TOWARDS A MATURE GREEN GAS MARKET

STATE OF AFFAIRS AND POINTS OF ACTION

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NEW GAS PLATFORM

Creative Energy
Energy Transition

INDEX

1. INTRODUCTION

In 2006 the Green Gas work group was founded on the initiative of the New Gas Platform. By the end of 2007 this work group had developed a vision document with the title *Vol Gas vooruit!* (Full Throttle ahead!). This document describes the Green Gas work group's ambitions. The work group aims at 10% substitution of natural gas by 2020. This will amount to a production volume of about 4 billion Nm³/year: 25% of the government's target of 20% sustainable energy by 2020.

This ambition departs from the production of green gas based on the streams of biomass available in the Netherlands.The production of green gas will have to be realised with the use of two techniques. The first is upgrading of biogas produced from 'wet' biomass to green gas suitable for injection into the natural gas network. The second is enhancing the gasification technique of 'dry' biomass to further increase the production capacity. To fulfill the 10% ambition, the availability of gas from large-scale biomass gasification before 2020 is of crucial importance.

2. STATE OF AFFAIRS (NATIONALLY AND INTERNATIONALLY)

What have we achieved so far?

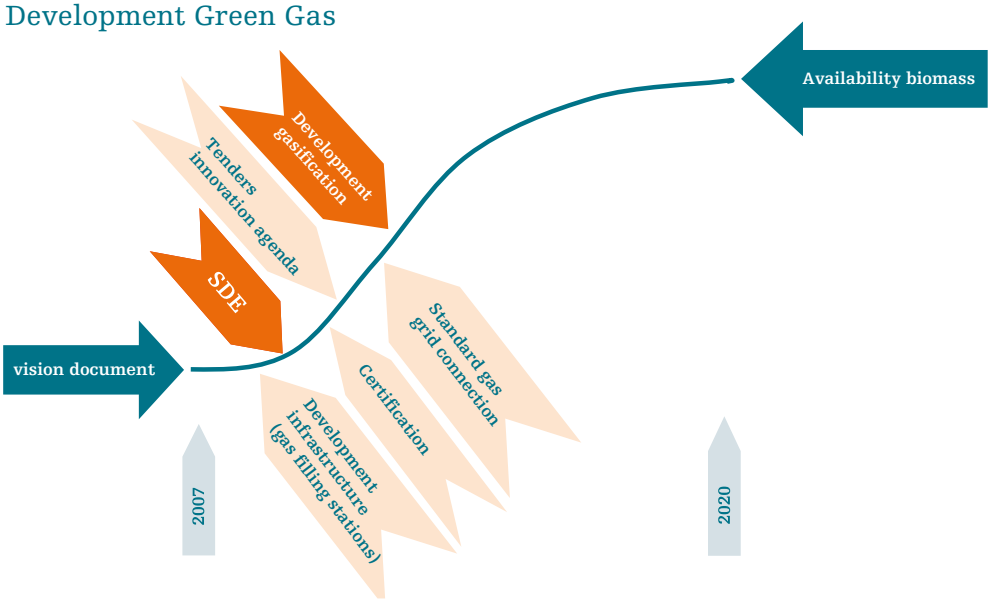
Since the presentation of the vision document, the green gas market has started to develop. Already, two important milestones have been reached: the availability of a subsidy category for green gas within the SDE (subsidy scheme for the stimulation of sustainable energy production), and the completion of a green gas certification system through Vertogas.
Meanwhile, some ten new Green Gas projects have been started. These will help to increase the production of green gas with around 35 million Nm³/year (from 15 to 50 million Nm³/year). The first serious step in the development of green gas!

Slowly but surely, the gasification of biomass is growing beyond its developmental stage.
The largest operational plant, gasifying waste wood, has been built by Essent on the site of the Amer power station near Geertruidenberg. This unit has a capacity of 33 MW (based on fuel volume). In 2008 it realised 5000 full load hours. The syngas it produces is added to the other fuel of the power station. At HVC (a waste and energy company in Alkmaar, Netherlands) projects are being developed based on the Milena gasifier. Whereas in Buggenum more experience has already been gained with the co-gasification of biomass and coal. A second plant (Magnum) is under consideration by Nuon.

