



SYSTEM INNOVATION: CASE STUDIES

NETHERLANDS - Biobased
economy



Case Study Systems Innovation

Biobased economy in the Netherlands

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1. Description of selected systems transition

Biobased Economy (BBE) is about the transition from an economy that runs on fossil oil to an economy based on biomass as a raw material: from fossil-based to bio-based. A biobased economy is, therefore, the use of biomass for non-food applications. These applications are chemicals, materials, transport fuels, electricity and heat.

Biomass is ideally suited to replace in applications where carbon is essential, such as liquid fuels, materials and chemicals. Biomass has compared with other fossil substitutes such as sun- and windenergy the unique property that it can be used for materials such as plastics, chemicals and cosmetics.

A biobased economy is where the used raw materials are primarily derived from nature (biomass). Current analysis shows that there is already a considerable biobased market in existence.

Widespread application of biomass will in the long term have a positive economic effect on the Dutch economy. A macro-economic survey of 2009 revealed that this effect could amount to 7 billion Euros per year. The environmental benefits are also considerable. The Social and Economic Council of the Netherlands has also emphasized the opportunities offered by a bio-based economy. In its recommendation to the government of December 2010 'More chemistry between green and growth', the Council stated that increasingly sophisticated technology means it is easier to utilize all parts of plants in new closed-loop value chains. The Council therefore urged the government to lend its full support to this promising and future-oriented economic approach.

The Netherlands has a strongly developed chemicals, energy and agricultural sector. The transition from fossil fuels to green raw materials offers major opportunities. Strategic partnerships between the various sectors will be required to maintain and build upon a good position.

Case study system.

The case study focuses on the transition towards a biobased economy in the Netherlands. The transition aims at the production of chemicals, materials and energy

carriers from agricultural feedstock, co-products and waste streams instead of fossil resources.

a) Addresses highly desirable societal benefits

The biobased economy aims to reduce greenhouse gas emission by replacing fossil resources as feedstock for chemicals, materials and energy by biomass. Furthermore diversification of feedstock is expected to make the Dutch society less dependent on a few oil producing countries, and thus increase economic and societal stability. Finally in view of the depleting fossil oil reserves, the biobased economy is expected to contribute to a more circular economy.

b) Links to major global business opportunities

The Netherlands have both a very strong agricultural sector and chemical sector. The agricultural sector is the second largest exporter of agricultural products in the world after the US, with a value of export in 2013 of 79 billion euro (5% more than in 2012¹). Furthermore, the Netherlands have a large, strong and innovative chemical sector², with a turnover of 60 billion euro. The Dutch chemical industry is after Germany and France the third largest producer in Europe. The Dutch chemical industry is responsible for almost 20 % of the export from the Netherlands. Linking these two sectors will give the Netherlands a strong business position in a new field of business activities.

c) Of importance to the country in question in terms of capabilities and competences

The Netherlands have a highly educated workforce. Both the agricultural as well as the chemical sector have a strong knowledge base in the Netherlands. Ever more farmers (both agriculture and horticulture) are highly educated. Wageningen University has a world-wide leading position as agricultural university. The chemical industry builds on several universities and applied universities providing chemistry education in various fields of expertise. Industrial biotechnology, integrating life science with chemistry is an evolving field. DSM, one of the larger Netherlands based multinationals is a key player in this field.

A related competency are logistics. With the presence of the harbour of Rotterdam and the other sea harbours, including the harbour of Amsterdam, which had a very strong position in agricultural commodities, the Netherlands have a very strong position in international trade. The Netherlands have over the years developed highly innovative

¹ <http://www.rijksoverheid.nl/nieuws/2014/01/17/agrarische-export-naar-recordhoogte.html>

² <http://www.vnci.nl/chemie/beschrijving-sector/>

logistic concepts. Furthermore the Netherlands have a large hinterland and is an important transit country for many goods aimed for other European countries. Just as Agri & Food, Horticulture & Starting Materials and Chemistry, Logistics is one of the topsectors, sectors that serve as a solid basis of the Dutch Economy.

d) Requiring considerable system transition to reach desirable performance

Using biomass for production of chemicals is not something that will develop automatically and overnight. The chemical sector is strongly linked to fossil feedstock. The scale of the chemical sector and the agricultural sector can be quite different. Also chemical companies and agricompanies, such as sugar and starch companies speak a “different language” using different jargon. Furthermore both lack a good picture of the competencies and skills of the other.

