mixtures of fossil fuels and biofuels (http://mineco.fgov.be/energy/biofuels/biofuels_nl.htm).

2.2.2 Belgian Federal Science Policy Office

The Belgian Federal Science Policy Office (BELSPO) is responsible for coordinating science policy at the federal level, for the design and implementation of research programmes and networks, for the management of Belgium's participation in European in international organisations and the supervision of the federal scientific institutions. It is also responsible for scientific collections and cultural scientific promotional activities via the federal scientific institutes. The annual budget amounts to € 513 million (http://www.belspo.be). One of the Federal Scientific Institutes is ILVO – the Institute for Agricultural and Fisheries Research. One of the research fields of this research institute is plant research, including plant breeding and molecular genetics of crops for the production of biopharmaceuticals, functional foods and biofuels (http://www.ilvo.vlaanderen.be). Of the few programmes managed and implemented by BELSPO one is indirectly related to the bio-based economy.

2.2.2.1 Science for a Sustainable Development

Name: Science for a Sustainable Development (SSD)
Short description: The programme succeeds the first and second Scientific Support Plan for a Sustainable Development Policy (SPSD I 1996-2001 and SPSD II 2000-2005). The SSD programme was launched in 2005 and aims to support the scientific research in the area of sustainable development. The programme includes eight priority research domains: Energy, Transport and Mobility, Agro-food, Health and Environment, Climate, Biodiversity, Atmosphere and Terrestrial and Marine Ecosystems, and Transversal Research. Research within the Energy area deals with energy policy issues, alternative and renewable energy, as well as with the organisation of energy systems in medium and long term. The total budget for the programme is € 64.5 million for the period 2005-2009. At the moment, there are three projects funded, which are related to bio-energy and biofuels research themes.
The project BIOSES (Biofuels Sustainable End uSe) analyses the impact of different market introduction scenarios of biofuels in the Belgian transport system, with the focus on the end user perspective. The project will look into the practical feasibility and the ecological, socio-economic and macro-economic impact of the introduction of biofuels in Belgium. The project will use the results to create a roadmap for the introduction of liquid biofuels in Belgium. The project will run from December 2006 unitl January 2011 with a total budget of € 688,504.
The project Q-DIRECT (Development of referentials for Belgian quality in distributed renewable energy concepts) aims to develop an instrument for implementing a quality system for small scale renewable energy systems. Good quality installations are

essential for end customer satisfaction but just as much a necessity for the sustainable growth of the renewable energy implementation. One of the energy systems analysed is a small-scale biomass energy system. The project runs from January 2007 until January 2011 with a total budget of € 778,545.
The TEXBIAG project aims to develop decision-making tools to support the development of bio-energy in agriculture. These decision-making tools include a database about the environmental and socio-economic impacts of bio-energy from agriculture integrating biomass logistics; a mathematical model monetarising bio-energy externalities from agriculture, and a prediction tool assessing the impacts of political decisions made in the framework of the development of bio-energy from agriculture on different economic sectors (energy, agriculture, industry, and environment). The project runs from December 2006 until January 2011 with a total budget of € 768,170.
Running period: The SDD programme runs from 2005-2009
Budget: Total budget € 64.5 million. The budget for three projects related to socio-economic issues of bio-energy is € 1.46 million.
Applicants: public research organisations
Type of instrument: research grants
Goals of the instrument: contribute to developing scientific knowledge and instruments aiming to the analysis of processes, the study of impacts; the development, follow-up, and evaluation of policy measures. Encourage interdisciplinary research so as to offer support to decision-making on the basis of an integration of different dimensions, perspectives, etc. of the issues concerned;
Source and more info at: http://www.belspo.be/ssd/

2.3 Flanders

2.3.1 Background

In 2006, the Flemish Minister of Science and Innovation initiated a platform on life sciences and a platform on chemistry to discuss industrial biotechnology and bio-energy. The results of these platform discussions were presented in the papers 'Life Science Industry in Flanders' and 'Chemical Industry in Flanders'. Both papers give many suggestions for policy and the main suggestion is to start policies dedicated to the development of industrial biotechnology and bio-energy, for example by setting up a new research institute or network.

Despite these discussions and suggestions for policy-making, there are no specific and dedicated policy measures available so far in Flanders. There are several policy measures available though that support the exploitation of renewable energies both in industry and at home, including those based on industrial biotechnology and biomass. However, none of these measures explicitly stimulates industrial biotechnology applications.

A recent public-private initiative is the establishment of the Ghent Bio-Energy Valley. Ghent Bio-Energy Valley is a joint initiative of Ghent University, the city of Ghent, the Port of Ghent, the Development Agency East-Flanders and a number of industrial companies related to the Ghent region that are active in the fields of bio-energy generation, distribution, storage and use. The Initiative promotes the development of the

bio-based economy through collaborative programmes and joint initiatives between the partners in the fields of R&D, structural measures and policy, logistics and communication towards the general public (http://www.gbev.org/).

2.3.2 Vice-Minister-President and Minister for Economy, Entrepreneurship, Science, Innovation and Foreign Trade

The Flemish Minister for Economy, Entrepreneurship, Science, Innovation and Foreign Trade is responsible for the Flemish science and technological innovation policy. This includes scientific research, research at higher education institutes, training of researchers, and technological innovation policy.

In the mid 1990s, the Flemish government considered biotechnology to be one of the main priorities in supporting research and innovation. One of the main initiatives, which is still active today, is the establishment of the Flemish Interuniversity Institute for Biotechnology. Another initiative - partly linked to the bio-based economy - is the establishment of Environmental and Energy Technology Innovation Platform Flanders.

2.3.2.1 Flanders Interuniversity Institute for Biotechnology

Name: Flanders Interuniversity Institute for Biotechnology (Vlaams Interuniversitair Instituut voor Biotechnologie – VIB)
Short description: In 1995, the Flemish government decided to set up a virtual interuniversity institute for biotechnology, the Vlaams Interuniversitair Instituut voor Biotechnologie (Flemish Interuniversity Institute for Biotechnology - VIB). It is the Flemish government's main investment in biotechnology research and development. VIB is a joint venture by four Flemish universities, bringing together eleven research departments from these universities into one virtual institute. VIB brings together 1100 scientists and technicians. The three main objectives are:

- Strategic basic research: the main task of VIB is developing new knowledge in biotechnology;
- Technology transfer: VIB has a proactive technology transfer policy. Scientific output is protected through patents, which are licensed to national and foreign companies. Scientific discoveries can also be developed into technology platforms, which can result in spin-offs;
- Scientific information for the public: VIB develops several initiatives to inform the public about biotechnology.

The Department of Plant Systems Biology, based at the University of Ghent (UGhent), has a group working on bio-energy research. The Department of Molecular Microbiology, based at the Catholic University of Leuven (KU Leuven) focuses its research on yeast molecular genetics and biochemistry.
Two VIB-departments work on issues related to bio-energy and biochemistry.
Running period: 1995 – (every five year evaluated and re-awarded), now the third phase is running (2007-2011).
Budget: In 2007, the total budget of VIB amounted to € 52.9 million, of which € 40.7 million came from subsidies, including € 38.2 million basic donation from the Flemish government.
Applicants: public research organisations
Type of instrument: institutional funding
Goals of the instrument: long-term and application oriented research, valorisation, interdisciplinary collaboration
Source and more info at: http://www.vib.be

2.3.2.2 Environmental and Energy Technology Innovation Platform Flanders

Name: Environmental and Energy Technology Innovation Platform Flanders (Milieu- en Energietechnologie Innovatie Platform Vlaanderen – MIP)
Short description: In 2006, the Flemish government initiated the Environmental and Energy Technology Innovation Platform Flanders (MIP) as a new competence cluster including government, industry and research institutes. The cluster aims to stimulate the development and exploitation of new environmental and energy technologies in Flanders. MIP has the form of a virtual research institute, where each of the participating research groups functions from their own institutions, completed with a limited number of central functions. MIP coordinates the research in the field of environmental and energy technologies by developing new research projects, discussing these projects with the Thematic User Groups, organising funding from the participants in the Thematic User Groups and from the regular programmes managed by IWT, the Flemish funding agency. For each relevant topic a thematic user group has been established. These user groups guarantee 'state of the art' input and additional technological, marketing support for development of new innovative products and technologies within the group and within projects. In these user groups companies, sector organizations, research institutes and government organizations are involved. Participating companies can receive funding through the regular programmes managed by IWT. There is one Thematic User Group focusing on bio-fuels, another Thematic User Group deals with industrial biotechnology for the chemical industry.
MIP is also working on a Flemish Action Plan for Environment, Energy and Innovation, which presents the work plan of MIP for the future.
The competence pole address a wide range of environmental and energy technologies, including biofuels and industrial biotechnology for the chemical sector.
Running period: 2005-2008
Budget: The budget for the period 2005-2008 is € 7 million
Applicants: public research organisations, companies
Type of instrument: institutional funding
Goals of the instrument: long-term and application oriented research, valorisation, collaboration with industry, interdisciplinary collaboration
Source and more info at: http://www.mipvlaanderen.be

2.3.3 Institute for the promotion of innovation by science and technology

IWT is the Institute for the Promotion of Innovation by Science and Technology in Flanders. The organisation is the Flemish funding agency stimulating and supporting innovation. On the one hand IWT grants financial support to companies, research institutes, individual researchers as innovation intermediaries. On the other hand IWT promotes innovation by offering several services. IWT mainly uses response mode programmes and support programmes with calls, but mostly not dedicated to specific themes. There is one programme that provides additional support and bonuses to projects that address sustainable development issues.

2.3.3.1 Sustainable Technology Development

Name: Sustainable Technology Development (Duurzame Technologie Ontwikkeling – DTO)
Short description: The DTO-programme aims to provide additional support to research and development projects addressing sustainable technological development in order to increase the number of projects supported by IWT in the area of sustainable development. The programme supports several sustainability topics, including the

development of renewable resources and energy. The programme is additional to other subsidies managed by the IWT in the sense that projects that apply for IWT funding can receive more funding or a better rating in the selection process if they focus on sustainable technological developments.
The DTO-programme supports the development of renewable resources and energy as part of a broad range of sustainability topics. It is however, not dedicated to biotechnology applications.
Running period: The programme started in 2002. No information is available on its total running period.
Budget: In 2007, the DTO-programme provided € 4.1 million additional funding.
Applicants: companies, public research organisations
Type of instrument: project funding
Goals of the instrument: long-term and application oriented research, knowledge transfer, collaboration
Source and more info at: http://www.iwt.be

2.4 Wallonia

2.4.1 Background

Energy and more specific efficient use of energy and energy from renewable resources, is main theme of the Walloon Government. In the Walloon Marshall Plan (an overall plan for Wallonia to stimulate economic growth and prosperity in the region, initiated in 2005) sustainable energy is one of the main topics. The Marshall Plan foresees three Mobilising Programmes focused on energy research, and one, FUTURENERGY, is focused on stimulating the research and development in renewable energy. The Direction générale des Ressources naturelles et de l'Environnement (DGRNE) is responsible for the Plan Air Climat, an action plan of the Walloon government to improve air quality in Wallonia. Plan Air Climat includes all kinds of measures to stimulate reduction of CO2-emissions en to improve air quality, but none are dedicated to bio-energy produced by biotechnological processes and biomass. Renewable energies is also one of the policy themes of the Walloon Minister for Energy and the Directorate-General for Technologies, Research and Energy (DGTRE) of the Ministry of the Walloon Region. The DGTRE is responsible for managing and implemented the research support programmes as well as the energy policy in Wallonia. There are many different programmes and subsidies to stimulate efficient use of energy, energy saving as well as use and investing in energy from renewable resources, but all these measures are open to all types of renewable energy and not dedicated to energy based on biotechnological processes (http://energie.wallonie.be/xml/index.html; http://environnement.wallonie.be).

Bioproducts (biochemical and biomaterials) receive far less attention. The Marshall Plan supports some initiatives. It initiated five Competence Poles (Pôles de Compétitivité) of which WAGRALIM focuses on the agro-food sector (http://www.wagralim.be/). In February 2008, the Walloon Government announced an additional call (€ 42 million) for the existing competence poles and clusters to formulate projects in the research fields of the poles, but with a focus on sustainability. Another biomass-related initiative is VALBIOM. VALBIOM aims to stimulate the promotion and development of non-food applications of biomass (http://www.valbiom.be).

The Ministry of the Walloon Region also funds and coordinates several research institutes, including Centre Wallon de Recherches Agronomique (CRA-W). The CRA-W is active in a wide range of agricultural research, including biomass research projects.

2.4.2 Directorate General for Technology, Research and Energy

The Directorate General for Technology, Research and Energy (Directorate General for Technology, Research and Energy – DGTRE) is part of the Ministry of the Walloon Region and is responsible for the preparation and implementation of the technology and energy policy. It develops projects, runs programmes and finances R&D and innovation in enterprises, research centres and universities in Wallonia and implements Walloon energy policy. The DGTRE manages many different programmes, which provide all kinds of opportunities to stimulate the research, development, exploitation and use of bio-energy, biomaterials and bio-chemicals. Nevertheless, there are almost no initiatives dedicated to biotechnological processing using biomass in producing energy, materials or chemicals.

2.4.2.1 FUTURENERGY

Name: Programme Mobilisateur de Recherche en Energies Renouvelabes - FuturEnergy
Short description: In 2007, the Walloon Ministre for Energy announced a new mobilising programme (programme mobilisateur) for energy research as part of the Marshall Plan. FUTURENERGY focuses on the development of renewable energies, including bio-energy based on biomass. The programme supports the development of new production methods for sources of renewable energy as well as the improvement of existing production processes.
Running period: 2007
Budget: € 5 million in 2007
Applicants: public research organisations, companies
Type of instrument: project funding
Goals of the instrument: long-term and application oriented research, demonstration projects, valorisation, collaboration with industry and interdisciplinary collaboration
Source and more info at: http://energie.wallonie.be/xml/doc-IDC-3205-IDD-10269-.html

2.4.2.2 WAGRALIM

Name: WAGRALIM – Pôle de Compétitivité Agro-Industry
Short description: In 2006, WAGRALIM was selected as one of five Pôles de Compétitivité funded in the Marshall Plan. The competence pole aims to stimulate the development of an innovative culture and collaboration among companies, research organizations, and business organizations in the agro-industry sector. It supports research and development, training and education, as well as internationalisation. The pole has 39 firm-members and 31 scientific-members.
WAGRALIM has four thematic axes:

- Health foods
- Innovative production and conservation technologies for food
- Bio-packaging

- Sustainable food industry sectors

The bio-packaging theme supports the development of food packaging based on biomaterials and includes the project BioWall, which promotes the development of food packaging based on bio-materials and biodegradable materials.
Running period: Since 2007
Budget: Total budget for the projects amounts to € 28.9 million, of which € 25.8 million is financed by the Walloon government
Applicants: public research organisations, companies
Type of instrument: project funding
Goals of the instrument: long-term and application oriented research, training, internationalisation, valorisation, collaboration with industry
Source and more info at: http://www.wagralim.be

2.4.2.3 VALBIOM

Name: VALBIOM – Valorisation de Biomasse
Short description: VALBIOM is supported by DGTRE and the Directorate-General of Agriculture of the Walloon Government. The association VALBIOM was created in 2002 and aims to promote and encourage the valorisation of sustainable non-food applications of biomass. VALBIOM focuses on energy and chemicals based on biomass, on the level of resources, the level of procedures and the level of products. VALBIOM has two units: Renewable Raw Materials and Biomass Energy. It aims to promote the use on non-food applications, support the development of biomass chains, provides information to the general public and represents the various actors in the biomass-chain
VALBIOM has many members from scientific research organisations, higher education institutes, industrial associations, companies, private persons. VALBIOM collaborates with the research institutes CRA-W (the regional agricultural research institute), the Gembloux Agricultural University, and the Catholic University of Louvain. VALBIOM organises valorisation projects, training projects and stimulates networking and partnerships.
Running period: Since 2007
Budget: no information available on the budget
Applicants: public research organisations, companies, business organisations, associations, private persons can become member
Type of instrument: funding from the government for operating costs
Goals of the instrument: valorisation, training, collaboration with industry
Source and more info at: http://www.valbiom.be

2.5 Brussels Capital Region

2.5.1 Background

Environment is one of the three themes in the Regional Plan for Innovation (Innovative Brussels 2007-2013) of the Brussels Capital Region. The other two themes are ICT and Health & Biotechnology. The Regional Plan for Innovation resides under the responsibility of the Minister for Employment, Economy, Scientific Research and Urgent Medical Support and Firefighting. The plan aims to stimulate innovative development in the region in the three sectors, by supporting research and development,

valorisation, internationalisation and clusters of firms, research organisations and business organisations. One of the concrete actions aimed at stimulating research and innovation is the Impulse Programme Environment, which funds R&D projects with the focus on: Eco-construction and eco-design, Green or Renewable Energy, Pollution and Waste, and Mobility. Furthermore, environmental and energy policies is the responsibility of Leefmilieu Brussel / Bruxelles Environnement (Brussels Environment), the administration for these policies. There are several instruments supporting energy savings and the use and application of renewable energies, both by private persons and organisations. Renewable energy is mainly formulated as solar energy and CHP (Combined Heat and Power) but biomass is not mentioned. Biomass applications for biomaterials and biochemicals are not mentioned in any Brussels' policy or programme (http://www.bruxelles.irisnet.be/nl/region/region_de_bruxelles-capitale/organismes_regionaux.shtml; http://www.iwoib.irisnet.be/).

