

In the transport sector, municipal efforts to reduce local emissions imply carrying out a modal transfer away from private car towards public transport and at the same time limiting the emissions produced by urban public transport and captive fleets of vehicles. Several municipalities have started to investigate the possible energy uses as motor fuel of biogas, a renewable energy source produced from household refuse and/or agricultural waste on landfill or in sewage plants.

GENERAL ASPECTS

Stockholm is the capital of Sweden as well as an important port and has a population of 700,000 inhabitants (1,041,000 if considering the whole urban area). The old part of the city has partly kept its narrow streets and old houses and spreads over the Norrström islands. To the north and the west are the business and administrative districts whereas residential areas are to be found in the east. Stockholm is the biggest industrial and commercial centre in the country: mechanical engineering, electrical appliances, textile industry, leather industry, rubber and food processing, printing industry.



CONTEXT

Stockholm's 700,000 inhabitants make almost four million journeys per day. Ten million tonnes of goods also come in and out or transit through the city every year. The share of public transport is quite high (55%). The number of private cars on the roads, however, keeps on increasing. In 1996, Stockholm's inhabitants indeed bought 25,000 new vehicles.

As in many cities, road traffic is the main source of pollution in Stockholm (between 70 and 80% of emissions). The transport sector is also the largest energy consumer in the city (20% of total energy consumed). One of the solutions to improve the quality of life and the environmental situation in the long run consists in using renewable energy. The introduction of less polluting and more energy-efficient vehicles can contribute to reaching this objective. The Municipality of Stockholm, in collaboration with other European cities, developed the ZEUS project („Zero and low Emission vehicles in Urban Society“) which aims at introducing a high number of more environmentally-friendly vehicles. ZEUS is partly financed by the Thermie programme of DG XVII of the European Commission.

