Technical Support Document

Cooperation between public and private partners in investment of clean fuel infrastructure

Interreg Baltic Sea Region Project #R032 "Sustainable and Multimodal Transport Actions in the Scandinavian-Adriatic Corridor"

Work Package	WP2 Clean Fuel Deployment				
Activity	A2.2 Technical Support Document				
Responsible Partner	Region Skåne and Skåne Association of Local Authorities				
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Version	4.0	Date	31.10.2018	Status	Final

Document Approval Chronology

Document			Revision / Approval	
Version	**Date**	**Status**	**Date**	**Status**
1.0	18.09.2017	Partial draft	25.09.2017	Revision required
1.1	23.10.2017	Full draft	03.10.2017	Revision required
1.2	03.11.2017	Final draft	10.11.2017	Small changes
2.0	17.11.2017	Final draft	22.01.2018	Revision required
3.0	2018.06.18	Final	2018.06.18	Approved
4.0	2018.10.31	Final	2018.10.31	Approved

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Executive Summary

Scandria®2Act is a project that brings together regions located along the Baltic sea region stretch of the Scandinavian-Mediterranean Core Network Corridor (ScanMed CNC). The project aims to answer major regional development challenges associated with future transport development along the newly established ScanMed corridor. It supports regional activities to foster the corridor deployment and to adopt regional development measures to the opportunities provided by the European transport policy approach.

Within the context of the Scandria®2Act project, this report presents work relating to the deployment of clean fuels. Specifically, the report looks at how partners from public and private organisations cooperate in establishing clean fuel infrastructure in Sweden. Clean fuel infrastructure includes distribution facilities, charging units and refueling stations. The main target groups for this report are smaller municipalities as well as regional authorities located along the northern ScanMed corridor. This report should function as a supporting document for knowledge and experience exchange between municipalities in the northern ScanMed corridor, thus enabling establishment and expansion of clean fuel infrastructure.

The aims of the study presented in this report are the following:

- To support exchange of experience between regions along the northern ScanMed corridor in order to support the development of clean fuel infrastructure
- To present ways for the private and public sectors to cooperate which lead to good solutions
- To investigate which elements are important in the development of working public-private partnership finance models for clean fuel infrastructure (incl. driving forces from municipalities)
- To show the roles of the public (on different levels) as well as private bodies in the development of clean fuel infrastructure on an overarching level

The different fuel types that are covered by this study are: compressed biogas (CBG) or compressed natural gas (CNG); liquified biogas (LBG) or liquified natural gas (LNG); electricity for battery electric vehicles (BEV); hydrogen for fuel cell electric vehicles (FCEV).

The method used was primarily desktop research complemented with interviews for 5 case studies. The consultants who authored the report had regular meetings with representatives from Region Skåne and Skåne Association of Local Authorities.

The framework for the study is set by describing the policy framework as well as current state of clean fuel infrastructure and the market for different fuels in the region of Scania which is the main geographic focus of this project. Then the theoretical background for case studies is presented covering a definition of PPP (public-private-partnerships), and a presentation of different financing forms and organisational forms that can be used for establishing clean fuel infrastructure.

5 case studies of cooperation between public and private actors in the establishment of clean fuel infrastructure were chosen. Each case study includes a short description of the clean fuel infrastructure, a description of the cooperation between public and private actors, the market for the infrastructure, and lessons learnt / transferability. The 5 Swedish case studies are:

1. Biogas Ystad-Österlen: biomethane refuelling station
2. Hydrogen refuelling station in Gothenburg
3. CBG production facility in Linköping
4. Electric fast chargers within the GREAT project in Scania
5. LBG refuelling station in Helsingborg

The report finishes with conclusions and recommendations for other municipalities and regional authorities working with establishing clean fuel infrastructure.

Main conclusions

The main conclusions from the report are divided into three categories: conclusions regarding organisational forms, conclusions regarding the role of public organisations and conclusions regarding transferability. The conclusions are summarised below.

Conclusions regarding the organisational forms for clean fuel infrastructure

The findings from this study show that there are no PPP financing models for clean fuel infrastructure in Sweden. However, public and private partners *do* cooperate to establish clean fuel infrastructure; often this is through agreements that one party will purchase vehicles or in another way support the growth of the customer market for the new infrastructure, while the other builds the infrastructure. Nearly all of the case studies show examples of limited companies that own and run the clean fuel infrastructure. This means that business thinking needs to be in place, and a business model needs to be considered right from the outset. If infrastructure is established as a part of a project without a clear business model, continuity can be a problem.

Conclusions regarding the role of public organisations in the establishment of clean fuel infrastructure

The public sector drives the establishment of clean fuel infrastructure, and takes the financial risk in nearly all cases. The public sector in many cases also supports the market development by being customers themselves, and have an important role to play in driving the initial development of the market for clean fuels. It is important that the framework conditions are right in order to create solutions that will last in the long term, and help to support the growth of the clean fuel vehicle market. Public authorities can help to create the right conditions through policies, regulations, incentives but also work on behavioural change to stimulate the market, and support in management / administration regarding funding applications / projects. When policies are not long-term, and change over time, this can create uncertainty for cleaner fuels, and lead to lack of willingness to invest in infrastructure. The examples presented in this report show that public funding is needed at the outset. Different types of public funding are possible, e.g. subsidies or publicly-owned companies which make the investment.

Conclusions regarding transferability – what needs to be considered?

There are many things that need to be considered by a local or regional authority embarking on establishing or supporting the establishment of clean fuel infrastructure. Some framework conditions need to be in place, and they should be evaluated. These include looking at policy framework, political support, existing subsidies and regulations as well as an understanding of the existing and future vehicle market and stakeholder analysis. If the framework conditions are in place, there are also a number of key things that need to be addressed in setting up the clean fuel infrastructure including ensuring that enough resources are in place, the organisational form, definition of partnerships and roles, and consideration of the business model.

Recommendations

Based on the findings from the study, several recommendations are made for local and regional authorities along the northern ScanMed corridor. These follow two strands, the first based on maintaining and using public sector support, and the second on thinking long term, and with a business mindset in order to create sustainable solutions in the long run.

The recommendations on how to maintain and use support of the public sector are:

→ **Use public financing from EU or national or regional level if it coincides with your own goals for the region / municipality**

There is often funding available, and it is important to use this in order to stimulate both supply and demand since often sustainable business models cannot be established from the beginning. Public financing is needed to kick-start establishment when the market is not in place.

→ **Lobby higher levels of government to support relevant incentives and legislation**

The national governmental level especially (or regional if they have legislative power in your country) have a role to play in creating the right framework conditions to support the vehicle market for clean fuels. Use your lobbying potential to support this in the right direction.

→ **Use the tools at your disposal to support both supply and demand**

It is not just through financing that the public sector can support the private sector in establishing clean fuel infrastructure. Understand what the private sector are interested in and go from there: if demand for the clean fuels needs to increase perhaps behavioural change measures are important or legislation or regulations, networking opportunities, etc. The public authority has a role to play in setting the right framework conditions.

→ **Choose the right fuels based on the profile of your municipality**

It is important to have customers for the fuel, so the right fuel type needs to be considered for the area e.g. large amounts of freight transit traffic can benefit from LNG refuelling station, or a highly innovative authority that is developing fuel cell technology may want to support hydrogen refuelling etc. Consider what matches your needs and profile best.

→ **Be your own customer**

Use your own fleets and the transport for which you are responsible – or that you contract – as a way to create a market for the alternative fuel infrastructure. Engage companies and civil society to do so as well. The public sector can be the pioneers adapting new technology to show functionality and support the adoption by others.

→ **Join resources with other public bodies**

This can be done for example by grouping several municipalities together that jointly invest in infrastructure.

Think long-term and business minded

→ **Do a market analysis before you start**

It is important that the conditions are right in order to set up the infrastructure, and this should be studied before the work is done. For the examples shown here, it has quite often been possible to get funding to study the pre-requisites before embarking on pilots and establishment of refuelling stations. This should look at whether the conditions are appropriate for a sustainable business model to be established in the long run. The market analysis also needs to be repeated regularly once the infrastructure is established.

→ **Cooperate with the private sector to create a market**

The cooperation with the private sector can take various forms. It is important to have a dialogue with private partners to understand their needs, and build a cooperation model that takes this into account.

→ **Diversify your customer base from the outset**

Diversifying the customer base buying the fuel reduces risk for the clean fuel infrastructure. For example, if there is only one customer and they decide not to retrofit their fleet as agreed, this creates problems for creating a sustainable business model.

→ **Use (research) projects**

Publicly financed cooperation projects between private and public sector enable different organisations to work towards shared goals. It also gives the possibility to involve the vehicle industry if new vehicle technology needs to be developed within a pilot project, and allows public and private partners to share their (differing) competences and experiences with each other. However, even within a research project, the business model should be considered at the outset otherwise it is likely that the pilot cannot be scaled up.

→ **Bind partners who will buy the fuels**

Without binding partners, there is a risk that the market will not be established. Binding of partners can be done for example by getting them to buy shares/membership in the infrastructure/association, or getting them to sign contracts. This can be another way to share the risk, and can help to define clearly the roles and responsibilities as well as financial input from different actors.

→ **Look at and communicate the benefits in a wider perspective**

Even if the return on investment is not clear, consider how the infrastructure contributes to wider societal benefits. The benefits for air quality, fuel independence, CO_2 emission reduction and job creation are important for public authorities but are not quantified when the cost of infrastructure is considered. It is important to consider these wider benefits. Communication on the benefits can help to get continued political (and financial) support.

→ **Consider using a publicly owned company for investments**

This reduces the risk for the public authority, and focuses the investment towards being market-orientated. If the authority then changes policy, it should be possible to sell off investments more easily. Using a publicly owned company rather than a private company also allows more flexibility in terms of return on investment, and more investments directed by policy rather than (solely) profit.

→ **Be prepared for changes in the popularity of fuel types**

Be aware that changes in the use and popularity of different types of clean fuels can change suddenly due, for example, to changes in policy, market, technological improvements of other fuel types etc. This is not always within your control. But prepare by building a resilient business model by diversifying costumers and close cooperation with other actors in the value chain.

1 Introduction

Scandria®2Act is a project that brings together regions located along the Baltic sea region stretch of the Scandinavian-Mediterranean Core Network Corridor (ScanMed CNC). The project aims to answer major regional development challenges associated with future transport development along the newly established ScanMed corridor. It supports regional activities to foster the corridor deployment and to adopt regional development measures to the opportunities provided by the European transport policy approach.

Scandria®2Act covers partners from all Member States and Norway located along the Baltic sea region stretch of the ScanMed Corridor. It represents relevant urban nodes as well as multimodal nodes along the corridor. The project coordinates efforts related to the deployment of the ScanMed Core Network Corridor as one of four Core Network Corridors connecting the Baltic sea region to the rest of the European Union.

The major objective of Scandria®2Act is to foster clean, multimodal transport through the corridor regions to increase connectivity and competitiveness of corridor regions while at the same time minimising negative environmental impact induced by transport activities. To achieve this objective, the project partners have developed a joint approach that addresses:

- the deployment of clean fuels,
- the deployment of multimodal transport services and
- the establishment of a multilevel governance mechanism based on mutual dialogue between decision makers at regional, national and European level.

Within the context of the Scandria®2Act project, this report presents work relating to the deployment of clean fuels. Specifically, the report looks at how partners from public and private organisations cooperate in establishing clean fuel infrastructure in Sweden. Clean fuel infrastructure includes distribution facilities, charging units and filling stations. The target group for the report is regional authorities as well as smaller municipalities located along the northern ScanMed corridor, and this report includes a consideration of how findings can be transferred to this target group.

The conclusions and recommendations in this report depend on the information gathered over the summer/autumn of 2017. It is important to note that things can move quickly in this field, and depend on the state of play when the information is gathered.

1.1 Background

There are ambitious goals for decarbonising transport in Europe, and this depends – amongst other things – on a shift to the use of cleaner transport fuels for both passenger and freight transport. Although there are efforts to increase the use of renewable fuels in transport, the share is still very low. In order for fleet operators and private vehicle owners to make the shift to cleaner fuels, it is important that charging infrastructure is in place. Public authorities need support to understand how best to set up clean fuel infrastructure, for example by sharing experience between different regions and examples. This report focuses exactly on this topic and highlights examples of how public authorities have worked together with private organisations in the establishment of clean fuel infrastructure.

The focus in the report is particularly on setting up clean fuel infrastructure, and how public and private partners have worked together to do this within 6 case studies. Just partnerships between public and private actors are the focus of the report, as it is accepted that both public and private actors have a role to play in the establishment of clean fuel infrastructure. Often public authorities cannot do it alone, as infrastructure financed primarily by public subsidy is rarely economically sustainable in the long run.

Private companies on the other hand can find it hard to invest, since the market is often not established enough for cleaner fuels for there to be a clear business model from the outset. Cooperation between public and private organisations allows for a sharing of risk and finance. This can help solve the classic “chicken-and-egg” problem related to clean fuels whereby no one wants to invest in infrastructure before the vehicle market is established, and no one wants to invest in the vehicle market before the infrastructure is established.

Within the context of the Scandria®2Act project, the study presented here provides input to other work looking at the deployment of cleaner fuels as well as evidence and findings to support the dialogue between decision makers at regional, national and European level. This report provides input to project deliverable Assessment Report of clean fuel deployment experience in the Scandria corridor regions for which the aim is to make the extensice experience in the region availale for the deployment of clean fuels in the ScanMed corridor.

1.2 Aim and scope

The aims of the study presented in this report are the following:

- To support exchange of experience between regions along the northern ScanMed corridor in order to support the development of clean fuel infrastructure
- To present ways for the private and public sectors to cooperate which lead to good solutions
- To investigate which elements are important in the development of working PPP finance models for clean fuel infrastructure (incl. driving forces from municipalities)
- To show the roles of the public (on different levels) as well as private bodies in the development of clean fuel infrastructure on an overarching level

The report presents cooperation possibilities between the private and the public sector that lead to good solutions as well as lessons-learned from experiences in Sweden. The importance of the public involvement in the development of clean fuel infrastructure is especially highlighted. Clean fuel infrastructure includes distribution facilities, charging units and filling stations. The different fuel types that are covered by this project are:

- Compressed biogas (CBG) or compressed natural gas (CNG)
- Liquified biogas (LBG) or liquified natural gas (LNG).
- Electricity through battery electric vehicles (BEV)
- Hydrogen for fuel cell electric vehicles (FCEV)

The study includes case study examples of clean fuel infrastructure covering the above fuel types from Sweden, with a focus on the Scania region, where available. Both passenger and freight transport are covered. The case studies are considered with respect to their transferability to other municipalities, with a focus on small municipalities: this means we highlight key points that need to be considered if another municipality is interested in establishing clean fuel infrastructure as described in the case presented in this report.

1.3 Method

In order to cover the aims of the study, the following steps were undertaken:

- Mini workshop with representatives from Region Skåne, Skåne Association of Local Authorities, and Trivector to define the aims, scope and methods for the study.
- Desktop research to:
    - investigate PPP finance models
    - understand the conditions for clean fuel infrastructure in the Scania region
    - identify case studies and relevant interviewees for case studies

- Interviews to gain insight into case studies, and find further relevant case studies. Interviews were based on an interview guide
- Analysis to identify main conclusions and recommendations from the study performed by the consultants.

Beyond this, the consultant that was tasked with this study has had regular update meetings with representatives from Region Skåne and the Skåne Association of Local Authorities. The report was written by the consultants with two rounds of feedback / quality control from Region Skåne and Skåne Association of Local Authorities

Below in Table 1, is a summary of how the aims of the study (defined in section 0) were addressed.

