

Biomass

in the Netherlands

2009



Preface

This brochure aims at connecting foreign companies and institutes to the Dutch approach in order to accelerate the development of bioenergy and biobased products.

The Netherlands has set ambitious goals in the energy transition and the utilisation of biomass is expected to play a major role, but only when it can be produced and utilised in a sustainable way.

Many universities, institutes and companies work in this area and seek collaboration with foreign companies to accelerate their development and extend their markets.

This brochure presents an introduction into the biomass policy in the Netherlands and an overview of companies and institutes.

There are rapid developments in this area and changes in companies can occur frequently, so we encourage you to look at www.biowho.nl to see the latest information.

We wish you a lot of success in working with the Dutch biomass society

Kees Kwant, SenterNovem

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Introduction

Science, technology and business in the Netherlands on biomass for feed and food is strong. Since long time a number of renowned institutes work in the forefront of feed and food research whereas the products of a large number of farmers and cultivators are exported to all places all over the world. There is a strong biobased economy in the Netherlands. This biobased feed and food economy is now extended with activities related to biomass for energy and non-food products, biomass for heat and power and biomass for the production of chemicals. This involves, to some extent, other processes and other stakeholders. The main objective of this brochure and the corresponding website www.biowho.nl is to present biomass activities and stakeholders in the Netherlands to the international audience.

Energy in the Netherlands

The Netherlands is located between Germany and the North Sea in east and west and the Scandinavian countries and France in north and south. It is one of the most dense populated countries in the world (16 million inhabitants on 41.000 km²) with a strong industrial and business base. Energy production and consumption patterns are therefore dense as well. Nowadays fossil fuels are the main feedstock for the energy system. This has to change in the next decades. A transition to a sustainable energy system is under development now and biomass is considered to be one of the main feedstocks in that sustainable energy system.

This, although the amount of biomass in the Netherlands is limited.

Despite all efforts to change the energy system, the Netherlands still has to be characterised as a 'gas country'. The Dutch energy market is dominated by a large share of gas, mainly from indigenous resources. The Groningen gas field is the largest gas field in Western Europe. About 34% of the European natural gas reserves can be found in the Netherlands. Somewhat less than half of the domestic gas production is exported, mainly to Germany, Belgium, France, Italy and Switzerland. In 2006 approximately 25% of gas handling in the Netherlands was from import, mainly from the UK and Norway. As of 2001, gas is imported from the Russian Federation as well. Of the total primary energy consumption in The Netherlands, natural gas is about 50% of the feedstock. Oil, mainly for transport and industry,

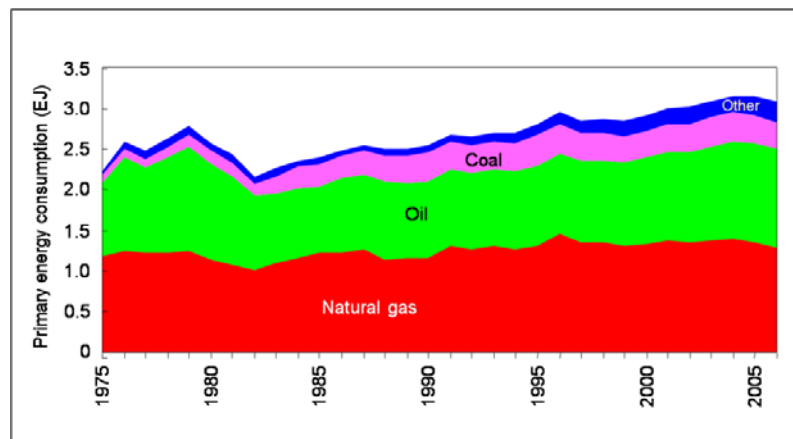


Figure 1 Primary energy consumption in the Netherlands

provides another 40% and coal, for electricity production, fills the last 10%. The share of renewables slowly increases but it still limited to 2,9% of the national energy supply. The current (2007) energy demand is 3300 PJ/year. The energy demand has increased by 1.4%/year over the last two decades although a slight decrease was observed in the last years.

The share of electricity production in central power plants compared to total Dutch electricity use has reduced over the last four year from 60% to about 50%. Over the same period the import of electricity has increased from 11% in 1998 to 18% in 2000.

Ambitions

Sustainable development and sustainable energy are cornerstones of the long term policy of the Dutch government and are societal well accepted. There are quite a number of technologies and feedstocks to make the energy system sustainable. But from all possible sources of sustainable energy in the Netherlands, biomass is likely to be the dominant supplier.

The biobased economy

The concept of a Biobased Economy is gaining ground worldwide and offers all kinds of opportunities for the Dutch business sector. Biomass is seen as a 'green' raw material that can be used in the chemical industry and other non-food sectors to produce products and materials such as plastics, adhesives and paints, and to produce fuel and generate energy. This process usually involves some form of biotechnology. As far as the Netherlands is concerned, the prospect of using residual and by-product flows generated by the agro food industry is of particular interest.

This development is driven by the desire to strengthen the economic competitive position of the business sector, to address the problem of climate change, to reduce waste and the distribution of environmentally hazardous substances, and to be less dependent on oil.

While Biobased Economy has a strong international character and is dependent on continuous changes, the areas of challenge appear and disappear. Business and government face the opportunity to acknowledge these areas of challenge. There are significant economic opportunities for the Netherlands in the production of high-grade applications. Greater sustainability can be realized by making full and intelligent use of the available resources and by-product and residual flows.

The transition to a biobased economy faces two challenges. Firstly, the development of new technology to convert green resources needs to be accelerated. Secondly, a wide range of parties, including the Ministry of Economic Affairs, the Ministry of Housing, Spatial Planning and the Environment, the Ministry of Agriculture and Nature Conservation and the business sector and research sector need to work together to promote and implement the concept.

The business sector stands to gain from these developments, which ensure an improved economic competitive position and contribute to the national economy and a sustainable society. The Biobased Economy offers an alternative to oil, which is both scarce and expensive. Products can be made more safely and with less risk to health. This also appeals to consumers.

Long term policy: Energy transition

Some years ago it became obvious that the energy system in the Netherlands should be drastically changed. The system was, and still is, to a large extent based on fossil feedstocks whereas it should be based, to the utmost possible, on sustainable and renewable sources. So the Dutch government, supported by many stakeholders from the society, initiated the Energy Transition as a cooperation model with involved ministries and many, many participants from industry, knowledge infrastructure, agencies and NGO's. A Taskforce was installed and a number of transitions routes were developed. For each route a Platform with representatives from the stakeholders was set up. Within the transition routes different transition paths have been designed. The transitions route Biobased Raw Materials has the closest link to the biobased economy and therefore shall be discussed in more detail below. The platform New Gas is also related to biomass whereas the transitions routes Sustainable Mobility (biofuels), Sustainable Electricity Supply (combustion, gasification, fermentation, digestion) and the 'Green House as Energy Source' have interactions with biomass. The Energy Transition will not be fully realized in the short term. Time Schedule is more directed to some decades.

Criteria for the biobased economy

Concerning the role of biomass in the Energy Transition it is important to agree with all stakeholders involved on the criteria under

which the biomass can be made available to the energy system. In 2006 The Cramer Commission, called after Jaqueline Cramer, the actual Minister of the Environment and Housing developed the guidelines for the sustainable production and use of biomass [1]. According to the commission the production and use of biomass should:

- ▶ Not harm nature and environment
- ▶ Lead to a reduction of greenhouse gases
- ▶ Not danger food supply
- ▶ Contribute to wealth and wellbeing of the local population

Platform raw materials

The Platform Biobased Raw Materials is a collaborative effort between representatives from industry, knowledge infrastructure and NGOs. The platform acts as a mediator in society. The Dutch government formulated a policy based on the vision of the Platform to reinforce the international competitive position of the agricultural sector in the Netherlands and make this sector more sustainable.

The Platform Biobased Raw Materials advises the Dutch government about a future in which, through the use of biobased raw materials, the dependence on fossil raw materials will decrease. The raw materials can be used as feedstock to provide electricity, heat, transport fuels, chemicals and many other materials. The Platform believes that the dependence on fossil raw materials can be significantly reduced through the use of biomass (material of plant origin) that has been cultivated and processed in a sustainable way. Biobased raw materials can supply at least 30% of the need for raw materials and energy in the Netherlands within 25 years. The ambition for 2030 is to use biobased raw materials as the basis for:

- ▶ 60% of transport fuels
- ▶ 25% of chemicals and materials
- ▶ 17% of space heating
- ▶ 25% of the electricity demand.

The Platform Biobased Raw Materials designed a number of Transition Paths (TP):

1. Sustainable Production and Development of Biomass
2. Realization of the Biomass Import Chain
3. Co-Production of Energy, Fuels and Chemicals (Bio-Refinery)

4. Synthetic Natural Gas
5. Innovative Use of Biobased Raw Materials in Chemistry

Transition Path-1: Sustainable Production and Development of Biomass

Based on the final applications (electricity, heat, transport fuels and chemicals), the Platform Biobased Raw Materials has envisaged the type of biomass that has to be developed, produced and/or imported:

- ▶ More efficient use of the biomass that is already available in the Netherlands. Existing biomass streams from the Netherlands and waste streams from imported raw materials for food and feed can supply about one-third of the required biomass.
- ▶ Development of crops for bio-refining for production in the Netherlands or abroad can contribute about one-fourth of the required biomass.
- ▶ Over the long term, aquatic biomass (non-land-based production) can also cover about one-fourth of the biomass requirement.