2.5.2 Institute for the Encouragement of Scientific Research and Innovation of Brussels

The Institute for the encouragement of Scientific Research Innovation of Brussels – IRSIB (Instituut ter Bevordering van het Wetenschappelijk Onderzoek en de Innovatie van Brussel - IWOIB) was established in 2004. The mission of the institute is to promote, support and valorize scientific research and technological innovation in the Brussels-Capital Region. This task consists principally in funding research projects undertaken within the companies, the universities and the higher education institutes located in the Region. IRSIB manages the regional Impulse Programme Environment.

2.5.2.1 Impulse Programme Environment

Name: Impulse Programme Environment (Impuls Programme Leefmilieu)
Short description: The programme covers the field between fundamental and industrial research. It aims to strengthen the technological potential of the Brussels-Capital Region, and is therefore dedicated to research units belonging to universities, institutions of higher education and collective research centres located within the Brussels-Capital Region. The programme attempts to encourage networking between research teams. Selected projects will receive funding for an initial period of three years, with possible renewal for up to three additional years after a second assessment procedure. The projects need to cover one of the priority themes:

- Eco-construction and eco-design
- Green or Renewable Energy
- Pollution and Waste
- Mobility

Running period: Call in 2008
Budget: no information available on the budget
Applicants: public research organisations, higher education institutes
Type of instrument: research grants
Goals of the instrument: fundamental and strategic basic research, interdciplinary collaboration
Source and more info at: http://www.iwoib.irisnet.be/ip_envi_nl.htm

2.6 Summary

We have identified eight Belgian programmes in the field of biomass-based chemicals, fuels and materials. See the table below for an overview of the policy goals are addressed by these programmes. Most have an important research component, often in combination with stimulating cooperation with industry and between researchers and valorisation activities.

Policy goals: / **Policy instruments:**	**Human Resources**	**Research & Development**	**Collaboration with industry**	**Valorisation**	**Demonstration**	**Production facilities**	**Other: …. ***
SSD		√					a, b
VIB		√		√			b
MIP		√		√			b
DTO		√	√	√			b
FUTURENERGY		√	√	√	√		b
WAGRALIM	√	√	√	√			
VALBIOM	√		√	√			
Impuls programme Environment		√					b

* Other includes:
a) follow-up and evaluation of policy matters, support policy making
b) collaboration between research teams

3 France

3.1 Introduction

For some years now, the development of a French bio-based economy has received increasing attention from both industry and government. France has a long history in agriculture and is the biggest producer of wood in Europe. The increasing attention for the bio-based economy is driven by the need to revitalize the French agricultural sector as well as the decreasing availability of fossil fuels and increasing concerns about environmental issues such as CO_2 emissions (Twynstra The Bridge, 2006). This last issue was also the main item for the societal debate linked to the environmental policy plan Grenelle de l'Environnement about the sustainable society.

Regarding the bio-based economy, France distinguishes two main applications: energy and chemistry. Energy includes the production of warmth and electricity as well as the production of transport fuels. Chemistry includes both bio-molecules (for lubricants and solvents) and biomaterials (e.g. biodegradable polymers) (TWA-Nieuws, 46/2, Maart/April 2008).

The French government concentrates its attention and policies on energy and specifically transport fuels. In 2005, the government assigned an interdepartmental co-ordinator for biomass, Claude Roy. Also in 2005, the French government announced Plan Biocarburants (Plan Biofuels), including the ambitious objective of reaching a 10% share of bio fuels in the total use of fuels in 2010, coming from only 1.2 % in 2006. In September 2006, the government announced several measure and instruments to implement the Plan Biocarburants. The government has a budget of €200 million for the development of environment-friendly cars (flex-fuel) and bio-fuel stations (pompes vertes) as well as a budget of € 312 million for fiscal measures increasing the attractiveness of biofuels ('Frankrijk boost biobrandstoffen', Artikel TWA-Nieuws, 1 november 2006). Also in 2005, the government announced two public procurements for the production of 2.5 million ton biodiesel and 0.8 million ton bioethanol. In 2007, there was a public procurement of a biomass (organic waste) Combined Power Heat Facility (TWA-Nieuws, 46/2, Maart/April 2008). The Grenelle d'Environnement brought up an important issue as various experts criticised the government's focus and support for first generation biofuels. This made the French government to decide to increasingly shift its focus to second generation biofuels ((TWA-Nieuws, 46/2, Maart/April 2008).

Several ministries are responsible for the bio-based economy: the Ministry of Ecology, Energy, Sustainable Development and Spatial Planning (Ministère de l'Ecologie, de l'Energie, de Développement durable et de 'Aménagement du territoire), the Ministry of Agriculture and Fisheries (Ministère de l'Agriculture et de la Pêche), the Ministry of Economy, Industry and Employability (Ministère de l'Economie, l'Industrie et de l'Emploi) and the Ministry of Higher Education and Research (Ministère de l'Enseignement supérieur et de la Recherche). The most important instruments include fiscal measures for biofuels and equipment using sustainable energy, as well as measures for stimulating the production and use of biomass for energy production through public procurement and special rates for buying electricity.

Research and development in biomass is stimulated by programmes from ANR (the Agence Nationale de la Recherche / National Research Agency), ADEME (the French Environment and Energy Management Agency / Agence de l'Environnement et de la Maîtrise de l'Energie) and OSEO (the French Innovation Agency). The Directorate-General for Enterprises of the Ministry of Economy, Industry and Employment manages the Pôles de Compétitivité, the competitiveness clusters in France, bringing together universities, knowledge institutes, large companies and SMEs.

3.2 Agence Nationale de la Recherche

3.2.1 Introduction

The National Research Agency – ANR was created in February 2005 and acts as a research council, funding both basic and applied research in response mode under open calls for specific topics. The ANR has six thematic departments, including one on Sustainable Energy and Environment, one on Ecosystems and Sustainable Development, and one on Engineering, Processes and Security. The department Sustainable Energy and Environment has a Programme Bioénergies 2008 and the department Ecosystems and Sustainable Development has a Programme de Génomique, which includes plant genomics research for non-food applications. In addition, this department manages a trilateral programme between France, Germany and Spain on Scientific and Technological cooperation in plant genome research as basis of the Knowledge Based Bio-Economy. The department Engineering, Processes and Security has a Chimie et Procédés pour le Développement Durable programme, focusing on the development of new chemical processes and 'green' chemistry.

3.2.2 Programme Bioénergies 2008

Name: Programme Bioéenergies 2008
Short description: The Programme Bioénergies focuses on the development of biomass-based energy production and products from bio-refineries, using physical, chemical and biotechnological processes. It focuses on the development of second-generation biofuels (bio-ethanol and biodiesel from ligno-cellulosic biomass) and third-generation biofuels (bio-hydrogen and bio-lipids from the action of micro-organisms, as well as the co-products coming from bio-refineries).
The programme has four themes:

- The biomass resource collection and pre-treatment processes
- The development of thermo-chemical processes
- The development of biological processes
- The technological bricks

Within the programme there is also a possibility to fund bilateral research and development projects between France and Brazil.
Running period: The programme started in 2008. No information about the duration of the programme is available.
Budget: No information about the budget of the programme is available.
Applicants: companies, public research organisations
Type of instrument: research grant
Goals of the instrument: long-term and application oriented research, demonstration projects, valorisation, collaboration with industry and interdisciplinary collaboration

Source and more info at:
http://www.agence-nationale-recherche.fr/?NodId=17&lngAAPId=198

3.2.3 Programme de Génomique

Name: Programme de Génomique
Short description: This programme focuses on three main fields of genomics research, namely animal, plant and large-scale microbial genomics. The plant genomics research theme aims to provide new knowledge about the diversity of genes that are important targets for a) improving productivity, for example for the use of plants for fuels; b) environmental concerns and c) improved and safer food ingredients and products
Running period: The programme started in 2007. No information about the duration of the programme is available.
Budget: No information about the budget of the programme is available.
Applicants: companies, public research organisations
Type of instrument: research grant
Goals of the instrument: long-term and application oriented research
Source and more info at:
http://www.agence-nationale-recherche.fr/?NodId=17&lngAAPId=16

3.2.4 Scientific and Technological cooperation in plant genome research as basis of the Knowledge Based Bio-Economy

Name: Scientific and Technological cooperation in plant genome research as basis of the Knowledge Based Bio-Economy (Plant-KBBE)
Short description: This is third joint call in a trilateral (France, Germany and Spain) collaboration initiative within the ERA-net Plant Genomics. The programme support research and development projects in the following themes: bio-energy, biomaterials and bio-based products (plant cell factories), sustainable production of healthier and safer food, and systems biology.
Running period: The programme started in 2008. No information about the duration of the programme is available.
Budget: No information about the budget of the programme is available.
Applicants: companies, public research organisations
Type of instrument: research grant
Goals of the instrument: collaborative, application-oriented projects with a high degree of scientific and technical innovation, interdisciplinary collaboration, collaboration with industry, valorisation
Source and more info at:
http://www.agence-nationale
recherche.fr/AAPProjetsOuverts?NodId=17&lngAAPId=195

3.2.5 Chimie et Procédés pour le Développement Durable

Name: Chimie et Procédés pour le Développement Durable (CP2D)
Short description: This programme aims to stimulate the development of 'green' chemistry. In 2008, the themes are: Syntheses that respect the environment; green processes assuring a clean chemistry; evaluation, monitoring and analysis; and evaluation and transformation of biological resources for the chemical industry of

tomorrow. Within the CP2D programme, there are also possibilities to fund bilateral research and development projects between France and Finland.
Running period: The programme started in 2007. No information about the duration of the programme is available.
Budget: € 8 million in 2008
Applicants: companies, public research organisations
Type of instrument: research grant
Goals of the instrument: long-term and application oriented research, demonstration projects, collaboration with industry and between researchers
Source and more info at:
http://www.agence-nationale-recherche.fr/?NodId=17&lngAAPId=176

3.3 OSEO

3.3.1 Introduction

OSEO is the French agency stimulating innovation in SMEs. OSEO is the successor of ANVAR, the Agence nationale de valorisation de la recherché (National Agency for the Valorisation of Research). OSEO has three pillars: OSEO Innovation, OSEO Financement and OSEO Garantie. In January 2008, OSEO merged with AII, the Agence de l'Innovation Industrielle (Agency for Industrial Innovation), which was just initiated in 2005 for supporting large industrial research projects. The merger with AII implied an increased focus on supporting 'gazelles', innovative SMEs developing breakthrough innovative technologies with large potential for growth. It is expected that in January 2009 OSEO will also become the managing agency of the Pôles de Compétitivité, which are now under management of Directorate-General Enterprises of the Ministry of Industry (TWA-Nieuws, June, 5th 2008). BioHub, which was started by AII and is now being managed by OSEO, is a large programme focusing on industrial biotechnology.

3.3.2 BioHub

Name: BioHub
Short description: The BioHub programme focuses on the development of cereals-based chemical products to the point that they are sustainable substitutes for fossil-origin products. The six-year programme is coordinated by the French company Roquette Frères. Other partners are DSM, Cognis, Eurovia, Sidel, Metabolic Explorer, Solvay, Tergal, Arkema, as well as the research institutes INSA Lyon and Rouen (Instituts Nationaux des Sciences Appliquées) and the Institute Michel Eugène Chevreul (CNRS and Université de Sciences et Technologies de Lille 1). On the one hand, the research focuses on the development new products, such as isosorbide deriviates. On the other hand, the research will lead to new biotechnological processes for current products, including chemical intermediates and active ingredients
Running period: 2007-2014
Budget: € 90 million for 7 years, of which € 42 million is financed by the French government
Applicants: consortium of industry and public research organisations
Type of instrument: € 22 million as a subsidy and € 20 million as a reimbursable loan

Goals of the instrument: long-term and application oriented research, collaboration with industry and between researchers
Source and more info at: http://www.biohub.fr/delia-CMS/indexEN/

3.4 Directorate-General for Enterprises at the Ministry of Economy, Industry and Employment

3.4.1 Introduction

The Directorate-General for Enterprise at the Ministry of Economy, Industry and Employment manages the Pôles de Compétitivité, which are initiatives that brings together companies, research centres and educational institutions in order to develop synergies and cooperative efforts in various field of technology. Based on a five-year plan, the clusters can develop partnerships, promote knowledge-sharing and innovation and conduct joint strategic R&D projects, which are mainly funded by the Interministerial Fund (FUI). However, the clusters can also apply for funding from other programmes. There are 71 Pôles de Compétitivité, which received € 1.5 billion over the past three years. In 2007 and 2008 all clusters have been evaluated and the general conclusion was very positive. As a result of this, another € 1.5 billion will be available for an extension of three years, although for 13 clusters it is not known if they can be extended. Of the 71 clusters, four are directly or indirectly related to bio-based economy issues (http://www.competitivite.gouv.fr/; TWA-Nieuws, 46/2, maart/april 2008; TWA-Nieuws 11/7/2008).