Table 1 The aims of this study, and how they were addressed.

Aim	How addressed
To support exchange of experience between regions along the northern ScanMed corridor in order to support the development of clean fuel infrastructure	Collection of case studies from Sweden, described and analysed including transferability / lessons learned.
Present ways for the private and public sectors to cooperate which lead to good solutions	Investigation of PPP finance models and collection of case studies including details of financing
Investigate which elements are important in the development of working PPP finance models for clean fuel infrastructure (incl. driving forces from municipalities)	Investigation and discussion/analysis of why no examples of PPP finance models were found in Sweden.
Show the roles of the public (on different levels) as well as private bodies in the development of clean fuel infrastructure on an overarching level	Investigation of framework conditions – including policy framework in Scania region as well as on national and European level. Discussion of PPP in case studies, and analysis of implications.

1.4 Target group

The main target group for this project is smaller municipalities located along the northern ScanMed corridor. A second target group is regional authorities located in the northern ScanMed corridor. This report should function as a supporting document for knowledge and experience exchange between municipalities, thus enabling establishment and expansion of clean fuel infrastructure.

Additionally, this report provides input to another report, *Assessment report of clean fuel deployment experience in the Scandria corridor regions*, being prepared within the framework of the Scandria®2Act project, and the target group is also partners involved in the preparation of that report (led by Skåne Association of Local Authorities).

1.5 What's in this report

This report investigates how organisations cooperate in setting up clean fuel infrastructure. Chapter 3 sets the framework for the project by describing the policy framework as well as current state of clean fuel infrastructure and the market for different fuels in the region of Scania which is the geographic focus of this project. Then the theoretical background for case studies is presented in chapter 4, covering definition of PPP, and presentation of different financing forms as well as organisational forms that can be used for establishing clean fuel infrastructure.

Following this, 5 case studies are presented which cover the fuel types of relevance for this project. The case studies all include a short description including location and context, the cooperation that was required to establish the infrastructure, the market, lessons learnt and transferability aspects. The focus of the case studies is on the organisational forms and cooperation between organisations in the establishment of the facilities.

The report finishes with conclusions from the project and case studies, and recommendations for municipalities working with establishing clean fuel infrastructure.

2 Policy framework and state of clean fuels in the Scania region

To best understand examples of the establishment of clean fuel infrastructure in Sweden – and particularly the Scania region – it is important to understand the context in which the infrastructure is built. This is important, both to understand the examples, as well as to understand how transferable the examples can be. For example: if there is already an established CBG market in the region, the business case for a CBG refuelling station can be quite clear and thus a private operator can establish a refuelling station without significant support or public subsidy. Understanding the conditions for establishment of clean fuel infrastructure is key to provide context to the case studies presented in chapter 4. This chapter looks at this context: policy frameworks on regional, national and European level; relevant legislation / incentives; the market for clean fuels; and the current state of clean fuel infrastructure.

2.1 Policy framework

The policy framework for clean fuel infrastructure that has an impact on the Scania region comes from three different levels: European, national (Swedish) and regional (Scania region). These are described below.

2.1.1 European level

The European Union has ambitious goals for de-carbonising the transport sector as set out in the Transport White Paper published in 2011 [EU, 2011]. These include a reduction of at least 60% of GHGs by 2050 with respect to 1990 from the transport sector and 20% below their 2008 level by 2030. There are specific goals for both passenger and freight transport for urban and long-distance transport.

At the same time, TEN-T policy, which underpins the funding of the Scandria®2Act project focuses on providing a fully functional and EU-wide multimodal ‘core network’ by 2030, with a high quality and capacity network by 2050 and a corresponding set of information services. Thus, the implementation and development of the infrastructure must go hand-in-hand with a consideration of reducing CO_2 emissions. This is further emphasised in the European Clean Fuel for Transport Package, which includes a directive on the deployment of alternative fuels infrastructure published in 2014 [EU, 2014]. The European Union takes a strong role in supporting the development of alternative fuels, as well as considerable funding through structural funds as well as European research funds. This is because it is thought that Member States require cooperation to implement alternative fuels in a coherent fashion across the Union, and to create a market.

A policy that the European Union uses, is research money through the H2020 programme as well as other funding mechanisms. These funds support the establishment and development of clean fuel infrastructure but at the same time support cooperation between partners – both within and across borders.

Even though the plans are written on reasonably long timeframes, the economic-budgetary backing for the policies is not always consistently delivered on equally long timeframes due to changes in political priorities over time. It can be said that budgets are “policies by numbers”, and the budgets do not always follow the policies. This is true at European level, but also at lower levels of government.

2.1.2 Swedish level

The Swedish government submitted their national policy framework for clean fuel infrastructure in November 2016, as required by the European Directive on the deployment of alternative fuels.

Existing policy in Sweden already covers the requirements in the European Directive, and Sweden has higher ambitions with regards to de-carbonising the transport sector than the European framework. The goal for Sweden is to have one of the first fossil-fuel free vehicle fleets in the world [Regeringskansliet, 2016].

A strategic plan for making the transport sector fossil-fuel free was published in 2017 [Energimyndigheten, 2017], and is the latest policy in this area. The plan includes a raft of measures to achieve the goal that CO_2 emissions from the transport sector will be reduced by at least 70 % from 2010 levels by 2030, and the goal to be climate neutral by 2045. As part of this plan, there is a suggestion that regional authorities make their own plans for clean fuel infrastructure, as a basis for municipalities to be required to consider clean fuel infrastructure in their planning processes.

Sweden also supports research and development in clean fuel technologies through different programmes run by national organisations: the Swedish Energy Agency, the Swedish Environmental Protection Agency, the Swedish Innovation Agency and the Swedish Transport Administration being the main funding bodies. Through these agencies, there is also support for cooperation, exchange of experience, and capacity building to support the development of clean fuel infrastructure.

2.1.3 Regional level (Scania region)

Scania has the vision to be independent of fossil fuel in the areas of electricity, heating and transport by 2030. In a cooperation between Region Skåne, Skåne Association of Local Authorities and the County Administrative Board of Skåne, a pledge to be fossil free by 2030 has been made [Region Skåne, 2017a].

Scania's regional development strategy (Open Skåne 2030) is the overarching policy document, acting as an umbrella for several other policies [Region Skåne, 2017b]. For the transport sector, there are several different policies that support the decarbonisation aim, most notably the strategy for a sustainable transport system in Scania 2050 [Region Skåne, 2017c] as well as various other strategies that fall under this including a freight transport strategy [Region Skåne, 2017d], and an action plan for fossil-free fuels which is under preparation. With specific reference to alternative fuels, the region has a strategy for biogas [Region Skåne, 2015], which predates work on the strategy for a sustainable transport system, and for which there is a goal for the region to be Europe's leading biogas region by 2030. There is no strategy for electromobility or hydrogen (FCEV), however a strategic study has been performed outlining ways forward for electric charging stations in the region [Strömfelt, 2013].

Within the context of the policies and goals set up at the regional level, the Scania region is involved in work to support the development of alternative fuels through coordination actions/networking (coordinating municipalities within the region, coordinating with other regions and over national borders), participation in research and innovation projects, capacity building, and exchange of information with various partners.

2.1.4 Regional level (Västra Götaland region)

The region of Västra Götaland is a region to the north of Scania, located on the west coast for which the main city is Gothenburg – Sweden's second biggest city. Even though the focus of this report is the Scania region, some examples from Västra Götaland region were also used. The northern ScanMed corridor branches in Scania to the west and east as it travels northwards. The western part of the corridor passes through the Västra Götaland region.

The region established policy goals in 2009 for the region to be fossil-fuel independent by 2030. How this will be done is described in a strategy document "Strategic choices for a good life in a fossil fuel independent Västra Götaland" [Västra Götaland, 2017]. One of the four thematic priorities in this

strategy is sustainable transport, for which the accelerated shift to alternative fuels is a key part. Here are included measures to coherently plan charging and gas refuelling infrastructure across the region, and cooperate with other regions.

In Gothenburg, there is much ongoing vehicle research since the headquarters of Volvo are located there, and several other vehicle-based initiatives. The region clearly includes cooperation with the vehicle industry in developing technologies, running pilots and researching new fuels as part of their policy.

2.1.5 Municipality level in Scania region and Västra Götaland region

There are 33 municipalities within the Scania region – in Sweden there are 290 municipalities in total divided into 20 regions. The size and population of the municipalities in Scania differ considerably. The largest municipalities in terms of population (which in Scania are based around the main cities: Malmö, Helsingborg, Lund in order of population size) develop their own strategies for sustainable transport, and have resources to implement and follow-up work in the area. Although some smaller municipalities also have strategies and policies to decrease CO_2 emissions, there is often a lack of financial and personnel support to implement and follow up measures. Smaller municipalities tend to group together or work in cooperation with the regional level – either with Region Skåne or with the Skåne Association of Local Authorities – to implement measures.

This is similar in other regions in the country. In Västra Götaland region, the municipality where the City of Gothenburg is located has the highest population and has established plans for working on sustainable transport and the promotion of clean fuel use and infrastructure. Other municipalities work in different groupings – sometimes with geographical Gothenburg region or otherwise.

Whether the smaller municipalities are engaged in the question of clean fuel infrastructure on the policy level is often reliant on individuals (on the political or civil servant level) who are engaged and willing to drive the question forward. Ultimately in smaller municipalities, the question of resources is decisive in whether a policy is driven / taken forward.

2.2 Regulations & incentives

2.2.1 European

On the European level, the most important directive regarding clean fuel infrastructure is the Directive on the deployment of alternative fuels, adopted in 2014 [EU, 2014]. The directive:

- Requires Member States to develop national policy frameworks for the market development of alternative fuels and their infrastructure.
- Foresees the use of common technical specifications for recharging and refuelling stations.
- Paves the way for setting up appropriate consumer information on alternative fuels, including a clear and sound price comparison methodology.

An overview of what is included in the European directive is included below in Table 2. So far 18 Member States out of 28 have submitted their national policy frameworks (June 2017), and those that have been submitted will be evaluated by the European Commission by the end of 2017.

Table 2 Fuel types, requirements and deadlines for clean fuel infrastructure in Europe. Source: 2014/94/EU [EU, 2014]

What	Coverage	Timings
Electricity in urban/suburban and other densely populated areas	Appropriate number of publically accessible points	by end 2020
CNG in urban/suburban and other densely populated areas	Appropriate number of points	by end 2020
CNG along the TEN-T core network	Appropriate number of points	by end 2025
Electricity at shore-side	Ports of the TEN-T core network and other ports	by end 2025
Hydrogen in the Member States who choose to develop it	Appropriate number of points	by end 2025
LNG at maritime ports	Ports of the TEN-T core network	by end 2025
LNG at inland ports	Ports of the TEN-T core network	by end 2030
LNG for heavy-duty vehicles	Appropriate number of points along the TEN-T core network	by end 2025

2.2.2 National

The Swedish national policy framework includes a description of the state of clean fuels in Sweden, as well as policy initiatives that have and will be undertaken including: fiscal incentives such as energy and CO_2 taxation, reduction in vehicle tax for clean fuel vehicles; bonus-malus for purchase of passenger cars; electric bus premium, reduced vehicle tax for heavy goods vehicles (HGV) with clean fuels, Klimatklivet (a subsidy programme for local climate investments to private and public organisations); national funds for local public transport improvements; incentives for vessels in port and R&D financing.

Most of the legal and political incentives are of a general nature and are technology neutral. The most relevant of the incentives mentioned above are

- **Infrastructure incentives.** In 2015, a state programme called “Klimatklivet” was introduced. The frame for the budget is set in regulation (2015:517) with a 700 miljon Swedish kronor per year (valid through 2020). However, parliament decides on a yearly basis in in its budget bill on the exact budget for “Klimatklivet”. The main objective of the programme is to reduce CO_2 emissions on the local and regional levels. The subsidies within the program support, amongst other things, the building of charging stations for electric vehicles and the expansion of biogas production.
- **Bonus-Malus.** When buying a new car, a taxation bonus is given to the driver if the car has no or low CO_2 emissions, while if the car has high CO_2 emissions, there is an increased tax. A decision on this new incentive is expected before the end of 2018 but has not been pulished at the time of writing. If parliament decides on bunus-malus the new rueles get into action first of july 2018.

- **Company car taxation.** The taxation of company cars promotes the use of alternatively fuelled vehicles by differential taxation for vehicles (another form of bonus-malus). This new rule is supposed to get into action in January 2018. The final decision of parliament is expected before the end of the year, but has not been published at the time of writing.
- **Environmental zones in cities from 2020.** From the year 2020 municipalities will be able to introduce environmental zones (aka low emission zones) for cars in urban areas. This supports the adoption / purchase of alternatively fuelled vehicles.
- **Tax benefits.** All biofuels that meet the EU sustainability criteria (directive 2009/28) are exempt from carbon and energy tax. This includes CBG produced in Sweden. However, this decision is only valid until the end of 2018 for liquid biofuels and until the end of 2020 for biomethane.
- **Tax disbenefits for fossil fuels.** The taxation of fossil fuels is quite high (around 70% of the price at pump is tax) and includes CO_2 and energy taxes as well as VAT. This is an indirect way of supporting alternative fuels.

In addition, there are other regulations and incentives regarding vehicles with low CO_2 emissions, for which the objective is to increase the attractivity to use cars with low CO_2 emissions. Many of these incentives are included in budget propositions – the autumn budget proposition for 2018 is currently under discussion and will probably be agreed in parliament in December 2017 – some of the examples above are included in the current budget proposition, thus have not available yet as of November 2017 (e.g. bonus-malus, environmental zones). Currently the ruling government consists of a coalition between the Social Democrats and the Green Party, but they cooperate even with the Left Party in matters of budget negotiations. New elections in Sweden will take place in September 2018.

2.3 Current state of clean fuel infrastructure in the Scania region

The focus here is on the Scania region, although this reflects mainly the state of play in Sweden as a whole. More information on the state of clean fuel infrastructure in Sweden can be found in another Scandria®2Act report (*Assessment of Clean Fuel Deployment and Market Access of Clean Fuels in the Northern Scandria corridor*) to which we refer [Gjerløw & Cornander, 2017].

2.3.1 CBG and CNG

In 2014 there were 46 CBG plants, 28 public refuelling stations and 13 stations for buses in Scania [Region Skåne, 2015b], and there has been no growth in CBG in the region since 2014. The total amount of produced biogas was 0,45TWh in the region. In 2016 the number of public refuelling stations, buses excluded, in the whole country for CNG was 160 [Regeringskansliet, 2016]. Almost 30 of these are situated in Scania.

About 90% of the stations for compressed gas in Sweden are situated in the Swedish part of the northern ScanMed corridor [Gjerløw & Cornander, 2017].

2.3.2 LBG and LNG

There is only one LBG refuelling station in Scania, which is the biggest of its kind in Sweden [Öresundskraft, 2014]. It is situated in Helsingborg and run by Öresundskraft (more details, as well as connections to the ScanMed corridor are presented in chapter 4). The liquified gas is transported to Helsingborg from Lidköping (a city further north in Sweden) where there is an LBG processing plant. It is a requirement from the EU directive that by 2025 there will be refuelling possibilities for LNG at the core ports of the TEN-T network. There are currently two ports in Scania which are core ports: Malmö and Trelleborg. Helsingborg is part of the “comprehensive” network. Gothenburg and Stockholm are

also core ports, while there are several other ports in the comprehensive network along the ScanMed corridor.

