



Case Study Report
Synergy Parks:
collaborative strategies
to valorise side streams
between companies

June 2015





Improving sustainable biomass utilisation in North West Europe

Colophon

This report was compiled in the framework of action 5 of the ARBOR* project.

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Please check www.arbornwe.eu for the other reports that have been compiled within ARBOR:

- Five case study reports on a diversity of subjects like nutrient recovery, low impact energy crops, agro side streams, synergy parks and biomass closed-loop systems.
- An update of the 2012 Benchmark report on biomass for energy use in NWE
- A strategies report on biomass for energy for regional authorities in the North West European region.



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Introduction

This document is part of the deliverables for ARBOR, an Interreg IVB project for North-West Europe. ARBOR stands for Accelerating Renewable Energies through valorisation of Biogenic Organic Raw Material. Various of the projects consider multi-stakeholder collaborations, with or without a financial share of ARBOR in the project realisation. This project runs from 2011 till 2015. The different ARBOR-partners are:

- From Germany: IZES gGmbH
- From Luxembourg: LIST, Luxembourg Institute for Science and Technology
- From Belgium: VCM, POM West-Vlaanderen, Ghent University, Inagro, FlandersBio
- From the Netherlands: Wageningen UR, Provincie Utrecht, DLV Plant
- From the UK: Stoke-on-Trent city council, Staffordshire University (lead partner)
- From Ireland: UCD Dublin

The total budget for ARBOR is € 7 361 959.

The framework for ARBOR are the EU 2020 targets in order to reduce climate change and the fact that biomass accounts for 50% of the renewables in Europe. Although a lot of expertise concerning biomass is available, it is noted that this information is not disseminated in a coordinated way, nor is it related to commercial exploitations. That is why the ARBOR-mission is to accelerate the sustainable development and use of biomass in North West Europe, to facilitate the achievement of the EU 2020 objectives.

The increasing competition and environmental pressure and growing demand for food and resource efficiency requires cooperation and collaboration between agriculture and other business (Smeets, 2009) especially in the highly populated NWE. When companies systematically cooperate to achieve more sustainable biomass utilization through creating production synergies, we call this a synergy park. Ideally, synergy parks can be called a system innovation, that bring new technical, commercial, institutional, and social connections geared towards sustainable development.

Ongoing collaboration and advice on stakeholder management should improve the synergy park composition, to the benefit of optimal biomass valorisation and energy efficiency. This report aims to describe outputs of ARBOR action 5 on Synergy parks, within individual ARBOR-regions. Following an initial meeting on the matter in Stoke-on-Trent, format with leading questions were circulated and filled out by the partners as far as possible for their single case.

Due to the rather divergence amongst projects and the different priorities set by the different countries or even regions, it turned out to be difficult to harmonize the datasets and the texts. Splitting up the data countrywise was the feasible way to structure the report. Detailed information on biomass streams, the National Renewable Energy Action Plans, the National Biomass Action Plans and the instruments in the developments of biomass strategies can be found in The ARBOR benchmark report: Biomass for Energy in the Northwest European region. (ARBOR 2012) A brief overview of most pilots and investments under ARBOR can be found in the brochure "Biomass for Energy in the Northwest Europe region: An overview of pilots and investments" (both available at: www.arbornwe.eu). Gathering of information ended by the end of 2014.

This report was edited by Wageningen UR (E.Wubben, G.Nuhoff-Isakhanyan) with input from Provincie Utrecht (Sieta de Vries), POM West Vlaanderen (Brecht Vanhecke, Lien Roosvelt), University College Dublin (Robert Dowdall), Stoke-on-Trent (Elliot Jones), and InnovaEnergy (Lies Bamelis). LIST-Luxembourg (Kasia Golkowska) helped with text corrections and FlandersBio (Willem Dhooge) took care of the final lay-out work.



Chapter 1 – EU Framework for synergy parks



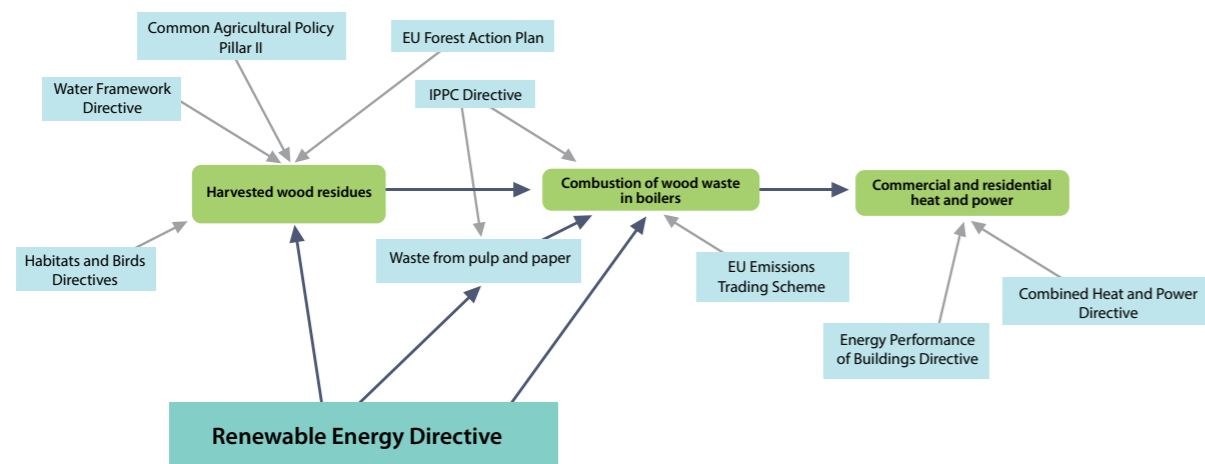
This first chapter will pick out European policies concerning relevant subsidies, common agriculture policy, and the renewable heat incentive.

1.1 EU policies concerning biomass and bioenergy

With biomass we mean the biodegradable fraction of products, waste and residues from biological origin from agriculture (including vegetal and animal substances), forestry and related industries including fisheries and aquaculture, as well as the biodegradable fraction of industrial and municipal waste (EU Directive 2009/28/EC). The EU is setting up frameworks by way of directives, but it has no subsidy policies specific for biomass and bioenergy. Governments of the Member States implement directives via their own subsidy schedules and laws. Although some directives dominate the promotion of using biomass-based energy production to reduce CO₂-emissions, other policy instruments are very relevant as well, dependent on the supply chain stage one is focussing on (see figure 1). The prime piece of European legislation laying down sustainability criteria for biofuels and liquid biomass is the Renewable Energy Directive 2009/28/EC (RED). According to the National Renewable Energy Action Plans, biomass used for heating, cooling and electricity could supply about 2/5th of the 20% renewable energy target for 2020. Regarding biofuels the RED is seconded by the Fuel Quality Directive 98/70/EC, amended by Directive 2009/30/EC.

The RED is critical for the Supply chain-stages “Harvested wood residues” and “Combustion of wood residues” in boilers, but less for the Supply chain-stage “Commercial and residential heat and power”. The Habitat & Birds directive, and the Common Agricultural Policy Pillar II relate directly and only to the stage called harvested wood residues, while the Combined heat and power directive (CHP) and the Energy performance of buildings directive set the scene for the Supply Chain-stage called Commercial & residential heat and power in the biomass supply chain. A strong uptake of renewables, especially in Germany, was caused by the Renewable Energy Sources Directives 2001/77/EC, and subsequent national acts. Apart from other major factors such as market prices, and biomass availability, the variety in relevant directives (and their amendments), schemes and plans impacts the complexity, speed and innovativeness of the valorisation of biomasses, especially when adding to the ambition the (re-)use of sidestreams, closing biomass cycles. The entire system promotes the immediate use of biomass as energy source against using biomass by its highest added value. An adaption of the EU Renewable Energies Directive and the Renewable Energy Sources Directive, could strengthen those active on the more valuable applications of biomass.

Figure 1: EU level legislation impacting on solid biomass energy production and use (by IEEP March 2012: Deliverable 6.5: Collection of Biomass Futures support materials for policy makers).

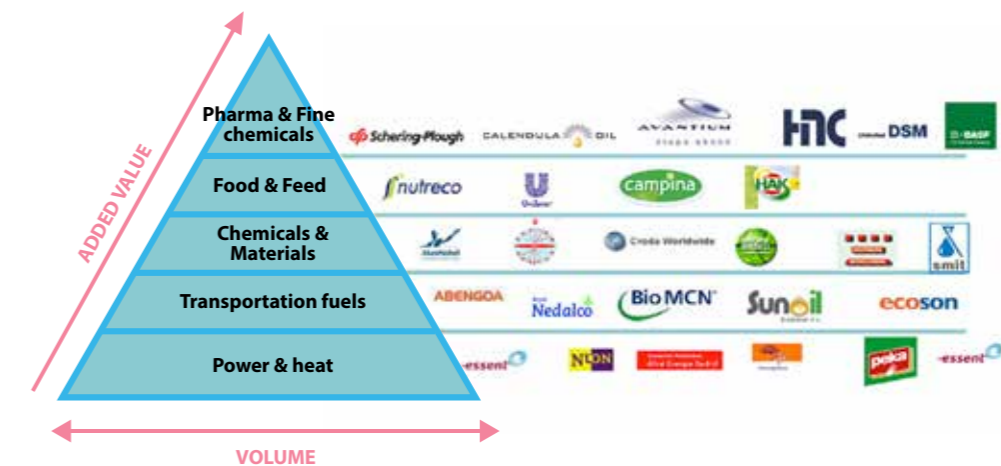


As biofuels became more and more common the subject of debates in business, academic and public arena shifted in favour of more smart energy and biomass cascading, (see figure 2). The concept of Biomass for energy sets the spotlights on promoting more sustainable sources for non-sustainable fossil fuels. However, agrifood both uses energy directly (diesel, heat, cooling) and indirectly (fertilizers), and it produces energy (biofuels and biogas) and GHG-emissions. The food-feed-fuel debate made it clear that in North-West Europe socially preferable products from biomass are of high social and economic value, such as food, and biomaterials (FAO, 2012).

The biomass cascading principle (see figure 2) summarizes the preference for using the biomass according to its highest added value and using (repeatedly) the remains or waste for applications with lower added value. Stated with caution, this biomass cascading seems to bring about also the best life cycle assessments (Nova-Institut GmbH (2014), Environmental Innovation Policy – Greater resource efficiency and climate protection through the sustainable material use of biomass, Umwelt Bundesamt, 2014).

Accordingly, we started to deploy the term synergy park, defined as an agro-industrial cluster in which companies systematically cooperate to achieve PPP-founded biomass utilization through creating (production) synergies. The term agropark restrict this ambition to spatially-restricted agrofood clusters (Wubben & Gohar Nuhoff-Isakhanyan, 2013). In general, research and literature that uses related terms, like eco-industrial parks, (agro-) industrial clusters, industrial ecology, industrial symbiosis, and inclusive economic development, has its focus on stimulating sustainable development by system integration in mixed commercial areas, for example the cases of Burnside Park and Kalundborg.

Figure 2: Focus on highest added value; biomass cascading. Source: Presentation by R.Bol 2012, Bio-economy in the Netherlands.



The exact sciences-driven R&D-stream that focuses on the highest value added of biomass can be recognized by the use of the term Biorefinery. Biorefineries are the result of commercial applications of the cascading principle on biomass utilization. A biorefinery is defined as ‘the sustainable processing of biomass into a spectrum of marketable products and energy’ (IAE Bioenergy, 2009). Recognizing the wide variety of configurations, inputs and end products, biorefineries exist in a wide variety of and generate many different end products. Energy saving opportunities for the biorefinery integration itself are already substantial, up to 25%. Nevertheless, few fully operational cases can be found as yet, except for Borregaard, and Roquette.

Ideally such biorefineries enhance environmental, economic, and social performance of economic activities, but the technological optimism that comes with it is often criticized (e.g., Huesemann, & Huesemann, 2011), and refuted by major delays if not suspensions in most initiatives. Even low hanging fruit is quite often not seized as social embeddedness, commercial partial interests, and established (linear) legal frameworks hinder collective-decision making and the closing of material cycles (C2C), in short the (rapid) realisation of (industry crossing) synergies. Therefore in this report we focus on the wider agro-industrial collaborations, in which companies systematically cooperate to achieve (better) PPP-founded biomass utilization. An adaption of the EU Renewable Energies Directive and the Renewable Energy Sources Act, would already strengthen this cascading use of fresh biomass against the immediate use of biomass as energy source, that is promoted at present. This report shows that practices still have a long way to go for before reaching this ideal.