3.4.2 Industries et Agro-Ressources

Name: Industries et Agro-Ressources (IAR)
Short description: This Pôle de Compétitivité is based in the regions Picardie and Champagne-Ardennes and focuses on the development and use of plant-biomass for non-food applications. The cluster focuses on four themes in biorefinery: bio-energy, biomolecules, biomaterials and food ingredients. The cluster brings together skills and technologies for the extraction, transformation and formulation of biomass components, enabling the performance of all the steps - from the laboratory to industrial development.
Running period: 2005-2009
Budget: no information available
Applicants: cluster of large firms, SMEs, universities and higher education institutes, public research organisations and various regional institutions
Type of instrument: R&D projects within the cluster are financed through research grants.
Goals of the instrument: application-oriented research, collaboration with industry and between researchers, valorisation, networking, stimulating environment for innovation
Source and more info at: http://www.iar-pole.com/index02.php

3.4.3 Axelera

Name: Axelera
Short description: This Pôle de Compétitivité is based in the region Rhône-Alpes and focuses on chemistry and environment. The cluster aims to support the development of

sustainable production processes in the chemical industry. The cluster supports 12 R&D projects in three themes: catalysis, processes and materials. In addition, there are five cross-theme projects.
Running period: 2005-2009
Budget: no information available
Applicants: The pole clusters 115 members coming from large firms, SMEs, universities and higher education institutes, public research organisations and various regional institutions
Type of instrument: R&D projects within the cluster are financed through research grants.
Goals of the instrument: application-oriented research, collaboration with industry and between researchers, valorisation, networking, stimulating environment for innovation
Source and more info at:
http://www.axelera.org/srt/axelera_en/home?location.id:=1395&location.root:=1395

3.4.4 Céréales Valléee

Name: Céréales Valléee
Short description: This Pôle de Compétitivité is based in the region Auvergne and focuses on improving the the quality and productivity of seeds and cereals for food and feed ingredients, as well as the development of biomaterials and other non-food applications based on cereals.
Running period: 2005-2009
Budget: no information available
Applicants: The pole has 400 members coming from large firms, SMEs, universities and higher education institutes, public research organisations and various regional institutions
Type of instrument: R&D projects within the cluster are financed through research grants.
Goals of the instrument: application-oriented research, collaboration with industry and between researchers, valorisation, networking, stimulating environment for innovation
Source and more info at: http://www.cereales-vallee.org/default.cfm

3.4.5 Plastipolis

Name: Plastipolis
Short description: This Pôle de Compétitivité is based in the regions Rhône-Alpes and Franche-Comté and focuses on plastics processing and composites. The cluster has several research themes: materials, production processes, composite materials, and micro- and nano-structuring of polymers. The cluster also has a cross-cutting project on biodegradable food packaging.
Running period: 2005-2009
Budget: no information available
Applicants: The pole clusters 60 members coming from large firms, SMEs, universities and higher education institutes, public research organisations and various regional institutions
Type of instrument: R&D projects within the cluster are financed through research grants.
Goals of the instrument: application-oriented research, collaboration with industry and between researchers, valorisation, networking, stimulating environment for innovation
Source and more info at: http://www.plastipolis.fr/index2.html

3.5 ADEME

3.5.1 Introduction

The Agence de l'Environnement et de la Maîtrise de l'Energie (French Environment and Energy Management Agency) is a public agency under the joint supervision of the Ministry for Ecology, Sustainable Development and Spatial Planning and the Ministry of Research. The agency facilitates, manages and coordinates research programmes in the field of environment and energy and promotes sustainable development in industry and among the general public. Annual budget for its activities is € 260 million, of which €49 million is allocated to research. One of the topics of ADEME is energy and renewable resources, which focuses on bio-energy, materials and chemistry. Within this topic, ADEME created in 1994 the consortium Agriculture for Chemicals and Energy.

3.5.2 Agriculture for Chemicals and Energy

Name: Agriculture for Chemicals and Energy - AGRICE
Short description: This consortium focuses on new uses and enhanced value of agricultural products and by-products as feedstock for energy, chemicals and materials. AGRICE facilitates, coordinates and funds research and development programmes in this area, including R&D projects in the field of agricultural biomass for bio-energy, biomaterials and bio-molecules. AGRICE was founded in 1994 and is now in its second six-year period. In the first period it supported more than 300 research projects, providing 500 million Francs in funding.
Running period: The programme started in 1994. No information about the duration of the programme is available.
Budget: No information about the budget of the programme is available.
Applicants: AGRICE's members come from industry, research organisation, universities, professional organisations in agriculture. In addition to the members, there are many stakeholders involved in the R&D projects.
Type of instrument: R&D projects within AGRICE are financed through research grants.
Goals of the instrument: application-oriented research, collaboration with industry and between researchers, valorisation, networking, stimulating environment for innovation
Source and more info at: http://www.ademe.fr/partenaires/agrice/index_gb.htm

3.6 Summary

We have identified ten French programmes in the field of biomass-based chemicals, fuels and materials. See the table below for an overview which policy goals are addressed by these programmes. All programmes support research and development activities. Collaboration with industrial partners and between researchers is in most cases a prerequisite or a favourable condition for funding. Seven of the 10 programmes stimulate valorisation. Two programmes provide also funding for experimental development or demonstration projects.

Policy goals: / Policy instruments:	Human Resources	Research & Development	Collaboration with industry	Valorisation	Demonstration	Production facilities	Other: …. *
Bioenergies 2008		√	√	√	√		a, b
Programme de Genomique		√	√				e
Plant-KBBE		√	√	√			b, e
CP2D		√	√		√		c, e
BioHub		√	√				
Pole IAR		√	√	√			d
Pole Axelera		√	√	√			d
Pole Valleee		√	√	√			d
Pole Plastipolis		√	√	√			d
AGRICE		√	√	√			d

* Other includes:

a) collaboration with researchers from Brazil
b) collaboration with researchers from Germany, and Spain
c) collaboration with researchers from Finland
d) provide a stimulating environment for innovation
e) collaboration between researchers

4 Germany

4.1 Introduction

The German bio-based economy can rest on a long tradition of attention and policies for the protection of the environment. Germany has extensive and ambitious environmental legislation and there is a strong push for sustainable products and recycling. Also the public attitude towards environmental sustainability and recycling is very strong and positive. In addition, Germany has a very large agricultural and forestry sector. These factors drive the development of the German bio-based economy. The German government started early (early 1990s) with programmes supporting the development of bio-energy and biofuels, while there is also increasing attention in both research and policy support for bio-chemicals and biomaterials (Twynstra The Bridge, 2006; TWA-Nieuws, 46/2, maart/april 2008).

Four federal ministries are involved in policy making that addresses a bio-based economy. The Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz (Federal Ministry of Food, Agriculture and Consumer Protection - BMELV) focuses on renewable resources through strengthening the agriculture and forestry. Programmes for renewable resources are managed by the Fachagentuur Nachwachsende Rohstoffe (Agency for Renewable Resources – FNR). The Bundesministerium für Wirtschaft und Technologie (Federal Ministry of Economics and Technology – BMWi) is responsible for supporting energy research. The Bundesministerium für Umwelt Naturschutz und Reaktorsicherheit (Federal Ministry for the Environment, Nature Conservation and Nucelar Safety – BMU) is responsible for renewable energy as well as safety for the environment in relation to biotechnologies. The Bundesministerium für Bildung und Forschung (Federal Ministry of Education and Research – BMBF) is responsible for research and innovation in relation to the bio-based economy. This ministry has a theme Environment and Sustainability, a theme Energy, as well as a theme Life Sciences. The research and innovation programmes are mainly focused on industrial biotechnology (production of chemicals using bioprocessing steps) and biomaterials; they are coordinated by Projektträger Jülich (Project Management Agency Jülich – PT Jülich).

In 2005, the four ministries have jointly announced the Fifth Energy Research Programme 'Innovation und neue Energietechnologien', which will fund energy research projects for a total amount of € 1.7 billion in the period 2005-2008 and another € 2.1 billion in the period 2008-2011. The first programme already was installed in 1974.
The programme has two main focus areas: energy efficiency and renewable energies. This is translated into four themes for funding research:

- modern power plant technologies on the basis of coal and gas (including CO_2 capture and storage),
- photovoltaics and offshore wind energy,
- fuel cells and hydrogen as secondary energy carrier and energy storage systems,
- technologies and processes for energy-optimized construction, and
- technologies for using biomass for energy purposes.

In addition, the programme also focuses on energy-saving technologies in industry, trade, commerce and services, other fields of renewable energy technologies such as solar heating, geothermal power and hydropower, nuclear safety and repository research, the development of nuclear fusion as a source of energy as well as systems analysis and dissemination of information. The Federal Ministry of Economics and Technology (BMWi) is in charge of the general orientation of the energy research policy and provides project funding in the area of 'nonnuclear energies' (not including renewable energies) and 'efficient energy conversion', as well as 'nuclear safety and repository research'. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) is responsible for the project-funding of R&D projects in the field of renewable energies (without bio-energy). The Federal Ministry of Consumer Protection, Food and Agriculture (BMELV) is responsible for project funding of R&D projects in the field of bio-energy and especially the use of renewable raw materials for energy purposes. The Federal Ministry of Education and Research (BMBF) is responsible for the institutional funding of the research centres of the Helmholtz Association in the field of energy research, as well as for basic and precautionary research in the areas of 'energy conservation' and 'renewable energies' (Federal Ministry of Economics and Labour (2005) 'Innovation and New Energy Technologies: The 5th Energy Research Programme of the Federal Government', Berlin).

Besides these ministries, the Deutsche Bundesstiftung Umwelt (German Federal Foundation Environment - DBU) is one of the largest funding organisations for bio-based technologies (TWA-Nieuws, 46/2, maart/april 2008).

Important legislation supporting bio-energy is the Erneuerbare-Energien-Gesetz (Renewable Energy Legislation – EEG). This legislation was installed in 2000 and demands from energy suppliers to yield renewable energy at minimum prices, fixed for 20 years. The aim of this legislation is to increase the share of renewable energy in the total production of energy to 25% in 2020. Biomass is explicitly defined as source for renewable energy (http://www.erneuerbare-energien.de/inhalt/4596/).
Other legislation aims to stimulate the production and use of biofuels. From 2004 to 2007 biofuels were free of excise, which stimulated the growth of production and use of biodiesel extensively. Since January 2007, this legislation is replaced by the obligation to mix biofuels with fossil fuels, increasing from 4.4 % for biodiesel and 1.2 % for bioethanol in 2007 until 8% for all biofuels in 2015 (Biokraftstoffquotengesetzes). In addition, there is new legislation on excise on biofuels with increasing levels of excise until 2012, differing for various types of biofuels (Energiesteuergesetz) (http://www.biokraftstoffe.info/cms35/Rahmenbedingungen.819.0.html). However, the quota have limited the production and use of fuels fully based on biomass and are not stimulating the production of biofuels, as there is more capacity than needed to fulfil the quota (TWA-Nieuws, 46/2, maart/april 2008).

The following sections present in more detail the relevant programmes of the federal ministries, as well as those of the Deutsche Bundesstiftung Umwelt and the Deutsche Forschungsgemeinschaft.

4.2 Federal Ministry of Food, Agriculture and Consumer Protection

4.2.1 Introduction

The Federal Ministry of Food, Agriculture and Consumer Protection (Bundesministerium für Ernährung, Landwirthschaft und Verbraucherschutz - BMELV) is responsible for public programmes supporting research, development and exploitation of renewable resources (in German: nachwachsende Rohstoffe). Already since the beginning of the 1990s the Ministry has installed programmes to support the use of renewable resources. The Agency for Renewable Resources (Fachagentur Nachwachsende Rohstoffe - FNR) was founded in 1993 and is responsible for managing the programmes for R&D support in the area of renewable resources. The FNR also informs the public about current research results, gives advice on applications of renewable resources and organizes and participates in scientific conferences.
Two main programmes are the Forschungs-, Entwicklungs- und Demonstrationsprogramm Nachwachsende Rohstoffe and the Markteinführungsprogramm Nachwachsende Rohstoffe. In 2007, the joint budget for these programmes amounted to € 50 million.

4.2.2 Research, Development and Demonstration Programme Renewable Resources

Name: Research, Development and Demonstration Programme Renewable Resources (Forschungs-, Entwicklungs- und Demonstrationsprogramm Nachwachsende Rohstoffe -FuE-Programm)
Short description: This programme supports projects that aim to build up production chains of renewable resources, develop further applications in the non-food sector, provide information and give advice to producers, processors and users, as well as projects that focus on marketing and public relations work. The types of renewable resources that can be funded are defined and also updated over time. It includes: starch, sugar, biomass-base oils and fats, fibres, wood and lignocellulose, proteins, and plant extractions, as well as biological rest and waste materials, animal materials like wool, milk, fats, skin and other co-products from the food industry, and biogas coming from the waste of the food industry. The programme supports both the application for energy production and the chemical-technical applications.
Running period: first phase: 1996-2000, second phase started in 2001
Budget: no information available
Applicants: companies, public research organisations
Type of instrument: grants; 100% funding for fundamental research projects, 50% for industrial research projects, 25% for demonstration projects and experiments.
Goals of the instrument: basic research, applied research, demonstration projects, collaboration with industry
Source and more info at: http://www.fnr.de/

4.2.3 Market Introduction Programme Renewable Resources

Name: Market Introduction Programme Renewable Resources (Markteinführungsprogramm MEP Nachwachsende Rohstoffe)
Short description: This programme aims to stimulate the application and use of bio-based products and provides support in two directions. The first direction focuses on

bio-based lubricants and supports companies in switching to bio-lubricants by compensating for the extra costs for using bio-lubricants and switching to machinery using bio-lubricants. The second direction focuses on biofuels and more specific private fuel stations in the agricultural and forestry sector as well as environment sensitive sectors such as the construction and transport sector. The programme finances 50% of the investment costs for private bio-fuel stations.
Running period: The programme started in 2005. No information about the running period is available
Budget: no information available
Applicants: companies
Type of instrument: compensating investment grants
Goals of the instrument: exploitation of bio-based products
Source and more info at: http://www.fnr.de/

4.2.4 Demonstration Projects Bio-energy

Name: Demonstration Projects Bio-energy (Demonstrationsvorhaben Bioenergie)
Short description: This programme support demonstration projects in bio-energy and concentrates on plants and wood as biomass and technologies to convert this type of biomass into bio-energy whose practicability has already been proven at pilot stage, are state of the art and are likely to be commercialised after the demonstration project.
Running period: 2005 - 2010
Budget: no information available
Applicants: companies, local governments (towns and villages), foundations, associations
Type of instrument: investment grants or allowance for operating costs
Goals of the instrument: exploitation of biomass-based products
Source and more info at: http://www.fnr.de/

4.2.5 Biorefinery: using wood as biomass for the chemical industry

Name: Biorefinery: using wood as biomass for the chemical industry (Bioraffinerie: Rohstoffe aus Holz für die Chemische Industrie)
Short description: The aim of the new pilot project is establishing a bio-refinery, which will use wood for producing resource material for the chemical industry. The bio-refinery extracts several useful components of wood for further processing in the chemical industry.
Running period: 2008-2011
Budget: € 1.9 million for 3 years
Applicants: a consortium of 16 companies and research institutes
Type of instrument: investment grants
Goals of the instrument: exploitation of biomass-based products
Source and more info at:
http://www.bmelv.de/cln_045/nn_1021300/DE/081-NachwachsendeRohstoffe/Bioraffinerie.html__nnn=true

4.2.6 Bioenergy Regions: Competition for most innovative bio-energy region e

Name: Bioenergy Regions: Competition for most innovative bio-energy region (Gesucht: die innovativsten Bioenergie-Regionen: BMELV startet Wettbewerb zum Aufbau regionaler Bioenergie-Netzwerk)

Short description: The Ministry initiated a competition for the most innovative regions in bio-energy. The aim of the competition is to stimulate the exploitation of innovative bio-energy concepts in regions, by enhancing collaboration, knowledge transfer and networking in regions in the field of bio-energy in order to stimulate economic development and employment in the region. In total 16 regions will be selected for funding realising their bio-energy concept and the competition will end with the selection of the concept with the most successful realisation.
Running period: 2009-2001
Budget: € 400,000 per region for three years. The funding covers personnel, travelling and operating costs. Investments in equipment etc will not be funded.
Applicants: Regions: villages and towns collaborating with local agricultural and forestry cooperations, consortium of several villages and towns, but also partnerships of firms, higher education institutes and knowledge institutes in specific regions.
Type of instrument: funding of operating costs
Goals of the instrument: Cooperation with industry, valorsation, networking
Source and more info at: http://www.bioenergie-regionen.de

4.3 Federal Ministry of Education and Research

4.3.1 Introduction

The Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung - BMBF) is responsible for research and innovation in various themes, including Life Sciences, Energy, and Environment and Sustainability. Within the theme Energy, the Ministry installed the programme BioEnergie 2021 (part of the Framework Programme Biotechnology), stimulating R&D in the field of energy from biomass applications. Within the theme Environment and Sustainability, the Ministry installed a Framework Programme 'Research for Sustainability'.
Within the theme Life Sciences, the ministry installed the Framework Programme Biotechnology (Rahmenprogramm Biotechnologie – Chancen nutzen und gestalten) in 2001; several sub programmes are relevant for the bio-based economy. Besides bio-energy, the Ministry focuses on biomaterials and biochemicals. This Framework Programme aims to enhance research and development, as well as exploitation of life sciences to strengthen and expand Germany's scientific and economic position in the life sciences. In the period 2001-2005 the framework programme provide funding to the amount of € 802.7 million. In 2006, it was decided to extend the programme for another five years with a budget of € 1 billion. The programme supports fundamental research, more applied research, as well as commercialisation. The Framework Programme is managed by the project agency Projektträger Jülich.