Supplying the chemical industry with a feedstock that has a widespread and intermittent production system, instead of a feedstock that is produced on a continuous basis concentrated in a few spots worldwide, requires a considerable change of the system. Furthermore, although the general public is generally unaware of the feedstock used to produce the materials they come across, a public discussion of the use of biomass (which is also the source of our food) for non-food products is necessary for eventual public acceptance of this production system, even though biomass use for non-food products is old as humanity.

e) Involving substantial policy involvement

Cooperation between different sectors such as agro & chemistry needs to be actively stimulated, this is a role for the government. Furthermore, sustainable innovations, which will form the basis of the transition towards a biobased economy need to be protected in the beginning of their life cycle, this also calls for active policy involvement. Another issue is that many of the advantages cannot be turned into value by private actors. It is typically the government that needs to act in order to let society benefit from issues like decreased greenhouse gas emissions, decreased emission of toxic substances, etcetera.

f) Involves public-private partnerships

The sustainable innovations that will form the basis of the transition towards a biobased economy are presently developed in a number of PPP R&D programs, in which companies of the various sectors and knowledge institutions cooperate, funded partly by the government and partly by the companies involved. A variety of programs

focuses on different technological aspects within the biobased economy: Towards Biosolar Cells (artificial photosynthesis and algae), Catch-Bio (catalytic chemistry on biomass), BE-Basic (biotechnological conversions), BPM (Biobased performance materials) and number of PPP projects fit on biorefinery. This listing is not complete.

g) Covering different layers of systems - Technological, Social, Economic, Policy

Technological: the transition involves set-up of new production processes, and using new feedstock involving new production chains

Social: The transition contributes to a transition towards sustainability. Society, however, is rightfully critical concerning the introduction of new technologies. Issues such as the perceived scarcity of food and the true sustainability of new products need to be discussed. Social wishes and preferences may limit the acceptability of certain applications. Social acceptance is important for the transition to actually take momentum.

Economic: The transition involves the development of new production chains, questions of partitioning added value within the chain; Furthermore important are macroeconomic effects on adjacent sectors, fit food prices; the transition is also intended to lead to new revenue models for farmers.

Policy: there is competition between renewable energy objectives of the EU directive, and the national policies based on this and renewable chemistry/materials, the importance of a level playing field cannot be underestimated, but it requires a policy also directed at stimulating higher value applications of biomass.

h) Covering different layers of policy governance Local, Regional, National, International

The transition requires local governance for instance in the case of location policies for new companies, especially relevant for the agriculture related activities. Regions are forming clusters with special focus in the biobased economy, depending on the kind of infrastructure and companies that are present. Dutch provinces are very active in the biobased economy. National policies are for instance innovation stimulation through PPP R&D programs, and also national policies on renewable energy vs renewable materials. The EU also has a policy on the development of a biobased economy, whereas different countries have different interests, the European policy influences the development in its member countries in a different way.

2. Characterization of System Transition Stages

The stage of the system transition can be defined as early. The transition is beyond embryonic: some production processes have proven to be economically feasible, ie Dupont's bioplastic, Sorona which has been in the market for over 10 years now. The biobased building block 1,3PDO used to be produced from fossil feedstock as well (f.i. Shell), however fossil production has stopped and biobased production is still in place.

The bioplastic PLA has entered the market and is presently being developed further for more demanding applications than just room temperature food packaging.

These two examples, tangible results within the transition process, help to fuel believe both in the agricultural as well as in the chemical sector that the idea of making high value chemicals and materials from biomass is actually feasible. Also the first signs of opposition from the dominating regime are apparent, for instance in their communication.

Tangible results will help to speed up the transition. Many companies are involved in R&D to develop new biobased building blocks for polymer materials and other applications (Harmsen 2014). However compared to the fossil based industry the biobased examples are still very small in size and number, the middle stage has therefore not yet been reached.

3. Identifying Transition Mechanisms and Bottlenecks

What have been key mechanisms in initiating and driving the transitions?

a) Idea generations – Idea generators

Since for the development of the biobased economy many new technologies need to be developed R&D has from the beginning played an important role.

Often R&D starts within research institutes, universities and some highly innovative companies.