Chapter 2 – National policies in North West European countries



National governments, and regional governments, introduce EU-directives into their own policies, and together with provinces they may introduce generic or dedicated instruments to direct the use of biomass residues towards energy or other applications. (see: www.res-legal.eu)

The Netherlands has implemented the Renewable Energy Directive 2009/28/EC (RED) sustainability criteria in a single Government Decree and Ministerial Order which entered into force on the 1 January 2011 and which also contains the RED target for renewable energy in transport. The RED sustainability criteria came into force by means of a decree in Belgium, in December 2011. The UK implemented the mandatory sustainability requirements of the RED on 15 December 2011, as an amendment to the RTFO, the UK biofuels legislation. RED was introduced into Luxembourgish law by the Règlement grandducal (RDG), by 15 November 2012. Finally, Ireland implemented the EU sustainability criteria for biofuels in February 2012 through a Regulation (Ecofys, 2012).

Regarding carbon related taxes a varied picture is found. In the Republic of Ireland the carbon tax for consumers of natural gas, exempted EU-ETS operators as in all countries, covers approximately 40% of all GHG emissions. In 2013 a carbon tax was also put on solid fossil fuels under the Solid Fuel Carbon tax. We refer to the Chapter on Ireland for more details. In Belgium electricity creation by coal and oils comes with an extra energy levy. Subsidies for “Biomass for energy” are awarded by the regional (Flemish) government. Belgium has no carbon tax scheme for consumers. In the Netherlands, there is no extra tax next to the EU ETS for electricity creation. The carbon tax for consumers in the Netherlands is raised especially at the moment of purchasing a car. The country invented 4 tax classes neatly linked to the CO₂-emission per km for a type of car and different for petrol and diesel. Around three-quarter of the sustainable energy in the Netherlands is created by burning biomass for electricity and heat. The government stimulates the growth of renewable energy by tax benefits and subsidies (for example SDE+).

The UK Climate Change Act (CCA) (2008) made provisions for a national carbon cap and trade scheme, that mandates many of the largest organisations in the UK to pay for carbon credits for emissions associated with building energy usage. More in general, the UK CCA links (often mirrors) UK-targets to EU-targets. Its Carbon Reduction Commitment Energy Efficiency Scheme mandates payment for carbon credits (£16/t CO₂ from 2014) for emissions associated with building energy usage in large public and private organisations which are not participating in the EU Emissions Trading Scheme. This runs alongside the Carbon Price Floor, which mandates generators of electricity in the UK to pay a levy against resultant CO₂ emissions with levels rising from £16/t CO₂ in 2013, to max £18/t CO₂ by 2016. However, the Energy Act (2013) failed to provide a decarbonisation target for electricity generation, lowering the conversions of coal plants to co-fired or stand-alone biomass plants.

Countries differ radically in stimulating collaborative biomass projects. For example, although there is no general spatial policy which stimulates synergies in Belgium in West-Flanders, for instance, two regional spatial implementation programs for greenhouse horticulture have been implemented (in Roeselare, and Oudenburg). The goal is a spatial zone specific for greenhouse horticulture which will be heated by residual heat. Differently, at 14 January 2009 the Dutch government and all provinces signed an Climate agreement (Klimaat akkoord 2009-2011) in which goals were set for renewable energy. Plans were designed by sectors, enabling location-specific links between agricultural and other industrial organizations to bring economic advantages and reduce the environmental burden from industrial companies (Boekema *et al.*, 2008, De Wilt and Dobbelaar, 2005). Aligned is the Dutch Green Deal Programme, introduced for identifying and advancing sustainable joint projects. The eligible projects vary from industrial, large-scale heat utilisation projects and smart grid projects, to smaller-scale biomass projects in the horticultural industry.

The setting regarding stimulating collaborative biomass projects is different in Ireland, where the influence of spatial policies for biomass based plants can be very significant. However, classification of projects for environmental regulation and planning permission approval can be extremely difficult, for a variety of reasons, such as the lack of knowledge of biomass with regulatory bodies, and difficulties in classifying the waste/product use of the feedstock material.

In the same vein we see (AD-) biogas tariffs differ (Euros per kWh) between 0,18-0,25 in the UK, down to 0,10-0,15 in Ireland and purely market based in the Netherlands. As a consequence of this variety in (conflating) biomass valorisation policies we will now turn to specific regions and their projects to get a better understanding on realizing biomass valorisation trajectories.



Chapter 3 – ‘From roadside grass to biogashub in the Province of Utrecht



3.1 Introduction: Energy goals

As part of the 2009-climate agreement (Klimaat akkoord 2009-2011) on renewable energy goals, the Province of Utrecht was to realise 8 PJ renewable energy in 2020. In 2012 the total amount of energy used in the Province of Utrecht was 84,1 PJ. Only 2 PJ or 2,4% of this energy was renewable. This share is significantly below national average. The present goal of the province of Utrecht is to realise 10% renewable energy in 2020. Reaching this goal requires a lot of focused efforts.

Within the ARBOR project, the goal of the Province of Utrecht is to use the biomass in her region more efficiently by turning it into sustainable energy. To make this possible, the whole chain has to be taken into account: from the base material (grass from verges) via an innovative conversion technique (dry digestion) to the distribution of the end product (green gas in the gas grid)

This case study report will present three sub-projects. The reason is that the Province of Utrecht has divided the whole chain in three sub-projects, given the complexity of the project:

1. Investigate the possibility of an innovative structure for roadside grass collection.
2. Facilitate dry digestion at existing composting companies.
3. Facilitate a biogashub, that upgrades biogas to greengas and injects into a gas grid.

3.2 Roadside grass

3.2.1 Problem and aim

The Netherlands requires all owners of roads, waterways and nature reserve areas to maintain and mow the verges. The main reasons for this are safety issues, but also biodiversity plays an important role. At the beginning of this project (2010) roadside grass was categorised in the Dutch legislation as waste (Wet Milieubeheer, ch.10 - Afvalstoffen), and therefore it was supposed to be processed in qualified composting companies. It was not allowed to bring it to a landfill or to use it as animals feed. Most of the grass from these verges ("roadside grass") was therefore processed by composting companies. This process returning annually is expensive, generating high recurring costs for municipalities, provinces, railroad companies and other verge owners.

In 2011, the Dutch legislation changed and now green wastes (including grass from verges) are excluded from being a waste when it can be recovered. With this case study we researched if it is possible to design an innovative structure for the collection of roadside grass. This should be within the preconditions that the cost should be lower than the present collecting structure and road safety nor nature values should suffer from the new collecting method.

2.2 Results

Current situation roadside grass In this case study the term roadside grass is used in a restricted version as grass from verges from roads, excluding for example grass nearby waterways, or railways, or grass from recreational areas, nature reserves, sports fields, etc. Most of the time roadside grass is mown and collected twice a year in May-June and in September-October. It is not fertilised due to biodiversity reasons. Therefore it contains relatively low amounts of proteins and is hence not suitable as feed for animals. Because quite some car drivers dump garbage next to their car the roadside grass is often polluted with plastics and cans. Due to this pollution it was legally not allowed to use roadside grass as a co-product in a co-digesting plant. Therefore the focus in the beginning of this project (2010) was on dry digestion, because this was the only way to digest roadside grass. Because the studies for this ARBOR-project showed that dry digestion was not profitable in the province of Utrecht, the Province has made a big effort to change the constricting National legislation in order to make it possible to use roadside grass in a co-digesting plant. And the efforts paid off!

Changes in Dutch legislation In March 2011 the Dutch waste regulation has been modified (Wet milieubeheer, art. 10.1a) in which roadside grass is exempted when it is used for bioenergy purposes. This change makes it possible to use roadside grass for the production of bioenergy.

Thanks to a change in 2012 in appl. Aa-part 1 of the Uitvoeringsregeling van de Meststoffenwet (Implementation of the Manure Legislation) it is now possible to use, under certain restrictions, roadside grass in a co-digesting plant.

Stakeholders, and contracts In the Region Utrecht (the Province of Utrecht combined with Het Gooi, which is a small part of the Province of Noord-Holland partly encapsulated by to the Province of Utrecht) 44 parties are indicated as owners of verges. Besides public owners (national government, provinces, municipalities and water boards) also a lot of private owners are at stake (nature conservation organisations, property owners, railways, golf courses etc.). All these parties put verge management contracts in the market. This is often done by means of procurement. In the contracts certain aspects are specified, for example which locations should be mown, how many times and in which period. It is also possible to specify certain management conditions, such as, the grass may not be higher than a certain amount of cm.

Techniques The party that mows the verges becomes owner of the grass and depending on the location may have an obligation to remove the grass from the verges and to process it in a qualified composting facility. Depending on the type of verge, different mowing techniques can be used (cyclo-mowing, mowing basket, mulching, sucking up, raking, picking up).

Potential In the Region Utrecht approximately 60 000 tons of roadside grass is mown, collected and processed every year. Approximately another 70 000 tons of roadside grass remains uncollected after mowing; when there is no biodiversity aim and it is safe for the traffic, this grass can be left on the spot. The total amount of potential available roadside grass is therefore 130 000 tons grass.

In this case study it is investigated if there is another, more sustainable and cost efficient way to process the grass from verges than composting. New techniques like dry digestion, gasification or wet digestion can be used to produce biogas from grass from verges. Through these techniques 1 tons of roadside grass can be converted to 80-200 m³ biogas. With the maximal 130 000 tons of grass the energy potential from grass in the region of Utrecht is therefore 10-26 mln m³ biogas or 7-17 mln m³ greengas. In the Netherlands, the average gas use of households is 1 600 m³/y. Roadside grass can provide gas for 4 000 -11 000 households. In 2014 the total amount of households in the Province of Utrecht is 561.553. Thus, potentially 1-2 % of these households can be provided with gas from road-side grass. Evidently, optimal grass digestion sets specific preconditions, such as mowing early in the morning to maximize the content of glucoses in the grass, and silaging grass as quickly as possible.

Environmental sustainability If co-digestion is compared to composting in the open air and dry digestion, co-digestion scores best on CO₂ reduction, air quality, noise, energy production, raw materials and processing costs. It scores worst on investment cost. It also needs more space than composting. Overall it has the best score on sustainability of the three investigated options (see figure 3).

Figure 3: Comparison of co-digestion with dry digestion and composting. Info: Province Utrecht.