According to expectations, about 60% of the required biomass will have to be imported. This offers Dutch agriculture and agro-industry, which are strong in international trade, unique opportunities to realize the domestic potential and benefit internationally from the advanced knowledge in the Netherlands. Nearly 300 PJ can be realized by around 2010, but the underlying sources must still be evaluated in terms of their sustainability and socially responsible character. The renewable resources require about 3.5 million hectares of additional land; a small amount of this land will be in the Netherlands, and the remainder will be located elsewhere in Europe and the rest of the world.

Transition Path-2: Realization of the Biomass Import Chain

With an expected share of 600-800 PJ in 2030, imports of biomass (or semi-manufactured and final products from biomass) will have a role that, in magnitude, is comparable to that of oil in 2006. This transition path focuses on the changes that are required to prepare the Netherlands for such large-scale import and processing of biomass: international cooperation with biomass-producing countries, criteria for

sustainability, transport and logistics, physical facilities, services and the link to processing.

According to current insights, biomass production in regions such as Southern Africa, Eastern Europe and Latin America can be profitable (in comparison to fossil fuels), the technological and economic potential is great and sustainable production can be assured. Nevertheless, the sustainable development of biomass production in specific regions will depend on many factors such as the development of domestic and international markets, the demand for food and land, the degree of rationalization of present-day agriculture and the quality of the infrastructure.

The role of Dutch companies can be especially strong in the areas of international logistics and trade, certification and commercial services. The positive consequences of biomass import are the following: increased diversity of the primary raw materials for our energy supply, lower prices over the long term for products from biomass than those from fossil oil, lower expenditures for energy imports and reduced expenditures on the trade in CO₂ emissions.

Transition Path-3: Co-Production of Energy, Fuels and Chemicals (Bio-Refinery)

In this transition path, the conversion of biomass into final products takes place via:

- ▶ Biorefining, separating the raw material into various useful fractions
- ▶ Fermentation or enzymatic/chemical conversion into chemicals, transport fuels and electricity/heat
- ▶ Thermo-chemical conversion, gasification/pyrolysis/co-firing/fermentation of biomass for the production of chemicals, transport fuels and electricity/heat.

According to studies conducted by the Platform, the large-scale use of biomass-based raw materials for the energy and chemical sectors is economically competitive in the long term, even without subsidies and other government financial support. However, during the introduction phase strong government support appears to be essential, primarily due to the major shift for today's primarily oil and gas-based industry. This necessity is confirmed by the large-scale investments being made in Europe and elsewhere. When making the best choice of technologies and chains, a biobased economy

offers real economic opportunities. Rapid developments are now taking place in science and technology, where the Netherlands holds a strong position in the expertise needed for the production and co-production of energy, transport fuels and chemicals. At present, no clearly superior technology has emerged, and it is important to ensure that multiple routes are kept open. Promising routes are the following:

1. Conversion of lignocelluloses and other agro-residue streams into motor fuels and other products using fermentation and thermo chemical conversion.
2. Linking energy production, especially electricity production, via gasification with the co-production of chemicals from synthesis gas or other streams.
3. Improving the utilization of current residue streams from the agro/food sectors by means of biorefining and conversion processes.
4. Establishing small-scale biofuel production networks and networks of other types of pre-conversion based on the agro industry, with the involvement of the energy and chemical sectors.

The trans-sector character of the biobased chain (agro/food - fuel - chemistry) slows market introduction. As a result, the leading expertise position of the Netherlands is insufficiently utilized. Due to the specific position of the Netherlands, with both a strong national energy-chemical sector and a strong international position as a European main port, it is urgent that we initiate and implement demonstration projects.

Transition Path-4: Synthetic Natural Gas

The best way to increase the sustainability of households concerning their need for heat is by using SNG (synthetic natural gas). SNG differs in composition somewhat from the natural gas from Groningen, but it has the same caloric value. Due to these properties, SNG can be added to the current infrastructure without additional infrastructural costs. The Netherlands has access to a high quality and extensive natural gas infrastructure, including end user applications and storage provisions. At this time, the Netherlands holds a leading position in the area of SNG due to the research conducted by the Energy Research Centre of the Netherlands and the involvement of Gasunie as one of the largest European gas producers and traders.

The process of SNG production is necessarily large scale (several hundred to several thousand megawatts of thermal capacity) where thermal gasification of biomass is followed by gas purification and ultimately catalytic synthesis to SNG. This results in relatively high efficiency for the total chain, from biomass to SNG. With current technology, the costs of SNG are 10 to 40% above those of natural gas, but with up-scaling and process optimization—aided by the increased gas price—this route can quickly become competitive.

At laboratory scale, it has already been demonstrated that SNG can be produced in the same composition by means of gasification followed by methanization. The expectation is that the entire conversion chain, from biomass to synthetic natural gas, can be scaled up to the level of commercial production within 10 years. More information can be found in: Let's give full gas!, a publication of the Platform New Gas.

Transition Path-5: Innovative Use of Biobased Raw Materials in Chemistry

In the Netherlands, the chemical sector is the largest industrial user of fossil raw materials; it uses more than 20% of the total, of which 60% is in the form of raw materials for final products. Worldwide, these figures are smaller by a factor of two; this is because the Dutch chemical industry is a major exporter. In the chemicals sector, the transition to biobased raw materials has been taking place for more than 10 years, where the Netherlands has taken a leading position. Replacement of fossil raw materials with the most suitable biomass components (where this is beneficial to the environment) is taking place especially in organic chemistry. Savings are possible by reusing materials (plastics), implementing more efficient catalytic chemical and biochemical processes and developing 'smarter' final products that can fulfil their function using less material (for example, thinner packaging with improved shelf-life for the contents, biomedical materials). These developments include reducing waste and the emissions of hazardous substances.

In combination with the new chemical building blocks and smart biorefining, new opportunities, especially for small and medium-sized companies, are created for the development of new, sustainable materials and products. The Platform has concluded that 25% savings of fossil raw materials in

organic chemistry is a modest ambition and estimates that savings of up to 50% are possible.

Short term policy: Clean & Efficient

The government of the Netherlands has the ambition to become one of the cleanest and most efficient energy countries in the world. In the action program 'Clean and Efficient: new energy for the climate' the cabinet describes the ambitions with respect to more efficient use of energy, sustainable energy and carbon capture and sequestration. The program is a cooperation of seven ministries coordinated by the minister of Environmental Affairs. Goals of the program are:

To reduce the emission of climate gases (mainly CO₂) with 30% in 2020 with respect to the emissions in 1990

To increase the level of energy savings from 1% to 2% per year.

To increase the contribution of sustainable energy from the actual 3% to 20% in 2020.

History

From all sustainable energy sources in the Netherlands, biomass is already the dominant supplier. Figure 2 shows the development of sustainable energy sources in the Netherlands for the period 1990-2007. This has grown steadily over the last years. The reduction in biomass for heat and power because of reduced use of co-firing of biomass in power plants has been compensated by an increased use of biofuels.

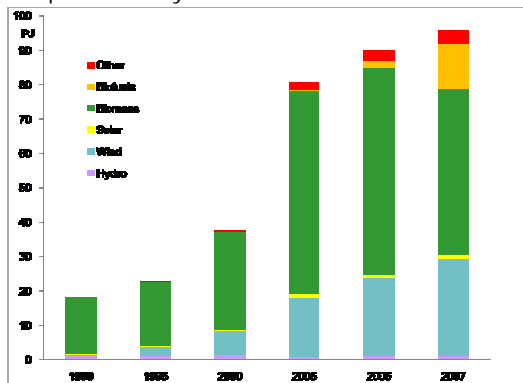


Figure 2: Sustainable energy (PJ) in the Netherlands

The nearly total of 100 PJ should be evaluated in view of the total primary energy consumption of 3300 PJ. The contribution that renewables makes to the total energy consumption – expressed as avoided primary energy – is thus relatively small, due to the continuing high (end-user) consumption of oil and natural gas in sectors such as transport, households (for spatial heating) and industry. The penetration levels of sustainable energy in the total energy consumption therefore, are increasing very slowly.

Figure 3 give some more details of the different biomass related contributors. Dominant players are waste incineration, co-combustion in power stations and biofuels. The reduction in biomass feedstock was mainly due to 50% drop in co-firing of biomass at power plants. This drop started on

1 July 2006, when subsidy for co-incinerating liquid biofuels, demolition wood ('B' wood) and organic residues was reduced from 7 to 2.5 €ct per kWh. The drop in bio energy production is somewhat compensated by increased wind energy production and the increased use of biofuels for transport.

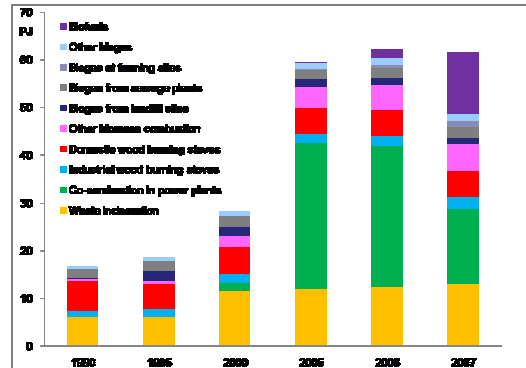


Figure 3: Biomass contribution to sustainable resources in the Netherlands

In 2006 a total of 1,979 TJ (67 million litres) of biofuel were used by the Dutch transport sector, which amounts to 0.4% of the total market for transport fuels. In 2005 this was only 0.02%. During 2007 the government required oil companies to sell 2% biofuels (on an energy basis).

