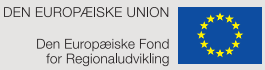
SCANDINAVIAN BIOGAS HANDBOOK

Aspects of planning a biogas plant

Implement
Sustainable development with biogas

AGRO BUSINESS PARK



Year of publishing: 2014

Authors: Anna Dorte Nørgaard and Knud Tybirk, Agro Business Park, Denmark:

The handbook has been edited and complemented by:
Salbo Miljokonsult, Sweden: Boel Carlsson
Energigas Sverige: Helena Gyrulf
Avfall Sverige: Angelika Blom
Svenskt Vatten: Anders Finnson
Innovatum, Sweden: Peter Eriksson
The Royal Norwegian Society for Development (Norges Vel), Norway: Johan Ellingsen
Biogasrejseholdet, Denmark: Anders M. Fredenslund
English editor: Sara Jones

Layout: Mikal J. Laursen, Art Director at Hepla

Photos Story2Media
Peter Eriksson, Innovatum
Göteborg Energi
Biogas Öst
Agro Business Park

Contents

Foreword

This Scandinavian Biogas Handbook describes the main aspects of the planning of a biogas plant in Norway, Sweden and Denmark and highlights the differences and similarities between the countries. The overall aim is to stimulate and inspire the implementation of biogas strategies and political visions.

The handbook addresses companies, authorities, citizens, organizations and other stakeholders with an interest in learning more about biogas and biogas planning processes in Scandinavian countries. The Handbook is not a detailed guide, rather an inspirational handbook outlining aspects of biogas planning in these countries or for inspiration of how to plan in other countries.

The intention is to describe, in short, the main aspects to be taken into account when planning biogas plants in Scandinavia, be it public or private, small or large scale, countryside or industrial areas, and refers to more detailed planning in each country.

The work is co-financed by Interreg ØKS through the project Implement (www.implement.nu) and was led by Agro Business Park, Denmark in consultancy with key stakeholders in Sweden and Norway.

Why biogas?

Biogas has entered the political scene in EU and Scandinavia and there are various reasons for that.

Essentially fossil based energy sources are dwindling, and through the production of biogas we can become less dependent on fossil gas resources and this plays an important role both politically and strategically.

In addition to this there are many other good reasons for producing biogas from waste products.

Biogas is very efficient in reducing greenhouse gas emissions from animal husbandry, and simultaneously produces valuable renewable energy that is suitable for the replacement of fossil fuel sources in the transport sector. The energy needs in the transport sector is a major challenge when aiming towards a bio-based economy; biogas can be part of the solution.

Furthermore the recycling of wastes from agriculture (including manure), the food industry and source separated household organic waste has risen on the political agenda. Biogas provides a way to recycle nutrients back to the farmers' fields in the form of digestate which has good fertilizing value. Recirculation of phosphorus is another challenge in the bio-based economy that biogas provides a good solution for.

Biogas as energy source is considered second generation or 'advanced' biofuel when based on societal wastes.

As previously mentioned, within the agricultural sector biogas plants have an important role as a fertilizer producer. Waste based digestate is a valuable, locally produced, non-fossil alternative to commercial fertilizers. Using the digestate as fertilizer reduces the odour when applied to the fields as compared to use of raw slurry, and is a better fertilizer than undigested slurry.

However, there are also some drawbacks to biogas; although not very complex in principle while converting a natural process into commercially interesting investment many challenges have arisen. Most challenges have been solved and the technology is maturing, yet there are still improvements to be made.

Two important challenges faced by large scale biogas plants are increased local traffic transporting substrate (waste and manure) to the plants, as well as the potential smell from the biogas plant when handling the ingoing and outgoing biomass or digestate respectively. These two factors may give rise to local debates about where to place biogas plants within the local region.

Another challenge is to make biogas a profitable business and an interesting investment. Biogas is currently not commercially competitive with fossil fuels and fertilizers at low prices, however as fossil fuels increase in price, it is expected that biogas should become a viable alternative and thus become profitable. Until then biogas has to be subsidized – society paying for the added values of reduced GHG emission, fuel independency and the recycling of nutrients.

Green biomass represents a large unexploited bio-resource which could contribute to the future energy supply. In addition societal investment supporting biogas technology gives rise to many direct and indirect jobs in the agricultural and food industry.

BIOGAS

In the context of this handbook we consider biogas as gaseous hydrocarbons produced from biomass. Typical substrates are manure, sewage sludge, agricultural waste (e.g. straw) and organic industrial, restaurant and household wastes. We mostly use the term biogas when referring to gaseous fuel produced through anaerobic digestion of organic matter, which consists mainly of methane (CH_4) and carbon dioxide (CO_2).