2.3.3 BEV

Today there are over 220 public charging stations (including fast and slow chargers provided by differet public and private organisations) in the Scania region [uppladdning.nu, 2017].Fast-chargers are built by fuel companies, fast-food restaurants, energy companies and electric car retailers. There is considerable range among the available charging points: different standards and different speed of charging, as well as different owners of the charging stations, including: E.ON, Clever, Tesla, municipalities, private companies. Information of charging stations in Sweden is crowd-sourced through a private initiative: www.uppladdning.nu.

The government programme Klimatklivet has promoted BEV vehicles by funding up to 50% of the cost of a charging station. This has resulted in a doubling of the number of charging stations from 2015-2017. Both fast and normal charging stations have been built and the majority of these are along the ScanMed corridor. The infrastructure is usually built by energy companies which are creating their own networks of fast chargers (e.g. E.ON, Clever, Fortum, Vattenfall). The subsidy programme is currently only open to organisations, but there is a possibility that it will be extended to private individuals in the future. About half of the Swedish population lives in apartments, which means recharging points must be provided without relying on individuals having access to their own parking or garage. This is still an unsolved problem. Within the EU funded project GREAT project, 50 fast chargers will be installed in the northern ScanMed corridor in Sweden by E.ON who are a partner in the project (about 30 are already in place, October 2017 – see chapter 4) [Gjerløw & Cornander, 2017]. Within the project, there is also work to get developers and property owners to install charging infrastructure for residences. E.ON have been using a combination of financing from EU through the GREAT project and Klimatklivet to support the roll-out of a charging network (both fast-chargers and non fast-chargers) in the Scania region.

2.3.4 Hydrogen

Currently there are no hydrogen refuelling stations in Scania. There has previously been a refuelling station in Malmö, but it was closed down since it was established as a pilot project with temporary building permission. Additionally, the market was not established enough to provide a sustainable business model.

There is no national funding programme for hydrogen infrastructure. Instead, regions and municipalities has driven this development. The regions of Scania and Västra Götaland have supported research, innovation and testing with hydrogen for FCEV for more than 10 years [Gjerløw & Cornander, 2017].

The previous temporary hydrogen refuelling station was established partially through the EU-funded project *Next Move*. Region Skåne and Malmö municipality got the possibility to purchase two hydrogen fuel cell cars for their own vehicle fleet. By being early users of fuel cell vehicles, the first steps towards a hydrogen infrastructure and a new market for FCEVs was taken. Region Skåne and the municipality of Malmö organised different activities to increase the demand for hydrogen in Scania [Gjerløw & Cornander, 2017].

There are plans to build a permanent refuelling station in Malmö. A document of intent has been formulated between relevant public and private partners - the municipality of Malmö, Region Skåne and Air Liquide. Work continues, but there is no fixed timetable for the establishment of the refuelling station.

A hydrogen refuelling station exists in Gothenburg – more details can be found in chapter 4.

2.4 Market for clean fuels in Scania

2.4.1 CBG and CNG

The region sees a large potential to use waste to produce biogas that is used for transport. The Scania region is an agricultural region with large amount of agricultural waste that can be used to produce biogas, but also other sources of waste (e.g. household waste) are used in the region.

In 2010, the County Administrative Board of Skåne analysed the potential for biogas production in the Scania region. They concluded that the region has the potential to produce 3 TWh biogas every year. However, the cost of production was still relatively high, with biogas dependent on subsidies and long-term political decisions [Region Skåne, 2015b]. This creates vulnerabilities in the market that highly affect the willingness to invest in production, infrastructure and use. There's a need of more visible and effective incentives for CBG/CNG vehicles [Gjerløw & Cornander, 2017 & Fredriksson-Möller, 2017].

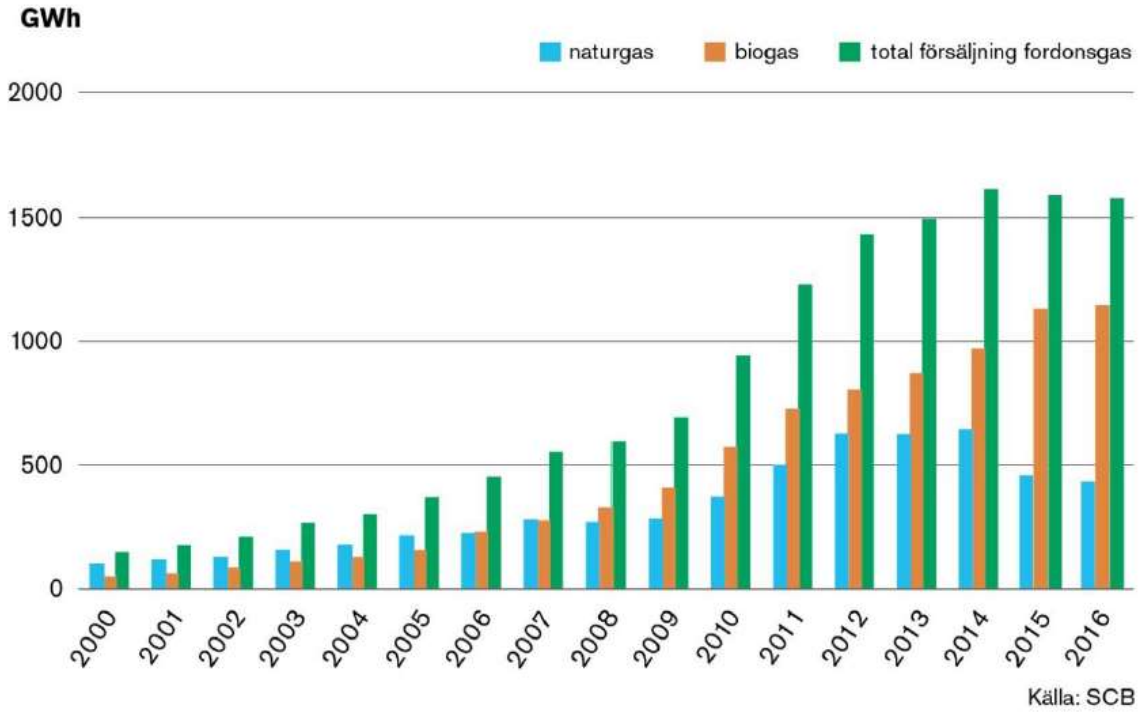

Figure 1 Sale of CBG=biogas (in orange), and CNG=naturgas (in blue) as part of total sales=total försäljning (in green) 2000-2016 in Sweden. Source: SCB 2017

The use of CBG slightly increased until 2015, but since then the use seems to have stabilised [Regeringskansliet, 2016]. This reflects a trend on the Swedish level, where it can even be seen that the share of CBG has risen compared to CNG (see Figure 1). The decline in growth of the CBG/CNG market since 2015 is blamed partly due to the strong policies on national level to support electric vehicles, and lessened support to gas vehicles [Fredriksson-Möller, 2017]. Additionally, a higher

purchase and maintenance cost as well as a low second-hand value for gas cars is considered to limit sales along with the lack of acceptance of new technologies [Gjerløw & Cornander, 2017]. Even though the market share of CBG/CNG vehicles has stopped increasing over the last few years, the number of vehicles are still relatively high in all vehicle categories compared to other fuel types in Scania. The public transport operator in the Scania region (*Skånetrafiken*) is one of the largest customers for biogas, using CBG in nearly all of their city buses, and many of their regional bus lines [ULO, 2016].

Region Skåne started investigating the possibilities (in 2014) to expand the infrastructure for biogas. Several stakeholders have expressed that a network of CBG is an important condition to expand the market for CBG. The assumption is that there is a possible market in Scania, but the potential is not fully used. The lack of infrastructure for CBG forces the producers to sell CBG only locally, which means the prices remain high. Additionally, other countries' national economic subsidies could make it harder for Swedish biogas to compete. For example in Sweden, the use of biomethane is subsidised whereas in Denmark the production of biogas is subsidised which results in Danish gas being imported to Scania / Sweden since it is more competitively priced than Swedish-produced gas.

The infrastructure for gas refuelling in Sweden is denser than in other countries along the northern ScanMed Corridor. There is good coverage of gas filling stations between Malmö and Gothenburg as well as between Malmö and Stockholm. It is more challenging in the rural areas and at the same time the localisation of refuelling stations is important. The market for CBG and CNG in dense areas is good and could grow [Gjerløw & Cornander, 2017].

2.4.2 LBG and LNG

There is a considerable amount of transit traffic travelling through Scania as well as several ports in the region [Region Skåne, 2017d]. LNG/LBG could be used as a replacement for the heavy transport (both heavy goods vehicles (HGVs) on road and sea crossings) which gives Scania good prerequisites to increase the demand and use of this fuel in Scania and create a market opportunity [Region Skåne, 2015]. However, there are very few vehicles using LNG today in Scania.There is a need for more visible and effective incentives for LBG/LNG vehicles.

Since LBG and LNG mainly is a fuel for heavy duty transport, the development of infrastructure is of importance to facilitate cross-border transport. This is recognised within European policy and legislation and requirements are made for LNG refuelling points along the CNCs and at core ports. In many countries in Europe there's an increasing interest in LBG and LNG and transport with this fuel along the northern ScanMed corridor is expected to increase. By building infrastructure for LBG and LNG it is possible to refuel long-distance trucks in the region. However, the lack of LNG infrastructure in Denmark and Norway is an obstacle for this development [Gjerløw & Cornander, 2017]. Öresundskraft has an ambition to deliver LBG that is produced in Skåne. They are considering investing in a processing plant where they want to produce liquid gas from compressed biogas [Öresundskraft, 2014].

2.4.3 BEV

In September 2016 there were approximately 8000 BEV-vehicles in Sweden [Regeringskansliet, 2016]. In Scania, more than half of all electrical vehicles are to be found in Malmö and Lund. The increase of BEV-vehicles is expected to accelerate because of the subsidies for environmental friendly vehicles and the bonus-malus system. These benefits promote buying a BEV vehicle by paying subsidies if you choose a BEV (or PHEV) vehicle instead of a fossil fuelled vehicle (see section 2.2.2). Even though the policies are technically neutral, there is a stronger promotion for BEV than other fuel types.

There are certain barriers to buying BEVs in Sweden. The main reason Swedes do not buy that many BEVs is because of the limited driving range, high purchase price and lack of charging stations [Gjerløw & Cornander, 2017]. To increase the demand for BEV-vehicles a national infrastructure with fast-chargers needs to be established. Scania is an important part in this network, partly because it is a link to Denmark in which a network of fast-chargers for BEV-vehicles is already established [Gjerløw & Cornander, 2017]. There is also a network established in Norway, and if there was a reliable charging network also in Scania and along the west coast of Sweden, the Norwegian and Danish network of fast chargers could be connected and allow trips with BEV vehicles from Norway to Sweden and Denmark and further on to Europe. Fast-chargers also promote daily use of BEV-vehicles within cities [Gjerløw & Cornander, 2017]. At the same time, since many people in Sweden live in apartments, there is need for charging infrastructure in connection to residential areas as well [Gjerløw & Cornander, 2017].

The second-hand value of clean vehicles is high in Sweden resulting in a slow growth of the fleet. This results in that the total fleet of clean vehicles is increasing more slowly than it should, if Sweden wants to reach the objective of being fossil fuel-free by 2030 [Gjerløw & Cornander, 2017].

2.4.4 Hydrogen (for FCEV)

So far, 28 hydrogen cars have been sold in Sweden, only to municipalities, regions and some companies [Gjerløw & Cornander, 2017].

There is a public/private partnership called Hydrogen Sweden (*Vätgas Sverige*). The members and funders are from the industry, NGOs and local, regional and national government levels. They try to improve national and regional incentives to develop hydrogen infrastructure and vehicles. There are currently no incentives that support the set-up of a vehicle fleet together with hydrogen refuelling stations. Such incentives could encourage more resellers to sell FCEVs and make the business more profitable, which also would help to sell more hydrogen vehicles on the commercial market [Gjerløw & Cornander, 2017].

The high investment costs make it hard to identify profitable business opportunities for hydrogen refuelling stations and vehicles. To do so, stakeholders must be prepared to bear the extra costs of investing in fuel cell car fleets [Gjerløw & Cornander, 2017]. Early July 2017 the fund Connecting European Facility approved a project application including funding of eight new hydrogen refuelling stations in the Scan Med-corridor from Copenhagen to Oslo and Stockholm. The stations should be in place before 2020 and the exact location of the stations is still to be discussed.

3 Public-private cooperation for clean fuel infrastructure

This study focuses on how different organisations cooperate in the establishment of clean fuel infrastructure. It is particularly the *establishment* of the infrastructure that is of interest, and thus also the financing: who pays for the infrastructure and owns it? Who takes (financial) risks in the establishment of the infrastructure?

This chapter presents the theoretical background for the study which is used to support the understanding of the case studies presented in the next chapter. At the outset of the project, public-private-partnership (PPP) finance models were the focus for this study, but it emerged while reviewing the theoretical background for PPP that there were no examples of PPP financing models for clean fuel infrastructure in Scania / Sweden. This chapter presents a definition of PPP finance models, different financing models as well as organisational forms that can be established to support clean fuel infrastructure. The chapter also touches on the topic of why examples of PPP financing models cannot be found in Scania / Sweden, and thus why the focus of the case studies in chapter 4 instead concentrates more on cooperation between different partners and organisational forms established in setting up clean fuel infrastructure.

Further text on PPPs to give a better understanding of the theoretical background is included in an appendix.

3.1 PPP definition

A PPP is a contractual arrangement involving the private sector in the delivery of public services. As the name suggests, this is based on a partnership approach, where the responsibility for the delivery of services is shared between the public and private sectors, both of which bring their complementary skills to the enterprise.

In this study, we follow definitions of PPP for finance that exist in the literature (see appendix for more information). A project is a PPP if:

- There are mutual objectives for the private and public partners
- Risk is shared between public and private partners
- A contractual agreement is made between public and private partners that covers either:
    - Operation and maintenance
    - Concession[1] (public ownership)
    - Concession (private ownership)

Neither full privatisation nor fully publicly owned and run facilities are examples of PPP. If services are outsourced (tendered), i.e. services are defined and paid for by the owning entity over a short timeframe, then this is not considered to be PPP either. However, services that are contracted to a private entity whereby the private entity receives payment all or in part from the end-user are considered to be PPP.

[1] Grant of exclusive privileges (such as to be the only seller of a good or service) by a government authority or by the owner of a singular property (such as an airport, amusement park, hotel) to a grantee. Also called a concessionaire, the grantee carries out a commercial undertaking (such as a restaurant), and pays a rent or a certain percentage of the sales or earnings to the grantor. Source: http://www.businessdictionary.com/definition/concession.html

3.2 PPP & financing for this study

In looking for case studies, the authors were unable to find examples of PPP which fit the theoretical framework. This is because the theoretical framework focuses primarily on the use of PPP in order to finance projects – as originally was to be the focus of this study. There are no examples where risk has been shared between the public and private sectors to the extent that we consider it being a representative example of a PPP for finance.

This is partly because PPPs are usually on a large scale (several million euros capital investment). The partnership stems from the idea of complementarity; in the normal case this means that the public organisation has a need for capital or resources (physical and human) that the private actor can supply. Through a partnership, needs and resources may be combined for the benefit of both parties. Most commonly, the public body lacks enough financial resources (capital) for large investments in long term assets. Setting up a PPP is a demanding process for both parties (transaction costs) and therefore the form is normally used for large projects, i.e. so big the public body cannot finance it or it would represent a substantial part of the overall capital budget.

