



BioGas2020

Best Practice Collection

Overview of Scandinavian Experiences with Transition Towards
Biogas Use in Transportation

Interreg

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Executive summary

Biogas has been identified as a viable alternative to fossil fuels in heavy transport, offering significant environmental gains throughout the whole life-cycle. The aim of this report is to present the experiences on the use of biogas-driven vehicles gathered from 30 actors based in Denmark, Norway and Sweden. The actors span a wide range of both public and private entities, representing sectors such as public transport, waste collection or freight transport. These experiences have been gathered through a series of in-depth, structured interviews with companies' representatives. Apart from the detailed description of each of the cases, the report includes an overview of the current situation in each of the three countries. The findings paint a highly complex picture, one where various factors need to be considered, from tax system to filling infrastructure availability, with both obstacles and opportunities. Despite existing challenges, biogas proves to be a viable option for heavy transport, although its final success hinges on a legal framework that provides incentives and predictability to actors along the whole value chain. The report finds that only through a clear vision and commitment from the authorities and policy makers, can biogas become an important part of the energy mix in transportation. Therefore, it is recommended that actors in the biogas market, from biogas producers through gas distribution companies to public authorities and end users cooperate in order to influence the lawmakers, so that conditions are set in place for the industry to thrive.

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Introduction

The European Union carries a responsibility for the environment and the climate and therefore wants to be a frontrunner in the securing of a sustainable society and most importantly security of supply. This means to switch the energy and transport sector to renewable sources produced locally, both to be independent on fossil fuels, as they are limited and will run out, and also to be independent on supply from other countries, such as oil from the Middle East or gas from Russia. The European Union has acknowledged the fact that a transition to more sustainable fuels is vital, but also that it comes with certain challenges. The European Parliament and the Council has set up a framework through the *Directive on the deployment of alternative fuels infrastructure* for this development, demanding the nations to assist in a transnational network, to build new infrastructure for electrical driven vehicles, gas driven vehicles and, where appropriate, hydrogen driven vehicles (European Parliament; Council of the European Union, 2014). This directive requires the nations to ensure support to the commercial development of alternative fuels through policy frameworks. Gas driven vehicles is a common technology, with more than a million vehicles just in Europe. The problem is that almost all vehicles drive on natural gas – a fossil fuel. The task for the future is to, first of all, promote more gas driven vehicles and to shift the use of natural gas into biogas instead.

Biogas is considered a renewable and sustainable fuel, as it is produced from residues from agriculture, wastewater treatment, household waste, animal manure and things alike. Practically biogas is mainly consisting of methane gas, CH₄, and carbon dioxide, CO₂. When it is upgraded, it gets close to 100 % methane – just like natural gas. Upgrading basically means to clean it from CO₂ and other residue trace gases. When the biogas is upgraded, it is possible to mix it with natural gas, which is often done in distribution grids underground. The methane part of the biogas is the part with the energy content. Methane is a good energy source due to a high-energy density, when it is either compressed or liquefied. This results in a competitive fuel based on sustainable sources. As biogas is a limited fuel – meaning there is not unlimited resources to produce it – it is important to utilize it, where it is best fitted into the energy system. Both the European Union and Biogas2020 sees it most optimal utilized in the heavy transport sector, as there are not many alternatives in this sector. To promote this utilization a tool is to get experiences from stakeholders with profiles allowing other stakeholders to identify them with.

As this Work Package regards the utilization of biogas in the heavy transport sector in Denmark, Sweden and Norway, this study looks at stakeholders who have already switched to utilizing biogas and their experiences with this fuel in this region. In terms of methodology, for the most part the

report is based on interviews and survey with the respective actors, however in some cases where it was impossible to carry out such interviews (Copenhagen Municipality and Posten Norge), the report is based on publicly available information, such as press releases, sustainability reports or information on the respective entities' websites.

European policies on the utilization of biogas in the transport sector

The European Commission has stated in the White Paper: *Roadmap to a single European Transport Area – Towards a competitive and resource efficient transport system*, a main target of reducing the greenhouse gas emissions by 80-95 % in 2050 compared to the 1990 level (European Commission, 2011). In the same document, the target for the transport sector is to reduce the greenhouse gas emissions by 60 % in 2050 compared to the level in 1990.

To reach the 2050 goal, there are made several sub-goals. The European Council has in 2014 approved a binding 2030-target of reducing greenhouse gas emissions by 43 % in 2030 compared to the 2005 level. This comes with a goal of 30 % reduction from the non-ETS sector in the same period (European Parliament; Council of the European Union, 2014). Furthermore, the European Commission has a binding target of a 27 % share of renewable sources in the energy consumption in 2030 (Ibid.)

Regarding the transport sector, the European Union has stated in the White Paper a target of reducing greenhouse gas emissions by 20 % in 2030 compared to the level in 2008 (European Commission, 2011). Even though the technologies are getting cleaner, there are also a growth in transport, which results in that the abovementioned number in 2030 still will be 8 % above the 1990 level (Ibid.). Thus, there is still a significant amount left striving for in order to reach the 2050 target.

The European Commission, through the adoption of Directive 2009/28/EC on the promotion of the use of energy from renewable sources, has approved a binding target of 10 % admixture of biofuels in the conventional fuels (European Parliament; Council of the European Union, 2009). This means that the final energy consumption in the transport sector in 2020, must encompass either an implementation of LPG, biomethane (CBG/LBG), electricity, biofuels or hydrogen (Ibid.). An important requirement is that the energy consumption cannot rely on only one alternative, but needs to be a holistic mix of all the alternatives. They have different abilities and the right planning is necessary for an optimal implementation and utilization of each source.

In a 2013 alternative fuels strategy, the European Commission has published a table indicating the applicability of different alternative fuels in different sectors (European Commission, 2013). As seen in Table 1 Coverage of transport modes and travel range by the main alternative fuels the heavy transport sector should gravitate towards Liquefied Petrol Gas (LPG), natural gas (later biogas) and biofuels (including bioethanol, biomethanol and higher bioalcohols, biodiesel (fatty-acid methyl ester, FAME), pure vegetable oils, hydrotreated vegetable oils, dimethyl ether (DME), and organic

compounds), as the European Commission sees them as the only alternatives competitive on the long-distance transportation.

Fuel	Mode Range	Road-passenger			Road-freight			Air	Rail	Water		
		short	medium	long	short	medium	long			inland	short-sea	maritime
LPG												
Natural Gas	LNG											
	CNG											
Electricity												
Biofuels (liquid)												
Hydrogen												

Table 1 Coverage of transport modes and travel range by the main alternative fuels (European Commission, 2013)

Denmark

Utilizing biogas in the transport sector is a well-known and well-developed technology in general. It is widely utilized in several European countries (e.g. Sweden, Germany and Italy). In Denmark, it is still a niche technology, but it is recognized that it should be easily adapted in the Danish distribution system due to the national natural gas grid. The Danish gas grid spreads widely throughout the country, which is a vast opportunity for the upgraded biogas, as it can be mixed with the natural gas and distributed through this grid. This also means the utilization of biogas can be implemented on a short term and at a relatively low cost, as the most significant infrastructural investment – the grid – is already in place. As natural gas and biogas mix in the grid, to ensure that the end-user is supporting biogas production a system of biogas certificates has been established. Energinet, the Danish gas grid owner, registers and issues certificates to those biogas producers that inject biomethane into the gas grid, where each certificate is a guarantee that 1 MWh biomethane has been injected into the grid and was not sold elsewhere (Energinet, n.d.). This means that it is possible to buy a desired amount of biogas injected into the grid. Therefore, it is not necessarily biogas the vehicles are driven by – more certainly natural gas – but the certificate ensures that there will be injected a certain amount of biogas into the grid. This is a tool in this starting period of the transition. However, the gas in the grid is meant to be 100 % biogas in the future.

Several manufactures construct gas-driven vehicles around the world, however, there are no Danish manufactures, which makes the Danish gas vehicle market depending on foreign companies. As of July 2017 (Fenger Flindt, 2017), there were 461 gas driven vehicles (including 115 trucks, 123 buses, 223 vans and private cars) registered in Denmark, which is a very small part of the entire Danish fleet – around 0.01%. This result is clearly below the potential and expectations, since the Denmark plans to be independent on fossil fuels in 2050. Furthermore, following EU legislation, Denmark has a goal of adding 10 % sustainable sources in the energy consumption of the transport sector by 2020. This means either mixing the conventional fuels with biofuels or introducing sustainable alternatives as hydrogen or electric cars – if the electricity comes from a sustainable production. Buying the biogas certificates can also assist to the 10 % admixture goal.

Through the Energy Agreement of 2012, the Danish government has decided to make a fund of DKK 70 million to advance vehicles running on electricity (DKK 40 million), gas in the heavy transport (DKK 20 million) and hydrogen (DKK 10 million). One of the projects financed through this fund was a project called “Application of gas-powered trucks with point of departure in Høje-Taastrup Transport Center”, which received DKK 3,140,000 to establish a biogas filling station as well as to support

potential buyers of biogas vehicles. In an analysis from The Danish Transport Authority, it is identified that a heavy gas vehicle averagely costs DKK 300,000 more than a diesel-driven vehicle (Danish Transport Authority, 2013). The Government has therefore made a funding opportunity subsidising for 40 % of the additional cost – which in this case would be up to DKK 120,000 (Danish Energy Agency, 2013). The fund run from 2013-2017 and is funded through the mentioned DKK 20 million given to the advancement of biogas in the heavy transport sector.

There are though limitations to a further utilization of biogas in the transports sector in Denmark. Here the most significant limitation identified is the taxation system. A taxation system is a tool to regulate and control the utilization of different resources. To lower the greenhouse gas emissions, the Danish Government has put a tax on all sources emitting greenhouse gases, which means that the more emissions there are associated to a given fuel type, the higher the tax. Regarding the transportation sector there are numerous taxations. The taxes limiting a further utilization of biogas in the heavy transport sector are the following:

Regulation	Applicability	Tax amount	Who pays
Act on registration tax	Registration tax on vehicles	Depending on the size of the vehicles	The owner of the vehicle
Act on road usage tax	Road tax for vehicles above 12 tons	Depending on the size and emission class	The owner of the vehicle
Act on gas tax	Tax on biogas utilized in engines with a lower heating value of 39.6 MJ	DKK 301.80 øre/Nm ³ (2017)	End-user
Act on carbon dioxide tax of certain energy products	Tax on CO ₂ -emissions	DKK 38.9 øre/Nm ³ (2017)	End-user
Act on methane gas tax	Taxation on methane emissions	DKK 6.7 øre/Nm ³ (2016)	Production plant
Act on nitrogen oxides tax	Taxation on nitrogen oxides emitted (NO _x particles)	DKK 2.8 øre/Nm ³ (2016)	End-user

Table 2 Danish taxation system affecting biogas utilisation

These taxes are reducing the business case for biogas vastly. As seen in the table, it is particularly the tax from the *Act on gas tax* – or the energy tax, as it is called – that is significantly reducing the business case with ca. DKK 3/Nm³ on top of the gas price.

AFLD I/S



Overview

Type of company:	Waste disposal
Transport commodity:	Waste
Size of company:	36 employees
Fleet characteristics:	AFLD owns seven vehicles, whereof two vans and one truck runs on biogas.
Location (geographically):	AFLD operates in Ringkøbing-Skjern and Varde municipalities.

Company description

AFLD is a renovation company based in Tarm that handles a broad range of waste management assignments for the six municipalities; Ringkøbing-Skjern; Varde; Billund; Hedensted; Herning; and Ikast-Brande municipalities. Being owned by a range of very climate ambitious municipalities, AFLD wishes to participate in the fight against climate change.

As a result of this wish, AFLD did in 2014 invest in a Scania P 340 biogas truck. This truck collects trash, waste and recycled material from the approximately 110.000 citizens and 4.000 companies. Besides just running on biogas, the overreaching idea is for the truck to be part of an environmental friendly circle. Therefore, some of the collected waste is transported to the local biogas plant, where it is treated and later used as fuel for the truck.

Besides the Scania P 340, AFLD has also subcontracted several renovation vehicles running on biogas and has an ambition to gain their own experience with biogas as an alternative fuel for their heavy transport.

Decision about acquisition

When deciding upon the acquisition of a biogas driven truck, one of the motivating factors behind this decision was the idea of reusing landfill gas. Having entered the business of collecting organic matter, AFLD has a wish to support the idea of also being a user of the gas and thus being part of a circular value chain.

Besides purchasing their own biogas driven truck, AFLD also made biogas a viable option in their latest tender on waste collection. AFLD thus requested offers on both diesel and gas trucks and as a result, the tender was granted to a subcontractor who purchased four biogas trucks.

Furthermore, the acquisition was also spurred by Ringkøbing-Skjern municipality's desire to achieve their goal of being 100 % self-sufficient by 2020. Therefore, the acquisition of biogas trucks was supportive of the municipality's overarching policy.

There have been granted no financial support, neither for the purchase of AFLD's own biogas truck or for the four trucks that was purchased by the subcontractor.

Available information

When purchasing the biogas truck and when writing the tender, AFLD found it to be a very complex process. At the time of the purchase, there were no gas trucks with a fixed crane running in Denmark. Therefore, AFLD had to do extensive research in order to be able to achieve adequate knowledge before purchasing their truck and writing the gas vehicle tender.

Seeing how AFLD simultaneously wished to live up to the latest Euro 6 requirements, there was only one manufacturer that was able to comply with their demands. This limited competition, of course weakened AFLD's position in negotiation, but with an extra cost of approximately DKK 150,000, it was, however, not more expensive than expected.

Vehicle utilization

When driving the biogas vehicle, AFLD has experienced no technical difficulties. However, when planning the routes of the vehicle, it is important to keep in mind that the driving range is shorter than it is for diesel vehicles. Seeing how the infrastructure for biogas in western Jutland is very limited, AFLD has been forced to take this into account and it is therefore only the vehicles that pass daily by the tank station in Tarm that could be required to run on biogas in the tender specification.

Despite not having experienced any technical difficulties, Martin Poulsen from AFLD, would for future reference recommend changing the gearbox in biogas driven waste collection vehicles. As in diesels trucks, their biogas truck has a hydraulic gearbox. This is very useful for a diesel truck that has a heavy torque. However, since a gas truck has a more even torque, the gear box could advantageously be switched into an electromagnetic gearbox, as this would save up to 15% of the fuel.

Promotion and CSR strategy

On an annual basis, AFLD sets four environmental goals for the company. Working within the recycling business, these goals can be much differentiated, but common for them all is that these are set to help the company improve their business in an environmental friendly manner. Four years ago, one of these goals were to environmentally improve AFLD's transportation, wherefore an investment was made in a biogas truck.

AFLD has not used the purchase to promote the company. There has been a lot of publicity about it, but as a municipally owned, non-commercial company, AFLD has not had a great economic incentive to promote the investment.

Political obstacles

When deciding upon the acquisition of biogas vehicles, AFLD had hoped for a development of the Danish taxation system. As the situation is now, biogas trucks are taxed equally to traditional diesel trucks, meaning that there is an emission tax on the gas, despite it being emission free. According to AFLD Operations Manager Martin Poulsen this is a sign that the government is acting directly against their own interests, as it several times has been signalled that the heavy transport sector should run on gas. However, instead of supporting this transition aim, the politicians have kept punishing the companies willing to do the transition, which according to Poulsen is very counterproductive.

Simultaneously Poulsen sees an infrastructural issue. As long as there are not more vehicles than there are now, the infrastructure for biogas will not be developed – and as long as there is an insufficient infrastructure, no more transport companies will invest in biogas vehicles. He thus sees this infrastructural issue as a hindrance, which is only reinforced by the current legislation that makes it impossible for biogas driven transport to compete with diesel driven transport.

Future plans

As for future plans to invest further in biogas, AFLD has no plans to do so. In order for further investments to be made, AFLD will need an economic incentive, so that their daily operations of biogas trucks e.g. are at the same cost as the operation of diesel trucks. If this was the case, AFLD would most definitely invest in more biogas trucks, but under the current conditions this will not be the case.

Results

As a general result, AFLD has had much positive feedback on the fact that their biogas vehicles are less noisy than traditional biogas vehicles. Moreover, the company is very satisfied with the environmental benefits of using biogas and they are therefore also aggravated that the politicians are not interested in making it economically beneficial as this, according to them, would generate massive environmental savings.

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Overview

Type of company:	Traffic company
Transport commodity:	Public traffic
Size of company:	Approximately 4,000 employees in Denmark
Fleet characteristics:	Approximately 1,400 busses, whereof 68 run on biogas (including 41 in Copenhagen)
Location (geographically):	The biogas busses run in Gladsaxe, Aalborg, Frederikshavn, Skive and Holstebro

Company description:

Arriva is an international traffic company that has been a part of the Danish bus traffic since its purchase of Unibus in 1997. Ever since, Arriva has purchased several smaller bus companies and is today the biggest bus operator in Denmark. Additionally, Arriva is leading on the market, when it comes to operation of gas busses and runs gas busses in both Gladsaxe, Holstebro, Skive, Aalborg and Frederikshavn.