Once biogas has been upgraded (CO_2 has been removed) it is then referred to as bio-methane, in order to distinguish it from the chemically similar fossil-based natural gas. The fuel produced by thermal gasification of wood, straw and other biomass can also be labelled biogas (typically H_2, CH_4, CO) but this technology is still in the development phase and is not included in this handbook.

FINANCIAL SUPPORT SYSTEMS [1]

Norway: Delivery support system that pays approximately 3.5 EUR per tonne of manure delivered to biogas plants
Different investment aid systems are available, depending on size of plant (www.enova.no)

Sweden: No carbon dioxide or energy tax on biogas until 2015
40% reduction in fringe benefit taxation for the use of company NGV's (natural gas vehicles) by 2016
Investment grants for the marketing of new technologies and solutions for biogas production during 2013-2016
0.2 SEK/kWh (0.02 EUR/kWh) subsidy for manure based biogas production

Denmark: The support system of 2012 is complex but the main elements are:
- 0.056 EUR/kWh (115 DKK/GJ) for biogas used for CHP unit or injected into the grid
- 0.037 EUR/kWh ((75 DKK/GJ) for direct usage for transport or industrial purposes
These subsidies include natural gas price compensation and temporary support, and will not be regulated by inflation rates.
In the energy agreement, new support frameworks for biogas transportation, processing and other applications were also agreed upon. These framework conditions have not yet been approved by EU.

Political visions, strategies and financial support systems

Norway, Sweden and Denmark are all focused on biogas as a source of renewable energy. All have published reports, strategies and policies concerning biogas and its production, and have all introduced different kinds of financial support systems that can increase the establishment of new biogas plants and the production of biogas. The main goal is to gain greater independence from fossil fuels and reduce the introduction of greenhouse gasses like CO_2 and methane into the atmosphere. A further aim is to recycle more of the organic waste produced by industry and households in order to improve the nutrient cycle.

Politicians are paying great attention to both animal manure, domestic waste and other kinds of organic material as important biomass substrates for biogas production. In Denmark there is also a great concern regarding energy crops for biogas production and the Government has chosen to set national limitations in the subsidies for biogas produced on the basis of energy crops.

POLITICAL VISIONS AND STRATEGIES IN THE SCANDINAVIAN COUNTRIES

Norway: St.meld. nr. 39 (2008–2009): "Klimautfordringene – landbruket en del av løsningen"

Sweden: Förslag till en sektorsövergripande biogasstrategi, Slutrapport, ER 2010:23

Denmark: Aftale om Grøn Vækst, 2009, Energiaftalen fra 2012, Danmark uden affald, ressourcestrategi 2013, Biogas Taskforce rapport, 2014.

NATIONAL GOALS

Norway aims to treat 30 % of the produced manure in biogas plants in 2020 and reach a status of 67% renewable energy by 2020.

Sweden aims to reach fossil free vehicle fleet by 2030 and reach zero Green House Gas emission by 2050. The biogas technology implemented will focus on sludge and thermal gasification. 50 % of the organic food waste produced will be separated and treated biologically by 2018[2].

Denmark aims to be independent from fossil fuels by 2050[3] and aims to treat 50 % of the produced manure in biogas plants by 2020[4].

FINANCIAL SUPPORT SYSTEMS AND CERTIFICATES

Norway, Sweden and Denmark all support the production of biogas in different ways in order to motivate the market and to ensure that biogas can compete with other sources of energy. The three countries have various systems of feed-in-tariffs, investment grants and tax exemptions. The countries all introduced investment grants for the construction of biogas plants. Norway and Sweden already have existing schemes; however in Denmark these expired in 2012 after having provided financial support to 19 biogas plants. In both Sweden and Denmark the financial support systems were a part of the EU Rural Development Program.

Norway and Sweden have a joint electricity certificate system, where the producer receives one certificate for every MWh of electricity produced from renewable resources and end-users are obliged to buy certificates in proportion to their total electricity use. Denmark has also introduced certificates for biogas; the system is administrated by Energinet.dk and certificates are issued to the biogas producer.

1 Informations from IEA Bioenergy Task 37 – Energy from Biogas. January 2014
2 Etappmål om ökad resurshushållning i livsmedelskedjan, Regeringen
3 Ressourcestrategien, 2013 from the Danish Government
4 Grøn Vækst aftalen, 2009


SEK
KRONOR
SIG
PW
Nm³
VOLYM
SEK
KRONOR/Nm³
STÄNG AV MOTORN UNDER TANKNING
START
Livsfarligt att tanka med adapter mellan tankmunstycke och bil
Bio-
gas

Status of biogas in the Scandinavian countries

There are both differences and similarities between Norway, Sweden and Denmark with regards to the biogas industry. The legislation in Sweden and Denmark is naturally quite similar due to their membership of the European Union. Norway regulates the same issues and has a similar system of legislation. In the following we give an introductory status to the biogas development and use in Scandinavia

OWNERSHIP AND TYPES OF BIOGAS PLANTS

The scale, ownership and type of biogas plants differ somewhat between the three countries.