Aspect	Unit	Technique		
		dry digestion	Co-digestion	Composting (open)
Footprint	m ² /t/y	0,5	0,5	0,35
CO ₂ reduction (netto)	kg/t	137	156	55
- production	kg/t	54	65	59
- saving	kg/t	191	221	114
Odor	++ to --	++	++	-
Air quality	++ to --	-	0	-
Noise	++ to --	--	0	0
Safety	++ to --	--	-	+
Energy production (H&P)	MJ/t	1899	2659	0
Products	t/t	0,57	0,6	0,55
Processing costs	€/t	35	15	25
Investment	€/t	128	140	75

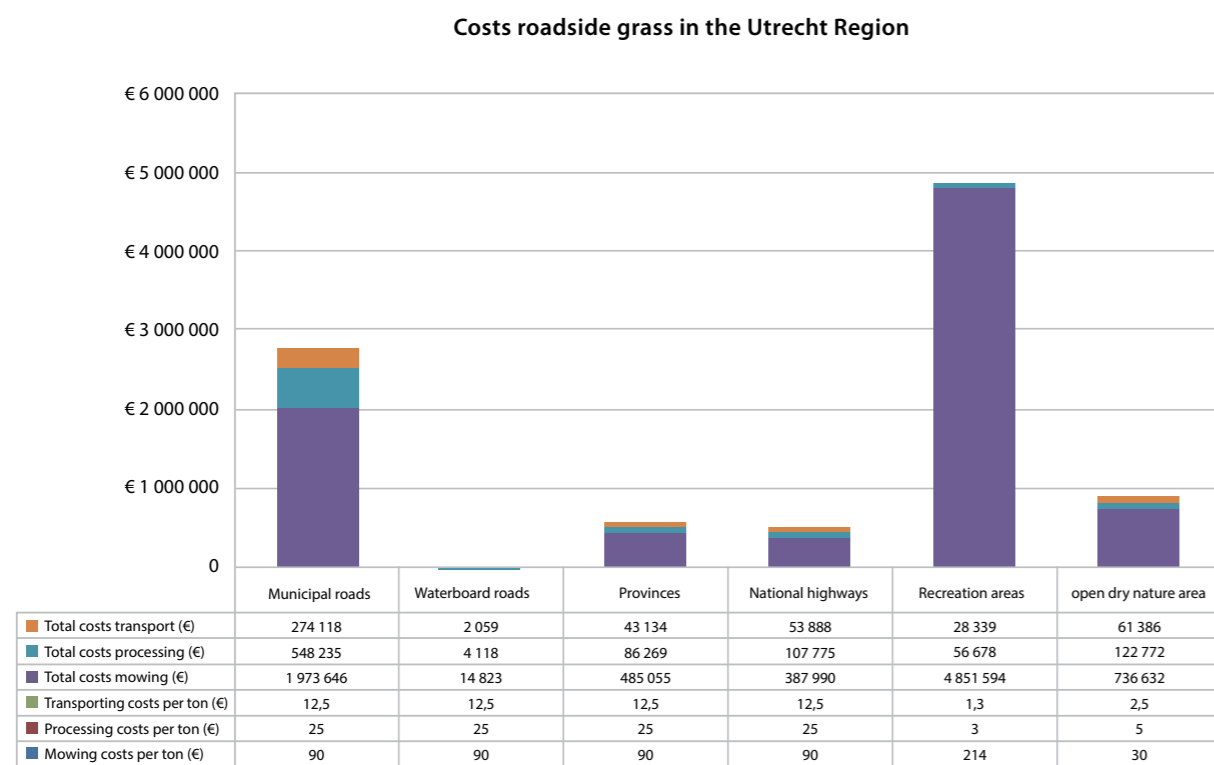
Financials The project has shown that a collective collecting structure, in which a large number of verge owners tender the grass together, is most profitable. The more parties joint, the bigger the profit. When all 44 parties join, the total advantage in processing/digestion costs of this collecting structure will be around € 250 000,- per year. The preconditions of the contract will be that the owners of the grass are responsible for the 'delivery' of the grass (in volume and quality) and the contractor is responsible for the exploitation of the digesting installation (including investment and exploitation costs). The contract with the processor (digester) should last 10 years. The contracts with the mower can be shorter, for example 2 years. If this form is chosen, the most appropriate contract form is a concession agreement. In this case this would be a contract requiring service. It is advisable to do a European tender.

When these results were presented to the market (roadside owners, mowing companies, composters and farmers who are interested in building a co-digestion plant), it appeared that the market wants a different type of collecting structure. They want a shorter contract period (3-5 years). It would also be advisable to create one to one relations between mower and digester. In this case, also smaller amounts of grass can be put under contract. These comments imply that a collective collection structure with many parties and a long period is not necessary.

To honour the wishes of the market the Province of Utrecht has chosen to do an innovative public tender that fits the wishes and possibilities of the market. In this tender EMVI (most economically advantageous initiative) criteria are used to steer the processing of the grass towards the most preferable option (in this case: digestion with production of green gas). Before this innovative tender is shaped, a strategy document is made in which the Province of Utrecht substantiates her choices. Also a guide is made so all other 43 verge owners can learn about the innovative tender of the Province of Utrecht. In this guide the process and the steps are described to come to a cost efficient collection and sustainable use of the roadside grass.

Figure 4 shows the different costs for maintenance of roadside grass per owner type. The ownership types 1) recreational areas and 2) municipal roads take most of the costs. Categorically, mowing dominates is the largest costs category, followed by processing costs. Processing grass in Utrecht costs almost 1 million euro each year.

Figure 4: The different costs concerning the maintenance of roadside grass per owner type.



Total processing: € 925.847

3.2.3 Conclusion on the collection of roadside grass

In the Region Utrecht approximately 60 000 tons of roadside grass is mown, collected and processed every year. Approximately another 70 000 tons of roadside grass is not collected. With the maximal 130 000 tons of grass the energy potential from grass in the region of Utrecht is 10-26 million m³ biogas or 7-17 million m³ greengas. As stated, roadside grass can provide gas for 4 000-11 000 households. This co-digestion is now legally and technically possible and is more sustainable and cost effective than composting. In order to make it possible to co-digest the grass, it is necessary to use an innovative public tender in which EMVI (=economically most advantageous initiative) criteria are used to steer the processing of the grass towards the most preferable option (in this case: digestion with production of green gas).

3.3 Dry digestion

3.3.1 Problem and aim

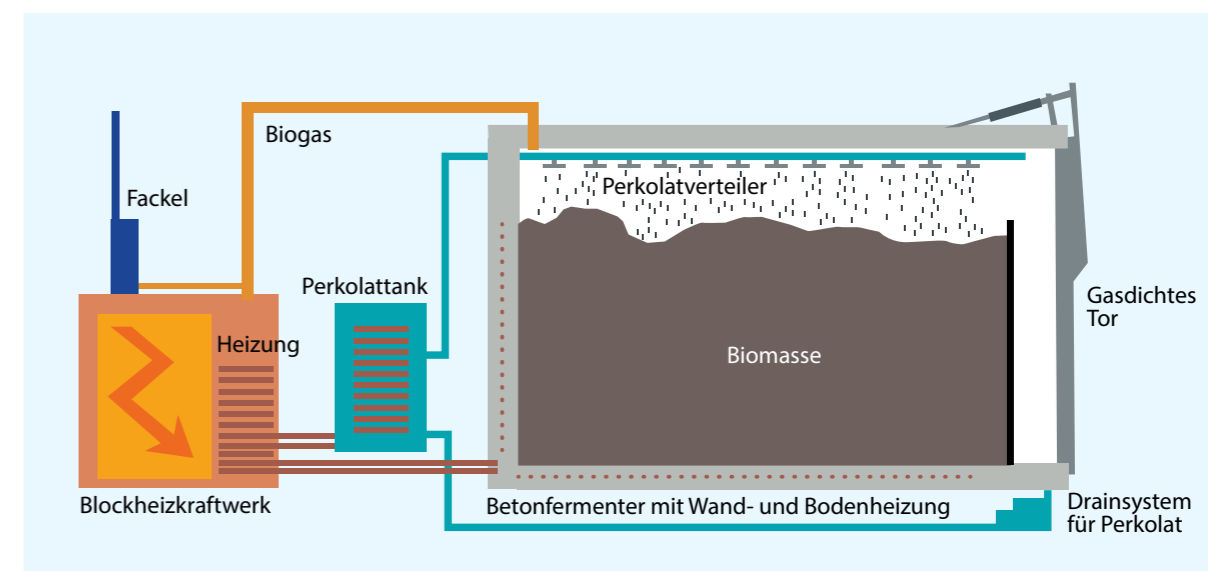
In several countries in North West-Europe (The Netherlands, Germany, Luxembourg, Belgium), grass from verges is digested through a process of dry digestion. Most dry digesting plants digest the grass together with the green parts of household wastes (vegetable, fruit and garden waste). This waste creates a high methane output when digested and therefore, in some cases, a profitable business case. In other cases, a significant amount of subsidy is still necessary. In the Province of Utrecht the green parts of household waste are under a long-term contract until 2018. Because of this, it is investigated if it would be profitable to dry digest grass from verges together with green cuttings at composting sites.

3.3.2 Results

In the province of Utrecht, there are seven large composting facilities present. Case studies have been made to assess the technical and economical possibilities of dry digestion with green cuttings, at the following four locations: 1) Cultuurtechniek H.G. van Dorrestein BV; 2) Van Doorn Soest BV ; 3) Groenrecycling Nieuwegein; and 4) Verhoef Groenrecycling.

The technique of dry digestion that was researched was the discontinuous garage box (batch) digestion at a temperature of 37 degrees Celsius. The incubation time is 4 weeks. After digestion, the digestate is composted for 8 weeks and sold as good quality compost.

Figure 5: Schematic image of dry digestion (BEKON-proces)



There were no problems concerning the technical possibilities (see figure 5), but financially the outcomes of all four case studies were negative. The three main reasons for a negative outcome were (1) the high costs of the dry

digesting plant, (2) the low price of regular electricity and gas and (3) the low governmental energy subsidies (SDE) for biogas. When the biogas can be injected in the gas grid, the ROI is better than when CHP is used. Also the material collected by the separate companies is not enough to build a profitable business case. In order to create a positive business case, at least 15 000 tons material needs to be digested. Only Van Doorn Soest BV has enough material on site. For the others co-operation with colleague-companies can be an option. But not all companies are willing to work together. Finally, at some composting plants, there is not enough space on the site to build a dry digestion plant. It is very expensive to new grounds for this purpose, since it has to be built on industrial grounds which are far more expensive than agricultural grounds.

3.3.3 Conclusion on dry digestion

At the start of the ARBOR project, due to stringent Dutch legislation, it was not possible to digest grass from verges in a common co-digester (with manure) as co-substrate. Dry digestion seemed to be a good alternative to digest the grass legally. Research showed that dry digestion in de Province of Utrecht is not feasible. During the ARBOR project, the legislation changed and it is now possible, under strict rules, to use grass from verges as co-substrate in a co-digester. This success is partly achieved because of the ARBOR project.

3.4 Biogashub

3.4.1 Problem and aim

By the end of 2014, under the current preconditions (i.e., without a biogashub), co-digestion is not feasible in the Province of Utrecht. There are a lot of farmers interested in digesting their own manure and the manure from other farmers. Several farmers already assessed the technical, economic and environmental possibilities of co-digesting at their farm. These assessments showed that the business cases were not viable. A wide range of reasons is responsible for this outcome. For example, the western part of the province of Utrecht, where a lot of cow farms are present, the soil consists of peat land. A heavy co-digesting installation will sink in this soft soil, unless piles are used for support. This makes an installation much more expensive than if it would be built on sand soil or rock bottom. The use of biogas in a CHP turned out to be unfeasible, due to the low electricity prices. The use of the heat is not possible in most cases because of the long distances to urban areas. The production and distribution of green gas is too expensive for a single farmer. Another serious issue is the high prices for co-products. Finally, the uncertainty to get governmental energy subsidy (SDE) is for most farmers the main reason, not to invest in a co-digesting plant. Also, the governmental energy subsidy was relatively low. A biogashub, in which several biogas producers can inject there produced biogas and collectively upgrade the biogas to green gas and inject it in the gas grid, can tackle some of the problems mentioned above.

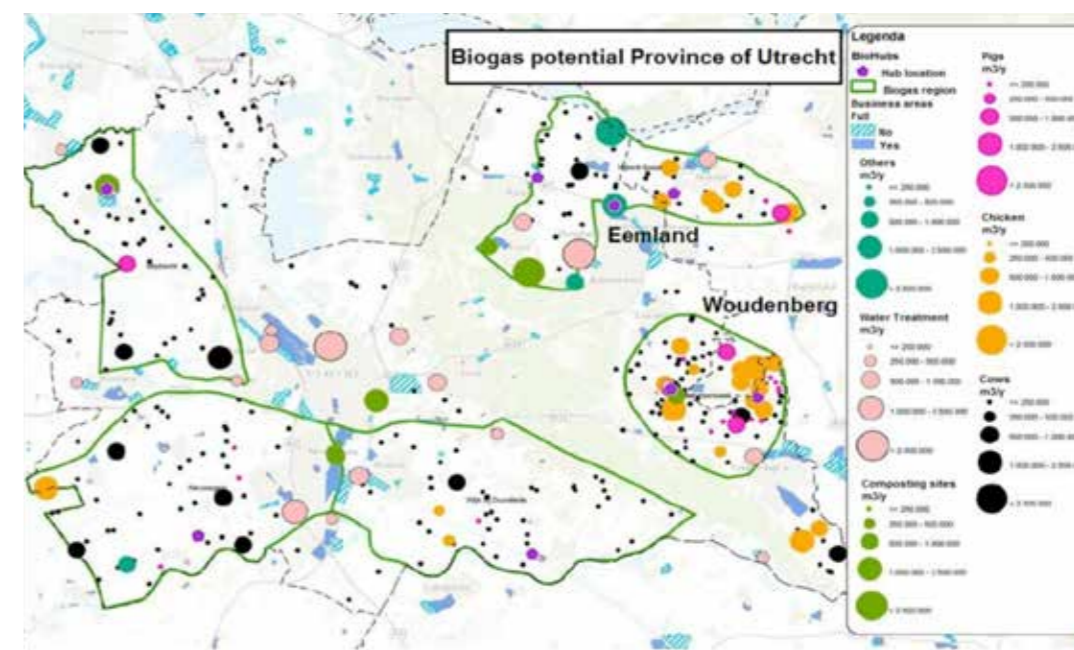
The use of grass from verges as cheaper alternative co-product is another way of making co-digesting more profitable. All these options combined can make co-digesting a profitable option in this province. In this case study it is investigated if a biogashub in the Province of Utrecht is feasible.