As its latest move towards a greener fleet, Arriva has recently instated six new gas busses in Aalborg. These busses are to serve the city traffic and are instated on the basis of the municipality's climate strategy. These six new busses give Arriva a total biogas-driven bus fleet of 27 busses.

Decision about acquisition

Originally, they started with three busses in Gladsaxe, which were the first gas-driven busses in Denmark. These busses were part of a demonstration project, Go' Bus, in 2014 of natural gas driven busses supported by the Danish Traffic Agency. At the time, they did not imagine utilizing biogas in the busses instead of natural gas. It was a technology to far away from a practical implementation at the time.

They entered this project as a combination of three things. First, because they wanted to be front-runners when it comes to a green profile and sustainability. Secondly, the government had some finances for green investments that almost exempted them economical wise. These finances were allocated to electrical driven vehicles and gas driven vehicles. As a lot of others looked into utilizing electricity, Arriva saw gas as a better solution for their services. Electrical systems did not have enough range and at the same time the gas engine were a well-known technology for them. The third reason

was their ambitious, entrepreneurial managing director they had at the time. He wanted to promote Arriva as green and had an idea of driving on biogas with the slogan: “Copenhagen drive on its own trash”. In this regard, Arriva researched in how much biomass there were available in Copenhagen and it was a lot – enough for all Arrivas 800-900 busses.

They have good experiences with driving on biogas and do actively try to put some pressure on the municipalities where they service, to include biogas in their tenders. Arriva is a private company, so they have to win tenders to extend their bus services. Like the busses from Aalborg to Frederikshavn, which were a tender they won, where biogas was a part of the required fuel in the tender.

Arriva only received financial support to the busses they have in Gladsaxe.

Available information

It has been easy to get information. They contacted the different vehicle manufactures and asked what they could offer them. At that time, there were only three companies delivering gas busses on the Danish market, where they ended up buying from MAN. The MAN bus was a bit longer, had a larger tank capacity and the right design, which gave a good flexibility. After getting some experiences driving them, Arriva is glad for their choice. The routes are quite long and their experiences has shown that the larger tank capacity is necessary to service the routes.

The price on the busses depends on which vehicle manufacture and which bus model you invest in, but in general the price is 5 – 8 % more expensive than diesel busses.

Vehicle utilization

There have been surprisingly few problems with the busses. Of course, there will always be some problems, but they have had almost no problems – even fewer than for diesel busses. The engine is simpler and therefore easier to maintain.

They have not done anything to train the chauffeurs, as the driving is the same as driving diesel busses. However, even though it is contradicting the report from Teknologisk Institut, both chauffeurs and passengers experience the busses as being less noisy. Arriva do not know why, as the noise reduction apparently cannot be measured, but the general expression is like this anyway.

All the places Arriva services, the infrastructure is established, with filling stations installed at all the bus-parking areas. This is good for Arriva now, but if they lose a tender, it will be expensive for the winning company, as the filling stations are at Arrivas ground and the winning company thus have to build new infrastructure. This will in the other end affect the customers ticket prices and make their trip more expensive if their public transport runs on gas. In Holstebro and Skive, the municipality has financed the filling stations and made the gas available.

Promotion and CSR strategy

Arriva themselves have not done much to actively promote that their busses are biogas driven. The promotion has been through the municipalities, who have done a lot to draw attention to the incentive. The municipalities want to tell the good, green story and make a signal to the public that they are doing something for the environment.

Political obstacles

The price has developed against hope and expectations, as diesel has dropped in price. If the gas price would stagnate and the diesel price grow, it would have been attractive for the gas business and there would have been a lot of gas driven busses running now.

If the taxation system would be changed and exemption were granted for biogas, that would be enough to accelerate investments in biogas busses. The ministers in Denmark have expressed that this incentive is not discussed at Christiansborg – on the contrary, Magnus Heunicke (the former Danish Transport Minister) has an expectation of the market will drive the transition itself.

Arriva has a clear impression that the easiest and most efficient way to save greenhouse gas emissions and become sustainable, is to change the fuel in the transport sector to biogas. When you see it in a larger, societal picture, the green municipal accountings will save millions of tons of greenhouse gases in a cheap efficient way if utilizing biogas. With the necessary infrastructure, the urban public and service transport will easily be converted to biogas utilization and it will only cost a few more filling stations. It is just for the politicians to decide.

Future plans

As a private company, Arriva are bidding on public tenders. If the tender does not include sustainable propellants Arriva, will in the early stages of the tender, ask, if it is allowed to make a bid containing sustainable fuels and try to influence the tender to have some sustainable measures incorporated. Sometimes this opens the opportunity, but it is still important not to ruin the chances of winning the tender. This means that the sustainable incentive needs to be a validating factor in the tender as well, before they will bid.

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Overview:

Type of company:	Municipality
Transport commodity:	Varied (waste, passenger traffic)
Size of company:	41,211 employees
Fleet characteristics:	75 garbage trucks and 41 buses running on biogas
Location (geographically):	The City of Copenhagen and surrounding municipalities

Company description:

Copenhagen has the ambition to become the first climate neutral capital city in the world, and switching to biogas use in heavy transport is one of the steps in achieving this goal (The City of Copenhagen, 2012). The City of Copenhagen took on the responsibility to lead the way, which is why already in the autumn of 2013 it decided to purchase the first four gas-powered garbage trucks (Gas2move, 2017). At first it was only an experiment but it quickly turned into a success. Therefore, the municipality gradually began to set minimum requirements in its waste collection tenders for the number of biogas trucks in the individual districts. This translated into a gradual increase and already in 2016 there were 75 biogas-powered garbage trucks driven in Copenhagen (Gas2move, 2017). These rapid developments meant that target of 60 percent of garbage trucks running on alternative fuels in 2018 has been achieved two years ahead of schedule.

Apart from garbage trucks running on biogas, the City of Copenhagen decided to invest in biogas-fuelled buses to serve the most popular bus line in the whole of Denmark. The bus fleet is operated by Arriva, a subcontractor of Movia, the public transport company, and starting from April 2017 there are 41 buses running on biogas. They have been deployed to one of the most popular bus lines in the whole of Copenhagen, namely line 5C (Køkkenværnen, 2017).

An indispensable component of the transition to biogas in heavy transport was the establishment of the first biogas filling station by E.ON and OK. This was part of the pilot project which was run in cooperation with the City of Copenhagen (Det Økologiske Råd, 2015).

Decision about acquisition:

The initial decision to purchase the biogas-driven vehicles was part of a demonstration project, which was supposed to answer questions about the viability of these vehicles for everyday waste collection. The subsequent decision to include biogas-fuelled trucks as a requirement in the tenders was based on the successful outcome of the pilot and on the heavy investment made in the biogas filling station. The decision came from the understanding that as of now, biogas is the most environment-friendly fuel available for heavy transport and that readiness level of electric trucks is not yet sufficient (Det Økologiske Råd, 2015). Therefore, biogas will continue in the coming years to be an important part of the environmental goals set out by the City of Copenhagen. This is particularly so, as HOFOR, Greater Copenhagen Utility company, produces biogas from food waste since 2013, and there are plans to further expand this capacity (The City of Copenhagen, 2016).

Vehicle utilization:

After the first trials, the garbage men found it relatively easy to switch to the biogas-driven trucks and no technical problems have been identified (Det Økologiske Råd, 2015). The benefits of less noise and lower emissions are associated with the transition to biogas. The obvious challenge is the expansion of the filling stations network, which is currently slow. However, with the increased proportion of biogas-powered vehicles, the incentive to increase the number of biogas filling stations is growing. Additionally, it has been reported that the vehicles are somewhat quieter, which allows the garbage men to talk to each other more often when emptying the trash (Grontmij, 2014).

On the downside, in the beginning it was difficult to assess how much biogas is left in the tank, even though there are indicators on the dashboard that display the amount left, and so it was difficult to assess how far one could drive with the indicated amounts. Another potential disadvantage is that the tank needs to be refuelled more often and it takes longer to fill it, which combined can amount to up to 1.5 hours additionally spent just filling the tank compared to diesel trucks (Grontmij, 2014).

In case of the new buses, one of the bus drivers has reported that the buses are so quiet that they are unsure whether the engine is still on (Engelschmidt, 2017). He has also pointed out that they are easy to steer, even though they are five meters longer than the previous buses on this route.

Although not related directly to biogas as a fuel, some of the garbage men reported increased physical strain, as the cabin was placed higher than in the trucks they have been accustomed to (Grontmij, 2014). Similarly, at the very beginning the passengers of the 5C line have experienced increased travel times and unreliable service (Sørensen, 2017). This resulted mostly from deploying longer buses with more doors and different boarding characteristics of the new buses. While not directly related to biogas, both cases indicate a risk of affecting people's perceptions regarding biogas use as something that requires additional effort to make it work.

Organisational relations:

The transition to biogas-driven trucks required little additional training for the drivers, as the main differences were in the tank filling process, and in the way drivers get in and out of the cabin as some of them were used to a different of the truck cabin (Grontmij, 2014).

Promotion and CSR strategy:

The City of Copenhagen places great emphasis on its environmental friendly initiatives as they are part of the strategy to become the first CO₂ neutral capital city in the world in 2025. Therefore, promotion of such undertaking plays a major role in informing all relevant stakeholders about the progress in achieving this goal. This is why the launch of the new biogas-fuelled 5C bus line was celebrated with great pomp. In a similar vein, the intake of new biogas-driven garbage trucks has been widely reported in the media, so as to create awareness of the green mobility transition.

Political obstacles:

The City of Copenhagen has encountered some political obstacles as it tried to cooperate with surrounding municipalities with respect to establishing a new biogas production plant (Kabell, 2017). For this reason, even though the City is already introducing a better waste collection system, the collected organic waste will have to be transported for over 100 km to be used in biogas production (ibid.).

Future plans:

As mentioned earlier, the City of Copenhagen invests heavily in biogas for transport use, making its waste collection and increasingly more buses rely on biogas (The City of Copenhagen, 2012). This is in line with the strategic goals of becoming a CO₂ neutral city by 2025, and therefore it is expected that achieving this goal will require further expansion of biogas-fuelled fleet and biogas infrastructure, including both production facilities and filling stations to make biogas more widely available.



Overview

Type of company:	Recycling bottles
Transport commodity:	Recycle bottles from stores to reuse facilities
Size of company:	450-500 employees in Denmark
Fleet characteristics:	54 trucks, hereof one that runs on biogas (7 tons)
Location (geographically):	The biogas truck runs in and around the greater Copenhagen area

Company description:

Dansk Retursystem is the leading Danish company for the collection and recycling of empty bottles and cans. The company has more than 50 trucks operating all over the country.

Seeing how the core job of Dansk Retursystem is to reduce pollution by collecting and reusing used packaging, the company in March 2016, decided also to take steps towards environmentally improve the company's transport. Dansk Retursystem has therefore purchased their first biogas truck, which will be collecting bottles and cans from shops, cafés and offices in the Copenhagen area. The purchase of the biogas truck is envisioned to enlighten Dansk Retursystem on how to create a greener profile for the company and provide them with valuable knowledge of how to best move forward in the green transition.

Decision about acquisition

Dansk Retursystems decision to invest in biogas driven trucks where based on future demands both from EU, the Danish State and the Municipalities. Strategies tells that within 5-7 years CO₂ emissions needs to be reduced in urban areas and a way to do this is by changing the fuel. Dansk Retursystem sees biogas as an easy solution, as it meets the future targets, it is already available on the market and the infrastructure for biogas utilization in the Copenhagen area – where Dansk Retursystems trucks' drive – is build. Economic matters have not influenced the decision, Dansk Retursystem sees this a test of a possible solution to meet the future demands.

Available information

According to Dansk Retursystem there is a lack in easy accessible information and experiences available. Currently the exchange of experiences goes through, when transport company managers meet. Laustsen explains that the subsidy from the Danish Energy Agency, which Frode Laursen

received, is well known in these circles, but it is not communicated further down. This makes it difficult for a sales manager to weigh the options available.

Furthermore, they have experienced that there is a limited amount of information concerning gas in general, e.g. information about which gases that can be utilized in vehicles and what greenhouse gas reductions the different fuels have and what limitations there are to them.

Vehicle utilization

So far, it has been an easy transition with no operating problems. This is especially due to the effective infrastructure there is in the Copenhagen area, where the truck serves currently. There are plenty of gas filling stations available and there have not been any problems filling with biogas instead of diesel.

Simultaneously there are no specific training or education in utilizing the biogas instead of diesel as it is approximately similar operating methods. There is a of bit work for the drivers who needs to familiarize themselves with the new truck, but that would be the same buying a new diesel truck.

Promotion and CSR strategy

The communication department has strived to promote the investment as much as possible and disseminated the message in various media – especially in the Copenhagen area. Dansk Retursystem changed their visual identity with new colours and a new logo. In this change the biogas truck were the first to be painted with these conditions, which branded the truck some more.

There is a prestige in being green and it is important not to underestimate the effect of a CSR strategy and CO₂ accounts. Especially when the company's business is environmentally related, it strengthens the green image to have trucks driven by sustainable sources. They feel a responsibility to be pioneers within this segment and are willing to be it.

Political obstacles

They have a clear opinion that the taxation system is old and is a barrier to the development of biogas in Denmark. Currently the tax on biogas is the same as on natural gas – a fossil fuel – which is contradicting with the political sustainable goals. Dansk Retursystem suggests skipping the tax in a start-up phase until 2020 and then review them afterwards. In their eyes, it is necessary to review the taxation on biogas due to the bad business case it gives to profitmaking companies. They see it essential that these kinds of companies help pushing the development and make a foundation to establish the necessary infrastructure. The infrastructure is a barrier in some parts of the country so to ensure a development in the whole country we need the profitmaking companies to demand the biogas in the whole country.

Future plans

There are considerations of buying a larger truck that are meant to drive in the whole country. This is the real test, they tell, as they through this will see if the infrastructure can handle this challenge. It is essential with a broad infrastructure to get more investors buying biogas driven trucks. It needs to be

as similar as possible to driving a diesel truck, with gas stations often available along the roads. This gives a good flow in the truck drivers' everyday life.

If they buy a new truck, they will search for funding, as it could give a business case necessary for this investment. At the same time, they plan to look into the utilization of a hybrid system regarding the use of biogas and electricity.

Results

They have good experiences with their investment and expect to invest in more biogas-driven vehicles in the future. In general, they also receive good feedback, especially from the environmental department in the Copenhagen municipality, who hope more will follow their good example. For future investments, they will put it as a demand in the tender to have some kind of sustainable fuel.

Contact

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Overview

Type of company:	Logistic company
Transport commodity:	Logistic services mainly for the grocery market and the construction sector
Size of company:	1,900 employees
Fleet characteristics:	800 vehicles – 1 on biogas
Location (geographically):	The biogas truck runs in and around the Copenhagen area

Company description

Frode Laursen is a Danish logistics company that provides services to the grocery market and the construction sector. As a logistics company, Frode Laursen acknowledges the significant influence that road transport has on the environment, especially through CO₂ emissions. The company therefore considers the promotion of a responsible behaviour to sustain the environment as an integrated part of their business philosophy.

As a part of its environmental strategy, Frode Laursen has therefore in 2016 purchased a gas driven truck from Iveco. The truck will run in the Copenhagen area and contribute to creating a greener and more sustainable profile for the company.

Decision about acquisition

Frode Laursen wanted to be first movers. This includes being the first on the market to get experiences with biogas. They have seen a demand from their customers, who want green solutions and this is a way to give it to them. It is a good way to promote yourself and to show what you stand for. They see good value in being the first to get real life experience driving on biogas – both for economic and environmental purposes.

Vehicle utilization

It is the same as driving a diesel truck, so there is not any technical limitations or barriers. The new thing is that they need to think about where the next filling station is. Therefore, it takes a bit more planning for the chauffeur on his daily routes, as the filling stations are not on every corner. It needs a bit creative thinking, but most of all adjustment. In the beginning, it can take some time to figure out what the best route is for the day. However, after a while it is just a daily routine and does not take a long time. It can have a psychological impact on the chauffeur due to the fear of running out of

gas, because it can be quite far between the stations. At the same time, it is important that new filling stations are built, which will also accelerate the investments in biogas trucks – because the lack of filling stations is a barrier.

Promotion and CSR strategy

It is a very important tool to have the press. This makes the company able to show their customers their green image and their will to be first movers. Frode Laursen does not want to be passive and be a follower, they want to show that they have invested and are ready for the transition. When people come and ask for prices and green accounts, then they already have experiences and can give a realistic answer based on real life driving.

Besides their customers' needs, Frode Laursen also have an environmental policy. This envisions reducing their CO₂ emissions and other harmful particles.

Political obstacles

They see a vast barrier in the price on biogas – this price also hinders the development of the necessary infrastructure, thus also the investments in the vehicles. It is important to have a broader view to the utilization of biogas and see it from a European perspective. In this respect, Denmark is far behind and a political change of attitude and favour towards the utilization of biogas is needed.

