

New Non-polluting and Energy Efficient Vehicles

Biogas in Captive Fleets



Policy notes

What is it about?

Characteristics

Biogas (biomethane) made from wastewater or solid biological material is the cleanest vehicle fuel commercially available. There are almost no hazardous emissions at all and very little greenhouse gases. Producing and using biogas as a fuel is a way to reduce the vehicle emissions and can also be used to reduce the waste problem and increase the competitiveness of rural society. Biogas is suitable for city fleets as it is normally available in all cities from the water treatment plants.

A large variety of vehicles are available including buses, garbage trucks, transporters, cars, vans and lorries. Using biogas in a fleet means that no extensive fuelling infrastructure is needed for cities with a natural gas grid used for vehicles, as it is convenient to inject the purified biogas directly into the grid. Hence the use of biogas in fleets has the potential to be further spread in many countries but the concept needs more promotion and dissemination. Examples of successful implementation of the Concept are Svensk Biogas AB in Linköping (SE), Lille Metropole (FR), Gothenburg Green Gas (SE) and BiogasMax (EU project).

Key benefits

Introducing biogas as a fuel...

- reduces emissions of greenhouse gases;
- contributes to noise reduction, as biogas vehicles are less noisy than diesel vehicles;
- reduces dependency on oil;
- provides a strategy for recycling of waste;
- contributes to rural development through the use of agricultural feedstock for biofuel production.



Refuelling of biogas bus at Marquette, Lille, France

Photo: Max Lerouge

Example: Biogas bus fleet in Lille

In 1992, Lille Metropole decided to optimize the recovery of any kind of households waste. The selective collection of organic waste began in 1994. A few years later Lille came across the idea of biogas fuel to stop flaring biogas produced from sewage sludge. In 1995 a pilot biogas purification plant was ready, serving 8 buses. This was successful and a decision was taken to convert 100 % of the bus fleet from diesel to natural gas / biogas.

To fulfil the objective of waste recovery and increasing of the biogas production, a new anaerobic digestion plant is under construction and will be ready in Spring 2007. Lille will use solid organic waste from households, restaurants and parks as feedstock and produce 4 million Nm³ (normal cubic metres) upgraded biogas/year and suffice for 100 buses. The price will be 0.27 €/Nm³, which equals a diesel price of 0.68 €/l when used in buses.

Is this something for us?

Biogas in Captive Fleets is suitable when:

- The political commitment is strong;
- The tax system favours biogas for transport;
- There are plans for biogas production (or already in place) from sewage, waste or similar, for transport use;
- A potential user of the biogas volume is engaged, i.e. a bus fleet.

Biogas for captive fleets is not a solution when:

- The tax system favours biogas used for electricity and heat production instead of transport fuel.



Biogas waste truck in Stockholm

Photo: Per Westergård



Photo: Olof Sjoden Fordonsgas Sverige
Source: Fordonsgas Sverige AB

«It started with nine biogas waste trucks in a demonstration project. In 2006 there were 32 biogas driven waste trucks and in 2010 I expect all 85 waste trucks in Stockholm to be biogas driven»

Nils Lundkvist
Stockholm Waste management
administration,
Stockholm, Sweden

Check list

City size	No restriction, cooperation between smaller cities facilitates the implementation.
Costs	High investment cost in production. Low operational costs gives payback time 10-15 years.
Implementation time	Medium term (3-5 years).
Key Stakeholders involved	<ul style="list-style-type: none">• Public authority (city);• Private companies (fuel producer/fuel distributor).
Undesirable secondary effects	Lack of biogas (problems with production or biogas quality) after fleets are introduced can create problems.

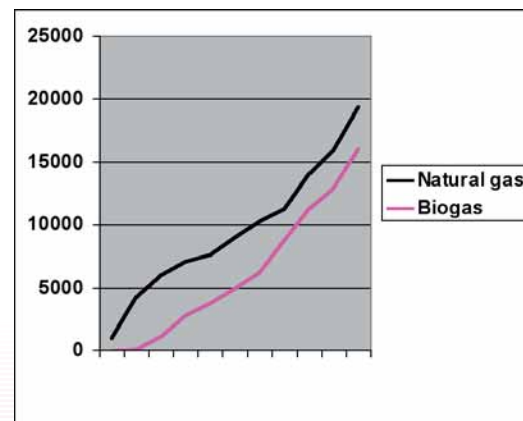
Benefits & Costs

Benefits

The introduction of production and use of biogas for transport can give positive effects on the local economy and solve problems with sewage and waste:

- Biogas can be produced from **local sewage and waste**. Apart from producing a renewable transport fuel the production also reduces the waste volumes. The local biogas fuel can be used in both light and heavy CNG vehicles. There is a wide range of gas vehicles available on the European market.
- Use of biogas **reduces** the emissions of **greenhouse gases**. The emissions of **NOx** and **particles** are considerably **lower** compared to diesel. Biogas-driven vehicles are more **silent** than conventional diesel vehicles.
- If there is an existing natural gas grid and vehicles running on natural gas biogas can be introduced in the same grid as "**green gas**".
- Biogas produced locally and used in captive fleets can be an important part of a local **climate action** strategy.

Volumes of biogas sold in Sweden (Nm³)



The sales of biogas and natural gas for transport increases continuously since 1995 in Sweden.

Source: Svenska gasföreningen

Costs

The investment costs for production and distribution are high. The cost for distribution is considerably lower if the biogas can be introduced in an existing natural gas grid. Low operational costs and cheap raw material means that the payback time is about 10-15 years.

If biogas is already produced but flared away the investment will focus on upgrading of the biogas and setting up fuel stations.

A fuel station for biogas costs approximately 300,000 €. The investment costs for fuel stations can be reduced if the biogas is used by a captive fleet kept at a depot, and all the vehicles can be fuelled at one fuel station.

CNG vehicles are 10 –15 % more expensive than conventional vehicles.

The total costs for the fuel depends on the taxes on biofuels. If the biogas is tax free the price can be very competitive compared to petrol.

Biogas fuel is cheaper at the fuel station

The price of biogas (not taxed) is very competitive with petrol. The price is presented in Nm³ (normal cubic meter). In December 2006 the price of biogas in Linköping, Sweden, was:

Biogas price at the fuel station:
9.25 SEK/Nm³ (1.03 €)

Petrol equivalent biogas price:
8.57 SEK/l (0.95 €)

Petrol price: 10.45 SEK/l (1.16 €)

The driver of a biogas vehicle saves 1.50 SEK/l (0.16 €).

Users & Stakeholders

Users and target groups

- **Public transport authorities**, as the bus fleet is the key user of biogas. The bus fleet is often large and can be fuelled over night at a depot;
- **Local or regional authority** fleets have to be used in order to show that biogas is a convenient fuel;
- Other large **captive fleet owners** that use a depot, for example waste trucks and the postal services;
- When there is an available infrastructure for biogas **private companies and the public** can be addressed.



Biogas bus at Arlanda

Photo: Jan Sundström

Key stakeholders for implementation

A range of actors are involved in a biogas introduction scheme:

- The **local or regional authority** is an important stakeholder to initiate the production and use of biogas. The authority can also decide on local/regional incentives.
- **National authorities** decide on national incentives as tax benefits for fuel and vehicles.

Production

- **Sewage treatment or waste company.** The local water and sewage treatment company and the waste handling company can produce and upgrade biogas.
- **Farmers.** Farmers can deliver feedstock for the biogas production (i.e. manure).

Distribution

- **Fuel distributor.** The fuel can be distributed at a depot, for one fleet only. It can feed into natural gas grid or be distributed and sold at separate biogas fuel stations.

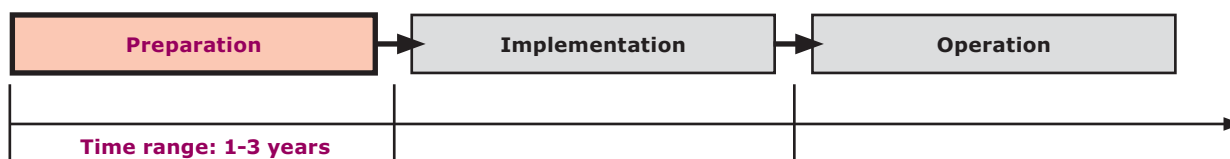


Biogas upgrading in Lille

Photo: Björn Hugosson

From concept to reality

Preparation



The driving forces for introduction of biogas for transport are problems with bad air quality and local action plans for reduction of greenhouse gases.

The implementation of biogas in captive fleets requires different actions depending on the access to biogas. If biogas is already produced but flared away the investment will focus on upgrading of the biogas and the setting up of fuel stations. If not, the first step is to build a production plant for biogas.