3.4.2 Results

In order to find the best region to realise a biogashub, the biogas potential of the province of Utrecht has been mapped. Figure 6 displays the biogas potential in the province of Utrecht. The bigger the dot, the more biomass is present and the more biogas can be produced. The green circles indicate regions where a biogashub could potentially be interesting.

To choose the region, an initial survey was carried out among all the larger potential biogas producers (the bigger dots). Questions that were asked were if the surveyed company was interested in digesting their biomass and if so, if they would be interested to be part of a biogashub. The northeast region (Regio Eemland) and east region (Regio Woudenberg) look especially promising since there are more big dots close together, and the survey confirmed that several companies were interested in digestion and taking part in a biogashub.

Figure 6: Biogas potential in the Province of Utrecht. The sizes of the dots represent the amount of biogas and the colours of the dots represent the origin of the biogas (for example: from cow manure).



To choose the region, an initial survey was carried out among all the larger potential biogas producers (the bigger dots). Questions that were asked were if the surveyed company was interested in digesting their biomass and if so, if they would be interested to be part of a biogashub. The northeast region (Regio Eemland) and east region (Regio Woudenberg) look especially promising since there are more big dots close together, and the survey confirmed that several companies were interested in digestion and taking part in a biogashub.

Next, for each region a stakeholder analysis was conducted and for both regions an information meeting was organised for the interested parties. Subsequently business cases were drafted for both regions. The outcomes of both business cases were positive. During the process, it appeared that there were several uncertainties in the region Eemland, which would lead to a serious delay of the process. It would not be possible to realise a biogashub there within the timeframe of the ARBOR project. Therefore it was decided to continue only with the region Woudenberg.

Initially, the design of the biogashub in this region started with three parties interested in realising co-digesting plants. These three plants would be connected through a biogashub of around 10 km long (figure 7).

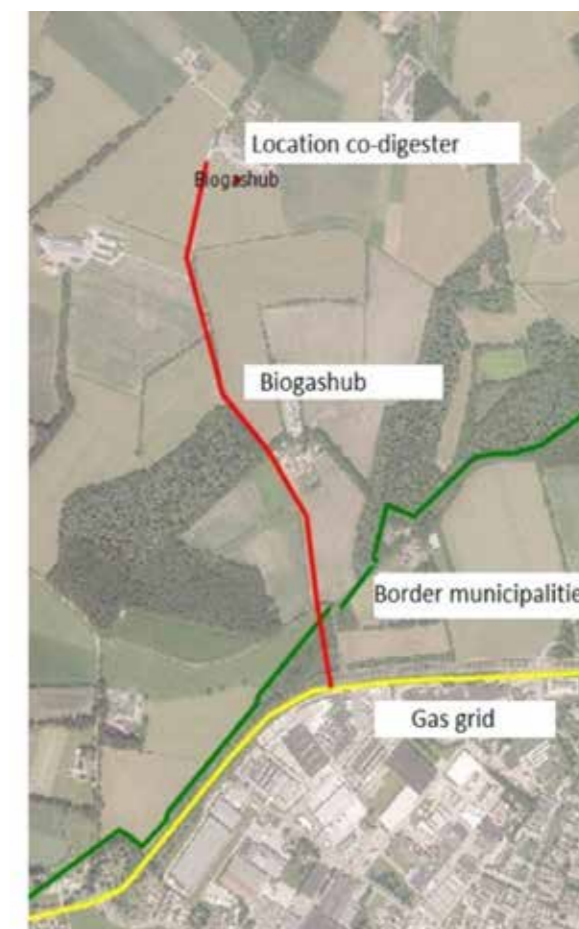


Figure 7: Biogashub (red) and 8 bar gas grid (yellow)

Also, a factory nearby was found that was interested to use the green gas in their production process. The largest and most distant digesting plant could not be realised in time, because the municipality was not in favour of this large digesting plant being too close to a camping site and a new residential area. Also the road was too small to carry the extra trucks. This digesting plant was taken out of the initial design. Next, one of the parties decided to change from a co-digesting plant to an innovative gasification plant. The reason for it was that the digestate could also be processed. This makes the biomass use more profitable. Unfortunately, this very innovative technique was not as reliable as he hoped, therefore this plant was not realised.

This entrepreneur had another possibility to take on an existing digester in another region, in another province. Again, this is more profitable on the short term. In sum, currently, only one co-digesting plant will initially be built and connected to the biogashub. But in the future, several other biogas producing parties can connect to the hub as innovation on the production of biogas proceeds.

3.4.3 Conclusion

Many stakeholders are interested in connecting to a biogashub. A biogashub makes it financially possible for entrepreneurs to digest biomass and use the produced biogas in an efficient way. Because of this case study, the Dutch energy subsidy (SDE+) has been adjusted to make it possible to get energy subsidy for biogas in a biogashub. For now, the backbone of the biogashub is realised with initially one digestion plant producing green gas which will be injected in the gas grid and one nearby factory using the green gas.

3.5 Wrapping up

It may be concluded that max 130 000 tons of roadside grass of the province of Utrecht can be collected and used as co-product in a co-digesting plant through an innovative public tender in which EMVI (most economically advantageous initiative) criteria are used. The energy potential from this grass is 10-26 million m³ biogas or 7-17 million m³ greengas. Research showed that dry digestion in the Province of Utrecht is not feasible. Under strict rules (see Annex Aa of the Dutch Manure Law) it is possible to use grass from verges as co-product in a co-digester .

A lot of stakeholders are interested in co-digesting roadside grass and connect to a biogashub. It is evident that a biogashub makes it financially possible for entrepreneurs to digest biomass and use the produced biogas in an efficient way. A biogashub is realised in the region Woudenberg with initially one digestion plant producing green gas which will be injected in the gas grid and one factory using the green gas.



Chapter 4 – Valorisation of woody biomass, in Stoke-on-Trent



4.1 The case

The initiative to install a wood boiler using woodchips arising from municipal park and open space tree waste is expected to reduce the Council CO₂ emissions, reduce park maintenance costs for local businesses and community, and secure energy supply. The 2013-commissioned technology was a 130kW direct combustion wood chip boiler, as it offers a proven concept and a simpler delivery method. It was installed in St James House Enterprise Centre, a Business Enterprise Centre for 30 start-up firms. Already in the first year of operation the boiler saved approximately 100 tons CO₂ and created a demand for 65 tonnes of woodchip per year.

To complete the supply chain, the plan called for the development of a wood fuel hub at a location owned by the City Council which could process approximately 1 000 tonnes of wood waste each year. The hub, which was to be operated by a contracted third party, required a suitable location with an area of more than 4,000m² to allow for both a 'shed' and outside storage. In addition, it was essential that the location be proximate to major park areas, have suitable access for large vehicles, be located away from significant residential



areas, and be available within budget and time constraints. Interestingly, out of 200 potential places identified to locate the wood hub only 2 sites met all of the requirements, and these were eventually ruled out upon further investigation. The difficulties in utilising these two sites derived primarily from covenants placed on the land from past owners which limited the scope of development. Although it may have been possible to relax these, it was determined that it would not have been likely to have been achieved within the project timeline. One example is the otherwise perfect location of a former coal mine workings, which has a covenant that it can only be used for a museum.

It was decided therefore to reduce the scope of the Hub to allow for only 100 tonnes of wood waste to be processed annually. This allowed the review of smaller sites to a maximum of 1000m² and one further suitable site was identified. After detailed investigation this site was also deemed to be unsuitable as it was located on a flood plain which would have required significant remediation measures to allow for planning permissions to be approved. Ultimately it was decided that the only viable way to achieve the closed loop supply chain was to contract a third party to fulfil the processing part of the supply chain at a location that would not be owned by the Council. Although this would remove the need to build a Wood Fuel Hub, it would still require the creation of a storage location whereby wood waste arising from works throughout the City area would be decanted prior to delivery to the third party. This option does have some advantages; primarily that the wood fuel hub could be brought in-house once the concept had been proven and demand had increased. In addition, the supply chain would have been directly replicable by other Local Authorities without considerable investment.

4.2 Regulatory context

Subsidies for the operation of biomass heating plant are provided in the UK through the Renewable Heat Incentive (RHI) and the Renewables Obligations Scheme (closing for applications in 2017). The UK tariff rate is dictated by the medium (i.e. wood chip or wood pellet) rather than the source of fuel as in other EU countries (such as Germany). The renewable subsidy schemes have two primary short-comings. First, the recently mandated inclusion of sustainability criteria to receive the RHI (the Biomass Suppliers List), still does not effectively discourage the use of transnational sources ahead of locally sourced wood stocks. Second, there is no specific incentive to use secondary sources of biomass, such as waste wood from arboricultural sources.

'Contracts for Difference' which is to be introduced in April 2014 as the primary subsidy for large scale biomass plants within the Electricity Market-Reform, does not distinguish between either sources (high demand areas, forest areas, foreign) or types (e.g., virgin timber, short rotation miscanthus) of biomass. The scheme does award generators of electricity from renewable sources and provide a guaranteed 'strike price' well above the wholesale market: Large CHP plants using biomass will qualify for £125/MWh; Anaerobic Digestion is included at a strike price of £150/MWh; and, advanced conversion techniques including Pyrolysis and Gasification are guaranteed £155/MWh.

Considered an excluded carbon neutral fuel under the UK Climate Change Act (CCA), single fuel biomass boilers avoid all current carbon taxes.

As with all EU member states, farmers in the UK receive 50% Grants for establishing costs and annual subsidies through the Single Payment Scheme. Current bio fuel costs have not significantly impacted the woody biomass market and there is still little incentive for farmers to move towards biomass production.

The wood waste from arboricultural arisings that Stoke-on-Trent is aiming to use is not specifically classified within the waste hierarchy and can be used as a standard waste stream. The UK Environment Agency allow the burning of certain waste (e.g., untreated wood, sawdust, wood shavings, and wooden packaging, waste bark and cork, and plant tissue waste) in smaller plants (<4MW) as long as it is used to provide heat or power. The waste pathway for felled timber from SME's (the final destination) is unknown. The tax associated with landfilling of timber is £72/t, compared with a range of £64-82/t for the incinerators.

Synergies regarding energy innovations are promoted in the UK. The 2014 expansion of the RHI-scheme supports large biomass (>1MW) boilers, ground source heat pumps and solar thermal. It relates, for example, to biomass CHP, and larger biogas (>200kWth) units. Apart from that, the Localised Energy Systems subsidizes research and development of innovative local energy systems. Even Trigeneration (combined heat, power and cooling) (CHPC) is possible and suits large scale collaborative activities. The key to success is to find a setting with stable demand, low prices, and a reliable plant to make back-up capacity redundant. It would probably require subsidies for both cooling and heating. Alternatively biomethane injection into the national gas grid is made possible by the Network Entry Agreement and the Gas Safety (Management) Regulations 1996. All installations are subject to planning conditions by UK local authorities which take into account many potential impacts such as access, visual impact and regulatory requirements in determining suitability of sites. Large scale plants (such as a manure digester) would likely require a large scale public consultation, and an Environmental Impact Assessment.