There are too few manufactures with know-how in gas-driven trucks. When there are only few suppliers, it affects the price and makes it difficult to compete with the diesel trucks. This is another price barrier. It is logical, when the vehicles are more expensive and the fuel is more expensive, it is not very attractive to choose instead of diesel. Hence, political support and commitment for biogas is necessary.

Future plans

Frode Laursen works on the basis of the customers' needs and desires. Of course, it is a puzzle where both customer demand, environmental benefits and economical profits needs to go to a higher level – but customer demand is a critical aspect of their company transition. However, at the moment their customers demand a sustainable propellant and here Frode Laursen sees biogas as the best solution for them. They do need to have a whole year of experiences with biogas, before they can draw any conclusions, but currently they have had good experiences.

Contact

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Overview:

Type of company:	Grocery chain
Transport commodity:	Groceries from storage to the stores
Size of company:	2,400 employees in Denmark
Fleet characteristics:	Lidl does not own any trucks, but has a permanent contract with 35 trucks, while some additional trucks are loosely connected. One of these trucks runs on biogas
Location (geographically):	The biogas truck runs in and around the Copenhagen area

Company description:

The Danish branch of the international supermarket chain Lidl owns more than 100 stores across Denmark. As a declared part of its CSR strategy, the supermarket chain works towards burdening society as little as possible, and improving the environment – e.g. by improving transport solutions and reducing fuel consumption.

As an integrated part of Lidl’s sustainable store in Valby, Lidl has together with Mercedes-Benz built Denmark’s first gas driven truck for distribution of staple goods. The truck is designed and constructed in such a way that it does not only run on gas, but simultaneously uses gas to cool the refrigerated trailer. At the same time, the boiler has been replaced by an electrically powered solution, thus replacing the heating of the engine and the cabin with an environmental friendly alternative. The purpose of this specialised construction has been to minimize the emissions from the transport as much as possible, and Lidl has thus successfully managed to make the goods distribution with the gas truck completely CO₂-neutral.

Decision about acquisition:

When deciding upon the acquisition of a biogas driven truck, one of the motivating factors behind this decision was Lidl’s focus on social responsibility. The supermarket chain has a motto named “on the way to a better tomorrow”, through which they are aiming at supporting a transition to a better world and taking their share of the responsibility. In achieving this, the environmental issues play a significant role and Lidl has therefore had a great focus on finding the best possible sustainable solutions, including the use of alternative fuels. Biogas has therefore been chosen based on a desire to achieve the companies overarching goals.

In order for Lidl Denmark’s first vehicle on alternative fuels to contribute to Lidl’s environmental goals, Lidl first approached a number of manufacturers to request whether they could completely cleanse a

truck from CO₂ emissions. Initially the response was negative, but then Lidl was put in contact with some other companies who had tried building such a vehicle and was interested in helping. The final solution ended up entailing a complete rebuild of a traditional truck, by e.g. installing a gas cooler, an electric boiler and making it longer, so that it can carry a bigger load and thus minimize the number of daily runs.

As Lidl has seen the development and utilization of this vehicle as a pilot project, the economical aspect of the design process has not been decisive. With this project, Lidl decided to set the bar high and aim for the greenest solution possible in order to tie it to Lidl's green convenience store in Valby. Costly elements, such as an electrical boiler, has been essential to the sustainability project and was thus installed regardless of no matter the price.

The company owning the truck has not received any form of financial support for the purchase.

Available information:

In the decision and acquisition phase, Lidl founds a clear lack of information on biogas trucks, while the information that was available was difficult to find. Lidl therefore has a wish that more stakeholders would start paying an interest in spreading the message, but this is a process, which they find to be slowed down, by the big producers continued interest in selling their vehicles running on fossil fuels.

Vehicle utilization:

When it comes to the operation of the vehicle, Lidl has experienced no problems. The engine has worked as wished for and there have not been any breakdowns of the cooler or the boiler either.

The experienced challenges have been with the infrastructure. Compared to diesel filling stations, there are significantly fewer gas filling stations, which means that the vehicle has to drive out of its route to fill up its tank, thus making this aspect more expensive.

Organisational relations:

With regards to the training of the chauffeurs, Lidl has left this largely to Mercedes and the haulier. The main difference between the biogas truck and traditional diesel trucks has, however, not been related to the biogas itself, but rather to the fact that the new truck has lowered doors, thus making it more gentle for the drivers to get in and out of. The training process was completed within a couple of days and caused no problems.

Promotion and CSR strategy:

At Lidl Denmark the purchase of a biogas truck is an integrated part of the company's CSR strategy. The truck has mainly been purchased to grant the company a greener profile and it is very hard to estimate whether it generates any direct revenues. It is, on the contrary, clear that the vehicle has been more expensive than a diesel truck, but as part of the CSR strategy this purchase has been an active decision, where extra expenses are accepted.

As for promotional purposes, Lidl has actively communicated their green purchase via various online sources. They have published press releases, written about it on the web page and had different infographics produced to communicate the message in an easily understandable way on e.g. Facebook. Moreover, Lidl has presented the truck both at the opening of the sustainable store in Valby and at the 2015 Transport Fair in Herning, where it was nominated for the Construction of the Year award.

Internally, Lidl has also communicate the message of the company turning in a greener direction to the chains approximately 2400 employees. In this manner, the employees have been equipped to function as ambassador for the company, while it has also created a common understanding of the direction the company desires to move in.

From their Facebook page, Lidl has received many positive feedbacks, like several environmental organisations have also been positive and praised Lidl for their initiative.

Political obstacles:

As for the political landscape, Lidl does not see the current legislation as hindering the further utilization of biogas in transport. However, Lidl is of the opinion that the Danish government's 2020 plans lack a green profile and that the politicians generally does not provide the driving force that is necessary for the market to evolve further.

Future plans:

As for the future, Lidl Denmark is very open to possibly investing in additional biogas vehicles. These would not necessarily have to run to the store in Valby, but could in theory run all over the country.

When looking into such possibilities, there are, however, a range of options, such as the size of the truck and the fuel choice (CNG/LNG) that Lidl wishes to explore to see whether they can optimise their vehicle. In doing so, Lidl Denmark would be able to benefit from the knowledge of the other international branches and thus hope to optimise the vehicle as much as possible. Moreover, Lidl will, for future purchases, also look into the possibility of constructing a less noisy truck. Many of the stores in the greater cities are classified as environmental stores, for which reason normally noise trucks cannot deliver groceries before 7 in the morning. For Lidl it is thus essential to look at the construction of the truck from a complete economical aspect and assess whether it might be worth investing more in the truck itself, in exchange of a truck that can drive longer, carry more goods and deliver goods to the stores around the clock.

Contact

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Overview

Type of company:	Waste disposal
Transport commodity:	Waste
Size of company:	600 employees
Fleet characteristics:	325 disposal trucks, whereof 15 runs on gas
Location (geographically):	Primarily Zealand, where the company is contracted by municipalities.

Company description

Since its establishment as a local haulier in 1947, M. Larsen has grown to be among the largest haulier companies in Denmark with a fleet of 325 vehicles and almost 600 employees. As in 1947, M. Larsen's core competency today is waste management, wherefore the majority of the fleet and the employees are involved in the management of collection schemes for both private and public clients.

M. Larsen has as part of its environmental policy stated that the company will aim at reducing their use of resources and include environmental considerations when deciding on bigger investments. As a consequence of this, M. Larsen did in 2014 purchase its first biogas vehicle, a Scania P 280 renovation vehicle that lives up to the Euro 6 standards.

Decision about acquisition

M. Larsen is a private company that bid on tenders. Their acquisitions of gas driven vehicles is due to a demand in the tenders where they have bid. In these tenders, it gives more points to make an offer including biogas (or in some cases just specified as gas), why it made sense to make the offer with biogas as fuel. This has resulted in that only some of their gas trucks run on biogas (certificates) and the rest on natural gas, as they just follow the tender specifications. As their investments are fully regarded to the tenders, this is the main reason they have invested in gas vehicles.

They did not have any knowledge of a subsidy possibility, so they have never received a subsidy for any of their vehicles.

Available information

It is easy to get relevant information from the tender providers.

Vehicle utilization

There are no significant problems with the vehicles. The challenge is the lack of infrastructure. This is a vast barrier, when the trucks need to be moved across the country. Here it is necessary to transfer them by a flatbed truck, as it is not guaranteed that they can refill during the whole distance. Additionally, there is a lot of extra driving to reach the few filling stations there are – they are not on the most optimal route of M. Larsens services. In general, they have experienced an increased consumption of 15 %. This reduces the environmental benefit significantly.

Promotion and CSR strategy

They do not have a CSR strategy or something alike. Their investments are only based on the expectations of the tenders they bid on and what gives them the best compatible chance for the tender. They do not think they save the world by doing this.

Political obstacles

Gas as a fuel is considerably more expensive, but the tender specifications apply to all the bidders, so there is a level playing field. M. Larsen sees it as a political will to go in this direction and then some municipalities have adopted this vision and are willing to pay some more to adhere to this. They see it as a barrier that so few manufactures develop gas trucks. It is a small market, where too much depend on too few suppliers.

Future plans

The company is driven by what specifications are in the tenders. The trucks get a reduced payload, as the gas tanks has a larger volume. This makes it difficult to construct the vehicles. However, this is only one point in a serial of limitations. M. Larsen would not have invested in gas vehicles, if the tenders had not required it.

Contact

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Overview

Type of company:	Waste disposal
Transport commodity:	Waste
Size of company:	78 employees
Fleet characteristics:	P. Fournaise owns 45 renovation vehicles, out of which six runs on biogas
Location (geographically):	Fredericia

Company description

P. Fournaise A/S is one of the oldest transport businesses in Denmark, employing more than 70 staff members and operating approximately 50 trucks. P. Fournaise A/S is a turnkey transport business delivering versatile services within transport and environment, wherefore the fleet entails trucks for crane tasks; renovation assignments; Container transport; boat transport; and other special transports.

At P. Fournaise the environment has always been a priority, both when it comes to collecting and handling waste and when it comes down to the vehicles. When Frederica Municipality in 2014 released a tender on gas-driven waste collection, P. Fournaise therefore put down an offer. As a consequence of winning the tender, P. Fournaise thus purchased five new Scania gas driven waste collection trucks.

Decision about acquisition

The investment in biogas driven vehicles were due to requirements in the Tender from Fredericia Municipality. They would like to make a sustainable footprint and have a green image. However, through their experiences with driving the vehicles it is clear that they are doing the opposite. The gas vehicles emit more than the Euro VI standard of diesel trucks, they have a shorter distance per litre, cost 250.000 DKK more and they cost 15 % more in maintenance. Additionally, they are not so practical due to the lack of infrastructure. It takes time and money to adjust their routes so they pass the few filling stations there are. P. Fournaise has a feeling that they are 5-10 years too early with the investment and the system is not ready yet for biogas vehicles.

Available information

They had the necessary information to make a bid for the tender, but at the time it was only Scania who had the trucks. This made it all on their premises and there was not any competitiveness.

Vehicle utilization

There are no significant problems with the fuel, but the gas engine requires a lot of maintenance and the lifetime of the machinery is short. They do think it is because it was the first vehicles on gas on the market. They have complained to Scania regarding a lower range per cubic metre gas than they promised. The Danish “Teknologisk Institut” has tested P. Fournaises vehicles up against a Euro VI diesel truck. Here they recommended from an environmental perspective that they should drive in the diesel truck. Of course, it is important to follow the innovation and new technologies, but it also needs to make sense and the gas vehicles do not make sense in their case.

As the first to have gas-vehicles in Denmark they knew there could come problems with the maintenance. Due to this, they made a full-service agreement with Scania, which turned out to be a good idea. The trucks are at Scania for reparations every weekend. Without the service agreement, the company would have closed. Trucks with another fuel they can repair themselves, but it is required to have special licenses to repair gas engines.

P. Fournaises vehicles drives on natural gas and not biogas, because there are no biogas filling stations in the area. Fredericia Municipality promised to build this, but this has not happened yet.

Promotion and CSR strategy

Investments like this is part of P. Fournaises strategy. They are willing to test something new and to pay some more to have environmental benefits. It is necessary for them to make long-term predictions and investments. Municipalities always change direction or there is made new laws and goals, so it is necessary to invest in the newest technology to ensure that its lifetime is obtained and fulfil environmental requirements.

They put a lot of effort in promotion through various media. Their work also resulted in a visit from the mayor, who is fond of their work. Additionally, they have received the “price for initiative” six years in a row for environmental benefiting work. This is not an easy task and they work hard to earn this.

Political obstacles

The political system is not composed for the utilization of biogas. There are no incentives to invest in biogas vehicles, as they are DKK 250,000 more expensive than diesel vehicles and the biogas is more expensive than diesel. If the price were around DKK 4,5 plus VAT per cubic metre, it would give a better business case. Everyone should drive on sustainable propellants, but when the political system makes sustainable solutions more expensive, there will never be an incentive.

Future plans

It is too difficult to compete with diesel bidders in tenders and 80 % of the tenders is only price related without any requirement for fuel. This means, it is the offer with the lowest price, that wins – and it is impossible to have the lowest price with biogas. They see it as pointless to bid on these tenders. The

politicians demand more sustainable propellants in the transport sector, but the price is higher and they do not do anything to change this – that does not make any sense.

Contact

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Overview

Type of company:	Municipality
Transport commodity:	Transporting passengers
Size of company:	250-300 employees
Fleet characteristics:	Samsø has one ferry running on gas
Location (geographically):	Servicing between the island and Hou in Jutland

Company description:

By producing more renewable energy, than consumed by fossil fuels, Samsøe Municipality has for a number of years enjoyed the status of a renewable energy island. Following this, the city council has decided that the island needs to take the next step and become 100% fossil-free. In order to become successful in this journey, the key measure to be taken is to shift all transport on, to and from the island to fossil-free operation. The goal is by 2030 to become a model society for the national 2050 target of a fossil free Denmark.

The single most important transport entity on Samsø is the ferry infrastructure, wherefore the green conversion of the ferries is the focal point in the transition. Having established its own ferry company in 2014, Samsø Municipality in 2015 bought a gas driven ferry to sail the route from Samsø to Hou in Jutland. The ferry is at the current moment operating on liquefied natural gas (LNG), but the plan is to build a biogas and liquefaction plant on the island, so that the ferry can sail on locally produced biogas in the future.

Decision about acquisition

Samsø Municipality and Samsø Energy Academy won a competition in 1997 established by the government at the time. The competition was about being a sustainable island and the winning price were money to accelerate the transition, which kick-started the process. In 2012, Samsø decided through an “open-space” meeting attended by citizens, NGO’s, companies and politicians to be a fossil free island in 2030. The ferries to the island are a necessity for people to live on the island. Thus, the ferries are a fundamental element in the fossil free vision and a starting point for the transition.

The municipality believed that they could run the ferry cheaper than a private company, why they bid on their own tender in 2014. This resulted in an investment in a ferry driven by natural gas. This is the first step of being fossil free, as the plan for the ferry is to run on biogas in 2018. Running on biogas, gives many benefits for the whole island, as a local production gives value for various parts in the life cycle of the fuel from field to ferry – as they call it. In other words, the vision is met with a holistic approach and does not only affect the transport sector but the whole society. The most important

part doing this is to engage the people on the island. There are 450 shareholders in the energy systems on Samsø today, which is important both for the image and for the further development.

Available information

There are many sources where through it is possible to get inspiration. Samsø are involved in a program called Energy Safari – a program participated by Ringkøbing-Skjern Municipality, Skive Municipality, Viborg Municipality and Samsø Municipality. This program is a good incentive to learn from each other, see new technologies and share knowledge.

Vessel utilization

There were few challenges with the ferry in the beginning, which were mainly connected to the captains' need to practice this new type of fuel – a gas engine reacts a bit different from a diesel engine. Furthermore, the ferry they received from the manufactures were 160 tons heavier than the ordered model. This gives, logically, a larger energy consumption for the ferry than expected.

Promotion and CSR strategy

The municipality does not do much actively to promote themselves. They are invited to many events as the front-runners and for having this green image, so people want to learn from their experiences and receive the good story of Samsø. Even CNN and other large television broadcasters ask for interviews and visits to the island. Hence, the promotion part of Samsø mainly comes from external stakeholders, who have a good impression of the work done on Samsø.

Political obstacles

They have not met any significant political obstacles. The ferry has a dual fuel engine, which means it runs on both diesel and natural gas. At the moment, it runs mostly on diesel, due to a lower price on diesel. This is not the point, as it should run on gas and only use the diesel as a backup fuel. Thus, it is necessary that the politicians support the utilization of e.g. biogas by reducing the price on the fuel.