For the green gas market to get a serious boost, two developments are necessary: improving the biomass gasification technology and enabling a standard connection to the gas grid for green gas. The following figure shows the S-curve for green gas market share. The flattenig of the curve is mainly related to the available biomass

volume in the Netherlands. Besides the development of large-scale biomass gasification, the potential volume of imported biomass has a positive influence on this.

Development Green Gas



A new market thrives with transparency and knowledge sharing. Therefore, an investigation is now being carried out into the possible support among stakeholders for a Green Gas knowledge centre.

Innovation agenda - funding and investment subsidies

Within the New Gas Platform two tenders have been defined with regard to the development of green gas

- Tender for gasification:
  Through this tender three demonstrative projects for biomass gasification are supported. These projects serve to demonstrate the gasification technology on a practical scale of at least 10 MW. The syngas being produced does not yet have to be upgraded to natural gas quality. That development, together with a further scaling-up of the technology, will have to be stimulated in a second stage of the innovation agenda. Through this first tender, at least a first scaling-up is realised from research project to practical demonstration.
- Tender for fermentation:
  Although fermentation of biomass is already a widely used technology, this technology certainly needs to be further developed to make it more cost effective. The tender has a wide scope and is going to support project proposals aimed not only at the front of the fermentation process (such as pretreatment of the biomass input) and at te end of the process (such as treatment of the digestate), but also at optimisation of the fermentation process itself.

International developments in green gas

The Netherlands is not alone in its efforts to develop green gas. The number of countries where the development of green gas is being discussed, has increased markedly over the past year. Until recently the development was limited to Sweden, Germany, Austria, Switzerland, and the Netherlands. But now they have been joined by countries like France, theUK, Italy, Spain, Denmark, and some East European countries. The development is also beginning tot take shape in Canada, the USA, and some South American countries.
Right now however, Germany is still unique with respect to concrete ambitions and accompanying regulation. Germany has set an absolute target for the production of 6 billion Nm3 green gas by 2020, amounting to 6% of its internal use, and by 2030 this will have increased to 10%. And this on the basis of biomass fermentation only. To support the market development, this has also been regulated through the so-called 'Gasnetzzugangsverordnung'. An important part of this regulation are agreements with regard to the division of duties and responsibilities between supplier and grid manager and the accompanying cost structure. Right now, France and Sweden are also working at the regularisation of gas grid connections for green gas.

In the 2009 RED published by Brussels, green gas is also named as a subject, although still a limited one. Among the subjects mentioned are certification, grid access, research into the suitability of the natural gas system for the injection of green gas, and the greenhouse gas balance of biogas production.
In addition, DG TREN has announced the start of a project with CEN with the aim of defining a gas quality standard for gas that is to be fed in the natural gas system. The Netherlands will have to anticipate these developments.