Norway has relatively few biogas plants and most of these are public plants, often based on source separated organic domestic waste and sewage. However manure and farm based biogas may be a more important part of the future in areas with high livestock densities.

In Sweden there are also many biogas production units based on municipal sewage sludge and landfill gas. A few are industrial and there has been an increase in the agricultural biogas sector where plants are owned by biogas companies or farmers.

In Denmark the publicly owned sewage treatment plants and landfill gas plants do not receive much attention in the current debate. Most of the manure based biogas plants are private investments in farm-scale or large cooperative biogas plants. Traditionally the manure based plants are owned by farmers, but new investors, such as gas companies have been entering the market in recent years.

In Denmark the total biogas production is 1.19 TWh according to the report 'Biogas i Danmark – status, barrierer og perspektiver', 2014. The same report estimates that it is possible to increase the production to 2.77 TWh by 2020.

In Sweden the total biogas production has been fairly constant for several years at around 1.3-1.7 TWh. The potential production of biogas from anaerobic digestion was evaluated in the report 'Realiserbar biogaspotentiali I Sverige 2013 genom rötning och förgasning'. The potential production for 2030 is estimated to be 1-3 TWh in a scenario based on poor development, 5-8 TWh in a scenario with moderate development and 5-10 TWh in a scenario with good development.

In 2010 Norway had a total biogas production of approximately 0.5 TWh. According to 'The Norwegian Environment Agency, 2013, Report TA3020 the realistic potential for biogas production is estimated to be 2.3 TWh in 2020; with 32% of the total based on manure, 22% from industry waste, 14% bio-waste from households,7% bio-waste from catering and trade, 12% landfill, 7% straw and 6% waste water sludge.

INFRASTRUCTURE AND THE END USE OF BIOGAS

The focus is presently on the same technologies and end use possibilities in Norway, Sweden and Denmark, but the different markets and infrastructures create different conditions for the use of biogas.

Type of plant	Numbers of plants Sweden 2013	Number of plants Denmark 2013	Number of plants Norway 2013
Sewage treatment	137	57	23
Co-digestion, manure, biowaste and sewage	23	23	6
Farm based	39	46	7
Industrial	5	5	
Landfill gas	60	25	
In total	**264**	**156**	**36**

The Swedish co-digestion plants primarily treat household organic waste. Manure is only a small proportion of the biomass input. In Denmark manure is the primary biomass used. The Swedish data is from the Statens Energimyndighet 2014. Produktion och använding av biogas och rötrester år 2013. The Danish data is from Energistyrelsen. Biogas Task Force. Afslutningsrapport. Maj 2014. The Norvegian data is from the Avfall Norge rapport 3-2010.

In Norway there is a focus on district heating and upgrading. The market price of electricity is low due to cheap and ample hydroelectricity; therefore biogas in Norway cannot compete with electricity. The heating system outside cities is also traditionally based on electricity so this is not a possible market either. Some areas of cities have district heating systems and these are expanding to include some new residential areas; biogas could be used in the district heating plants supplying these cities. Various areas of Western Norway have gas grid systems for natural gas and these could also be used for upgraded biogas. Recently a few biogas plants have started to distribute biogas in gas cylinders for the transport sector.

In Sweden upgrading of biogas for transport (bio-methane) is the fastest growing usage according to statistics of the Swedish Energy Agency. Most of the upgraded biogas in Sweden comes from sewage treatment plants and co-digestion plants (897 GWh); most of the upgraded biogas is used as gas for transportation. The biogas from farm, industrial and landfill biogas plants is mainly used for heating. More than 50 % of the biogas in Sweden is produced in the regions of Skåne, Stockholm and Västra Götaland. One of the reasons for this may be that the south western part of Sweden, including the regions of Skåne and Västra Götaland, has a gas grid and that Stockholm has a gas distribution system and a need for gas for transport.

In Denmark a national energy agreement in 2012 changed the traditional focus on Combined Heat and Power production towards more upgrading of biogas. Biogas production is expected to more than double before 2020 and it is expected that 75 % of the biogas produced in the future will be upgraded for the gas grid and used for transport. Denmark has a well-developed national natural gas grid, and the government and gas companies are focused on securing the use of this system in the future for upgraded biogas. Denmark also has a well-developed district heating system in its towns and cities; this is also a market for biogas based Combined Heat and Power production, but the use of wood, straw, solar energy and geothermal energy are often competitive alternative for heat production.