The capital investments for clean fuel infrastructure tend to be in a range where it definitively would be possible for the public bodies to carry them. However, for operational reasons, the priorities are such that the public bodies prefer encouraging private actors to be involved. Therefore means to share risks are sought but on a smaller scale compared to PPPs. Additionally, in establishing clean fuel infrastructure, often the driving force is governmental policies, but at the same time, the market is not established enough at the outset for private companies to be willing to invest in the infrastructure. It is not like a road bridge infrastructure project whereby a private company already knows that many people will drive, and will have a clear understanding of willingness to pay to use a bridge. For clean fuel infrastructure, the market is often not in place at the outset, and the establishment of the infrastructure is driven instead by policy goals / societal benefit, and seen also as a way to stimulate the consumer market.

The definition of PPPs above related primarily to PPP as a way of financing projects (as this was originally meant to be the focus of this study). It is however clear that public and private partners cooperate in the establishment of clean fuel infrastructure. Instead of focusing on PPPs with the strict theoretical definition, the scope of this study was widened to instead look at how public and private actors cooperate in establishing clean fuel infrastructure. It is clear that cooperation includes elements of the partnership as described above – having mutual objectives, sharing risk, and making agreements / contracts. The main difference between the strict theoretical definition and what is included in this study is the lack of the use of PPPs to finance large-scale infrastructure projects.

The examples presented in the next chapter do include cooperation between public and private partners. We focus on different financing models as well as organisational forms, and in the case studies present how cooperation between different organisations has worked in practice. The next two sections focus on presenting different examples of financing models as well as organisational forms that can be used in the establishment of clean fuel infrastructure. The case studies are coupled back to these different theoretical forms.

3.3 Different financing models for clean fuel infrastructure

Financing clean fuel infrastructure requires investments in fixed assets with a life span of several years. It is assumed that initial investments are provided by the organisations that establish the infrastructure (including potential government subsidies) and that consumption and user fees will represent a large part of the revenues.

Apart from consumption fees there are different models for financing the investment and the supply:

- **Full public investment** – a public body makes the investment, uses public spending, and a public body takes care of operations.
- **Mixed investment** (mixed company) – public and private actors provide equity and/or debt, mixed company for operations
- **Private investment (equity), private ownership, private organisation for operations** – stimulated by public grants for initial investments.
- **Private investment (equity), private ownership, private organisation for operations** – stimulated by periodical public grants for operations.
- **Private investment (equity), private ownership and operations by private organisation**.

The models above assume either free market consumption or free market consumption in combination with directed public funds/grants. In the case of clean fuel infrastructure, public funding for infrastructure may be substituted/complemented by a promise/ agreement to use the infrastructure (e.g. the fuel provided by a refuelling station can be used by local bus services run by public authority).

To these forms you could also add the option of crowdfunding where individuals contribute with financial resources (invest) in projects or activities they wish to support. Individuals or local companies will invest because they want to have clean fuel infrastructure, either to support a good cause or to get a better supply for their own needs. This allows both raising of capital and creation of interest in the supply by attracting potential users. Which organisational form and how to arrange the factual supply still needs to be decided. Such crowdfunding variants are however seldom seen in practice.

Experience shows that making things happen at the local level in society requires a pragmatic approach and combination of resources, in terms of both knowledge (competencies) and financial/physical assets. Obtaining this requires networking and trade-offs between different stake-holders. It is not to be expected to find any pure examples of the forms above in practice. Instead there tend to be combinations and hybrid forms based on the local conditions.

3.4 Different organisational forms of relevance

In establishing clean fuel infrastructure, a new organisation often needs to be created that owns and runs the infrastructure. The type of organisational form matters because it sets out the kind of cooperation that can be made among partners, and how it can be developed in the long term. In general, there are different legal forms to choose from, and which is most suited depends on the situation. Below are descriptions of different available legal forms in Sweden. The two most common forms (which also appear in the case studies in chapter 4) are described more fully, followed by a brief presentation of the use of contracts (instead of legal forms), and then a short description of other available legal forms which do not feature in the case studies.

3.4.1 Limited company

The most common form for initiating joint activities is a limited company (in England denoted “Ltd”, in Sweden denoted “AB”). It is regulated by private law and constitutes a legal entity of its own. This kind of organisation has a long history, and a framework has been developed over time giving today a clear distribution of roles and responsibilities in the business. It is regulated by The Companies Act stipulating that Owners' liability is limited only to the share capital invested in the company. Ownership is exercised by appointing the board, where the influence is distributed in relation to the ownership of voting shares. In return, the legislation stipulates rules to guarantee reasonable shareholder transparency in the company.

Studies of limited liability companies in relation to public bodies show that they work well and that there are advantages. The main advantages are:

- clarity in roles and mission: and
- possibility to create a separate economic entity specifying roles, rights and obligations for all stakeholders.

As a legal form, the limited liability works well to combine public and private interests. It is possible to mix financial resources from public and private bodies and still give each party influence in relation to share of ownership. Since the company accumulates capital over time, the economic value in the company (for the owners) might change over time.

Given that the economic value can change over time, it is important for the parties to agree at the outset regarding future changes; a consortium agreement specifies such terms, for example when additional partners enter, or existing partners leave. Thereby the parties eliminate the possibility that the mutual relationship of power changes as a result of the fact that any party sells its shares without the consent of the others. However, the form is heavy to administrate if there are a large number of owners (i.e. private persons).

3.4.2 Economic association

An economic association is a legal entity and responsible for the activities in its own name. Economic associations are governed by special legislation supplemented by the association's statutes. The owners / members are solely responsible for the association's obligations in relation to the insured membership capital. The owners' mutual relationship and influence are governed by the statutes. In order to form an economic association, there is a need for at least three members. But on the other hand, the association cannot refuse someone to be a member as long as they share the interest of the association.

In addition, members are required to purchase, sell or otherwise use the association's services. The form appears to be possible to apply in public-private partnerships. It is especially well suited when there are a large number of stakeholders (members) since it has established procedures for individual members to enter and to leave the association.

3.4.3 Contracts – an easier way?

It is possible for independent organisations to cooperate, for example within a project, by making agreements in contracts, and often this is also seen in network settings where several parties contribute in different ways in different parts of the network. But a contract/network solution provides a more complicated situation to divide financial risks. The organisation that makes the investment will carry a higher financial risk, even though it is possible to agree upon sharing it. Looking at operational matters, contracts could be a good way to cooperate in terms of securing supply of input goods, or securing a customer base, from the facility invested in.

There are two elements that are primarily agreed in contracts:

1. Guaranteeing sales volumes
   For example, an agreement of buying a certain amount of fuel if a refuelling station is built.
2. Sharing of tasks / competences / resources
   This can be quite wide-ranging and provides a way for the organisation to take advantage of competences or resources which they do not have themselves, usually in a mutually beneficial way. For example in using food waste (a resource) to produce biogas in exchange for reduced price biomethane.

3.4.4 Other organisational forms

Non-profit organisation

A non-profit organisation (an association with members) can be a legal entity that is responsible for its own obligations. Members regulate their mutual relationships through the statutes. This form is usually not found in areas of economic nature but rather with respect to specific issues of public interest where individuals show high level of involvement.

Foundation

A foundation refers to the case whereby property is dedicated to continuously fulfilling a specific purpose. A foundation lacks formal owners and an ownership influence can only be exercised in connection with the formation. Thereafter, the business is governed by the statutes that govern the focus of the business. The ownership is exercised through the founding purposes.

Trading partnership and limited partnerships

If you want to run your business with someone else, you can form a trading partnership. The trading partnership has to have at least two owners, referred to as partners. This is a common form for minor activities with minor capital investments. The partnership does not have its own assets and each partner pays tax individually every year.

4 Case studies

This chapter describes 5 case studies of cooperation between public and private actors in the establishment of clean fuel infrastructure. Each case study includes:

- **A short description** of the clean fuel infrastructure which includes when it was set up, where it is located, what the driving forces were for the establishment, and other relevant details regarding how it is run.
- **A description of the cooperation between public and private actors** which describes the organisational form used for the infrastructure; the key relationships and contracts needed to set up the infrastructure as well as how the cooperation was established, and who owns and runs the infrastructure.
- **The market for the infrastructure** which describes the customers for the infrastructure.
- **Lessons learnt / transferability** to other municipalities. This section highlights the main lessons learnt *as highlighted by those interviewed*, and takes up several elements related to transferability of the experience to other municipalities focusing on:
    - Legal framework
    - Continuity of fuel policies, incentives, strategies
    - Possibility for smaller municipalities to do replicate
    - Constraints to transferability

The case studies were chosen to cover the different fuel types of relevance to this study. The aim was to take case studies from the Scania region which included examples of public-private cooperation, but the search was extended to other parts of Sweden (still located on or near the northern ScanMed corridor) when examples could not be found in the Scania region.

The information for the case studies was collected primarily through interviews. The main interview persons are detailed in Appendix. Other material has also been reviewed to support the interview descriptions, including publically available reports from the websites from the projects described (e.g. GREAT and HIT-2-Corridor). The description is therefore a summary of this information, written within the context of this report. In some very few cases information from interviewees differed (between each other, or information found in reports), and we have endeavoured to offer a balanced description within the context of the aim of this report. The main sources are included as footnote at the beginning of each interview.

The 5 case studies are:

1. Biogas Ystad-Österlen: biomethane refuelling stations
2. Hydrogen refuelling station in Gothenburg
3. CBG production facility in Linköping
4. Electric fast chargers within the GREAT project in Scania region
5. LBG refuelling station in Helsingborg

Half of the case studies are from the Scania region, and all are from Sweden.

4.1 Case study 1: Two biomethane refuelling stations in Tomelilla and Simrishamn[2]

4.1.1 Key details

Name	Biogas Ystad Österlen (BYÖ)
Fuel type	CBG (CNG)
Organisational form	Economic association
Financial form	Mixed investment – although almost all investment from public sector
Partners involved in establishment	Tomelilla and Simrishamn municipalities, 18 individuals and 20 companies all members of economic association.
Subsidy?	No subsidy. Loan taken with Tomelilla and Simrishamn municipalities as guarantors.
Date of implementation	2013
Share of risk	Very low risk for private sector

4.1.2 Short description of the clean fuel infrastructure

The infrastructure consists of two filling stations for gas, one outside of Tomelilla and one on the outskirts of Simrishamn (both in Scania – see Figure 2). They have been in operation since 2013. The gas used is standard natural gas or biomethane compatible for both cars and trucks. The fuel is transported by the energy company E.ON in trucks from a production facility based in Malmö. When the filling stations where built in May 2013, natural gas was supplied but the share of biomethane has increased over time, with an aim to be 100 % biomethane in the future. 15 – 20 tonnes of gas must be sold per month for the business model to break even.

The driving forces behind the establishment of the refuelling stations were threefold:

- the municipalities of Tomelilla and Simrishamn were in the process of renewing contracts for their leasing cars
- the municipalities wanted to take advantage of raw materials (primarily agricultural) that were in abundance in the vicinity
- the municipalities had local policies to reduce CO_2 and local emissions.

The municipalities wanted to guarantee the use of biomethane for vehicles that they leased but this required some kind of investment in biogas infrastructure. Ystad, Tomelilla and Simrishamn jointly funded a study that was co-financed by the Swedish Board of Agriculture (*Jordbruksverket*) to

[2] The information in this case study is based primarily on interview with Ida Abrahamsson, Tomelilla kommun. Additional material was also gathered from the reports “Småskaliga tankställen för biogas. Biogas Öst, december 2016” and “Strategi för etablering av gastankställen i Skåne – Underlag med fokus på affärsmodeller, organisationsstrukturer och finansiering. Trivector rapport 2013:72”

investigate the potential for establishing biomethane refuelling stations in the area. This was the basis for the refuelling stations which were subsequently built.

Originally, there were plans to build a biogas production plant that could deliver biomethane to the filling stations. This has not happened, and it is currently not under consideration. This was mainly due to lack of resources amongst those working with the project.

In the nearby vicinity there are other refuelling stations for gas: one in Ystad and one in Åhus in the north-eastern part of Skåne.

Figure 2 To the left, where Scania is located in Sweden. In the middle: the east of Scania where the cities are located, and to the right the location of the CNG/CBG refuelling stations: in blue those of relevance in this case study (in Tomelilla and Simrishamn), and in green other nearby biomethane refuelling stations (Ystad and Åhus).

4.1.3 Partnership

Organisational form

The refuelling stations are owned by an economic association for which any individual or entity can buy membership. The association is called Biogas Ystad-Österlen (BYÖ). When the economic association was established, the membership fee was about €1000 (10 000 Swedish kronor). The membership still costs the same amount today, but there have been very few new members since the infrastructure was established in 2013. Currently there are 18 individuals and 20 companies that are members in the association.

It was originally planned that a private (limited) company would run the refuelling stations. However, none of the energy or fuel companies contacted would take on the project, since they deemed the risk to be too high, and wanted to focus their efforts on other geographic areas. Instead, the group working on the project took inspiration from the wind power sector and started an economic association. In this way, organisations and individuals could buy into the association in return for access to (cheaper) fuel.

Ownership and management

BYÖ lease the land from the municipalities of Tomelilla and Simrishamn. BYÖ own the infrastructure and sub-contract the running and maintenance of the refuelling station to a private actor.

It took a large amount of manpower and time to create the momentum and find all of the contacts who would be part of the association. A large amount of voluntary work was put in by two women from Tomelilla and Simrishamn which they estimated amounted to 1,5 full time equivalent work, spanning the

time from the preparation of the study (beginning 2012) to the establishment of the refuelling stations (2013). This included meetings, contacts with stakeholders, contract preparation, invoicing, etc. The municipalities paid for support in certain practical elements, but the largest part of the work was done voluntarily.

The capital infrastructure cost was approx. €800 thousand (8 million SEK). The financing came from 3 sources:

1. The municipalities of Tomelilla and Simrishamn and the publicly-owned energy company of Simrishamn (Österlens kraft) invested €100 thousand each – total €300 thousand (37 %)
2. Individuals, companies, and political organisations invested a total of €100 thousand, by buying membership in BYÖ (13 %)
3. A bank loan was taken out for €400 thousand, with the municipalities (not BYÖ) as guarantors on the loan (50 %)

However, as mentioned above, a considerable amount of voluntary time was also invested in the creation of the economic association, and the establishment of the refuelling stations. The running costs are today financed by the sale of biomethane (the business model is sustainable).

Sharing risk

The municipalities and the publicly owned energy company of Simrishamn are the biggest risk takers in this project since they have invested the most money. However, all the investors have taken a risk when investing in such a facility when the financial model is constructed as an economic association. The investors were informed that if the economic association was to make a profit, it would be invested back into the refuelling stations for the first 10 years.

The members can leave the economic association at any time, but there is a risk that the money that was invested will not be refunded. According to legislation governing economic associations in Sweden, an association like this one needs to have the amount that is refunded in surplus when the departing member wants to leave. If there is no surplus, there will not be any money repaid to the departing member.

4.1.4 The market

The customers consist of: private car owners; hospital/community transport performed for Region Skåne; waste disposal trucks in Tomelilla and Simrishamn; other trucks; part of the municipal car fleet; and a bus that runs in Simrishamn. There are currently 7 waste disposal trucks and 1 bus that use the refuelling stations, but the number of private car users is unknown. In the summer months, approximately 20 000 kg worth of biomethane is sold whereas in the winter the sales are usually lower, between 15-18 000 kg. This is probably because the area of Scania in which the refuelling stations are located is a holiday destination where many Swedish people have summer houses. The primary users are for municipal services (e.g. community transport, waste disposal, public transport), either directly or through procured / tendered services. Payment is made by card – payment cards issued by E.ON or Kraftringen (power companies that supply gas in the region), or credit card.