Finally, local authorities are given some freedoms to draw up their own planning policies, however no policies are known that specifically encourage interfirm collaborations. Nevertheless, there are examples of Local Authorities that require minimum levels of renewable energy in new area developments that has incentivised some businesses to develop district heat networks. Except for retail locations, that have a high energy demand and sufficient internal knowledge to drive projects, there is a lack of knowledge and/or awareness to engage with other likeminded businesses. Thus there are relatively few joint energy clusters in the UK in comparison to leading EU member states.

Chapter 5 – Synergy Parks in West-Flanders



The Province of West-Flanders (situated in Flanders, Belgium) is economically characterized by the agriculture- and fishery-sector, next to well-developed presence of industry, trade and distribution. Therefore, POM West-Flanders plans to develop a synergy park linking up agriculture to industry with the aim to optimize biomass valorization.

The initial focus was on the region of Roeselare (Mid-West-Flanders), due to its high-performing industrialized area. In particular its food processing industry, textiles, metal and wood industries are flourishing.

Early on a workshop was held to launch the synergy park-action and to gain insights in the specific needs and the suited approach. Various stakeholders, such as companies, government agencies, and relevant associations were present. Companies in the designated area with biomass surpluses, biomass and heat demand or a biomass conversion installation were identified. A questionnaire was composed and circulated, and follow up calls and meetings were helpful to map the biomass exchange potential in the region.

5.1 Initial results, new strategy.

The lessons of the inventory were crucial: first, companies are frequently questioned concerning biomass streams by other Flemish organisations and the willingness to respond in the questionnaire was very low. Second, companies with detected biomass surpluses were not highly interested to participate in local exchanges. A third issue concerned practical problems such as logistic bottlenecks (eg seasonality of huge streams), while, fourth, large players in the biomass sector offer competitive prices.

Due to those rather fundamental problems it was decided to broaden the potential area and to the Province of West-Flanders as a whole. The following new strategies were developed:

A. Food and agriculture: West-Flanders has a high concentration of intensive livestock farming and of vegetable production, in combination with a well-developed food production sector. As a consequence, the region has a high potential to produce renewable energy from biogas, but profitability of digesters was pressured. The economic feasibility was investigated of small-scale digesting of vegetable wastes from a specific company (section 2). Furthermore, from large-scale Anaerobic Digestion and Anaerobic wastewater treatment plants were also studied as potential producers of biogas. With a major part of all Flemish large scale digesters in this area, innovative solutions for the whole sector (existing and new plants) and for specific cases were formulated (section 3).

B. Wood-processing industry: West-Flanders houses very important players in the wood-processing industry: producers of chipboards, fiberboards, wood flooring, furniture, etc. Since wood waste for energy is competing with material applications, it is relevant to define in detail the waste wood supply and demand (section 4). Additionally, two companies produce high amounts of excess green heat, not yet valorized. Possible heat exchanges between these and other companies, and further heat consuming stakeholders in the region (horticultural growers, public buildings, future industrial estates, etc.) was investigated (section 5).

5.2 Small-scale digestion

5.2.1 Problem and aim

Flanders houses 54 small-scale digesters (< 200 kW each), of which 12 are situated in West-Flanders (Figure 8). Small-scale digestion in the agricultural sector has a strong upward potential, because at present only 1,7% of the available manure is energetically valorised. Further, the concentrated food producing and processing companies produce large amounts of organic side streams which can contain relatively large amounts of energy. Small-scale digestion is typically used for manure.

We investigated both whether the installation of a small-scale digester at the site of a vegetables company is economically feasible, and noted the bottlenecks that hamper such investments.

Figure 8: Location of small-scale digesters in Flanders (source: Biogas-E)



5.2.2 The case study

Verduyn is an international vegetable company in Kortemark, nearby Roeselare. The company grows, washes, sorts, selects, chops, packs, and sells all sorts of fresh vegetables. Carrot products are their speciality, being one of the main carrot suppliers in Europe. Per year, the company produces 3500 tons of carrot cutting wastes, plus 600 tons of celeriac and 900 tons of carrot pulp.

Lab analysis of these waste streams showed a biogas potential of 74.5Nm³ biogas/ton containing 60% CH₄. Carrot pulp had a biogas potential of 57.4Nm³/ton containing 55.6% CH₄. It seems feasible to install a wet (DM<15%) mesophile (37°C) reactor unit: The methanisation-process will run in one completely mixed reactor. This is a quite robust and stable process, as there will be a low organic load of the reactor volume.

Verduyn consumes 3250 MWh (2012) of electricity, and takes into consideration 4000 MWh following an investment plan. Next Verduyn has a low heat demand (62 MWhth, 6000 liters fuel p.a.). One third of the electricity is spend on cooling. The energy profile of Verduyn throughout the year is shown below (kWe vertically, months at horizontal axis). The lowest average electricity consumption is realized at weekends (figure 9).

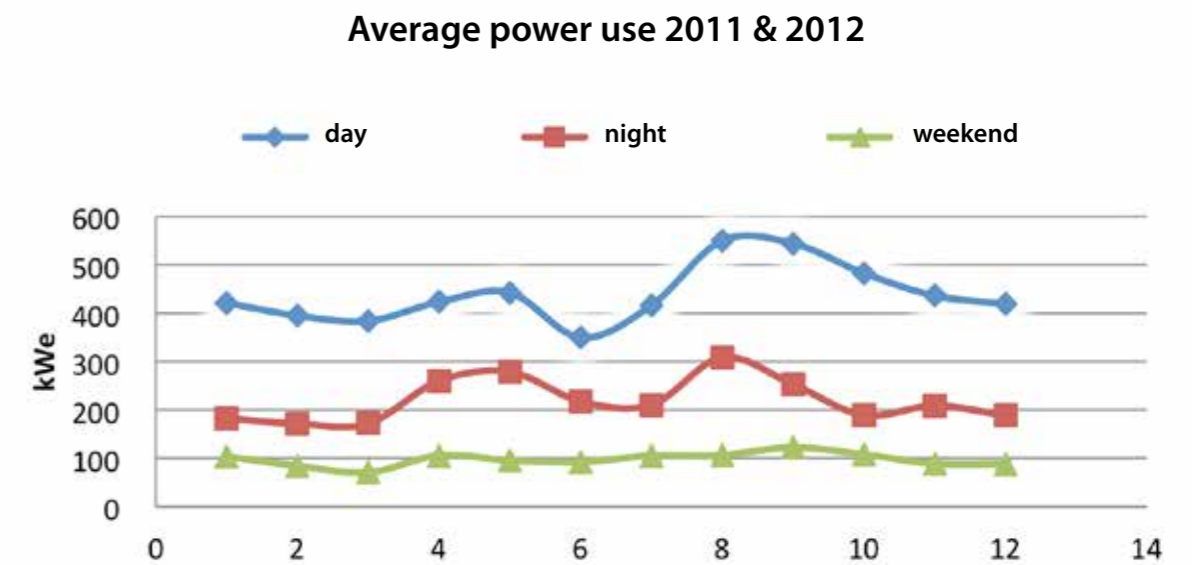


Figure 9: Average power use 2011,2012 (day, night, weekend)

The waste stream of approximately 5000 tons can deliver around 90kWe, on average. This roughly coincides with the power demand during weekends. This means that the produced electricity can always be fully exploited on site, leaving no need to transfer excess electricity to the e-grid. In sum, the produced electricity can be used in the most efficient way locally.

5.2.3 Economic assessment

Based on the outlined scenario, some conservative assumptions are taken, meaning that the most expensive outcomes will be taken into account. The investment horizon is 10 years. Avoided electric and heating costs may be considered as an income. 16% of the total electrical consumption of Verduyn can be covered by the CHP-unit. But the 150 kWh thermal capacity can fully cover the required 62 MWhth heat consumption. The excess heat still needs a useful application.

The market analysis shows that the investment cost for the installation (digester + CHP) is expected to be €280 000,-. Other costs are maintenance (engine and digester unit), permits, grid-connection, administration and insurance, plus 10% for unforeseen costs is taken into account (€41 500). As a lot of biomass becomes available in August and September, requiring a buffer capacity from which to feed the digester. A ditch of 1800 m³ should be sufficient. Digesting 5 000 tons of side streams produces appr. 4750 tons of digestate to be stocked for 6 months. Therefore a digestate buffer unit of 2425 m³ should be foreseen (Verduyn already has a buffer unit of ca. 500m³). The fall of existing profits on selling side streams (sometimes sold to neighboring farmers) is considered a cost.

The most realistic scenario is to evaporate and spread out the digestate on the land. Especially spreading of the digestate has a significant impact on the feasibility of the project. An assumed cost of 9€/ton for spreading on their own land (max 7ha), and 15€/ton when spread elsewhere. 37ha land is needed elsewhere to spread all of the digestate.

The result is a slightly positive case, with an annual surplus of €6 000. However at a total investment of appr. €550 000, profitability is marginal, with two major preconditions to profitability:

- a lower cost for spreading the digestate (an annual cost of around €40 000) will have a significant influence on the result of the feasibility study;
- a more useful application for the excess heat during summer would provide a significant income (900 MWhth to be used).

To conclude, small scale digestion food industry streams can be profitable. However, specific local conditions are decisive for the margins. A constant heat demand can become very lucrative, but food companies that require primarily cooling won't find sufficient added value in a local biogas plant. With a positive case there could be a further search for synergies with other stakeholders, concerning their organic biological waste, generated electricity and/or heat.

5.3 Potential of biogas production in West-Flanders

5.3.1 Opportunities and aim

Biogas in the Province of West-Flanders is mainly produced through Anaerobic Digestion (AD) of industrial organic and agricultural sidestreams. The region holds 15 out of the 40 digesters installed in Flanders. These 15 large-scale digesters account for a total capacity of 834 000 tons/year and an electricity production of 32 384 kWh. Other sources of biogas production are industrial wastewater treatment plants, sewage treatment plants and flue gas.

As mentioned in section 2, there is still a large part of the digestible biomass that is left unused for energy production: more specifically manure, agro sidestreams and organic waste streams from the food industry. What are the opportunities to produce renewable energy by biogas-installations?

We investigated, by means of an inventory and a feasibility analysis, how biogas-production in West-Flanders could be increased, with a focus on the food producing companies. Because of changes in the Flemish legislation concerning subsidies for green energy production (Certificates for green power and for CHP-units), actions to

consolidate the already existing biogas-installations are explored. In addition, the potential for new biogas-installations is evaluated from which a strategy for biogas production is developed and actions are formulated. The food sector can increase the amount of renewable energy from biogas by extracting the energy from the following waste streams:

1. *Organic waste water:* No all companies combine wastewater treatment with energy recuperation. Shifting completely from aerobic to anaerobic treatment or using new technologies, would increase biogas produced. In addition, some companies that produce biogas through anaerobic wastewater treatment (UASB) do not use the biogas as source of energy, heat or fuel, but burn it as waste gas.

2. *Organic-biological waste streams (OBA):* food residues contain a lot of energy. This energy can be extracted through AD or new technologies. Considering the large volume of waste in the food sector, there is potential to grow the renewable energy production by digesting food wastes.

3. *Inventory* As stated, we carried out an inventory of the biogas-installations in the food sector in West-Flanders. The sources of biogas taken into account are AD and UASB. In addition, we carried out an inventory of the OBA in the food sector, to detect the potential for new biogas-installations. Based on the inventory and a questionnaire, the main bottlenecks and solutions for exploiting existing biogas-installations are described, and possibilities for new installations are described.

4. *Feasibility:* biogas for green heat/electricity From the inventory, we selected two companies that have an UASB-plant, sufficient biogas amounts produced, and a high interest for installing a biogas-valorising installation. For these 2 companies the economical and practical feasibility of following scenario's is evaluated: Scenario 1) holds that Biogas is converted into heat and electricity through a CHP-unit, and the produced heat and electricity that can be used by the company itself; under Scenario 2) biogas is temporally stored on site, and the biogas is used in a heat boiler to produce hot water for the company. We formulated the boundary conditions under which the investments were viable, the minimum amount of biogas needed, and some practical issues.

Feasibility: biogas for green transport When synergies between companies are developed to jointly valorize the produced biogas from their AD or UASB-plant, larger investments can be realized and raising new possibilities for biogas-applications. In a first scenario, biogas is upgraded (cleaned) to biomethane and injected in the grid. In a second scenario, biogas is upgraded to biomethane, and collected in a petrol station, to be used as a green transport fuel.