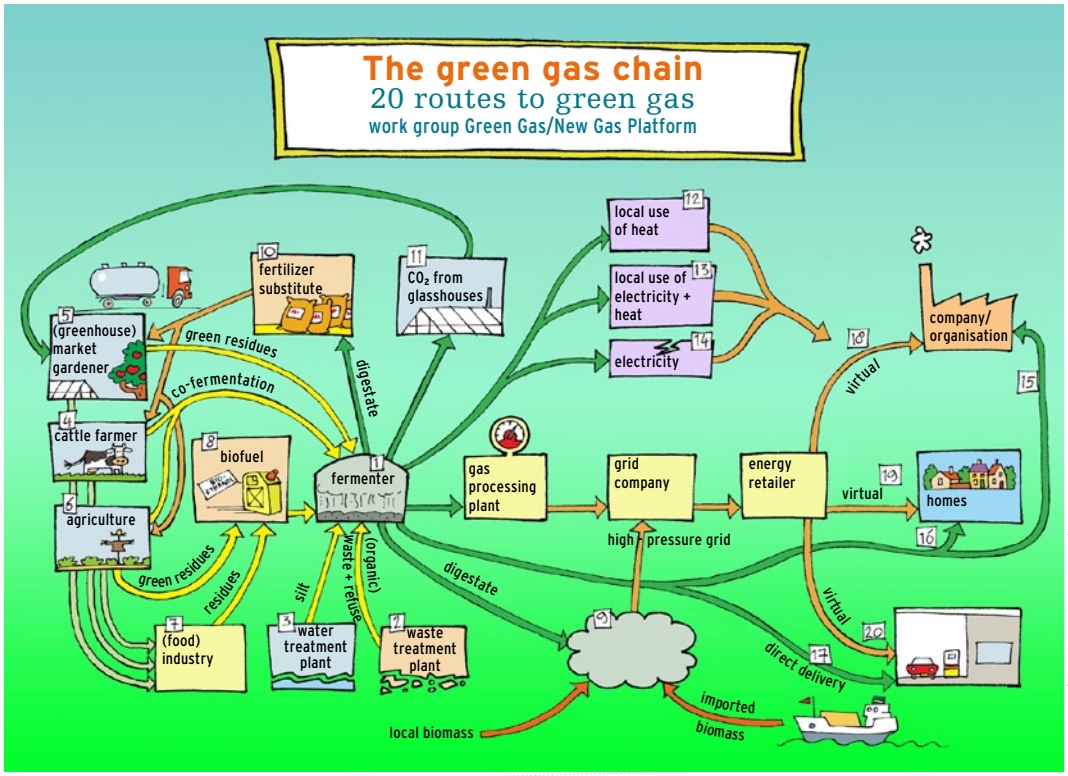
With respect to the developments in the field of gasifying biomass, no large projects have been started up yet, neither nationally nor internationally. In Austria, great efforts are being made to roll out biomass gasifiers based on the well-tested gasification technology by Güssing. At this moment the technology can by used for a capacity of 10-20 MW. A further scaling-up of this technology is in the pipeline. However, the production of green gas with this technology on this scale has not yet been demonstrated. The first large-scale demonstration of it will be in Götenborg and will have a capacity of 20 MW.

3. WHAT DO WE NEED TO BRING GREEN GAS FURTHER AHEAD?

The figure below shows the relations to other policy and market parts.
Broadly, five research areas can be distinguished:

a. Production of biogas through fermentation in clear relation to the slurry problem;
b. Upgrading of biogas to natural gas quality;
c. Injection into the gas grid
d. Marketing of green gas for end uses, including use in mobility;
e. Production of syngas/green gas from gasification of biomass.

Complexiteit Groen Gas route



Sub b. and c.

Access green gas to the gas grid netwerk

The Dutch national grid company *Netbeheer Nederland* is proactively assisting efforts to realize connections to the grid for some ten pilot projects to produce green gas. However, many open questions are still remaining on subjects like: gas quality, gas measuring quality, the capacity of our natural gas system, costs of upgrading and connecting to the gas grid in combination with (seasonal) storage capacity for green gas production in the summer.

The pilots serve to gain experimental knowledge. Effective monitoring of the projects, particularly with respect to the above-mentioned aspects, will have to provide answers to these questions. In addition, the pilots yield a great deal of information about new duties and responsibilities surrounding a decentralized gas production and its consequences for the gas supply. Also questions about strict liability and duties and responsibilities in changing conditions for the gas supply will need to be addressed. This requires close cooperation between green gas producer and grid company.

With a large-scale introduction of a decentralised green gas production the above-mentioned issues will need to be determined in a fixed framework. This will necessitate adjustments to the Gas law. In 2011 Netbeheer Nederland expects to deposit a set of quality requirements with the NMa (Netherlands Competition Authority). These requirements will then replace the present gas quality requirements in the statutory connection and transport conditions for regional grid companies. Since this will mean adjusting the present gas law, it seems natural to take advantage of the momentum and introduce even further adjustments to the gas law.