The biggest demands come from filling larger trucks. A car is often not that dependent on using these specific filling stations because it is easier for them to use a different facility. The larger vehicles – for example waste disposal trucks – plan their routes based on the locations of the two refuelling stations, and are dependent on the biomethane being available when they arrive. BYÖ maintain a close dialogue with the waste-disposal and bus companies in order to ensure that things run smoothly. The waste disposal trucks and the bus run on a pre-arranged refuelling timetable, and serving of the station can be timetabled for when it is not in use by these larger vehicles.

BYÖ maintains a good relationship with its customers, and keeps a dialogue open with them. The relationship with customers works so well partly because many investors are local and consider the refuelling station to perform an important function in the area.

4.1.5 Lessons learnt and transferability

The following text describes conclusions and lessons learnt as described by the interviewee.

The model used in this case is to be recommended but there are a few things that are very important to ensure success. It is very important that the organisational form is set from the beginning and that there is at least one person who can dedicate a lot of time since it demands hard work, particularly at the beginning.

When the refuelling stations were built the subsidy "Klimatklivet" did not exist (see section 2.3). When planning new stations, it is highly recommended to take advantage of any subsidies that are available.

To be successful from the start it is also important that there is a broad base of customers so that the volume of gas sold is at a fairly high level since the first year may be difficult financially. The municipality itself is an important customer for the refuelling stations – this is an easy customer to involve, and important for getting the organisation off the ground. In this example local actors were highly engaged to the point of becoming members in an economic association. Chances for engagement are higher if there is a strong local or regional interest in the value chain, such as it is the case for biogas.

It is one thing to build the facilities and a different thing to manage the continuous service. By outsourcing the operation of the stations as is done for BYÖ, the organisation itself can run more cheaply and efficiently.

Table summary (based on analysis of case study)

Question	Answer
Aspects of legal framework that hamper transferability?	An economic association is a common organisational form even outside of Sweden. The crowd-sourced mixed financing used here can also be used elsewhere. Sweden has been working hard on supporting biogas industry and policy supports this both on the production side (requirements for municipalities to re-use waste) and on the consumption side (tax exemptions for gas vehicles). Similar legal aspects are evident in other European countries, but are stronger / more advanced in Sweden than certain other countries.
Continuity of fuel policies, incentives, strategies that hamper transferability?	By involving consumers of the refuelling stations as members of the association, this helps to maintain the market, and the form is less vulnerable to changes in external policies and strategies. Nevertheless, policies at the local level were driving factors for the establishment of the refuelling stations. Local engagement among employees in the municipalities was key to the success.
Is it possible for smaller municipalities to do this?	Tomelilla and Simrishamn are both small municipalities – this is perfectly transferable.

Which constraints experienced?	It is a lot of work to set up this organisational form – at least one dedicated person should be assigned to it. A lot of customers are needed to make it financially viable (this takes a lot of time).
Other points of relevance for transferability	Outsourcing the operation of the stations allows for more slimline organisation.

4.2 Case study 2: Hydrogen refuelling station in Gothenburg, Sweden[3]

4.2.1 Key details

Name	Hydrogen refuelling station, Gothenburg
Fuel type	Hydrogen
Organisational form	Refueling station owned by limited company, but set up within a European project
Financial form	Mixed investment
Partners involved in establishment	Finnish gas company Oy Woikoski. Organisational support Sweco Environment AB and Hydrogen Sweden. The station is located next to the premises of PowerCell Sweden and PowerCell supports in the operation of the station.
Subsidy?	Västra Götalands Region 25 % capital cost; EU 50 % capital cost (TEN-T)
Date of implementation	2015
Share of risk	Risk in private sector, but exposure to risk reduced significantly with public subsidies

4.2.2 Short description

The hydrogen refuelling station was opened in October 2015. The hydrogen refuelling station is located next to PowerCell Sweden AB's premises at Hisingen in Gothenburg, Sweden (see Figure 3). The station is located in a container, and could therefore easily be moved to another location. Currently it is situated on the outskirts of Gothenburg, in the west of the city, some distance from the E6 motorway which is part of the ScanMed corridor.

[3] This case study is based primarily on interviews with Geert Schaap, Sweco & Kari Salovaara, Woikoski. Earlier discussions were also made with Björn Aronsson of Hydrogen Sweden and information was searched online since it was difficult to find the right contact people. This includes articles from Powercell (Powercell, 2015) and Altenergymag.com (Altenergymag, 2015)

Västra Götalands Region (VGR) were the driving force behind the establishment of the refuelling station, to fulfil their policies with regard to sustainable transport and fossil-fuel independence (see section 2.1.4).

Passenger car as well as lorries and buses can refuel hydrogen gas. The gas is produced through electrolysis where green electricity is used. In the city of Kokkola, Finland Oy Woikoski has the largest electrolysis plant in Europe where the hydrogen for the fuelling station is produced [News, 2015].

The location of the station was chosen as it was part-financed within the context of the European project HIT-2-Corridors[4], and there was cooperation with PowerCell Sweden who are developing hydrogen fuel cells technology. HIT-2-Corridors financed two hydrogen refuelling stations in Sweden – one in Gothenburg and one at Arlanda (airport near Stockholm). It cost approximately €1.5 million for each station (15 million Swedish kronor).

The refuelling station was implemented as a technical pilot project to develop the technology. Oy Woikoski are drawing back on their commitments outside of Finland, and at the time of writing are looking for an interested party to purchase the refuelling station.

Figure 3 Location of the hydrogen charging station in Gothenburg.

4.2.3 Partnership

Organisational form

The Swedish fuel cell company PowerCell Sweden supported Hydrogen Sweden and Sweco Environment AB to assist the Finnish gas company Oy Woikoski to build the new hydrogen station. The partners were chosen based on their experience in research and innovation in hydrogen fuel cell technology, and it was not difficult to find interested parties. The European project HIT-2-Corridors was deemed successful (all activities in the project delivered and complete approved subsidy budget has been reimbursed to the partners), and three refuelling stations were built during the project (two in Sweden and one in Finland). Cooperation between the partners worked smoothly.

Ownership, management and cost

Oy Woikoski own the facility and will operate the station until 2021. The investment however is mainly based on contribution from the public sector: contribution from the EU through the Innovation Network

[4] http://hit-2-corridors.eu/

Executive Agency INEA (50%); and contribution from the Västra Götaland region (25%) while the Oy Woikoski company invested the remaining (25%). The cooperation between these actors was done within the context of a European project for which the aim was to increase coverage of the hydrogen refuelling network and use of FCEV along certain CNCs in Europe. Thus the establishment of the refuelling station was made within the context of a pilot project.

By establishing the refuelling station within a European project, Oy Woikoski receives support in applying for and administrating the application / management process for the grant application. In this case done by a transport consultancy company.

Sharing risk

Västra Götaland region discussed with several possible suppliers to build the hydrogen refuelling station, but none were interested, because they assessed the risk of low demand too high because of the low interest of potential customers in the region. When Sweco secured co-financing from the European Union, Oy Woikoski agreed to be involved (since thereby the financial risks were reduced considerably). The risk for the facility lies with the private sector (Oy Woikoski) since they own and run the facility on market conditions. At the same time, the refuelling station was established as part of a pilot project, and the public sector has taken an (operational) risk since they supplied most of the funding.

Market

The first customer for the refuelling station was the municipal administration, Western Hisingen, in Gothenburg that used the refuelling station for their first fuel cell car. The fueling station was also from the beginning used by PowerCell Sweden AB and their customers when testing fuel cell packs designed for automotive applications.

The market has slowly grown since it started in 2015. The main target groups are fleet operators, both those owned by public authorities and taxi companies which drive longer stretches than BEV allow. 100 vehicles are needed in order to make a sustainable business model. The market for FCEV has however not taken off in Gothenburg at the time of writing.

It is difficult for Oy Woikoski to make a profit on the sale of the hydrogen due to the lack of FCEV vehicles on short term.

A credit card machine is installed at the fuelling station to ensure a convenient way for customers to pay for the hydrogen gas. However, it is not yet in operation. Instead customers pay for the hydrogen using invoice.

4.2.4 Lessons learnt and transferability

The following text describes conclusions and lessons learnt as described by the interviewees.
The location of the refuelling station was very important – not just because of access for FCEV, but also to market the refuelling station. Being close to Powercell but still separate was important for this purpose since Powercell is a known actor in the field but having own land showed that the refuelling station was in fact separate and could be branded/marketed accordingly. At the same time the location was close for other target fleets to refuel, and is strategically placed close to the ScanMed corridor connecting Sweden to Denmark and Norway.

Local support from public and private organisations was also very important, as well as getting financing. The local support makes it easier to build up the customer base for the refuelling station.

It is important that information about the benefits of hydrogen as a clean fuel are communicated to the political level and decision makers. They need to realise that hydrogen is part of the fossil fuel free

solution, and that it is important to support all types of clean fuels. Today, there seems to be a political preference to certain types of fuels.

It is important to get at least some customers for the refuelling station when it is established, since lack of customers can be extremely bad for economical viability and from a marketing perspective. Focus should be on getting fleets (e.g. public authority owned / tendered or taxi fleets) to agree to use the refuelling station.

Smaller municipalities can indeed establish a hydrogen refuelling station, but it requires the right partners. The municipality of Sandviken has for example partnered with two private companies involved in the production of hydrogen to build a hydrogen refuelling station in Sandviken.

Table summary (based on analysis of case study)

Question	Answer
Aspects of legal framework that hamper transferability?	There are no legal aspects that have supported / hindered the establishment of the hydrogen refuelling station in this case study. On the consumption side, there are several policies that support the use of FCEV. However, they have so far not had sufficient effect for the FCEV market to take off.
Continuity of fuel policies, incentives, strategies that hamper transferability?	The driving force behind this hydrogen station was the regional authority Västra Götaland. Such a driving force was essential for the establishment of the hydrogen refuelling station since the hydrogen FCEV market is still in its infancy.
Is it possible for smaller municipalities to do this?	Without the market it is difficult. Smaller municipalities that want to be leaders in terms of innovative technologies are the most likely to succeed – but a business plan is needed.
Which constraints experienced?	The main constraint experienced has been competition with fossil fuels. There is less political willingness to invest in hydrogen compared to CBG and BEV.
Other aspects relative to transferability	Getting local support from public and private organisations is very important to help support the growth of the FCEV market. Zero emission zones for the urban areas in VGR would be key.

4.3 Case study 3: CBG facility and refuelling station in Linköping, Sweden[5]

4.3.1 Key details

Name	CBG production facility and refuelling station in Linköping
Fuel type	CBG
Organisational form	Limited company
Financial form	Mixed investment
Subsidy?	KLIMP and LIP programmes (see below)
Main partners involved in establishment	Tekniska Verken, Scan Farmek, Federation of Swedish Farmers, Konvex
Date of implementation	1996
Share of risk	Shared between public and private sectors, although more risk in public sector.

4.3.2 Short description of the gas facilities

In 1996 the company Tekniska Verken built a biogas production facility in Linköping. The company is a publicly owned energy company, owned 100 % by Linköpings municipality. The biogas production facility converts both solid and liquid raw materials to biomethane. The largest amount is from food, meat production and food waste, including from households in Linköping and Norrköping. The production facility receives excess gas also from the water treatment system in Linköping which is upgraded to biogas. The final product is 97 % biogas, and 3 % natural gas. In 2016, about 9 million tonnes of biogas were produced, although this is down on the production from the previous year.

The main driving forces for the production of biogas were local environmental policies and goals (particularly air quality), and the possibility to take advantage of waste products in the city. At the time, there was a large slaughterhouse in Linköping, and they wanted a better way to dispose of waste products. The idea was to use the gas to fuel buses in the city, and thereby improve air quality.

The biogas production facility is located to the north of the city of Linköping, in close connection to the E4 route which is part of the nothern ScanMed corridor from the Scania region to Stockholm (see Figure 4). It is located on the outskirts of town, surrounded by agricultural land.

Additionally to the production of biogas, bio-fertiliser is produced during the biogas production process, and this is used as a replacement to synthetic fertiliser used in agriculture.

[5] Details for this case were primarily obtained by interview with Jenny Danell, Svensk Biogas AB and Bertil Carlson, Tekniska Verken (semi-retired, but very involved in the details of the establishment). Orignally the interview was conducted with Jenny Danell, but then when extra information regarding cooperation models was requested, Trivector were directed to Bertil Carlson who also significantly supplemented (and in some cases slightly contradicted) information previously obtained. Further information from masters thesis Golpagon et al (2013)

In 2003, a new company was formed called Svensk Biogas, which is 100 % owned by Tekniska Verken, and therefore also a publicly owned company. The purpose of this new company was to take over the managing of biomethane refuelling stations from Tekniska Verken. The company buys, sells and distributes biomethane in the region. Svensk Biogas has (2018-01-22) 13 refuelling stations in the region and runs the bus depots in Linköping, Norrköping, Motala and Västervik. The latest refuelling station to open was as recently as January 2018 in Linköping.The biomethane is delivered to the refuelling stations from the production facility by truck.

Tekniska Verken and its subsidiaries have received many subsidies over the years to support their biogas production. This is primarily through the KLIMP programme[6], followed by the LIP programme[7]. Local biogas production in Linköping has led several research projects, and has supported the development of biogas/biomethane production in Sweden.

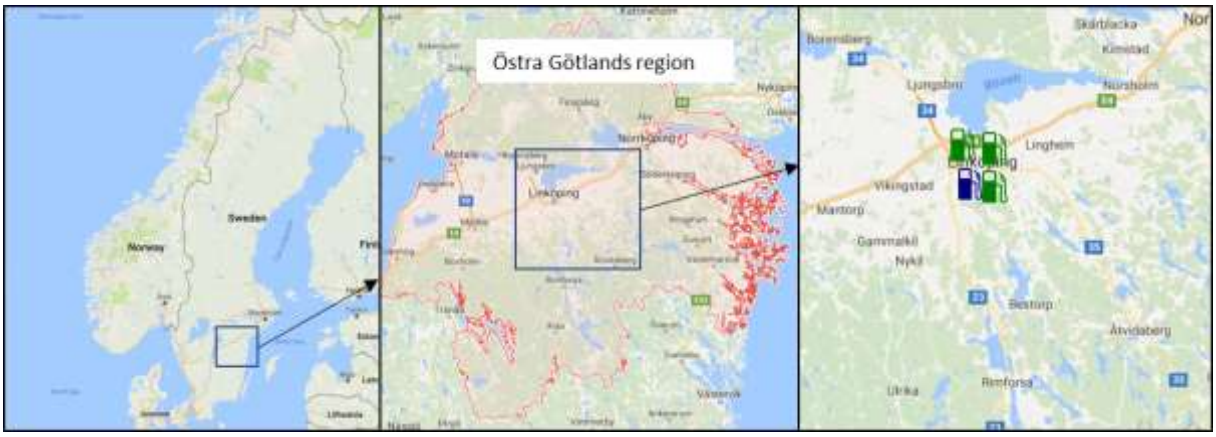

Figure 4 Location of the biogas production facility is in the North of Linköping, a city in Östra Götlands region. There are three refuelling stations run by Svensk Biogas and one run by SBI in Linköping.