In the synergy park Roeselare, possible synergies with regard to biogas valorization are screened. For one specific collaboration, it is investigated whether a biogashub becomes feasible and which actions should be taken to make the investment viable.

5.3.2 Bottlenecks

Subsidies: The support measures per unit of green electricity produced were cut back to a ten years by the Flemish government and the support per kWh was lowered. Additionally, a so-called banding factor was introduced, to reduce the excess number of green certificates at the market.

Negative gate fees: Until a few years ago a gate fee was common practice at digesters, even for certain interesting organic waste streams. Today, the competition for these streams has increased; the AD-plant has to pay for it. This was not foreseen in the business plans of the early digesters.

Permits: Flanders requires both an urban and an environmental permit. But applications for them require two separate public inquiries, run different time scales, and they are assessed by different public institutes. The public inquiry is the bottleneck: residents are concerned with potential odour and other emissions, traffic problems, and so on. Decision makers are susceptible for these objections. With the aim of this measure is to reduce administrative burdens, the Flemish government implemented an all-in-one-permit with only one public inquiry, in 2014.

Removal of digestate: Strong competition between spreading manure or digestate on agricultural land, causes digestate exports to nearby France. This requires generated heat to dry and thus reduce the volume of the digestate. That heat is no longer fully available for other applications/synergies. To reduce costs for exporting the digestate

by trucks to France, POM West-Flanders launched in december 2014 a trial to ship large volumes of digestate to France. With a fully loaded ship in retour, transport by ship is 10% cheaper than by way of trucks.

5.3.3 Conclusion

The results of this study allows running three actions: (1) develop a digestion plan for West-Flanders. The plan describes a strategy concerning biogas production, including support actions to further expand the contribution of biogas in the targets for renewable energy production; (2) Convincing food producing companies to valorize the biogas produced by the UASB-plant, instead of burning it as a waste gas; and (3) exploring the use of biogas as a green transport fuel.

5.4 The use of wood in renewable energy production

As described in the overall introduction on West-Flanders, a major problem was to gather the right data about bio-waste availability and (private) energy demand. West-Flanders is a province with rather low forestation degrees. Substantial efforts were spend on the inventory dedicated to wood-for-energy in West-Flanders.

5.4.1 Wood demand and supply

Initially, we started with the inventory of the installed wood combustion installations, using waste wood, and installations subject to authorization (≥ 300 kW). This amounted to 43 locations, somewhat concentrated in the South-Western part of the province.

A survey targeted these companies with the intention to get clear information on the types and volume of wood used per installation in 2013. In the case of waste wood the type is specified following the commercial classification of type A (untreated wood waste, e.g., pallets), type B (non-polluted treated wood waste (e.g., chipboard, MDF), and type C (polluted treated wood waste). Following the Flemish legislation, waste wood of type A is not allowed to be burned for energy purposes. The survey response rate was very good: 33% in the agricultural and horticultural sector, 70% in the wood-processing industry, and 100% in other industries. In case of non-response we made a simulation based on the profile of the burner, and assumptions on the use of the generated energy.

Survey brought about interesting results. The total use of wood for renewable energy production amounts to 242 000 tons/year. The 43 locations use in total 62 000 t/y (26%) of it to produce green heat. Thus 180 000 t/y (74%) is used for the production of green electricity. This production of green power is concentrated in one company (2014). It uses type B wood waste, a substantial part of it being imported. A second company is allowed to burn type B- and type C-wood, but it does so only in certain periods. Green heat is produced primarily by burning company-owned wood from production side streams (46%, 28 000t/y, next to 45% from burning purchased type A or B-wood.

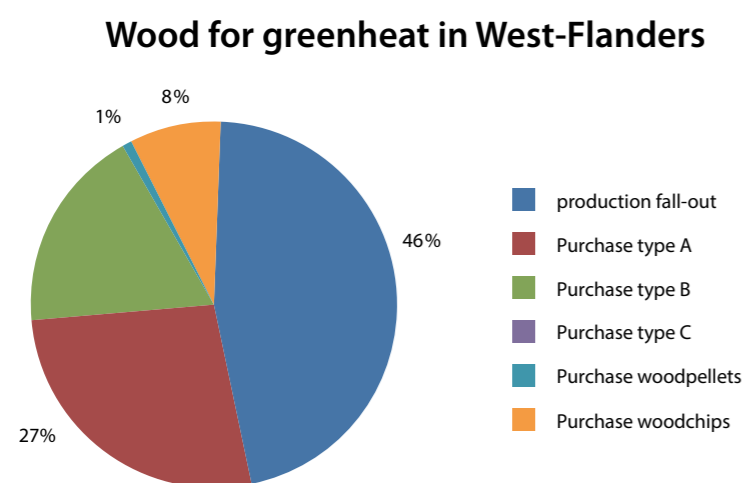


Figure 10: Wood for green heat, West Flanders

In sum, the total demand of wood is 242 000t/y minus 28 000t/y is 214 000 t/y, largely sourced locally. The agri- and horticultural sector acquires its wood mainly regionally. The wood processing industry purchases locally only when short of own side streams. However, some firms processing large volumes are mainly importing wood.

Deduced from various sources (e.g., IMJV reports 2011, communal recycling parks 2013) the waste wood supplies can be summarized as follows: about 140 000 t/y of waste wood is available from companies. 20 000 ton of this is type A wood, not allowed for energy purposes. Due to this 120 000 tons/year is available in theory from companies. Additionally 20 000 t/y type B-wood is available from recycling parks. Summing up, the potential supply of waste wood for energy purposes is 140 000 t/y.

5.4.2 Conclusion on using wood for renewable energy

If we compare demand (214 000t/y) with supply (140 000t/y) and taking into account the very limited forestry in the Province, we can roughly estimate that there is a shortage 74 000 t/y of wood in West-Flanders.

Based on this information we need to evaluate the potential of using local wood and wood waste in local energy production. In this evaluation we will need to take into account, among other things, the logistical challenges, the impact of increasing biomass cascading of woody resources, and the impact on the wood-processing industry. Another pathway is to achieve growth by implementing innovative efficiency boosting measures. A feasibility study of connecting the residual heat of wood waste fuelled power station to a district heat network is ongoing (see section five).

5.5 Green district heat network

The renewable energy production in Flanders almost tripled between 2005 and 2013 till 5,9% of final energy consumption. Green heat contributed for almost half (47%) of this renewable energy production. As part of the 2014-2019 Flemish coalition agreement that strongly promotes biomass for green heat (co-)production, comes investment support for green heat and an investigation, roadmap and full policy framework (before 2016) on efficient district heating and -cooling. This study is ongoing.

5.5.1 Existing and potential district heating

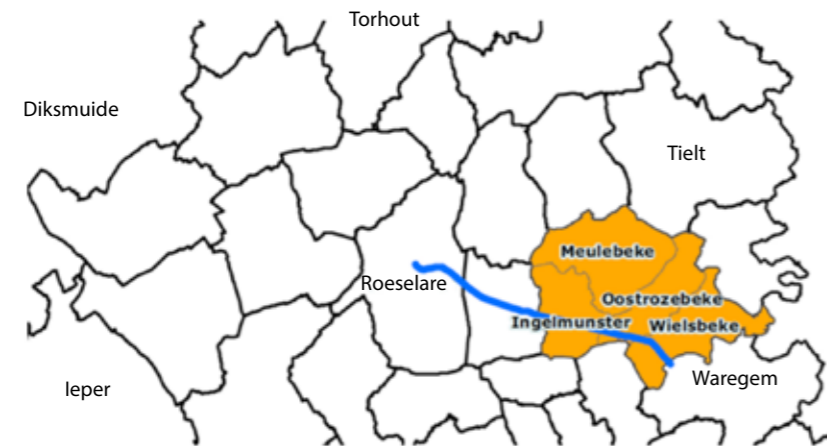
The Province of West-Flanders already has district heat networks running, based on local synergies, and others in consideration. Firstly, the oldest district heat grid in Flanders exists since 1986, without much ado: The public waste incinerator of the intercommunal association MIROM (Roeselare) generates heat, both for an ORC-power generation, and for large district network of public and private buildings (e.g., schools, hospitals, horticultural growers, a public swimming pool and a residential expansion plan). Almost half of the waste consists of biogenic material, 48% of the heat produced is labelled green heat.

Secondly, the intercommunal incinerator IMOG exchanges waste heat to Nerva, a neighbouring producer of concrete construction elements in Harelbeke. Interestingly, there exist no contractual obligations concerning the amount of delivery or the purchase of heat. IMOG director J. Bonnier: "if there is no willingness to trust, don't start". The cooperation is primarily based on mutual trust with the demand side of a backing up heat system.

Thirdly, new district heat systems are expected, because large companies with excess green heat want to valorize their excess heat (POM). For example, the biomass power plant A&S Energie (24,6 MWe), in the canal zone Roeselare-Leie, processes large volumes of non-recyclable wood residues, partly from the local chipboard industry. It also planted about 1 ha of Short Rotation Coppice (willow). Considering previous studies and political plans for a more optimized energy performance the company brought about the plan to assess the potential of an innovative green heat grid in the zone nearby A&S Energie.

5.5.2 Stakeholders and study content

Development agency POM made an inventory of all interested parties with a substantial heat demand or a substantial heat supply, to promote and realize a green heat-synergy park between companies and the surrounding agricultural area. The demand side concerns the municipality of Oostrozebeke (running, e.g., a rest house, and municipality offices), greenhouse farmers and live-stock breeders, supermarkets, industry parks, and (a developer for) future residents (social and private housing). Not only this but also neighboring municipalities (see map) became interested in joining the initiative. Currently almost 70 parties are interested in heat off-take.



To guarantee an uninterrupted delivery of heat the study includes more companies in the area with excess heat, such as Unilin in Wielsbeke, that burns company-own wood waste and -dust.

5.5.3 Conclusion

The ongoing study will focus on two main tasks. First, the design of an economically feasible green heating grid, either a low temperature grid (about 40 °C, upgraded with heat pumps), or a higher temperature grid (about 100 °C). Second, with investments in the heat grid at 200 to 1000 Euros per meter (a heat water plus a return pipe) an alternative by way of mobile heat storage will also be investigated. The system consists of heat storage (sorption) in a container, driven to large and continuous heat demanders, such as e.g. swimming pools. What are the suited sorption materials? And what are the suited economic parameters? A steering group committee consisting of prime stakeholders will have to implement a feasible scenario, be it either a district heat network (promising synergetic loops), specific clusters, and/or mobile heat delivery.





Figure 11: EcoWerf Composting unit

EcoWerf is a intercommunal incinerator for waste management from 27 communities in the region of Flemish-Brabant. EcoWerf installed a digester and consumes the biogas produced in a CHP-unit on site. This allowed reducing CO₂-emissions by about 2 700 ton CO₂/y. Are there local synergies possible with neighbouring stakeholders (companies) on heat usage optimization, digestate treatment and/or biogas usage? These items were first and foremost in question for partnering with Aquafin, a communal waste water treatment plant. Next, the construction company (Ertzberg) may consume biogas for district heating of newly constructed houses and apartments. Finally, an inventory was made for collaboration on joint treatment of organic waste material that could be added to the VGF-flow already collected by EcoWerf.

6.1 The case study

Several alternatives have been investigated. First, the self-use of biogas produced in a CHP unit; Second, selling biogas to a third party, still to be identified. Third, upgrading the biogas to biomethane for injection in the gas grid. And fourth, upgrading the biogas to biomethane for use by EcoWerf-trucks next to grid injection.

Several cooperatives (EcoPower, etc.) have shown interest in (co-)funding the project as it concerns renewable energy, although they require a positive return for their members. Other companies (e.g., Ertzberg) showed interest primarily through the application of the upgraded biomethane. Aquafin EcoWerf seems to be in need of a neighbouring company in demand of heat, though there is no space available at the site itself. Heat is a non-valorised flow at the moment. There are alternative opportunities nearby (e.g., district heat networks), but they are not easy to reach due to infrastructural problems (e.g., canal, railways). Interestingly, if a district heat network would be realized then the heat-capacity of the CHP-unit at EcoWerf turns out to be too small.