Photo: Sven Alexanderson

Key aspects at this stage

Production of biogas

Production capacity: Possible producers of biogas as well as possible feedstock (sewage, waste, restaurant waste, offal from slaughterhouses, surplus grain etc) has to be identified. If there already is biogas production an investment in a gas purifying system is needed in order to get a transport fuel. It is important to estimate the potential production volume. The volume gives an idea of the maximum fleet size.

Plan for adjustment time: When planning the time needed for building a biogas plant, experiences from the current production of biogas shows that it is important to also consider the time needed for adjustments of the production process.

Learn from other production sites: A lot of experiences have been made at other biogas production plants. Learning from others can cut down the time from planning to the start of the production.

Agreement with buyers of biogas:

The contract with the users of biogas should be ready before the production unit is built. The future biogas volume can be sent out for tender. When a tender has been accepted the building process can start.

Distribution of biogas

How shall the biogas be distributed?

Can it be fed into an existing natural gas grid or transported in lorries to separate fuel stations? It is preferred to have an agreement with a distributor before the production starts. The distributor should also guarantee the number of fuel stations.

Procurement of the production plant:

The production plant and purifying step have to be procured in the next step. A lot can be learned from other sites. It is important to have all contracts ready from the start of the building of the plant. All necessary permits should be ready, both for production and distribution.

Vehicles

A survey of available vehicles (light and heavy) at the national market should be carried out. There is a wide range of vehicles on the EU market. The car dealers can easily introduce these models on the national market.

Users

Identify the possible users with large captive fleets that refuel at a depot. The local bus fleet, the municipal fleet and waste trucks are possible users in the first step.

Survey national incentives: Identify the preconditions for introducing biogas, for example taxes on fuel and vehicles, requirements of the fuel stations (it can also be a question for the local authorities). If there are no tax exemptions or other incentives for the use of biogas it might be too costly to use biogas for transport.

Examples of national incentives:

- Lower or no tax on biogas;
- Lower car tax on biogas vehicles;
- Lower company car tax for biogas vehicles.

Survey the local situation: Are there any available local incentives? What are the requirements for using biogas as a fuel at the local level (safety issues for fuel stations, transport of biogas etc)?

Examples of local incentives:

- Free parking;
- Grants for fuel stations;
- Test fleet for companies.

Ready for implementation?	✓
Fuel production existing or planned	
Interested distributor	
Political will and support	
Available vehicles (at least on the European market)	
A planned pilot demonstration to show feasibility and create awareness	

BiogasMax

BiogasMax is an EU funded project that aims at increasing the knowledge about more efficient production, distribution and use of biogas in the transport sector. The production of biogas will focus on waste feedstocks:

- Waste water;
- Food waste from the food production chain;
- Municipal organic waste.

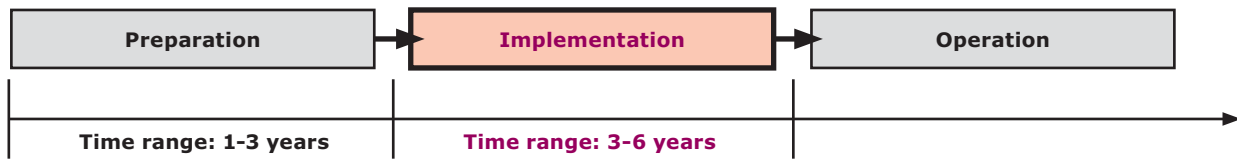
28 partners from France, the Netherlands, Sweden, Poland, Switzerland and Italy will work together. Lille Metropole in France is the coordinator. The activities will focus on:

- Biogas production from various waste;
- Biogas upgrading so that it reaches fuel quality;
- Fuel distribution - to ensure biogas availability for transports, and experiment with biogas injection in natural gas grids;
- Use in vehicles - increase the number of vehicles running on biogas in public transport, taxis, waste collection trucks etc.

Priority projects are biogas highways (Stockholm, Gothenburg), organic recovery centre (Lille), biogas fuel from residual waste (Rome).



Implementation



The next step is to start producing and using the biogas. The biogas fleets can start running.