4.3.2 BioEnergy 2021 – Research for the use of plant-based biomass

Name: BioEnergy 2021 – Research for the use of plant-based biomass (BioEnergie 2021 – Forschung für die Nutzung pflanzlicher Biomasse)
Short description: The programme BioEnergie 2021 aims to stimulate research focusing on developing new methods and technologies to increase the efficiency and effectiveness of plant-based biomass in the production of energy. The programme has three modules. Module A focuses in bio-refinery concepts for the future. Module B addresses plants as providers of energy and raw materials by focusing on system

biology and biotechnology as main routes to increase efficiency and effectiveness of using plants as raw material. Module C is a competition of innovative concepts for producing bio-energy. The programme stimulates research and development in bio-energy based on plants. The programme explicitly stimulates the application of bio-refinery concepts, system biology and biotechnology.
Running period: 2008-2013
Budget: € 50 million
Applicants: companies, public research institutes
Type of instrument: research grants
Goals of the instrument: fundamental research, application-oriented research, technology transfer and collaboration with industry and between researchers
Source and more info at: http://www.fz-juelich.de/ptj/bioenergie2021

4.3.3 BioIndustry 2021

Name: BioIndustry 2021 – Competitiveness Clusters for the Development of Products and Applications in the Industrial Biotechnology (BioIndustrie 2021 – Cluster-Wettbewerb zur Entwicklung Produkte und Verfahren in der industriellen Biotechnologie)
Short description: The programme aims to speed-up the commercialisation process of research ideas and results in the field of industrial biotechnology. The programme supports clusters and networks of firms and research institutes dedicated to the research and development in industrial biotechnology applications. These applications can also include the use of biomass as raw material for the chemical industry.
One of the 5 clusters that has received funding, deals with biopolymers and biomaterials (BIOPRO Baden-Württemberg); the other are not biomass-related.
Running period: 2006-2011
Budget: € 60 million. The budget of the BIOPRO cluster is € 10 million.
Applicants: all companies, public research institutes
Type of instrument: grants for cluster building by funding personnel and operating costs, as well as investments in equipment. The first phase includes funding for developing the cluster concept, while the second phase supports the building and operating the clusters.
Goals of the instrument: pre-competitive and application-oriented research, technology transfer, networking and collaboration
Source and more info at: http://www.fz-juelich.de/ptj/bioindustrie; http://www.biotechnologie.de/bio/generator/Navigation/English/funding-and-grants,did=71314.html

4.3.4 Genomanalyse im biologischen System Pflanze

Name: Genomanalyse im biologischen System Pflanze (Genome Analysis of the Plant Biological System – GABI)
Short description: This programme supports plant genomics research and aims to strengthen the international position of German plant genome research, to create a national network and establishment of competence centres, to gain information on the structures and functions of important plant genomes, to transfer technology between the research institutes and private enterprise companies, and to patent and thereby the disclosure of research results and improvement of the international cooperation.
Plant genomics research, contributes to the understanding of plant biological systems in order to improve and breed plants with higher yields and better functionalities; the latter

can include also better functionalities for plants as raw materials for non-food applications.
Running period: GABI I: 1999-2003; GABI II: 2004-2007
Budget: GABI I: € 45 million; GABI II: € 8 million per year + € 3 million per year since 2007 for ERA Net Plant Genomics
Applicants: companies, public research institutes
Type of instrument: research grants
Goals of the instrument: fundamental and application-oriented research, technology transfer, centres of excellence and competence centres and international collaboration
Source and more info at: http://www.fz-juelich.de/ptj/gabi; http://www.gabi.de/

4.3.5 GABI-FUTURE Plants as a Basis for Life

Name: GABI-FUTURE Plants as a Basis for Life – from Genome Analysis to Product Innovations (GABI-FUTURE Lebensbasis Pflanze – von der Genomanalyse zur Produktinnovation)
Short description: This programme intends to stimulate the development of new innovative varieties and the exploitation of plants as suppliers of raw materials and bio-factories of the future, replacing conventional production methods by energy-efficient and environmentally compatible biological processes. The programme supports fundamental and pre-competitive research in the following topics:

- Crops and suitable wild plants that produce customised innovative substances for further industrial processing;
- Crops and suitable plants optimised for energy production under extensive conditions;
- Crops containing medical substances or improved food quality and safety;
- Crops capable of withstanding biotic and abiotic stress and thus contributing to innovative plant protection concepts;
- Crops that take up and utilise nutrients or water more efficiently;
- Crops that have been optimised with respect to their metabolism, the development of crop organs and their plant architecture;
- Structure and further development of the GABI infrastructure required in the future (genomics resources, bioinformatics and platform technologies).

Running period: 2007 - 2013
Budget: € 50 million
Applicants: companies, public research institutes
Type of instrument: Long-term explorative projects will be funded under GABI-BASIS module; bridging projects focusing on implementation in the medium term are funded under the GABI-BRIDGING PROJECTS module; Application-oriented projects at the pre-competitive state are funded under the GABI-PRODUCTS module; projects focusing on the scientific infrastructure are funded under the GABI-RESOURCES module and the establishment of post-doc groups as a start-up of centres of excellence is funded under the GABI-START module.
Goals of the instrument: fundamental research, application-oriented research, knowledge transfer, collaboration, centres of excellence, research infrastructure
Source and more info at: http://www.fz-juelich.de/ptj/gabi-future

4.4 German Federal Foundation for the Environment

4.4.1 Introduction

The German Federal Foundation for the Environment (Deutsche Bundesstiftung Umwelt - DBU) was established in 1990 with funds from a privatised steel factory. The foundation's capital amounts to € 1.2 billion. The Deutsche Bundesstiftung Umwelt focuses on supporting projects which help to protect the environment by integrating products and production methods and by shaping attitudes with environmental education programmes aimed at changing patterns of behaviour. According to the law, the subsidies are concentrated on small and medium-sized enterprises, with priority going to the support of pioneers with innovative environmental ideas. The DBU particularly encourages co-operation projects between small and medium-sized enterprises and research institutions The DBU supports nine fields in three main themes: Environmental technology; Environmental research and nature conservation; Environmental communication and protection of cultural assets.
Especially the theme of Environmental research and nature conservation is relevant for the bio-based economy as it includes "Sustainable chemistry - procedures and products" as well as "Biotechnological procedures and products". In 2007, the DBU funded 30 projects in the field of 'Applied environmental research", which includes a scholarship programme as well as the research themes 'Sustainable chemistry' and "Biotechnological procedures and products. The 30 projects received funding for € 8.7 million in total, which represents 16.59 % of the total funding provided in 2007 (DBU (2008) Jahresbericht 2007).

4.4.2 Research theme Sustainable Chemistry

Name: Research theme Sustainable Chemistry (Förderbereich Nachhaltige Chemie)
Short description: The DBU supports research projects in the field of sustainable (or 'green') chemistry. Sustainable chemistry includes renewable resources, minimised use of energy, improved recyclability of the products and diminished toxic risks for humans and environment.
The DBU funds the following types of projects:

- Development of processes for the conversion of renewable raw materials and materials coming from recycling into new raw materials and products
- Development of procedures for micro and nanotechniques (e.g. micro- reaction techniques in the synthesis chemistry)
- Development of optimal processing techniques, especially new catalysts and separation techniques

Running period: continuous since 1990
Budget: no information available
Applicants: companies, public research institutes
Type of instrument: research grants
Goals of the instrument: basic and applied research, partnerships and collaborations with industry
Source and more info at: http://www.dbu.de/1018.html

4.5 German Research Foundation

4.5.1 Introduction

The German Research Foundation (Deutsche Forschungsgemeinschaft) is the central research funding organisation that promotes research at universities and other publicly financed research institutions in Germany. The DFG serves all branches of science and the humanities by funding research projects and facilitating cooperation among researchers. Promoting research includes supporting individual projects and research cooperation, awarding prizes for outstanding research achievements as well as funding scientific infrastructure and encouraging contacts in science and research. The DFG can decide on funding autonomously. The DFG does not have specific programmes focusing on industrial biotechnology or topics related to the bio-based economy; instead DFG funds bottom-up applications. One of these initiatives is the Exzellenzcluster Tailor-made fuels from Biomass.

4.5.2 Excellence cluster: Tailor-made fuels from Biomass

Name: Excellenc cluster (Exzellenzcluster) Tailor-made fuels from Biomass
Short description: In 2007, the DFG awarded the Exzellenzcluster Tailor-made fuels from Biomass. The cluster includes several research groups from the Technical University Achen and institutes from the Fraunhofer Gesellschaft and Max-Plack Gesellschaft. The cluster focuses on third generation biofuels. The cluster will cover three research areas: molecular transformation, reaction and process design for biomass, fuel injection and combustion. The three research areas form together the field of fuel design, including the conversion from biomass into bio-fuel as well as the optimal combustion in the engine.
Running period: 2007-2012
Budget: The annual budget is € 6.5
Applicants: companies, public research institutes
Type of instrument: research grants, grants for cluster forming
Goals of the instrument: basic and applied research, centre of excellence, collaboration and interdisciplinary research
Source and more info at: http://www.vka.rwth-aachen.de/tmf/; TWA-Nieuws, 46/2, maart/april 2008

4.6 Summary

The table below shows an overview of the 11 programmes we have been able to identify that are active in the field of biomass-based fuels, chemicals and materials. What strikes is that many programmes have a structure that integrates the goals of stimulating research, collaboration with industry and valorisation or demonstration. Collaboration with industrial partners is stimulated in seven programmes and is often a prerequisite or favourable condition for funding.

Policy goals: / Policy instruments:	Human Resources	Research & Development	Collaboration with industry	Valorisation	Demonstration	Production facilities	Other: …. *
FuE-programme Renewable Resources		√	√		√		
MEP Renewable Resources						√	
Demonstration Projects Bio-energy					√		
Biorefinery on wood					√		
Bioenergy Regions			√	√			
BioEnergy 2021		√	√	√			b
BioIndustry 2021		√	√	√			
GABI		√	√	√			a, b
GABI-FUTUR		√	√	√			b
Sustainable Chemistry		√	√				
Excellence Cluster Biomass		√					b

* Other includes:

a) International collaboration with researchers from other European Member States

b) Collaboration between researchers from different disciplines, interdisciplinary research

5 The Netherlands

5.1 Introduction

Sustainable development has been an issue in Dutch policy making for many decades. Research and other initiatives dealing with use of biomass for energy and non-food applications have been stimulated and funded through several funds. However only since very recently – October 2007 - the biobased economy has received specific attention from Dutch policymakers through the 'Governmental vision on biobased economy in energy transition', published by the Minister of Agriculture, Nature and Food Quality, also on behalf of the Ministers of Housing, Spatial Planning and Environment, of Economic Affairs, of Development and of Traffic and Transport (Overheidsvisie, 2007). Dutch governmental policies in the field of sustainable energy (20% in 2020, including a considerable part biomass) and biofuels are also relevant for this study. One of the measures to implement these policies is to limit the emission of greenhouse gases, CO_2 being the most important, is the implementation of the EU guideline of 5.75 % biofuel share in transportation fuels by 2010. The use of biofuels produced from renewable sources is one of the measures being implemented in the Netherlands, as in many other world regions.

The policy framework for the sustainable production of biomass for energy applications for the period 2007-2011 has been set out by the Minister of Housing, Spatial Planning and Environment (MinVROM) in a letter to the Dutch parliament (Tweede Kamer, Vergaderjaar 2006-2007, 30 305 and 30 800 XI, nr. 26). It holds the criteria for a sustainable production of biomass; these have been used for the development of the 'Government vision on biobased economy in energy transition'. The vision presents a number of activities that are meant to meet the Dutch national goals as set out in the energy and climate policies. The strategy that will be worked out in more detail in the next period must:

- contribute to the reduction of CO_2 emission as presented in the governmental Work programme 'Schoon en Zuinig: Nieuwe energie voor het Klimaat (Clean and Sober: New energy for the Climate);
- be in accordance with the economic strengths of the Netherlands: chemical industry, logistics, agrosector, food and drinks industry and related public R&D-infrastructure;
- contribute to international cooperation in this field, especially concerning the position of developing countries.

The Governmental Vision document presents running activities and announces new initiatives. They cover the production of biomass, technology development (especially that of second-generation technologies), market development and logistics. They will not only deal with the use of biomass for bio-energy production, but also for the (co-) production of high-value added products (including biomaterials, chemicals). Together with the most important stakeholders in the field (companies, research organizations and NGO's) a policy agenda with will be developed. This so-called 'noregret' policy agenda will focus on:

1. more efficient use of biomass through biorefinery;

2. sustainable production of biomass worldwide;
3. stimulate the production of green gas and sustainable energy;
4. market development, including the government as launching customer.

The Work Programme 'Clean and sober: New energy for the Climate' provides the financial framework for new initiatives to be launched.

In this chapter the most important national funding instruments in the field of biobased economy that are running in 2008 are presented. They are grouped according to the organization that is managing them: SenterNovem (section 5.2) and the Netherlands Organisation for Scientific Research (section 5.3). They include the funding instruments related to the Biobased Economy strategy as presented in the governmental vision document and those that are part of the Energy Policy of the Minister of Economic Affairs. The last section (5.4) provides a summarising table.

5.2 SenterNovem

SenterNovem is an agency of the Dutch Ministry of Economic Affairs and is responsible for the management of more than 40 national programmes and projects thereby implementing national policies in the field of:

1. innovation,
2. energy and climate change
3. environment and spatial planning.