As EcoWerf is an intercommunal organisation, thus each of the 27 communities have a person assigned to the Board of EcoWerf. They are powerful, as they must in the end decide on implementing projects. Although project developers can raise their voices and are considered influential, at the end of the day EcoWerf Board of Directors takes the final decisions.

Considering dependencies, injection in a grid would realize a relatively low form of dependency. The grid would always be able to buffer possible lacks or excesses of biogas. However, grid injection requires intensive communication and collaboration with Synergrid (Belgian association of utilities). They issued technical recommendations for biomethane injection, biomethane monitoring, and quality specifications (Synergrid, page 6 <http://tiny.cc/ksamnx>). In case of a direct consumption of biogas or excess heat by others, there would of course be a direct dependencies as the number of potential buyers seems low. Synergy could be created by treating the liquid fraction of the digestate at the water treatment plant Aquafin. However, legal restrictions does not allow Aquafin to treat industrial waste water. Therefore, the complete digestate flow needs to be processed at the premises of EcoWerf (ARBOR (2014)).

6.2 Conclusion

Overviewing the four economic scenario's, calculated with great detail and all assuming a digester-capacity of 40 000 t/y, there is support for production of biogas in a digester and selling all biogas. The use of biogas in a CHP and using heat excess for drying digestate is the second best option. The most negative scenario is the upgrading of all biogas for grid injection of all the resulting biomethane. Overall, none of the scenarios is really economically feasible in the actual support system of the Flemish Government.

A licencing policy supporting biomethane injection would radically change the local collaboration potential. When using the biogas in a CHP-unit, in Flanders one receives green power and green heat certificates. In contrast, CHP-units are not classified nor subsidized as green power and heat across the border with the Netherlands (see the study on Utrecht). Flanders, in contrast is, however, lacking support for the injection of biomethane to the grid, where support is building up in the Netherlands. Evidently, an economically feasible transformation of biogas into biomethane and the injection of it in the grid would be a huge benefit for the development of the synergy-park, systematically increasing potential of other collaborations.



Industrial companies could improve their sustainability performance by means of interorganizational collaborations, especially in agrofood and agro-industrial complexes (Van Waes and Huurdeman, 2009, Biopark_Terneuzen, 2013, Smeets, 2009, De Wilt and Dobbelaar, 2005).

As stated, by 2014 around 5% of energy is produced from green sources, while the goal of the Dutch government is to produce 14% of energy from sustainable sources in 2020. In the early years of this century ideas were developed to create agro-industrial collaborations in so called agroparks (De Wilt *et al.*, 2000). Simultaneously, the Dutch government decided to expand possibilities of Dutch greenhouse complexes to move out from overloaded locations in the Netherlands, such as the Westland, to ten assigned expansion areas, called LOGs, such as and Terneuzen (Sealand), Bergerden (province Gelderland), and Grootslag (North-Holland). Additionally there is also one case on the large Synergy park-initiative under development called InnoFasEnergy in Duiven (Gelderland). The companies present in the latter industrial area are there long, often decades, but the systematic search for synergetic collaborations has been substantiated only since 2013. By the turn of 2014-15, the prospects are still too uncertain and the data too sensitive to allow a description of the expected setting in some detail. We will therefore continue to present three synergy park activities in the provinces Sealand, Gelderland and North-Holland.

Figure 12: Descriptives on three synergy parks in the Netherlands.

	Biopark Terneuzen	Agropark Bergerden	Agriport A7
Location	Province of Zeeland	Province of Gelderland	Province of North Holland
Initiated (y)	2005	1990	2003
Established (y)	2007	2000	2006
Total occupied area (ha)	15 000	320	930
Organisations active at location (N°)	60	17	31
Organisations involved in the park (N°)	23	17	24

7.1 Biopark Terneuzen

Biopark Terneuzen was one of the first attempts in the Netherlands to realize a synergy park, creating “smart links” between local companies in the zone Gent-Terneuzen. It was planned in a roughly 150 km² area in Chanel-Zone Gent-Terneuzen, in the province of Zeeland. The area holds over 60 local companies, varying from chemical, food, and metals, via pulp and paper industry to storage and transshipment (Spekkink, 2013). These companies have different types of production, are different in their size and capabilities, and operate in different markets. Available for glasshouses are 280 ha. The negotiations among stakeholders to establish exchanges started in 2005, and the official launch was in 2007. It was concluded that co-location of horticultural companies could improve resource use among agro- and other industrial companies. Geographical proximity of various organizations was an opportunity to create a climate neutral complex, that specifies how of rest heat and CO₂ produced by industry from biomass could be used in glasshouses.

Key in the developing and implementing Biopark Terneuzen are the following partners: Zeeland Seaports (harbour authority), Yara (mineral fertilizer producer), Visser & Smit Hanab (construction company), EcoService Europe (transport dangerous products, trader fertilizers & biomass), HEROS Sluiskil (waste service provider), Cargill (international agrifood producer and trader), and horticultural companies. Structurally parties were organized by a mixture of loose network structures, subsidiaries, and alliances.

The biomass power plant and Yara generate large amounts of carbon dioxide and rest heat. Previously, heat was emitted in the river and CO₂ in the atmosphere. Interestingly, growers are critically dependent on heat and CO₂. After the far from smooth realization of the Biopark Terneuzen, heat and CO₂ are transported to the newly realized greenhouse complex via a two kilometer pipeline and WarmCO₂, a joint service company. However, the seasonal

pattern of heat use in horticulture requires substantial storage capacity, especially in summer periods. Rosendaal Energy brings biomass and water into the system. Bioethanol-producer Nedalco sources starch, steam and water from Cargill. Besides, WarmCO₂ is responsible for energy supply and gives growers a fixed price for energy for at least 15 years to ensure their business stability. Finally, water is brought from various sources to the Heros-group and from them to the greenhouses.

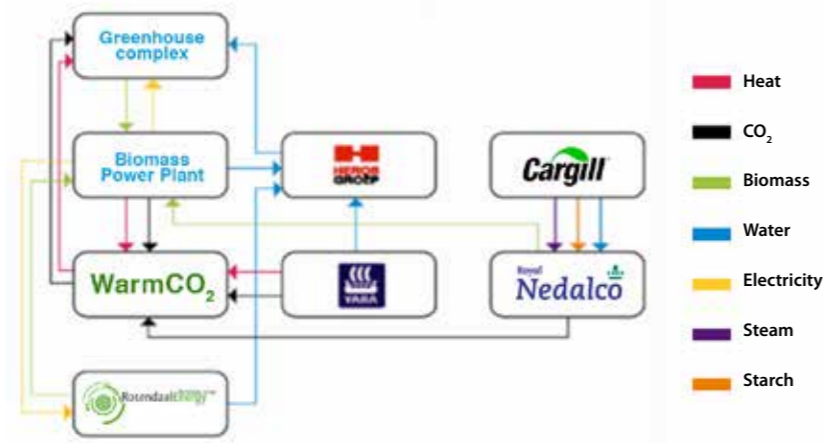


Figure 13: Biobased exchanges in Biopark Terneuzen, province of Sealand.

Since the establishment of Biopark Terneuzen, at least six further critical developments took place. First, the idea to locate intensive animal husbandry in the region received strong criticism. This part of the project has been eliminated due to the social pressure. Second, despite the potential synergies several important partners went bankrupt, especially the bio-business companies, such as Rosendaal Energy, Nedalco, and Lijnco. Third, by 2013 only three horticultural plots have been used from seven available plots, with one of them even going bankrupt, having the land sold to a major grower with glasshouses elsewhere in the Netherlands. Fourth, the bankruptcy was partly attributed to the heat provided by industry, being insufficient for the glasshouses during the winter season. Therefore, the horticultural companies still need additional heating facilities, redundant in other seasons. Additional industrial heat supplies can in principle make the growers natural gas-independent (Warm-CO₂BeheerB.V., 2011). Fifth, WarmCO₂ is a costly business, claiming substantial external funds from the support program Sustainable Horticulture (Stidug). The initiative received 9 mln Euros for improving sustainability of the region. The money was used for realizing the heat and CO₂ exchanges. In 2012, additional maintenance of WarmCO₂ did cost Zeeland Seaports about € 20mln, and it lend about €10mln to WarmCO₂ to keep the business running for 2 more years (ZeelandSeaport, 2013). Sixth and final, as often feared and mentioned, mutual dependencies turned out to be costly. Nedalco was an early large scale producer of bio-ethanol, sourcing steam, residual water and grain from its neighbour Cargill. However, Nedalco went bankrupt in 2011. Cargill decided to make a forward expansion buying Nedalco, partly because of the strong connections.

Indicated causes behind the different developments were the financial crisis of 2008, the low interest with local firms to expand non-core exchange relationships, and the lack of communication and mutual unfamiliarity. This lowers mutual trust and the willingness to build strong commitments, dependencies, in (non-core) activities. Finally, next to the earlier mentioned Stidug-subsidy the project was also awarded funds from the institute Transforum and an Euregio-subsidy to advance the innovative knowledge infrastructure, aimed at industrial ecology of bio-economy processes. In sum, some 8 years after initiation, experiencing major successes and problems during realisation, Biopark Terneuzen got settled at rather stable patterns, to the satisfaction of most of the stakeholders involved.

7.2 Agropark Bergerden

Agropark Bergerden is to be found in the Rhine-riverdelta between Arnhem(North) and Nijmegen (South) only 15 miles from the German-border (See figure 14). This initiative, an expansion area/plan for growers, started in 2000. Soon after the spatial plans were adapted and approved growers started to build new glasshouses at the location, and up until 2008 Bergerden experienced rapid growth. Already in 2003, 15 horticultural companies have been located in Bergerden at about 110 ha. Although the firms were new to the region, quite some of them had other production locations nearby or elsewhere in the Netherlands.



Figure 14: Agropark Bergerden, province of Gelderland

Euros in total. It was paid out from the Support program Sustainable Horticulture (Stidug). The CHPs for heat and electricity were expected to be replaced with at least heat produced by bio-energy technologies. The firm Bio-based Bergerden (BbB), initiated by two farmers in the area, indeed planned to use biowaste in a digester, for the sake of energy and (in future) fertilizer production. The oft announced investment is still not realized, despite even an allocated, substantial valid subsidy-claim. Long term input contracts for non horticultural biomasses coverage for the investment itself were critically problematic.

The horticultural companies established first the Energy Cooperation, through which they pooled the energy costs and CHP-investments. It reduced both the total energy costs, as well as the individual energy costs. This initiative benefited from European GMO-subsidies. Second, also the joint irrigation water system was uncommon but an interesting activity. More indirectly and early on, the companies were connected through vegetable and flower auctions. The fourth and oft discussed joint activity of the growers was the planned exchange of heat and CO₂ from BbB to the joint energy cooperation. This initiative had already received substantial subsidies (conditional on realization) from MEP and later SDE, but until recently the business case remained unfeasible, and was thus not (yet) realized.

Until 2008 Agropark Bergerden was considered a real success story, with substantially lower variable (energy) costs, a lot of free publicity and visitors from home and abroad. Wageningen UR took a great interest in spreading the agropark concept (Smeets, 2009). The 'central position' was rather equally distributed among collaborating partners, indicating the absence of a dominant firm. Interestingly, although considered a success, research showed that the firms are more strongly connected to each other via formal agreements than via informal, social contacts. This may cause relatively high transaction costs, lower incentives for externals to join the network and it may take relatively long before new problems are recognized or ideas surface.

Regarding special developments again the financial crisis and the energy cooperative should be mentioned. Firstly, there is still land available for another 15 horticultural firms. However, also horticultural firms outside this region can, since the crisis, find enough allocated land. Secondly, profits of almost all horticultural firms went down, if not strongly negative, lowering appetite for new investments and dependencies. Thirdly, the bankruptcy of the energy cooperation, early in 2008, became a turning point for this synergypark. The initial investments for the energy system were too high, and seemed to be solved by a new cooperation, this time established by the

The ambition of Agropark Bergerden was to create joint exchange systems for heat, electricity, water and CO₂. These ambitions were indeed realised, with even the water (storage)-pond in joint ownership. Physical and personal networks were put in place. As an outcome, the horticultural firms are linked to one another via three (!) cooperatives, by 2008.