4.3.3 Partnership

Organisational form

When the biogas production facility was first established, the municipality was the key driving force. It first started as a pilot project in cooperation with the municipality of Linköping, the sewage treatment plant and the public transport authority (LITA), and a slaughterhouse which wanted a new way to deal with their waste products. Following a successful pilot project, a limited company called Linköpings Biogas AB (LBAB) was formed to take care of slaughterhouse and agricultural waste *and* produce biomethane for the city buses. It was a company with four co-owners: Tekniska Verken (50 %), Scan Farmek (food producer), the Federation of Swedish Farmers (*Lantbrukarnas Riksförbund* - LRF) and Konvex (the slaughterhouse's waste company).

Today Swedish Meats and the Federation of Swedish Farmers (*Lantbrukarnas Riksförbund*) are longterm suppliers for the production facility, as well as customers for the biomethane which they use

[6] Klimatinvesteringsprogrammet – climate investment programme was a programme that ran from 1998-2002 financed by the Swedish government to give subsidies to projects that resulted in reduced CO_2 emissions and used for many projects to improve biotechnologies for the production of biogas.

[7] Lokalinvesteringsprogrammet – local investment programme

in their fleets. The distribution of biomethane, and management of the biomethane refuelling stations is also run by a publicly owned company (Svensk Biogas).

Tekniska Verken cooperates with the Norwegian company Greve Biogass at Oslofjorden. The Norwegian company gives support in terms of experience and competence regarding setting up robust biogas production and refuelling facilities.

Tekniska Verken also co-funds and are active in the Biogas Research Center (BRC). This is a knowledge centre for research on biogas with a multidisciplinary focus. BRC works actively to bring together industry, academia and society.

Ownership and management

When LBAB was established, Tekniska Verken had a 50 % stake, and therefore were given the position as chair of the board. Tekniska Verken took over the administrative side of the company, managing the project as well as finding subcontractors, and running the facility on a day-to-day basis. This meant that personnel from Tekniska Verken were onsite and ran the facility. In 2003, Tekniska Verken bought up the other partners in LBAB and at the same time LBAB merged with Svensk Biogas.

There was also considerable work done by Tekniska Verken / Svensk Biogas in establishing the customer market. The first customer for the biomethane was Östgötatrafiken (public transport company). Tekniska Verken also worked hard on getting private companies to change their fleets to gas-powered vehicles, but the progress was very slow in the beginning.

Sharing risk

The risk was shared between Tekniska Verken (publicly owned company) and three private companies: Scan Farmek, the Federation of Swedish Farmers and Konvex, although the public sector took most of the risk by having the largest stake in the company that was formed, as well as taking over the management of the facility (which costs a lot in terms of time of personnel). The private actors that were involved in the establishment of the facility were on the production side – since such a facility provided a way for them to deal with their waste products. The key contract in the establishment of the facility was that between LBAB's co-owners.

In terms of selling the biomethane, the key contract at the outset was with Östgötatrafiken, the public transport company that ran the city buses in Linköping.

Several minor contracts were also signed with farmers who were consumers of bio-fertiliser that was produced as a by-product in the facility.

4.3.4 Customers

Public transport stands for 60 % of sales, while cars for 40 % (privately owned, company cars and publicly owned fleets). For cars, only a small amount of the biomethane that is bought at public refuelling stations is bought by private individuals and companies; the vast majority is bought by publicly owned fleets. The public sector is therefore by far the largest customer for the refuelling stations.

When the production facility was set up, all of the biomethane was used by the public transport company for city buses in Linköping. It was only after several years that private companies and individuals started to use the gas – there was absolutely no private customer market when the facility was established, and it took a while to get it up and running. The first private company to sign a contract with Svensk Biogas (/Tekniska Verken) was a taxi company (Taxikurir), since the CEO of the company thought that the environmentally friendly branding of the company could give them a competitive edge in the taxi market in the city.

It is possible to pay with credit card or Svensk Biogas payment cards at the refuelling stations. However, there were problems at the outset with payment since at the beginning, there was no possibility to pay with credit card. Each biomethane refuelling station had its own separate payment system. It took some time to reach an appropriate solution, and depended on there being enough customers to allow for maintenance costs of a credit-card solution from an external supplier.

4.3.5 Lessons learnt and transferability

The following text describes conclusions, lessons learnt and advice as described by the interviewee.

Knowing the local and regional market is key to succeeding in setting up this type of facility. This includes the whole chain from waste / raw material production, which actors will be involved in the distribution of biomethane, and an understanding of the market for biomethane including scenarios for how the market might develop in the future.

Following up on this, cooperation between actors in the whole value chain has been key to the development of the facility, since it reduces the risk for the actor making the investment. It is key to find the right actors that produce and distribute the biogas/biomethane. At the same time, working together across different regions also helps to balance demand and supply over a larger geographical area.

In the case of Linköping, clear political support was key in the establishment of the biogas production facility. At some points in the process, unclear communications from the political level or changes to policy made it difficult. Overall though, long-term policy for the promotion of biogas, as well as municipality support has been key in the establishment and success of the Linköping plant. The public sector has had a powerful role to play in directing the discussion on biogas and to support local players in the development of biogas.

There have been some problems that have made it difficult for the establishment of the biogas production facility:

- Complicated and slow process to receive building permission
- Lack of infrastructure such as production facilities, food waste collection, biogas pipelines
- Low returns economically have made it difficult to scale up production.

Advice from interviewee to other municipalities is:

- Understand the local and regional market! Make sure you know who all of the players in the value chain from substrates for production to customers for the product.
- Cooperate with actors from the very beginning of the project planning, and continue the cooperation to ensure that things keep on running smoothly.
- Try to get clear political support for the project of establishing the infrastructure and long-term and clear policies to support biogas (from the local level).
- Use your role as municipality to direct the discussion and bring the subject to attention, as well as support local stakeholders.

Table summary:

Question	Answer
Aspects of legal framework that hamper transferability?	In recent years Sweden has put in place policies to support the biogas industry, both by pushing the production (e.g. requirements for municipalities to re-use waste) and by increasing demand (e.g. tax exemptions for gas vehicles). However, the refuelling station in this case study was established before these policies were in place. Therefore this case is a good example for municipalities in countries where national regulatory frameworks for supporting biogas are not as strong as in Sweden.
Continuity of fuel policies, incentives, strategies that hamper transferability?	Continued political support at the local level has been key to the success of this example.
Is it possible for smaller municipalities to do this?	Yes- Linköping is a small municpality, and this is perfectly replicable.
Which constraints experienced?	Complicated and slow process to get building permission Lack of infrastructure such as production facilities, food waste collection, biogas pipelines, Low returns economically have made it difficult to scale up production.
Other points of relevance for transferability	Involve all actors from all elements of the value chain. The municipality has a key role to play in supporting the market.

4.4 Case study 4: E.ON fast charging points[8]

4.4.1 Key details

Name	Charging points GREAT project
Fuel type	Electricity for BEV
Organisational form	Fast chargers owned by limited company, but set up within a European project
Financial form	Mixed investment
Subsidy?	CEF funds (European Union) – 50 %
Main partners involved in establishment	E.ON (also within the GREAT project: Region Skåne, FordonsGas, Nissan, Renault, DTU)
Date of implementation	Ongoing (2016- Q1 2019)
Share of risk	Risk in private sector, but exposure reduced by subsidy

4.4.2 Short description of charging points

Within the context of the EU funded project GREAT (Green Regions with Alternative Fuels for Transport) a total number of 70 quick chargers will be deployed. 15 quick chargers will be built in Denmark, 50 in Sweden and 5 in Northern Germany. The charging points are owned and maintained by E.ON. The charging points are located along the northern TEN-T core network which include the ScanMed corridor (see Figure 5).

The establishment of the charging points as part of a European project means that together with the establishment of the infrastructure, other partners are working on measures to influence behaviour and increase the interest and trust in BEVs. The project as a whole is a collaboration between Region Skåne and six private companies, receiving support from eight other public partners along the corridor from Hamburg to Oslo.

The driving force for Region Skåne for initiating and managing a project that fosters the establishment of fast charging points is fulfilment of European policy and regulations as well as fulfilling national and regional policy goals and development strategies in Sweden (see sections 2.1.2 and 2.1.3). The overall goal of the GREAT project “is to reduce fossil emissions by establishing a strongly increased market demand for alternative fuels transport solutions by ensuring access to supply over the long distances between metropolises in northern Europe” [GREAT, 2017]. From E.ONs side, the driving force is to create a fast-charging network in Sweden, connecting existing fast charging networks in Denmark and Norway, and to make money.

[8] Details for this case study primarily from interview with Britt Karlsson-Green, Region Skåne and : Mattias Vendel, E.ON. Further information taken from GREAT website, and presentations made about GREAT project including report 2014-EU-TM-0477-S, Activity 6 (Region Skåne et al, 2016), and a presentation “Solving societal challenges requires and motivates PPP! Example from the transport sector where decarbonisation is a big challenge!” (Karlsson-Green, 2016)

It costs on average €50 thousand per fast-charger to be installed and ready for operation, with a maintenance cost of about €6000 per year. Break-even for E.ON is calculated on a 10 year horizon, and this depends on a significant increase of the number of BEVs compared to today's levels.

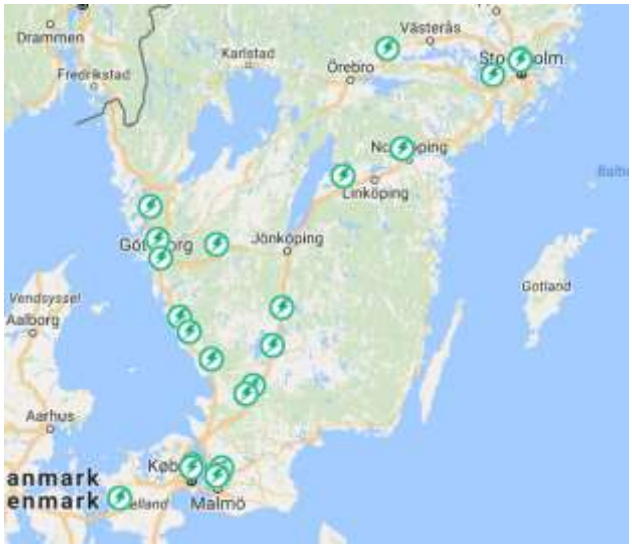

Figure 5 Charging points implemented within GREAT project. Source: https://great-region.org/progress/ (accessed 2017-10-20)

4.4.3 Partnership

Organisational form

The GREAT project is a collaborative EU-funded project. The project is supported by 8 public organisations in a corridor from Hamburg to Oslo. E.ON got involved through existing contacts in the City of Copenhagen. E.ON has a strong e-mobility presence in Denmark where they own and run a large number of charging points (they bought up 400 charging points previously owned by the now bankrupt company Better Place). Region Skåne are the coordinator of the GREAT project, and there are several other private companies in the consortium. E.ON was interested in getting involved in the project in order to get co-financing for establishing a fast-charging network in Sweden. Before the project, E.ON did not have any own fast chargers in Sweden, and it was deemed at the time to be non-profitable to build them without external grants in Sweden.

Ownership and management

E.ON owns and runs the fast charging points but 50 % of the financing to buy and install the chargers comes from the CEF funds. E.ON recognises the importance of working together with Region Skåne to increase the credibility of the product, and to influence the development of policy measures on national levels in the right direction for an increased market share. Moreover, Region Skåne as project coordinator stand for the project management cost and administration linked to European collaboration projects. It takes a large amount of time to apply for money and run European projects, and the public authority takes the burden of this to help support private partners. By organising the cooperation in a European project, the partners can work together towards common goals. The cooperation in the project has been deemed to be successful both by Region Skåne and E.ON

representatives who were interviewed. The project also provides an excellent discussion forum for both public and private actors.

The placing of the fast-chargers is determined by E.ON, but following a framework set out by the EU requirements (ensuring proximity to TEN-T core network). They make the decision based on where they are most likely to get most customers – often following the location of "petrol" stations and rest stops. E.ON does not buy the land on which the fast chargers are located, but instead finds partners to cooperate with to install them. These include MAX hamburger restaurant chain, OKQ8, Preem and Circle K as well as public authorities when publicly owned land is used. The locations must be somewhere where a service such as toilets, food or coffee is nearby, and this considerably reduces the locations which can be used.

Region Skåne have a big mission to communication both to companies with big carfleets and to the general public with the aim to increase the market share of cars for alternative fuels ensuring the use of the infrastructure that are being built. Moreover, Region Skåne contributes with organising events together with the automobile industry and charging point operators with the aim of stimulating demand for fossil free fuels. Without the support of public authorities, as well as EU-funding, there is a large risk that the fast-charger network will not be built at the same speed because the risk is too high for private companies.

Sharing risk

The risk is in the private sector in this case, since E.ON own and run the fast-charging points, and ultimately they feel the pinch if they cannot make money from them. Their exposure to risk is however reduced by receiving public subsidy – even if the risk itself is not reduced.

The public sector, in this case Region Skåne, supports through EU-project coordination, communication and project evaluation.

Key contracts that E.ON have signed are:

- Contract for hardware (fast chargers) with a tendered supplier
- Cooperation agreements for the use of land where fast chargers are located
- Contracts with different, tendered companies which build the fast charging sites

4.4.4 Customers

The fast chargers established as part of the GREAT project serve the same customers – both captive fleets as well as private individuals and companies. Payment can be made with credit card or E.ON RFID card, as well as other third-party payment methods. Payment solutions are constantly evolving. Until the 1st February 2018, the use of the fast chargers is free for the end users in Sweden. Within the GREAT-project surveys to EV-customers in Denmark and Sweden enhance the knowledge about the thoughts and behavior of customers. However, more time must be put in to understanding the different types of customers using the fast chargers.

4.4.5 Lessons learnt and transferability

The following text describes conclusions and lessons learnt as described by the interviewee.

Bringing together public and private actors in a EU-funded project created a framework and a forum for collaborative learning based on listening and understanding each others' points of view. By this the partners could establish common goals which can be considered as a good and fruitful way of solving societal challenges.

Working with several different actors also has its challenges. It is important to define clear roles and responsibilities of different partners in the project. This will be especially important once the project

ends, so that it is clear what responsibilities different partners have when they are no longer bound by a contract with the EU.

With the subsidy from EU, the deployments of quick chargers is happening much sooner than what otherwise would have been the case. Without the subsidy from the EU, E.ON would not have (yet) taken the step to install fast chargers in Sweden which means the subsidy is an important push to support the establishment of fast charging infrastructure. At the same time, the public sector has an extremely important role to play in supporting the growth of the market, both through policies, legislation and behavioural change initiatives on different levels.

Table summary (based on analysis of case study)

Question	Answer
Aspects of legal framework that hamper transferability?	Regulations and legislations that support the purchase and use of electric vehicles such as bonus-malus, company car, taxation of fossil fuel vehicles, etc help to support the introduction of electric vehicles and create a market for the charging infrastructure.
Continuity of fuel policies, incentives, strategies that hamper transferability?	There is a clear policy from the Swedish government to support the introduction of electric vehicles. This is not just for the environmental benefits due to use, but also support of the vehicle industry in Sweden.
Is it possible for smaller municipalities to do this?	The involvement of the public sector in this case has primarily been in the promotion of the market as well as increasing use of alternative fuels within the own organization Smaller municipalities can do this, but probably with most impact in collaboration with other municipalities / regional authorities. They can also use electric vehicles within their own fleets.
Which constraints experienced?	Without the subsidy, the fast-charging network would not have been built up in Sweden with the same speed.
Other points of relevance for transferability	The private and public authorities have very different roles in this case. The private organisation to build up the fast-charging infrastructure, and the public authority to support market growth. Working within a project together provides a forum for cooperation.