Besides the development of stand alone green gas projects, express consideration is also being given to starting up collective projects, the so-called green gas hubs. Green gas hubs can not be developed without discussing the installation of the necessary biogas pipes. In the coming years we will have to gain knowledge and experience in this field too.

Sub d.

Marketing of green gas for end uses, including use in mobility

An issue that needs to be addressed is the fact that Vertogas does not yet have a legal ground, which allows producers to market their green gas without a green gas certificate. Another issue is the establishment of a knowledge centre for new gas, since dispersing knowledge contributes to a healthy market.

Green gas for use in mobility

Although embedding green gas certificates in the bio ticket trade, has been put on the agenda by the so-called acceleration team as part of the statutory obligation to add in biofuels, this subject merits extra attention. The issues discussed in the acceleration team will typically be policy issues. The realisation of the projects is

the job of the market parties. These projects include building a nationwide network of gas filling stations. For this, the first initiatives have already been taken by the IPO (Association of Provinces of the Netherlands).
For a real breakthrough in the development however, it is of the utmost importance that the barriers between the two biggest energy players, the oil industry and the gas/electricity industry, are broken down. A successful development of the green gas route in mobility is possible only when those two industries work together in this field.
At this moment, the use of green gas in mobility is its most cost effective application. The development of this application can be started without SDE subsidies. So let's not miss this opportunity.

Sub e.

Production of syngas/green gas from gasification of biomass

With the further development of gasification a number of issues are of the utmost importance:

1. Technological developments related to the scaling-up of the gasification of biomass and the subsequent production of syngas/green gas, leading to a reduced use of fossil natural gas.
2. Availability of biomass. Realisation of our goal of substituting more then 10% of our natural gas by green gas after 2020 will only be possible on the basis of the sustainable import of biomass.
3. Vision development as to the role of green gas within the natural gas roundabout. Large-scale production facilities for green gas from gasification could be built at ports. In that way the logistics around biomass could be realised efficiently and under the conditions of a good greenhouse gas balance. Alternatively, installations could be built in areas where biomass is available and the gas could be transported through gas pipes or in liquid form and subsequently distributed.
4. Vision development as to applications of syngas besides traditional natural gas applications for heating fuel and power generation. Large-scale use of syngas is also possible in the petrochemical industry. In the Rijnmond area ideas and possibilities for this are already being developed.

Development of the points above runs parallel to the development of the demonstrative projects that are to take place based on the gasification tender from the innovation agenda.

Summary and planning of activities

Action Plan Green Gas - Summary of Activities	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Acceleration team for breaking down policy obstacles	■	■	■								
Fermentation tender	■	■	■								
1st block gasification tender	■	■	■	■							
2st block gasification tender including green gas production			■	■	■	■					
Standard conditions for gas grid access (regulation)		■	■								
Developing vision on integration green gas/gas roundabout	■										
Developing vision on green gas from provincial perspective	■										
Formulating vision on developments around green gas hubs	■										
Specifying regulations framework for green gas		■	■								
Developing vision on alternative syngas applications	■	■	■								
Take-off market development green gas/ rising on S-curve			■	■	■	■					
Developing large-scale gasification of biomass						■	■	■	■	■	■
Taking down 'barriers in the energy field' between oil and gas	■	■									
Lobbying activities (including political)	■	■	■	■	■	■					
Establishing Green Gas Knowledge Centre for wide dispersion of knowledge	■	■	■								

4. WHAT DOES THIS DEMAND FROM POLICY?

On the basis of the developments so far, as outlined above, we may conclude that quite some progress has been made. But it should also be clear that a lot of steps have still to be taken for our ambitions to become reality. Most of the obstacles that have to be cleared are policy matters. To this end, an acceleration team has been set up. The acceleration team consists of representatives from the following Ministries: Housing, Spatial Planning and the Environment; Agriculture, Nature Management and Fisheries; and Economic Affairs. On 1 December 2009 the team has met for the first time.