Future plans

The plan is to get the ferry to run on biogas instead of natural gas. Therefore, the municipality will work on establishing a full system for biogas from field to ferry. The main challenges here is “how do they make it profitable” and “how do they organize it”. A question here is who should be the owner of the different elements in such system. The municipality needs to be a shareholder in the project somewhere in the life cycle, but legally it is uncertain if they are allowed to be that. The municipality as a shareholder will prolong the payback time of the project and ensure low interest rates, which can secure the profitability. Additionally, they hope to get a good price on the biogas plant, as many want to connect with the story of Samsø and utilize their green image. Several biogas actors have shown interests in participating in the project and be a part of the Samsø development. Samsø Municipality

hope they can benefit through this interest by getting cheaper prices on components. If this happens, Samsø are certain of a good business case for their transition.

Another part of the plans is to replace a diesel engine with a battery pack and then have a dual fuel combination of batteries and biogas. This is an optimal combination for the ferry to reduce the energy consumption and be sustainable at the same time. It is just an expensive solution – especially with the biogas price.

Results

The project will result in green energy, green fertilizer and new crops. Simultaneously it will create thirteen new jobs on Samsø, which is a vast challenge as an island municipality. It will end up giving a new story to tell, with a full circle island with full circle economy. In the centre of this circle is biogas. All the other side benefits sprout from the utilization of biogas, which is why biogas is the key to a fossil free future on Samsø.

Contact

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Overview

Type of company:	Municipality
Transport commodity:	Various
Size of company:	3,000 employees
Fleet characteristics:	Private cars, van, handicap busses, small truck that the municipality owns. Besides this, the city traffic and the local traffic has been publicly tendered and there are therefore now 4 city busses and 7 local routes that runs on biogas
Location (geographically):	Runs mainly within the municipality

Company description:

Sustainable development is a target in Skive Municipality's strategy, which is why the city Council set a goal for the city to be CO₂ neutral latest in 2029. Skive Municipality has been working with improving energy efficiency for more than 30 years and was consequently named the first Danish energy city in October 2008. The city has been involving citizens, businesses and organizations in creating a more sustainable society for the benefit of everyone in Skive Municipality.

Related to the bioenergy, biogas is considered as a potential energy sources. It is planned to be used by the Municipality by various purposes but especially in transport. The Municipality will be the motivator and leading in using biogas in transport with a plan of having 3-5 biogas filling stations installed. Until today two biogas filling stations were built in Skive Municipality, with one of them being the first 24-hour gas station in Denmark. The investment is encouraged from the private sector whereas the Municipality will participate in the partnership to ensure the process and taking decision as the political level.

Decision about acquisition

The politicians in Skive demanded that the city busses must run on gas. Therefore, they put this demand in the tender for the new city busses. The tender for the local busses running outside the city depends on whether they drive by the city to refill or not – if they are not driving in to the city, the gas demand is not put in the tender. This ended in having 7 of the 14 local busses outside the city running on gas – the buses which driving patterns made sense regarding the tanking facilities.

The tender focuses on both environment and price. The environmental minimum demand for diesel is also the EURO VI standard to ensure the highest environmental benefits as possible. As a municipality, the environmental part is where they can influence the tender, it is important to notice these solutions also are more expensive. The tender period is for eight plus four years. This can be a

barrier. For example, if there comes a EURO VII standard within 5 years, then the tender will be outdated.

For the busses, it was necessary to build a new filling station, as the other filling station only could pressure the gas with 4 bars – which is not enough for busses. Therefore, they build a new filling station for the busses just outside the city near a MR station so it was cheap to connect the pipeline to the gas. This is a clear recommendation to do, if it is possible for the city planning.

The municipality has a political vision and goal of being CO₂ neutral in 2029. The transport sector is responsible for 1/3 of the greenhouse gas emissions in the municipality, why it is necessary to focus on this element. Skive sees biogas as the best alternative available for them currently. Later on, it might be interesting to look into electricity or hydrogen, but for now biogas is the best technology at the market. There are also biogas plants in the municipality, which make good synergies to utilize the product in the local community. They also see benefits in being front-runners and be an inspiration to others, showing that it is economical feasible to drive on biogas.

They have not received any funding or subsidy for the vehicles. In 2014, the home care got 26 VW Up!'s driving on biogas, which they leased. This method gives good flexibility for the municipality but also for the car rental. Leasing will also be the method, they will use in the future.

Available information

Skive Municipality are actively participating on different conferences and follow the market development with new initiatives and incentives. It is important not only to learn from Danish experiences, but also to look into Swedish and Norwegian work, as they are more developed in this field and quite similar to a Danish environment.

Vehicle utilization

Driving the biogas vehicles is easy, it is the same as driving diesel driven vehicles – so there have not been any training of staff. They have experienced that some drivers have been a bit insecure in filling the vehicles, because they are afraid the gas can explode. For example, the piston needs to be locked when filling and not just put into the tank as in a diesel vehicle. This small difference in filling method could be a barrier to foster the uses of biogas vehicles.

The hindering thing is that the vehicles needs to be located in Skive, as it is there the filling stations are. Regarding the busses in Skive, Midt Trafik has made a filling plan. It takes 30 minutes to refill a bus, so they made a time schedule concerning when each bus can refill, so there never are queue at the piston. This has been a very good incentive, that the chauffeurs value. Additionally, Skive Municipality receive good feedback for the reduced noise and the better acceleration the gas vehicles have.

Promotion and CSR strategy

Skive Municipality made a new energy and climate strategy in 2012. The goal in this is to be CO₂ neutral in 2029. It was revised in 2016 and the progress is going well. There is still a vast challenge in the transport sector, in the private homes and in the industry. The Municipality has an idea that it is not going to change itself, so it takes a lot of work influencing people and companies to do sustainable choices. Hereto follow the latest technologies and tools to reduce CO₂ emissions and test them in a representative context.

The Municipality sees it as important to tell the good stories of sustainable transitions and tell about the projects they are involved in. Related to the gas filling stations mentioned above Related to the gas filling stations, drivers were taken out to the filling station and got a small training on how to fill the vehicle.

Videos and brochures are available to guide drivers through the fill process and to show them that it is safe to fill in the vehicles with biogas.

Political obstacles

Skive municipality has been involved in several projects with several political agencies. It is their experience that the political agencies are too narrow-sighted and do not think out of the box to find solutions for real life challenges. At the same time, the government is unambitious within the energy and climate sector. Too much is let up to the municipalities without any help from the government. There is no green funding anymore, which is demotivating to do new work and stops the current work within sustainable transition. The government does not put up clear goals or a clear strategy on what direction the municipalities should go. Additionally, the focus from the government is most on urban areas and larger cities, which does not include any incentives for a municipality as Skive – a municipality mostly consisting of rural areas.

Future plans

It is planned to do a new tender for renovation vehicles, where the municipality will require biogas as the fuel. They have a clear vision that all heavy transport must be biogas driven in the future. In this matter, some of the work is to connect the company with other renovation companies to get their good experiences and to get rid of the prejudice about gas vehicles.

In the future, Skive municipality will make a strategy for the full fleet in the municipality. In this regard, they will make fleet analyses of the public vehicles, to make the transition more effective. It is vastly hindering that there are reduced funding possibilities, as it makes the business case worse. Thus, it is demotivating for innovative incentives to break through and a large risk for anyone to invest in sustainable solutions.

Results

The tender is the municipality's tool to include gas in the transport sector. At the same time, Skive Municipality buys the gas for the filling stations. This takes the risk away from the private companies, which have made it more attractive for them to bid on the tenders. This is an incentive they also recommend for others to do, as they have had good experiences with it. Furthermore, they have made a bonus scheme for the drivers. This includes if the chauffeurs drive economically they get a bonus. At the same time, they get a fine for driving uneconomically. This incentive is recently implemented, why they do not have any experiences of how effective it is yet.

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Sweden

In Sweden, gas was first used for road transport in 1995, while the development within this field seriously took off in 2001. In 2006 there were approximately 65 Swedish gas filling stations and more than 8,000 gas vehicles, whereof 550 were busses. In June 2011, the number of registered personal vehicles had increased to approximately 35,000, while there were 1,700 gas busses and 1,000 trucks. As of 2016, there were more than 54,000 gas-driven vehicles, including 2,300 buses and 800 trucks (Energigas Sverige, 2017). Today, approximately 10% of all city busses are gas driven.

The background for this rapid development is a national Swedish goal of the transport sector being free of fossil fuels by 2030. The prioritisation of biogas, must be understood in the context of Sweden having a relatively high biogas commodity potential, while natural gas needs to be imported from Denmark. The total biogas potential from waste and residues is estimated to be enough to provide 900,000 Swedish cars with fuel – a potential that is significantly greater if you include thermal gasification of wood.

On a practical basis, the development within the biogas field has first and foremost been spurred by the Swedish municipalities, who have taken the lead in establishing biogas plants and procuring gas driven city busses and other municipal vehicles. This municipal initiative has thus initiated the development of a gas grid with filling stations, which gradually has made it possible for private companies and private persons to purchase gas driven vehicles.

Unlike Denmark, Sweden boasts a strong automotive industry both in relation to passenger cars, with and Volvo, and to trucks, with Volvo and Scania being the main manufacturers. Therefore, Sweden is not as dependent on foreign companies to develop biogas-driven vehicles as Denmark is, which is a major advantage in successful introduction of these new vehicles.

Biogas, as one of the renewable fuels for transportation, is supported by different policy instruments, among which energy and CO₂ taxes have played the biggest part. Together with a value-added tax of 25 %, the final tax of fuels can reach up to 65 % of the total gasoline price (Lönngqvist, 2017). Whereas traditional fossil fuels are heavily taxed, biogas benefits from tax exemptions, as its production cost is still significantly higher than that of traditional fossil fuels. This mechanism can only be in place for as long as the production cost of biogas is higher than gasoline price, so as to avoid overcompensating these costs.

Except from these general measures, Sweden has also used more direct instruments of support for sustainable transportation, which included tax exemptions and cash premiums for environmental

friendly cars. Additionally, support for building proper infrastructure in the form of filling stations was provided as well as support for productions, distribution and use of biogas.

On a local level, the support measures included exemption from congestion charges in Stockholm, or providing free parking space in other municipalities for vehicles using environment-friendly fuels. However, some of these measures have been withdrawn over time, as there has been a significant increase in the number of environmental friendly cars and so the measures did not provide additional gains in terms of promoting such vehicles.

Swedish cases

AB Östgötatrafiken



Overview

Type of company:	Public transport provider
Transport commodity:	Passenger
Size of company:	175 employees
Fleet characteristics:	The company has a fleet of around 350 vehicles, and as of 2016 all buses run on fossil-free fuels, with around 50% running on biogas
Location (geographically):	Operates within the Östergötland region

Company description:

AB Östgötatrafiken is a public transport provider owned by Östergötland County Council, responsible for buses, trams, boats, hoverers and trains in Östergötland County. The bus fleet operates in the municipalities of Linköping, Norrköping and Motala. Already in 1992, the company decided it needed to revamp its fleet to reduce air pollution. At the beginning of 2008 the goal was for Östgötatrafiken to have fossil-free bus traffic in Östergötland. When the new contract for rural services came into force in June 2016, this goal was achieved, which now places Östergötland as one of the leaders in green transition.

The buses operating in the Linköping, Norrköping and Motala municipalities have been running on biogas for many years. The biogas is produced locally, mainly from waste from the food industry, restaurants and private households.

Decision about acquisition

The main reason for investing in biogas-fuelled vehicles was the owner's, that is the county's, decision motivated by the environmental goals of having a fossil-free public transportation, which in turn was motivated by the country's goal of a fossil-free fleet by 2030. The goal was set in 2008 and already in 2016 it has been achieved. The decision was to a smaller extent incentivised through grants from the KLIMP environment programme and some contribution from the municipality.

Available information

The company has a long-standing experience with operating biogas-fuelled fleet, therefore coming across information about potential suppliers has not been an issue.

Vehicle utilization

The company finds there are no problems related to the use of a fleet running on biogas, although there were some small technical issues that were soon resolved. There are no obstacles in terms of refuelling stations, however the cost of both the fuel and maintenance are higher compared to conventional fleet. After many years operating the biogas fleet, little more training is needed.

Promotion and CSR strategy

The company uses its environment-friendly fleet to promote its services via advertising and other PR activities.

Political obstacles

The use of biogas has been in a large part facilitated by the tax exemptions allowed by the EU, and its further use will also heavily rely on the decision the EU Commission makes in regard to supporting the use of biofuels. The company believes that the tax system plays a crucial role in the adoption of biogas and therefore it should be preserved.

Results and future plans

The overall results of using biogas are very positive as it's the best currently available, environmentally friendly option for bus services. Because of the extensive investments made by the Östergötland County, the location of the Biogas Research Center in Linköping and the experience with the use of biogas for transportation, there are plans to use this fuel in the future as well, further increasing its use. At the same time, other types of energy sources, such as HVO and electricity, will also play an increasing role in the transition towards green mobility. Nevertheless, biogas will remain a significant part of the fuel mix of the company.

Contact

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Overview

Type of company:	Public transportation authority
Transport commodity:	Public bus transport
Size of company:	580 employees
Fleet characteristics:	The fleet consists of 165 buses, including 158 buses running on biogas, 1 electric bus and 6 diesel buses
Location (geographically):	The fleet operates in the whole Västmanland Country

Company description:

AB Västerrås Transport is a Swedish transport company with more than 160 busses. AB Västerås Transport is placed in Västerås, but services the entire Västmanland Country in the Western part of Sweden.

AB Västerås Transport has as a stated goal to work for lowering the environmental impact of transport in all parts of its business; from planning services, to repairs and maintenance of vehicles and to the transportation itself. This is so, as the company has recognised that all traffic disturbs the environment and consumes resources, wherefore it is important to conduct all travels as efficiently and environmental friendly as possible.

Today, AB Västerås Transport holds a fleet of 165 buses, of which 158 runs on biogas. All of these busses run primarily on biogas, but also have natural gas reserve tanks.

Decision about acquisition

The main goals behind the introduction of biogas-fuelled vehicles into the fleet was due to environmental considerations stemming from political requirements. Already in 2004, the company conducted a market research in order to identify the possibility of buying biogas run buses. The decision was also motivated by the stakeholders' expectations, including those of the city of Västerås. There were no issues with acquiring the buses as support was provided by the municipality.

Available information

No issues related to availability of information has been found and therefore the whole process was based on a solid understanding of the biogas bus market.

Vehicle utilization

Initially some issues arose related to the engine and gas quality, however these have already been remedied in cooperation with the suppliers. There are no infrastructural obstacles associated with refuelling of the buses, as the company has dedicated fuel stations in their base. The staff received training based on own resources of the company, and no additional support was needed in this regard.

Promotion and CSR strategy

The utilization of biogas-driven vehicles is a part of both the company's and the municipality's strategy. It is estimated that thanks to this measure about 10,000 tonnes of greenhouse gases emissions have been avoided annually, compared to diesel-driven vehicles. Therefore, greenhouse gas emissions have been reduced by about 75%. Investing in biogas-driven vehicles has also been part of a larger plan to market the company as a green company, which was realised through advertising and PR articles. Additionally, the buses are marked with signs that inform that they are "biogas buses". In addition, advertising campaigns managed to attract more people to travel by public transport. We have received a number of awards and have drawn media attention. Importantly, we have also often received visits from other cities that wish to know more about our business. However, it has recently diminished since several bus companies also look at electric buses.

Political obstacles

The regulatory framework has been found to be sufficient and no obstacles occurred during the whole transition towards a biogas-driven fleet. Hence, according to the company it is enough if the current framework is maintained.

Results and future plans

In regard to future plans, the company sees greatest potential for future growth of biogas buses in the regional express bus segment, which is why up to 10 new vehicles may be bought in the near future. At the same time, it is less likely that they will be bought to operate in the urban environment, as city buses are most likely to be run on electricity in the coming years.

Contact

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Overview

Type of company:	Ambulance company
Transport commodity:	Healthcare
Size of company:	320 employees
Fleet characteristics:	The fleet consists of ca. 30 ambulances, with 16 running on biogas and the rest on diesel
Location (geographically):	Ambulance are placed in 7 ambulance stations spread around the Stockholm area

Company description:

AISAB is the leading Swedish ambulance company that provides ambulance care services in the Stockholm area. AISAB is owned by Stockholm County Council and currently operates 27 ambulances from seven ambulance stations and has around 300 employees. AISAB was the first ambulance company in the world to develop an environmental ambulance – a vehicle that drives on biogas and is entirely cleaned of hazardous chemicals and plastics. This ambulance was developed in cooperation with Euro-Lans AB as a response to a wish from Stockholm County Council’s vision of a green ambulance service. Looking at the price of the environmentally-friendly ambulance, the first eco-ambulance was 14% more expensive compared to a standard ambulance of the same make. The additional costs were incurred in part from running on biogas, from alternative fitting and furnishing materials, and from the aerodynamic alarm/light system. Just over half of these costs were, however, caused by the fact that the eco-ambulance was a prototype. Therefore, it is expected that during construction of the next green ambulance the total additional cost will be halved – to around 6%.

Decision about acquisition

The decision to invest in biogas-fuelled vehicles was part of a joint project of AISAB and Stockholm County Council “Drivit” concerning the development of ambulances running on alternative fuel. One of the main purposes of this project was to minimize the use of fossil fuel driven cars. After the pilot project, there was a political decision to run a certain percentage of its operating cars with alternative fuels. AISAB has had environmental certification for many years before and so there has always been much emphasis on environmental friendliness of the company’s operations.