EGE - NORWAY

The Waste-to-Energy Agency (EGE) in Oslo produces environmentally friendly energy from up to 50.000 tonnes of source separated waste and fluid waste from the food industry. Residual waste is used to generate energy for heating water for the district of Oslo and as engine fuel for up to 135 public buses. Electricity and bio-fertilizer are two important side-products. The modern biogas plant Romerike Biogassanlegg is part of EGE and it was finished in December 2012. It is among the most advanced treatment plants for food waste in the world today. It will produce 90 000 m^3 of liquid bio-fertilizer and 4.5 million Nm_3 of biogas per year when fully utilized.

NATIONAL STATUS AND CHALLENGES

The challenges for implementation of the biogas strategies and visions differ between the three Scandinavian countries.

In Norway the development of biogas projects has been slow despite a national goal of utilizing 30 % of the manure produced in the country for biogas production before 2020[5]. A new strategy is in the process of being developed in order to speed up the activities. The investment focus seems to concentrate on public domestic waste biogas plants and there are only a few investment activities with regards to manure based biogas. One of the reasons for the lack of interest in manure based biogas is the small average size of farms and that they are rather widely dispersed, this is further compounded by only relatively few areas, such as Jæren near Stavanger, Østfold and Trøndelag, having a high concentration of livestock animals. Generally speaking there is little focus on mixing the substrates of domestic waste, sewage and manure, as they rarely are found at the same locations. In Norway, the challenge is generally not in financing the plants, but rather in finding sufficient biomass and an attractive market for the gas.

In Sweden there has been some activity with the construction of biogas plants within the last few years. The main production of biogas is from source separated household waste biogas plants and sewage treatment plants, however from 2011 to 2013 the production of biogas from manure based biogas plants was increased from 20 to 77 GWh[6] (0,077 TWh). This increase is due to the introduction of subsidies for manure based biogas plants. More than half of the biogas produced is upgraded for transportation, a 7% increase when compared to 2012[7]. In 2013 there was total production of 1,7 TWh from 264 biogas plants, 54 %

[5] Landbruks- og Matdepartementet. St.mld 39 (2008 -2009)
[6] http://www.energimyndigheten.se/sv/Press/Nyheter/Allt-storre-produktion-av-biogas-vid-svenska-gardar/
[7] http://www.energimyndigheten.se/sv/Press/Nyheter/Allt-storre-produktion-av-biogas-vid-svenska-gardar/

of the biogas was used for transportation, 31 % for heat production, 3 % was used for electricity production and 11 % needed to be flared off[8].

In Denmark biogas production is increasing, but not at the pace needed in order to reach the national goal of utilizing 50 % of the livestock manure in biogas plants before 2020. The Danish Biogas Taskforce recently presented a list of challenges[9]: one of which was that for a few years the delayed EU approval of the improved Danish subsidies prevented new projects from securing the economy. In addition the present subsidy payments are decreasing each year.

GOBIGAS AND LIDKØBING BIOGAS

In Sweden GoBiGas is a newly inaugurated thermal biogas plant based on woodchips, it is used for CHP in Gothenburg and this concept could be an important player on the Swedish biogas market in the future. Lidköbing Biogas is another Swedish biogas plant, one of the first of its kind in the world, it produces liquefied biogas (LBG).

In Denmark it is difficult to gain long lasting agreements with CHP's and it is difficult to compete with cheaper sources of energy (straw, woodchips, heatpumps etc.) and the cost of upgrading biogas into the gas grid is also a challenge. The investment grants for biogas plants expired in 2013 and thus the potential financial risk is too high for the financial sector to lend money to fund biogas projects. Another challenge is the long planning and approval period of biogas projects in Denmark; it is not unusual for a planning period to span 5-10 years. One of the reasons for such a long planning period is the scepticism of the local public and as the decision is made at the municipal level, it is politically sensitive. This challenge is difficult, but new processes of public involvement are being tested.

HANDLING OF THE DIGESTATE

(Biorest, fermentat, afgasset gylle, biogödsel, rötslam)

The handling of degassed manure is rather similar in the three countries. Again Denmark and Sweden are regulated by EU legislation, and Norway follows similar legislation.

[8] http://www.biogasportalen.se/BiogasISverigeOchVarlden/BiogasISiffror
[9] The National Agency of Energy (Energistyrelsen): "Biogas i Danmark – status, barrierer og perspektiver", p. 75.