These programmes and projects are initiated by the Ministry of Economic Affairs (MinEZ), but also by several other Dutch Ministries including, the Ministry of Housing, Spatial Planning and Environment (MinVROM), the Ministry of Agriculture, Nature and Food Quality (MinLNV), the Ministry of Traffic and Transport (MinVV).

SenterNovem also works on behalf of international organisations such as the European Union, the International Energy Agency (IEA) and foreign governments. SenterNovem has approximately 1.000 staff members of which about 10% works on international activities.

Six of the nine programmes that fund research and/or other activities in the field of biobased economy fall under the energy and climate change policy and are part of the overall programme 'Sustainable Energy the Netherlands' (Duurzame Energie Nederland – DEN): EOS, Energy Transition, EIA, SDE, Green Funds and GAVE. The other three funding instruments relate to innovation policy: SBIR, Innovative Fuels for Transport and B-Basic.

5.2.1 Energy Research Subsidy

Name: Energy Research Subsidy – ERS (Energie Onderzoek Subsidy – EOS)
Short description: The Energy Research Subsidy programme aims to initiate and support innovation and research in the fields of energy efficiency and sustainable energy. It covers all activities ranging from research to market introduction. The program funds research but also organises brainstorm sessions, workshops and conferences. The research fields covered by the programme are grouped into five

separate networks: 1. Energy efficiency in agricultural and manufacturing industries; 2. Biomass; 3. New gas / Clean fossil fuels; 4. Built environment; and 5. Generation and Networking.
The programme has four instruments related to a specific development phases:
• ERS: New Energy Research. This instrument covers the first stage of the innovation process and stimulates the development of new, innovative ideas that has the potential to evolve into a new energy research area or into a new direction within an existing energy research area.
• ERS: Long Term. This instrument supports research into a future sustainable energy technology that reinforces the Dutch knowledge position in the field, provides the economy with a powerful and sustainable economic boost, and facilitates market introduction.
• ERS: Short Term Energy Research. This instrument supports research and development projects (this includes a first prototype) and feasibility studies that are innovative and sustainable and that has economic relevance.
• ERS: Demonstration. This instrument provides subsidy for testing new energy technologies in the environment in which they will actually be applied.
Through ERS several projects in the field of biobased economy are being funded.
Running period: no information available about at what time EOS started
Budget: no information available about the total annual EOS budget.
For 2008, budgets available for ERS Feasibility studies € 700.000; for ERS Research projects € 500.000; for EOS Short Term Feasibility studies € 1 million; for EOS Short Term Research Projects € 6 million.
Ministry involved: Ministry of Economic Affairs
Applicants: private researchers, universities, research institutes, companies,
Type of instrument: grants
Goals of the instrument: application-oriented research and demonstration projects
Source and more info at: www.senternovem.nl/eos/

5.2.2 Unique Opportunities Subsidy

Name: Unique Opportunities Subsidy (Unieke Kansen Regeling – UKR)
Short description: This scheme stimulates research that facilitates the transition to a sustainable energy system. In particular it wants to accelerate the market introduction of technologies that contribute to this transition. The scheme has five themes: Efficient and Green Gas; Chain Efficiency; Green Raw materials; Alternative Motor fuels and Sustainable Electricity. On a regular basis calls for tenders are published.
Running period: The law on the basis of which UKR (and ERS Demo) is based, was installed in 2004
Budget: no information available.
From the call 'Energy savings' (published in 2007) the following financial information is available: Total budget for the call: € 10 million. The non-profitable top of projects is being subsidised up to a maximum of 40% of the extra investments. SME's receive 10% extra subsidy. The maximum subsidy is € 4 million per project.
Applicants: market and non-market organisations
Type of instrument: grant
Goals of the instrument: speed up the market introduction of technologies for the transition to a sustainable energy system by funding research.
Source and more info at: http://senternovem.nl/eos/EOS_Financiele_steun/ukr

5.2.3 Energy Transition

Name: Energy Transition (Energie Transitie)
Short description: The goal of the Energy Transition programme is to speed up the transition to new energy sources of energy. Part of the Energy Transition approach is to increase interest of Dutch companies in biofuels. The programme has identified seven themes for achieving a sustainable energy economy within 50 years: green raw materials, sustainable mobility, chain efficiency, new gas, sustainable electricity, energy in the built environment, and greenhouse as energy source. Within each theme a platform (including companies, knowledge institutes and NGOs) has been set up. The platforms advice the government on policy, they initiate cooperation in the market, organise meetings and formulate strategies and policy advices.
The Platform for Biobased Raw Materials has selected five transition paths to attain the goal of replacing 30% of the raw materials in the Dutch energy supply with biobased raw materials in 2030. The Platform makes a distinction between the production of biomass and its processing into chemicals/materials, transport fuels, heat and electricity. The five transition paths include:

- Sustainable production and development of biomass (both in the Netherlands and abroad)
- Realization of the biomass import chain
- Co-production of chemicals, transport fuels, electricity and heat via bio-refining (fractionation), fermentation, enzymatic/chemical conversion and gasification/pyrolysis
- Production of SNG (substitute natural gas) for natural gas infrastructure
- Innovative use of biobased raw materials for non-food/non-energy applications and making existing chemical products and processes more sustainable.

Running period: start in 2000, but since 2004 in its actual form with platforms
Budget: there is only a small budget for small studies, communication
Ministry involved: Participants of Energy Transition programme are:
Ministry of Economic Affairs
Ministry of Housing, Spatial Planning and the Environment
Ministry of Agriculture, Nature and Food Quality
Ministry of Transport, Public Works and Water Management
Ministry of Finance
Ministry of Foreign Affairs
Applicants: participants are representatives of companies, research organizations and NGO's
Type of instrument: no information available
Goals of the instrument: networking, provide advice to policy makers
Source and more info at: http://senternovem.nl/energytransition/dutch_approach

5.2.4 Energy Investment Allowance

Name: Energy Investment Allowance – EIA (Investeren in energiebesparing en duurzame energie)
Short description: The Netherlands aims to reduce its dependence on fossil fuels and to create an economy that is both efficient and sustainable in terms of its energy use. One of the ways to reach that goal is to stimulate investments in energy saving assets and renewable energy sources. The EIA is a tax deduction scheme for investments in energy-saving equipment and renewable energy. Dutch companies investing in energy efficient equipment and renewable energy sources can deduct 44 percent of such investments from their fiscal profit up to a maximum of € 111 million per year (figure

for 2008). The equipment that is to be procured has to be on the 'Energy List' which holds a number of criteria. Energy criteria can be the amount of energy conservated per invested euro, an efficiency criterion, an energy label etc. There are five categories, each have their own criteria: Buildings, Processes, Heat and power co-generation, Transport and Renewable energy sources. In order to qualify, the investment should be reported to the Investment Schemes and Arbitrary Depreciation Office in Breda within three months after the purchase was made.
Running period: no information available
Budget: no information available
Applicants: entrepreneurs who pay income or corporate tax in the Netherlands; the EIA asset must be included on the balance sheet of an enterprise
Ministry involved: Ministry of Economic Affairs
Type of instrument: tax deduction
Goals of the instrument: investments in energy saving and renewable energy sources
Source and more info at: http://senternovem.nl/eia

5.2.5 Stimulating Sustainable Energy Production

Name: Stimulating Sustainable Energy Production (Stimulering Duurzame Energieproductie - SDE)
Short description: Goal of the SDE-programme is to financially support private persons or organisations that want to invest in equipment for the production of renewable electricity or renewable gas through a number of specific technologies (including incineration, fermentation and gasification of solid biomass). Investors that can not cover all costs are eligible for funding and receive within financial assistance from the government. SDE provides multi-annual assurance on the output of the projects as it pays for the difference between the cost prices for fossil energy compared to sustainable energy. In case the sustainable energy does not provide sufficiently, SDE will take care of the shortage. For biomass and green gas this period is 12 years.
Running period: no information available on what year SDE has started
Budget: for 2008 € 1.344 million.
Ministry involved: Ministry of Economic Affairs
Applicants: private persons, organizations that want to produce renewable electricity or renewable gas
Type of instrument: grant
Goals of the instrument: investments in energy production equipment
Source and more info at: http://senternovem.nl/sde/

5.2.6 Green Funds Scheme

Name: Green Funds Scheme
Short description: The Green Funds Scheme has been set up to encourage environmental friendly projects by making the funding of such green projects attractive. This includes project in the following categories: Nature, forests and landscape, organic farming, Green Label greenhouses, closed greenhouses, agrification, renewable energy, sustainable residential construction, sustainable commercial and industrial buildings, cycle-track infrastructure and soil sanitation. The Scheme offers a tax advantage to ‘green’ savers and investors as banks can offer loans at lower interest rates. Green financing (by a Dutch 'green' bank) means paying a lower interest rate on the loan. In the Dutch tax system, savers and investors normally pay 1.2 % capital gains tax over the amount saved or invested (30 % of the fixed return of 4% equals 1.2 %). Green capital

is exempt from such tax, up to a maximum of € 52,579 per person (2006). This ceiling is indexed annually. Green investors also receive an extra tax reduction (1.3 %) on the value of the green investment (up to the same maximum amount). Compared to standard savings or investments, green savers therefore receive a total tax advantage of 2.5 %. This compensates for the lower interest or return paid by the green fund. The banks then use the capital in the green fund to offer soft green loans to finance green projects (green financing). Investors in green projects benefit from this.
Projects within one of 13 project categories are eligible for funding: one of the categories is dealing with generating electricity from wood and energy-rich crops.
Running period: The Scheme existed already in 1998 and probable before that date
Budget: no information available
Ministry involved: The Green Funds Scheme is a collective scheme from the ministry of VROM (Housing, Spatial Planning and the Environment); ministry of Finance and the ministry of LNV (Agriculture, Nature and Food Quality. The Ministry of VROM coordinates the implementation of the Green Funds Scheme. SenterNovem and the Dienst Regelingen (implementation department) at the Ministry of LNV are responsible for evaluating the projects, and if approved, these organisations also issue Green Certificates on behalf of the Minister.
Applicants: companies, institutions and citizens
Type of instrument: tax reduction
Goals of the instrument: environmental friendly investments
Source and more info at: http://senternovem.nl/greenfundsscheme

5.2.7 Climate Neutral Gaseous and Liquid Energy Carriers

Name: Climate Neutral Gaseous and Liquid Energy Carriers (Gasvormige en Vloeibare klimaatneutrale Energiedragers - GAVE).
Short description: Goal of the GAVE programme is to encourage the use of existing biofuels and the development of new climate-neutral biofuel technologies, by facilitating the exchange of information between all relevant players, supporting an extensive network on biofuel initiatives and gathering available research for dissemination among stakeholders. GAVE activities support the Dutch government in the implementation of the EU Biofuels regulation.
Running period: no information available
Budget: no information available
Ministry involved: Ministry of Housing, Spatial Planning and the Environment
Applicants: no information available
Type of instrument: information and network support
Goals of the instrument: support government in implementing the EU biofuels regulation
Source and more info at: http://senternovem.nl/gave

5.2.8 Small Business Innovation Research Programme: 'Biobased Economy' and 'Innovative use of green materials'

Name: Small Business Innovation Research Programme (SBIR): Biobased Economy
Short description: The Small Business Innovation Research Programme (SBIR) is an innovation programme which gives small and medium sized enterprises (SME's) the opportunity to develop new and innovative products, processes and services that contribute to the solution of specific problems. The program has been copied from the USA; in the USA public authorities annually spend a certain percentage of their

research and development budget on innovative SME's. The SBIR Programme has three phases: a feasibility study (Phase 1) and – when the feasibility study is successful – a research and development study (Phase 2) in order to develop the new product or process. Phase 3 includes production and marketing and is not financed by SBIR.
After a first pilot project in 2004, in 2006 and 2007 a new set of pilot projects have been started by the ministries of Defence, of Agriculture, Nature and Food Quality, and of Traffic and Transport. The pilot of the Ministry of Agriculture, Nature and Food Quality on 'Biobased Economy' was meant to stimulate the development of new or strongly improved high-value added non-food products on the basis of biomass (not included are innovations dealing with bioenergy, like bioethanol of biodiesel). Through the programme the ministry wants to contribute to the transition of an economy based on fossil raw materials towards a biobased economy that uses biomass as raw material.
Four 'Biobased Economy' projects have been financed: 'Bioplastic based on by-products from potato's' (only Phase 1); 'BioSorb, a natural absorbents for organic materials', 'Ground consolidator' (only Phase 1) and 'Nabasco – Nature Based Composites'.
Running period: 2006-2009
Budget: € 1.1 million
Ministries involved: In the Netherlands the SBIR programme is an initiative of the ministry of Economic Affairs in cooperation with the ministries of Agriculture, Nature and Food Quality; Traffic and Transport; Defence; Public Housing, Rural Planning and Environment; Education, Culture and Science; and Public Health.
Applicants: Companies that perform innovative research and (product) development activities, in particular small and medium sized companies. Companies can work together in the project with public research organizations.
Type of instrument: grants for Phase 1 (maximum of € 50.000 per study) and 2 (€ 900.000 available for maximal 3 projects)
Goals of the instrument: feasibility studies, application oriented research, prototype / demonstration
Source and more info at: http://senternovem.nl/sbir/

Name: Small Business Innovation Research Programme (SBIR): Innovative use of green raw materials (Innovatief gebruik van groene grondstoffen)
Short description: This program is a second SBIR-pilot of the Ministry of Agriculture, Nature and Food Quality. This pilot focuses on the separation, isolation, processing and use of green raw materials for high-value added and strongly improved industrial non-food applications and making existing chemical products and processes more sustainable. It again is a biobased economy – or green economy – project on the use of biomass for non-food applications (excluding biofuels and other bioenergy applications). Phase 1 should not take more than 6 months.
Running period: 2008-2011 (Phase 3 should start ultimately at December 2011)
Budget: € 3.6 million
Ministries involved: In the Netherlands the SBIR programme is an initiative of the ministry of Economic Affairs in cooperation with the ministries of Agriculture, Nature and Food Quality; Traffic and Transport; Defence; Housing, Spatial Planning and Environment; Education, Culture and Science; and Public Health.
Applicants: Companies that perform innovative research and (product) development activities, in particular small and medium sized companies. Companies can work together in the project with public research organizations.
Type of instrument: grants for Phase 1 (maximum of € 100.000 per study) and Phase 2.