Figure 1 for example shows the development of the field of research on agrofibre composite

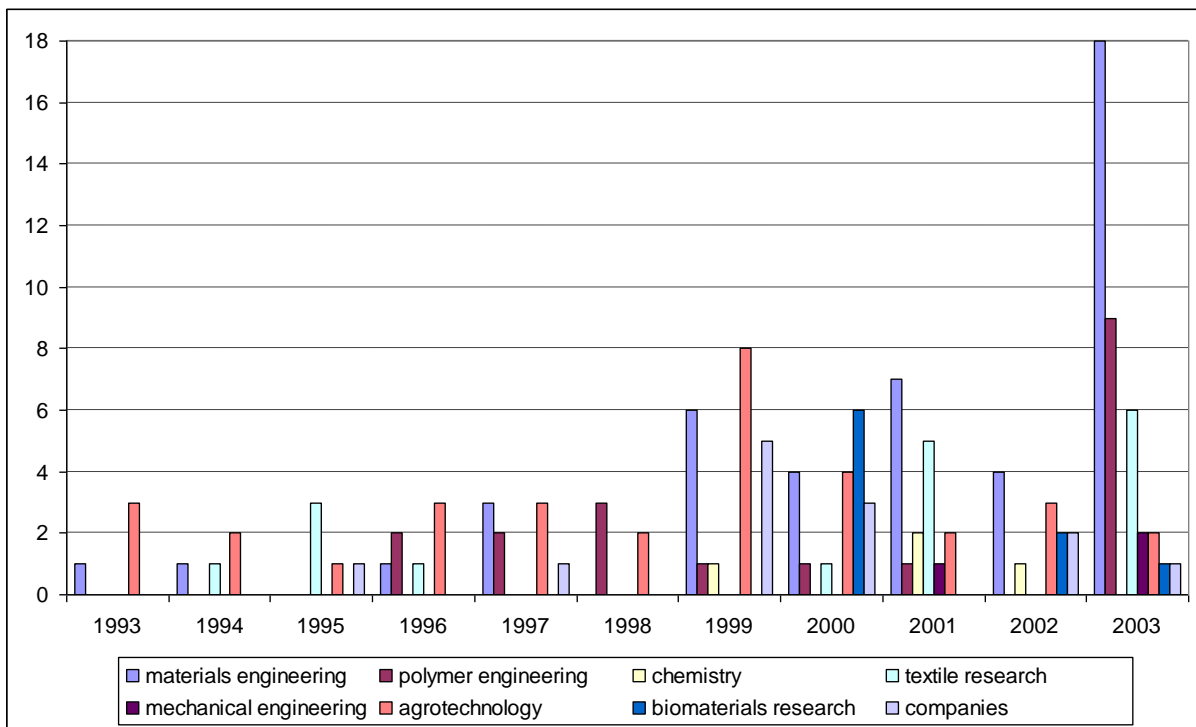


Figure 1 Example of the development of a field of research. The graph shows the number of publications per scientific discipline in the field of agro fibre reinforced composites over the first 10 years. Data taken from the affiliations mentioned in scientific publications collected in the PhD thesis of Bos (Bos, 2008).

materials, as seen from the origin of the researcher that published in the scientific literature (Bos, 2008). It can be clearly seen that the number of papers over the year increases as does the variety original expertise of people working on the subject.

A lot of the early research in the Netherlands was done in Wageningen in ATO-DLO (the Institute now known as Food & Biobased research), focusing on many aspects of the post-harvest technology. This institute was part of DLO the agricultural research organisation which was then part of the ministry of agriculture. ATO-DLO was a merger of three previous research institutes and it was founded in 1989 by the Ministry of Agriculture, Nature Management and Fisheries. The institute was to focus part of its research on what was then called agrification (non-food application of biomass). The founding of ATO-DLO was a policy measure, in order to stimulate the development of non-food applications.

Also the Dutch board for agricultural research (NRLO) has been very influential in the early days of agrification, by publishing in 1990 a long term action plan for agrification research.

In the early days there was also a network of policy workers from the ministry, farmers and some companies from the agri&food industry involved in the developments. Early innovators such as Rodenburg Biopolymers and Avebe were important in the development of the first materials.

Mercedes has been very instrumental in the development of agrofibre reinforced composite materials, they have done a lot of research in the early 90s and also published their results in a number of (semi)scientific papers.

Albert Heijn, a large Dutch retailer has helped the market introduction of bioplastics as packaging materials by their decision to pack their total range of organic products in biodegradable materials, including a number of different bioplastics.³ This decision was taken in 2005, after they'd experimented with biodegradable packaging since 2002.

b) Driving forces – Positive incentives

Over the years, the driving forces and the focus of the Dutch policy on agrification and subsequently biobased economy have changed. Three/four periods can be distinguished.

Driving forces circa 1985 - 1993

Developments in Dutch and European agriculture and the CAP: Dutch agriculture, focussing mainly on beet, potatoes and grain proved to be vulnerable in terms of market prices and

³ <http://www.duurzaam-ondernemen.nl/albert-heijn-kiest-voor-biologisch-afbreekbare-verpakkingen/>

profitability, especially when prices dropped due to overproduction. Originally overproduction was taken out of the market by the EU for guaranteed prices, but this policy became too expensive. When grain price subsidies were lowered Dutch agriculture lost its profitability (Ministry of LNV, 1993).