In Norway, the digestate is used for agricultural production in the same manner as undigested slurry. However, if food waste is used as substrate approval from the 'Mattilsynet' (ABP regulation) is required, and if the digestate is distributed to other farms, the fertilizer use should be approved according to environmental legislation ('Gjødselvareforskriften' which is under revision). Over 10 years period, only a total of 2 tons (dry matter) of digestate from sewage sludge can be spread on a field, whereas manure and organic waste digestate can be spread every year. The Norwegian Farmers Union (Norges Bondelag) recommends a separation of the digestate to separate the phosphorus and nitrogen into the solid and liquid parts respectively in order to spread precise dosages of each fitting the needs of the crops.

In Sweden, the use of sludge in agriculture is regulated according to Swedish regulation, which is much stricter than the Sewage Sludge Directive of the European Union. A new regulation was proposed by the Swedish EPA in September 2013, if this proposal is passed unchanged it will impact the possibility to recycle nutrients from sludge and all other organic wastes back into agricultural land. The Swedish Government will make its decision in late 2014 or 2015. In Sweden, a voluntary system of certificates documenting the quality of the digestate is used, simplifying the use of the digestate. Two systems are implemented: one for digestate based on manure and source separated organic waste (SPCR 120) and another for sewage sludge digestate (REVAQ). A total of 40 large and medium large sewage plants (= approx. 50% of the wastewater in Sweden) and the 15 common biogas plants have been certified and this eases the final use of the digestate as this declaration makes it easier to find customers.

In Denmark, the use of sewage sludge is regulated according to Danish regulation which is also stricter than the Sewage Sludge Directive of the European Union. The digestate of sewage treatment plants is either incinerated or brought to fields that have been approved according to The Sewage Sludge Directive. According to the Danish implementation of the directive, if the digestate of manure based biogas plants is more than 75% manure (measured by the solids), it is regulated by the legislation of livestock farming and animal manure, this means that the digestate will be handled within the same regulations as ordinary manure.

Legislation and authorities

None of the three Scandinavian countries have a collective work of legislation or a joint authority concerning the handling of biogas plants. Various authorities responsible for different legislation play a role but their activities are not necessarily coordinated. The legislation concerning biogas projects in the three countries concern a similar range of aspects like environment, emergency management, technology, animal by-products, infrastructure, nature conservation and district planning etc.

Both national and municipal authorities are involved in the approval process in all of the three countries, and in Norway and Sweden regional authorities are also involved. Most often a biogas project starting up an approval process does so through the municipal authority as the first point of entrance.

In the three countries the municipal authorities handle aspects concerning spatial planning, neighbours, buildings and techniques. In Sweden and Denmark safety, fire and explosion are aspects that are also primarily handled by municipal authorities whereas they are handled by the national authorities in Norway.

In Denmark the environmental aspects are handled by the municipal authorities (Kommune) while they are handled by the regional authorities in both Norway (Fylker) and Sweden (Länsstyrelse). It must be noted that in both Sweden and Denmark the approval process of biogas plants that exceed specific parameters, such as very large capacity of gas production, must be handled by national authorities. Animal by-products are handled by the national authorities in all three countries.

The owner(s) of a biogas plant is responsible for the coordination, approvals and controls of the biogas plant. Therefore it is wise for an owner to involve the different authorities in planning and organizing the progress of the project, right from the start of the project; in this way the early involvement and coordination of the authorities can work to ensure an optimized process and improved the support of the local politicians.

Authority	Norway	Sweden	Denmark
Municipal authority	• Kommune	• Kommune	• Kommune
Regional authority	• Fylke • Mattilsynet	• Länsstyrelsen	
National authority	• Mattilsynet • Direktoratet for samfunnssikkerhet og beredskap	• Miljödomstolen • Jordbruksverket • Myndigheten för samhällsskydd och beredskap	• Miljøstyrelsen • Plantedirektoratet • NaturErhvervsstyrelsen • Naturstyrelsen • Natur- og Miljøklagenævnet

List of authorities concerned with biogas plants in the three countries.

RELEVANT INFORMATION AND PLANNING TOOLS

Norway: A web based guide for biogas planning is in the process of being developed in 2014 by The Royal Norwegian Society for Development (Norges Vel).

Sweden: Many reports and manuals have been published concerning biogas and there is an easy access to updated information on webpages like www.energigas.se and www.biogasportalen.se

Energigas Sverige published 'Anvisningar för biogasanläggningar, BGA 2012'. This is a detailed planning manual updated every 5 years.

Denmark: A planning manual called 'Kogebog for etablering af biogasanlæg 2014' describes different aspects of the planning process. 'Biogasrejseholdet' is a national taskforce for the planning of a biogas plant to help local authorities obtain a smooth planning process. The taskforce offers to act as an entry point to the different authorities.