Goals of the instrument: feasibility studies, application oriented research, prototype / demonstration
Source and more info at: http://senternovem/sbir/

5.2.9 Innovative Biofuels for Transport

Name: Innovative Biofuels for Transport. Stimulation the transition towards a sustainable energy economy (Innovatieve Biobrandstoffen voor Transport: Stimulering van de overgang naar een duurzame energiehuishouding)
Short description: The goal of the programme is to stimulate the transition towards a sustainable economy by supporting projects that develop innovative biofuels for transport. The projects should deal with the development of new methods, procedures and processes for the production, distribution and use of innovative biofuels or new biofuel products or both that are new for the Netherlands and that lead to a CO_2 reduction that is at least 10% better than the 1st generation biofuels compared to the fossil fuels. Finally the project should be realized before 1 July 2013. Projects aiming at the cultivation of raw materials for biofuels or at developing new distribution or fill up infrastructures are not included. The programme finances two different types of projects: investment projects and application (exploration) projects.
Running period: 2006-2014
Budget: € 60 million (for the period 2006-2010)
Ministries involved: Ministry of Traffic and Transport
Applicants: companies, private actors and cooperatives
Type of instrument: grants
Goals of the instrument: demonstration projects
Source and more info at: http://senternovem.nl/biobrandstoffen

5.2.10 Bsik – Biobased Sustainable Industrial Chemistry (B-Basic)

Name: Bsik - Biobased Sustainable Industrial Chemistry (B-Basic)
Short description: Bsik (Besluit Subsidies Investeringen Kennisinfrastructuur) is a large and generic national research programme through which the Dutch government aims to strengthen the fundamental knowledge base for the future. In 2003 the Dutch government earmarked € 820 million for the Bsik programme (Bsik is the successor of the ICES/KIS-programme). Bsik-projects run 4 to 6 year.
The B-Basic programme is one of the 37 projects selected and financed by the Bsik subsidy. The programme focuses on the development of new bio-based production concepts for the chemical (and energy) industry which are rooted in increase in fundamental insights in molecular biology through the genomics revolution, combined with advanced bioprocess technology and existing chemical knowledge. The aim of the programme is to provide the chemical industry with an advanced set of tools and concepts by approaching bio-based sustainable industrial chemistry in a fully integrated manner, combining functional genomics, intensified bioprocess technology and feedstock scenarios. The B-Basic Consortium includes research groups from four universities, two research institutions; also 4 companies are part of the consortium. B-Basic is presented as an independent NWO-ACTS programme. ACTS is the Dutch platform for pre-competitive research in chemistry and chemical technology with a ain role for catalysis. ACTS is a public-private partnership in which government, industry, university and knowledge institutes cooperate together. ACTS' mission is to initiate and support the development of new technological concepts for the sustainable production of materials and energy carriers. Its activities contribute to a sustainable economic

growth, a specific part of the R&D infrastructure. Also it wants to attract young talent to a career in science and technology (see also 5.3.1).
Running period: 2004-2009
Budget: € 50 million, including € 25 million public subsidy, € 12 million financed by the industrial B-Basic partners and € 13 by the participating universities and research institutes
Ministries involved: Ministry of Economic Affairs
Applicants: public funded research organizations, companies
Type of instrument: grants
Goals of the instrument: fundamental research and training
Source and more info at: http://senternovem.nl/bsik/index.asp, http://www.b-basic.nl/ and http://www.nwo.nl/nwohome.nsf/pages/NWOA_6P69LY

5.3 Netherlands Organisation for Scientific Research

5.3.1 Introduction

The Netherlands Organisation for Scientific Research (Nederlandse Organisatie voor Wetenschappelijk Onderzoek – NWO) is the Dutch national research council. It is responsible for enhancing the quality and innovative nature of scientific research mainly through university research and implements this task mainly by allocating resources.

Three so-called Temporary Task Forces execute ministerial policy. They have a semi-permanent status and are accommodated by NWO. Two of them cover programmes in the field of biobased economy:

- Netherlands Genomics Initiative (NGI) with the Kluyver Centre for Genomics of Industrial Fermentation.
- Advanced Chemical Technologies for Sustainability (ACTS) with the CatchBio project. B-Basic is also a NWO-ACTS programme, but – like all Bsik-funded programmes – it is managed by SenterNovem (see 5.2.9).

5.3.2 Netherlands Genomics Initiative: Kluyver Centre for Genomics of Industrial Fermentation

Name: Netherlands Genomics Initiative: Kluyver Centre for Genomics of Industrial Fermentation
Short description: The Netherlands Genomics Initiative (NGI) is a task force dedicated to strengthening genomics-based research and business in the Netherlands. The key elements in the NGI strategy are Research, Business and Society. By clustering leading Dutch research groups together with (Dutch and international) industrial parties and societal organisations, NGI aims to build a world-class genomics infrastructure, stimulate innovative research that generates tangible social benefits, economic value and new business activity. NGI was established end of 2002 by the Dutch government to formulate and execute a clearly focused national genomics strategy aimed at capturing a leading position in scientific and industrial genomics within the next five years. The total budget of NGI in the first period (2003-2007) was € 296.4 million of which € 277.4 million is used for funding of research programmes and for valorisation activities, the rest is for management. A second phase of five years started in 2008, with a budget of € 280 million. The research programmes are organised in 11 centres and 5 programmes; one of the centres deals with aspects of the biobased economy: the

Kluyver Centre for Genomics of Industrial Fermentation (Delft). The research of the Kluyver Centre employs microbial genomics to improve microorganisms for use in industrial fermentation processes. Fermentation is used in the production, from renewable feedstocks, of food products and ingredients, beverages, pharmaceutical compounds, nutraceuticals, and fine and bulk chemicals. The research covers five programmes: Yeast for chemicals, fuels and beverages, Filamentous fungi for proteins and peptides, Lactic acid bacteria for fermented foods and food ingredients, Systems biology of industrial micro-organisms and industrial genomics for society. Other activities of the Kluyver Center include valorisation, education and training of secondary school children, develop projects for developing countries and communication activities for the general public and .
Running period: 2002-2007, 2008-2012
Budget: € 17.4 million (2002-2007); € 15 million (2008-2012). All programs require matching funds from the research organisations and from the participating companies; the matching varies between the programs.
Ministeries involved: NGI is funded by five ministries: the Ministry of Education, Culture and Science, Ministry of Economic Affairs, Ministry of Agriculture, Nature and Food Quality , Ministry of Health, Welfare and Sport, and the Ministry of Housing, Spatial Planning and Environment.
Applicants: public research organizations. The Kluyver Centre is a consortium of five universities and two research institutes.
Type of instrument: grants
Goals of the instrument: fundamental and application oriented research, valorisation, communication to/with the public
Source and more info at: http://www.kluyvercentre.nl/

5.3.3 Catalysis for sustainable chemicals from biomass

Name: Catalysis for sustainable chemicals from biomass (CATCHBIO)
Short description: CatchBio is part of the investment program Smart Mix of the Dutch government aimed at boosting innovation in the Netherlands. The new Smart Mix subsidy programme started in 2007. Consortia of users of research results (companies and other organisations) together with public funded research organizations (universities, research institutes) can develop a project proposal. Smart Mix research aims to be excellent scientific research and create focus and mass in scientific research in fields that are relevant for economy and society. For 2007 the Smart Mix budget was a € 100 million. The CatchBio project is one of the 7 selected projects in 2007 that is financed by Smart Mix. CatchBio has been initiated and is - after having been approved - managed by ACTS (see 5.2.9).
The CatchBio project aims at contributing to the development of clean and efficient processes for biomass conversion into low-cost and sustainable biofuels, chemicals and pharmaceuticals, by developing new energy-efficient catalysts and. It aims to process the various components present in biomass (cellulose, hemi-cellulose, lignin, proteins and oils) in useful fuels, chemicals and pharmaceuticals. To tackle the different scientific and technological issues involved in biomass conversion, the programme is divided in five clusters. Three of these clusters deal centre with the three main production sectors: 1. Energy; 2. Bulk Chemicals; 3. Fine Chemicals and Pharmaceuticals. Research projects in these three thematic clusters integrate fundamental, applied and industrial research into new homogeneous and heterogeneous catalysts, catalytic conversions, novel catalytic processes and their related reactor technologies for biomass conversion. Also the socio-economical and ethical aspects of

the different generated technological options are being investigated. The research is carried out in close co-operation with industry that also participates in the consortium: half of the 23 partners are research groups from 11 Dutch universities and research institutes operating in the field of catalysis research. The group of 11 companies includes five large chemical companies, two catalysts producing companies and a number of specialized SMEs.
Running period: start in 2007, Smart Mix programmes run for 4 to 8 years
Budget: € 28.3 million: € 16.6 million is public subsidy (ministry of Economic Affairs and the ministry of Education, Culture and Science), the rest of the budget is financed by the industrial and academic partners involved in CatchBio Consortium.
Ministries involved: Ministries of Economic Affairs and of Education, Culture and Science
Applicants: public funded research organizations, companies. B-Basic is a NWO-ACTS research consortium.
Type of instrument: grant
Goals of the instrument: fundamental and application oriented research
Source and more info at: http://www.nwo.nl/nwohome.nsf/pages/NWOA_6P69LY, http://www.catchbio.com/.

5.4 Other initiatives

5.4.1 Carbohydrates Competence Centre

Name: Carbohydrates Competence Centre - CCC
Short description: In 2006, the North-Netherlands Development Agency (NOM) took the initiative for the Carbohydrates Competence Centre. The virtual centres goal is to become a centre of excellence in the field of carbohydrate research. Carbohydrate rich crops such as wheat, potato and sugar beet are of great economic importance for the three northern provinces of the Netherlands (Friesland, Groningen and Drenthe). The research program of the CCC is focused at developing new innovative products on the basis of carbohydrates. Research will be focused on the use of carbohydrates for food and non-food applications. Research themes include health aspects of carbohydrates and biorefinery concepts and the production of fermentative sugars for biofuels.
Running period: 2008-2011
Budget: more than € 17 million. The Centre receives the subsidy from the Ministry of Economic Affairs (through the programme 'Koers Noord, op weg naar Pieken) and the European Commission (Operational Programme Noord) with the goal to stimulate the regional-economic structure of North-Netherlands. Additional financial support is provided by the Province of Groningen, and the local community of Groningen.
Applicants: In the Centre research organizations (universities of Groningen and Wageningen, TNO, the Hanze Hogeschool Groningen, the Hogeschool van Hall Larenstijn Leeuwarden, the University Medical Centre Groningen) and a group of 6 companies (AVEBE, Friesland Foods, Cosun, HZPC, Agrifirm en Aviko) work together. The organisation Cooperation North-Netherlands (SNN) manages the centre.
Type of instrument: grant
Goals of the instrument: precompetitive, demand-driven and innovative carbohydrate research, training and education on carbohydrates
Source and more info at:
http://www.nom.nl/ng01/index.jsp?catid=33035&&subcatid=2996

5.5 Summary

The table below provides an overview of the goals that are addressed by the public funding instruments of the Dutch government to stimulate a biobased economy.

We do not have a complete overview of the budgets of these programmes. However, for the SenterNovem programmes a rough estimate of an informed representative of SenterNovem says that SDE is the most important financer of biomass-related activities. Compared to that programme, the budgets of the other programmes are rather small.

There is a clear focus on instruments that stimulate research and development in the field (6 of the 13 instruments). Stimulation of programmes that support the testing of production facilities, demonstration projects and pilot projects (4 instruments) and investments in production facilities (3 instruments) are also of relative importance.

Policy goals: / **Policy instruments:**	**Human Resources**	**Research & Development**	**Collaboration with industry**	**Valorisation**	**Demonstration**	**Production facilities**	**Other: …. ***
ERS		√			√		
UKR					√		
Energy Transition			√				a
EIA						√	
SDE						√	
Green Funds Scheme						√	
GAVE							b
SBIR: BBE		√			√		
Innovative biofuels for Transport					√		
B-Basic	√	√					
Kluyver Centre		√		√			c
CatchBio		√					
Carbohydrates Competence centre	√	√					

* Other include:

a) Advice policy makers
b) Support government in implementing EU biofuels regulation
c) Informing the public, education of secondary school children, develop projects for developing countries

6 United Kingdom

6.1 Introduction

The UK is investing heavily in renewable energy sources in order to apply to demand for the climate change targets it has set. The Energy Paper published in 2002 declares that biomass as one of the largest contributors to the renewables generation mix aimed at meeting the UK's target of 20% of electricity produced from renewables by 2020 (TWA-Nieuws, 46/2, Maart/April 2008, p. 13). However, it is also acknowledge that bio-energy has the potential to create and sustain jobs in rural areas. For that reason also regional authorities have become active in this field.

An important mechanism through which the bio-energy policies are implemented is the so-called Renewables Obligation (RO) for the electricity market and the Renewable Transport Fuels Obligation (RTFO) for the transport market (ibid). The RO is a main mechanism for supporting generation of renewable electricity. Since its introduction in 2002 the generation of renewable electricity has more than doubled, but not enough (http://www.berr.gov.uk/energy/sources/renewables/policy/renewables-obligation).
New instruments are under construction and for consultation such as a Capital Allowance for Biofuels (http://www.hmrc.gov.uk/ria/eca.pdf).

The UK government has addressed the need of solving the climate change problem in many governmental policy papers. Except for the Energy Paper of the Department for Business, Enterprise & Regulatory Reform (BERR, the former DTI) mentioned above, BERR published the White Paper on Energy on the use of biomass-based and other 'green' energy generation systems for future energy supply in May 2007. Also the report 'Future of Transport' (July 2004) of the Department of Transport proclaims that more use should be made of biofuels (TWA-Nieuws, 46/2, Maart/April 2008, p. 13).
The Strategy for non-food crops and uses - creating value from renewable materials' of the Department for Environment, Food and Rural Affairs (DEFRA) and the Department of Trade and Industry (DTI) published on 5 November 2004 was followed in May 2007 by the UK Biomass Strategy. Both take a more general approach towards the production, supply and use of biomass as raw material (ibid).
In June 2008 BERR launched a consultation for the preparation of the UK Renewable Energy Strategy to be published in 2009, on how to drive up the use of renewable energy in the UK to meet its share of the EU target to source 20% of the EU's energy from renewable sources by 2020 (http://www.defra.gov.uk/environment/climatechange/uk/energy/renewablefuel/). The government's strategies are implemented by governmental task forces such as the Energy Group of BERR and the Sustainable Farming and Food Science group of DEFRA (TWA-Nieuws, 46/2, Maart/April 2008, p. 13). The policy instruments that are used by the governmental departments to stimulate a biobased economy in the UK are presented in section 6.3 of this chapter.

However, most of the BBE-programmes and other instruments run under the responsibility of the researcher councils in the UK. The Biotechnology and Biology Sciences Research Council (BBSRC), Natural Environment Research Council (NERC) and the Engineering and Physical Sciences Research Council (EPSRC) are participating in the Research Councils Energy Programme, which holds a number of initiatives.

These and some additional programmes run by separate research councils are presented in the next section. Section 6.4 provides a summary.

6.2 Research councils

6.2.1 Introduction

The Research Councils main goal is to fund research. The annual budget of around £2.1 billion research is spend on research at UK universities, at the Research Council's institutes and at getting access to international facilities for UK researchers. Energy is one of the six priority areas in which the RC's coordinates the delivery of multidisciplinary research. The Energy Programme brings together energy-related research and training in order to address 'the outstanding international issues of climate change and security of energy supply' (http://www.rcuk.ac.uk/research/ccprog/energy.htm). EPSRC leads programme; other participants are BBSRC, ESRC, NERC and Science and Technology Facilities Council (STFC). For 2008/2009, the research budget is £81 million and the training budget is £27 million.
The programme includes two research strands:

- Energy research capacity – engineering and physical science aspects of sustainable power generation and supply, conventional generation including coal, oil, gas, nuclear fission and nuclear fusion. Focus on speculative and underpinning aspects of technologies and postgraduate training.
- Energy multidisciplinary applications - applied, user-led multidisciplinary research activities in partnership with other research councils, Energy Technologies Institute, Technology Strategy Board and government.