Also in terms of sustainability (crop protection) and optimal land use the Dutch crop rotation had its limits. Therefore a search for new agricultural crops (*the 4th crop*, in crop rotation) was undertaken. The search for new applications of existing and new crops was named agrification in the early 80s. From 1985 dedicated research programs were undertaken to investigate the opportunities of different crops for the biobased economy.

Another early driving force were the energy saving goals of the Dutch government. The energy policy demanded alternative feedstock for energy, among which agricultural feedstock.

Furthermore, there was increased concern on environmental issues. Agricultural crops and products were expected to provide more environmentally benign solutions.

Agrification was mainly focussed on agricultural crops and less on animal derived feedstock. In the early years a lot of very optimistic reports were published describing the many new options for application of agricultural feedstock. However, very limited applied research in order to develop these new applications was done in those years.

Driving forces circa 1993 – 2002

The Dutch government⁴ wrote in 1993 a memorandum, discussing the new focus of the policy on agrification (Ministry of LNV 1993) The memorandum stated that the time of general knowledge build-up was over, and agrification should develop more market-oriented, companies were thus expected to take a more leading role. A number of drivers is still important also in this period:

- new crops and new applications for existing crops will provide perspective for the agricultural sector
- biomass can play a role in the energy policy

⁴ Ministry of Agriculture, Nature Management and Fisheries, Ministry of Economic Affairs, and Ministry of Public Housing, Town and Country Planning and Environmental Affairs together

- agrification can play a role in the environmental policy both by leading to a more sustainable agriculture (alternatives for crop protection) and by developing more environmentally friendly products and processes.

- and fourth, as a new driver, agrification can stimulate technology development, which can lead to new high value feedstock and new materials (fi bioplastics) and thus stimulate industrial activity.

These drivers were confirmed in a letter to the parliament in 1996. Ministry of LNV 1996). In this letter, also the role of agrification in CO₂ reduction is mentioned for the first time. The letter furthermore states that for the Netherlands applications with a high added value will provide the best chances.

The letter announces that agrification will be an important theme in the new “stimulation regulations” and confirms that also the subsidies of the Ministry of Economic Affairs will be open to receive agrification projects (this was already the case). Specific programs or regulations for agrification projects were phasing out.

Due to a lack of tangible results the enthusiasm on agrification started to wane late 90s. (Bos 2008)

A study was commissioned in 2000 to investigate ‘factors of succes and failure’ of agrification in the Netherlands. (Van Roekel 2000) The general idea was that agrification had failed to live up to its promises. (Bol, 2002) The feeling was that there were a lot of technological developments that had failed to reach the market and were “lying on the shelf”. Furthermore, since the Dutch agriculture was a relatively expensive producer, once a product might make it to the market the feedstock would probably be produced elsewhere.**Error! Bookmark not defined.** The search for the 4th crop was thus no longer needed. In 2002 the Ministry of Agriculture commissioned a relatively small research program named “Groene grondstoffen” with the special task to investigate how all the developments that were presumed to be “lying on the shelf” could be brought to the market after all.

Driving forces 2002 - 2007

After the fiasco of the agrification policy, in the years after 2000 a completely new set of drivers emerged.

A crisis arose in the Netherlands in the cattle breeding sector, with a number of diseases: BSE (mad cows disease), swine fever and food-and-mouth disease. Furthermore dioxin was found in mother's milk, apparently originating from cow's milk containing dioxins. Furthermore the manure regulations became ever more strict and a discussion on animal welfare emerged. This led to the expectation that livestock in the Netherlands would diminish. This was expected to pose a problem for the large amount of food producing companies who's side streams found a way as cattle feed. The Ministry of Agriculture became ever more worried that these companies would leave the Netherlands. (Bol, 2002) New applications for these side streams were urgently needed.

Furthermore the Kyoto protocol became effective in 2005, and fossil oil prices started to rise from 2003.⁵ The chemical sector became more aware of the fact that they might need to diversify their feedstock and that biomass might be an option. In the "energietransitie", which was a policy of the Ministry of Economic Affairs also a platform renewable resources was installed.

These drivers led in 2007 to a new Dutch policy now called Biobased Economy, for which a government vision "de keten sluiten" was published in 2007.