Biogasreports.com is a web library of biogas reports from various countries. It has been financed within the EU project Implement.

Peopleandbiogas.com is a manual on citizen involvement. It has been financed within the EU project Implement.

Planning a biogas plant

ORGANIZING STAKEHOLDERS

Many stakeholders are involved in the planning process of a biogas plant, and in order to optimize the process it is a good idea to describe the stakeholders involved and their roles within the process.
Below is a list of stakeholders usually involved in the planning process:

- The initiator of the project or the investor (farmer, utility, municipality)
- Financial partner
- Suppliers of biomass (farmers, industries etc.)
- Receivers of digestate (farmers, municipalities etc.)
- Buyers of the biogas (CHP, gas companies, industry etc.)
- Local municipal authorities
- Local stakeholders (neighbours, politicians, NGO's, local associations etc.)
- Suppliers of technology and advisors
- Contractors

It is a good idea to visualize the organization and the activities within it, providing a general overview for people involved both within and outside of the process. The structural organization must clearly indicate who is in charge of each activity and who is involved.
The following list represents some of the main activities within the planning process:

- Financing of the biogas plant
- Dialogue and approval process with the authorities
- Designing the biogas plant (site, buildings and technology)
- Dialogue and contract with suppliers of biomass
- Dialogue and contract with receivers of digestate
- Dialogue and contract with buyers of the biogas
- Dialogue with local stakeholders
- Building process
- Permissions from authorities

It is recommended to have working groups for each activity, an overall steering committee coordinating the main aspects of the process and a time schedule for making important decisions. According to the chapter on communication and participatory planning in Denmark it is strongly recommended to involve local stakeholders in the group.

Many of these activities are dependent on other activities. This makes it important to have an intense focus on coordination of the activities in order to optimize the process. The approval process is long and time consuming in all three countries and it is necessary to have the right information at the right time.

BIOGAS BUSINESS PLAN

The project management of the planned biogas plant has a natural focus on its technical aspects, resulting in technical descriptions and drawings addressing the suppliers and the contractors. To supplement this material it is a good idea to have materials addressing the other stakeholders.

An analysis on the stakeholders may reveal the need for different information provided for the different groups of stakeholders. Financial partners have an interest in the business case and background calculations. Suppliers of biomass and receivers of digestate have an interest in economy, logistics and the quality of the digestate etc. The authorities have an interest in the benefits concerning the climate and renewable energy, as well as an interest in the consequences for the local society and the environment as a whole at a broader scale. The local politicians, neighbours and stakeholders have an interest in the local perspectives concerning possible outcomes and consequences; this material could include information on local jobs, locally produced energy, cheaper energy, consequences for traffic, smell and visual effects on the local area.

The following list represents different informational material that can benefit the communication within the project, and about the project:

- A business plan addressing investors and financial partners.
- An informal publication outlining the biogas plant and addressing investors, financial partners, local politicians, neighbours, local stakeholders (e.g. reference plants).
- Professional material concerning the biogas plant describing input, output, choice of technology, economy etc. addressing the suppliers of biomass and the receivers of digestate.
- Professional material concerning the biogas plant describing the technology, the production and the quantity of biogas addressing buyers of the biogas.
- Approval material according to legislation procedures addressing the authorities.
- Technical descriptions and drawings addressing the suppliers of technology and the contractors.

The informational material could all include descriptions, drawings, visualizations etc. which can be used for all of

the different publications addressing different stakeholders. The aim is to tailor specific material to match the informational needs of each different stakeholder; this provides each with the best and most relevant information possible, gives a good overview. This transparency gives proof of an organisation which cared about all aspects of the biogas plant.

COMMUNICATION AND PARTICIPATORY PLANNING

Ideally a biogas plant should be planned from the bottom-up; the local municipality or parish has a lack of energy for heat, electricity or transportation and at the same time as surplus waste, which can include manure and household wastes. A local group proposes the idea for a biogas plant and finds investors and farmers and applies for the permissions from the authorities and the business model is clear. This is in an ideal world – to find an integrative solution to cross sectorial challenges –the biogas plant could be truly sustainable: socially, economically and environmentally.

In reality biogas projects are proposed mostly by farmers, waste companies or investors and the local stakeholders are rarely taken into account in a very serious matter. The local parish or municipality will experience an increase in traffic and do expect a risk of odour emissions – however they usually do not profit directly from reduced GHG emissions or the economic benefits.

