

Biobased PPP in the Netherlands

National policy in the Netherlands

In February 2011 the Dutch government defined ten top sectors in which the Netherlands excels globally. These sectors have since then become a government priority for the next decade and aim to put the Netherlands in the top 5 of world knowledge economies by re-allocation of Dutch R&D investments by forming co-financed public private consortia. The top sectors aim to provide a solid exchange between knowledge institutes, industry, and government. The government invites companies and scientists to draw up action plans to implement the goals and form public private partnerships (PPPs). Chemistry is one of the top sectors and is geared to put the Netherlands in the worldwide top of industries in green chemistry and smart materials by 2050.

The top sector Chemistry is divided into the focus areas: Smart Polymeric Materials, Process Technology, New Chemical Innovations and Biobased Economy. The latter is positioned at the interface of several top sectors, among which the top sectors chemistry and energy. For each of these areas so-called Top consortia for Knowledge and Innovation (TKI) have been set up.

Dutch PPP Delta

To form a successful PPP an experienced intermediate is vital. On a national level the Netherlands Organisation for Scientific Research (NWO, the national grant organisation), NL Agency (governmental body for the implementation of international, innovation and sustainability policy) and TNO (Netherlands Organisation for Applied Scientific Research) are key intermediates. NWO is a partner in the INNOVA BIOCHEM project of which the goals are closely connected to the focus area 'Biobased economy'. Despite the small surface area, the Netherlands have everything they need to make a biobased economy. First of all, it has a highly productive agrofood sector and petrochemical industry. Furthermore, there is a network of strong research facilities at universities and institutes. In addition, the Netherlands are a logistical hub for Europe with large sea harbors and airports.

The past decennium several successful biobased PPPs have been established. Many of these are focused on integrated biorefinery and biobased chemicals and they will form the basis of the future priority areas. In frame 1 the most prominent past and present Dutch PPPs in the field of biobased economy are listed.

Frame 1:

Dutch PPP in the field of biobased products

[ACRRES](#) : sustainable energy and green building blocks

[BE-BASIC](#) : sustainable chemistry and ecology (see also frame 4)

[BIOCAB](#) : conversion of biomass waste streams

[BioSolar CELLS](#) : efficient use of solar energy

[BPM](#) :biobased performance materials

[CCC](#) :carbohydrate competence center

[CatchBIO](#) : efficient processes for biomass conversion (see also frame 5)

[IBOS](#) : integration of biosynthesis and organic synthesis

[ISPT](#) : Institute for Sustainable Process technology

[WETSUS](#) : center of excellence for sustainable water management

National platforms have underscored the importance of developing a strong and sustainable biobased sector. First of all, several legislative obstacles have been removed by the national government when so-called 'green deals' were launched. Moreover, the Dutch government has put certificates for biobased fuels and import taxes on the European agenda in order to make competition with petrochemical fuels feasible.

To give start-ups a lift, so-called Centers of Open Chemical Innovation (COCI) have been developed in regional PPP consortia. In these centers general items such as licenses, infrastructure and test facilities are in place to allow companies to focus on product development. Biobased companies have also organized themselves to benefit from each other's knowledge and end products for instance in the Dutch Biorefinery Cluster, the organization of Dutch biomass feedstock producers.

Biomass conversion

The vast availability of sugar beets and agricultural waste in the Netherlands allows a potential rapid replacement of chemical building blocks derived from the petrochemical industry. Experts consider a time frame of approximately twenty to thirty years to be realistic for a major transition towards green chemistry. First generation biomass conversion and the first steps in the transition towards a biobased economy preferably take place within the conventional petrochemical infrastructure of plants and distribution networks. Primarily chemical building blocks with low carbon numbers can be isolated via this route such as bioethylene, bioethanol, biomethane, biosyngas and biomethanol. From biomass-derived glycerol even C3-compounds such as biopropene can be made.

The smart combination of thermochemistry, bio- and chemocatalysis paves the way for second generation biomass conversion focused on higher carbon number containing fractions of biomass. The most abundant fraction left unused in conventional first generation biomass conversion is lignocellulose (cellulose, hemicellulose and lignin). Not only does conversion of these compounds allow synthesis of higher carbon number containing building blocks, but also more value added chemicals such as aromates, composites and polymers. Several platforms are now optimizing the use of lignin for chemical production, for instance within the PPP BE-BASIC and CatchBio (see frame 2 and 3).

Frame 2:

BE-BASIC

This international PPP funded by the Dutch government unites approximately 30 parties from universities, research institutes and industries of various scales in the field of sustainable chemistry and ecology. Partners in BE-BASIC collaborate on both fundamental science and industrial challenges to develop bio-chemicals, bio-materials, bio-construction concepts and bio-based monitoring tools by using biotechnology as enabling technology. BE-Basic is coordinated by Delft University of Technology.

Frame 3:

CatchBio

The CatchBio consortium unites fundamental and applied researchers in academia with specialist chemical companies operating on the world market. The consortium is divided into three production sectors: energy, bulk chemicals and fine chemicals/pharmaceuticals. One of the main central questions of the consortium is the efficient conversion of lignin. Waste from the paper industry, wood waste, wheat straw and other non-food biomass streams all contain lignin. CatchBio researchers have discovered a catalyst that can dissolve almost all types of lignin. Within CatchBio the conversion of biomass into biopolymer raw material, and subsequent synthesis of polymers for the production of items such as car tyres, packaging material, automotive parts and carpets are being further investigated.

