The SEA BUS – a biogas driven commuter ferry for public transportation

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Abstract

The project is a public private partnership (PPP) between the City of Stockholm, the City of Lidingö, the municipality of Nacka, the County Council and the private sector.

The SEA BUS is a complement to the existing public transportation system in the Stockholm area using the water as infrastructure and short cuts instead of bridges and tunnels (Stockholm is situated on several islands and shores of both the lake Mälaren and the Baltic Sea).

To small costs, the project will create new transportation habits diminishing traffic on roads without investments in land adsorbing new infrastructure. Old industrial sites and docks around the lake and the sea will also be more accessible and therefore more attractive to develop for housing areas and work places.

Through technical procurement high environmental demands resulted in a ferry with low wash, no greenhouse gas (GHG) emissions, low other emissions, low noise, and higher energy efficiency.

The project is an important link in creating a market for locally produced (sewage) biogas to secure the transition from diesel to biogas driven local busses, trucks and service vehicles.

The SEA BUS is in traffic all year round, offers a fast and high quality commuting with the possibility to bring both bicycles and perambulators. Totally adapted for disabled persons.

The world unique SEA BUS will have an international and national acknowledge for its technical concept with its flexibility and environmental advantages.

The SEA BUS will also enhance the tourist industry – experience Venice of the Nordic from the seaside.

Introduction

The roads of water have always been an important part of the infrastructure in and around Stockholm. Long before this word even was invented people, animals and goods were going back and forth among the many islands the City was founded on. In the end of the 1700-century and in the first half of the next, rowing madams did the major part of the passenger transport on the inner waters of Stockholm. When the steam came many steamboat companies took over but this traffic was meant for the archipelago and for longer trips further into the Lake Mälaren and not for the city close docks.

Now the need of fast environmentally friendly short cuts on the inner waters of Stockholm is growing. The City is growing along shorelines and docks as never before. The immigration is constant growing. As a consequence the pressure on all land communications increases where both car drivers and bus travellers comes to a stand still in the genuine sense of the word. At the same time town and traffic planners are warning for the coming final traffic breakdown. Using the waters could be a complementary alternative solution.

Objective

During the fall 1999 the City of Stockholm and the developing project Hammarby Sjöstad started a co-operation with AP-fastigheter, a real estate company, to determine whether a commuter ferry system would be feasible around the inner waters of Stockholm. During this process a number of real estate companies joined the project along with the City of Lidingö and the municipality of Nacka, both surrounding the inner waters of Stockholm.

The project aims for a public regular commuter traffic on water, diminishing road traffic, between the Municipalities of Nacka and Lidingö, Hammarby Sjöstad and the Centre of Stockholm City in order to reduce GHG emissions and fossil energy using biogas - a locally produced renewable fuel – closing the Eco-cycle.

The Project

The on-going project has done pilot studies, tender demands, drawings and conceptual works. The work has been co-ordinated between the City of Stockholm and the Hammarby Sjöstads project, and the Municipalities of Nacka and Lidingö together with the Port authority of Stockholm City, The Swedish Maritime Administration, the Stockholm Environment and Health Administration, the Royal Institute of Technology, Stockholm Water Company, The National Inspectorate of Explosives and Flammables in Sweden and The County Administrative Board of Stockholm.

The project has developed a new type of boat powered by biogas (world unique) - biogas which is produced and delivered by the Stockholm Water Company within the traffic area – together with a special floating terminal concept which provides a fast and convenient embarking and deembarking. This concept gives very short stops, which make it possible to use smaller and therefore less energy consuming engines - still keeping the timetable. The SEA BUS is designed for year around use with very high environment standards and is highly adapted for disabled persons. The SEA BUS, the bunker station and terminals are drawn and ready to be built.

To find out and verify the possibility and feasibility of the SEA BUS the project has done environmental, safety and traffic analysis and an elaborate business plan.

The Project will initially invest in four to six SEA BUSES, the bunker station and eight terminals. The overall system will consist of up to 10 to 12 ferries and 13 to 15 terminals. Investment decision and purchase is still pending.

Since the turn of the year 2000/01 a manager group has been formed for the Project. The members of the manager group are construction companies and real estate companies together with the three municipalities and other private investors within the planned traffic area:

- Hammarby Sjöstad Project/The City of Stockholm;
- LIP-Council/ The City of Stockholm;
- Nacka municipality;
- The City of Lidingö;
- AP Fastigheter region Nacka Strand AB (real estate company);
- KF fastigheter AB (real estate company);
- HSB (real estate company);
- NCC AB (construction company);
- Telegrafberget HB (real estate company).

Environment, safety and traffic

LESS POLLUTION WITH BIOGAS

Of the total CO_2-emissions of the Stockholm region, traffic stands for one third and the energy sector for more than half of the emission. The City of Stockholm has the aim to reduce Co_2-emissions with 20% from 1990 til 2005, and a long-term goal of a 60-80% reduction in the next 50 years.

The planned ferry traffic will use a third of the energy compared to the use of buses and cars. NO_x emissions will be a sixth in the same comparison. This improvement is due to the shorter distance without any queuing-up and change of travel behaviour. If then the ferries use biogas instead of diesel the result will be even better.

Biogas consists of 85-95% methane - as natural gas – but is not from fossil finds. Except for hydrogen in fuel cells, biogas is the most optimal vehicle fuel in urban areas regarding both local and global environmental effects. Biogas is renewable and generates less health hazardous components than both ethanol and diesel and has no net of CO_2-emissions.