Available information

Because of the its profile, the company is not sure whether there is enough information about biogas vehicles in general, since the ones they operate have been custom made for their purposes.

Vehicle utilization

When it comes to the vehicles themselves AISAB found it difficult to adjust the vehicles completely to their requirements. This has resulted, among other things, in relatively small gas tanks that need to be refuelled frequently. Ultimately, this requires highly motivated staff to refuel the tanks several times per shift. Apart from some other minor technical problems resolved with the supplier of our vehicles at an early stage, no other problems have been encountered. Additionally, since the infrastructure has improved considerably during the time AISAB has had the gas vehicles, no major problems with the availability of gas refuelling stations are present today.

Staff training at AISAB required providing necessary information and followed-up on the results of the projects to make sure that the implementation is as smooth as possible. This allowed to make to operations permanent, which also required some clarification of our agreement with Stockholm County Council. The local traffic administration has been supporting these processes all along.

Promotion and CSR strategy

The transition towards biogas has in a large part been motivated by the environmental goals of the Stockholm County Council, who is the owner of the company. Although no exact data is available, AISAB estimates that thanks to the use of biogas and "green" diesel, the company has achieved almost 60% green miles in their operations. Since AISAB is a publicly owned entity, the environmental goals are set from above by the county council, which is responsible for promotion of green solutions.

Political obstacles

Since the company is owned by a public entity, which has set the environmental goals for AISAB, there haven't been any political obstacles in the implementation of the project.

Results and future plans

AISAB will continue to invest in sustainably fuelled vehicles, however due to the fact that the chassis of the already owned vehicles will no longer be produced, there will need to be a change in the vehicles bought in the future. This might result in a switch towards other vehicles fuelled by other biofuels, such as hydrogenated vegetable oil (HVO), instead of biogas.

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Overview

Type of company:	Municipality
Transport commodity:	Various
Size of company:	7,500 employees
Fleet characteristics:	Around 120 biogas-fuelled passenger cars and light trucks, as well as heavy trucks for procured activities (through municipal utilities).
Location (geographically):	The fleet runs mainly within the municipality

Company description:

Linköping Municipality is a Swedish municipality that ever since the early 1990's has had an ambition to convert its bus fleet to alternative fuels to reduce the local pollution from diesel buses. The investment in biogas busses was selected early on, because carbon dioxide emissions from transport represents one third of all carbon dioxide emissions in the municipality. Converting the municipal vehicle fleet has just been prioritised in reaching the goal of becoming CO₂ neutral by 2025.

Linköping municipality first invested in biogas fuelling stations in 1995, which was supposed to fuel the buses on the streets of the city. In 2000 60 buses were in operation on biogas and since 2002 all the diesel buses in operation in Linköping Municipality have been replaced by biogas buses.

Decision about acquisition

The main incentive for the municipality was reducing CO₂ emissions and setting an example for inhabitants and businesses in Linköping. The decision has also been motivated by the fact that the Linköping municipality has adopted a goal of becoming carbon neutral in 2025 and an important part of achieving this goal was to change municipality's own transport to renewable fuel. The decision was also based on the citizens' and employees' expectations that the municipality lives up to its climate profile and is an active partner in efforts to reduce greenhouse gas emissions.

The municipality did not receive any financial support for the purchase of the biogas busses, even though it was aware that such support is available. One of the reasons for this is related to the

preferred financing schemes for new vehicle fleet, since the municipality prefers to lease rather than buy new cars and there is no support available in case of leasing.

Available information

The municipality believes there is no problem with access to information regarding biogas and biogas-powered vehicles and it is already wide-spread among potential buyers, as well as among car dealers.

Vehicle utilization

Since the municipality of Linköping has been heavily investing in biogas infrastructure for many years now, there are little obstacles to vehicle utilization. If there are any, they are mainly related to the use of the fleet by people who seldom use it otherwise. Because of the well-developed network of biogas filling stations, the municipality has created an environment where it is extremely easy to refuel biogas in the central parts of the city.

All the staff that uses the biogas-run vehicles is trained on how to refill the tanks and movies with instructions are also available on the Internet. Additionally, the implementation of biogas-run fleet has been facilitated by the expertise from the car sharing provider, Sunfleet, and from the biogas producer, Swedish Biogas.

Promotion and CSR strategy

The Linköping municipality commitment to investments in biogas-run fleet is part of its environmental strategy to increase the proportion of renewable fuel and to reduce CO₂ emissions. Naturally, the municipality takes advantage of its biogas-fuelled fleet to promote itself as a green municipality, which is mostly done through conferences, annual reports and articles on the web. In the municipality's opinion, it is a way to gain credibility, trust as well as becoming an attractive municipality to live in and to work for. Most promotion campaigns which involved the fleet have received very good feedback, which reinforces the municipality in its commitment to biogas fuel.

Political obstacles

The Linköping municipality believes changes should be introduced to the long-term regulatory framework, especially regarding CO₂ taxes, benefits and incentives rules to further promote and develop the use of biogas-fuelled vehicles.

Results and future plans

The municipal travel policy assumes that investments in biogas vehicles in Linköping will continue, which is mostly motivated by the fact that biogas is a fossil free fuel and that using it helps to meet municipality's climate goals. To meet the increasing demand for biofuels the production of biogas by the municipally owned company Technical Works AB should also increase. The municipality also focuses on avoiding any unnecessary trips and ensuring that those that are undertaken are safe both for the passengers and for the environment.

Contact

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Overview

Type of company:	Municipality
Transport commodity:	Passenger and freight
Size of company:	4,000 employees
Fleet characteristics:	Passenger cars and light commercial vehicles. Of the 312 municipal vehicles used by the municipality 132 are running on biogas.
Location (geographically):	Runs mainly within the municipality

Company description:

In the recent years, Motala Municipality has worked hard to fulfil its ambition to be a frontrunner when it comes to tackling environmental issues. One of the ways in which Motala municipality has chosen to tackle these challenges, has been by investing vastly in biogas, and now it has a large number of biogas vehicles, its own biogas filling station and a biogas production plant. Looking ahead, the municipality has a range of projects in the pipeline, to promote the use of biogas, both in private households, in the business sector and in the public sector.

One of the most important reasons for the success of the biogas investment in Motala Municipality has been the timing of the investment. In 2002, Motala municipality was facing a need to replace its vehicle fleet and simultaneously one of the municipality's environmental objectives was to increase the share of renewable fuels. One of the keys to success factors was therefore the replacement of the existing municipal service vehicles with biogas vehicles.

Consequently, the Motala municipality has today replaced more than 100 passenger cars, minibuses and bigger vans with biogas vehicles. Simultaneously, the municipality has four renovation vehicles, while all 21 busses operating in and around Motala also runs on biogas.

Decision about acquisition

The main reason for investing in biogas-fuelled vehicles was municipality's climate and energy plan, which has been adopted in 2009 and which prioritises the use of biogas in municipal vehicles. Therefore, environmental considerations played a crucial role in the final decision. This has coincided with a governmental programme that introduced a support scheme, which came into force in 2012 and lasted until August 2015. The municipality has benefited from this programme in its shift towards a biogas-powered fleet.

Available information

The municipality believes there is no problem with access to information regarding biogas and biogas-powered vehicles.

Vehicle utilization

The municipality has experienced many concerns about the use of biogas, especially among the home care staff, for whom there is still a bit of perception barrier, and therefore it takes longer for them to get used to this technology and they express some concern about using biogas as fuel. The use of biogas-fuelled vehicles is also hindered by infrastructural issues related to the low density of filling stations, as there are only two biogas stations in Motala. The municipality believes there are too few of them, which some of the municipal employees think is inconvenient, as they need to go too far to fill up the gas tank.

In terms of teaching staff how to use biogas vehicles, only reviewing how the car refuelling is done is performed, and the training is mostly performed by the staff members who teach each other. The municipality has not received any additional support when implementing these solutions.

Promotion and CSR strategy

The importance of biogas for the future of Motala's mobility is reflected in municipality's ownership of a biogas production plant. The municipality is strongly committed to a sustainable change in their fleet, which is why next to investments in biogas, it is also investing in renewable synthetic diesel, which are a type of fossil fuel, but has lower emissions than traditional diesel. The municipality doesn't engage in promotional activities of their biogas fleet, as this is not a major part of their focus.

Political obstacles

The Motala municipality doesn't see an urgent need for changes in the legal framework to further promote biogas use in its fleet.

Results and future plans

Thanks to past investments, the municipality has already completed a fleet of vehicle relying solely on renewable fuels, such as biogas, HVO or electricity. Therefore, there are no plans for major investments in biogas in the coming years, since the municipality does not foresee a significant increase in demand for biogas.

Contact

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Overview

Type of company:	Waste disposal
Transport commodity:	Waste
Size of company:	780 employees
Fleet characteristics:	The fleet consists of around 220 trucks, fuelled by either biogas or HVO
Location (geographically):	The fleet operates in 10 municipalities around Göteborg

Company description:

The Renova Group is owned by ten municipalities in western Sweden. Renova is a leader in introducing environmentally friendly within waste and recycling industry in the region. Renova's environmental policy states that the company should strive to develop environmentally friendly vehicles, smart logistics and invest in education for sustainable driving.

Therefore, since 1994 Renova has been working on developing environment-friendly vehicles and in the most recent years Renova's focus has been on finding the right fuel. Because of this long-term effort, Renova accomplished having a completely fossil-free fleet in 2015, with all its 220 heavy vehicles running on renewable fuels, either biogas or the renewable HVO fuel BioMax – fifteen years before the national goals.

Apart from investing in a fossil-free fleet, Renova also engages in other activities in the ambition to contribute to energy-efficient transport. All Renova drivers, driving heavy vehicles, are trained in eco-driving, which reduces fuel consumption and emissions to air. Furthermore, all routes are planned with the help of computerized route planning software, which helps determine the best and most environmental friendly choices.

Decision about acquisition

Renova started to build a biogas facility and then they also converted a garbage truck. Hence, it became the first garbage truck in the world that drove on biogas. This allowed them to become the frontrunners of sustainable development in the waste collection industry. The decision has been very much influenced by Renova's environmental concerns. After conducting measurements on the emissions in one of Göteborg's tunnels and the company became aware of the huge environmental footprint they were leaving through their operations. This has lead them to become the first company

using biogas and subsequently lead them to develop other fuels. Thanks to these efforts, now their entire fleet runs on HVO and Biogas.

Available information

Although the company has extensive knowledge about the use of biogas in their daily operations, they still believe there is not enough information available for potential buyers to make a well-informed decision about a possible purchase of such vehicles.

Vehicle utilization

Renova sees major obstacles to a wider spread use of biogas vehicles in their initial purchase price as well as maintenance costs throughout their lifecycles. This is especially apparent, if one compares two equivalent trucks, one running on diesel and one on biogas. The biogas truck is approximately SEK 350.000 more in purchase, and on top of that about 15% more expensive to service on an annual basis. Seen from a cost-benefit perspective, this would only be justifiable if the environmental benefit would be greater than it is today when comparing the two. When the trucks with Euro-6 engines, that could run on HVO, came into the market, they outcompeted biogas trucks as the cost-benefit relation was much better. Additionally, one of the biggest obstacles is that there are no vehicle manufacturers who produce small, affordable biogas vehicles that the company can use. Since a large part of the serviced locations are farms, there is no need for large garbage trucks. Unfortunately, the only manufacturer providing these sorts of vehicles has very high prices, for both purchases and service costs.

Although Renova experienced no problems with the infrastructure in their area, they have had issues with the gas quality, as some gas can be of such poor quality that the engines start chocking.

Naturally, Renova puts much emphasis on training and explaining to their employees that they are at the forefront of sustainable development, which is usually met with positive feedback as many employees think it is fun to be noticeable because of this. Since Renova has been one of the world leaders in this area, no additional support is required in terms of advice or training for the staff.

Promotion and CSR strategy

Sustainable transportation is an important part of the company's promotional activities, and the company releases a sustainability report as well as informs about their sustainable fleet on their website. Thanks to the transition to a sustainable fleet it was possible to save around 700 tonnes of carbon dioxide per month in emissions, which adds up to 10.000 tonnes of carbon dioxide since May 2015, when the entire fleet is run on HVO and biogas. That is equivalent to emissions from 6450 new cars during the same period.

Political obstacles

The company believes that there is a need for new instruments encouraging more people to buy a biogas-fuelled car, by savings some money of the initial cost. A small, self-employed person will have difficulty buying a biogas truck, because it is simply too expensive. There needs to be more funds that

make it cheaper to have a biogas vehicle. Some of the tools that could be used include: exemption from the congestion tax or allowing longer parking time. But there is also a need for better cars for private individuals. Therefore, if Renova is to continue driving on biogas, there must be greater benefits from such policy measures.

Results and future plans

Based on the company's experience investing in biogas is worthwhile, however it is only up to a certain point, as biogas will probably face competition from other types of fuel in the future. Hence, there must be more benefits in buying biogas vehicles provided by the policymakers, as otherwise it will be too expensive for smaller companies to invest in biogas. Additionally, the company believes that urban transport will most likely focus on electricity in the future and it will be the longer-distance transport that will take on biogas more readily. However, for this to happen, issues with the infrastructure should be overcome, as there might not be enough filling stations.

Having all the above in mind, unless there are customers who will specifically require biogas to be used, the company will switch to diesel Euro-6 trucks with HVO, simply because it's a cheaper investment. If not for the Euro 6, the company would have driven on biogas. Biogas will probably still be used in longer distance transports. As mentioned earlier, one of the limitations is that there are no small biogas trucks available on the market today, which means that Renova cannot buy the vehicles that are needed.

Contact

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Overview

Type of company:	Public transportation authority
Transport commodity:	Public transport
Size of company:	366 employees
Fleet characteristics:	The fleet consists of trains, trams, personal cars, buses, including 775 buses running on biogas
Location (geographically):	The fleet operates across the whole Skåne County

Company description:

Skånetrafiken is responsible for managing and developing public transport in Skåne county according to the rules and regulations of the county. As a result of these regulations, Skånetrafiken has set a goal of all public transport in the country being fossil free by 2020, while they simultaneously had a sub-goal of the city traffic being fossil free by 2015. This sub-goal was achieved in December 2015, as all public transport vehicles had been shifted to run on either biogas, biodiesel or renewable electricity. Thereby, Skånetrafiken by the end of 2015 had increased the use of renewable fuels from 63 to 70 percent of the total fuel consumption.

Regarding Skånetrafiken's specific use of biogas, compared to 2015 Skånetrafiken increased its use of biogas by 47.000 MWh, up to 239.500 MWh. This increase has thus made Skånetrafiken the biggest biogas consumer in Sweden.

Decision about acquisition

The main goals behind the introduction of biogas-fuelled vehicles into the fleet was to achieve fossil free transportation, introduce circular economy thinking, as well as to achieve local social benefits. Therefore, sustainable development principles were the main motivators for this change. The first biogas buses were additionally co-funded through a grant from the Environmental Protection Agency's climate investment grants (KLIMP). The decision has received much attention from partners, politicians, industry and customers.

Available information

Vehicle utilization

Initially there have been some issues with vehicle utilization, in particular increased risk of fire in the older buses, poor tank-to-wheel energy efficiency, increased maintenance costs compared to diesel buses, and transport companies not having services for those that run on biogas proved to be challenging. Moreover, there was a risk of methane emissions during refuelling at the refuelling depot, which was handled through preventive maintenance of the refuelling facility. Skånetrafiken did not provide training to the staff operating the buses, since it's the operator responsibility to do so, as they are the ones running the buses.

Promotion and CSR strategy

As mentioned earlier, the use of biogas-fuelled vehicles was mostly motivated by environmental considerations, as one of the goals was to have a fossil free fleet. This transition has enabled to reduce the average emissions by about 70% compared to fossil diesel fuel. Although there is no information about the use of biogas on the website of Skånetrafiken, the public authority issues a yearly report on sustainability, where such information is presented. The customers believe it is an important goal that the transportation is fossil-fuel free. In our environmental and sustainability programs our sustainability strategy the focus is on green electricity in urban and regional buses, which is mainly biogas, and, if necessary, in the express bus traffic, running on bio diesel.

Political obstacles

When it comes to the political environment, Skånetrafiken believes that long-term instruments for biofuels and production support, similar to the ones existing in the rest of Europe, instead of usage support, should be more common.

Results and future plans

Skånetrafiken is strongly committed to promoting sustainable transportation, which is why apart from maintaining the biogas buses fleet, there are plans to apply for funding for electric vehicles in the nearest future.

Contact

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Overview

Type of company:	Waste disposal
Transport commodity:	Waste
Size of company:	1100 employees
Fleet characteristics:	The fleet consists of around 700 trucks, including around 100 biogas trucks
Location (geographically):	The fleet operates in 66 divisions spread all over the whole country

Company description:

Suez is a leading Swedish company within the recycling and waste management industry. With 1100 employees, 66 branches and its own waste treatment facility the company offers effective and environmentally sound solutions with a focus on innovation and sustainability.