Key aspects at this stage

- **Information campaign:** Passengers and other users of the biogas fleet services should be informed about the new fuel and the reasons behind the introduction of biogas. That can also increase the understanding if there are production problems in the beginning of the implementation phase.
- **Introduce local incentives:** Green procurement of transport services, priority in taxi line for biogas taxis etc.
- **Dialogue with captive fleet owners:** Continue the dialogue with owners of large captive fleets. The next vehicle choice should be a biogas vehicle. Support companies with material so they calculate the costs and green house gas reduction.
- **Expand infrastructure:** If the biogas volume can fuel more than the captive fleets it is important to get more fuel stations in place. The fuel distributor has to keep up the expansion of fuel stations as agreed.
- **Green gas concept:** If there already is a natural gas grid in the city it is possible to inject the biogas into the grid. Consumers can have a special «green gas contract». This means that they fuel with the mix of natural gas and biogas in the grid but they pay for the biogas (often a little more expensive) that have been injected (similar principle to green electricity).

Green gas concept

The City of Gothenburg, Sweden, is a pioneer in operating buses and taxis on natural gas. In the mid 80's Gothenburg installed a natural gas grid and a few years later started to operate the city bus fleet and the municipal fleet on it.

Through ambitious campaigns, information and incentives like free parking and a priority taxi line, also taxis and some private companies changed to natural gas vehicles.

In 2001 the City of Gothenburg required the bus operators to use gas buses and increase the amount of renewable fuels each year. This led to the concept «Green gas». Customers can choose to pay a little extra when fuelling natural gas. The same amount of biogas as they fuel will then be injected into the cooking gas grid.

The main buyers of «Green gas» are the public transport and the municipal fleets. Also some environmentally concerned companies and private citizens buy «Green gas» while very few taxis do.

Fordonsgas Väst, the distribution company for natural gas for transport, administers the system and buys the injection amount of biogas from Göteborg Energi, the municipal energy and waste water company. In the current project BiogasMax, Göteborg Energi will upgrade the biogas and inject it in the natural gas grid.

Success factors for Biogas in Captive Fleets

- **Innovative product:** Producers find biogas economically profitable;
- **Market issues:** Fleet owners find biogas a competitive fuel on a long term basis and has an awareness of the real cost for the whole user cycle;
- **Champion administration:** common vision between politicians and other stakeholders. Politicians have an environmental awareness and biogas is a politically appealing concept.



Carsharing with biogas vehicles

Photo: Sunfleet 2006

Barriers for biogas in captive fleets:

- **Market issues:** large initial investment costs and need for a change of tax system that favours the use of biogas for other purposes (i.e. heat and electricity);
- **Slow expansion of fuel stations:** few fuel stations makes many potential buyers and users hesitate;
- **Production problems** can undermine the support for biogas as a fuel.



Biogas production in Linköping

Photo: Svensk Biogas®

Svensk biogas in Linköping

The initial impulse for the use of biogas for transport was the local air quality problem at one of the bus nodes in Linköping. After rejecting trams as being too expensive, the city decided for natural gas buses and a natural gas grid was planned. For different reasons this was never realised and the city had to find another solution.

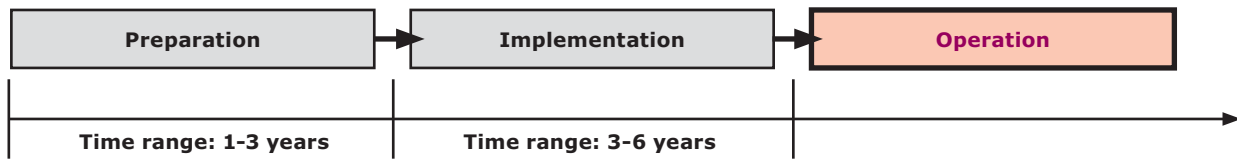
The public energy and waste company Tekniska Verken came up with the idea to utilise the biogas that was produced from the wastewater.

As pioneers in biogas driving, the city decided to initiate a pilot project including 5 buses that were operated and evaluated during a couple of years.

This pilot project also showed that it was even better to build a separate biogas production plant to be able to control the input and thus increase the output rate. In the mid 90's a new company - Linköpings Biogas (in 2003 the name was changed to Svensk Biogas)- was founded, including Tekniska Verken as producer and the Farmer's organisation and a butchery company as supplier of feedstock. The aim was to produce biogas to be able to operate the municipal buses. A production plant was ready in 1996, after an investment of 130 million SEK (140,000 €).

In 2001, the first public filling station opened, mainly to operate Tekniska Verken's company cars, the municipal fleet and a few taxis. Today there are 13 filling stations and 7 more to be opened. In addition to the bus fleet more than 500 cars operate on biogas. There is also a biogas driven train running.