The SDE Directive (legislation to encourage sustainable energy production) was published in the Government Gazette on 30 October 2007. This scheme is a follow-up to the MEP, but includes renewable gas projects that may qualify for subsidy, as well as renewable electricity and cogeneration projects. In contrast to the MEP, the subsidy amount varies each year, and is coupled to the relevant market price for energy. Other price corrections may, if necessary, also be applied. The first categories to be eligible for SDE subsidy are onshore wind energy, cogeneration, solar photovoltaic and small-scale biomass. Offshore wind energy and large-scale biomass will follow later. The government's SDE subsidy scheme was published in March 2008 for the various production categories, and include subsidy amounts, maximum subsidy levels, and allocation method (particularly regarding a 'first come-first served' basis or according to tender) and subsidy periods.

The use of vegetable oils is currently excluded from the SDE until the sustainable origin of the oils can be guaranteed.

The discussions concerning the sustainability of biomass that started in 2006 have been brought to a preliminary conclusion during 2007. The final report by the project group 'Sustainable biomass production' (Cramer Commission) was published in April 2007, and includes a proposed assessment framework for sustainable produced biomass (both domestic and foreign biomass), plus detailed criteria and indicators. This report includes stricter criteria than those presented by the RSPO (Round Table for Sustainable Palm Oil). The use of palm oil is currently excluded from the SDE, until the sustainable origin of palm oil can be guaranteed. The sustainability criteria are minimum standards to assess whether biomass can be regarded as sustainable. However, the implementation of minimum standards in laws and regulations is not acceptable in view of requirements of the World Trade Organisation. So this issue has to be solved somehow.

Biofuels

During 2006 some 67 million litres of biofuels (equal to around 2,000 TJ) were used in road vehicles. This is equal to 0.4% of the energy content of the petrol and diesel consumed on the Dutch market¹. This primarily concerns biofuels that are blended with traditional fuels. In 2005 the percentage of biofuels sold was only 0.2%. However, since 1 January 2007, Dutch commercial entities that sell transport fuels on the open market are compelled to supply a certain percentage of biofuels. In 2007 the obligation was 2% but a higher percentage was blended. This will increase each year, up to 4% in 2010.

Prior to 2006 the Netherlands produced or used very few biofuels. However, since the excise duty exemption for biofuels blended into petrol and diesel in 2006, and the compulsion of fuel suppliers to achieve a certain percentage of their turnover from biofuels since 1 January 2007, the production and use of biofuels has finally gained momentum. The amount of biofuels used in 2006 totalled around 38 million litres of ethanol and ETBE (ethyl tertiary butyl ether), plus 29 million litres of biodiesel. Together this amounted to 0.4% of all transport fuels in 2006². This market share undoubtedly increased further in 2007, because fuel suppliers were obliged to ensure that 2% (on

an energy basis) of their turnover was derived from biofuels.

There are currently four biodiesel producers operating in the Netherlands, with a collective production capacity of 220 million litres. There are also six new plants being built, which are expected to become operational during 2008 or 2009. This will boost production capacity by an additional 1.6 billion litres. Several projects are also at the preparation stage, where construction has yet to start. There are also several small-scale production facilities that produce PPO (pure plant oil). The total capacity of these projects amounts to around 39 million litres. No production expansion for PPO is expected for the next few years.

At this point in time the Netherlands has no ethanol production capacity for use in transport fuels, although two companies produce ETBE. Although ETBE production is not expected to expand over the next few years, two ethanol production plants are currently under construction and are expected to become operational during 2008 and 2009. The Abengoa plant will have an ethanol production capacity of 480 million litres. A large number of small-scale ethanol projects are also being prepared.

The first tender under the IBB (Innovative Biofuels) programme was implemented during 2007. In total some 12 million euro was split over three projects. More projects are expected to be realised over the next few years, and these have innovative characteristics such as advanced conversion techniques (also known as 2nd-generation biofuels'), the use of residues, integrated energy and material flows within the company or with other companies. An example is the supply of CO₂ to greenhouses by the Abengoa ethanol plant currently being constructed in Rotterdam.

In the shorter and medium terms, greenhouse gas emissions and sustainability aspects will play an important role for biofuels. The European Commission has made an important start with its proposed guideline dated 23 January 2008. The Netherlands has developed a calculation tool to determine greenhouse gas emissions for biofuel production chains on a well-to-wheel basis.

¹ Figures by CBS for 2007 (CBS, 2008).

² Preliminary figures by CBS for 2006, no information known for 2007 (CBS, 2007).

Research

Energy Research

The Netherlands has a longstanding energy research tradition. Start of the research tradition coincides with the start of electrification in the Netherlands. More than a century ago academic research and education on electricity production, conversion and consumption started at the Technical University in Delft. In 1927 the electricity industry founded KEMA, a test house for research related to electricity production and conversion. In 1955 along with Eisenhower's Atoms for Peace speech the Reactor Centre of the Netherlands (RCN) was created. Since then a lot has changed. In



the seventies of last century the Reactor Centre of the Netherlands has been transformed to the Energy Research Centre of the Netherlands and energy research and education in a much broader perspective is part of the programmes and curricula at at least 5 universities in the Netherlands. In parallel the research agenda on energy has become a partnership of public and private organisations.

Research organisations

Energy research is executed in many organisations and institutes. The main players are:

- ECN: the Energy research Centre of the Netherlands (ECN) is the most prominent institution for Energy Research in the Netherlands. Due to its importance it is described in more detail below.
- TNO
- KEMA
- The Universities of Delft, Eindhoven, Twente, Groningen, Utrecht and Wageningen.

ECN

The Energy research Centre of the Netherlands - ECN is the largest research

centre in the Netherlands in the field of energy. The mission of ECN is to develop high-level knowledge and technology for a sustainable energy system and to transfer the developed technology to the market. ECN employs about 900 people of whom 650 are engineer or scientist. Turnover is 125 million Euro. Main customers are the Dutch government, the European Union and the industry, national as well as international. ECN is located in the dunes near Petten, a small village in the northern part of Holland.

The Business Unit Biomass, Coal and Environmental research is an innovative partner for industry, government and other research institutions. Research and development activities are diverse and broad, categorized into five research programmes: Heat and Power, Syngas and SNG, Transportation Fuels and Chemicals, Air Quality and Climate Change and Environmental Risk Assessment. The Business Unit operates a number of experimental facilities related to biomass research.

Energy Research Strategy

EOS is the Dutch abbreviation for Energy Research Subsidy and reflects the coming of a new era by using the same name as the goddess of dawn in Greek mythology. The Energy Research Strategy³ was adopted by Parliament in 2002. Since then a market consultation was carried out to identify the needs, opportunities and strengths in the Dutch society. An additional scouting defined the research areas in more detail. This resulted in 5 Energy Research Priority areas.

- Energy Efficiency in Industry and Agriculture
- New gas / Clean Fossil
- Biomass
- Built Environment
- Energy Infrastructure and Offshore wind

The EOS programme addresses long term, medium term and short term research. The first tender for proposals is expected at the end of 2004. The total annual budget will be around € 35 Million for all the five areas.

The Energy Research Strategy addresses a number of different programs.

³ Download the Executive Summary of the EOS Energy Research Strategy from:
<http://www.ez.nl/publicaties/pdfs/02ME04.pdf>

1. EOS–New Energy Research (NEO–Nieuw Energie Onderzoek)
It concerns non conventional and new research that contributes to a clean, reliable and affordable energy supply system
2. EOS–Long term (LT–Lange Termijn)
Fundamental and Industrial Research for sustainable energy technology development on a time scale of 10 years.
3. EOS–Short term (KTO–Korte Termijn Energieonderzoek)
Industrial Research an pre-competitive development activities including the development of prototypes. Cooperation between partners from knowledge infrastructure an industry is important. A business case is a must.
4. EOS–DEMO
Investment projects for market the introduction of new technology.
5. UKR–Unique Opportunities (Unieke Kansen Regeling)
Large scale energy projects for the transition paths.

Within the field of biomass a field study and consultations of the market and research institutes have resulted in formulation of the following research areas:

- Biorefinery
- Electricity and heat from biomass, incl. co-firing and co-feeding
- Gasification and gas cleaning/ preparation
- Feed preparation (additional)

Bio-Refinery

The bio-refinery concept has been identified as a priority area and can be seen as an overall concept to utilise biomass efficiently for energy as well as other applications like chemicals. The goal for the bio-refinery area is defined as the efficient conversion of biomass in high value components for application in the energy and chemical sector.

The following sub areas will be developed within this part of the EOS Biomass program:

- Development of biorefining concepts; chain analysis
- Primary biorefining
- Secondary refining
- (Bio) chemical routes
- Thermo-chemical routes

- Application of biofuels in the transport sector

Primary refining refers to the preparation of the original source to intermediates. This could be a pyrolysis or hydrolysis process. Secondary refining refers to the production of the end-product which can be sold to the end-user.