Driving forces 2007 - now

Technology development and application development led halfway the years 2000 to a number of new products entering the market. Examples are PLA plastics for food packaging products and the building block 1,3 propanediol for use in polyesters (PTT). This started to change the attitude of some players in the chemical industry; biomass could indeed be a good feedstock for some chemical products. The focus changed from using biomass as is (ie starch for glues, flax for fibres) to using biomass as a feedstock that can be refined and fermented or chemically converted into the small chemical building blocks that the chemical and polymer industry are used to as basis for their operations. This led to the start of the development of many new building blocks and new bioplastic materials. Over the last five years this development has gained an enormous momentum, not only in the Netherlands but also in France, Germany the US and many other countries. (Harmsen 2014)

⁵ http://en.wikipedia.org/wiki/Price_of_petroleum#mediaviewer/File:Brent_Spot_monthly.svg

Furthermore, research in the US in the search for cellulosic ethanol led to a dramatic drop in enzyme costs for fermentation. Also in 2007 in the Netherlands (and EU), the biofuels directive became effective, leading to mandatory blending of biofuels with fossil transport fuels.

Actual application of biomass feedstock in non-food products, including fuels, became a commercial option. At the same time the food versus fuel discussion started to emerge as a consequence of the mandatory blending of biofuels in combination with the surge in food prices in 2007 – 2008. In the wake of this discussion application of biomass for more high end-applications, such as (fine) chemicals were promoted as more preferable.

The high oil price of the late 2000s made the application of biomass for a number of chemicals and plastics (nearly) competitive, helping enormously in intensifying the development.

In the Netherlands also the policy of the Ministry of Agriculture (and later its merger the Ministry of Economic Affairs) aiming at building a network of companies from different sectors focussing on the biobased economy helped to increase the number of companies and people active in the field.

c) Bottlenecks – Negative incentives

Originally, the background of the people active in research on agrification led to a focus on the research only on the crops and the feedstock, rather than also on developing the intended application of the new non-food products. This led to a low pace of development, also because originally only 1 sector was really deeply involved.

The low oil price during 90's up to 2003, implied that for a long time the replacement of fossil feedstock, especially oil, was commercially completely out of the question. Although research was performed from drivers such as the eventual expected lack of fossil feedstock and the wish for environmentally more benign products and processes many people viewed the application of biomass as feedstock for something other than food and feed as something for starry-eyed idealists.

The food-versus fuel discussion made and still makes some companies hesitant to use feedstock that is also suitable for food for non-food products. On the other hand this fact rather intensifies the search for second generation feedstock.

The lack in level playing field, both between fossil- and bioapplications and between biofuels versus biochemicals/materials also works as a bottleneck. Fossil feedstock is subsidized indirectly by tax levitations for producing companies, making biofeedstock relatively expensive. Furthermore the mandatoy use of biomass for tranort fuel applications and subsidies for biomass use for energy applications (SDE) drives up the prices for feedstock, making higher end applications economically unfeasible.

What would be key mechanisms in driving and continuing the transitions?

a) Business opportunities – Market forces

The transition has by now reached a stage that makes it expected and also imperative for the first larger scale investments to be made. There are a number of commercial chances, but the infrastructure of biomass handling, biorefinery and the production of chemical building blocks needs to be built up, in order to profit in the Netherlands from all previous investments in R&D. A number of companies are considering investments, but the choice for location and country is not yet made. The discussion on feedstock availability is intensified due to the fact that the sugar quota will be lifted, which makes the north-west of Europe potentially ideally suited for the production of fermentation feedstock.

The chemical industry in the Netherlands is slowly declining, installations are old and many have been closed down over the last years. High energy prices are a serious problem for the energy intensive chemical industry. For the preservation of jobs it is imperative to renew this sector, focusing on less energy intensive production routes. Application of biomass as feedstock can give good opprotunities in this respect.

The EU has in recent years as a follow up of their Lead Markets Initiative, started a number of initiative to facilitate the introduction of biobased materials, for instance focusing on the development of normalisation standards and certification. Also the level playing field between the application of biomass as fuel and as chemical/material is discussed on EU level. These EU policy developments are important for the development of biobased markets and thus for the opportunities for companies to invest in these processes and products.

Furthermore, since R&D will remain important for the next decade, the knowledge institutions active in this field (WageningenUR/ECN/TU Delft/Utrecht) will remain important actors to drive the development further.