A list of the subjects that will be discussed by this government team includes:

- SDE subsidies and other government instruments
- A positive list for co-fermentation
- Revaluation/application of digestate
- Monitoring biogas and green gas, particularly in the CBS (Central Bureau of Statistics) and Eurostat statistics
- Embedding green gas as vehicle fuel in the bio fuel obligation
- Establishing an independent information centre for green gas

Action points Green Gas

Transition Path Green Gas			
Sub-aspect	Desired end result per sub-aspect	Route	Addressed by
1. Biomass supply	Goal: Optimal use of biomass for energy and green raw materials		Nowhere so far
	1a Biomass owners use biomass for the production of green gas wherever this can be done efficiently: cattle farmers (manure), farmers (residues), water boards (sewage sludge), waste companies, food industry (refuse), forestry commissions and other nature organisations.	Fermentation/ Bio-SNG	
	1b Transparancy of the biomass market	Fermentation/ Bio-SNG	
	1c Extending the positive list to make more co-substrate available for fermentation		
	1d The logistics needed for importing dry biomass suitable for SNG production has been realised	SNG	
	1e Production of green gas in countries with abundant biomass and importing this gas (possibly through green gas certificates)	SNG	
	1f Production of aquatic biomass, specifically seaweeds and algae	Fermentation/ SNG	
	1g Biomass is certified with respect to sustainability	SNG	
2. Production of green gas (Fermentation route)	Goal: Optimal production of green gas		Fermentation tender
	2a The production of green gas is optimised through cooperation of biomass owners, leading to an optimal scale and the best locations in relation to the biomass and its buyers	Fermentation	
	2b The fermentation technology has been optimised by means including homogenisation of the biomass substrate, the use of enzymes, and the addition of chemicals	Fermentation	
	2c Fermentation takes place in combination with the production of valuable green raw materials	Fermentation	
3. Production of green gas (bio-SNG route)	Goal: Realisation of the large-scale production of green gas. By 2020: 4.5 bcm via bio-SNG route; by 2050: 40 bcm via bio-SNG route		First initiatives through gasification tender
	3a One SNG plant based on the Milena technology in combination with co-generation of 20 MW	SNG	
	3c One SNG plant based on the Milena/Olga technology plus scaling-up to 50 MW	SNG	
	3d Some pilot projects based on a small-scale technology (up to 20 MW)	SNG	
	3f An SNG plant in combination with the production of pyrolyse oil/H_2/CO_2 capture/green raw materials	SNG	
	3g An SNG plant in cooperation with an external player based on a technology other than the Milena/Olga technology	SNG	
	3h SNG production from wet biomass based on the supercritical water technology	SNG	Research institutes?
	3j Coal gasification with a high percentage biomass added in, combined with CO_2 capture	SNG	Research institutes?