BIOGAS IN LINKÖPING, SWEDEN

In the beginning of the 90's discussions on how to reduce the pollution from the local town busses, combined with potential access to local manure and waste from the local slaughterhouse, led to the construction of the Swedish biogas plant outside Linköping. It has been expanding successfully since it opened in 1997, due to an increased demand in the region. The production has led to a carbon dioxide reduction of more than 37.000 tonnes per year. Since 2002 all public busses have been fuelled by biogas and 6 % of fuel used for transportation in automobiles is biogas in Linköping.

Often a local community reacts negatively to such an 'intrusion'. A web-based manual has been developed, with advice on how to communicate with the local stakeholders. The site outlines examples of "do's and don'ts", and describes various aspects for citizen involvement during the planning of a biogas project, such as involvement of the local knowledge, the target groups, describes the process, the timing, the good meeting, the good story, etc. (www.peopleandbiogas.com). The manual is a product of the Interreg. ÖKS project "Implement" (www.implement.nu).


A Member of
The Linde Group
AGA
BIOGASS
Ren naturkraft

Cooperation and agreements

THE GAS MARKET

Biogas plants have two main products, biogas and digestate or fertilizer. The latter requires an agreement with farmers on delivery and storage, after which the farmers will use it according to crop needs.

Concerning the gas component, numerous markets may be available depending on the local conditions. These different markets involve different kinds of agreements – see the table below.

Where possible, upgrading and gas grid injection would be the optimal solution; the gas can reach a large market and be sold with green certificates to consumers willing to pay for green energy. A large gas grid is a buffer and a storage system between production and consumers; further it makes biomethane available for various usages, such as transport, for CHP, for industry etc. In Denmark biomethane for transport is only profitable after having been injected into the grid, due to the financial support system.

Using gas cylinders for distribution might be attractive where no gas grid is available and a gas fuel station for busses and/or cars is in use. Today Sweden has approximately 100 public gas fuel stations fed by gas cylinders (almost 200 in total) and Norway has 92 gas fuel stations. In Denmark the number is increasing rapidly, however with only around 10 in summer 2014 – all fed by the gas grid.

Raw biogas in local pipelines is an option, where biogas plants can cooperate and benefit for common gas delivery – either for central CHP production or for centralized upgrading and filling station or grid injection.

The most common biogas usage is directly for heat or CHP on the biogas plant. When the heat can be used for district heating this is the most efficient use of the biogas energy. In Sweden and Denmark this has been and still is attractive due to the subsidy system, paying for electricity, and with district heating being widespread. With the low price of electricity in Norway this is rarely a commercially interesting alternative, though CHP might be considered on sewage plants.

Gas use	Denmark	Sweden	Norway
Gas grid	• Increasingly important. Agreement with upgrading and gas distribution company	• Relevant in W. Sweden. • Agreement with upgrading and gas distribution company	• Relevant in Stavanger area. • Agreement with upgrading and gas distribution company
Gas for transport in gas cylinders	• Not relevant today	• Relevant everywhere except W. Sweden. • Agreement with distribution company	• Relevant around Oslo. • Agreement with distribution company (AGA)
Gas sold in local gas pipe	• Planned in few municipalities • Agreement with local distribution company needed	• Biogas Brålanda, Skövde, Sävsjö, Falköping, Västerås, Linköping Stockholm and others • Agreement between production company and distribution company	• Might become relevant in Stavanger area
Gas used directly for heat or CHP	• Commonly used at sewage plants, landfill plants, farm biogas and cooperative biogas plants for district heating • Agreement between producer and user company/ municipality	• Relevant in sewage plants, landfill plants, industrial plants • Agreement between producer and user company/ municipality	• Used for heat production in a few cases for district heating • Agreement between producer and user company/ municipality

Gas use and agreements in the Scandinavian countries.

PARTNER AGREEMENTS FOR BIOGAS PRODUCERS

When undergoing planning for a biogas plant the investor should be aware of the large number of agreements that need to be made for optimal running of the business. In principle these should be described in the business plan and we here provide an overview of the types of agreements.

Agreement type	Partners	When	Remarks
Insourcing of biomass	• Farmers, municipalities, waste companies, industries	• Frame agreement should be in place at an early stage of planning	• Different agreements with the various providers and types of biomass. Price should depend on quality (e.g. dry matter content of slurry) • Storage facilities and timing of delivery should be considered all year around
Sale of gas	• Gas upgrading company and/or gas distribution company	• Frame agreement should be made early	• Agree on gas quality. Price could be linked to natural gas market price. Consider green certificates
Sale of electricity	• Power company	• Regulated by law	• Usually standard agreement, standard incentives
Sale of heat	• District heating. Industry	• Early stage, price can be crucial for business	• Local price for heat may vary, agree on price indexation
Sale/delivery of digestate/ nutrients	• Farmers	• When applying for environmental permit	• Agree on responsibilities/ certification of the products (liquid/solid fractions). • Storage facilities and timing of deliveries should be considered. Models for motivating farmers to deliver manure with high dry matter content could be considered
Financial agreements	• Banks, credit companies, municipalities	• Pre-approval needed for business plan • Final agreement based on business plan	• Public guarantees can stimulate the process
Subsidy agreement	• Public bodies	• Investment subsidy: before construction starts application • Production subsidy: before production starts	• Different bodies in the 3 countries
Purchase of suitable plot for construction	• Land owner	• Pre-agreement before planning starts; agreement needed before local environmental planning starts	• Can be complex and expensive
Contracting biogas plant	• Biogas construction company	• Public procurement late in the planning	• Can be specified as total construction or spilt into sub-contracts