Electricity and Heat

The application of biomass for production of power and heat was not a priority area from the market survey. However building on Dutch experience in implementation in co-firing and co-feeding it became clear that this focus area can contribute substantially to the use of biomass for energy. The goal of this area is defined as CO₂ neutral power generation

For electricity and heat the following specific sub areas have been identified:

- Technology to be improved and new technology to be developed
- Improving performance of biomass/ coal fired power stations: high efficiency to power, adding a sustainable feed component, CO₂ recovery.
- Opportunities in the Netherlands:
- Co-feeding of biomass in the 250 MWe ICGC plant in Buggenum
- Co-firing in gas fired STEG's

Gasification and Gas Treatment

As mentioned, gasification, gas cleaning and syngas production is considered as focus area for research in the Netherlands. For the gasification and gas cleaning area the goal of the research is focused on the high efficiency production of syngas from biomass. In order to achieve the required result the integrated chain from biomass to the final application should be considered. This includes the development and optimization of the entire chain consisting out of: biomass feed, feed preparation (pellets, pyrolysis crude), air or oxygen gasification, gas cleaning, gas preparation, final product manufacture, emissions and by-product handling.

This generic chain will require a wide range of intermediate product gas qualities, depending on application. Considered are:

- Electricity/ heat
- Methanol, Fischer-Tropsch diesel, chemicals
- SNG, H₂

EOS Projects

Since the start of the EOS programme a large number of research and development projects have been facilitated. For illustration a number of projects are presented here.

Omega-3 fat-acids

The production of Omega-3 fat-acids is based on fish. The life cycle of the Omega-3 production results in a net CO₂ emission of ca 5 kg CO₂ per kg fish delivered. Omega-3 fat acids can also be produced from some maritime algae. In the production cycle of algae CO₂ is fixated. In the experiment an installation of commercial dimensions is designed, build and operated. The installation produces ca 6 tons of algae per year. This is sufficient to produce enough Omega-3 fat acids for practical experiment.

Supercritical water gasification

Biomass gasification in supercritical water offers an interesting perspective for wet biomass. In the process wet biomass (70-90% water content) is dissolved in supercritical water. A high heating value mixture of hydrogen, methane, carbon monoxide and carbon dioxide. No tars are formed and conversion is nearly complete. The gases are released at high pressures thus avoiding costly compressor work for following process steps.

Co-refining of biomass

Production of fuels from biomass is still a rather expensive technology. Aim of the project is to preprocess biomass in such a way that the intermediate products can directly or indirectly used in existing refining process technology.

Tortech

Biomass is a complex feedstock. It has a wide range of characteristics and properties. For processing it would be useful to limit and improve the properties of biomass. One such a technology is torrefaction, a mild thermal process to produce an intermediate product with excellent properties.

Innovation agenda

A sustainable energy infrastructure is, at least to a large extent, one of the fundamentals of the policy plan of the Dutch

government. To realize this infrastructure an innovation agenda has been developed. Scope of the agenda is the period 2008-2012. Available budget is nearly half a billion Euro. For biomass related activities a number of interesting aspects are involved.

In the short term following topics need to be covered:

- Stimulating of algae research
- Production of high value added products from biomass
- Demonstration of the production of Synthetic Natural Gas (SNG) from biomass

In a later stage additional projects will, amongst others, be developed.

- Demonstration of introduction of sustainable biomass.
- Experiments to demonstrate connections between chemistry, agriculture and logistics.
- Research on algae and plant
- Certification

Links

<http://www.senternovem.nl/english/index.asp>

This is the main website of SenterNovem. SenterNovem is an agency of the Dutch Ministry of Economic Affairs. SenterNovem promotes sustainable development and innovation, both within the Netherlands and abroad. Aim is to achieve tangible results that have a positive effect on the economy

and on society as a whole. Core competence of SenterNovem is converting government policy into reality. On behalf of the Dutch government policy regarding: Innovation, Energy and Climate Change and Environment and Spatial Planning is implemented

<http://www.platformbioenergie.nl/nl/english.php>

The Netherlands Bio-energy Association, NL-BEA in short is the Dutch association promoting the interests of all Dutch

companies involved in the biomass for energy chain. Members of the association represent the entire chain.

<http://www.senternovem.nl/energytransition/index.asp>

Realizing a sustainable national energy economy requires a new innovative way of thinking and acting—in economic, technological, and socio-cultural terms. The Netherlands chooses to use a transition

approach. In this approach, changes are not only necessary but they also create opportunities. This site is the main site for information on transition management processes in the Netherlands.

<http://www.senternovem.nl/eos/>

Information of research and development programs. (in Dutch)

BioWho.NL

Science, technology and business in the Netherlands on biomass for feed and food has a long tradition. Since long time a number of renowned institutes work in the forefront of feed and food research whereas a large number of farmers and cultivators produce products that are exported to all places all over the world. Dutch agriculture and horticulture show enormous diversity, with agricultural entrepreneurs distributed over various animal and crop sectors like arable or dairy farming, bulb growing, glasshouse horticulture, tree cultivation and pig farming. This biobased feed and food economy is now extended with activities related to biomass for energy and non-food products, biomass for heat and power and biomass for the production of chemicals. This is a great challenge for Dutch organisations.

Consultancy companies

Service organisations contribute to a considerable extent to the economy of the Netherlands. This is equally true for service activities in the biobased economy. Quite a number of organisations focus on the Netherlands but international activities are growing.

Process Engineering

Necessary for the biobased economy is process technology and engineering. Use of the existing process engineering for the chemical industry is strongly supportive for the biobased economy. The chemical process industry plays an essential role in the Dutch economy. In 2007, more than 68,000 employees generate a turnover of 50 billion euros a year, which is 3% of the Dutch Gross Domestic Product (GDP). This turnover has continued to grow by between 5% and 6% in recent years [...]. The existence of a large process industry goes along with a strong engineering and contracting base. In addition to the large engineering & contracting organisations, partly subsidiaries of global contractors, quite a number of smaller, specialized engineering companies are active in the field of the biobased economy. Due to the challenges posed by the biobased economy and the facilitation by the Dutch government this group is growing.

Technology

This success of the process industry is based on a favourable location, the availability of natural gas, and highly innovative companies. The Netherlands' high-quality knowledge infrastructure is also an important factor. Scientific research in the Netherlands is among the best in the world. In a recent report published by OWT (the Netherlands Observatory of Science and Technology), the Netherlands was ranked third amongst the top research countries, after the United States and Switzerland. This position is due to a large degree to the contribution made by the chemical industry. Now the technology for the biobased economy is developed by research organisations and the industry.

Organisation [Abengoa Bioenergy Netherlands B.V.](#)

Coordinates Weena 294, NL-3012 NJ Rotterdam, The Netherlands
Phone: +31 (0)10-271 0111, Fax: + 31 (0)10 271 0119

Contact Mr. R. Groeliker

WWW www.abengoabioenergy.com

Profile Abengoa Bioenergy Netherlands B.V. is a subsidiary of Abengoa Bioenergy. In Europoort-Rotterdam we produce from 2010 on 480 million litres of bio-ethanol from grain. Our facility will distribute bio-ethanol mainly via pipeline to the different refineries and ETBE producers in the Rotterdam harbour. Remaining product will be shipped via vessel and or rail. CO₂ is captured and is send to the greenhouses in the area via pipeline.

Organisation [Alterra B.V.](#)

Coordinates P.O. Box 47, NL-6700 AA Wageningen, The Netherlands,
Phone: +31 (0)317 48 0700, Fax: +31 (0)317 41 9000

Contact Dr. P.J. (Peter) Kuikman

WWW www.alterra.wur.nl/UK

Profile Alterra is a research organisation and focuses on issues of sustainability, impact on climate change and emissions of greenhouse gases in relation to development of a biobased economy and bioenergy. Specific expertise is available on issues that relate to biodiversity, landscape quality and impact, use of agricultural wastes and waste material from nature management.

Organisation [AVR van Gansewinkel \(Biomass Energy Logistics bv\)](#)

Coordinates P.O. Box 7184, NL-5605 JD Eindhoven, The Netherlands,
Phone: +31 (0)40 294 4444, Fax +31 (0) 294 4399

Contact Mr. A. Beeks

Phone: +31 (0)6 225 229 32

E-mail: toon.beeks@vangansewinkel.com

WWW www.avrvangansewinkel.eu www.biomassastroomlijn.nl

Profile The combination AVR - Van Gansewinkel, stands for integrated waste management services and reliable environmental solutions in eight European countries. Our 6,500 employees are specialists in collecting, transferring, recycling and processing all types of waste and provide solutions on a daily basis to our customers' extraordinarily widely ranging waste issues. We stand for sustainable relationships with our customers and with society. Biomass Energy Logistics (Biomassa Stroomlijn) is active in the field of collecting, upgrading, storing, transporting and supplying clean biomass for Biomass Energy Plants.

Organisation [BGI](#)

Coordinates P.O. Box 130, NL-7890 AC Klazienaveen, The Netherlands
Phone: +31 (0)591 39 0096, Fax: +31 (0)591 39 0091
E-mail: info@biogasprojecten.nl

Contact Mr. Alex L. Wittendorp

Phone: +31 (0)591 39 0096

E-mail: info@biogasprojecten.nl

WWW www.bioethanolprojecten.nl

Profile BGI has his activities in sustainable energy projects such as the realization of bio-energy installations for farmers and companies. BGI does the total Project development including licensing, scheduling, construction financing and administration and commissioning of the installation. These projects contain aspects like the production of biogas, bio-ethanol, gasification and first and second generation biofuel.