SME support

The notice is growing that innovation from fundamental research to a successful biobased product requires a flourishing small and medium sized enterprise (SME) segment, in particular a group of knowledge intensive SME. On a national level several measures have been taken. First of all, the national policy of top sectors is specifically designed to involve SMEs in PPPs. Furthermore, a series of tax benefits for companies are being developed.

Besides legislative reforms, SMEs need solid networks and excellent communication between knowledge institutes and industry. Several national and regional platforms are being initiated to support SME to operate at this interface among which new PPPs, regional clusters and biobased science parks.

Regional clusters

The successful formation of a biobased economy in the Netherlands strongly depends on regional efforts. The regional governments of provinces have invested money, facilities and manpower to create biobased clusters. Every region has its own focal point owing to the presence of universities and agricultural, chemical or petrochemical industry.

(see map below, in clockwise order)



Figure 1
Regional Biobased clusters in the Netherlands

1) North Region:

With a strong agricultural basis and increasing energy related activities this region is mainly focused on crop improvement and green chemical building blocks. Highlights of this region are the Carbohydrate Competence Centre and Biobased Economy Noord Nederland (North-Netherlands), the seat of the [Dutch Biorefinery Cluster](#) and [Energy Valley](#).

2-3) East and Central Region:

The core of this region lies at Wageningen University and Research Center. Together with energy companies, pilot facilities for microalgae and (paper) pulp have been initiated. Highlights of this region are [AlgaeParc](#), where the production of biodiesel and chemical building blocks from algae is being optimized, [ACRRES](#) and the spin-off company Waste2Chemical. (See also frame 4)

4) South Region:

The [Chemelot Campus](#) is situated around the DSM plant and is at the cross-section of chemical engineering, advanced bio-organic chemistry and bioperformance materials. Highlights of this region are the Chemelot Campus, with innovative company Avantium (see also frame 5) and Greenport Venlo.

5) South-West Region:

With the slogan 'agro meets chemistry' this international region has an integrated approach to invest in biobased economy. Agricultural (Cosun, Cargill) and chemical companies (DOW, Sabic, Shell), universities (Delft, Wageningen, Eindhoven, Gent) and government jointly invest in collaborative projects.

Highlights of this region are the Green Chemistry Campus (a COCI for biobased chemical innovations) and the subregions [Biobased Delta](#) in the Netherlands and [Bio Base Europe Pilot Plant](#) in Belgium.

6) West Region:

The area around the port of Rotterdam houses over 40 chemical companies and five oil refineries. Many companies provide base materials to their neighbors. The nearby Delft University of Technology is a knowledge hub for biorefinery.

Highlights of this region are [Plant One](#) (a COCI for process technology) and the Bioprocess Pilot Facility, among others pilot plant for the BE-BASIC PPP consortium (see also frame 2).

Frame 4:

Waste2Chemical

This young company is a spin-off company from Wageningen University and is founded on research within the sub-department of Environmental Technology. Waste2Chemical develops a platform technology that can robustly convert different types of organic waste or residues into chemical building blocks, mainly fatty acids. Currently, Waste2Chemical performs feasibility studies for different waste streams on lab scale and is preparing the technology for upscaling.

Frame 5:

Avantium

Avantium has created a technology for the production of a new category of green products from biomass called 2,5-Furandicarboxylic acid (FDCA) or Furanics. Furanics are green building blocks for a range of materials, chemicals and fuels. Up to now the production of furanics was not yet cost-effective. However, with the development of the YXY technology by Avantium and the development of the lead application polyethylene furanoate (PEF) this is radically changed. The YXY biorefinery pilot plant, a public private pilot programme, is located on the Chemelot campus in the South of the Netherlands. Avantium is currently in joint development programs with The Coca-Cola Company and Danone to make a 100% PEF bottle and with Solvay, Rhodia and Teijin Aramid for the creation of Furanic polyamide-based materials.

International perspective

The Dutch chemical industry is part of the large and international cluster spanning from Antwerp in Belgium to the Ruhr Area in Germany. Almost all leading U.S. and European chemical companies are active in this international cluster. Four of the 50 largest chemical companies (AkzoNobel, DSM, Lyondell Basell, and Shell Chemicals) are headquartered in the Netherlands. In addition, large multinationals Dow Chemical, Dupont de Nemours, ExxonMobil, and SABIC have significant operations in the Netherlands.

The development of a flourishing biobased economy in the Netherlands is strongly connected to international collaborations, especially in a country depending on the import of resources. Therefore, the bilateral collaborations with for instance China, Brazil, USA, Canada, Malaysia, Ukraine, Russia are being explored and developed. In addition to this, the development of a biobased economy will play an important role in the new European policy Horizon2020.

Consulted sources:

Newsletter Agro & Chemie, issue #1

[Innovation contract Biobased economy](#) 2012-2016

WTC [report](#) for the Biobased economy

[Innovation contract Bioenergy](#)

<http://avantium.com/>

<http://www.waste2chemical.com/>

<http://www.be-basic.org>

<http://www.catchbio.com/>

[VNCI-Deloitte report](#) The Chemical Industry in the Netherlands

Marjolein Lauwen, Netherlands Organisation for Scientific Research (NWO)