The economic crisis, however, lowered their performance and synergypark developments categorically. To develop the innovative and sustainable horticultural region, the Ministry of Economic Affairs supported the agropark Bergerden twice, with over 12 mln

local authority. However, the ensuing bankruptcy of several growers, raised the fixed energy costs of the other companies. Again, the original ambition to reduce energy costs of horticultural production was no longer fulfilled. The firms in Bergerden are rather homogeneous, primarily vegetable and flower/plant growers. However, even for productgroups production (safety, prices, volume), distribution/sales, and (international) competition are quite different, making it difficult to further align with each other. Further, in times of poor performance, entrepreneurs are reluctant to create new dependencies on others or shared investments. It happened in Bergerden that bankruptcies of some raises the costs of joint investments for others horticultural firms.

A study on future perspectives of Bergerden (LEI, 2012) shows that project developers should consider other alternatives, such as industry-crossing collaborations. Example of possible efficient collaborations are animal husbandry, biomass processing companies, and insect, algae, or weeds farms. In general, Bergerden can be described as an agro-industrial park with strong potentials that had a successful start between 2003 and 2008, but experienced unfavorable developments between 2008 and 2013, regrouping and catching up again since 2014.

7.3 Agropark A7

Finally, what is called Agriport A7 is an fully privately initiated, developed and run agro-industrial park located in the municipality Hollands Kroon, in particular in the polder Wieringermeer, in the province North-Holland, along highway A7. This location was chosen near the nationally allocated expansion region Grootslag. A group of growers was, however, searching for really large, flat plots (from 20 ha up till 100 ha) that Grootslag could not offer. Other prime advantages were the location next to the highway, good local roads, favourable sunlight conditions, the high-pressure gasgrid, the high voltage electricity grid crossing the area, and a waste company nearby. The revision of spatial planning started in 2005 and was confirmed by the community in 2006.

Agriport A7 aimed to reduce the harm to the environment through the collaboration of companies from different sectors, and raise economies of scale by bundling non-core business of growers such as central processing, logistics, recruitment, energy, etc. The collaboration among heterogeneous companies was planned to create closed material cycles, reduced traffic, exchanged information and knowledge, enhanced innovation performance, reduced costs and improved efficiencies. The project claims to have created more than 3 000 direct and 1 000 indirect jobs.

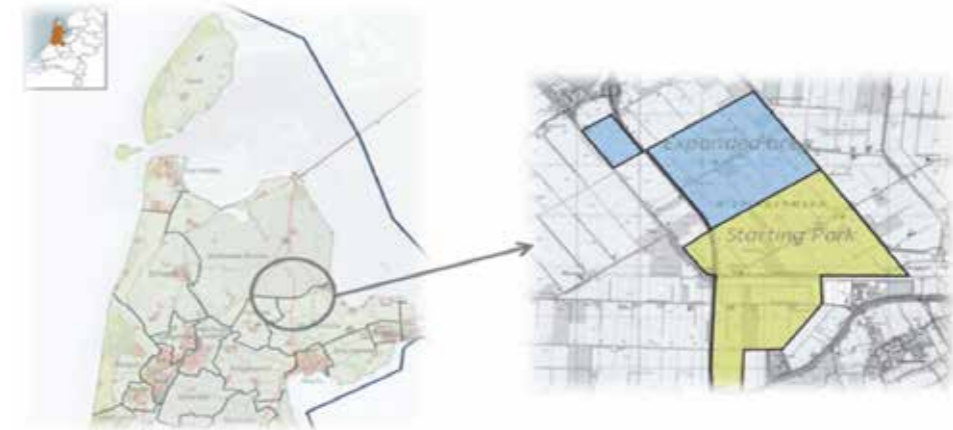
In total 24 companies from different sectors (horticulture, logistics, energy, food, construction, etc.) are involved in the Agriport A7 network. Almost half of the firms were growers, most of them with earlier of other production locations in the Netherlands. The companies typically started in Agriport A7 between 2006 and 2010. The main collaboration regarding exchanges among the local firms is the joint ownership of the energy company Energie Combinatie Wieringermeer (ECW). Established in 2006, ECW produces energy via decentral CHPs, and supplies heat, gas and electricity to the glasshouses. Other activities are more scale-related, combining for example transport to processing locations elsewhere in the Netherlands, and HR-recruitment.

With three leading organizations, the informal network is more dense than the formal network. Regarding interdependencies, most firms have a more or less similar position.

Regarding special developments one should refer to the original involvement of intensive livestock, such as poultry and pig farms. Additionally, the production in water, such as seafood, salty plants, and algae was planned to start at the location. However, none of these initiatives have been implemented, because of economic reasons and/or social pressure.

Further, before the economic downturn, growers were eager to link up to the nearby electricity-grid as the price-structures of electricity, especially in peak hours, was very interesting for their substantial but decentral CHP-units. Special optimization software was instrumental to exploit the optimization of gasinputs for heat, CO₂ and electricity-production. In recent years peak-shaving in electricity demand is no longer that profitable.

Another ambition was to develop a data center at the location; it could use the electricity generated by the CHPs, and transport the heat produced in the datacenter to the growers. The unfamiliarity with these relatively small scale agrofirms made datacenters hesitant for long. In 2013, only after several failures the park developers succeeded in attracting a datacenter; a very huge one for Microsoft.



In 2013, Agriport A7 agreed on building and running a new co-digester with a capacity building up to 180 000 ton inputs in 3 years time. It should produce nearly 6 mln m³ green gas, and 6 mln kg green CO₂, to be sold to TexelEnergie and local growers respectively. Total investment amounts to 4,3 mln Euros. Next to various partners, also Provalor will team up to reclaim extracts from side-streams (esp degraded vegetables) before put into the digester.

In sum, the agro-industrial park Agriport A7 can be called partially successful with large potentials. The core of the (collaborations in the) park comprises of horticultural companies that share energy resources and infrastructures, such as logistics. After a widening of the spatial plans the parc attracted also non-agricultural firms, such as a poultry processing company but these act more as stand alone firms. Major subsidies were realized from the Waddensea fund, the Province of North-Holland, and productboard Horticulture to get the synergypark up and running. Further expansion plans, e.g. a mid-range electricity grid, are on the table.



Chapter 8 - Supply of woody biomass in the Republic of Ireland



The Republic of Ireland does not yet have a Renewable Heat Incentive, but it is impacted by the UK RHI-scheme, via Northern Ireland's commercial biomass installations. The so-called perverse effect was that pellet or wood chip producers located in Ireland exported their biomass to avail of the incentive.

8.1 Regulatory context

As part of the "Draft Bioenergy Plan 2014" produced by the Irish government, the government plans for introducing a renewable heat incentive we identified. Due to a predicted shortfall in meeting the 12% renewable energy target for the heat sector, as specified in the 2020 plans, a number of combative options were considered, resulting in the instigation of a RHI program for Ireland. It is proposed, subject to State aid clearance from the European Commission & Governmental approval, that the Minister for Communications, Energy and Natural Resources introduce an Exchequer-funded incentive scheme for larger non-ETS industrial and commercial renewable heating installations from 2016. The scheme aims to reward users for each unit of renewable energy used from sustainable biomass while providing stability and security for long term investors, improving the value proposition for consumers and beneficially impacting non-ETS sector emissions. When an RHI for Ireland comes into action, it is expected to alleviate this biomass exporting issue. When an RHI for Ireland will be introduced, it is expected to alleviate this issue.



The carbon tax for all consumers, of natural gas, under the EU-ETS operators are exempted, covers approximately 40% of all GHG emissions. In 2013 a carbon tax was also put on solid fossil fuels under the Solid Fuel Carbon tax. In line with Government policy, the proportion of co-firing with biomass at the Edenderry plant is on the rise, achieving 22% co-firing in 2012. The owner is committed to the use of 300 000 tons per annum of biomass by 2015 at Edenderry (30% co-firing, replacing peat), up to 500 000 tons biomass by 2020. Specific issues include (<http://tiny.cc/76emnx>), first, the shortage of forestry resources and sawmill residues for pellet production; second, low uptake of energy crops despite indexed linked 20y contracts for power generation at the Edenderry plant.

In the Ireland, the Department of Agriculture, Fisheries and Food (DAFF) is implementing a series of measures to increase the share of bioenergy derived from the Agriculture and Forestry sector. Nevertheless, the EU CAP reform seems required to change the outlook of Irish Farmers, with CAP-still more attractive than any renewable incentives. DAFF supports, for example, the Bioenergy Scheme, the on-farm waste to energy projects, and the Wood Energy Supply.

Bioenergy Scheme: Introduced as pilot in February 2007 support farmers to grow miscanthus and willow as a renewable source of energy. The Establishment grants are payments to cover part of the costs of establishing the crops. A 50% subsidy is available to support establishment, at a maximum rate of €1 300 per hectare.

AGRI/Energy Research: Some €7 million in funding has been made available for 12 research projects, covering a broad range of bioenergy topics including the suitability of Irish grassland for biofuel production, Anaerobic Digestion, second-generation technologies and energy crop production.

Wood Energy Supply: Ireland's forests amounts to 725 000 hectares or 10% of the total land area. DAFF provides 100% grants and attractive premiums (max. €574 p.ha., p.y.) for up to 20 years to encourage the establishment of new forests on agricultural land. It is also supporting individual projects and initiatives around the country, which aim to encourage forest owners to thin their forests, with the aim to raise efficiencies in the biomass energy supply chain.

On-farm waste to energy projects: There is potential to supply energy through the use of grass or animal manures as feedstock in Anaerobic Digesters (AD) a proven technology that extracts energy in the form of biogas from organic and farm waste. It can be used to generate heat and/ or electricity. DAFF does not provide funding for alternative energy investment costs on farms, but the 'Scheme of Investment Aid for Demonstration On Farm Waste Processing Facilities' awarded ten Anaerobic Digestion-projects (2007) grants of €4m under the Scheme.

8.2 Digestion plants

In practice, Ireland has just a few AD-plants in operation, due to a number of reasons. First, Ireland's long growing season means that cattle are housed in the sheds for only a short period of up to 16 weeks. This means it is very difficult to collect manure for AD applications on site. Without a continuous supply of easily collectible of manure, onsite pocket digesters will not be feasible. Second, the grid operators lack knowledge / political pressure / finance to secure grid connection for produced gas/electricity. Third, 5 state agencies and 3 government departments must interact for the planning, licencing and consents. Fourth, unstable waste management companies and uncertain government waste policies add to feedstock uncertainty. Five, indigenous banks are severely restricted in lending, due to the economic crisis. The sixth and main reason is that electricity tariffs make for very low returns, with Ireland having some of the lowest electricity tariffs in Europe. These low electricity tariffs result in Ireland having some of the lowest amounts of biogas generated electricity in Europe.

8.3 Community projects

In Ireland, power for joint project success is in the hands of governmental ministers and state bodies. Their interest, agreement and collaboration is vital to the timely, successful uptake of any biomass project. The power of the various interested parties would be as follows (Highest to lowest): Public Authorities, Political Parties, Companies, Project Developers, Knowledge Institutions, Financial Institutions, social movement groups, and the community.

With the move to renewables, more people are going to encounter energy infrastructure in their locality. Communities as well as industry should have the opportunity of reaping the financial rewards of renewable energy project development, and those wanting a share of the action should be given the opportunity. A few findings on community project development which may be of use here (source: <http://tiny.cc/3dcmnx>): The community comes first, then the project; planning decisions are made more quickly for community projects; projects driven by environmental objectives tend to be more likely to be built; learning from others helps, especially the sharing of experiences of where things go wrong; having a supportive council is strongly correlated with project success. And recent research has shown that demanding a stake in ownership isn't necessarily on top of minds when a project is proposed in their area. However only good community engagement can get developers to know about the wants and needs of the local population. There is a vast difference between the best practice and worst practices.

8.4 Conclusion

In Ireland, only National policies, no regional subsidies, impacting biomass production & use, are in operation. A few farmer groups wanted to collaborate, but they get minimal if any support. Other farmers do not allocate any of their budget to energy projects. We conclude that a new EU Energy Pillar is needed.

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