In the second strategy, two initiatives - Towards a Sustainable Energy Economy (TSEC) and Sustainable Power Generation and Supply (SUPERGEN) - are so-called Multidisciplinary Research Consortia that provide a co-ordinated approach to developing the required research portfolio. These programmes are introduced in more detail in 6.2.2 and 6.2.3. It might be that the Bioenergy Initiative – presented in 6.2.4 - is the BBSRC's contribution to the Research Councils' Energy Programme, but this can not be concluded from the information available on the programme. Section 6.2.5 introduces a new BBSRC Biorefinery initiative that only recently started. Finally, in section 6.2.6 the LINK-programme on Competitive materials is introduced.

6.2.2 Towards a Sustainable Energy Economy

Name: Towards a Sustainable Energy Economy (TSEC)
Short description: The aim of this program is to stimulate the development of reliable, diverse, affordable, publicly acceptable and safe ways to supply energy and minimise the carbon dioxide emissions from burning fossil fuels. The programme focuses on multidisciplinary and whole systems approaches and deals with issues such as: hydrogen economy, fuel cells, barriers that prevent integrating newer energy systems into existing power supply and networks, economic instruments for managing the transition to a low carbon economy, implications for individual behaviour and societal change required to achieve a sustainable energy economy.
The main activities of TSEC are:

- The UK Energy Research Centre: providing a focus for energy research in the UK and for international collaboration (headed by Imperial College London).
- Keeping the nuclear option open: addressing some of the key issues in nuclear fission power.
- Managing uncertainties: the socio-economic challenges and implications of moving towards a sustainable energy economy.
- Carbon management and renewable energy: research taking a whole systems approach (and complementing the SUPERGEN programme).

In 2004 the UK Research Centre (UKERC) was established; one of the research themes of the centre is renewable energy.
In 2005/2006, BBSRC co-funded a large consortium project – together with NERC and EPSRC - under the Renewable Energy theme of the programme. This is the project 'A whole systems approach to analyzing bioenergy demand and supply: mobilizing the long term potential of bioenergy'.
Running period: Start in 2003, still running?
Budget: The initial budget for the TSEC-programme was £ 28 million over 3 years from 2003, £ 20 million from the 2002 Government Spending Review and £ 8 million from the Government Performance and Innovation Unit. Additional funding from Research Councils and the 2004 Government Spending Review has brought the programme budget up to £ 36.5 million.
Total budget of UKERC is £ 13.5/14 million for a period of 5 years.
BBSRC-budget for the systems approach to bioenergy-project is £ 650,000 (of a total budget of £ 2.5 million).
Research councils involved: The TSEC programme is supported financially by EPSRC, NERC, ESRC and BBSRC working in association with CCLRC
Applicants: universities, research institutes
Type of instrument: grants
Goals of the instrument: applied research, networking, coordination, valorisation
Source and more info at:
http://www.epsrc.ac.uk/ResearchFunding/Programmes/Energy/Funding/TSEC/default.htm

6.2.3 Sustainable Power Generation and Supply

Name: Sustainable Power Generation and Supply (SUPERGEN)
Short description: The aim of the SUPERGEN initiative is to assist the UK in meeting its environmental emissions targets through a radical improvement in the sustainability of power generation and supply by promoting the interaction, generation of new ideas and transfer of research results as well as significant step changes in tackling broad challenges rather than incremental progress. By building research consortia critical mass is generated in order to address the specific research questions and to build a platform for the development of new and improved products for efficient and sustainable power generation and supply. Users are actively involved in order to focus the research on problems of industry.
Thirteen consortia have been funded or approved for funding. One of the 13 consortia funded that were running in 2008, is the 'Biomass, biofuels and energy crops Consortium' (Bioenergy Consortium: 8 research organizations, 4 companies). Another project is 'Biofuel cells' (microbial fuel cells that mimic, reproduce or use biological systems; no information on consortium available).
Running period: First call in 2003. All consortia have received funding for 4 years with the possibility of renewal for a further four years.

Budget: At the start £ 25 million for 5 years. Until mid 2008 £ 32 million has been invested.
Bioenenergy Consortium: £ 2.9 million
Biofuels Consortium: no information available
Research councils involved: The programme is managed and led by EPSRC in partnership with BBSRC, ESRC, NERC and the Carbon Trust.
Applicants: Researchers work in consortia: multidisciplinary partnerships between industry and universities
Type of instrument: grants
Goals of the instrument: collaborative research, application-oriented and radical by character
Source and more info at:
http://www.epsrc.ac.uk/ResearchFunding/Programmes/Energy/Funding/SUPERGEN/default.htm

6.2.4 Capacity-building awards in Bioenergy Research

Name: Capacity-building awards in Bioenergy Research
Short description: This program is probably the same as what was announced as the Bioenergy Initiative. The aim of the programme is to build UK capacity in bioenergy research and to support the creation of a multidisciplinary research centre to act as a focus for UK bioenergy research.
Information about the Bioenergy Initiative: BBSRC has already a long tradition in stimulating bioenergy research; already since 1995 several project have been funded on the use of biomass for biofuels and on photosynthesis. In 2005 BBSRC reviewed its bioenergy research portfolio. Guided by the recommendations of the Biomass Task Force (Report for the BBSRC Strategy Board: 'Review of Bioenergy Research', May 2006), the Bioenergy initiative was announced in 2007. The aim of this initiative is to support research dedicated to understanding the way plants capture and convert the sun's energy and optimising the amount of energy that can be extracted from plants through to biorefining to produce useable fuels. This could include studies that aim at understanding plant growth and development including how plants partition and store energy, and the way in which plants capture energy from sunlight and use it to create sugars and starches and of microbes that can harness sunlight as an energy source, and microbial fermentation. Results of these studies could be applied to improving crops such as willow and Miscanthus for biomass for power generation and for liquid fuels, for improving arable crops for production of biofuels such as bioethanol and biodiesel and for microbial hydrogen production. Also studies dealing with the development of predictive mathematical models that can inform how these different energy sources might contribute to the future energy mix.
Running period: Four years. No information on starting date available.
Budget: Up to £18 million (other source £ 20 million). Co-funders will be agreed on a case-by-case basis depending on the content of individual applications.
Research councils involved: BBSRC
Applicants: no information available. The initiative was launched at Imperial College, London
Type of instrument: grants
Goals of the instrument: multidisciplinary application-oriented research
Source and more info at: There is only few information available on the programme part of the BBSRC website. http://www.bbsrc.ac.uk/funding/

opportunities/2007bioenergy_research.html. More information can be found at: /organisation/policies/reviews/scientific_areas/0603_bioenergy.pdf

6.2.5 Integrated Biorefinery Technologies Initiative Research and Technology Club

Name: Integrated Biorefinery Technologies Initiative Research and Technology Club (IBTI Club**)**
Short description: The Industry Clubs are a new instrument of BBSRC. According to its Technology Strategy the strategic partnerships and 'industry clubs' activities support high quality, innovative research and collaboration between academia and industry in strategic areas. Four Clubs have been started, one of them is on biorefinery technologies: the Integrated Biorefinery Technologies Initiative Research and Technology Club. The other three include: bioprocessing of pharmaceuticals, mammalian cloning and health benefits of foods.
The Integrated Biorefinery Technologies Initiative Research and Technology Club is a consortium of companies and the Bioscience for Business Knowledge Transfer Network (KTN). The Club has ten members: Biocaldol, BP Biofuels, British Sugar, Croda Enterprises, Danisco A/S Genencor, Green Biologics, HGCA, KWS, Syngenta and TMO Renewables. The goal of the Club's research program is to develop biological processes and feedstocks that can contribute to a reduction of the use of fossil fuels for the production of fuels, materials and chemicals. The research program includes three themes: Optimisation of feedstock composition, Integrative bio-processing and Enhancing product value.
Running period: 2008-2012 (5 years, 2 calls for proposals. The deadline for the 1st call is in October 2008).
Budget: The industry clubs are supported jointly by BBSRC, other funding bodies and consortia of companies. The budget for IBTI is around £5M (BBSRC £4M, Industry £730K)
Research council(s) involved: BBSRC, in addition the EPSRC will review proposals and provide funding on a case-by-case basis.
Applicants: higher education institutions, independent research organisations and BBSRC-sponsored institutes
Type of instrument: grants
Goals of the instrument: industrially relevant, innovative, basic biological research in biorefining technologies, collaboration between academia and industry
Source and more info at:
http://www.bbsrc.ac.uk/business/collaborative_research/industry_clubs/ibti/index.html

6.2.6 LINK: Competitive Industrial Materials from Non-Food Crops

Name: LINK: Competitive Industrial Materials from Non-Food Crops (CIMNFC)
Short description: The aim of this LINK-programme was to use technology to overcome the major barriers to the uptake of non-food, crop-derived feedstock by end-user companies. It supported the non-food uses of crops, eg applications in production of biodegradable materials or biomass.
The programme funded the following projects and case studies:
1. Antioxidants from rosemary (case study)
2. Plastics from maize (case study)
3. OPTIFIBRE - optimised non-wood pulp production
4. RPS FOAM - biodegradable cushion packaging blocks

5. SEEDEX - fixed oilseed products from novel crops by compressed CO_2 extraction routes
6. RAPFI - rosemary antioxidants for the pharmaceutical and food industries
7. STARPLAST - Biocompostable thermoplastic materials from starch
8. FILMSTARCH - Novel starches for use in film formation
9. IONEX - Plant fibres for Ion Exchange
10. PHYTOPLANT - phytochemical library from British plants
11. STRAWFRAC - value added products from wheat straw
12. NOVCOMPS - novel low environmental impact polymer matrix composites
13. RESINS - novel polymers from sustainable sources
14. TEXFLAX - cultivation and processing of short fibre flax to high-value textile uses
15. ABIPO - antioxidant-based industrial products from oats
16. SWEETGALE - Myrica gale as a source of natural products in toiletries and healthcare products
17. PHYTODERM - optimised production and extraction techniques for consistent yield and quality of skin protecting phytochemicals
18. SEMIOCHEM 2 - New semiochemical opportunities from Nepeta spp. grown as a non-food crop

LINK-projects involve collaborative research with at least one company and one science-base partner. Applications should be for pre-competitive research that would not be undertaken in this form without LINK support. Partners must agree ownership and exploitation of intellectual property arising from the project.

In 2005, BBSRC and DEFRA agreed to cosponsor a new LINK programme supporting the non-food uses of crops.

Running period: 1998-2007, extension with another five years is being discussed.

Budget: £ 15 million per year. Government support can be up to 50% of total eligible costs. The rest is paid by the industrial partners.

For a new five years extension of the programme the Sustainable Agriculture Strategy Panel and the BioScience for Industry Strategy Panel have recommended that BBSRC should agree to sponsor the new programme up to £2.5M. DEFRA has committed £2.5M to the programme.

Research council(s) involved: BBSRC

Applicants: public research organisations

Type of instrument: grants

Goals of the instrument: pre-competitive application-oriented research

Source and more info at: The programme is not on the BBSRC website anymore. Some information about a new five years next programme can be found at: http://www.bbsrc.ac.uk/organisation/structures/council/2005/0507_quarterly.pdf#search=%22LINK%22

6.3 Departments: DEFRA and BERR

6.3.1 Introduction

The Department for Environment, Food and Rural Affairs (DEFRA) and the Department for Business, Enterprise & Regulatory Reform (BERR) are the most active governmental departments in the field of biobased economy. Together they run 2 programmes in the field: ETF (6.3.2) and the Bio-energy Capital Grant Scheme (6.3.3). DEFRA is most active and apart from the LINK programme the department co-funds (CIMNFC), it has two additional schemes: the Energy Crop Scheme (6.3.4) and the Bio-energy Infrastructure Scheme (6.3.5). Finally the National Non-Food Crops Centre

is presented as one of the very view research centres in the UK that focus thei research on the use of biomass for non-fuel applications. DEFRA is an important funder of this centre.

6.3.2 Environmental Transformation Fund: Funding for Low Carbon Technologies

Name: Environmental Transformation Fund (ETF): Funding for Low Carbon Technologies
Short description: Goal of the Environmental Transformation Fund is to stimulate the development of new low carbon energy and energy efficiency technologies in the UK. The fund contributes towards the UK's climate change and renewable energy goals for 2020 and beyond by helping to reduce the carbon intensity of energy production and the energy demand. The fund specifically focuses on the demonstration and deployment phases of bringing low carbon technologies to market.
The Fund brings together DEFRA's and BERR's existing low carbon technology funding programmes together with a number of new investments to begin in 2008/09, as follows:

- Hydrogen Fuel Cell and Carbon Abatement Demonstration Programme
- Marine Renewables Deployment Fund
- Low Carbon Buildings Programmes
- Bio-energy Capital Grants and Bio-energy Infrastructure Schemes (more information: see below)
- Offshore Wind Capital Grants programme
- Carbon Trust's innovation programme, including research accelerators, technology accelerators, and incubators
- Carbon Trust funding for new low carbon technology enterprises, including Partnership for Renewables
- Carbon Trust investments in low carbon technology businesses
- Carbon Trust energy efficiency loans scheme for small and medium sized enterprises (SMEs)
- Salix Finance public sector invest-to-save loan schemes.

In developing its strategy the Fund works closely with other organisations funding earlier stage research and development including the Energy Technologies Institute, Technology Strategy Board, and the Research Councils' Energy Programme.
The Fund is linked to an international fund of DEFRA and DFID (International Development) that aims at poverty reduction and environmental protection, and help developing countries to tackle climate change.
In February 2008 the first set of three new schemes to be funded from DEFRA's part of the UK ETF were announced. Two of the three deal wit bioenergy and bioprocesses:

- £ 10 million in 2008/09 for new rounds of the Bio-energy Capital Grants and Bio-energy Infrastructure Schemes;
- Around £ 10 million over three years for projects that demonstrate the potential of anaerobic digestion technologies at commercial scale.

Running period: 2008/09 – 2010/11
Budget: The total budget is £ 1.2 billion. It includes a contribution of DEFRA and DFID of £ 800 million for the developing countries. The first £ 50 million has been earmarked to help tackle deforestation in the Congo basin. The UK element of the Fund will total £ 400 million during the 3 years period.
Ministries involved: Jointly by DEFRA and BERR
Applicants: no information available
Type of instrument: grants
Goals of the instrument: demonstration projects, pilots

Source and for more info:
http://www.berr.gov.uk/energy/environment/etf/page41652.html

6.3.3 Bio-energy Capital Grant Scheme

Name: Bio-energy Capital Grant Scheme, now part of ETF
Short description: The goal of the scheme is to support the installation of biomass-fuelled heat and combined heat and power projects in the industrial, commercial and community sectors. The biomass heat support scheme was announced in 2006 in the Climate Change Programme Review and in the Government response to the Biomass Task Force report. In order to provide continuity, the scheme is being run as a continuation of the existing Bio-energy Capital Grants Scheme.
The fourth round of the scheme is closed for applications. DEFRA hopes to run a fifth application round in autumn 2008, with further rounds in 2009 and 2010. It is likely that in the fifth round the scheme will provide capital grants to support the installation of biomass-fuelled heat boilers and biomass-fuelled combined heat and power (CHP) equipment, including anaerobic digesters for heat-only or CHP and to provide a variable grant rate of up to 40% of the difference in cost of installing the biomass boiler or CHP plant compared to installing the fossil fuel alternative.
Running period: The scheme was announced in 2006
Budget: Budget for the first round was £ 66 million.
The second round five year scheme will be worth £10-15m in England over the two financial years to March 2008.
Ministries involved: Rounds 1 and 2 of the scheme were funded by the Department for Business, Enterprise and Regulatory Reform (BERR, in that period DTI) and the Big Lottery Fund. Rounds 3 and 4 were funded by DEFRA.
Applicants: The fifth round (and probably all rounds of the scheme) is open to the industrial, commercial and community sectors. This includes companies, sole traders, farmers, local authorities, hospitals, universities, schools, housing associations, charities etc.
Type of instrument: grants
Goals of the instrument: investment in bio-energy installations
Source and for more info at:
http://www.defra.gov.uk/farm/crops/industrial/energy/capital-grants.htm

6.3.4 Energy Crops Scheme

Name: Energy Crops Scheme
Short description: Goal of the scheme is to increase the amount of energy crops grown in England, in appropriate locations. The Use of energy made on the basis of these crops should contribute to a reduction in greenhouse gas emissions and help to combat climate change. The scheme provides grants for establishing short rotation coppice and miscanthus under the Rural Development Programme England (RDPE). The operating details are subject to EU approval of the RDPE as a whole (website announces this will be due late in 2007). The scheme will be jointly funded by the European Union, through the European Agricultural Fund for Rural Development, and the United Kingdom Government.
It is currently planned to offer the following grants:
- £ 1,000 per hectare for short rotation coppice (willow and poplar on a 3-5 year rotation and ash, alder, hazel, silver birch, sycamore, sweet chestnut and lime on a 8-15 year rotation) (This figure might be lower as a result of the discussions with the European Commission).