Last, but not least, with the development of new processes and new feedstock/chemical production relations, also a number of Dutch regions are becoming active players in the field, trying to interest companies to invest. Actors are; the North of the Netherlands, combining a number of chemical production sites, a number of sea harbours and a large agricultural hinterland (including parts of North Germany), the South-West of the Netherlands, with a well developed chemical infrastructure, sea harbours and agricultural production. The South-East of the Netherlands, with the chemical site in Geleen, and some regions taking up smaller initiatives around horticulture.

b) Societal benefits – Policy generated incentives

Especially the spect of regional employment is expected to increase in importance in the coming years. This is already visible in the Netherlands, as various regions employ action to stimulate the development of a local biobased industry. The other benefits, such as climate and resource security will also remain important.

Biobased economy also fits within the new trend of a circular economy, thus also reuse of biomass will become an important issue.

c) Key actors in business and policy

Key actors are expected to remain the same as in the previous period, but their relative importance is expected to shift.

The traditional chemical industry is responding only slowly to the new developments. A stronger driving force for the new developments comes from producers of consumer products who actively promote the use of biobased products and packaging materials. Also the agroindustry is actively developing and piloting new biobased developments. The agroindustry is linked to agricultural production and thus a true local player. Furthermore new companies, wishing to exploit new technology emerge. These might originate from the chemical sector or the fermentation sector but also from the agrosector.

In 2009 the Ministry of Agriculture was merged with the Ministry of Economic Affairs. This implies that the policy lines on energy, agriculture and innovation are from that moment on

integrated in the same Department. The expectation is that this will in the coming years promote the integration of these policy lines. Only environmental affairs stays within the Ministry of Infrastructure and the Environment.

4. Describing related Policy Agendas and Measures

Which policy agendas, governance, and measures have been important?

a. Political visions – Political missions?

The use of biomass for new applications has been a focal point of Dutch policy since the 1980s. In the 80s this was driven mainly by the necessity to find new and alternative applications for the increased agricultural production. In the 1990s two additional policy lines, for sustainable energy and biofuels emerged. Since 2005 a more integral policy on the biobased economy was set up. The essential aspect of this policy is that optimal value should be derived from biomass, which implies the importance of using biomass for biomaterials rather than only for bioenergy. Biorefinery of biomass is the key technology to reach full use of the biomass. Nevertheless, the partly conflicting lines of policy remained in place: the policy on sustainable electricity and heat, the policy of mandatory blending of biofuels and the policy on the integral use biomass with focus on high value applications.

The Dutch policy is strongly influenced by European goals for sustainable energy and biofuels. This European policy is driven mainly by climate goals and energy security.

b. Policy targets – Quantitative impact targets related to specific indicators?

The framework for energy and climate policy is set by the European Commission. The present framework includes a goal for sustainable production of electricity and for blending of biofuels for transportation. In the Netherlands this translates into the use of biomass for electricity and heat and mandatory blending of biofuels.

The European commission proposes to continue the sustainable energy goals also after 2020. For application of biomass as feedstock for energy and materials at present no goals are set.

c. Policy strategies – Policy road maps?

An integral policy vision on the biobased economy from the Dutch government was published in 2007. This vision still provides a fitting framework for an integral policy approach and additionally provides more detail on a selected number of subjects like cascading of biomass. Research and innovation policy for biobased economy is now part of the topsector policy of the Ministry of Economic Affairs. This policy promotes cooperation between companies, research institutes and government in research and innovation.

Europe has published the Bioeconomy strategy in 2012, which has a broader focus than the Dutch policy on the biobased economy, in that it focuses next to chemicals, materials and energy also on food and feed.

d. Policy organization – Horizontal and Vertical organization?

Biobased economy is a policy domain in which various ministries and policy departments are involved. Energy, biofuels, chemistry and agroindustry are the responsibility of different policy departments. Furthermore, energy, chemistry and agrifood are also different topsectors. Also on a European level Energy, transport, agro and research are different directorates.

e. Coherent policy measures – Distributed policy measures?

Focus has been on the instalment of advisory platforms and committees, to provide a stimulus for interaction between all stakeholders.

Next to this a program was started aiming at solving conflicting interests (Ministry of Economic Affairs, 2011). This was initiated by the recognition of the government that the transition to an economy based in part at least on green raw materials could be affected by obstacles found in current legislation and regulations. A stocktake has been made of conflicting interests in the business community that could limit investments or operations in the biobased economy.

The programme aims to remove or limit any obstacles that might act as a barrier to investments in the biobased economy. It is important that the lack of a level playing field does not frustrate potential investments in the biobased economy. An example of this is found in European import levies on green raw materials that are used by the chemicals industry. Solutions to obstacles like this must be found at the European level. The Netherlands will therefore focus on arguing for increased scope within EU trade and agriculture policy for additional imports of sustainable green raw materials for the bulk chemicals industry and other industries, including fermentation. By following an integrated policy, the government aims to eradicate these obstacles using existing and new policy measures, including Green Deals.