BIOGAS PRODUCTION – ECO-CYCLING

The biogas is produced when wastewater is treated. Anaerobic digestion is a process whereby organic waste is digested under anaerobic conditions by bacteria. This will also reduce the vast volume of sludge, which is a problem handling. The residue can then be used as fertiliser and put back into the Eco-cycle. The gas has then to be purified from CO_2 and water and then pressurised to work as vehicle fuel.

There are no vessels in Sweden using neither natural gas nor biogas but there are some natural gas driven ones in other countries. The co-operation with The Swedish Maritime Administration made it possible to use biogas for the first time in Sweden in passenger traffic. This was not possible earlier due to interpretation of regulations.

The project is also an important link in creating a market for a locally produced biogas big enough to secure the transition from diesel to biogas driven local busses, trucks and service vehicles.

SAFETY

Since five years there is more than 200 gas driven buses in service in Sweden. Some of the buses use natural gas from the grid in the southern part of Sweden. Others use biogas produced locally by fermentation, for example in Linköping and in Uppsala. In these two cases the system is build for CBG (compressed biogas) and a 200 bar pressure.

The buses are normally refuelled during the night at special dispensers connected to tank stores and compressors. The process is done and monitored automatically. According to The Swedish Road Administration and The Swedish

Table. Estimated Pilot Project budget. (In Euro).

PROJECT COSTS	4 ferries, bunker stn	6 ferries, bunker stn
Finance costs (interest 7%, period of amort 15 year)	1,2 Million*	1,8 Million*
Personal (3-shift), fuel etc	2,2 Million	3,3 Million
Sum	**3,4 Million**	**5,1 Million**

REVENUES (estimated)	4 ferries	6 ferries
Tickets (work travels)	1,4 Million	2,1 Million
Advertising, EU-subsidy	pending	pending
Sum	**1,4 Million**	**2,1 Million**

INVEST. COSTS*	4 ferries	6 ferries
Ferries	10 Million	15 Million
Bunker station	1,0 Million	1,0 Million
Sum	**11 Million**	**16 Million**
Investment	**11 Million**	**16 Million**

PROJECT DEFICIT	4 ferries	6 ferries
Private sector City of Lidingö City of Stockholm Nacka municipality County Council	2,0 Million	3,0 Million
Sum	**2,0 Million**	**3,0 Million**

Rescue Services Agency no serious accidents has been reported connected to the use of biogas or natural gas in vehicles.

To mention an example of the function of the safety system there was a fire in a bus garage in Holland 1990. The 35 buses including two fully filled gas driven ones was totally destroyed. No explosion occurred despite the intensive heat. The fuel tank safety system worked as it should. The gas was released under controlled forms during the fire.

The conclusion is that natural gas and biogas used as fuel in vessels and vehicles is as safe as any conventional fuel when the gas systems is built according to regulations and standards. This is also established by the Swedish Maritime Administration.

TRAFFIC

Within the traffic area there will be about 60 000 habitant year 2010 and approximately 40 000 year 2004 compared to 28 000 today. In the same way there will be about 55 000 workplaces year 2010 and 40 000 next year. Today there is approximately 27-28 000 workplaces. That means almost a doubling of both habitant and workplaces in less than a decade.

The traffic starts at 06:00 ending at 23:00 seven days a week. The objective is a 20-minute traffic during rush hour and slightly less during low traffic. A traffic analyse is available for priorities within given resources.

Business analysis in short terms and long terms with full implementation

By the year 2010 the four commuter lines will have an average of 9 000 travellers per 24 hour. The overall system will consist of up to 10 to 12 ferries and 13 to 15 terminals. It will take some time before this average is reached. The long-term objective is to get the system in economical balance. While waiting the stakeholders will have to cover for some years of deficit. However, through a step-by-step extension the risk of large deficits is reduced.

Pilot project

To avoid large investments and to make it possible to evaluate the ferry system, a three-year pilot project is planned. It will consist of four to six ferries and six to eight terminals. A pilot project with six ferries would be preferable while it would give a more sturdy and better service to the public – experiencing a real alternative. Since one of the goals is to push technology and environment adaptation of sea transportation forward, an evaluation of technology, safety, traffic and national economy will be made. The results will determine if to close or to go forward with the ferry system.

The 3,2 Million Euro investments in eight terminals are not included in the budget. The different organisations will contribute with their own terminal.

The SEA BUS

Length over all. Total max. length of ship (LOA) = 27,1 m
Length between perpendiculars. (Length PP) = 26,0 m
Moulded depth. Naval architect term. Distance from keel (base line) to main deck (DMLD) = 3,0 m

Design draft. Distance from keel to waterline in design condition (TDES) = 1,5 m

Greatest breadth of hull at water line level (BWL) = 6 m

Moulded breadth. Greatest breadth of hull measured on framing. (BMLD) = 7,5 m

Moulded displacement. Displacement of underwater hull measured on framing. About equivalent to weight of ship (DispMLD) = 80 tons

Fuel = Compressed biogas, methane (CBG)

Main engine = 2 x Gas-electric generators, 3 x 400 V, 50 Hz

Power delivered to propellers. Shaft power = 2 x 200 kW

Propulsion = 2 x Azimuth thrusters

Bow thrusters = 1 x 85 kW

Auxiliary gen. = 1 x Diesel generator, 3 x 400 V, 50 Hz

Power = About 1 x 50 kW

Capacity = 250 passengers

Seated = 106 passengers

Standing = 144 passengers