Having a clear focus on sustainability, Suez is fully aware that their transportation services gravely affects the environment through emissions and dispersion of particles and with a fleet of more than 700 vehicles, the company has made it a sworn statement to reduce vehicle emissions.

As a means of achieving this, Suez has added it to its environmental strategy that where geographically possible, gas vehicles must be instated. This has resulted in approximately 10 percent of Suez' total fleet, today runs on biogas.

Decision about acquisition

The main factor in determining the fleet the company uses is the procurement process that determines which vehicles Suez uses. Ultimately, it is the needs and the quality of infrastructure around biogas in a given municipality that determine the type of fleet. The decision therefore derived from the municipalities requirements and was not an individual decision made by the company.

Vehicle utilization

As it has been a relatively new technology, the company experienced some technical problems with the trucks. There has been a number of challenges that arose from the utilization of these vehicles, which include the quality and availability of gas, as well as availability at the service stations. When there are more vehicles in a given area, it might introduce a delay because of queuing of several trucks.

However, this very much depends on the municipality, as some of them are better organized than others.

Promotion and CSR strategy

Since the company is dependent on the specific municipalities on what sort of vehicles to use, they do not include this in their environmental strategy. However most of the company tries to switch towards new, environmentally friendly vehicles, whether they are run on biogas, electricity or diesel. Since the company invests in the fleet, they not only promote their biogas trucks, but also those running on other environment-friendly fuels.

Political obstacles

The company believes there should be a clearer vision from the politicians about the preferred fuels of the future. Currently there are many possibilities and each municipality can decide on their own what sort of fuels they wish to use. For Suez Recycling this translates into the need to have a varied fleet corresponding to the needs of every municipality they cooperate with.

Results and future plans

As has already been mentioned, the sort of fleet the company uses is to a great extent reliant on the requirements set out by the municipalities and local governments in their procurement procedures. Nevertheless, the company does not see any obstacles in terms of a further change towards biogas-run vehicles. In their view, an increase in the uptake of biogas can only occur, if there is proper infrastructure in place as the time needed for refuelling plays an important role in their day-to-day activities.

Contact

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Overview

Type of company:	Taxi services
Transport commodity:	Passenger and goods
Size of company:	Ca. 100
Fleet characteristics:	45 cars, 85% operating on biogas
Location (geographically):	Trollhättan municipality

Company description:

Taxi Trollhättan was founded in 1923 and is one of the oldest companies in the city, offering passenger and goods transport. The company places great emphasis on operating a new and environmentally friendly fleet.

Decision about acquisition

The decision was mostly motivated by customer demand and contractual requirements placed on the company, although the company tries to implement high environmental standards even without such external requirements. The decision was also not motivated by any additional financial support as the company has not received any.

Available information

The company believes that overall there is enough information, although it does require some research from the interested company, especially since car manufacturers are not always eager to market their gas-driven vehicles.

Vehicle utilization

Only minor problems with some of the cars have been reported, and these have mostly been resolved by the car manufacturers, either by withdrawing the car or by giving compensation. In terms of

infrastructure, the company has experienced that the availability of filling stations is not satisfactory, even in Trollhättan there is only one filling station. This translates into practicalities when training the drivers, who must not only learn how a biogas car works, but also think about when and where to refill the tank. Although they can drive on petrol too, they can do so only for a short distance, therefore planning their route is crucial.

Promotion and CSR strategy

As much as environmental focus is an important part of daily operations, it is not used widely as a promotional tool or part of a CSR strategy. At the same time, the company believes it could do more in terms of promoting their sustainable fleet.

Political obstacles

The biggest obstacle currently to a wider adoption of biogas is its price, which according to the company remains too high. To alleviate this problem the government should consider either lowering taxes on biogas or offering some sort of subsidies to the end-users.

Results and future plans

Based on the day-to-day exploitation of the biogas fleet, the company plans to further invest in such vehicles, even though they are not as reliable yet as the gasoline-fuelled cars. Until biogas is widely available, the fleet will need to rely at least in part on the use of fossil fuels to ensure that services can be provided without any interruptions.

Contact

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Overview

Type of company:	Freight services
Transport commodity:	Goods
Size of company:	Ca. 160 employees
Fleet characteristics:	120 heavy and light trucks, with 46% running on biogas
Location (geographically):	Stockholm-Mälaren Region and Gothenburg

Company description:

Widrikssons Åkeri was founded in 1953 and offers freight services in Stockholm-Mälaren Region and recently also in Gothenburg. The development of the company is shaped by a strong focus on environmental issues related to its operations. This is reflected in a constant upgrade of the operating fleet towards a fossil-free fleet, a goal set by the company already for 2020. This is why, the company replaces fossil fuels with alternative, sustainable fuels such as RME (Raps Methyl Ester), HVO (Hydrated Vegetable Oils), or 100% Biogas. At the freight terminal in Västberga the company has invested in a gas stations for both RME and 100% biogas, without any natural gas. In 2015 alone twenty-one diesel trucks were exchanged for biogas trucks. This resulted in a substantial change in the grocery e-commerce segment, with a reduction of carbon dioxide emissions by 31% compared with the previous year. Because of these developments, Widrikssons has increased its biogas use by 30% compared to 2014. This change is in large part driven by customers' expectations, who have an increased focus on sustainable product life cycles, which means consumers are looking beyond the final product. Thanks to the municipalities' collection of private and corporate food waste, which is converted into 100% biogas in a Huddinge digestion plant, Widrikssons can base its operations on biogas, therefore closing the cycle.

Decision about acquisition

The decision to acquire biogas trucks is the consequence of the company's goal to have a fossil-free fleet by 2020, which reflects company's strong environmental focus. Naturally, the demand for environmentally friendly trucks is also a reflection of customers' changing needs, who increasingly expect to have goods delivered in a sustainable way to ensure small carbon footprint throughout the

whole value chain. The decision was not motivated by financial support, even though the company has sought such support.

Available information

The company believes there is still not enough information and awareness on the market and many people confuse the fossil based natural gas with fossil-free biogas. When coupled with lower prices for natural gas, this amounts to less people likely to switch to biogas.

Vehicle utilization

When it comes to vehicle use, the company recognizes that there is a number of obstacles to be overcome when introducing biogas-fuelled trucks into the fleet. First, the initial cost is significantly higher compared to conventional trucks. Second, the servicing is also more expensive. Lastly, the drivers said they were having trouble refuelling, particularly because they had to do it more often. The employees felt it was burdensome to tank biogas, since it requires more planning of the next refill but also takes more time than filling a diesel vehicle.

At present, there is no problem to fuel vehicles, which the company finds is a positive change. Especially when compared to the beginnings of the transition in 2007, when the company had considerable problems with filling stations availability, and even had to tow some of the trucks that did not manage to fill the tanks in time.

Promotion and CSR strategy

The transition towards biogas plays an important role in company's sustainability actions and is widely communicated to the stakeholders. The emissions have been brought down to nearly 0%, since the adoption of biogas and other sustainable fuels (e.g. HVO).

Political obstacles

The company believes the filling stations operators might struggle to achieve profitability on biogas sales. Additionally, although compressed natural gas is not as environmentally friendly as biogas, some municipalities, that do not know the difference, promote compressed natural gas in procurements. Therefore, the company believes that different actors should be more aware about the environmental impact of the different fuels, so that only fuels that are actually environmentally friendly are promoted.

Results and future plans

Overall, the company believes investing in biogas trucks is a complicated decision, one where environmental goals need to be well balanced with economic evaluation. The latter is heavily influenced by a higher purchase cost, higher maintenance cost, lower residual value, therefore making the purchase unviable economically. There still remains a barrier of market accessibility of biogas trucks, as finding companies that would have biogas trucks in their offer can pose some difficulties.

Nevertheless, having in mind the environmental goals, the constantly expanding net of filling stations and improved offer from manufacturers, the company plans to further invest in biogas trucks to provide environmentally friendly transport services.

Contact

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Norway

The Norwegian government has obliged to increase the usage of renewable energy to 67,5 percent by 2020. The climate statement, which was decided by the Parliament (Stortinget) in 2012, states, that Norway is to be carbon-neutral before 2050.

The Norwegian government wants to contribute to the development of chain of supply for second generation biofuels. According to an IEA report, in 2010 approximately 0.5 TWh energy was produced yearly in Norwegian biogas plants. Based on data from 2014, around 30% of the produced biogas is used for heat production, 10 % for electricity production, and around 40% is upgraded to fuel quality, whereas the remaining part is used for flaring and other purposes (International Energy Agency, 2016). The theoretical energy potential for biogas resources from waste and byproducts is estimated to be around 6 TWh/year, whereas the realistic goal for 2020 is around 2.3 TWh/year. Manure constitutes the biggest potential, with approximately 32 %, followed by industry waste (22%).

One area that is seen as a low-hanging fruit in Norway, and therefore one where substantial benefits are to be expected is in the transport sector, where it is possible to convert natural gas users into biogas users. Norway has 1487 biogas and natural gas vehicles (including 410 trucks, 446 buses, 631 vans and cars as of March 2017) and 57 ferries (Flaaten, 2017). Thus, the first step is to get these means of transport to use biogas rather than natural gas.

The biogas strategy, 2014, focuses on creating good frameworks for both the production and utilization of biogas in Norway. Sustainable fuels are not taxed in the Norwegian context, which increases the incentive for investments in biogas. The charges include road taxes and CO₂ taxes. Today, natural gas is exempted from the road user tax, this exemption was originally removed in 2016, but has since been reversed, with retroactive effect due to uncertainty about the tax and lack of impact assessment before introduction (GASNOR, 2016). Another approach used in Norway is to offer state aid schemes focusing on the utilization of biogas in transport, particularly through the establishment of production plants for upgrading biogas.

A promotion of these support schemes provides an economic incentive for actors in the biogas sector to make investments. At the same time, it shows a willingness and faith in the utilization of biogas from the state. This can be seen, for example, as Innovasjon Norway doubled their support from NOK 10m to NOK 20m in 2016 to Pilots for Biogas. The scheme deals with both new and old plants planning to test other substrates than wet organic and sewage sludge.

The increase of substrates supply is mostly driven by the landfill guidelines which prohibit biodegradables from landfills. On top of that, there are payments per each tonne wet weight of manure processed in a biogas production facility, which is part of a bigger policy plan to increase the use of manure. There is also state aid available for some types of new plants, ranging from 30% up to 50%, depending on the type of project, with more support available for special pilot plant/research projects (Innovasjon Norge, n.d.). Furthermore, upgrading to biogas is beneficial, since there is a tax exemption when it is used as automotive fuel. What is more, ENOVA, a governmental institution supporting sustainable fuels, supports the purchase of vehicles above 3.5 ton and the expansion of refuelling infrastructure.

However, a recent study (Fevolden & Klitkou, 2017) suggests that the incentives offered by the government to the biofuel manufacturers are not sufficient to make them competitive with the traditional petroleum suppliers. There seems to be evidence that these measures are unfortunately creating an unstable and unpredictable business environment. Nevertheless, Cambi, the most successful biogas producer, was one of the few companies in this sector that have benefitted from the legislative changes, mostly because of the requirements on manure treatment.

Additionally, a report prepared on behalf of Enova (Sund Energy AS, 2017), confirms that the main barrier is the significant uncertainty linked to both demand and production of biogas in Norway. The future availability is an overall barrier and is to some extent the result of a lack of clarity from government agencies and insufficient coordination between these agencies. The authors also point out that there is a significant risk of a mismatch between supply and demand, which prohibits companies from investing in more biogas production facilities. Furthermore, as the environmental benefits of biogas are not clearly documented, biogas faces fierce competition from biodiesel and other technologies, and many companies committing themselves to zero emissions already today, the perspectives for biogas use are not particularly favourable.

Norwegian cases

ASKO NORGE AS



Overview

Type of company:	Wholesaler
Transport commodity:	Grocery logistics
Size of company:	ca. 3,500 employees
Fleet characteristics:	The fleet consists of around 700 trucks, including 8 biogas-driven
Location (geographically):	The fleet operates in 13 regional divisions spread all over Norway

Company description:

ASKO is the biggest Norwegian food distributor, distributing food to a wide range of stores all across Norway. The company has three overarching goals, one of them is to be sustainable and environmentally neutral. Being one of Norway's biggest transport businesses, ASKO has set an environmental goal of only using renewable fuels by 2020. ASKO is therefore a frontrunner within development and use of biofuels and many of the company's trucks uses alternative fuels such as biodiesel, bioethanol and biogas.

In 2015, ASKO initiated a pilot on biogas driven trucks, running on sewage sludge from livestock, and has currently eight such vehicles.

Decision about acquisition

The decision about the acquisition of biogas-driven vehicles was motivated by company's plans to go fossil-fuel free by 2020, with 7-8 biogas vehicles, 40 bioethanol, and additional running on electricity, hydrogen or HVO. This was partly motivated by the expectations of NorgesGruppen's environmentally conscious clients, who care about the impact that the group's operations have on the environment. In a smaller part, the decision was motivated by newly introduced requirements in some of the tenders the company is taking part in.

Available information

The company has not experienced difficulties in finding information from vehicle manufacturers.

Vehicle utilization

In terms of everyday use, the company has mostly had positive experiences with biogas trucks, especially one with Euro 6 engines. NorgesGruppen, the owner of ASKO, believes that, especially in Western and Northern Norway there are not enough biogas plants and combustion plants, which means that a lot of waste is transported unnecessarily far in Norway. This is an important limiting factor in an increased use of biogas as a fuel, however the company is evaluating the possibility to use the spare capacity on the trucks to transport the food waste to biogas plants to alleviate the problem. Nevertheless, the company believes there is a need for a safe and dense biogas filling stations infrastructure all over Norway (NorgesGruppen, 2016).

Promotion and CSR strategy

ASKO as part of the NorgesGruppen, places considerable importance on the promotion of its green fleet using different channels to target specific stakeholders. The company promotes its sustainable endeavours through its homepage, press releases, as well as through the NorgesGruppen annual sustainability report, which presents the advances towards a more environmental-friendly future. The biogas vehicles also display stickers that inform that they are running on biogas.

Political obstacles

The company expressed their views clearly in a letter to the Norwegian government in February 2016 (NorgesGruppen ASA/ASKO NORGE AS, 2016), where it stated that in order to make the transition to biogas possible, there is a need for differentiated fees and subsidies, which will make biogas competitive, by supporting the development of infrastructure and filling stations. The company also stated that the government lacks a clear political vision for the development of the sector and should place more emphasis on management by objectives, which could be implemented by having an annual carbon budget to show emissions and measures that achieve the goals. The company indicated that public procurement could be used more actively to promote biogas and ensure that environmental criteria are more critical.

Future plans

Although the company has bought some biogas-driven trucks, it believes that it is hydrogen and electricity that will be the predominant energy sources for its fleet in the coming years, mostly because of the limited business case for the use of biogas-fuelled trucks (Råstad, 2017). This might however change, and the company might invest further in biogas, if LNG engines improve over time, especially in terms of range, and the filling infrastructure expands.

Contact

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Overview

Type of company:	Maritime transport
Transport commodity:	Goods and passengers
Size of company:	600-700 employees
Fleet characteristics:	The company has 4 ferries, including two LNG ferries
Location (geographically):	The company is based in Egersund

Company description:

Established in 1993, Fjord Line is a maritime transport company offering transport between Norway and the rest of Europe. Already in 2013, the company invested in the first and largest cruise ferries in the world to use LNG engines, which was part of an environmental initiative, to be at the forefront of new and more stringent emissions regulations.

Decision about acquisition

The company wished to be a front runner in environmentally cruise services, hence becoming the first operator in the world to have a solely LNG fuelled cruise ships. The decision was further motivated by support from NOx-fund and from the European Investment Bank, which loaned EUR 124 million.

Vehicle utilization

There was a lot of learning by doing involved in the implementation of the LNG ships, especially because of the large size of the order. Only minor technical issues arose and were dealt with the engine manufacturer, i.e. Rolls-Royce. The company has not experienced any issues with the infrastructure and has been pleased with it.

Promotion and CSR strategy

What started off as part of an environmental strategy, has turned out to be an economically viable decision. The costs lie along with strategy as well. Pr. Date cheaper than diesel. Financing is greater but operating less.

Political obstacles

The biggest political obstacles include the scrapping of the tax exemption for CO₂ emissions on domestic shipping, a burdensome and time-consuming process when applying for support, as well as little incentive to choose natural gas over other fossil fuels.

Results and future plans

The company is hoping that there will be an LNG engine for faster ships, as these would allow the company to exchange some of the ships that currently run on diesel. Therefore, as of now, there are no plans to further expand the fleet.