4.5 Case study 5: LBG refuelling station in Helsingborg, Sweden[9]

4.5.1 Key details

Name	LBG / LNG refuelling station in Helsingborg
Fuel type	LNG / LBG
Organisational form	Limited company
Financial form	Public investment
Subsidy?	None
Main partners involved in establishment	Öresundskraft, Fordonsgas (Air Liquide)
Date of implementation	2014
Share of risk	Risk only in public sector.

4.5.2 Short description of the facilities

The LNG (LBG) refuelling station is located on the outskirts of the city of Helsingborg in the Scania region. Helsingborg is a core port within the TEN-T CNC, but the refuelling station is located away from the port area, with a focus on supplying LNG for trucks rather than ships. The refuelling station is strategically located near to the E6 (towards Gothenburg to the north and Malmö/Copenhagen to the South) and E4 (towards Stockholm) (see Figure 6). These routes are part of the ScanMed corridor.

The refuelling station was established on market conditions in June 2014. Öresundskraft own and run the station which sells LBG which is bought from Fordonsgas (now Air Liquide). The refuelling station is situated also next to a biomethane station, thus both cars and trucks can refuel at the site. It cost approx. 2 million Euros (20 million Swedish kronor) to establish both the CBG and LBG refuelling stations. It is the largest LBG refuelling site in Sweden.

The driving force for the establishment of the refuelling station was policy to switch to more environmentally friendly fuels. Öresundskraft is a publicly owned company owned by the city of Helsingborg, and it was primarily environmental policies that drove the establishment. The primary driving force of Öresundskraft as a company is to provide more environmentally friendly energy solutions. The location of the refuelling station was chosen due to the vicinity to transport corridors to the main cities in Sweden (and beyond), and due to the fact that ICA (a large Swedish supermarket chain) which had a large depot in the vicinity had agreed to convert their 70 trucks to LBG/LNG. Break-even point economically for the refuelling station is 55 trucks.

Compared to other case studies, there is less input on this case due to a lack of information obtained.

[9] This case study is based primarily on interview with Marcus Extergren, Öresundskraft but also information found online (Öresundskraft, 2014)

Figure 6 Location of the LNG refuelling station in the West of Scania, in the city Helsingborg. No other LNG refuelling stations are available in this region.

4.5.3 Partnership

Organisational form

Öresundskraft are a publicly owned limited company. A project manager was assigned for setting up and running the refuelling station.

Ownership and management

Öresundskraft own and run the LBG refuelling station. The LBG is driven to the refuelling station from Lidköping and provided by Fordonsgas (now owned by Air Liquide).

A great deal of effort is made by Öresundskraft in finding new customers for LBG. They are pro-active in searching for new customers, and also in discussing with the vehicle industry about the development of technology. There is an active truck industry in Sweden: Scania have developed LNG trucks recently, and Volvo are developing the technology. It has been difficult in the past to make decisions to move to LNG since there have been many competing “clean” fuels – e.g. HVO, ethanol. Öresundskraft have even been in touch with Region Skåne about shifting to LNG, but it has been difficult to establish cooperation since the trucks over which Region Skåne has control are not located in Helsingborg.

Sharing risk

The risk is taken wholly by the public sector through Öresundskraft.

Part of the reason for the establishment of the refuelling station in Helsingborg was a request from the ICA supermarket chain for refuelling infrastructure, since they planned to convert their 70 trucks based at a nearby depot to LNG/LBG. An agreement was signed between Öresundskraft and ICA and was a key contract to ensure that the refuelling station would be economically viable. Unfortunately, the contract was broken when the infrastructure was in place. This was due to several factors including the lack of availability of the right vehicles for ICA to purchase, and the need to train the truck drivers in a different way which was difficult since it was not always the same drivers for the fleet.

4.5.4 The market

Öresundskraft feel that they were a bit ahead of time in establishing the refuelling station, since LNG is not an established fuel as yet. However, the market is increasing, and there is growing interest for this

fuel type for trucks. Currently, they have one main customer – a Dutch company (VOS Logistics) which runs 5 trucks from the Netherlands to Sweden. There are many more "individual" trucks that use the refuelling station, and the refuelling station is the largest of its kind in Sweden in terms of volume of gas used. Customers pay with credit card or with Preem card.

The market is not big enough today for the business to be profitable – it needs to have 55 trucks per day refuelling to reach break-even. However, Öresundskraft see a potential to keep the refuelling station. This is primarily due to the driving political forces, and need to move to more environmentally friendly fuel types. The station is seen as a long-term investment, and expected pay-off on a reasonably long time-scale.

4.5.5 Lessons learnt and transferability

The following text describes conclusions and lessons learnt as described by the interviewee.

Öresundskraft realise that LNG refuelling station is somewhat ahead of its time. However, as a publicly owned company with a strong environmental focus, they feel that it is their duty to support the development of the market and have a refuelling station in place. They need to make a profit, but this can be realised on a long-term perspective.

The vehicles are not widely available on the market yet, although the technologies are being developed. It is important to cooperate / discuss with the vehicle manufacturers as well as the possible customers of the refuelling station.

A lot of work needs to be done in establishing the vehicle market, and this should not be underestimated.

Although Öresundskraft signed an agreement with ICA, the supermarket chain backed out once the facility was built. This was an unfortunate setback, and shows the importance of doing a market analysis which covers aspects such as availability of vehicles, and practical aspects related to the use of vehicles (e.g. training requirements, whether spare parts can be supplied easily once in motion, etc).

At the same time, this example shows that it is possible to set up a refuelling station when the vehicle market is small, as long as a long enough time perspective is included – this is made easier when the organisation that owns and runs the refuelling station is publicly owned since benefits can be seen in a wider perspective and on a longer time scale.

The LNG market is thought to expand considerably in the future also due to policies and European level. It is important to have the infrastructure in place especially to support long-distance, cross-border transport which can be more difficult to gauge in a market analysis.

Table summary (based on analysis of case study)

Question	Answer
Aspects of legal framework that hamper transferability?	There are certain tax breaks regarding CO_2 and energy taxes for the purchase of low-emission heavy goods vehicles (HGVs)
Continuity of fuel policies, incentives, strategies that hamper transferability?	There is a strong policy in Sweden to develop alternative fuel infrastructure, but in terms of LNG/LBG this market is still in its infancy, so there is little difference to other settings.

Is it possible for smaller municipalities to do this?	The main pre-requisite would be that it would be possible for a market to be established. The most suitable would be small municipalities where a large amount of heavy goods transit flows through.
Which constraints experienced?	Lack of market is the largest constraint.
Other points of relevance for transferability	Need to check the availability of vehicles /progress in the development of vehicle technology.

5 Conclusions & recommendations

The main conclusions from this study are presented below. First, the general conclusions, then conclusions for specific fuel types.

5.1 General conclusions

The general conclusions can be divided into three categories:

1. Conclusions regarding the organisational forms for clean fuel infrastructure
2. Conclusions regarding the role of public organisations in the establishment of clean fuel infrastructure
3. Conclusions regarding transferability – what needs to be considered?

5.1.1 Conclusions regarding organisational forms for clean fuel infrastructure

The findings from this study show that there are **no public-private-partnership (PPP) financing models for clean fuel infrastructure in Sweden**. By PPP financing models, we mean examples of public-private-partnerships which are built in order to finance projects whereby partners jointly own and take the risk in the investment as well as running the infrastructure when established. The lack of PPP financing model examples is due to the fact that the infrastructure is on such a small scale compared to examples in the literature which usually refer to multi-million Euro investments which *require* funding from several partners. In the case of clean fuel infrastructure, the financial burden of establishing infrastructure can generally be carried by a single organisation.

At the same time, **public and private partners do cooperate to establish clean fuel infrastructure.** It is usual for there to be some sort of cooperation between public and private entities in the establishment of clean fuel infrastructure. Often this is through agreements that one party will purchase vehicles or take action to increase demand for the fuel that will use the new infrastructure, while the other builds the infrastructure. However, agreements by themselves are not watertight, and it is important to have both the vehicles and infrastructure in place for the infrastructure to be successful.

Nearly all of the case studies show examples of limited companies that own and run the clean fuel infrastructure. There is one example of an economic association, but even in this case, stakeholders would have preferred the establishment of a limited company at the outset. **This indicates that the best form is probably a limited company to establish and run the clean fuel infrastructure**.

A grouping of organisations can also be brought together within the context of a project (e.g. research project, cooperation project). This allows for public and private actors to collaborate with a common goal, and also work together and understand each other's perspective.

If infrastructure is established as a part of a project without a clear business model, continuity can be a problem. **The business model needs to be considered right from the outset**, and it should be clear how the clean fuel infrastructure can be financially sustainable once it is up and running. Steps need to be taken to make a robust business model by for example diversifying the customer base and ensuring a smooth cooperation with all actors in the value chain.

5.1.2 Conclusions regarding the role of public authorities in the establishment of clean fuel infrastructure

The main conclusion here, is that even though there is cooperation between the public and private sectors, **the public sector drives the establishment of clean fuel infrastructure**, and takes the

financial risk. The public sector in many cases also supports the market development by being customers for the clean fuel infrastructure, and have an important role to play in driving the initial development of the market for clean fuels. It is normal for infrastructure projects in general that the public authorities play a key role, since it can be seen as providing an important societal function, and this reasoning can be extended to clean fuel infrastructure. Public authorities can also play a role in supporting administrative / manpower burden associated with setting up projects, applying for funding, etc.

It is important that the framework conditions are right in order to create solutions that will last in the long term, and help to support the growth of the clean fuel vehicle market. **Public authorities can help to create the right conditions.** This can be through policies, regulations, incentives but also work on behavioural change to stimulate the market.

In fact, **policy is a key driving force in establishing and ensuring continuity of the infrastructure**. Policy on the European, national and local levels all supports the establishment of infrastructure. At the local level, the driving policies tend to be climate and environmental policies (better air quality, reduced CO_2 emissions), whereas on the national and European level, the clear driving force is decarbonisation. **When policies are not long-term, and change over time, this can create uncertainty for cleaner fuels**, and lead to lack of willingness to invest in infrastructure. Technologically neutral policies should be preferred.

An important follow up from this is in making policy concrete through **regulation, legislation and incentives that help to support the clean fuel vehicle market development.** Examples such as bonus-malus, low emission zones or fiscal disincentives for fossil fuels play an important role in supporting the use of clean fuel infrastructure. On the local level there are not so many examples (yet), but in the future low emission zones for cars in urban areas as well as other regulations will also support the market.

The examples presented in this report show that **public funding is needed at the outset.** Due to the lack of market at the outset, it is generally too risky to invest in infrastructure for private partners. Public funding can make it more attractive. Different types of public funding are possible, e.g. subsidies or publicly-owned companies which make the investment. When publicly owned companies make investments rather than directly using public funds in subsidy form, a public organisation can support the infrastructure financially while at the same requiring that the infrastructure is developed in a market-minded way. Publicly owned companies are driven by government policy as well as profit, and thus often are allowed a degree of flexibility regarding returns on investment if their work is inline with policy. Publicly owned companies provide a way to make investments which have high risk, and for which the business model is not established at the outset.

5.1.3 Conclusions regarding transferability

There are many things that need to be considered by a local or regional authority embarking on establishing or supporting the establishment of clean fuel infrastructure. Some framework conditions need to be in place, and they should be evaluated including:

- Existing policy framework at local, regional and national level and how it supports the development of clean fuels
- Political support at the local level
- Existence of subsidies that are available to support the establishment of clean fuel infrastructure
- Existing and possible customers for the fuel
- Possible partners to cooperate with: other local authorities, private partners, research partners covering everyone in the value chain (which for biogas also includes raw material suppliers)

- Location of the infrastructure – where is there land available, and is it correctly situated with respect to potential customers?
- Synergies with other activities in the local/regional authority
- Right competence in the local authority, and enough resources to work with establishing the clean fuel infrastructure

In some of the case studies, it was highlighted that a study was performed prior to the establishment of the infrastructure, and funded externally. This can be a good way to analyse these framework conditions. These are sometimes funded by i.e. the EU.

If the framework conditions are in place, there are also a number of key things that need to be addressed in setting up the clean fuel infrastructure including:

- Ensuring that the resources are in place throughout the set-up stage
- Establishing partnerships with a diverse range of partners: both on the supply and demand side. Diversification is important in order to keep sales up (e.g. if one company / organisation does not buy the fuel as expected)
- Defining roles and responsibilities of the partners
- Deciding on the model for maintenance
- Deciding on the organisational form
- Identify the key points which needs to be agreed upon in the steering documents regulating the organisational form. In a contract this includes for example how resources / tasks / competences are shared.
- Signing contracts to ensure that risk is spread among partners
- Consideration of the business model from the outset

A good solution for the key points to be considered in the infrastructure project for clean fuels varies between the different fuels and even depends on the local/regional framework conditions.

5.1 Fuel-specific conclusions

CBG and LBG

Producing CBG / LBG from waste provides an excellent example of the circular economy. Particularly for the production of biogas, local actors can be engaged at all stages of the chain: from production (e.g. farmers who want a way to dispose of their waste), to sales (local individuals or organisations that buy biomethane). The local connection to the production of biogas also helps to get local individuals and organisations more involved, and thus more willing to support and buy the product. This also allow for the creation of a diverse customer base for the fuels which is important to create a more sustainable income.

In Sweden, municipalities have requirements to “use” waste. Waste companies are publicly owned and run. Thus, there is an incentive for Swedish municipalities to create fuel from waste – using a resource that the public sector already “owns”. Additionally, Sweden has a lot of raw materials that can be used in biogas production – particularly agricultural waste in the south, and timber-related waste in the north.

Although private partners are also involved in the establishment of CBG and LBG production and refuelling stations, this sector is very much driven by the public sector. The sector has also been active a relatively long time in Sweden and Scania. The example from Linköping, where a successful production facility was built 20 years ago is an example of this. The older examples with much experience can be particularly interesting for municipalities in other countries with no established CBG market.

It is important to consider the local conditions before setting up a CBG production facility or refuelling station. This is particularly regarding the production of biogas – are there local actors who are interested in finding a new way of dealing with their waste, and maybe also converting their fleets to biomethane? Since the fuel can be transported away from the production facility, there is less stringence on the placement of biomethane refuelling stations, although – as with all fuels – it should be done based on the needs of the existing and future customer market.

Local considerations also need to be taken into account for LBG/LNG. LBG/LNG is primarily a fuel for larger vehicles (trucks and ships), so there needs to be a clear market of large vehicles that will use the fuel, and refuelling stations need to be located on major transport corridors. Scania is for example an important freight transit region, with several ports.

Hydrogen

Although hydrogen fuel cell technology has been around for a long time, supported by research and policy initiatives politically at the European level, it is slow to take off.

There is still very little market for hydrogen vehicles in Sweden. FCEV compete with BEVs given that they both produce zero local emissions (a driving factor from local policy). There have been attempts to propel the hydrogen industry in Sweden, but thus far it is still small scale. FCEV are still in the "research phase", and the example of a hydrogen refuelling station given in this report is situated near to university and company that is developing new fuel cells. The public sector is involved in the establishment of infrastructure, but to date largely through project-funded initiatives and subsidies.

Unlike with CBG, public authorities do not run and manage the refuelling stations, but this is left to the private sector. This means that there is less leeway when setting up the infrastructure since private companies have different requirements regarding return on investment compared to the public sector (including publicly owned companies), and are more likely to close down if a sustainable business model is not found. This means that the public bodies' role is primarily in creating the right framework conditions through policy and legislation, but also promoting the use of FCEV and converting some of their own fleets. Given that FCEV are still in the research phase, public authorities can also have a role in supporting administrative burden of applying for funding from e.g. European funds.