Organisation [BioEnergie Twente B.V.](#)

Coordinates P.O. Box 71, NL-7600 AB Almelo, The Netherlands

Contact Mr. R. Ch. van Hutten

Phone: +31 (0)546 83 6703, Fax: +31 (0)546 81 1267

E-mail: r.van.hutten@cogas.nl

WWW www.bruinsenkwest.nl, www.cogas.nl

Profile Small-scale combustion of biomass (woodcock and demolition wood) for production of renewable electric and thermal energy for industrial parks. Collection, handling and recycling wood waste (Bruins & Kwast). Exploitation of landfill gas plants for production green energy and green gas. (Cogas Energie)

Organisation BiogaS International

Coordinates P.O. Box 130, NL-7890 AC Klazienaveen, The Netherlands
Phone: +31 (0)591 39 0096, Fax: +31 (0)591 39 0091
E-mail: info@biogas.nl

Contact Mr. Alex L. Wittendorp
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WWW www.biogas.nl

Profile BiogaS International was founded in 1996, with the primary mission to deliver a significant contribution to the development, implementation and realization of renewable energy producing installations, trading of renewable energy and acquiring the required resources and raw materials for biogas projects in The Netherlands. During the last years more and more other biomass options have become interesting, e.g. bio-ethanol, gasification technique and various other techniques. These techniques will be adopted in currently developed 2nd. generation bio-energy projects. BiogaS International main activities are:

1. Giving independent advice to local governments, companies and private individuals on the territory of bio-energy and all adjacent sites in the area of the renewable energy supply.
2. Initializing, developing and realizing Bio-energy installations both nationwide and international.
3. To acquire, manage and distribute Biomass currents (input & output) both nationwide and international.
4. Trading in renewable energy, green certificates and related value documents and – assets.

Organisation Biovalue Holding B.V.

Coordinates P.O. Box 63, NL-9930 AB Delfzijl, The Netherlands
Phone: +31(0)596 51 6856, Fax: +31 (0)596 51 6868

Contact Dr. M.A. Kousemaker / Mr. N.Vos
E-mail michiel.kousemaker@biovalue.eu / nico.vos@biovalue.eu

WWW www.biovalue.eu

Profile Biovalue is a joint development between Innovantec B.V. and DELTA Development & Water, a full subsidiary of DELTA NV, to benefit from the opportunities for environmental-friendly alternatives for fossil fuel. As fossil fuels become scarcer, the market for durable alternatives has significantly increased. Subsequently, environmental emission issues as well as European legislation offer scope for environmental-friendly alternatives for fossil fuels. Biovalue Holding B.V. has anticipated these developments with the development of a biodiesel plant in the Eemshaven area in the province of Groningen in the Netherlands. The technology behind the production of biodiesel has been proven for a long time. A number of production facilities based on the chosen technology by Christof Gruppe AG are currently operating in Germany and Austria. Biovalue has studied the production process of biodiesel in-depth, and has optimised the process significantly.

Organisation Bosschap, Board for Forests and Nature

Coordinates P.O. Box 65, NL-3970 AB Driebergen, The Netherlands
Phone: +31 (0)30 693 0130, Fax +31 (0)30 693 3621

Contact Mr. J. Jansen
Phone: +31 (0)30 693 0103
E-mail: jansen@bosschap.nl

WWW www.bosschap.nl

Profile The Bosschap is the industrial board for the Conservation of Forests and Nature, legally based in the Dutch Industrial Organizations Act. The Bosschap has legislative powers: it can draw up rules and regulations that apply to all the enterprises it unites. The Bosschap's sole task is to serve the communal interests of the forest and nature owners and forest contractors and their employees, being the organizations that maintain Dutch forests and nature areas. It does so by mainly developing all kinds of 'products'. The Bosschap, for example, has published a handbook on safety measures when working in forests, facilitates the negotiations between employers and employees about their annual salary and other working conditions and sometimes lobbies for better nature laws. Background information on industrial boards can be found on the website of the Social and Economic Council of the Netherlands. The board of directors of the Bosschap consists of representatives of the enterprises it unites.

Organisation [Brouwers BioEnergy B.V.](#)

Coordinates P.O. Box 203, NL-8901 BA Leeuwarden, The Netherlands
Phone: +31 (0)58 291 1100, Fax: +31 (0)58 291 1198

Contact Mr F. J. van Rooyen
E-mail: fred.vanrooyen@brouwersbioenergy.com

WWW www.brouwersbioenergy.com

Profile Brouwers BioEnergy BV is part of the Wilaard Group, a group of companies with more than 50 years of experience in the dairy livestock industry. Many of the concepts used today in livestock housing originated on the drawing boards of the Wilaard group. Brouwers BioEnergy is a supplier of turn-key biogas plants. The name Brouwers has always been associated with true quality. A quality we want to express in the execution and efficiency of our installations. Brouwers BioEnergy aims for a realistic approach and efficient installations with optimised output. Together with its partners Brouwers BioEnergy BV has many years of experience with biogas plants in The Netherlands and Germany.

Organisation [Bruins & Kwast](#)

Coordinates P.O. Box 103, NL-7470 AC Goor, The Netherlands
Phone: +31 (0)547 28 6600, Fax: +31 (0)547 28 6600

Contact Mr. H.G. Kwast
E-mail: info@bruinsenkwest.nl

WWW www.bruinsenkwest.nl

Profile Bruins en Kwast is committed to recycling of biomass based organic waste streams. Bruins en Kwast is principal client for the erection of a 9MW CHP based on biomass as feedstock. Start of operation is foreseen for the end of 2004. Bruins en Kwast delivers biofuels to Germany and Belgium.

Organisation [CE Delft](#)

Coordinates Oude Delft 180 2611 HH Delft The Netherlands
Phone: + 31 (0)15 215 0150

Contact Mr. Geert Bergsma
E-mail: bergsma@ce.nl

WWW www.ce.nl

Profile CE Delft is an independent research and consultancy organization specialized in developing innovative solutions to environmental problems. The solutions CE Delft delivers are technologically robust, economically prudent, politically feasible and socially equitable. Every CE Delft project is geared to practical results. Whether trained in engineering, economics, philosophy or environmental science, every one of CE Delfts 35 staff is keen to see their work lead to real change. Established in 1978 as a not-for-profit operation, CE Delft remains financially independent and unsubsidized to this day. CE Delft is a tight-knit think-tank geared to projects where quality is of the essence, projects that benefit from a multidisciplinary approach, with the required skills directly at hand, as well as people accustomed to working from a broad perspective. A wide range of clients -government, industry and NGOs, Dutch as well as international-have already found their way to CE Delft. They recognize the organization's expertise and experience and prize its independent attitude

Organisation [CleanerG B.V.](#)

Coordinates Lindtsedijk 8, NL-3336 LE Zwijndrecht, The Netherlands
Phone: +31 (0)78 610 9911

Contact Mr J. van Driel
Phone: +31 (0)78 610 9911
E-mail: j.driel@unimills.nl

WWW www.unimills.com

Profile CleanerG is a producer of biodiesel, based on a variety of crude materials

Organisation [Cogen Projects B.V.](#)

Coordinates P.O. Box 197, NL-3970 AD Driebergen-Rijsenburg, The Netherlands
Phone: +31 (0)30 691 1844, Fax: +31 (0)30 691 1765
E-mail: info@cogen.nl

Contact Mr. A.T.M. Schlatmann

WWW www.cogenprojects.nl

Profile Cogen Projects is a consultancy company active with local energy supply, including chp units with biomass. We cover the whole project definition and feasibility phase, including technology choices, the biomass logistics, contracts, investments, subsidies and economics, permits and the tendering.

Organisation **Cornelissen Consulting Services B.V.**

Coordinates Welle 36, NL-7411 CC Deventer, The Netherlands
Phone: +31 (0)570 667 000, Fax + 31 (0)570 - 667 001
E-mail: secretariaat@cocos.nl

Contact Dr. R. Cornelissen

WWW www.cocos.nl

Profile CCS is an innovative consultancy and engineering firm in the field of energy saving and renewable energy. The activities of CCS range from energy saving studies for buildings to designing innovative installations for the generation of second generation biofuels. The consultants and developers of CCS apply exergy analysis and process integration to reduce the amount of energy needed and to make the generation of this energy more sustainable.