Contact

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Overview

Type of company:	Public waste handling department
Transport commodity:	Waste
Size of company:	42 employees
Fleet characteristics:	Waste collection is operated by trucks running on biogas, 2 existing (2017, Mercedes) and 3 new ones (Feb. 2018, Scania)
Location (geographically):	The fleet operates within Fredrikstad

Company description:

The Fredrikstad municipality places great importance on achieving environmental goals, particularly it set a goal of becoming fossil-free by the end of 2030. The municipality is committed to implementing the circular economy concept, and renewable sources of energy for its fleet comes from this commitment. Since 2001, Frevar, a company owned by the municipality, operates a biogas production facility with the capacity to transform 30,000 tons of waste into biogas, which is then used to fuel more than 100 buses in the Østfold region, private cars, as well as garbage trucks. The investment in the biogas production facility reflects the strong political support that biogas has in the region, as it plays an important role in reaching both the waste management and environmental goals.

Decision about acquisition

The municipality has invested in biogas vehicles already in 2008, which has made it one of the first in the Nordic region to purchase a biogas-driven garbage truck. Therefore, the municipality has extensive experience concerning the operation of biogas-driven trucks, which means that the decision to purchase further such trucks was better informed. The favourable experiences with the first biogas-fuelled trucks made it easier for the municipality to further invest in this type of vehicles, which continue to operate.

Available information

Thanks to a long-term commitment to biogas, a special expert unit functions guaranteeing that the knowledge is institutionalised within the municipality.

Vehicle utilization

The municipality had mostly good experiences with the use of biogas driven garbage trucks, except the first one, which was delivered by Renault. The subsequent trucks were operated without any issues since 2013. The establishment of a filling station has played a major part in providing the appropriate infrastructure for the trucks to operate, although this has proved insufficient, and there are already plans to build new filling stations. Because of the long-standing experience with biogas use, there is little need for training for the drivers.

Promotion and CSR strategy

The biogas investment is part of the overall strategy to become fossil-free by 2030, and increasing biogas use would allow to cut out as much as 190,000 litres of diesel on a yearly basis. Switching to biogas is viewed as a way to improve the image of the municipality as well as a way to promote a more sustainable way of living, one based on circular economy, where waste is put to productive use. Using biogas in municipal vehicles set an example for the inhabitants and shows that the local authorities take responsibility for the environment.

Political obstacles

The municipal unit responsible for waste management believes there is a need for a clear and long-term policy and environmental strategy at the municipal level.

Future plans

The existence of a biogas production facility operated within the municipality means that there is readily available renewable fuel for waste collection fleet. In turn, this means that there are favourable conditions for the municipality to further invest in biogas driven vehicles, and there are already plans to buy 3 additional biogas waste trucks, whereas there are 27 trucks that could be replaced by biogas trucks. The municipality also plans to invest in a new filling station, with both slow filling CBG and LBG.

Contact

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Overview

Type of company:	Municipality
Transport commodity:	Public services and goods
Size of company:	ca. 2,200 employees
Fleet characteristics:	The biogas fleet consists of around 22 vehicles, including small cars, local cargo transportation and minibus
Location (geographically):	The fleet operates within the Horten Municipality

Company description:

Horten Municipality, located in Vestfold County, is a small municipality of 27,000 inhabitants. The municipality is one of the shareholders in GreVe Biogass, a joint venture of the Grenland and Vestfold counties, operator of “The Magic Factory” opened in 2016 to provide biogas suitable for use in vehicles. Already in 2011, in Horten’s climate policy the importance of biogas as a transportation fuel was recognised, being one of the few viable alternative fuels available at the moment.

Decision about acquisition

Horten Municipality decided to acquire biogas-driven vehicles based on a political goal to be a part of a “green change”. Because of the ownership in a biogas production facility, the local authorities chose biogas as the best available option to provide sustainable fuels for transportation. The decision was backed up with financial support from the Department of Climate and Environment.

Available information

The representatives of the municipality do not believe that there is enough information about the biogas-driven vehicles.

Vehicle utilization

The implementation of biogas vehicles did not encounter any major obstacles, as there were no problems with either operations or technology. What is more, thanks to an investment in a

municipality owned filling station, that will be open for public from January 2018, there were no infrastructural obstacles to operate the fleet.

Promotion and CSR strategy

The municipality has been promoting the use of biogas to prove that they are addressing the environmental challenges and are doing their utmost to induce a green change. Therefore, there has been considerable publicity with the use of local newspaper articles and large format stickers on the vehicles themselves.

Political obstacles

The current tax system is seen as a hindrance, and according to the representatives of the municipality, a move in the right direction would be to recognise the benefits of biogas vehicles and set them on par with electric vehicles by making them exempt from vehicle taxes.

Future plans

The municipality is strongly committed to being part of the green change, which is why there are already further plans to expand the biogas fleet with 50 more vehicles, which should benefit from the available funding opportunities.

Contact

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Overview

Type of company:	Public transport
Transport commodity:	Passenger, including schoolchildren and passengers with special needs
Size of company:	185 employees
Fleet characteristics:	The fleet consists of around 140 minibuses, including 30 biogas-driven
Location (geographically):	The fleet operates in Østfold, Akershus, Oslo and Vestfold

Company description:

The company, established in 2006, is a passenger transport provider and has experienced robust growth in the recent years, with the number of employees passing 180, and number of minibuses amounting to 140. The core business encompasses transport services mostly relating to school children and patients leaving treatment. The biggest clients of the company include Østfold kollektivtrafikk, Ruter, Pasientreiser and Nettbuss.

Decision about acquisition

Since the company offers public transport services its operations are highly influenced by the public tendering, which in recent years is increasingly concentrated on alternative fuels, including biogas. Therefore, to win new contracts, the company needs to adjust its fleet to the environmental requirements of the contracting authorities. The decision was not motivated by any form of financial support.

Available information

There is little information available and the current offer is also very limited.

Vehicle utilization

The major problem with using biogas fleet stems from the low density of filling stations, which adds unnecessary mileage, that can be as big as the mileage from doing the actual transport. In turn, the routes needed to be altered to cater for the extra mileage required for filling. In the brief period that the vehicles have been in operation no additional technical or operational issues have been encountered.

Promotion and CSR strategy

Because of the company's profile, the purchase of biogas-driven vehicles is not particularly part of a CSR or environmental strategy, and is to be seen as part of regular business and complying with tender requirements. The vehicles help company to present itself as a company that adjusts to the growing environmental constraints.

Political obstacles

The company believes, that apart from the sparse distribution of filling stations and the reduced range biogas vehicles offer, the main issues relate to taxes, which should be similar to those for electric vehicles.

Results and future plans

The overall results are mixed, as the poor filling infrastructure weighs heavily on the evaluation of biogas-driven vehicles. In any case, the company's decision to purchase further biogas vehicles will depend solely on the requirements set by the authorities contracting public transport services.

Contact

Erik Skaaden
CEO



Overview

Type of company:	Mail and logistic
Transport commodity:	Mail, packages
Size of company:	16,900 employees
Fleet characteristics:	The fleet consists of around 6,000 vehicles, including 700 fossil-free trucks, around 120 biogas vehicles and 1,200 electric vehicles (Arnesen, 2017)
Location (geographically):	The fleet operates in whole of Norway

Company description:

Posten Norge is a Nordic mail and logistics group that develops and delivers complete solutions within postal services, communications and logistics, with the Nordic region as its home market. As one of the largest transport operators in the Nordic countries, Posten Norge realizes that they are part of the problem with rising CO₂ levels. The group, however, also considers themselves as part of the solution. The Group is therefore actively working to improve the framework for reducing emissions from heavy goods vehicles, and adopt new solutions to establish a market for renewable fuels.

In living up to the groups' goal of reducing its CO₂ emissions by 40 percent before 2020, Posten wishes to perform all transport environmentally neutrally (Posten Norge, 2016a). What is more, in 2017 it has been decided that Posten Norge will become fossil free by 2025 (Posten Norge, 2017). Posten Norge therefore already has a fleet of 120 biogas vehicles in Norway and Sweden, including the world's first biogas truck that lives up to the strictest emission standards, Euro 6. Besides these biogas vehicles, Posten decided in 2015 that all heavy transport vehicles must switch to renewable diesel (Arnesen, 2017).

Decision about acquisition

The decision to invest in biogas vehicles was mostly motivated by the company's strong commitment to sustainable development. The company cooperates with important stakeholders and authorities, among others with ZERO in Norway and the 2030 secretariat in Sweden. This has resulted in the Group's continuous effort to use renewable fossil-free fuels for all vehicles, with renewable diesel used mostly for heavy transport, and biogas and electricity for other types of vehicles.

Promotion and CSR strategy

Using biogas-driven vehicles is part of company's strategy to become more environmental-friendly and emission-free, therefore it is also part of the promotion and CSR strategy. The company informs about their green fleet through their website, press releases as well as through the annual sustainability report (Posten Norge, 2016a).

Political obstacles

Although the company appreciates that the Norwegian government is beginning to recognize the role that biogas can play for heavy transport, the incentives in the tax policy that could stimulate the use of biogas are still missing (Posten Norge, 2016b). Posten also believes that CO₂ emissions should be more heavily taxed, to create an incentive to choose vehicles with lower emissions, whereas tax exemptions for the latter ones should not be phased out fast (ibid.). This is especially important in the initial stage, until biogas reaches sufficient commercial penetration. This is an important prerequisite for achieving our environmental goals.

Future plans

Posten Norge will continue to invest in fossil free fleet in the future, which will consist of a mix of electric, HVO and biogas-fuelled vehicles (Arnesen, 2017). Such a mix of different types of vehicles ensures a greater diversification of fuel sources, making the company more resilient to changes in fuels prices and able to adapt to a changing legal environment.



Overview

Type of company:	Construction sector
Transport commodity:	Staff, tools, service materials
Size of company:	15 employees
Fleet characteristics:	The biogas fleet consists of around 5 minivans, other vehicles run on diesel
Location (geographically):	The company is based in Fredrikstad, Østfold

Company description:

Roar Steen Edvardsen Entreprenør is a small company established in 1971 and has been operating in the construction business, mostly waste disposal, since its inception.

Decision about acquisition

The company was predominantly motivated by the company's wish to reduce its carbon footprint and to take advantage of lower road tolls, whereas considerations about political demands or customer expectations come in next place. No part of the decision was due to a financial support.

Available information

The representatives of the municipality do not believe that there is enough information about the biogas-driven vehicles.

Vehicle utilization

There were no problems with the implementation of biogas vehicles, and there was no problem with the availability of biogas filling stations.

Promotion and CSR strategy

The company has a goal of becoming fossil-free and to fuel its fleet with renewable fuels, and it is important to communicate these goals to its stakeholders through stickers on the vehicles, articles in newspapers, participating in local climate conferences and through social media.

Political obstacles

Because of the company's profile, the most obvious obstacle for increased biogas use are the road tolls, that inhibit a greater use of biogas vehicles.

Results and future plans

The company is very pleased with the biogas minivans and plans to further invest in minivans running on biogas, bringing the total number of these to eight and therefore achieving a completely sustainable fleet of minivans.

Contact

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Overview

Type of company:	Gas distribution
Transport commodity:	Service personnel and goods
Size of company:	7 employees (the Skagerak Energi AS group has over 600 employees)
Fleet characteristics:	A biogas van
Location (geographically):	The company delivers natural gas and biogas in Tønsberg and Grenland, but also to Agder and Østfold

Company description:

Skagerak Naturgass is part of Skagerak Energi group and its main operations are concentrated on the The company aims to market and distribute natural / biogas to industry, transport / fuel, maritime industry and public buildings, etc. In the recent years the company managed to become a leading and attractive player in the biogas segment through strategically targeted utilization of position, expertise and gas infrastructure. Skagerak Naturgass designs and builds gas distribution networks, as well as owns and operates the network with its associated facilities.

Decision about acquisition

The decision to purchase the biogas fuelled vehicle was the outcome of the need to purchase a new service vehicle and the fact that the company is establishing its foothold in the biogas market, including the opening of new biogas filling stations. Therefore, it was only natural for the company to lead through example and invest in a biogas vehicle.

Available information

There is little information available, with dealers having limited knowledge and the current offer is also very limited.

Vehicle utilization

There were no technical problems encountered during the exploitation of the vehicle. Moreover, since the company itself is a biogas distributor and operates four biogas filling stations, there were no problems with the filling infrastructure. It also didn't require much training, as all employees are well aware of how such vehicles are to be used and were highly motivated to use them.

Promotion and CSR strategy

Being a biogas distributing company it is self-evident that the company uses the vehicle as a way to brand itself and to promote biogas use, as this is in line with company's core business.

Political obstacles

There is a number of political obstacles that inhibit a greater use of biogas. In particular the tightening of the environmental demands, an increase of the CO₂ tax on fossil fuels, the price of biogas needs to be supported to compete with conventional fuels. Overall, biogas should be recognised as a clean fuel and enjoy the same benefits as electric cars.

Results and future plans

The company sees biogas as part of saving the environment, even if the vehicle's range is limited by the number of filling stations. This is why, in the future, the company considers to replace the rest of its fleet with biogas vehicles.

Contact

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Overview

Type of company:	Waste disposal
Transport commodity:	Waste
Size of company:	13 employees
Fleet characteristics:	The company itself has 2 biogas cars, while providers of waste collection services has 25 garbage trucks and 3 vans running on biogas
Location (geographically):	The fleet operates within the Vestfold region

Company description:

Vesar (Vestfold Avfall og Ressurs AS) is owned by the municipalities Horten, Hof, Holmestrand, Larvik, Nøtterøy, Sandefjord, Tjøme, Tønsberg, Re and Lardal. The company's main task is domestic waste management on behalf of the owner municipalities, although the exact scope of activities depends on each given municipality. The municipalities also determine the size of the renovation fee, and it is the municipalities that adopt the regulations (rules) Vesar needs to comply with. In October 2015, due to a new public procurement procedure aimed at finding a new waste collecting company, trucks running on biogas were included as part of the requirements. Vesar owns no machinery, buildings or plants, but relies on other companies chosen through tenders. It is however important to note, that Vesar is one of the founders and owners of the Greve Biogass, which is the operator of 'The Magic Factory', a biogas production facility, to which Vesar provides food waste supply. This was a way to make better use of the collected waste, by which the company could contribute to the circular economy and hence to the environmental goals of company's owners.

Decision about acquisition

Since Vesar is one of the founding companies behind 'The Magic Factory', the decision to invest in biogas-driven fleet was self-evident and in line with both company's and its owners long term environmental and sustainability goals. The decision finally came into life in 2015, when Vesar chose the new waste collecting company. This way, the company participates in circular economy, since it collects waste which is then transported to a biogas production facility, there it is transformed into

biogas, which ends up in the tanks of the biogas trucks. The decision was not motivated by additional financial support available.

Available information

The company believes there is not enough information available and that it should be more accessible than it is today. A particular point of interest is the correlation between available vehicles and filling options is important. There is also a need for dealers and suppliers of transport services to offer biogas vehicles as an alternative more often.

Vehicle utilization

The utilization of their current trucks did not encounter any obstacles. However, the company is hoping to have an increased number of heavier trucks running on liquified biogas in the coming years, as these have not been available on the market until now, which has somewhat limited the current shape of the fleet. There has been a challenge for Vesar's suppliers with the insufficient number of filling stations for biogas.

Promotion and CSR strategy

The use of biogas contributes to the reduction of the carbon footprint of the company, however it is not clear exactly how big this reduction is. The company uses the vehicles as a way to promote

Political obstacles

One of the most powerful political tools available to public authors is public tendering, where requirements concerning the reduction of emissions need to play an increasing role. For the biogas market to achieve maturity and be able to sustain itself, it is crucial to support the industry, so that someday there is a sufficient number of filling stations and vehicles up to the market.

Future plans

The company is strongly committed to supporting the greater use of biogas as a source of energy for transport, therefore it is expected that the future tender procedures should continue to require that the contractors use biogas-fuelled trucks. The strategic investment in the biogas production facility ensures that the company will have a secured source of biogas in the coming years.

Contact

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Overview

Type of company:	Public authority
Transport commodity:	Varied
Size of company:	2,500 employees
Fleet characteristics:	The county itself has several service cars running on biogas, whereas the public transport operator's fleet consists of around 105 biogas-fuelled buses (80% of the whole fleet)
Location (geographically):	The fleet operates within the Østfold County

Company description:

Østfold county is a county in southeastern Norway, and one of the main objectives of the county plan for Østfold county is for Østfold to be a county that maintains the climate, nature and culture, while also taking environmental aspects into consideration when it comes to the public and private sectors.

In Østfold, transport is the largest source of greenhouse gas emissions. The county has therefore set a goal of increasing the proportion of the population using public transportation, but also to ensure that public transport is as environmentally friendly as possible. The county has thus set a goal of reducing CO₂ emission with 50 percent compared to 1990 levels, and in reaching this goal, Østfold County did in 2013 initiated a cooperation with Nettbuss, where 105 biogas busses were inserted on the bus routes in Østfold. These buses can use the two filling stations for biogas that have been established in Fredrikstad and Sarpsborg. Biogas buses are an important contribution to reaching the goal of halving greenhouse gas emissions compared to 1990 levels (Biogas2020, 2016a).