4. Solving digestate problems	Goal: Full use of the digestate while preventing impoverishment of the soil		Fermentation tender
	4a Complete processing of the digestate into minerals and green raw materials including fertilizer substitute	Fermentation/ SNG	
	4b Returning the minerals to the lands where the biomass has been collected	SNG	
	4c Using the fertilizer substitute in agriculture	Fermentation/ SNG	
5. Transport of green gas and realising the storage of green gas (including green gas hubs)	Goal:		Fermentation tender
	5a Monitoring the feeding of green gas into the gas grid	Fermentation	
	5b Biogas pipelines in places with insufficient capacity to deliver gas in urban areas, possibly in combination with 6c	Fermentation	
	5c 10 Biogas Hubs (nationwide). A green gas hub is a concentration model for the production of green gas where a number of (decentral) biogas producers are being connected to a central facility for upgrading the gas and injecting it into the suitable natural gas infrastructure.	Fermentation/ SNG	
	5d Large-scale feeding of green gas into the gas grid	SNG	
6. The green gas market	Goal: Green gas being bought by consumers, businesses, and a public sector buying only sustainable goods		Action Plan Green Gas
	6a Driving vehicles on green gas helps to get the market going	Fermentation	
	6b Marketing a Green Gas logo	Fermentation/ SNG	
	6c More than one party selling green gas	Fermentation/ SNG	
	6d The Green Gas certificate is used with direct delivery, delivery through biogas grids, and with international transactions. It is also used with the calculations made in relation to the obligatory add-in of biofuels.	Fermentation/ SNG	
	6e Realising a large volume in the supply of green gas	Fermentation/ SNG	
7. Collaboration	Goal: Creating forms of collaboration to realise optimal solutions and control risks		Fermentation tender
	7a Cooperatives of farmers for the fermentation of manure to make production and things like purchasing co-substrate more efficient	Fermentation	
	7b Collaboration between farmers and other biomass owners to achieve reliable deliveries of co-substrates	Fermentation	
	7c Collaboration with grid companies in connection with capacity problems (such as spreading the risk of a mains turn-off with insufficient capacity, rest risk)	Fermentation	
	7d Collaboration with local authorities on biogas infrastructure and constraining possible competion	Fermentation/ SNG	
8. Knowledge exchange	Goal: Wide sharing of knowledge about green gas in society		Action Plan Green Gas
	8a Establishing Green Gas Knowledge Centre to share specific knowledge and experience with parties involved in concrete projects	Fermentation/ SNG	
	8b Involving educational and research institutes in dispersing knowledge about green gas	Fermentation/ SNG	
	8c Courses for market parties aimed at increasing knowledge	Fermentation	

9. Research	9a Cooperation between knowledge institutes with a view to coordinate research	Fermentation/ SNG	Fermentation tender
	9b Testing new technologies on test locations through collaboration between knowledge institutes and business parties. Businesses can't afford large risks and mostly opt for existing technologies. Here, an important role reststs with public corporations like waste companies, water boards, etc.	Fermentation/ SNG	
10. Funding	Goal: Sound financial bases for initiatives		Acceleration team fermentation
	10a Government participation in initiatives	Fermentation/ SNG	
	10b Fund in connection with rest risks	Fermentation/ SNG	
11. Subsidizing, regulating, and licencing	De overheid faciliteert een versnelde start van de Groen Gas markt		Acceleration team fermentation
	11a Organising one office per government layer for all licences related to green gas projects, and mutual arrangements between the various government layers. This concerns EIA procedures, environmental permits (in connection to matters like waste processing), spatial planning procedures, fertilizer laws (authorizing positive lists, sampling manure at transport, the use of upgraded digestate as ferilizer substitute), innovative techniques not yet known..	Fermentation	
	11b Solving the digestate problems, such as the grow of the fertilizer problem with co-fermentation, and the loss of exemption status with derogation in cases of co-fermentation ans cooperation	Fermentation	
	11c Regulating green gas within the gas laws, including defining Green Gas, priority for green gas, legal status of biogas pipelines	Fermentation	
	11d A smart adjustment of the SDE scheme aimed at an effective scaling-up, to enable realisation of our volume ambitions. This may well require adjustments in terms and sizes of subsidies, and also the creation of facilities for switching between biogas for micro-cogeneration and direct feeding into the gas mains. It is also advisable to get insight into the medium term plans for the SDE.	Fermentation	
	11e Possibility to convert the former and present subsidy schemes for the use of biogas for electric power into SDE subsidies for green gas	Fermentation	
	11f Gearing the regulations concerning biofuels, Green funding, EIA to the possibilities for green gas, making SDE redundant	Fermentation/ SNG	

Energy Transition - Creative Energy

The business community, governments, knowledge institutes and civil society organisations all work together to ensure that energy supplies in 2050 are sustainable.
Energy will then be clean, affordable for everyone, and in continuous supply. Energy Transition demands and supplies creative energy.

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