Organisation **Cumae B.V.**

Coordinates P.O. Box 65001, NL-6800 JM Arnhem, The Netherlands
Phone: +31 (0)26 356 9999

Contact Mr. R. Prop
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E-mail: rene.prop@cumae.nl

WWW www.cumae.nl

Profile Cumae is a multidisciplinary company on Project Management & Engineering in the field of Civil, Industry & Energy. Cumae serves clients through offices in The Netherlands and Aruba. Regarding the Energy market Cumae focuses on Waste-to-Energy, Biomass, Geothermal Energy, Ocean Thermal Energy Conversion (OTEC) and Cryogenic ORC's (CORC). Cumae is part of the IV-Group of companies (www.iv-groep.nl)

Organisation **Dahlman (Technisch Bureau Dahlman B.V.)**

Coordinates P.O. Box 438, 3140 AK Maassluis, The Netherlands
Phone +31 (0)10 599 1111

Contact Mr. Jan-Willem Könemann
Phone: +31 10 5991114
E-mail: j.w.konemann@dahlman.nl

WWW www.olgatechnology.com www.dahlman.nl

Profile Dahlman is a Dutch company founded in 1885. Our main markets are power, (petro)chemicals and refineries, where we deliver filtration and separation technology and custom made special equipment. We serve clients worldwide. In cooperation with ECN we developed the OLGA technology, which removes tar out of biomass gasification product gas. In 2007 the OLGA technology became a commercially available. A special dedicated team focuses on the OLGA technology and the renewable energy market. Gas cleaning and conditioning is our specialty. Gas cleaning equipment including OLGA is designed for power generation plants (gas engines and gas turbines) as well plants producing SNG, H2 and other green applications

Organisation **DELTA Milieu Biofuels**

Coordinates P.O. Box 445, NL-4530 AK Terneuzen, The Netherlands
Phone: +31 (0)115 67 8800, Fax: +31 (0)115 67 8880

Contact Mr. Ton Jacobs
Phone: +31 (0)6 223 765 22
E-mail: tjacobs@delta.nl

WWW www.delta.nl

Profile Production of solid biofuels (chips, shrips), digestion of wet biomass residues, co-firing of biofuels in a coal fired power plant, trade in solid biofuels.

Organisation **Diligent Energy Systems B.V.**

Coordinates Smalle Haven 87, NL-5611 EH Eindhoven, The Netherlands
Phone: +31 (0)40 750 5517
E-mail: request@diligent.nl

Contact Mr. Ruud van Eck

WWW www.diligent.nl

Profile Diligent Energy Systems produces sustainable biofuels: bio-oil from the tropical plant *Jatropha Curcas* in Tanzania, and bio-ethanol from coffee wastes in Colombia. Established in 2004, Diligent is involved in production, processing as well as research activities, and occasionally supports consultancy activities. Diligent biofuels are produced in close cooperation of rural communities and with the strictest standards of environmental, ecological and social care - as has been testified in various independent evaluations by SenterNovem, RIVM and other third parties. Diligent seeks to be innovative, both in technology, and in the way it organises its business, in order to remain a leading producer of sustainable biofuels.

Organisation Dutch Waste Management Association / Vereniging Afvalbedrijven

Coordinates P.O. Box 2184, NL-5202 CD 's-Hertogenbosch, The Netherlands
Phone +31 (0)73 627 9444, Fax: +31 (0)73 627 9449
E-mail: info@dwma.eu

Contact Mr. D. Hoogendoorn

WWW www.verenigingafvalbedrijven.nl (Dutch site)

Profile The Dutch Waste Management Association represents the interests of Dutch waste companies at both the national and international level. Our members are active throughout the whole waste chain and are responsible for collecting, recycling, processing, biological treatment, incinerating and land filling waste. Some companies are active in sewer maintenance. The Dutch Waste Management Association works for a healthy and balanced business climate in the Netherlands and Europe and promotes efficient, practicable and sustainable waste management. The Dutch Waste Management Association represents its members in negotiations with government and other organisations. The Association represents about two-thirds of the Dutch waste market. Waste-to-energy is a important subject for the Dutch Waste Management Association. Waste-to-Energy plants and sludge incinerators produce more than 15% of all Dutch sustainable energy each year. The sector is building new biomass power plants to process wood waste into energy. A transition is underway from composting to anaerobic digestion of VGF waste in which not only compost but also biogas is produced. In addition, the woody fraction separated from VGF waste can be used as a fuel for energy production in biomass power plants.

Organisation ECN - Energy research Centre of the Netherlands

Coordinates ECN Biomass, Coal & Environmental Research,
P.O. Box 1, NL-1755 ZG Petten, The Netherlands

Contact Mrs. Yvonne Vriendjes
Phone: +31 (0)224 56 4729
E-mail: vriendjes@ecn.nl

WWW www.ecn.nl

Profile ECN is the leading institute on energy-related R&D in the Netherlands. ECN develops high-level knowledge and technology for a sustainable energy system and transfers it to the market. In the R&D Programme on Biomass and Coal, the focus is on development and application of thermo-chemical conversion techniques to convert biomass, coal and/or waste into heat and power, gaseous energy carriers, transportation fuels and chemicals. Activities include desk studies to assess the techno-economic potential of different technology options, experimental R&D using lab-, bench- and pilot-scale test rigs, technical assessment and de-bottlenecking of commercial installations, and advice and policy support.

Organisation Ecochip B.V.

Coordinates Burgemeester Backxlaan 248, NL-7711 AL Nieuwleusen, The Netherlands

Contact Mr. C.B. Siero
Phone: + 31 (0)529 48 8075
E-mail: info@ecochip.nl

WWW www.ecochip.nl

Profile Ecochip is a company specialised in the supply of cuttings and other remaining products from the wood processing industry, with key clients in the energy sector, as well as board industry. Ecochip trades only in virgin rest wood products as woodchips and wood pellets. Ecochip, however, is far more than only a supplier of biomass and commodities. Client's specifications, business development with care for the future, as well as politics have lead tot the development of a global supply chain management system, in which "sustainable" is the key word. Ecochip is certified under ISO 9001:2000.

Organisation Eindhoven University of Technology, Environmental Technology Group SET

Coordinates P.O. Box 513, NL-5600 MB Eindhoven, The Netherlands
Phone: +31 (0)40 247 2850, Fax: +31(0)40 244 6653

Contact Dr. K.J. Ptasinski
Phone +31 (0)40 247 3689
E-mail: k.j.ptasinski@tue.nl

WWW www.chem.tue.nl/set

Profile Research at SET group includes: biomass torrefaction, in-bed measures in biomass gasifier for SNG production, catalytic biogas cleaning and evaluation of biomass-to-biofuels chains using exergy analysis.

Organisation ENECO

Coordinates P.O. Box 1950, NL-3000 BZ Rotterdam, The Netherlands

Contact Mr. K.M Langen, International sourcing
Phone: +31 (0)88 895 3620
E-mail k.m.langen@eneco.nl

WWW www.eneco.nl

Profile Eneco is an integrated energy company working in the field of energy production, trading, distribution and supply of gas, electricity, heat and additional services. Eneco has approximately 5300 employees. The head office, the core companies and the business units are located in Rotterdam: several offices are located in other parts of the country. The shares of Eneco are held by 61 Dutch municipalities. Some 2 million customers use the energy supplied by our company. Large companies, small and medium sized businesses and many households rely on our services.

Organisation Essent

Coordinates P.O. Box 2088, 7420 AB Deventer, The Netherlands

Contact A.L.J. van Weereld, Senior vice president global commodities
Phone: +31 (0)6 558 259 30
E-mail: alf.van.weereld@essent.nl

WWW www.essent.nl

Profile Essent is market leader in energy in the Netherlands with more than 800.000 Green Energy customers (Groene Stroom®). Essent is active throughout the entire energy chain: from the production of energy up to and including supply to end users. With over € 150 million invested in biomass plants/facilities, Essent has extensive experience in biomass firing and is one of the largest buyers of biomass in the world (1.5 – 2 million tons annually; biomass is the main source of our Green Energy). The unique 'Essent Green Gold Standard' track & trace system was the first certification label of its kind developed to manage and control all steps in the biomass chain 'from source to customer'. Essent is involved in research, strategic and technical development groups in connection with sustainable energy. It is Essent's aim to use as much biomass as possible for the sustainable production of energy.

Organisation FACT Foundation

Coordinates Horsten 1, NL-5612 AX Eindhoven, The Netherlands
Phone: +31 (0)40 236 4315, Fax: +31 (0)84 836 2006

Contact FACT Foundation
E-mail: info@fact-fuels.org

WWW www.fact-fuels.org

Profile FACT Promotes biofuels in developing countries for local economies. FACT collects, analyses and disseminates knowledge and expertise on biofuel production, use and marketing. FACT conducts R&D on agricultural as well as technical aspects of biofuels. FACT also initiates and supports rural biofuel development projects.

Organisation IMSA Amsterdam Sustainability and Innovation

Coordinates Prins Hendriklaan 15, NL-1075 AX Amsterdam, The Netherlands
Phone: +31 (0)20 578 7600, Fax: +31 (0)20 662 2336

Contact Mr. Arthur ten Wolde
Phone: +31 (0)20 578 7624
E-mail: arthur.ten.wolde@imsa.nl

WWW www.imsa.nl

Profile IMSA Amsterdam is a leading global think tank on matters of environment and sustainability, formed in 1985. IMSA's founder and chairman is Wouter van Dieren, member of the Club of Rome. IMSA has a staff of 20 in house professionals. As a think tank and a so-called resultancy (rather than a consultancy), IMSA has designed breakthrough environmental management systems for major industries, governments and green NGOs. It has managed solutions in difficult political-ecological conflicts such as the fifteen-year old dispute over gas production in the Wadden estuary. IMSA has been deeply engaged in biomass research, consultancy and business from the start. Currently, IMSA is working on various biomass projects for the portfolio of a new investment fund. In addition, many biomass activities fall under the OASE Foundation (see separate listing), an IMSA initiative.