Operation



Key aspects at this stage

The biogas production is ongoing and the number of users is increasing. There are some possible barriers at this stage:

- Problems with biogas production and low availability of fuel pumps;
- Decreased price of petrol and diesel makes biogas use comparably expensive;
- Problems to get more car models onto the market.

This makes it very important to continue the work and the dialogue with the stakeholders:

- How shall the biogas production and the number of fuel stations increase further?
- Invite neighbouring regions to start the development of biogas production;
- Discuss with car dealers how more models of vehicles, perhaps in other segments, need to be available on the market. If there are problems with the range of available models, initiate a joint procurement of biogas vehicles;
- Training for car dealers staff to make sure the customer gets information about biogas cars;
- The incentives have to be kept until a real market break through is reached (5 % of the total fleet);
- Information campaigns to increase awareness and knowledge among car buyers in general might be needed.

A Biogas Highway



The E20 highway which links the cities of Stockholm and Gothenburg will also offer a biogas infrastructure. The expanded network of biogas fuel

stations will enable biogas vehicles to make the journey between the two cities. 7 new fuel stations will be built until 2009. This has a further benefit for Stockholm as it will expand the refuelling infrastructure in neighbouring cities in Mälardalen, where many of the people working in Stockholm live. Biogas vehicles will be a real option for these commuters.

Further information & contacts

Further information

BiogasMax

BiogasMax is an EU funded research and development project on biogas.

www.biogasmax.eu (English)

Lille Metropole

The City of Lille is the coordinator of BiogasMax, produces biogas and drives biogas buses.

www.cudl-lille.fr (French)

City of Stockholm

The City of Stockholm produces biogas and has a large fleet of biogas vehicles, including buses, lorries and light vehicles.

www.miljobilar.stockholm.se (Swedish)

German Biogas Organisation

An organisation working for wider use of biogas in Germany

www.biogas.org (German and English)

ENGVA

The European Natural Gas Vehicle Association which also works with biogas.

www.engva.org (English)

SVENSK BIOGAS

Information on the biogas project in Linköping.

www.svenskbiogas.se (Swedish)

NICHES - further documents with more details

Reports on the state of the art, analysis of success factors and barriers for implementation, transferability potential and integrated strategies are available on the NICHES websites (English):

www.niches-transport.org

www.osmose-os.org

Contacts

Björn Hugosson is working with biogas

introduction in the City of Stockholm.

E-mail: bjorn.hugosson@miljo.stockholm.se

Peter Boisen has a long experience with biogas and works at ENGVA.

E-mail: Peter@boisen.se

Owe Jönsson from the Swedish Gas Technology Centre, knows the biogas production process.

E-mail: Owe.jonsson@sgc.se

Peter Undén works at Svensk Biogas and knows about the process from planning to realisation of a broad biogas introduction.

E-mail: peter.unden@svenskiogas.se

Arthur Wellinger works with biogas at Nova Energie in Switzerland.

E-mail: arthur.wellinger@novaenergie.ch

Pierre Hirtzberger, coordinator of BiogasMax.

E-mail: phirtzberger@cudl-lille.fr

Yves Baesen works on biogas in Lille Metropole, France.

E-mail: yves.baesen@cudl-lille.fr

For **more information** on the NICHES project, contact the NICHES Coordination at:

POLIS

Leire Iriarte

E-Mail: iriarte@polis-online.org

Phone: +32 2 500 56 74

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The mission of NICHES is:

to stimulate a wide debate on innovative urban transport and mobility between relevant stakeholders from different sectors and disciplines across Europe.

NICHES promotes the most promising new concepts, initiatives and projects, to move them from their current 'niche' position to a 'mainstream' urban transport policy application.

NICHES team

The NICHES consortium is composed of a variety of experts in the field of urban transport, ensuring the knowledge of the academic sector (Warsaw University of Technology), the experience of cities (Stockholm), the expertise of consultants (Rupprecht Consult, PTV Planung Transport Verkehr AG) and the multiplier effect of the networks (POLIS, EUROCITIES, CEMR).



CITY OF STOCKHOLM
ENVIRONMENT AND HEALTH ADMINISTRATION

*For more information on the project,
contact the NICHES Coordination at:*

POLIS
Leire Iriarte
Phone: +32 2 5005674
Fax: +32 2 5005680
liriarte@polis-online.org

or visit the project websites:

www.niches-transport.org
www.osmose-os.org

Author:

*Kristina Birath, Inregia AB, (kristina.birath@inregia.se),
working for the City of Stockholm*

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