Green deals are deals between government and companies aiming at cooperation between these parties in order to solve various issues concerning development of sustainable business cases. The green deal policy was started in 2011.

Key initiatives – Key actors?

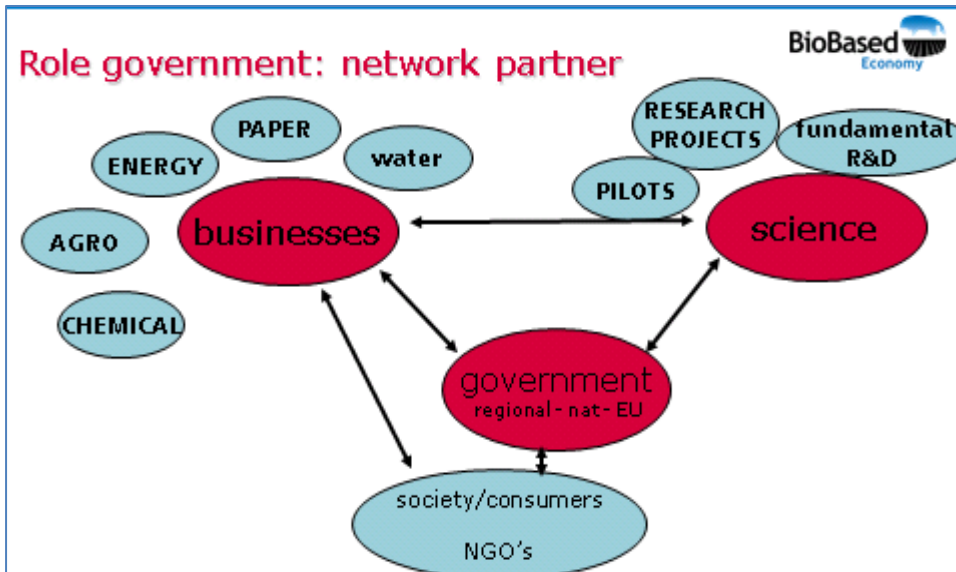


Figure 2. Overview of key actors and platforms

Platforms installed include:

- WTC (scientific technological advisory committee, former and present university professors)
- High Level Advisory Committee (Captains of Industry)
- Biobased renewables business platform (companies and knowledge institutes)
- APC (Agro-paper-chemistry) platform (companies from these three sectors)
- Transition House (SME support)
- Committee Corbey on the sustainability of biomass (companies, knowledge institutes, NGO's, government).
- TKI (Topconsortium on Knowledge and Innovation), with the aim to coördinate cooperation, knowledge exchange, synergy and valorisation of the various biobased aspects within the top sectors

The TKI set up the Biobased Economy Innovation Contract: 'Green Growth – From Biomass to Business' in 2011. This Innovation Contract follows on from 'A Point on the Horizon [Een punt op de horizon]' WTC advise from June 2011 in which five top sectors set out the broad outlines of their vision on the research and innovation agenda of the biobased economy.

f. Specific initiatives and policies initiated in relation to the case study transition

Several policy supporting advise studies were issued over the last years:

- SER (social economic board): advise on the socio-economic aspects of the development of the biobased economy. (SER 2010)
- Rathenau Institute (advisory institute on social issues), Getting to the core of the bioeconomy (Independent advise). Asveld (2011).
- IMI (Institute on Societal Innovation) Societal dialogue on the biobased economy, 2011-2013. (IMI 2013).

5. Analyzing the role of Policy and Policy Measures

5.1 Policy Analysis

How have policy agendas, governance and measures impacted the transitions?

The policy agenda's and measures described in the previous paragraph were supported by a method of network governance.

"What is Network governance?"⁶

Network governance is relevant in many areas in the domain of Economic Affairs. Within our society, many developments are under way that can contribute to the achievement of the government's objectives; the big question facing the government is how it can best respond to these initiatives and accelerate their dynamics. The breakthrough changes must come about in the market and the community itself; the government cannot do this itself; but it can act as an enabler and facilitator. The challenge for the government is to give social initiatives every opportunity to develop, while simultaneously supporting its dynamics with targeted policy wherever necessary. The core of network governance is that the parties 'outside' must take the initiative based on their own intrinsic motivation.