Organisation IMSA Amsterdam Sustainability and Innovation - OASE

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Contact Mrs. Jeannette Hoek
Phone: +31 (0)20 578 7652

WWW www.oasefoundation.eu

Profile OASE, Organisation for Agriculture in Saline Environments, is an offshoot of IMSA-Amsterdam (Institute for Environment and Systems Analysis). It's mission is to encourage developments in bio saline agriculture and agro-forestry by raising awareness, showing the power of bio saline solutions and building coalitions between public and private partners. The production of biomass for energy and biomaterials on saline 'waste'-lands is a major focus of OASE. Other activities are the production and sales of speciality food products like Salicornia. OASE is cooperating with partners in Mexico, the Emirates, S-Asia and Europe.

Organisation IVAM Research and Consultancy on Sustainability - University of Amsterdam

Coordinates P.O. Box 18180, NL-1001 ZB Amsterdam, The Netherlands
Phone: +31 (0)20 525 5080, Fax: +31 (0)20 525 5850

Contact Mr. B. Krutwagen
Phone: +31 (0)20 525 5911

E-mail: bkrutwagen@ivam.uva.nl

WWW www.ivam.nl

Profile IVAM is the sustainability research centre and consultancy of the University of Amsterdam. Integral approaches and life cycle thinking in analysing complex problems regarding sustainability are the main competences. IVAM is at the forefront of life cycle analyses on biomass and waste with in depth knowledge of the (agricultural) supply chain, biomass and waste generating industries and households, biomass treatment and applications, not only in energy conversion but also on (partly) extraction and production of valuable products from biomass and waste. The IVAM LCA database is a well known knowledge base. IVAM is active both on national level (National Waste Management Plan) as on European level (e.g. development of the European guidelines for management of biodegradable municipal waste) in research, modelling, tool development and advice.

Organisation KARA Energy Systems B.V.

Coordinates P.O. Box 570, NL-7600 AN Almelo, The Netherlands

Contact Mr. G. Prinsen
Phone: +31 (0)546 87 6580, Fax: +31 (0)546 87 0525,
E-mail: kara@kara.nl

WWW www.kara.nl

Profile KARA is a company specialised in the combustion of biomass fuels, e.g. wood chips, MDF dust, waste wood, agriculture waste. The energy formed by the combustion can be transferred into warm water, hot water, steam, thermal oil, or electricity or a combination of these. The design, production, installation and commissioning of the turn-key combustion systems is done by KARA engineers and production personnel. The installation are in the range of 200 kW up to 10 MW thermal output. KARA supplies not only the combustion system, but also shredders, flue gas cleaning and all other auxiliary equipment around biomass combustion systems. So KARA can deliver a total project from shredder up to the chimney of the installation. KARA supplies installation to the Netherlands and to the rest of the world.

Organisation National Institute for Public Health and the Environment (RIVM)

Coordinates

Contact info@rivm.nl

WWW www.rivm.nl

Profile The National Institute of Public Health and the Environment is a research institute for policy support relating to public health and the environment. It also serves as the government centre of expertise, incorporating a policy assessment function for both the environment and nature conservation. Core tasks, as laid down by legislation are:

1. to conduct research geared to policy support and supervision in the fields of public health, the environment and nature conservation;
2. to publish periodic reports on the current status and future trends of public health and the environment;
3. to carry out any other activities that may be required by the Minister.

The RIVM is professionally autonomous in carrying out these tasks. Other activities undertaken by the RIVM may not impinge upon the tasks explicitly assigned to it by legislation. The RIVM is accountable to the Minister of Health, Welfare and Sport. RIVM's products (information, advice, measurement data, research reports, status reports, long-range forecasts, journal articles, vaccines) find their primary use in the support and implementation of government policy on public health, the environment and nature conservation. The RIVM comprises approximately 30 laboratories and centres divided into four divisions. The divisions work closely together on an project basis. Their main activities are

described in our brochure.

Organisation Netherlands Bioenergy Association

Coordinates P.O. Box 9035, NL-6800 ET Arnhem, The Netherlands
Phone: +31 (0)26 356 3488, Fax: +31 (0)26 351 3683

Contact Mrs. Ria Kalf
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E-mail: info@platformbioenergie.nl

WWW www.platformbioenergie.nl

Profile The Netherlands Bioenergy Association its mission is to promote the development of bioenergy in The Netherlands, in all its forms, in a socially acceptable way. The members of our association are project developers, energy and waste companies, agricultural organisations, universities and knowledge institutes.

Organisation Nij Bosma Zathe ASG Wageningen UR

Coordinates Boksumerdyk 11, NL-9084 AA Goutum (near Leeuwarden), The Netherlands,
Phone: +31 (0)58 21 7592

Contact Mr. Durk Durksz
E-mail: info@nijbosmazathe.nl

WWW www.nijbosmazathe.nl

Profile Nij Bosma Zathe is one of the dairy research farm of the Animal Sciences Group of Wageningen UR. NBZ 3 digesters: 1 small manure-digester (80 M3) especially for research on co-digestion products in the digester. And 2 digesters (1200 m3) for production biogas. The biogas is being uses for the production of green-electricity and for heating a part of the city Leeuwarden (700-800 households). We are preparing a 4th digester for production biogas for using as biogas-fuel for the city busses.

Organisation Orgaworld B.V.

Coordinates P.O. Box 5076, NL-5216 PR 's-Hertogenbosch, The Netherlands
Phone: +31 (0)73 687 2600, Fax: +31 (0)73 687 2609

Contact Mr. Henk Kaskens MSc

WWW www.orgaworld.nl

Profile Processor of organic waste. Producer of energy products out of waste.

Organisation Port of Rotterdam

Coordinates P.O. Box 6622, NL-3002 AP Rotterdam, The Netherlands
Phone: +31 (0)10 252 1010

Contact Mr. W. Schonewille
Phone: +31 (0)10 252 1624,
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Profile The Port Authority is the authority that develops, manages and operates the port of Rotterdam effectively and efficiently. The Port Authority also promotes the interests of the port community and helps strengthen the port's competitive position. Sustainability is one of the focus points of the Port Authority. The Port of Rotterdam covers some 10,500 hectares, and is a major factor in the international and regional economy. The port is a hub for international freight flows, and a business location for industry and logistics services. As the manager of the port, the Port of Rotterdam Authority leases sites amounting to around 5,000 hectares to businesses.

Organisation Probos Foundation

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Profile The Probos Foundation is a knowledge centre for forestry and forest products. Already since 1990 the group has been involved in different studies and projects to develop woody energy plantations. Also since 1990 market studies are performed for used wood, rest products from the wood working industry and forestry for the production of sustainable energy.

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Profile Procede Biomass BV is a subsidiary R&D company of Procede Group involved in R&D and commercialization of bioenergy technologies. Specific research and consultancy services are provided to industries and governments involved in market implementation of bioenergy systems. Activities of Procede Biomass are aimed at increasing the efficiency of bioenergy technologies, and lowering emissions and costs of operation. Focus areas are biomass combustion systems (varying from wood stoves to industrial biomass combustion plants) as well as new routes for liquid biofuels. About 30 highly skilled process engineers, laboratories, skilled technicians and a well-equipped workshop are available to perform research and troubleshooting in R&D projects.

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Profile Rabobank Group is a full-range financial services provider founded on cooperative principles. We are a global leader in Food and Agri financing and in sustainability-oriented banking. The Group comprises 174 independent local Dutch Rabobanks, a central organisation (Rabobank Nederland), and a large number of specialised international offices and subsidiaries.

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Profile The Raedthuys Group is a chain of enterprises specialized in renewable energy projects. Our activities consist of Project Development, Project Financing, Project Execution, Insurance of renewable energy projects, Maintenance management, Development of green Funds. The Raedthuys Group wants to play a leading role in the development of renewable energy and contribute to a stable and environmental friendly supply of energy world wide now and in the future.

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Profile Rodenburg Biopolymers B.V. produces bio plastics from starch and modified starch

Organisation Rosendaal Energy B.V.

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Profile Construction on Rosendaal Energy's first biodiesel plant began in 2007. In the summer of 2008 this factory's production, destined for the North West European market, will amount to 280 million litres per annum. The factory is multifeedstock: both vegetable oils and animal fats can be used as raw materials. Rosendaal Energy does research in co-operation with Wageningen University and the Technical University of Eindhoven to discover new alternative sources of energy. The research is directed at: better raw materials; more efficient production processes and cheaper biodiesel; algae and algae oil; creating new, high yielding applications for glycerine; cogeneration based on biomass; technology for second and third generation biodiesel; other forms of biofuels.

Organisation Royal Dutch Shell plc

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Profile Shell buys, trades, stores and blends biofuels and is the largest distributor in the world with 5 billion litre in 2007. Shell is a leader in the research and development of the next-generation biofuels, with several R&D centres around the world. We have a number of partnerships, both academic and commercial, to accelerate our work.

Organisation Royal Nedalco

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Profile Nedalco is one of the leading alcohol producers in Europe. At the moment Nedalco participates in several R&D partnerships in both Europe and the US to commercialise the production of fuel ethanol from (hemi)cellulosic biomass. Nedalco has a strong knowledge and IP position in C5 fermentation.