- £ 800 per hectare for miscanthus.

Farmers can also receive the Single Payment for energy crops grown on set-aside. In addition, for growing energy crops under contract on non-set aside land an annual energy aid payment of up to € 45 per hectare is available.
Running period: The RDPE runs form 2007 to 2013.
Budget: no information available
Ministries involved: DEFRA
Applicants: farmers
Type of instrument: grants
Goals of the instrument: support growth of energy crops
Source and more info at: http://www.naturalengland.org.uk/planning/grants-funding/energy-crops/default.htm

6.3.5 Bio-energy Infrastructure Scheme

Name: Bio-energy Infrastructure Scheme
Short description: Goal of this scheme is to support the development of supply chains that are required in order to harvest, store, process and supply energy crops and wood fuel to combined heat and power, and electricity end-users.
Grants are available for:

- growers to set up producer groups to supply biomass to energy end-users (eligible costs include legal and administrative work in setting up the group, rental of office accommodation, purchase or rental of IT and office equipment etc.);
- producer groups and businesses to purchase or rent specialist capital equipment for use in harvesting, pre-use processing, quality assurance and handling, storage and hard-standing;
- producer groups to receive training in issues directly relevant to the successful operation of the supply chain.

Eligible biomass includes: short rotation coppice (willow, poplar, alder, ash, hazel, lime, silver birch, sweet chestnut and sycamore), miscanthus, switch grass, reed canary grass, prairie cord grass, rye grass, straw, wood fuel from forestry, arboricultural tree and management and primary processing and other energy crops at DEFRA's discretion
Running period: the second round was announced on 6 June 2008.
Budget: Each project can claim grant of up to £ 200,000.
Ministries involved: DEFRA
Applicants: farmers, foresters, businesses, local authorities and charities
Type of instrument: grants
Goals of the instrument: develop supply chain
Source and more info at:
http://www.defra.gov.uk/farm/crops/industrial/energy/infrastructure.htm

6.3.6 National Non-Food Crops Centre

Name: National Non-Food Crops Centre (NNFCC)
Short description: There is no government program on biomass for non-fuel applications. However, the National Non-Food Crops Centre was set up in order to stimulate research in this field. In 2001 the Office of Science and Technology's Foresight Panel "Food Chain and Crops for Industry Task Force: unlocking the potential of industrial crops" recommended that *'a respected, independent centre of know-how should be created with a remit to bring together all the existing and potential players to facilitate developments in the non-food area*'. The government agreed to

extend the competitive non-food uses of crops. It accepted the need for a long-term strategy for creating and exploiting opportunities in non-food crops in the Strategy for Sustainable Farming and Food, published in December 2002 and in November 2004 its Strategy for non-food crops and uses was published and.
The NNFCC's field of activities includes all plant-derived materials, derivatives and by-products used for commercial non-food purposes, with the exception of ornamental plants and forestry grown solely for timber. The centre also plays a key role in the development of non-food crop supply chains (biolubricants, plant-derived pharmaceuticals, renewable polymers, fuels, energy, biorefineries and crop-derived construction materials). The centre develops and disseminates scientific and technical information in order to increase knowledge and understanding; to initiate and facilitate technology uptake; and to meet the objectives for sustainable development. The information service of Biomass Energy Centre (BEC) complements those of the NNFCC as it advises on biomass derived fuels and associated conversion technologies, focusing on wood fuel and some energy crops.
Running period: no information available
Budget: DEFRA provides grant funding for the NNFCC for delivery of services. This funding is provided to take forward the government's sustainable development objectives. Some of the NNFCC's technology transfer activities are funded by the Knowledge Transfer Network (KTN) 'Bioscience for Business' which aims to benefit industry and offers ideas for bio-renewable supply chains.
Ministries involved: DEFRA
Applicants: -
Type of instrument: grant
Goals of the instrument: applied research, valorisation
Source and more info at: http://www.nnfcc.co.uk/metadot/index.pl

6.4 Summary

The table below provides an overview of the goals that are addressed by the policy instruments of the national government within the UK to stimulate a biobased economy.

There is a clear focus on instruments that stimulate research and development in the field (six of the ten instruments). The goal dealing with education and training (Human Resources) is not explicitly addressed by one of the instruments. All others are covered but most by only one; collaboration with industry and valorisation by two of the ten instruments.

Policy goals: / Policy instruments:	Human Resources	Research & Development	Collaboration with industry	Valorisation	Demonstration	Production facilities	Other: …. *
TSEC		√	√	√			
SUPERGEN		√					
Capacity building Bio-energy Research		√					
IBTI Club		√	√				

CIMNFC		√					
ETF					√		
Bio-energy Capital Grant Scheme						√	
Energy Crop Scheme							a
Bio-energy Infrastructure Scheme							b
National Non-Food Crops Centre		√		√			

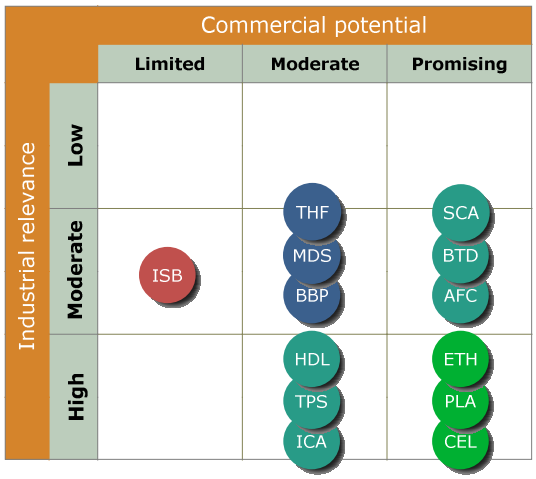
* Other includes:

a) Support the growth of energy crops
b) Develop supply chain

7 Recommendations: policies for biomass-based fuels, materials and chemicals

In this chapter we present specific and generic policy instruments for stimulating the development, productions, sales and use of products of the chemical industry (fuels, materials, chemicals) that are made from green raw materials (biomass).

The recommendations concerning the introduction of these policy instruments have been formulated on the basis of what the project team of this study considers as the most important barriers for the successful market introduction of the group of 'relevant' (blue: see the figure below) and the Top 3 of the 'very relevant' products / product groups (green).



1. Poly lactic acid - PLA
2. Agro-fiber composites - AFC
3. Thermoplastic starch - TPS
4. Modifed starch - MDS
5. Succinic acid - SCA
6. Ethanol - ETH
7. Itaconic acid - ICA
8. Isosorbide - ISB
9. Tetrahydrofuran - THF
10. 1,4-Butanediol - BTD
11. Biobased paints - BBP
12. HTU Diesel - HDL
13. Cellulase - CE

Both groups include commercially attractive and for the chemical industry relevant products. However, due to specific barriers the development, commercial production and marketing runs with difficulty or is even not possible, although there is an attractive potential market (blue) respectively there is potentially more market than what is actually realised (green). These barriers can not be solved by the chemical industry alone as in the present market economy these products can not be produced and marketed on an economically sustainable way. Assistance from the government is needed. By implementing the proposed policies it is expected that these barriers are being levelled in order to get closer to the realization of a biobased economy.

Our proposal is based on a combination of strategies: the strategy of 'picking the winners' (addressing the Top 3) and that of 'supporting the potentials' (addressing the

blue group). The potentials will never make it without government support; the winners can in principle without, but by implementing the proposed recommendations processes can be accelerated and a biobased economy being realised more rapidly. The other 6 'very relevant' product/product groups (aqua) are located with respect to relevance between the blue and the green groups. They can benefit from the instruments we propose for these two groups.

The set of seven policy instruments we propose includes both specific instruments (instruments that address specific products/product groups) and generic instruments (instruments that are generic as they apply for all products/product groups).

7.1 Specific instruments

7.1.1 Picking the winners

1. Second generation bioethanol: demonstration projects for development and testing of large scale production processes

There is already considerable attention for biofuels in Dutch national policy. Nevertheless the development of second generation biofuels and more specific of bio-ethanol is proceeding very slowly. One reason for this slow progress is the lack of cheap enzymes that can break down lignocellulosic raw materials which makes that still relative very expensive raw materials (starch, a so-called 1st generation raw material) have to be used for bio-ethanol production. The other reason is that companies still are hesitating to invest in 2nd generation bioethanol production because of the high costs of the development of large scale production processes (see also Cellulases).

Demonstration programmes for 2nd generation bioethanol production facilities – such as those introduced by the USA government[1] – give companies the opportunity to develop and test production processes on pilot scale (100.000 litres/year) and demo scale (15 million litres/year).

2. Cellulases: research and development of improved and cheaper cellulases

In this study we have selected cellulases from the group of enzymes as they are one of the key enzymes in the production of 2nd generation bio-ethanol and of other 2nd generation products that can be made from biomass rest streams.

The cellulases and hemicellulases that are already available on the market now, are still very expensive and do not have the required functionalities. Research is the only way to find and develop new types of (hemi)cellulases that meet the required specifications (especially hemicellulases that can hydrolyze several types of hemicelluloses from a large variety of biomass species) and cheaper production processes of these (hemi)cellulases. At the moment this type of research is already performed at the Kluyver Centre of Industrial Genomics and with the two research programmes B-Basics and CatchBio, but this is still very inadequate.

The Netherlands has an excellent position in the field of enzyme research, especially in fermentation. It can expand and exploit this position in case the Dutch government is willing to invest heavily particularly in this field of research. The enzymes market is

[1] The United States government promotes the construction of cellulosic ethanol factories. In February 2007 six projects were selected for funding by the US Department of Energy with a total 4-year budget of USD 385 million (www.energy.gov/news/4827.htm).

dominated by Danish companies (Novozymes, Genencor) with facilities also in the Netherlands. DSM is producing specific cellulases for the food market. By stimulating the development of cellulases for applications in 2nd generation biofuels and other products this can help Dutch companies to build and consolidate a position in this specific market. The cheaper production of better (hemi)cellulases, stimulates the use of lignocellulosic raw materials for bioethanol and other products.

3. Lactic acid/poly lactic acid and modified starch: development and production of non-food grade products

This recommendation relates to products of Dutch companies that already have a good market position in the higher ('fine chemicals') market segment: lactic acid (LA) and modified starch (MST) for food applications, poly-lactid acid (PLA) for medical applications. These markets require high standards for product quality (especially purity). However these products also can be applied as raw materials for non-food and non-health applications i.e. for lower market segments ('bulk chemicals') such as bioplastics, paper, glue and textile. Products for these markets are subject to less stringent quality demands.

Policy instruments are recommended that include:

- research programmes for the development of processes for the production of non-food grade variants of these product;
- demonstration projects to test the large scale production processes;
- investment schemes to build these large scale product processes.

When the production of bioethanol, cellulose and poly-lactid acid have become substantial economic activities this also will stimulate the production of other biobased products, since these forerunners will organise and facilitate the import, collection, cultivation, transportation and pre-treatment of biomass for other biobased products. Therefore, the proposed recommendations could be the starters of a biobased economy.

7.1.2 Supporting the potentials

4. Tetrahydrofuran and succinic acid: development of cheap conversion processes

Tetrahydrofuran (THF) is one of the products that can be made from biomass-based succinic acid. THF is a chemical building bloc for many different products such as materials, plastics and coatings. The most important barrier that hinders the cheap production of THF from biomass-based succinic acid is the high costs for the conversion of succinic acid into THF.

A research programme that specifically addresses this problem can lead to the development of cheap and efficiently operating catalysts which lower the production costs. Although there is no producer of THF located in the Netherlands, THF is interesting for the Netherlands because it can be produced from succinic acid, a biobased product planned to be produced by a Dutch company, and it can be applied in plastics and coatings, which are two important product categories of the Dutch chemistry sector.

Succinic (made from 1st generation sugars) is now taking into production by DSM/Rochette, but also in this case the high fermentation costs play a role, and the relative high costs for the raw materials.

In the case of both products – tetrahydrofuran and succinic acid – the development of these catalysts and the implementation in the existing production process will take many years; thus investments costs will be extensive.

7.2 Generic instruments

5. Biomass-based Chemicals Investment Allowance

For many biomass-based chemicals that have been evaluated by us as (very) relevant, the relevant companies consider the high development and production costs and the costs for building production facilities in combination with the still small market for these products as the most important barrier for biomass-based production processes. The returns on investment still are too low. This applies for poly lactic acid, 2nd generation bioethanol and agrofibre composites.

By introducing an Investment Allowance specifically for biomass-based chemicals – analogue to the Energy Investment Allowance (EIA) – companies can be persuaded to invest in biomass-based production processes and the price levels of the products will decrease. A 30% contribution of the investment costs is expected to be effective.

6. Public procurement for products made from biomass

A second strategy to lower the price levels of biomass-based products is to develop new markets for these products. We recommend that in the Dutch public procurement policy (*Rijksaankoopbeleid)* a new measure will be introduced that says that Dutch national, but also regional and local governments and other public funded organizations are obliged to buy only those plastics-holding products in which the plastic is produced on the basis biomass. This measure will stimulate a larger scale production and sales of biomass-based polylactic acid (PLA), succinic acid (SCA), tetrahydrofuran (THF), modified and thermoplastic starch products (MST and TPS) and agrofibre composites (AFC) and might lead to a lowering of the price levels of these chemicals to the price level of fossil oil-based plastics.

A similar measure is proposed for the use of paints and coatings (this includes itaconic acid (ICA) as raw material for latex en coatings).

7. Biomass-based chemicals production chains

The production of biomass-based chemicals requires different production chains compared to the existing petro-based chains. These biobased chains still are in an infancy stage and its development goes rather slow and with many hurdles.

The report on Phase 2 of this study presents for all 13 product/product groups the production chains and informs the reader about in which parts of the chain Dutch companies are active and where Dutch commercial activities are missing. No information is available about the level of integration or coordination between Dutch companies that operate in one chain; but it is expected that this level will be rather low to zero.

We recommend introducing a new policy instrument that has as its main goal to construct *(new) biomass-based products chains*. By implementing such an instrument companies get into contact with each other and production chains can be organized in a faster and more efficient manner. A chain develop can also address several aspects that are relevant from a chain perspective and which can not be overlooked (let alone: organised) by individual companies.

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