Hands-off government may sound like a contradiction in terms, but it is the reality that is currently emerging in many domains where public organisations are pursuing crucial objectives. Sustainable construction, economic innovation, a greener fuel mix in the transport sector and socially responsible agriculture are all examples of areas where the government depends on the effort, energy and creativity of external parties to achieve its objectives, many of which are linked to hard-and-fast political commitments. The logical next question is: what does this mean for the government's repertoire of methods? What kinds of interventions must government organisations have at their disposal to assist and guide this process? And what kinds of interventions must they refrain from? ()

An evaluation of the governance of the policy on biobased economy shows that the Dutch model (Network governance) can serve as a role model for the governance of transition processes. (Steen, 2014)."

⁶ Cited with permission from Steen (2014)

From the idea of network governance the different networks and platforms mentioned in the previous chapter were set-up in order to support the transition processes in society. Building on the experience and learnings of the "agrification period" (see chapter 2) networks of companies from the different sectors, that would normally not meet and do business together were set-up. This was taken up after 2007, when the vision on the Biobased economy was published. Platforms (and a network to connect these platforms) of companies from the agro sector and the chemical sector were installed. Later this was supplemented with science and society oriented platforms and a network for knowledge sharing. Companies and research institutes have formulated a shared research agenda. Knowledge sharing and cooperation between SMEs was also stimulated.

This has led to a vibrant and growing society that meets twice a year, organised by the Ministry of economic affairs, to discuss recent advances in the biobased economy field and meet new stakeholders.

5.2 Impact Analysis

In 2013 RVO, an agency of the Ministry of Economic Affairs made an impact analysis of the Dutch Biobased Economy policy. Investigated were the size of (biobased) material streams, the economic added-value, market developments and the knowledge position.

The knowledge position, measured as the number of registered patent, compares positively to other countries.

Investments in early markets are supported via the EIA en MIA frameworks, in recent years between 30 and 90 M€ per year (for 2012: 70 M€) was invested by companies in Biobased economy related projects. Most of these investments however are bio-energy related (EIA), on biomaterials only a limited number of projects were started.

In order to speed up the step from innovation to market the Dutch government set-up green deals (see chapter 4), 64 of these are related to the biobased economy transition, 52 linking to bioenergy and 24 to biobased materials. Within these deals focus lies on improving innovative business and development, developing business cases and remove obstacles of non-technical origin.

Together with the German Nova Institute the positioning of Dutch companies within the biobased products and chemicals market was investigated. It was found that the biobased economy in the Netherlands in 2011 amounted to € 2,6 tot 3,0 billion value added. This concerns the production sector (materials), the chemical sector and the energysector. Thebiobased share of these sectors together amounts to approximately 0,5 to 0,6% of the total Dutch economy. In these sector in 2011 aproximalty 29.300 tot 33.400 FTE are employed. It appears that the materials sector with a value-added amounting to € 2 tot 2,4 billion has by far the largest share of the biobased econom, followed by the chemical sector (€ 542 mln.) and the energy sector (€ 70 mln.). Production of biofuels in the Netherlands (€ 100 mln.added valus in 2011) is in this evalutation presented as part of the chemical sector. The "radar sustainable energy" shows that the sustainable energy sector has a total added value of € 1,3 billion. Unfortunately there are no data on the size of the biobased economy in the Netherlands before 2011.

5.3 Future policy perspectives

Which policy agendas and measures would be important in the future?

Green growth and employment

In the economic policy of the Netherlands, just as on European level employment and new jobs are an important driving force. In various economic regions in het Netherlands innovative companies are supported in order to compensate for the decreasing employment the traditional industrial sectors.

Climate policy

European climate policy and targets beyond 2020 will be revised in de coming years. A more general stimulation of reducing CO₂ emissions is one of the options being considered. The policy for the use of biomass currently gives a strong incentive for the use of biomass for energy purposes driven by the European goal to increase the share of renewable energy .

How should policy agendas and policy measures be designed for the future?

Market development, demonstration and upscaling

Market survey indicates that there is a growing market for bio-based materials, for example for packaging. Biobased materials serves the consumer demand for sustainable products. The European and national government supports the market development by encouraging certification of biobased materials and by developing knowledge about bio-based materials. The administrative evaluation concludes that the policy has been successful in encouraging a movement supported by the sector.

Conclusions

The transition of the Biobased economy is a clear example of a complex system innovation. The paper describes 3 different stages in the last 30 years. Each stage has different driving forces and a different policy perspective. The network approach set up in the last period is in this respect particularly important. The coöperation between government, business and knowledge institutes over the decades contributes to a 'take –off' fase in the transition and a large scale commercial production of biobased materials and chemicals in the Netherlands.

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