Organisation State University of Groningen, Department of Chemical Engineering, Unit Green Chemical Reaction Engineering

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Profile Novel catalytic conversions as well as activities to improve the performance of existing catalytic processes for biomass conversions to biofuels and biobased products are explored. The emphasis is on low-medium temperature (< 400 °C), liquid phase catalytic systems using both homogeneous and heterogeneous catalysts. Three types of biomass and derived products have our special attention: fast-pyrolysis oil, vegetable- and animal oils and fats and valorisation of the waterhyacinth plant.

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Profile TCCB is a relatively young research and education group on biomass as an energy source. Our research mission is: "Creating and perfecting new thermo-chemical routes for the production of biomass derived solid, gaseous and liquid fuels for renewable and sustainable energy". Research items are: liquefaction, gasification, upgrading to fuels and chemicals, CO₂ capture and (industrial) biomass production. Currently TCCB has 4 fte scientific staff and 14 fte PHDs and post-docs. Funding is obtained from national and international subsidy programs and also for a significant part from bilateral projects with the industry.

Organisation TNO

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Profile TNO, the Netherlands Organisation for Applied Scientific Research, is a contract research organisation with clients from industry and governments. In the field of biomass process development, optimisation and modelling is carried out as well as testing and LCA studies. Subjects are feedstock engineering for fermentation processes, conversion of biomass into bioethanol, biohydrogen, biogas, lactic acid and other chemicals; pre-treatment and hydrolysis of lignocellulosic biomass; second generation biofuel production, pyrolysis, HTU, gasification and incineration of biomass, bioplastics and carbohydrate modification.

Organisation **Tri-O-Gen B.V.**

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Profile Tri-O-Gen B.V. develops and produces ORC systems that apply waste heat to generate electricity in a cost efficient and environmentally friendly manner, thus substantially contributing to solving the global warming problem. An ORC (Organic Rankine Cycle) operates just like a steam cycle. However, water and steam are replaced by a working fluid which fits better lower operating temperatures and the small scale of the plant. Tri-O-Gen ORC's handle heat source temperatures from 350 to 600 o C, producing 160 kWh. In principle, anything that provides heat can be linked to a Tri-O-Gen ORC, varying from flare gas on an oil rig or landfill site to exhaust gases of a gas or diesel engine or a gas turbine. As long as there is sufficient at least 350 o C waste heat, the gas can serve as the ORC's heating source.

Organisation **TU Delft, Faculty 3mE, Department of Process & Energy Technology, Energy Technology Section**

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Profile The Energy Technology section is active in research and education concerning sustainable technologies. The focus of research is on thermodynamic evaluation of different conversion technologies (incl. fuel cells, gas turbines, ORC), dynamic system behaviour and biomass/coal thermal and chemical conversion technologies (combustion, gasification, hydrolysis / CO₂ capture) as well as advanced flameless combustion of derived gaseous fuels. The section is active in many European and nationally funded projects.

Organisation **Twence B.V.**

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Profile Twence is a waste-processing company that is increasingly becoming a producer of energy. An important factor in that is the Biomass Power Plant, one of the largest stand-alone plants of its kind in the Netherlands. In contrast to other such plants, the one at Twence only processes waste materials such as waste wood and other organic waste that is unsuitable for composting. Part of the fuel it uses comes from Twence's own composting company and waste-sorting plant. That means that no special crops of trees are grown to serve as fuel for this biomass power plant. Thanks to the type of fuel it uses, 100% of the electricity it generates can be designated as "green" energy. Each year, the new plant will be able to convert 140,000 tonnes of biomass into 163 GW of electricity, enough to satisfy the electricity needs for 44,000 households. In addition, Twence also recovers landfill gas from various landfills.

Organisation **Van der Wiel Stortgas B.V.**

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Profile The company of Van der Wiel and her affiliated companies develops and executes projects which are related to sustainable and renewable projects. The projects which Van der Wiel focuses on are projects which produce electrical and/or thermal energy based on biogas and landfill gas. Van der Wiel selects projects based on a turn-key basis which she can develop, designed and built. In various cases Van der Wiel is also involved as the exploiter of such projects together with other project partners.

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Profile Van Hall Larenstein is a University of Applied Sciences offering Bachelor programmes for, amongst others, Agriculture, Animal Sciences and Environmental Sciences as well as a number of Specialist Certificate programmes. In their Bachelor programme, students can specialize in the theme of Bioenergy. Applied research and consultancy activities are part of the education programme and are done in cooperation with the department of Training & Consultancy. A laboratory is available for doing lab- and pilot tests. Van Hall Larenstein is part of Wageningen University and Research Centre. Our activities on Sustainable Energy are displayed on our theme site www.vhlde.nl.

BioWho.NL

	Along the biomass chain											Activities										
	Front End			Conversion							End Use											
	Biomass Production	Logistics	Pre-treatment	General	Combustion	Gasification	Digestion	Fermentation	Thermal Upgrading	Gas/Water Treatment	Biorefinery	Heat Power	Fuels	Chemicals	Research & Development	Products / Processes	Engineering	Consultancy	Financing	Association	Governmental Body	NGO
Abengoa Bioenergy Netherlands B.V.								x							x	x	x					
Alterra B.V.	x	x		x			x								x			x				
AVR van Gansewinkel	x	x	x	x	x		x	x	x	x		x	x	x	x	x	x					
BGI																						
BioEnergie Twente B.V.																						
BiogaS International	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	
Biovalue Holding B.V.	x		x								x		x		x	x	x	x				
Bosschap, Board for Forests and Nature	x			x											x							x
Brouwers BioEnergy BV				x			x					x				x	x	x				
Bruins & Kwast																						
CE Delft	x		x	x	x	x	x	x	x	x	x	x	x	x				x				
CleanerG B.V.			x								x		x			x						
Cogen Projects B.V.				x	x	x	x	x		x		x					x	x				
Cornelissen Consulting Services B.V.				x											x	x	x	x				
Cumae B.V.		x	x	x	x		x	x	x	x		x	x	x		x	x	x				
Dahlman (Technisch Bureau Dahlman B.V.)						x			x	x	x	x	x	x		x	x	x				
DELTA Milieu Biofuels	x				x	x	x		x			x				x						
Diligent Energy Systems B.V.	x	x	x	x											x	x		x				
Dutch Waste Management Association																					x	
Energy research Centre of the Netherlands			x	x	x	x			x	x	x	x	x	x	x	x		x				
Ecochip B.V.	x	x	x									x	x			x		x				
Eindhoven University of Technology SET Group															x							
ENECO	x			x	x	x	x				x	x	x			x	x	x				
Essent	x											x				x		x				
FACT Foundation	x				x		x					x	x		x		x	x				x
IMSA Amsterdam Sustainability and Innovation	x	x		x								x	x	x	x	x		x				
IMSA Amsterdam Sustainability and Innovation	x	x			x	x							x		x	x						
IVAM	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x			x
KARA Energy Systems B.V.					x											x	x					
Institute for Public Health and the Environment				x																		x
Netherlands Bioenergy Association	x	x	x	x	x	x	x	x			x	x									x	
Nij Bosma Zathe ASG Wageningen UR	x			x			x					x			x	x						
Orgaworld B.V.	x		x				x	x					x			x	x					
Port of Rotterdam		x			x	x	x	x	x	x	x	x	x	x		x		x			x	
Probos Foundation	x	x		x											x			x				
Procede Biomass B.V.				x	x						x	x	x	x	x	x	x	x				
Rabobank Nederland																		x	x			
Raedthuys Groep		x	x	x	x	x	x	x		x		x	x		x	x	x	x				
Rodenburg Biopolymers B.V.				x					x						x	x						

References

- [1] SenterNovem. Testing Framework for Sustainable biomass. February 2006.
http://www.senternovem.nl/mmfiles/Testing%20framework%20for%20sustainable%20biomass_tcm24-232796.pdf
- [2] CBS, 2008. Duurzame energie in Nederland 2007 (Sustainable energy in the Netherlands, 2007). Voorburg/Heerlen, December 2008.
- [3] CBS, 2007. Duurzame energie in Nederland 2006 (Sustainable energy in the Netherlands, 2006). December 2007.
- [4] CBS, 2006. Duurzame energie in Nederland 2005 (Sustainable energy in the Netherlands, 2005). November 2006.
- [5] ECN/KEMA, 2007. Technisch-economische parameters van duurzame elektriciteitsopties in 2008-2009. Conceptadvies basisbedragen voor de SDE-regeling. (Technical-economic parameters of sustainable electricity options in 2008-2009. Draft recommended basic amounts for SDE scheme). November 2007
- [6] KEMA, 2008. Bio-energie in Nederland: monitoring vergunningverlening 2006 (Bioenergy in the Netherlands: monitoring permits) (commissioned by SenterNovem). February 2008.
- [7] SENTERNOVEM, 2006. Protocol Monitoring Duurzame Energie Update 2006 (Protocol for monitoring sustainable energy, update 2006). December 2006.
- [8] STAATSBLAD 2007, 410. Besluit stimulering duurzame energieproductie (Decree on incentives for sustainable energy production)
- [9] VROM *et al.*, 2007. Werkprogramma Schoon en zuinig (Clean and Efficient programme). September 2007.
- [10] Milieujaarverslagen E-centrales, AVIs (annual environmental reports by power plants and waste incineration plants).
- [11] Download the Executive Summary of the EOS Energy Research Strategy from:
<http://www.ez.nl/publicaties/pdfs/02ME04.pdf>