Decision about acquisition

The county has been insisting on investing in biogas as part of its environmental strategy, in which eliminating the emissions from transport is a crucial component. Hence, in the tender procedures regarding new public transport services, the county placed foremost importance on environment-friendly vehicles, biogas. This decision will help the county achieve its goals of going fossil-free in the coming years (Biogas2020, 2016a).

Available information

Nettbuss, the company that operates the biogas buses within the municipality, believes that there is not enough information available concerning the biogas-driven buses.

Vehicle utilization

The county reports that there have not been any problems with the introduction of biogas buses, and in fact both bus drivers and passengers have been praising the reduced noise levels, warmth in winter, comfort and reliability (Biogas2020, 2016a). The operating company has not had any breakdowns related to biogas and has increased production by 15% since the introduction (ibid.). Additionally, the drivers have reported that it has become much easier to fuel the buses, since they just need to connect a cable and they are no longer exposed to environmental conditions (ibid.). Nettbuss recognised that the limited range, half of a diesel vehicle, poses some logistical problems. There have been also some issues with biogas quality, since inadequate quality leads to clogging up of the filters. Another challenge that Nettbuss is working on is to expand the slow filling and to optimise the filling process, when all buses are connected overnight. The arising issues have been resolved in cooperation of the providers that is MAN, the bus supplier, AGA, the biogas supplier, and the supplier of the filling system. Having expanded the slow filling station, and being able to use the fast-filling station next to the bus terminal, Nettbuss is satisfied with the filling infrastructure. The staff training was done within a one-day training session, so the transition has been smooth.

Promotion and CSR strategy

The county has been using the biogas buses as examples of a sustainable transition in the transportation sector. Setting the example for others to follow is one of county's responsibilities, hence the buses are used to promote more sustainable forms of transportation among the wider population. The county and the public transport operator have received positive feedback from different stakeholders, including the bus drivers and the passengers (Biogas2020, 2016a). These goals are also in line with Nettbuses environmental strategy, where it intends to become the leader within green public bus transportation. These makes it easier for Nettbuss to attract new customers and creates a positive image for the company.

Political obstacles

Nettbuss believes that the price of biogas, which is a critical factor in their business as there are small margins, is too high. This means that the running cost per km is approximately 1,5 times higher than for diesel. The pricing in tenders is based on an index referring to the price of diesel, which leads to problems since the pricing of biogas relies on specific calculation of costs and margins. Therefore, a support system to secure a lower, stable and more competitive price of biogas would be appreciated by the company.

Results and future plans

Thanks to the positive experiences with the biogas-driven vehicles, both with the service cars and buses, the county intends to continue investing in a sustainable fleet, as this will contribute to reduce greenhouse gases emissions within the county. The expansion of the fleet is naturally also dependent

on the availability of resources, that is waste, that can be refined to biogas fuelling the green fleet. Nettbuss, as the service provider, depends on the future tenders and the policy of the headquarters.

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Summary and Conclusions

A quick glance at the biogas industry in the three Nordic countries reveals a mixed picture, one where each country experiences distinct levels and dynamics of biogas uptake, although some challenges are common across all the countries. Apart from the differences in the dominant natural resources, their availability, one of the major factors shaping the industry today is the legal framework that the actors on the respective markets need to face. Sweden comes out as the clear leader in embracing biogas as an alternative to traditional fossil fuels. The number of gas-driven vehicles in Sweden (more than 54,000) and the number of public refuelling stations (173) dwarfs the numbers observed in Norway (1487 and 20 respectively) and Denmark (461 and 17 respectively) (NGVA Europe, 2017; Biogas Oslofjord, 2018). Sweden has been able to become the leader in the region partly because of a large domestic supply of organic waste, but mostly because of the early adoption of a clear political will to support the growth of the biogas industry. In contrast, in the case of Norway, the regulators fail to provide stable and reliable conditions, which introduces excessive uncertainty on the market, prohibiting companies in the industry to plan and undertake long-term financial commitments. Denmark also seems to be lagging behind and only recently has turned more attention to supporting biogas for transport purposes.

The regulators in the three countries have used and continue to use a wide array of fiscal tools, including RD&D grants, investment grants, grants for the purchase of biogas-driven vehicles and tax exemptions (e.g. fuel, vehicle, congestion). The use of these tools differs between the countries in question as presented in Table 3. The purpose of this table is to give a general overview of historically applied instruments and does not necessarily reflect the current set of policy tools used in respective countries. A more in-depth overview of the support opportunities is available in another Biogas2020 report, under the title “Nationale og Internationale Tilskudsmuligheder”, available via Biogas2020 website (Biogas2020, 2016b). Additionally, the regulators can use command and control instruments to influence the biogas uptake through setting limits on the amount of organic waste being directed to landfills or other less energy efficient and less environmentally friendly ways of waste treatment. Furthermore, the regulators may require refuelling stations exceeding a certain threshold of annual sales to include a renewable transport fuel.

Type of support instrument	Denmark	Norway	Sweden
Fuel tax exemptions		✓	✓
Vehicle tax exemptions			✓
Other tax exemptions (congestion charge, parking fee)			✓
Vehicle purchase grants	✓	✓	✓
RD&D grants	✓	✓	✓
Investment grants or preferential loans (production and distribution infrastructure)	✓	✓	✓
Subsidising supply of feedstock	✓	✓	✓
Subsidising fuel sales	✓		

Table 3 Comparison of fiscal incentives promoting biogas use across the three Nordic countries (Danish Energy Agency, 2013; Innovasjon Norge, n.d.; Sund Energy AS, 2017; Lönnqvist, 2017; Nørgaard & Tybirk, 2014; Biogas2020, 2016b)

Looking at the engagement of the public and the private sector in taking up biogas, it becomes clear that the change is still mostly driven by the public sector. The public-sector companies, such as public transport providers, are usually obliged to follow environmental goals set up by their proprietors, therefore allowing to achieve the reduction of GHG set out in their strategic documents. The public

“the change is still mostly driven by the public sector”

authorities play an instrumental role in raising public awareness of the environmental issues resulting from using fossil fuels for transportation, in particular the negative externalities associated with it. By actively promoting the green renewal of the bus fleets, the authorities hope to set an example to follow for private actors. At the same time, most of the private companies, which own biogas-fuelled vehicles, do so because they provide services to public authorities (usually waste collection services) and are usually required to include environmentally friendly vehicles, if they want to participate in the tenders. In other sectors, it is mostly logistic companies or supermarket chains that have a strong CSR profile and want to improve their image to stand out against their competition.

The experiences from adopting the biogas vehicles using the biogas-driven vehicles have mostly been positive, with the drivers reporting an improved working environment, with lower noise levels, less vibrations, lower emissions, and better olfactory sensations. As with any new technology, their uptake is usually associated with a transition period, where people need to get accustomed to the changes, which may result in some initial hurdles for a smooth transition. Furthermore, it needs to be underlined that the new vehicles also have some downsides, especially in terms of refuelling. In many places, the relatively long refuelling times were additionally exacerbated by the low density of the refuelling stations. This added unnecessary kilometres to the daily operations, lowering the proportion of time the trucks were used productively. To alleviate these scarcity problems the companies had to rethink their operations to account for the range limitations. At this point, exchanging a diesel fleet for one based on biogas implies additional challenges compared to simply buying newer diesel-fuelled vehicles, where the overall business environment doesn't change significantly. This might prove to be a deterrent for companies and municipalities looking into biogas vehicles, as resources need to be deployed to better route planning. As biogas stations network expands, especially along the TEN-T corridors, the problems should be mitigated, which is why an early intervention by the government is not to be underestimated in establishing appropriate refuelling infrastructure. Where the biogas filling station is already well-developed, as it is in Sweden, it is crucial to ensure the quality of biogas, especially where biogas is supplied from small-scale biogas production facilities and is not delivered through a gas distribution network.

“the relatively long refuelling times are additionally exacerbated by the low density of the refuelling stations”

In Table 4, main drivers, challenges and opportunities for biogas have been enlisted.

DRIVERS	
Technical factors	
<ul style="list-style-type: none"> • Suitable for medium and long range heavy transport operations, offering better range and reliability than electric vehicles • The vehicles are very similar in operation to diesel-fuelled vehicles, which makes it easier for the drivers to adapt • The refuelling process is not very different from refuelling diesel 	
Financial factors	
<ul style="list-style-type: none"> • Limited financial incentive to switch to biogas, as both initial vehicle purchase cost and operational expenses are higher compared to traditional fossil fuels 	
Energy supply and infrastructure factors	
<ul style="list-style-type: none"> • Existing gas distribution networks together with a growing biogas infrastructure, including biogas production facilities and refuelling stations facilitate the wider adoption of biogas as a transport fuel 	
Environmental focus	
<ul style="list-style-type: none"> • Municipalities and cities pursuing environmental goals, including reduced GHG emissions and better air quality 	

Regulatory factors

- Organic waste treatment regulations, requiring a decrease in landfill disposals
 - Governments and local authorities committing themselves to reduce dependence on fossil fuels and to achieve an increased share of sustainable fuels
 - Procurements requiring specifically a certain amount of biogas, as otherwise the tender can be won by suppliers running on HVO
 - Governments offering different incentives and tax exemptions along the whole biogas value chain
-

Human factors

- Circular economy gaining traction, with a societal expectation for a better use of waste material
 - Drivers are usually positively surprised by the vehicles running on biogas, reporting them as quieter, less polluting
 - Vehicles can be used by companies as image boosters, associating the brand with environmental-friendliness, which is especially important for some environmentally-conscious customers
-

CHALLENGES

Technical factors

- Expertise on servicing biogas-driven vehicles is only slowly building up
 - The range is still a limitation and requires the drivers to refuel frequently
 - Cases have been reported where the reliability of gas tank indicator was questionable
 - Relatively long refuelling times and a need to refuel more often compared to diesel engines
 - High biogas consumption when air conditioning is intensively used
-

Financial factors

- The financial burden of biogas trucks is higher than for a comparable diesel truck, which is partly because of a small number of biogas-driven vehicles suppliers
 - The establishment of new biogas refuelling stations is also more expensive than a traditional gas station
-

Energy supply and infrastructure factors

- Limited number of refuelling stations (except for Sweden)
 - Limited biomass resources, as energy crops cannot be used due to ILUC (indirect land use change)
 - In case of Norway, competition from cheap, abundant and mostly renewable electricity severely affects biogas competitiveness
 - Competition from other end users for the substrate (e.g. district heating, CHP, electricity)
-

Environmental focus

- The low density of the refuelling stations' network negatively affects the overall environmental impact of biogas-driven vehicles, since it adds unnecessary mileage and hence increases emissions
 - Biogas seen as a "dirtier" fuel than electricity (from renewable sources), which is an obstacle for municipalities planning to become zero emission in the coming years (especially in Norway)
-

Regulatory factors

- Inconsistent and unpredictable policy regarding the use of biogas, especially in Norway
 - Biogas seen only as a transitional fuel before electricity takes over as the main energy source for heavy transport, at least in the case of short and medium range transport
-

Human factors

- The introduction of biogas is sometimes met with scepticism, especially if the more time-consuming refuelling is taken into consideration
 - Many transport companies believe that HVO is the way forward, which is problematic because of its use of palm oil
 - Little know-how about biogas and little awareness of its lifecycle benefits in Norway
-

OPPORTUNITIES

Technical factors

- The infrastructure required to distribute biogas is the same as the one used to distribute natural gas nowadays, which is an advantage compared to electricity, hydrogen or even biofuels

Financial factors

- All three countries offer financial benefits, either in terms of tax exemptions or direct grants, to different actors along the biogas value chain, which should lead to making the business case for biogas
- As the biogas vehicles become more common and the technology matures, the initial purchase cost as well as the operational expenses should decrease over time, eventually levelling with that of diesel vehicles

Energy supply and infrastructure factors

- The increasing number of biogas production plants will increase supply, eventually pushing down the prices of biogas
- The increasing number of refuelling stations will reduce the unnecessary mileage experienced today by the drivers
- Better organic household waste collection systems should provide additional supply to biogas production plants, leading to increased biogas production

Environmental focus

- The increased focus on circular economy and energy independence should put more pressure on utilising locally available resources, such as biomass
- The obligation to reduce GHG emissions will continue to path the way for biogas to substitute fossil fuels

Regulatory factors

- The governments should continue to support biogas as a feasible alternative to fossil fuels in long-distance heavy transport
- The pressure to further reduce inefficient waste disposal will increase the amount of feedstock available for biogas production

Human factors

- As biogas becomes more prevalent, people's attitudes should change and it should become easier for them to treat biogas as a valid fuel, therefore increasing the attractiveness of biogas-fuelled cars

Table 4 Drivers, challenges and opportunities

Having in mind all the drivers, challenges and opportunities, it is of utmost importance to understand what governments, local governments, municipalities, and private sector actors can do to speed up the uptake of biogas as a fuel for heavy transport. Even in Sweden, which comes out as the front-runner in spreading the use of biogas in Scandinavia, there are complaints about the lack of long-term vision and a support framework that creates an unpredictable and unstable environment (Lönnqvist, 2017). All three countries in question can still do a lot more, especially compared to Germany, to promote biogas for heavy transport. In this regard, in the absence of a sudden oil price shocks, focus needs to be placed on providing support, whether financial or regulatory, for all stages of value creation, not only on chosen ones. Even though, as can be seen in Table 4, all three countries have used some forms of tax exemptions or subsidies and grants, these instruments have not been implemented in a continuous and systemic manner. In some cases, they have even led to distortion of the biogas market in the other countries, as Swedish biogas industry is now threatened by imported biogas, which means there is a

“the most important task for the regulators is providing a predictable environment”

greater need for harmonisation in all three countries. The biogas industry is still a relatively young one, with production costs exceeding those of traditional fossil fuels, which is why it is still very vulnerable to policy changes. The industry is also dependent on policies spanning a wide range of areas from agriculture, rural development, through waste treatment, fossil fuels regulations, to environment protection. This adds complexity to the general picture and involves many stakeholders, often having contradictory interests and goals. Even within the biogas industry, there are competing pathways regarding the end use of biogas, whether it be heating, electricity or transport fuels.

In this context, the most important task for the regulators is providing a predictable environment, one where actors have clear incentives to invest in biogas and where they can build a viable business case. As has been mentioned, this requires that the governments treat biogas as a valid, environment friendly alternative to fossil fuels in heavy transport, and therefore include it in their long-term

“The success of biogas in heavy transport hinges on the appropriate cooperation between private actors and public authorities”

environment and energy strategies. It is crucial to clearly indicate the pathway towards sustainable transportation, since today many companies are unsure as to how they should expand their fleet, which adds unnecessary

uncertainty to their decisions as well as additional costs, stemming from fleet complexity. In the case of Denmark, most interviewees have indicated the taxation system as the main obstacle, since the price is considerably higher than for diesel. Therefore, the government should recognize that, if left only to market forces, the proliferation of biogas will encounter substantial obstacles for as long as fossil fuel prices remain relatively low, which will significantly delay the sustainable transition in heavy transport. This will in turn hinder the environmental goals set out by the government. In Norway, it is predominantly about stimulating the demand side, since the supply side has already received considerable attention, however it is the demand that needs stronger incentives for biogas to establish itself as an easily accessible alternative to fossil fuels (Sund Energy AS, 2017). This increased need to support the demand side has found reflection in a newly introduced support scheme, where Enova offers a grant covering from 40% to 50% of the additional cost of a biogas vehicle, depending on the size of the company (ENOVA, 2017).

Nevertheless, the actors on the biogas market should not simply rely on the governments to propose the perfect solutions right away. The success of biogas in heavy transport hinges on the appropriate cooperation between private actors and public authorities, which should first and foremost concentrate on procurement of biogas vehicles and practically showcasing the lifecycle environmental benefits of biogas, which are otherwise well scientifically documented (see e.g. Hagman, L., & Eklund, M. (2016). The role of biogas solutions in the circular and bio-based economy), and how it can

contribute to achieving a sustainable future. The companies deciding to switch to biogas should have strong commitment from the leadership, patience to endure initial setbacks, and should see biogas as a way to brand themselves and stand out against the competition. Ultimately, there is a need to create broad coalitions encompassing companies along the whole biogas value chain, from biogas producers through biogas distributors to vehicle manufacturers, to guarantee that all pieces of the puzzle are in place.

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BioGas2020

About Biogas2020

Biogas2020 is a partnership project within the EU-program Interreg Öresund-Kattegat-Skagerrak. The goal is to build strong networks throughout the biogas value chain. To reach this goal, one objective of the project is to develop a Scandinavian biogas platform where industry players can grow in partnership.

The project encompasses three countries and three regions taking a major step forward together, despite being in different situations and different stages in developing their biogas industry. The project 34 partners work on expanding biogas production, improving processes and creating infrastructure.

Within the project, NTU ApS is the lead partner of Work Package 5 concerning the use of biogas for heavy transport. The activities within this WP include, among others, examining national and international funding opportunities, mobilizing the stakeholder network, setting up a biogas station map, presenting best practices, analyzing business models, disseminating knowledge on biogas use through articles.

<http://biogas2020.se/>

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