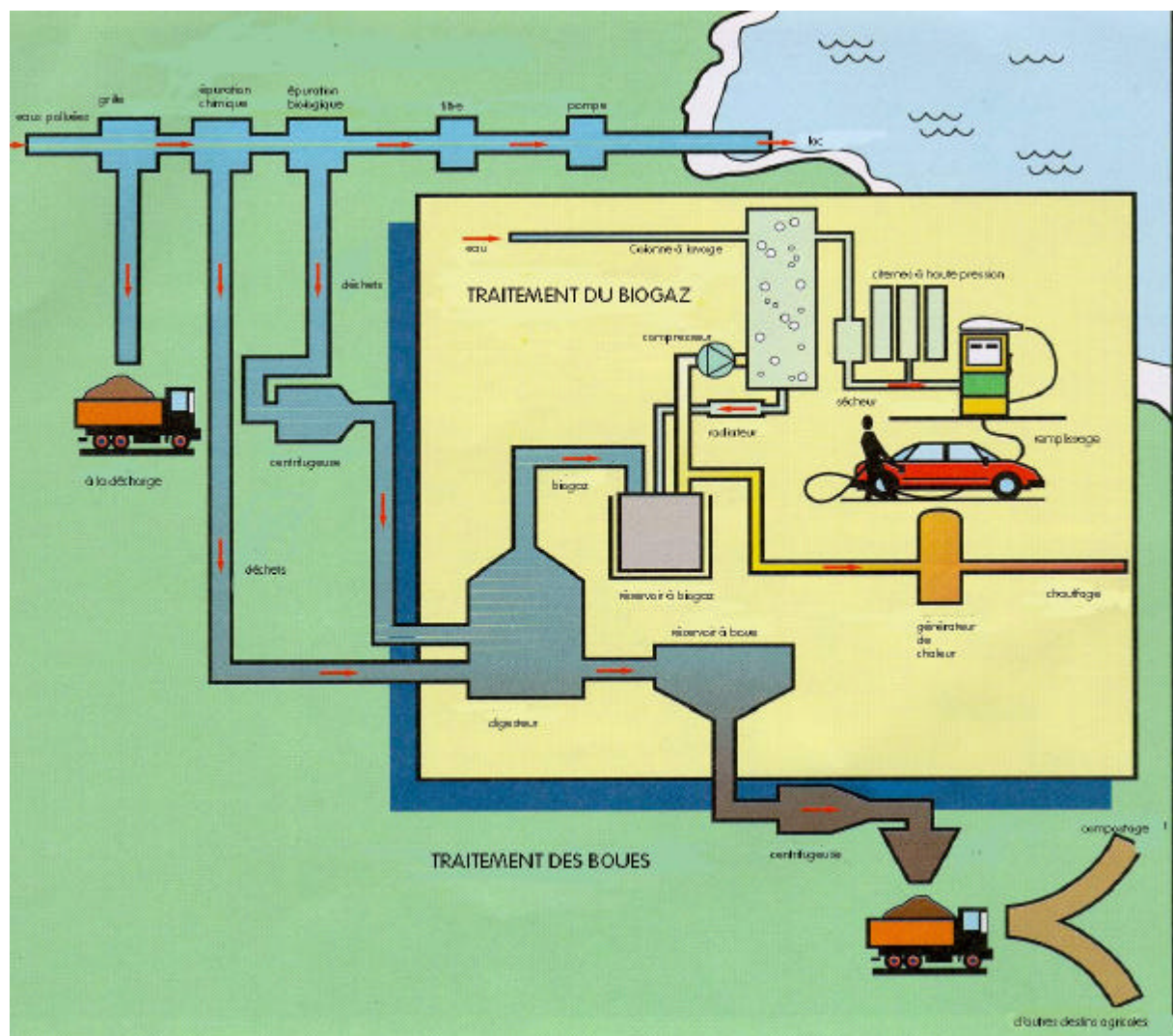
EXPERIENCE OF STOCKHOLM

In 1994, the Municipality of Stockholm implemented the European project ZEUS, whose coordinator is precisely the Municipality of Stockholm. One of the ZEUS sub-projects concerns the introduction of vehicles running on biogas fuel produced from liquid waste treatment in sewage plants.

In 1996, the positive commitment to reduce pollution made it possible to introduce the first 20 vehicles with dual petrol/biogas carburation as well as to build a pilot site for the production of biogas from the digestion of organic matters conveyed to the waste water treatment plant in Bromma.

At the end of 1997, the manufacturer Scania delivered its first lorry running on biogas and capable of transporting biogas fuel to refill up to 160 cars from the production site to the distribution site. Today 200 cars with a dual petrol/biogas carburation are currently running in Stockholm.

The building of the pilot site for the production of biogas was partly financed by the Swedish National Offices for Research in Transport and Communications (KFB) and for Environmental Protection.



Partners involved

The main local partners involved were:

- Stockholm Vatten, the municipal company in charge of distributing water and treating waste water,
- Oiltech AB, a company specialising in the development and sales of fuel and gas tanks,
- SKAFAB, the municipal company in charge of recycling waste,
- MFO, the municipal company responsible for municipal facilities,
- OK, Shell and Statoil, three fuel distributing companies.

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Biogas production in Stockholm

The Bromma sewage plant is run by Stockholm Vatten and handles every year fifty millions of m³ of waste water, representing the effluents from 250,000 inhabitants. 400,000 m³ of gas, i.e. 11.4% of the biogas produced by the digester, are cleaned to produce biogas fuel. Before 1996, they were burnt off.

To be used as fuel, biogas needs to be cleaned for the proportion of methane (CH₄) in uncleaned biogas (65 to 70%) is not enough to ensure the proper working of vehicle engines. This is why the proportion of CO₂, water and other gases is reduced to increase methane content.

Once cleaned, biogas is compressed and stored in a 250 bar high-pressure vessel at a temperature of -30°C. It is then conveyed by “tanker lorry” to the site where vehicles are filled up. The “tanker lorry” and the filling stations were also partly financed by the European ZEUS project.

A highly innovative system was designed for the transportation of biogas. It consists of a lorry equipped with hydraulic tanks capable of transporting the fuel to the filling station.

Vehicles running on biogas

The “tanker lorry” has 30 high-pressure tanks that can accommodate the sufficient capacity to provide the whole fleet of vehicles with enough fuel to operate during one day. There is no pressure losses between the lorry tanks and the those of the filling station, which is a major asset.



Four different private car models with dual petrol/biogas carburation operating in Stockholm from 1996 to 1997.

EVALUATION AND PERSPECTIVES

Emissions

It must be pointed out that the EC 2000 standard on polluting emissions is already applied in Stockholm whereas it will only come into force in 2000. The measurements carried out indicate that a dual petrol/biogas carburation vehicle emits fewer pollutants when running on biogas rather than on petrol.



Financial aspects

1995 investment costs in Euro	
Biogas treatment plant	407,000
Related facilities	132,000
Buildings	88,000
Personnel, miscellaneous	121,000
Total	748,000
Subsidies	248,600

Annual expenditures in Euro	
Investment costs (499,400 x 0.256)	127,846
Maintenance, personnel, misc.	48,400
Total	176,246
Annual incomes in Euro	
Biogas sales	215,600

In 1998, the Municipality of Stockholm submitted a proposal to the European Commission with the aim of building two new biogas production sites, one in Bromma (extension of the pilot site) and one in Henriksdal. Works should start at the end of 1998 and should be completed by 2001.

The annual production of biogas fuel should reach 4,500,000 Nm³ per year. A heat exchange system will be created to save energy during the cleaning process.

FOR FURTHER INFORMATION

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