FCEV are suitable for fleets in areas where air pollution is a problem due to zero emissions at tailpipe, and for fleets where the range of BEV is not far enough. This can include for example bus fleets, taxi fleets and urban goods vehicles to name a few. Additionally, since FCEV are still in the research phase, often municipalities with a "high tech" or "innovation" brand (and e.g. innovative companies) can be good places to find possible customers (although this is also true for BEV).

Electricity

The private sector is driving the establishment of quick charging stations, although subsidies are still required, since the market is still small. The role of the public authority is mainly in creating the right framework conditions to stimulate the market, including policy, legislation (on the local level e.g. with parking regulations), promotion of BEV and converting their own fleets, as well as support in applying for funding e.g. from EU. They can also help in getting access to land on which chargers can be installed.

Unlike other fuel types, electricity is already widely available, thus the relative cost of setting up a charging point is low (e.g. compared to establishing a hydrogen or biomethane refuelling station). There is also a strong willingness and drive from particularly the higher policial levels as well as car manufacturers to support a shift to electric mobility. The focus is primarily on private cars, but there are ultimately many markets that are of interest: public and private fleets, public transport, urban freight (and in the longer run maybe even long distance freight).

5.2 Recommendations

Based on the findings from the study, several recommendations are made for local and regional authorities along the northern ScanMed corridor. These follow two strands, the first based on maintaining and using public sector support, and the second on thinking long term, and with a business mindset in order to create sustainable solutions in the long run.

The recommendations on how to maintain and use support of the public sector are:

→ **Use public financing from EU or national or regional level if it coincides with your own goals for the region / municipality**

There is often funding available, and it is important to use this in order to stimulate both supply and demand since often sustainable business models cannot be established from the beginning. Public financing is needed to kick-start establishment when the market is not in place.

→ **Lobby higher levels of government to support relevant incentives and legislation**

The national governmental level especially (or regional if they have legislative power in your country) have a role to play in creating the right framework conditions to support the vehicle market for clean fuels. Use your lobbying potential to support this in the right direction.

→ **Use the tools at your disposal to support both supply and demand**

It is not just through financing that the public sector can support the private sector in establishing clean fuel infrastructure. Understand what the private sector are interested in and go from there: if demand for the clean fuels needs to increase perhaps behavioural change measures are important or legislation or regulations, networking opportunities, etc. The public authority has a role to play in setting the right framework conditions.

→ **Choose the right fuels based on the profile of your municipality**

It is important to have customers for the fuel, so the right fuel type needs to be considered for the area e.g. large amounts of freight transit traffic can benefit from LNG refuelling station, or a highly innovative authority that is developing fuel cell technology may want to support hydrogen refuelling etc. Consider what matches your needs and profile best.

→ **Be your own customer**

Use your own fleets and the transport for which you are responsible – or that you contract – as a way to create a market for the alternative fuel infrastructure. Engage companies and civil society to do so as well. The public sector can be the pioneers adapting new technology to show functionality and support the adoption by others.

→ **Join resources with other public bodies**

This can be done for example by grouping several municipalities together that jointly invest in infrastructure.

Think long-term and business minded

→ **Do a market analysis before you start**

It is important that the conditions are right in order to set up the infrastructure, and this should be studied before the work is done. For the examples shown here, it has quite often been possible to get funding to study the pre-requisites before embarking on pilots and establishment of refuelling stations. This should look at whether the conditions are appropriate

for a sustainable business model to be established in the long run. The market analysis also needs to be repeated regularly once the infrastructure is established.

→ **Cooperate with the private sector to create a market**

The cooperation with the private sector can take various forms. It is important to have a dialogue with private partners to understand their needs, and build a cooperation model that takes this into account.

→ **Diversify your customer base from the outset**

Diversifying the customer base buying the fuel reduces risk for the clean fuel infrastructure. For example, if there is only one customer and they decide not to retrofit their fleet as agreed, this creates problems for creating a sustainable business model.

→ **Use (research) projects**

Publicly financed cooperation projects between private and public sector enable different organisations to work towards shared goals. It also gives the possibility to involve the vehicle industry if new vehicle technology needs to be developed within a pilot project, and allows public and private partners to share their (differing) competences and experiences with each other. However, even within a research project, the business model should be considered at the outset otherwise it is likely that the pilot cannot be scaled up.

→ **Bind partners who will buy the fuels**

Without binding partners, there is a risk that the market will not be established. Binding of partners can be done for example by getting them to buy shares/membership in the infrastructure/association, or getting them to sign contracts. This can be another way to share the risk, and can help to define clearly the roles and responsibilities as well as financial input from different actors.

→ **Look at and communicate the benefits in a wider perspective**

Even if the return on investment is not clear, consider how the infrastructure contributes to wider societal benefits. The benefits for air quality, fuel independence, CO_2 emission reduction and job creation are important for public authorities but are not quantified when the cost of infrastructure is considered. It is important to consider these wider benefits. Communication on the benefits can help to get continued political (and financial) support.

→ **Consider using a publicly owned company for investments**

This reduces the risk for the public authority, and focuses the investment towards being market-orientated. If the authority then changes policy, it should be possible to sell off investments more easily. Using a publicly owned company rather than a private company also allows more flexibility in terms of return on investment, and more investments directed by policy rather than (solely) profit.

→ **Be prepared for changes in the popularity of fuel types**

Be aware that changes in the use and popularity of different types of clean fuels can change suddenly due, for example, to changes in policy, market, technological improvements of other fuel types etc. This is not always within your control. But prepare by building a resilient business model by diversifying costumers and close cooperation with other actors in the value chain

Abbreviations / acronyms used in the report

AB	Aktiebolag – Swedish acronym for limited company
BEV	battery electric vehicle
CBG	compressed biogas
CEF	Connecting Europe Facility
CNC	core network corridors (of TEN-T network)
CNG	compressed natural gas
FCEV	fuel cell electric vehicles
GHG	greenhouse gases
HGV	Heavy Goods Vehicle
KFS	Kommunförbundet Skåne (Skåne Association of local authorities)
LBG	liquified biogas
LNG	liquified natural gas
PPP	public-private-partnership
ScanMed	Scandinavian-Mediterranean TEN-T corridor
TEN-T	transport-European transport network

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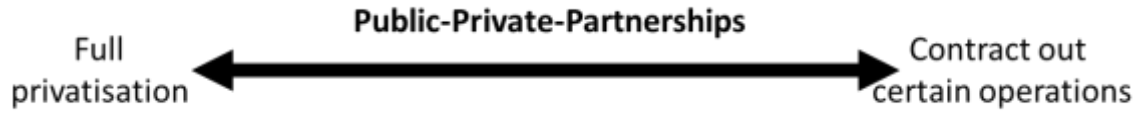
Appendix: List of interviewees

- Biogas Ystad-Österlen: Ida Abrahamsson, Tomelilla kommun: Ida.Abrahamsson@tomelilla.se, 0709958126
- LBG refuelling station Helsingborg: Magnus Extergren, Öresundskraft: 042 490 32 97
- CBG production facility Linköping: Jenny Danell, Svensk Biogas AB: 013-20 92 19 · jenny.danell@svenskbiogas.se & Bertil Carlson, Tekniska Verken:
- Electric fast charges (GREAT project), Skåne: Mattias Vendel, E.ON: mattias.vendel@eon.se, 0722 44 54 05 & Britt Karlsson-Green, Region Skåne Britt.Karlsson-Green@skane.se
- Hydrogen refuelling, Gothenburg: Geert Schaap, Sweco (Project Manager, HIT-2-Corridors) 0734-12 63 24, geert.schaap@sweco.se & Kari Salovaara, Woikoski +358 (0) 40 515 3881 kari.salovaara@woikoski.fi

Appendix: Theoretical background PPP

Introduction to PPPs

Public-private-Partnerships (PPP) projects have caught the attention of decision-makers ever since they were introduced in investment-intensive sectors. In many European countries, private investments in public infrastructure can be traced back to the 19th century (for example drinking water in Paris). Nevertheless, over the last two-three decades, the approach has become more frequent and widely implemented globally. For example, since the 1990s, PPP has been used a lot in the UK where national private companies have been involved in facilities development, including financing, construction, ownership and/or operation of public utilities. In China, the same development is seen but then mainly driven by international companies or financial institutions[10]. However, the concept is widely used in many countries and many different sectors. There are at the same time many ways to involve private interests in the supply of public services, and procedures for cooperation vary greatly in different contexts/geographies. These range from outright privatisation of previously state-owned industries, to contracting certain operations of public services to private companies (see figure)



Fel! Hittar inte referenskälla.

Different definitions of PPP

There are different views on the concept of PPP and there is no standard, internationally-accepted definition. Depending on the project and part of the world, many views on what constitutes a PPP can be found[11]. The term is used to describe a wide range of agreements between public and private sector entities, and different countries have adopted different definitions as their PPP programmes have evolved. However, most views emphasise that PPPs are established because they can benefit both a private and public organisation, and be mutually enhancing.

There are several similar definitions emphasising slightly different issues such as ownership, financing or risks:

> *A PPP is "contractual arrangement between a public sector agency and a for-profit private sector developer, whereby resources and risks are shared for the purpose of delivery of a public service or development of public infrastructure."*
> *(United Nations Development Programme, 2005)*

[10] Tang, L., Shen, Q. & Cheng, E. (2010). A review of studies on Public–Private Partnership projects in the construction industry. International Journal of Project Management, pp. 683-694.

[11] For an overview: Meidute, I. & Paliulis, N. K. (2011). Feasibility study of public-private partnership. International Journal of Strategic Property Management, Vol. 15 (3), pp. 257-274.

A PPP is defined as "arrangements where the public and private sectors both bring their complementary skills to a project, with varying levels of involvement and responsibility, for the purpose of providing public services or projects."
(Efficiency Unit, 2005)

The basis is a contractual agreement

A PPP is a contractual arrangement involving the private sector in the delivery of public services. As the name suggests, this is based on a partnership approach, where the responsibility for the delivery of services is shared between the public and private sectors, both of which bring their complementary skills to the enterprise.

PPPs bring together the public and private sectors in a long-term contractual relationship to deliver high quality public services. The private sector becomes a long-term service provider rather than a simple upfront asset builder. Public departments are more involved as regulators and procurers of services rather than direct providers of services to the public.

Traditionally large, but now also smaller projects

In many cases the PPP concerns large infrastructure projects involving huge investments with long-term consequences. But there are also smaller examples such as a joint shared service company supplying the public body with for example ICT expertise and capacity (Joha & Janssen, 2010). In the transport field, the area with most examples from PPP is the public transport sector. Here – as in other sectors – the focus has traditionally been on large-scale projects, but PPPs have been gaining increasing prominence for smaller projects, covering, for example extension of existing station, to marketing of public transport services[12].

Other forms of private sector involvement

PPPs differ from other forms of private sector involvement.

- **Outsourcing** takes place when the public sector directly procures services through shorter-term contracts while
- **Privatisation** takes place when a government owned entity or asset is transferred to the private sector and the government's role, if any, is reduced to that of a regulator.
- **Traditional private sector provision** where the government has no involvement in the provision of a service as the demand is being adequately served by the market.

[12] Hedges et al (2017). Public Transportation Guidebook for Small- and Medium-Sized Public-Private Partnerships. National Academy of Sciences, TCRP Research Report 191.

Classification of PPPs

There are almost as many classifications of PPPs as there are definitions of PPPs. These depend on the context in which they are applied. Within the European Union, PPPs are classified into purely contractual PPPs and institutionalised PPPs (joint company)[13]:

- **A purely contractual PPP** comprises a concession, a.k.a. "affermage" (where the operator does not bear the investment) – a type of management contract. The main characteristic is that the public body owns the assets and assigns a company to manage/operate or develop it. The public body (owner) still decides on re-investments and capital expenditures. Different types of contracts comprise different distribution of financing, risks and responsibilities.

- **An institutionalised PPP** consists of a new joint organisation (mixed company), created to provide the public supply. The purpose of the company is to create a new organisational body to establish the partnership and to own assets, organize the financial flows and manage the supply.

These categories can be divided even further with contractual PPPs covering Private Finance Initiatives (PFI) (privatisation) and franchises and concessions, while institutional PPPs can cover joint ventures and wider market initiatives, and Partnership companies and investments.

Another way to classify PPPs is based on how private partners receive a return on investment. There can be two broad categories here:

- **Payments received both from public subsidy and end-user charges**.
  Projects that provide services to the public at less than cost, for which the payments to the private partner involve a mix of public subsidy from the government and end-user charges imposed on consumers of the services. Examples of such services are sports centres, where the consumer pays a subsidised fee for the use or hire of facilities and equipment

- **Payments received only from end-user**
  Financially free-standing projects where the services are provided for the use by the public end-user which pays the private partner directly. These are often economic infrastructure projects, such as toll-charging road bridges and tunnels

[13] Marques, R. & Berg, S. (2011). Public-Private Partnership contracts: A Tale of two cities with different contractual arrangements. Public Administration, Vol 89 (4), pp. 1586-1603.

Table 3 Different classifications of PPP models based on contractual structures, risk and how private partners receive payment. These different options are all of different scales of how private / public the projects are (indicated at the bottom of the table). Source: based on Gatti 2014[14].

Operation and Maintenance services	Concession (Public ownership of the facilities)	Concession (private ownership of facilities)	Full privatisation
Management of public facilities by private parties Leasing agreements	Rehabilitation of existing facilities management and transfer Design, building, management and transfer (service agreements with public administration)	Design, building, own, management and transfer	Asset sales Divestitures
Main risks and relative allocation among involved parties			
Low risk by private sector	Medium private sector risk	Higher private sector risk	Highest risk private sector
Type of payment			
Payments received both from public subsidy and end-user charges		Payments received only from end-user	
Public ⟷ Private			

Definition of PPP for this study

In this study, we follow definitions of PPP that exist in the literature. A project is a PPP if:

- There are mutual objectives for the private and public partners
- Risk is shared between public and private partners
- A contractual agreement is made between public and private partners that covers either:
  - Operation and maintenance
  - Concession (public ownership)
  - Concession (private ownership)

[14] Presentation by Jane Lethbridge, Director, Public Services International Research Unit (PSIRU), University of Greenwich, UK, 9 March 2015.

Neither full privatisation nor fully publicly owned and run facilities are examples of PPP. If services are outsourced (tendered), i.e. services are defined and paid for by the owning entity over a short timeframe, then this is not considered to be PPP either. However, services that are contracted to a private entity whereby the private entity receives payment all or in part from the end-user are considered to be PPPs. An overview is given in the table below

Outsourcing (tendering)	**Operation and Maintenance services**	**Concession (Public ownership of the facilities)**	**Concession (private ownership of facilities)**	**Full privatisation**
Management of public facilities by private parties paid directly by public entity	Management of public facilities by private parties paid by end-users Leasing agreements	Rehabilitation of existing facilities management and transfer Design, building, management and transfer (service agreements with public administration)	Design, building, own, management and transfer	Asset sales Divestitures[15]
Is it PPP?				
✗	✓	✓	✓	✗

[15] A divestiture is the partial or full disposal of a business unit through sale, exchange, closure or bankruptcy. A divestiture most commonly results from a management decision to cease operating a business unit because it is not part of a core competency. Source: http://www.investopedia.com/terms/d/divestiture.asp#ixzz4w9FUWY4d