Types of agreements for biogas plants.

Agreements should be locally adapted to the specific local conditions, type of biogas plant and the gas market. The length of agreements will depend on the local conditions and markets.

Examples of these agreements can be found in existing plants, however they always need to be adapted to the local conditions and market. Normal business aspects of market development, rights and duties, insurance, disputes etc. should be considered for each agreement, and often legal advice is needed along construction and financial advice. Smaller biogas plants often have challenges when starting up, and in these situations it is important to have a detailed contract describing the responsibilities of the partners involved. It is recommended to raise the standards of the contracts and follow the principles of public procurement procedures.

Additional reading

NORWAY:

Det Kongelige Landbruks- og Matdepartement; St.meld. nr. 39 (2008–2009): Klimautfordringene – landbruket en del av løsningen

Det Kongelige Miljøverndepartement; Meld. St. 21(2011–2012): Melding til Stortinget - Norsk klimapolitikk

Klima- og forurensningsdirektoratet (2010) Klimakur 2020; Sektorrapport jordbruk: Tiltak og virkemidler for reduserte utslipp av klimagasser fra jordbrukssektoren; TA 2593 2010

Klima- og Forurensningsdirektoratet: Underlagsmateriale til tverrsektoriell biogass-strategi; TA 3020 2013

Fylkesmannen i Rogaland i samarbejde med Mattilsynet et al (oktober 2010), folder: "Biogass - basert på husdyrgjødsel - Informasjon om etablering og drift av biogassanlegg"

Norges Bondelag (juni 2011), folder: Fakta om BIOGASS - Norsk kulturlandskap - det nye gassfeltet

Enova; Støtteordning for biogasanlegg: Program Biogassproduksjon

Innovation Norway, Bioenergiprogrammet

SWEDEN:

Energigas Sverige (brancheorganisation), website about biogas: www.biogasportalen.se

Energigas Sverige (2012): Anvisningar för biogasanläggningar, BGA 2012

Dahlgren S (2013): Realiserbar biogaspotentiali i Sverige 2013 genom rötning och förgasning

Statens energimyndighet (2014), rapport: Produktion och användning av biogas och rötrester år 2013

Statens energimyndighet (2010): Förslag till en sektorsövergripande biogasstrategi, Slutrapport, ER 2010:23

DENMARK:

Folketinget (2012): Energiaftalen 2012

Fødevareministeriet (2008): Landbrug og klima - Analyse af landbrugets virkemidler til reduktion af drivhusgasser og de økonomiske konsekvenser.

Naturstyrelsen (2013): Biogasanlæg – arkitektur og landskab.

Naturstyrelsen (2014): Biogas i danske kommuner. Afprøvede løsninger.

Regeringen (2011): Energy Strategy 2050 – from coal, oil and gas to green energy

Regeringen (2013): Danmark uden affald.

Agro Business Park/INBIOM (2014): Kogebog for etablering af biogasanlæg 2014.

OTHER:

IEA Bioenergy (2014): IEA Bioenergy Task 37 – Energy from Biogas

This Scandinavian Biogas Handbook describes the main aspects of planning a biogas plant in Norway, Sweden and Denmark and it highlights the differences and similarities between the countries.

The intention is to provide a summary of the main aspects to be taken into account when planning a biogas plant in Scandinavia, whether it is public or private, small or large scale, countryside or industrial areas, and refers to more detailed planning in each country.

The work is financed by Implement and has been led by Agro Business Park in consultancy with key stakeholders in Sweden and Norway.

Grøn Gas ERHVERVSKLYNGE

AGRO BUSINESS PARK

INBIOM INNOVATION NETWORK FOR BIOMASS

Implement Sustainable development with biogas

DEN EUROPÆISKE UNION
Den Europæiske Fond for Regionaludvikling

Interreg IV A ÖRESUND – KATTEGAT – SKAGERRAK

midt regionmidtjylland